## 22F2, 22M2

## WAVEFORM DATA

(Woveforms given on schemotic)
Waveforms taken with CONTRAST control set fully to the right, all other controls set for normal picture (in sync). Warning,
control will cause waveform distortion.
Waveforms at video and sync stages obtained with transmitted signal input to receiver. The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of the horizontal frequency) so that two pulses appear on the screen.
The peak-to-peak voltage readings shown are subject to some variations due to response of the oscilloscope and parts tolerances.

## CAUTION

Pulsed high voltage is present on the caps of V406, V407 and pin 3 of V403. Do not make direct connection to these points with ordinary test equipment. Waveform and peak-
to-peak voltage at pin 3 of V408 taken, using an oscilloscope with a capacitive voltage to-peak voltage at pin 3 of V408 taken, using an oscilloscope with a capacitive voltage
divider probe. Waveform at pin 3 of V408 can be taken by clipping or twisting the lead divider probe. Waveform at pin oscilloscope high side over the insulation on the cap lead. When taking the
from the one
waveform this way the shape of the waveform will be the same but the peak-to-pak voltage waveform this way, the shape of the waveform will be the same but the peak-to-peak voltage will be much lower, depending upon the degree of coupling.

## TV VOLTAGE DATA

(Voltoges given on schemotic)

- CONTRAST control turned fully clockwise. CHANNEL control set on an unused channel Other front controls set at approximately half rotation. Vert. Lin. and Height set a
approximately half rotation. DX Range Finder control set fully to the left (at "0 position).
- Antenna disconnected from set with terminals shorted.
- Voltages marked with an asterisk * will vary widely with control setting.
- Line voltage 117 volts AC.
- Vollages measuied with a vacuum tubc voltmetcr between tube socket ierminals and
- Voltages at V101 and V102 (TV Tuner) are measured with tube in socket. Use an
adapter or lift tube out of socket just high enough to allow a needle point probe to adapter or lift tube out of sncket just high enough to allow a
contact tube pins.


## CAUTION

Pulsed high voltages are present on the cap of V406, pin 3 of V408, and on the filament terminals and cap of the 1 B3GT tube. NO A AITHOUT SUITABLE TEST EQUIPMENT Picture tube 2nd anode voltage can be measured from the 2nd anode connector and
should be taken only with a high voltage instrument such as a kilovoltmeter or vacuum-tube should be taken only with a high voltage instrument such as a kilovoltmeter or vacuum-tube
voltmeter with a high voltage probe. 2nd anode voltage is approximately 17.5 KV . Proper voltmeter with a high volage probe. 2nd anode voltage is approximatey
flament voltage check of the 1 BGT
compared with that obtained with a 1.5 volt dry cell battery.

DIAL STRINGING
Dial stringing for the radio tuning control is shown
below.


Figure 17. Dial Stringing for the 22P2 Chassis.

## ALIGNMENT OF RADIO TUNER

The radio tuner in television and radio chassis should be aligned as instructed under "Radio Alignment Procedure" below.

The radio alignment trimmers are accessible without disassembly of the radio tuner from the TV chassis.


Figure 18. Trimmer $\underset{\text { in }}{\text { in }}$ 22P2 Chassis.

## SCHEMATIC NOTES

Run numbers are rubber stamped at the rear of the chassis. 22 series chassis.


6Ba6 Figure 20. Schematic for 22P2 Television and Radio Chassis


$$
L_{2}^{T V}
$$









## SCHEMATIC NOTE

Numerical symbols (1) (9) (O), etc. indicate rear the chassis. 22 series chass



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White flashes across the picture caused by extreme external noise can sometimes be minimized by careful ad justment of the DX Range Finder.
Where the TV signal strength is weak, the picture can often be improved by turning the DX Range Finder part

way to the right or, if necessary, fully clockwise. It may be necessary to make a slight readjustment of the Noise Gate control after adjusting the DX Range Finder. If the signal strength changes, it may be desirable to change the setting of the DX Range Finder; however, it is generally possible to set it at a single compromise position which gives reasonable reception for the different signa strengths.

Caution: If the DX Range Finder is turned too far to the right for a strong signal, the picture may bend or
disappear completely.

Horizontal Oscillator ond Horizontal Drive
Adjustment
When switching channels, the Horizontal control (on front panell should keep the picture in horizontal sync through at least three fourths of its range. If the picture does not remain in horizontal sync, then adjust the rear panel controls as follows

1. Allow the set to warm up. Tune in a station and adjust the Brightness and Contrast controls for average setings. Be sure that the Noise Gate and DX Range Finder controls are properly adjusted
2. The Horizontal Drive control (at rear of set) is a potentioneter adjustment. Set the control to the ap. proximate center of its rotation. If a white vertical line appears, turn the control to the left until the line just disappear
3. Turn the Horizontal control (on front panel) fully to the left. While slowly rotating the Horizontal control to the right, switch the Channel Selector off and on horizontal syn- for at. Test phree fourths remain in zontal control range. If not, set the Horizontal con trol to the position at which horizontal sync is lost
owly turn the Horizontal Lock control to the righ or left until the picture synchronizes. It may require one or more turns of the Horizontal Lock control to
obtain the proper range for the Horizontal control on front panel.

## THEORY OF OPERATION



Diagram of UHF Tuner A4160.

## TOUCH-UP OF RATIO DETECTOR

 SECONDARY USING A TELEVISION SIGNALThis adjustment is accessible through the $1 / 4^{\prime \prime}$ hole (just below T201) in bottom of the cabinet or the chassis mount ing shelf, located toward the right side facing the rear of
the set. Removal of the chassis is therefore not required.

Adjustment need be made on one channel only. Proceed as follows:

1. Turn set on and allow about 15 minutes for warm up. 2. Tune set for normal picture and sound.
2. Carefully insert a non-metallic alignment tool through the top of T201. An alignment tool with a hexagonal end is required. When the alignment tool engages the bottom tuning slug A12, adjust the slug for best sound with minimum buzz level. Do this carefully as only
slight rotation in either direction will generally be required. Correct adjustment point is located between the two maximum buzz peaks that will be noticed when turning the slug back and forth about $1 / 4$ to $1 / 2$ turn.
3. If necessary, repeat individual channel slug adjustment and conclude with retouching the ratio detector secondary. Note: If oscillator adjustment is required for other channels, it will not be necessary to repeat the ratio detector seco

## \section*{OF 4.5 MC TRAP TELEVISION SIGNAL

}rectly adjusting it.

Beat interference ( 4.5 MC ) appears in picture as very fine vertical or diagonal lines, very close together, having "gauze-like" appearance, the pattern will vary with speech, forming a very fine herringbone pattern.
The trap can be tuned by watching the picture and ad usting the slug Al3 for minimum 4.5 MC interference. If as instructed in step 3 under "4.5 MC Sound IF and Trap Alignment" procedure

ure 19. Equivalent Circuit of UHF Preselector

## SERVICE HINTS

## UHF TUNER

The high frequencies at which the UHF tuner operates make it necessary that extreme care be exercised when servicing. The only field service recoinmended is minor repairs to the tuner such as replacement of tubes, switch Sl and resistors which are mounted on switch Sl.

## Alignment

The UHF tuner has been carefully aligned at the factory and generally should never require realignment in the field. Also, since alignment of the UHF tuner is quite involved, it is not recommended for field service. If it has been definitely determined that complete tuner alignment is required, it should be returned to your Admiral distributor for replacement.
Important: Do not under any circumstances attempt adjustment of the tracking screws or bend the capacitor tuning plates in any way

The UHF tuner slug (mixer coupling network) may be adjusted to improve performance in weak signal areas or eliminate some forms of interference. This adjustment is located directly below the VHF channel slug adjustment. For information on "UHF Tuner Slug Adjustment"


> Figure 44. Front View of UHF Tuner.

Trouble Shooting
To isolate UHF trouble in a VHF-UHF receiver, it is sug gested that VHF test equipment be used to check the VHF portion of the receiver in the same manner as checking for a defective VHF booster. If VHF operation is satisfactory, and it is known that a UHF signal of considerable strength exists, it can be assumed that the antenna or the UHF tuner is at fault. Carefully check the antenna and transmission line. If new tubes have been substituted in the UHF tuner and reception is still poor, the UHF tuner should be re placed. Be certain, however, that the VHF portion of the receiver is functioning normally. It is easy to be deceived where a strong VHF signal exists. Whenever possible, check VHF receiver sensitivity before replacing a UHF tuner. See "Fringe Area 'Television Reception" booklet, form number S346 Rev. 2, for instructions on checking sensitivity, ex pected sensitivity figures, and recommended equipment.

Faulty tubes will cause the majority of UHF tuner trou bles. Listed below are some of the most common troubles generally due to faulty tubes.

1. Weak signal (excessive snow or no picture) can be caused by a faulty tube. Check V1 (6AM4) and V2 (6AF4).
2. Spurious responses. Spurious responses will show up as flashing on the screen while tuning in a picture. If flashing occurs at more than 6 points while tuning through the UHF band, check for a faulty oscillator ube V2 (6AF4).
3. Oscillator tube V2 (6AF4) gets excessively hot and B+ voltage at terminal "a" of VHF-UHF switch Sl is below 80 volts. Replace V2 (6AF4).

Note: Replacement of oscillator tube V2 (6AF4) may cause slight detuning of the oscillator circuit and thus affect tracking. If this occurs, a number of tubes should be tried, until the most satisfactory substitute for the original tube is found. Be sure that tubes and tube shields are pushed down and seated firmly.

## Replacing Detent Spring on Switch S1

To replace the detent spring on switch Sl, remove the mounting screw from the rear of the switch directly behind the spring. Lift the spring out with long nose pliers. Insert the replacement spring and mounting screw; do not tighten screw. Turn the High-Channel Selector shaft fully clockwise and position the detent spring until it engages the switch arm stud; then tighten screw. Check the operation of the switch to be sure that the switching action is positive.
Replacing Switch 51
To replace the VHF-UHF switch S1, carefully disconnect the leads and components from the switch. Remove switch mounting screws from the rear of the switch. Mount the replacement switch; do not tighten screws. Turn the HighChannel Selector shaft fully clockwise and position the detent spring until it engages the switch arm stud; then tighten screws. Check operation of the switch to be sure that the detent spring engages the switch and switching action is positive. Connect leads and components to the same terminals as on the original switch.

## Servicing Tuning Drive

An all gear tuning drive assembly is used on UHF tuner A4160; see figure 45. The gear drive of these tuners should require very little attention. Rough tuning or play may be caused by insufficient clearance between gear M2 and idler pinion M3. The individual gears or the complete gear drive assembly are replaceable.
Lubrication: In general, the lubrication applied to the gears or bearing surfaces at time of manufacture should make lubrication seldom, if ever, necessary.
Lubricate gears or bearing surfaces with Admiral lubriCant, part number 98A64.2, or light vaseline.

CAUTION: Use care so that lubricant does not come in contact with the UHF.VHF changeover switch. Do not use lubriplate or any similar lubricant containing zinc or cadmium.

Replacement of Gears: The complete gear train as. sembly or individual gears (M3, M4, M5, M6 and M7) are available for replacement (see figure 45). In general, it is recommended that the complete gear train and gear M2 be replaced, however, if difficulty is due to a specific gear or pinion, that particular part may be replaced individually.
When replacing the complete gear train, it will be neces. ary to remove the UHF tuner from the chassis

Gear M2 can be replaced without removing the UHF tuner from the chassis.

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To replace gears M3, M4, M5, M6 and M7, proceed as follows:

1. Turn UHF fine tuning shaft (vernier) fully to the left (counterclockwise).
2. Remove the three screws which mount the gear cover plate to the tuner.
3. Remove and replace defective gear(s)
4. Set gears to original position. The UHF fine tuning shaft (vernier) must be rotated fully to the left (counterclockwise) and gear M2 must be about one tooth clock. wise from full counterclockwise rotation.
5. Replace the three screws which mount the gear cover plate. Important: Before tightening screws, be sure gear M2 and idler pinion M3 have proper clearance to avoid binding or excessive backlash.


Figure 45. UHF Tuner Drive Assembly.

figure 46. Front Viow of UHF Tuner A4160 Removal of Gear Train.
To replace gear M2 without removing the UHF tuner me chassis, it will be necessary to remove the screws which mount the VHF and UHF tuners to the chassis. Lower the tuners (without disconnecting wires) just far enough to allow access to gears. To replace gear M2, proceed as fllows:

Turn UHF fine tuning shaft (vernier) fully to the left (counterclock wise)
2. Remove the two screws which mount the gear train assembly to the tuner; see figure 46.
3. Shift the gear train assembly to the right.
4. Using a \#6 Allen wrench, loosen set screws on hub of gear M2; see figure 46 .


To remove the UHF tuner, proceed as follows

1. Remove tube shields and tubes from the UHF tuner


Figure 48. Side Yiew of Chassis Showing UHF and YHF Tuners.
2. Unsolder the transmission line connected at point " $A$ ", terminals at the side of the UHF tuner.
3. Unsolder end of transmission line ( $23^{\prime \prime}$ length) connected to the lower terminals of the antenna terminal strip located at the top of the high voltage housing.
4. Unsolder the transmission line ( $7^{\prime \prime}$ length) at point "C", this runs from the VHF tuner to the VHF.UHF switch.
5. Unsolder the transmission line ( $6^{\prime \prime}$ length) at point "D", terminals of feed-thru insulators at top side of the UHF tuner. See figure 47.
6. Remove pilot light socket from mounting bracket.
7. Place the chassis on its side with the high voltage com partment away from the service bench
8. Unsolder the lead connecting from terminal "b" of Unsolder the lead connecting from PHF.UHF switch at point " F ". Point " F " is the unction of C442 ( 20 mfd .) and R460 ( $12,000 \mathrm{ohms}$ )
 Figure 49. Bottom of TV Chossiz With Connection Pointu
for UHF ond $V H F$ Tuner Replocement.

V501 (tie-point), junction of capacitor C503. (.1 mfd .) and resistor R503 ( 9,000 ohms).
9. Unsolder the lead (usually brown) connecting from terminal " $b$ " or " f " of VHF.UHF switch to point " G ", terminal strip connection of resistor R461 ( 10 ohms).
10. Unsolder heater lead (wire with RF choke coil) at point "L", pin 5 . of V402 (tie-point).
11. Unsolder the UHF tuner ground lead at point " H ", ground lug in chassis.
12. Remove the tie bar at the front of the UHF tuner
13. Remove the VHF tuner front mounting screws and only loosen the rear mounting screws. Use care so as not to break the short lead connecting from the VHF tuner to pin 1' of V301 (6CB6) tube.
14. Remove the UHF tuner front mounting screws and only loosen the rear mounting screws. Remove the rear mounting screws from the UHF tuner. Be careful so that the connections from the UHF tuner are not broken. To remove from chassis, lower the UHF tuner and slide it out while guiding the leads so that they do not catch on the chassis. See figure 50 .


Figure 50. Botrom Yiew of TV Chassis Showing, Removal of UHF Tuner.

To install the replacement tuner, proceed as follows:

1. Remove the tube shields and tubes from the replacement UHF tuner Insert the UHF tuner into the ent that the tuning shafts of the VHF tuner protrude through the center of the UHF tuning shaft. See figure 50.
2. Insert the pilot light socket through the rectangular cutout and over the bar at the top front of the TV chassis. Insert the two lengths of transmission line through the rectangular cut-out in the chassis. Guide the heater lead (with choke coil), the ground lead (usually black) leads from termin "b" " i " of VHF UHF switch to the underside of the chassis through the rectangular cut-out in the chassis.

Replace the VHF and UHF tuner mounting screws. Be fore tightening screw, check tuner shafts to be sure that shafts operate freely, without binding. It may be necessary to shift tuners sideways or lower either tuner from the chassis, using washers as shims for proper clearance so that tuner shafts operate freely
4. Solder transmission line from UHF antenna terminal to point "A", terminals at the side of the UHF tuner. Important: Do not twist wires. Lay wires parallel to each other, then solder
5. Solder transmission line ( $23^{\prime \prime}$ length) connecting from terminals " $m$ " and " $n$ " of VHF.UHF switch to the lower terminals of the antenna terminal strip located at the top of the high voltage housing.
6. Solder transmission line ( $7^{\prime \prime}$ length) connecting from terminals " k " and " l " of VHF.UHF switch to point "C", junction of transmission line from VHF tuner Important: Do not twist wires. Lay wires parallel to each other, then solder and tape.
Solder transmission line ( $6^{\prime \prime}$ length) connecting from terminals " i " and " j " of VHF-UHF switch to point "D", terminals of feed-thru insulators at top side of UHF tuner. See figures 47 and 48. Important: Do not twist wires. Lay wires parallel to each other, then solder.
8. Solder lead connecting from terminal "b" of VHFUHF switch to point " $F$ ". Point " $F$ " is the junction of C442 ( 20 mfd ) and R460 ( 12,000 ohms).
9. Solder pilot light lead (usually brown) connecting from terminal " f " of VHF-UHF switch to point " G ", terminal strip connection of resistor R461 ( 10 ohms)
10. Solder heater lead (wire with RF choke coil) to point "L", pin 5 of V402 (tie-point)
11. Solder the UHF tuner ground lead to point "H" ground lug in chassis.
12. Replace tie bar at front of TV chassis.
13. Insert tubes and tube shields in tuner. Important: Be sure that tubes and tube shields are seated firmly.
14. Before operating set. check tuner to see that all mounting screws are tight and all soldered connections are secure. Refer to
"Installation and Service Adjustments".

## VHF TUNER

## Servicing Channel Coils

The cabinets containing 23 series chassis have been pro vided with a rectangular cut-out in the chassis shelf jus below the TV tuner. This access opening will permit servic ing of the tuner channel coils or for installing UHF channe coils without removal of the chassis from the cabinet
To gain access to the underside of the tuner, it is neces-
sary to remove the screen covering from over the cut-out in sary to remove the screen covering from over the cut-out in the chassis shelf. Then remove the bottom shield from the bully of the tuner. After servicing the channel coils, care using staples or thumb tacks to secure it to the cabinet


Figure 51. Exploded View of VHF Tuner.

Removing Channel Coils: Insert a screwdriver blade Twist the coil retainer spring and the turret end plate. coil upward.

Replacing Oscillator Slugs: If VHF oscillator slugs fall into the coil form, remove the channel coil, move the slug retaining spring M112 aside, and tap the coil assembly
until the slug slips forward. Set the slug retaining spring into position; it should rest firmly against the slug.

## Servicing Contacts of VHF Tuner

A rectangular opening is provided at the side of the chassis for convenience in servicing the stationary contacts of the TV tuner or for making voltage or resistance meas urements.

To gain access to the stationary contacts of the TV tuner it is necessary to remove the mounting screws from the side cover plate on the tuner and unsolder the soldered joint grounding the cover plate to the tuner. Reassemble the cover plate in the same manner.

Adjusting Contact Springs: Should the stationary contacts make poor connections due to insufficient tension, remove several sets of coils from the turret. Rotate the turret to position making the bottom of the contact strip accessible for observation. With a narrow blade screw driver, adjust the contact spring tension by carefully bend ing the spring inward until the highest point on the spring extends about $9 / 64$ of an inch above the plastic surface o the contact plate. With correct tension of the contact spring the spring should clear the flat surface of the turret coil by about $1 / 64$ of an inch.

Cleaning Contacts: Remove several sets of coils from turret and rotate turret to position making contact points of contact plate accessible for cleaning.
Using a small. stiff brush and carhon tetrachloride. clean contact surfaces of stationary contacts.
Remove accumulated dust or grease from stationary con tacts and contact plate with a soft canvas cloth dampened mored with a suff cloth dampened with alcohol.
Clean contact surfaces of rotating coils in same manner

## Removing Tuner Turret Assembly

1. Remove retaining bracket MIOT in front of the tuner.
2. Remuve rotor shaft assembly M10.4, rotor contact spring M12.2 and fiber washer Mil3. For reassenbly. note urder of parts removal
3. Remove front and rear turret retaining springs M12. by pressing straight end away from tab on chassis.
4. Lising a screwdriver hlade at the side of the tuner. press the detent spring M122 and roller M121 away from the turret detent plate.
5. Grasp tuner shaft and slip out of end plate hearings.

## Removing Contact Plate Assembly M123

1. Rembere turret.
2. Remove the mounting screws at the front and rear of Contact Plate and Bracket Assembly M123.
outward the front and rear tuner chassis end plates.
3. To free contact plate assembly, release the contact plate tals by pushing them away from the slots in the end plates.
4. Unsolder all commections to contact plate. Unsolder the solder joint holding contact plate to the center partition of the tuner chassis.
5. Reassemble in the same manner

## Replacement of the Ungrounded Stator Plate of Tuning Control

Stator plate M118 (part number 94A45-86) is replaced with wiring lead and trimmer capacitor C110 attached,都 plated surface on the ceramic stator plate disc.
To replace the stator plate, remove the turret assembly. Remove mounting rivets from stator plate by drilling out or clipping them out with diagonal wire cutters. Remove
rimner screw M115 and locking nut M114 from trimmer capacitor Cl 10 . L'nsolder wiring lead connecting trinmer o terminal on contact plate.
Assemble the replacement stator plate (M118) by placing the ceramic button over the ${ }^{5 / 6 /}$ hole in the chassis with the wiring lead extending into the chassis. Place the mounting bracket over the ceramic button and mount securely using $\# 4 \times 3 / 16^{\prime \prime}$ round head machine screws with \#4.40x $3 / 16^{\prime \prime}$ hex nuts and \#4 shake proof lock washers. Mount trimmer capacitor C110 in chassis and solder wire lead to its original terminal on the contact plate making inic star phate io trins Dress niring lead from cercome in contact with the turret drum. fiter the stator plate, adjust trimmer capacitor Clil fowall scillator adjustment). Tuner Lubrication

In general the lubrication applied to points of wear or friction at time of manufacture should make lubrication eldom. if ever. necessary. However, should tuner lubricaion become necessary, it is important that the correct mount and type of lubricant be used.

Using a clean brush. apply a film of switch contact oil Admiral part number 98A64-l or Viscosity Oil Co. \# $\quad 0691$ to the surfaces of the coil contacts and stationary ontact points.
Lutricate bearing surfaces of all other moving parts with Admiral lubricant. part \#93A64-2. Viscosity Oil Co. \#8857 ubricant. or light vaseline.
Caution: Do not use lubriplate or any similar luhricant ontaining zinc or cadmium.

## VHF Tuner Replacement in Sets Using UHF Tuner

The removal or installation of a replacement VHF tuner in VHF-UHF sets using the All-Channel UHF tuner requires he lowering of the LiHF tuncer and unsoldering of leads as hown in figure 52.
A step-by-step procedure is given helow for removing and installing a replacement VHF tuner in sets using All-Channel HF tuner A 4160 . Use figure 49 for location of comnection oints J. K. M. I and R, and figure 52 for illustration

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To remove the VHF tuner, proceed as follows:

1. Remove all screws mounting the UHF tuner to the chassis. ever, use care so as not to break
connector lugs on VHF. UHF switch.
2. Place the TV chassis on its side with VHF-UHF tuners nearest the workbench. Place a block under the side of the chassis to avoid damage to the antenna coupling terminals extending through the side of the chassis from the UHF tuner.


Figure 52. Botion View of TV Chassis Showing Remav

## PRODUCTION CHANGES

Production changes coded RUN 2 and higher are given below. The run number is stamped on the rear of the chassis and indicates that the particular chassis has the change described under the run number, as well as all changes made prior to that time (i.e. all lower run numbers).

At the start of production the $23 E 1 Z$ and $23 B 1 A Z$ chassis were stamped RUN 1 , however RUN 1 of the 23B1AZ chassis includes all the changes listed below through RUN 3. The 23C1AZ and $23 F 1 Z$ were stamped RUN 4 at the start of production, and the 23E1AZ was stamped RUN 5.

## RUN 2 (23E1Z Chassis)

Resistor Change to Improve Horizontal Linearity See 23 ElZ schematic for new circuit, see figure 53 below for original circuit.
R442 changed from 5,600 ohms, 2 watt to 18,000 ohms, 2 watt. R462, 5,600 ohms, 2 watt deleted. R462, 1,200 ohms, 2 watt added across horizontal linearity coil L403.


RUN 3 (23E1Z Chassis, also RUN 1 23B1AZ Chassis) Magnet Addition to Eliminate Pin-Cushion Effect Curvature correcting magnets added to top and bottom of deflection yoke housing to eliminate pin-cushion effect at top and bottom of raster. Early production sets used part number 94A65 magnets while part number 94A67.l mag. nets are currenly being used. 9 Are 54 for illustration of different magnets)

## RUN 4 (23B1AZ, 23C1AZ, 23E1Z

 and 23FIZ Chassis)Capacitor Change to Improve Horizontal Oscillator Stability When Switching Choanels
C419 changed from 470 mmfd , to 330 mmfd
RUN 5 (23B1AZ, 23E1Z and
23E1AZ Chassis)

## Resistor Change to Increase Width

R440 changed from 150 ohms, 2 watt to 120 olims, 2 watt. RUN 6 (23B1AZ and 23E1AZ Chassis) Change to Increase Vertical Stability When Switching Channels
See 23BlAZ schematic on page 51 and 23E1AZ schematic on page 53 for new circuits. See figure 55 at right for original circuit.
R472 changed from 4,700 ohms to 3,300 ohums. R478 22,000 ohms, 2 watt and C445, 20 mfd , filter network added to plate circuit of V401B ( $1 / 2$ 6SN7GT)


## RUN 7 (23B1AZ and 23E1AZ Chassis)

Resistor Change to Improve Horizontal Stability at Minimum Contrast
R335 changed from 1,000 ohms to 330 ohms, R331 changed from 180,000 ohms to 270,000 ohms.

## ALIGNMENT

## GENERAL

Complete alignment consists of the following individual procedures and should be performed in this sequence

1. IF Amplifier and Trap Alignment
2. IF Response Curve Check.
3. 4.5 MC Sound IF and Trap Alignment
4. RF and Mixer Alignment.
5. Over-all RF and IF Response Curve Check.
6. VHF Oscillator Adjustment.

## TEST EQUIPMENT

To properly service this receiver, it is recommended that the following test equipment be available.
Important: Many service instruments do not meet the requirements given below. A list of recommended equip ment is available from your Admiral distributor.

## Oscilloscope

Standard oscilloscope, preferably one with wide band vertical deflection, vertical sensitivity at least .5 volt (RMS) per inch.

## Signal (Marker) Generator

### 4.5 MC frequency.

18 to 30 MC frequency range.
50 to 90 MC frequency range.
170 to 225 MC frequency range.
Must have a calibration crystal for checking dial accuracy.

Sweep Generator
The sweep generator must provide sweep frequencies from 18 to MC , 50 to 9 MC and T to 22 MC . The adjustable with at least lenst output impedance should be 300 ohms balanced to ground.
A sweep generator not having constant output voltage ver the swept range and linear sweep, will produce curves which are widely different from the ideal curves shown in obtaining these curves, the sweep generator should be checked. A simple check is to observe the response curve for a set that is in alignment.
Before suspecting the generator, be sure the alignment instructions in this manual have been followed carefully.

## Vacuum Tube Voltmeter

Preferably with low range ( 3 volt) DC zero center scale and a high voltage probe ( 30,000 volt range)

## ALIGNMENT TOOLS

The following alignment tools are required. They are available from your Admiral distributor under the part numbers listed below:
Metal alignment screwdriver part number 98A30-9.
Non-metallic (fiber) alignment screwdriver ( $111 / 2^{\prime \prime}$ long,
$1 / 8^{\prime \prime}$ diameter) part number 98A30-10.
Non-metallic alignment wrench ( $9^{\prime}$ long, for hexagon core IF slugs) part number 98A30-12.

## ALIGNMENT HINTS

The following suggestions may be of assistance if diffi culty is experienced during the alignment procedure.

## Adjacent Channel Trap

If difficulty is experienced in aligning the 27.25 MC and 19.75 MC traps (A7 and A8), using the method outlined in the alignment procedure on page 38 make trap alignment as follows:

1. Connect an oscilloscope between plate of video amplifier V305 and chassis.
2. Make all connections and receiver control settings as instructed in steps 5 and 6 of the alignment procedure

Operate the signal generator with AM (audio) modul Operate the signal generator with AM (audio) modula
tion turned on. Full generator output may be required. Note: If a termination resistor is used in the eqeerato output cable, increased generator output can be ob tained by disconnecting the terminating resistor. Con nect a condenser ( .002 mfd . or larger) in series with the generator high side.
4. Adjust A7 ( 27.25 MC trap) and A8 ( 19.75 MC trap) for minimum amplitude of the waveform on the oscilloscope.

## IF Instability

When spot frequency aligning the IF amplifiers, the VTVM pointer may swing when the hand is placed too near the IF transformers. When viewing the IF response curve the If transiormers. When viewing the ir response curve
on an oscilloscope, the curve may change shape with hand on an oscilloscope, the curve may change shape with hand
capacity, especially when aligning A5 (3rd IF transformer T303). To correct either of these conditions, the following alignment hints should be tried:

1. Check the generator output leads to be certain that the unshielded portion (especially the grounded lead) be as short as practicable.


INSULATE MASKING TAPE

Figure S6. Special Tube Shield for IF Alignment and IF Response Curre Check.
2. Be sure that a decoupling network is used at the video detector output and that the leads on the network ar kept as short as possible. (See figure 60)
3. Insulate a tube shield as shown in figure 56
4. The use of a non-metallic alignment tool, approximately eight inches long, will permit adjustment without coming
too near to the IF transformers.

## Receiver Overloading When Checking Over-all

 Response CurveDue to the inherent high sensitivity of these receivers, it is very easy to cause overloading in the third IF amplifier stage. In some cases, generator leakage alone is enough to produce a response curve on the oscilloscope. To prevent overloading do the following

1. Be certain that the generator output attenuators are set at a minimum.
2. Some generators have a built-in pad in the output cable to be used when viewing the over-all response curve. Be the circuit. Refer to the generator instruction manual for details.
3. If a pad is not built in, the 12 db pad shown in figure 57 can be constructed and connected between the gener ator and the antenna terminals.

figure S7. Illustration of 12 db Attenuation Pad for Viewing Over-all RF-IF Response Curre.

## IF AMPLIFIER AND TRAP ALIGNMENT

- Connect bias battery; negative to test point "T", see hgure 61 , positive to chassis. A $41 / 2$ volt battery is
equired for steps $1,2,3,4,7$ and 8 . A $11 / 2$ volt battery is required for steps 5 and 6 .
- Disconnect antenna. Connect a jumper wire across the antenna terminals.
- Set Channel Selector to channel 12 or other unas
during signed high channel, to preven interference during lignment.
- Set the Contrast control fully to the left (counterclockwise).
- Allow about 15 minutes for receiver and test equip ment to warm up.
Use lowest DC scale on VTVM.

| Step | Signal Gen. Freq. | VTVM and Signal Generator Connections | Instructions | Adiust |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 25.3 MC | VTVM high side to test point " $V$ " through a decoupling filter, common to chassis. See figures 60 and 61 . Connect generator high side to top of special tube shield for 6 Jb (V102); connect low side of generator to bottom part chassis. See figure 56. | Use $41 / 2$ volt bias battery. <br> Use lowest DC scole on VTVM. <br> When peaking, keep reducing generator output for VTVM reading of approx. 1 valt or less. <br> Set channel switch to channel 12 or other unassigned high channel. | A1, A2 and A3 for |
| 2 | 22.3 MC |  |  |  |
| 3 | 23.5 MC |  |  | A4 for maximum. |
| 4 | 21.25 MC |  |  | A6 for minimum. |
| 5 | - 27.25 MC | Connect Generator and VTVM same as in step 1. | Use $11 / 2$ volt bias battery. Set channel switch between channels to break channel coil contact; VTVM reading will change when coil contact is braken. | A7 for minimum. |
| 6 | -19.75 MC |  |  | A8 for minimum. |
| 7 | 25.3 MC | Connect Generator and VTVM same as in step 1. | Use $41 / 2$ volt bias battery. Set channel switch same as in step 1. | Readiust A1, A2 and A3 for maximum. |
| 8 | To insure correct If alignment, make the "IF Response Curve Check" given below. |  |  |  |

IF RESPONSE CURVE CHECK

| Bia |  |  | Oscilloscope | structio |
| :---: | :---: | :---: | :---: | :---: |
| Set Channel Selector on channel 12 or on unassigned high chan fully to the leff. Con nect negotive of $41 / 2$ volt bias bottery to test point "I"; posi- tive to chassis. | Connect high side to top of 6 J 6 mixer-osc. special tube shield. Connect low side to Set sweep frequency to 23 MC , and sweep width approximately 7MC. | If an external marker generator is used, loosely couple high side to sweep generator lead on top of tube shield, low side to bottom of tube shield. Marker frequencies indicated an If Response Curve. | Connect to test point "V" through a decoupling filter. See figures 60 and 61. Marker pips on scope will be more distinct if a condenser from 100 mmfd to 1000 mmfd is connected across the oscilloscope input. | Check curve obtained against ideal response curve in fig. 58. Note tolerances on curve. Keep-marker and sweep outputs of very minimum to prevent overloading. A reduction in sweep output should reduce response curve amplitude without altering the shape of the response curve. If the curve is not within tolerance or the markers are not in the proper location on the curve, touch-up with If slugs as instructed below. If curve changes shape with hand capacity, see "Alignment Hints" |
| dif at center of curye shoulo not exceeo jox measured fmom highest pear - mfasuffo frow mighest rear <br> Figure S8. Ideal IF Response Curve. <br> Figure 59. IF Response Curves, Incorrect Shape. <br> If it is necessary to adjust for approximate equal peaks, carefully adjust slug A5 ( 23.5 MC ). It should not be necessary to turn slug more than one turn in either direction. <br> If the curve cannot be made to resemble the response curve shown at left, repeat all steps under "IF Amplifier and Trap Alignment" making sure that generator frequencies are accurate and adjustments are carefully made. If a satisfactory curve cannot be obtained after repeating these steps, it may be necessary to change IF amplifier tubes or check for a defective circuit component to be sure that each stage is operating properly. |  |  |  |  |

Before proceeding, be sure to check the signal generotor used in alignment against a crystal colibrator or other frequency standard for absolute frequency colibration required for this operation. Also see "Adiacent Channel Trop"

### 4.5 MC SOUND IF AND TRAP ALIGNMENT

a. Connect signal generator high side to pin 1 or pin 2 of V304 (12AT7) through a .01 mfd . condenser, connect low side to chassis.
b. Allow about 15 minutes for receiver and test equip. ment to warm up.
c. Set Contrast control fully to the left (counterclockwise) d. Use a non-metallic alignment tool. If Ratio Det. Transformer (T201) has hollow core slugs, bottom slug adjustment All can be made from top of chassis, if you use alignment tool \#98A30-12 obtainable from Admiral distributor.

| Stop | Signal Gen. Freq. (MC) | VTVM Connections | Instructions | Adjust |
| :---: | :---: | :---: | :---: | :---: |
|  | When using a signal generator, be sure to check it against a crystal calibrator or other frequency standard for accurate frequency calibration at 4.5 MC . Accuracy required is within one kilocycle. <br> IMPORTANT: If a signal generator and frequency standard are not available, alignment can be made using a TV station signal. Tune in a station and follow steps 1,2 and 3 below. If necessary use a higher scale on the VTVM. |  |  |  |
| 1 | $\begin{aligned} & \text { Set to } \\ & \text { exactly } \\ & 4.5 \mathrm{MC} . \end{aligned}$ | High side to test point "Y"; common to chassis. | Use lowest DC scale on VTVM. | A9, A10 and All for maximum (keep reducing generator output to keep VTVM at approx. 1 volt). |
| 2 |  | High side to test point "Z" common to chassis. | Use zero center scale on VTVM, if availoble. | A12 for zero on VTVM (the correct zero point is located between a positive and a negative maximum). If Al2 was far off, repeat step 1. |
| 3 |  | High side to test point "Y"; common to chassis. | Connect a 10 mmfd . condenser from plate of V305 to pin 8 of V304 (12AT7). Use lowest DC scale on VTVM. | Al3 for minimum. |

## SIMPLIFIED ALIGNMENT

After becoming familiar with alignment procedure, some servicemen simplify subsequen alignment of sets by merely using the essential alignment data given in figures 61 and 63
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$$
\begin{aligned}
& \text { TO TEST- } \\
& \text { POINT } V
\end{aligned}
$$

TO TEST
POINT $V$


Figure 60. Decoupling Filter
figure 61. Bottom View of Chassis Showing Test Point Connections and IF Alignment Data.


## RF AND MIXER ALIGNMENT

a. Connect negative of $4 \frac{1}{2}$ volt bias battery to AGC buss (test point " $T$ "), positive to chassis. If it is difficult to obtain a curve of sufficient amplitude, remove battery and connect a wire jumper from test poin "T" to chassis.
b. Connect sweep generator 300 ohm output to antenna terminals. If sweep generator does not have a built in marher geneiator, locsetly couple a marker gener

| Step | Marker Gen. <br> Freq. (MC) | Sweep Gen. <br> Frequency | Instructions |
| :---: | :---: | :---: | :---: |


1 (Video Carrier) \(\left.\begin{array}{c|c|c|}197.75 \mathrm{MC} <br>

(Sound Carrier)\end{array}\right)\)| Channel lo. |
| :---: |
| See frequency <br> table below. | | Check for RF response cu |
| :--- |
| to obtain equal peak |
| correct mat |

3 \begin{tabular}{c|c|c|c}
83.25 MC <br>

\hline \& | (Video Carrier) |
| :---: |
| 87.75 MC |
| (Sound Carrier) | \& | Sweeping |
| :---: |
| Channel 6. |
| See frequency |
| table below. | <br>

\hline
\end{tabular}

Set the sweep generator to sweep the channel to be checked. Set
the marker generator for the cor responding video carrier frequency and sound carrier fre quency.
ator to the antenna terminals. To avoid distortion of the response curve, keep sweep generator output at a minimum, marker pips just barely visible.
c. Connect oscilloscope through a 10,000 ohm resistor to test point "W" on tuner (figure 63). Keep scope leads away from chassis.
Allow about 15 minutes for receiver and test equip.

Instructions


| FREQUENCY TABLE |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Channel Number | Channel Freq., MC | Video Carrier, MC | $\begin{aligned} & \text { Sound } \\ & \text { Carrier, } \\ & \text { MC } \end{aligned}$ | VHF Osc., MC |
| 2 | 54.60 | 55.25 | 59.75 | 81 |
| 3 | 60.66 | 61.25 | 65.75 | 87 |
| 4 | 66.72 | 67.25 | 71.75 | 93 |
| 5 | 76.82 | 77.25 | 81.75 | 103 |
| 6 | 82.88 | 83.25 | 87.75 | 109 |
| 7 | 174.180 | 175.25 | 179.75 | 201 |
| 8 | 180.186 | 181.25 | 185.75 | 207 |
| 9 | 186.192 | 187.25 | 191.75 | 213 |
| 10 | 192.198 | 193.25 | 197.75 | 219 |
| 11 | 198.204 | 199.25 | 203.75 | 225 |
| 12 | 204210 | 205.25 | 209.75 | 231 |
| 13 | 210.216 | 211.25 | 215.75 | 237 |



Figure 63. Top of TV Tuner, 5howing
Adjustment Locations.


Shoull
at hale fotation
Flat of selector shafi centere

- 8 tween chanel colls 3 ano 4.
igure 64. Front View of TV Tuner.

OVER-ALL RF AND IF RESPONSE CURVE CHECK
 action of the mixer tube.

VHF OSCILLATOR ADJUSTMENT USING SIGNAL GENERATOR
It is always advisable to make VHF oscillator adjustments using a Tele. vision Signal as instructed If a Television Signal is not available, VHF oscillator adjustment can be made using a crystal calibrated signal generator. Make adjustments as follows:

| Receiver Control Settings |
| :--- | :--- |
| Set Channel Selector for each channel <br> to be odiusted. Set "Tunin" control <br> af half rotation. Turn volume control <br> fully to the right (clockwise). |


instructions
Connect a wire iumper from test point "W" on the uner to test point "Z". See figure 61 . Remove the
uatio detector tube V202 (6ALS). Carefully adius ratio detector tube V202 (6ALS). Carefully adiust
he individual oscillator slug Al7 until a whistle (beat) is heard in the speaker of the receiver.


- John P. Rider


## schematic notes

(11), (12).....(1), (1). elc. indicate alignment points and alignment connections.


## SCHEMATIC NOTES

(1), (12).....(1), (1). ele. ind





Top View of Chassis.

waveform data










## TV VOLTAGE DATA oltages given on achometie


 tion.o. Dex. Range Finder contrul wel (ully to the left (at
poiition).
 : Line volage 117 volitach.



 - Voltageres marked with in asterisk ( ${ }^{\circ}$ ) will vary widely with coopaution
 ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS
FROM THESE POINTS WITHOUT SUITABLE TEST EQUIP.





Figure 67．B＋Diagram of 23B1AZ，23C1AZ，23E1Z and 23F1Z Chassis．

## PARTS LIST

Electrical components are numbered in different series according to their location on the schematic．Numbers $1-99$ indicate components in the UHF tuner；101－199， VHF tuner；201－299，sound circuits；301－399，intercarrier IF and video circuits； $401-499$ ，sync and deflection circuits； $501-599$ ，power supply circuits．Order re placements from your Admiral distributor by part number and description

|  |  | Sym． | Description | Part No． |
| :---: | :---: | :---: | :---: | :---: |
|  | RESISTORS | R204 | 390 ohms， $1 / 2$ wal | 60B |
|  |  | R205 | 10，000 olms，${ }^{1 / 2 / 1}$ wath | 60R 8．103 |
| Sym． | Description Part No． | R206 | 10，000 ohms， $1 / 2 /$ wall | ．60B 8 |
|  |  | R207 | 47，000 ohins，1／2 watt． | 60B 8.473 |
| R1 | 470 chms， $1 / 2$ wall（23C1AZ， 23 FIZ only）．．60B 8.471 |  | 1 megohm，Volume control | 75 B |
| R2 | 6，200 ohms， $1 / 1 / 2$ walt， $5 \%$ |  | 1，000 ohms，Contrast control） |  |
|  | （23C1AZ．23F1Z only）．．．．．．．．．．．．．．．．60B 7.622 |  | ${ }_{4}$（R208 includes switch 5301） |  |
| R3 | 1，000 ohms， $1 / 2$ watt（23ClAL． | R209 | 4.7 megohms， $1 / 2$ watt． | 60B 8．474 |
|  | 23F1Z only）．．．．．．．．．．．．．．．．．．．．．．．60B 8．102 | ＋R210 | 470，000 ohms， $1 / 2$ wall |  |
| R4 | 300 ohnis． $1 / 2$ walt， $5 \%$ | $R 211$ | Not Used |  |
|  | （23C1AZ，23FIZ only）．．．．．．．．．．．．．．．．60B 7.3 | †R212 | 1 megohm， $1 / 2$ wall． | 60B 8．105 |
| R $\overline{5}$ | 68.000 ohms， 2 wall（ $23 \mathrm{CliAZ}$.23 FIZ only）．60B 20.683 | R213 | 330 ohms， 1 wa |  |
| R101 | 15.000 ohms ， $1 / 2$ wall ．．．．．．．．．．．．．．．．． 988 A 45.67 | R214 | Not Used ${ }^{\text {a }}$ ， | 60B 20.561 |
| R102 | 47，000 ohnis， $1 / 2$ watt ．．．．．．．．．．．．．．．． 988 A 45.17 | ${ }_{\text {R216 }}$ | 560 ohms， 2 walt． |  |
| R103 | Not Used |  | Not Used |  |
| R104 | 1.500 ohms， $1 / 2$ wall ．．．．．．．．．．．．．．．．94D 47．58 |  |  |  |
| R105 | 10.000 olinis，1／2 watt ．．．．．．．．．．．．．．．．．．．．98．4． 45.18 | ${ }_{\text {R219 }}$ | 1 megohm， $1 / 2$ wall（ part of L203） | ． 6088.105 |
| R106 | 220，000 ohms． $1 / 2$ wäll ．．．．．．．．．．．．．．．98． 45.21 |  |  |  |
| R107 | 10，000 ohms． $1 / 2$ wall ．．．．．．．．．．．．．．．．．．．48A 45．18 | R22 | 33,000 ohms，1／wath |  |
| R108 | 15．000 ohms， $1 / 2$ watt ．．．．．．．．．．．．．．．．．．98A 45．67 | ${ }_{\text {R222 }}$ | 100000 ohms， $1 / 1 / 2$ wat |  |
| R109 | 15,000 ohms，1／2 watt．．．．．．．．．．．．．．．．．．．98．A 45－67 | R223 | 2 megohms，Tone contro |  |
| R110 | 1100.000 ohns， 1 | R224 |  |  |
| R111 |  | R225 | 82,000 ohms，1／2 wall |  |
| R112 | 190．000 ohms， $\mathrm{\prime}$ ，watt．．．．．．．．．．．．．．．．．．．94C 37.87 | R301 |  | 60B 7.822 |
| R113 | Not Used | R301 | 8.200 ohms， $1 / 2$ wall， $5 \%$ |  |
| R114 | 8，200 ohms， $1 / 2$ watt ．．．．．．．．．．．．．．．．．．．．60B 8．822 | R302 | 1，000 ohms， $1 / 2$ wall． | 60B 8.471 |
| R201 | 470，000 ohms，1／2 watl ．．．．．．．．．．．．．．．．．．．．60B 8．474 | R304 | 1,000 ohms， $1 / 2$ watt． | 60B 8.102 |
| ${ }^{\text {R202 }}$ | 120 ohms，${ }^{1 / 2}$ watt．carbon only ．．．．．．．．．．．60B 808.121 | R305 | 47 ohms， $1 / 2$ watt，carbs only | 60B 28.45 |
| 03 | 1，000 ohms，watl ．．．．．．．．．．．．．．．．．．60B 8．102 | R306 | 15,000 ohms， $1 / 2$ watt， $5 \%$ ． | 60B 7－15 |
|  |  | K307 | 330 ohms，1／2 wall | 60B 8.3 |



Figure 68．B＋Diegram of 23E1AZ Chassis．


## $\begin{array}{ll}\text { R316．} \\ \text { R3472 } \\ \text { R } 200 \text { ohm } \\ \text { R348 } & \text { Not Used }\end{array}$

R349 100,000 ohms， $1 / 2$ watl（23E1AZ oll）


R352 $\{1.5$ megohms， $1 / 2$ watt（ 23 ELAZ only）．
RR401 22,000 ms， $1 / 2$ wall


R405A 1.5 megohms，Vert．control
R405A 1.5 megohms，Vert．control
R405B 25,000 ohms，Horiz．Hold controls
R406 1.8 megohms， $1 / 2$ watt．


CHASSIS 23B1AZ, 23C1AZ, 23E1Z, 23E1AZ, 23F1Z

| Symm | Description <br> 3.3 megohms, $1 / 2$ wall ( 23 BlaZ , | Sym. <br> C121 <br> C122 | Description Part No. | Sym. §C403 | Description Part No. |  | $\begin{aligned} & \text { Sym. } \\ & \text { L101 } \end{aligned}$ | Description Part No. |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | . $005 \mathrm{mifd}, 600$ rolts, | , paper................64B 5.12 |  | Antenna Coil (Stamped 20, 3Q, etc.) |  |
|  |  |  | Not Used | ${ }^{\text {C404 }}$ | . 0017 mfd m 300 volt | s, mica...............6658 21-472 $^{\text {a }}$ |  | for Channel \#2...........94D 46.52 |  |
|  |  | ${ }_{C 124}$ |  |  | .1 mfd, 600 volts, p | paper.................648 9.57 |  | for Channel \#3.............94D 46.538 |  |
|  |  | C125 | 1.5 gmind, ceramic..................... 94D 46.84 | C406 | . $047 \mathrm{midd}, 600$ volts, | paper............... 64B 9.9 |  | for Channel \#5..............94D 46.55 |  |
|  | 23C1AZ, 23E1AZ only) ...............603 8.474 | C201 | 6.8 mmidd, ceramic, N330 temp. coeff. $\ldots . .65 \mathrm{C} 6.71$ | ${ }_{C}$ C407A |  |  |  | for Channel \#6.............94D 46.56 |  |
| R466 | 5 megohnis, Noise Gate control (23B1AZ, |  | 39 mmfd ceramic, NPO tenp. coeff. . ....65C 6.888 |  | $10 \mathrm{mfd}, 250$ volis | (e) electrolytic (not used . 67D 15.25 |  | for Channel \#7.............94D 46.57 |  |
|  | 23C1AL, 23E1AL only).............. 75 C 1.54 |  | . 180 mmidd, $5 \%$, ceramic, No30 temp. coefl . . 65 SC 6.59 |  | 120 mifd, 250 volts |  |  | for Channel \#9.............94D 94659 |  |
|  | 56,0041 ohms, $1 / \mathrm{F}$ watt ( 23 BIAZ , |  | 500 mmfid , 500 volts, ceramic ............ 65C 6.6 |  | 150 mfd , 50 vols |  |  | for Channel \#10.............94D 46.60 |  |
| R468 | 33,000 ohms, 1 watt (23B1AL, |  | 4 mfd, 50 vols, electrolytic.............67A 4.9 |  | 10 midd, 400 volts | ${ }_{\text {(2EELAZ }}$ enly) .....67D 15.34 |  | for Channel \#11............94D 946.61 |  |
| R4 |  |  |  | C407 | $80 \mathrm{mfl}, 450$ volis |  |  | for Channel \#12...........94D 94 D 46.62 | For |
|  | 23C1AZ, 23E1AZ only) ................... 60B 8.224 | C209 | . 01 mfd, 450 vols, ceramic...............65C 6 10.3 | C40 | Not Used |  |  |  |  |
| R470 | 4.7 megohms, $1 / 2$ watt (23B1AZ, | ${ }_{C} 210$ | 50 mmid , 500 vols, ceramic. ............ 65C 6.4 | C409 | $.022 \mathrm{mfl}, 400$ vols, $123 \mathrm{ElZ}, 23 \mathrm{FlZ}$ |  |  | for Channel \#2.................94D 46 | only |
|  | 23C1AZ, 23E1AZ only) ..............60B |  | Not Used | C410 | . 01 mfd, 450 volts | ceranic................648 65 C 9.30 10.3 |  | for Channel \#3..............94D 46.73 |  |
|  | 2,700 ohms, $1 / 2$ watt ( 23 B 1 $23 \mathrm{Cl} 14 \mathrm{Z}, 23 \mathrm{ElAZ}$ only) | $\begin{array}{r} +\mathrm{C} 212 \\ \mathrm{C} 213 \mathrm{~A} \end{array}$ | 20 mid , 25 vol's s ] | C411 | 330 mmid , 500 volis, | s, mica................65B 21.331 |  | for Channel \#4............998 46.74 for Channel \#5 |  |
| R472 | $4,700 \mathrm{ohms}, 1 / 2$ watt (Run 5 and lower) ...608 8.472 |  | $10 \mathrm{mfd}, 450$ volis $\mathrm{electrolytic} \mathrm{..........67D} 15.19$ | C412 | . 001 mfld , 500 volts. | mica................ 65B 21.102 |  | for Channel \#5..............94D $44.78{ }^{46.75}$ |  |
|  | 3,300 ohms, $11 / 2$ watt (Run 6 and higher) ...60B 8.332 | ${ }^{\text {C213C }}$ | $10 \mathrm{mfd}, 25$ volts) | ${ }^{4} 413$ | . 001 mifi, 500 volts. | mica...............65B 21.102 |  | for Channel \#7...............94D 46.77 |  |
|  | (23BIAZ, 23C1AZ, 23EIAZ only) |  | . 005 mfd, 1,000 volts, ceramic...........65C 6 C 10.14 | ${ }_{C}^{C 415}$ | ${ }^{.1} \mathrm{mfd}$, 6000 vols, p | paper................648 9.57 |  | for Channel \#8..............94D 46.78 |  |
| R473 |  |  |  | C416 | . 0047 mfd mid, 400 volis, | s, paper..............648 9.15 |  | for Channel \#9...........94D 46.79 for Channel \#10 |  |
| R474 |  |  | . 0022 midd, 600 volts, paper..............64B 9.17 | C417 | . 0022 mfd, 600 volts | s, paper...............64B 9.17 |  | for Channel \#11.............94D 46.81 |  |
|  | ${ }_{23 C 1 A Z, ~ 23 E 1 A Z ~ o n l y) ~ . . . . . . . . . . . . . .60 B ~ 8.222 ~}^{\text {2 }}$ |  | .001 nifd, 200 volts, paper...............6488 9.9 39 mmdd, ceramic NPO temp, coeff .... 65 C 6.88 | C418 | . 0039 mfd d, $5 \%$, silve | er mica (part of L401) . . 65B 1.63 |  | for Channel \#12............94D 46.82 |  |
| $\begin{aligned} & \mathrm{K} 4 / 5 \\ & \text { R R 746 } \\ & \text { R477 } \end{aligned}$ | 675 ohms, Focus control (23E1AZ only) . .75C 13.31 |  | . 001 mfd d, 500 volts, |  | [ 470 mmifd, 500 volts, mica (Run 3 |  |  | for Channel \#13.............94D 46-83) |  |
|  | Not Used |  | . 0015 midd, ${ }_{450}$ volts, dual ceramic | C419 | and lower) $\ldots 330$ | , mica (Run 4 . ${ }^{\text {a }}$. 658 B 21.4 |  | Mixer Plate Coil. |  |
|  | 22,000 ohms, 2 watt (Run 6 and higher) ...60B 20.223(Not used Run 5 and lower)(Not used in 23EIZ, 23FIZ) | ${ }_{C} 303 \mathrm{~A} .004 \mathrm{mfd}$, |  |  | and higher) | .65B 21.331 |  | Heater RF Choke |  |
|  |  |  | . 004 mid, ${ }^{\text {d }}$ 450 vols, dual ceramic. . . . . . 65A 17.1 | ${ }_{\text {C420 }} \mathrm{C} 421$ | 270 minfld, 500 volts, mica ............. 658 21.271 |  | L106 | Peaking Coil |  |
|  |  |  | . 005 midd, 450 volts, ceramic............65C 10.1 |  | Not Used |  | L108) |  |  |
| ${ }_{\text {R } 201}$ | 270,000 ohms, 1 watt . . . . . . . . . . ....608 14.274 |  | Not Used 01 midd 400 volts, paper (not used | ${ }_{\text {C423] }}$ |  |  | Not Used |  |  |
| R552 R503 | 3,000 ohms, 15 watt (23EIAZ only) .......61A 3.14 4,250 ohms, 10 watt (23E1AZ only) ......61A 17.4 |  | .01 mifd, 400 volts, paper (not used <br> in 23E1AZ) $\qquad$ 64B 9.32 |  | Electrolytic ........................ See |  |  |  | Sound Takeoff Coil ..................728 99.10 |  |
|  |  |  |  |  | . 01 mfd, 600 vols, paper................64B 9.13 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  | Sound Peaking Coil (..................73A 5-2 |  |
|  | CAPACITORS <br> $100 \mathrm{mmfd}, 150$ volts, mica |  |  | $\begin{aligned} & \text { C428 } \\ & \text { C429 } \\ & \mathrm{C} 430 \end{aligned}$ | .047 mifd, 600 volts, paper.................... 64 A 2.14 Not Used |  | L203 |  |  |  |  |
| C1 |  |  |  | $\mathrm{L}_{\mathrm{L} 301}^{\mathrm{L} 302}$ |  |  | Video Peaking CoVideo Peaking Co |  |  |  |
| C2 | (23C1AZ, 23FIZ only) ...............65A 25.2 | C307B $40 \mathrm{mfd}, 400$ voltsC 307 C60mfd , 450 voliselectrolytic(23E1AZ |  |  | $140 \mathrm{mmfd}, 5 \%, 1,500$ volts, mica <br> ( part of T403). |  |  |  |  |
|  |  |  |  |  |  |  | Yideo Peaking Coil (wound on R321)..... 73 |  | Heater RF Choke..................... 73A 2.5 |
| с3 | 100 mumfd, 150 volis, nica | C309 | . 047 mfi, 400 volis, paper.............. 64 B 9.2 |  | $\begin{aligned} & \text { C4311 } \\ & \text { C432 } \end{aligned}$ |  |  | L305 L306 | Not |  |
| C4 |  |  | Not Used .005 midd, 450 vols, ceramic. $\ldots \ldots . . . . . . .65 \mathrm{C} 10.1$ | C433\} | Not Used |  |  | c |  |
|  |  |  |  | ${ }_{C}^{\text {C433 }}$ |  |  | ${ }_{1310}^{1309}$ | Coil, 1st If Input..................... 72 B 109.1 |  |
| C5 | $500 \mathrm{mmfd}, 500$ volis', silver mica <br> button (23C1AZ, 23F1Z only) ............65B 24.1 |  | Not Used |  | 150 mmfd , 3,000 volts, ceramic. ........65C 10.10 |  |  |  |  |  |  |
| C6 | $.001 \mathrm{mfd}, 500$ vols, ceramic feed.thru $123 \mathrm{ClAZ}, 23 \mathrm{FIZ}$ only $)$. | $\begin{array}{r} \text { C314 } \\ \hline \text { C } 315 \end{array}$ | $120 \mathrm{mmfl}, 500$ vol |  | Not Used |  | 1311 | C324 and R345) ....................... 72C 96 Coil, 19.75 MC Trap |  |
| C7 |  | ${ }_{C} \mathbf{C 3 1 7}$ | mica $\qquad$ <br> $.001 \mathrm{mfd}, 600$ volts, paper <br> 64B 9.19 | ${ }_{\text {C449 }}^{\text {C43 }}$ |  |  |  | Coil, 19.75 MC Trap <br> Coil, Peaking $\}$......................... Part of M301 |  |
|  | 470 mmfd, 600 volts, ceramic disc (23C1AZ, 23F1Z only). |  |  | ${ }_{\text {C442 }}^{\text {C41 }}$ | 1 mfld 600 vols, paper................648 9.57 |  |  |  |  |  |  |
| C8 | 470 mmid, 600 volts, ceramic disc (23C1AZ, 23F1Z only) |  | .47 mifd, 100 volts, paper..............64A 10.51 .1 mfd, 400 volts, paper....................64B 9.26 .1 mfd, 400 volts, paper...................64B 9.26 |  | Not Ilsed <br> 20 mfd. 475 volts, elect. (23C1AZ, |  | $\begin{aligned} & \mathrm{L} 401 \\ & \mathrm{~L} 402 \end{aligned}$ | Horizontal Lock Coil (includes C418, R431) .94B 17 Width Coil $\ldots$.............................. 94. 49.3 |  |
|  |  |  | . 005 mfd mot 450 volts, ceramic.............65C 10.1 | C443 | ${ }_{0} 23 \mathrm{FlZ}$ only) $. . .1 . . . . . . . . . . . . . . . . .67 \mathrm{~A} 25.1$ |  |  | Horizontal Linearity Coil................ 944 50.2Focus Coil |  |
| C9 | 500 mmfd , 500 volts, silver mica button (23C1AZ, 23F1Z only) | C320 C321 C322 cen |  |  |  |  | $\xrightarrow{\text { L403 }}$ |  |  |  |  |
| ${ }_{C 102}^{\mathrm{C} 101}$ |  |  | .47 mfd , 100 volis, paper.......................64A 10.51 $22 \mathrm{mmfd}, 500$ volts, $5 \%$, ceramic, | C444 | coeff. (not used in 23E1Z, 23F1Z) .......65C 6.52 .22 mfd, 400 volts, paper (not used |  |  | for $24 \mathrm{TP} 4 / 24 \mathrm{CP} 4 \mathrm{~A}$ picture tube <br> (23E1Z 23F1Z) <br> 69D 117.15 |  |
|  |  |  |  |  |  |  |  | for 24TP4/24CP4A picture tube(23E1AZ) ..........................69D 117.14 |  |
| ${ }_{C 10}^{\mathrm{Cl} 10}$ |  |  | NPO tenip. coeff. (part of L3i0) . ....... 65C 6.47 Not Used | C445 | $20 \mathrm{mfd}, 475$ volps, electrolytic <br> (Run 6 and higher) <br> 67A 25.1 |  |  |  |  |  |  |
|  |  | $\begin{aligned} & \text { C325 } \\ & \text { C326 } \\ & \text { C327 } \end{aligned}$ |  |  |  |  |  |  |  |  |  |
| ${ }_{C 10}^{C 10}$ |  |  | 6.8 mmifd, $5(x)$ volts, ceranic. ...............65C 6.82 3.3 nimfd. 500 volts. $\pm .25 \mathrm{~mm} / \mathrm{dd}$ cer., <br> NPO temp. coeff. (part of I.310) ........65C 6.89 | (Not used Run 5 and lower)(Not used in 23E1Z, 23F1Z) |  |  | $\begin{aligned} & \mathrm{L} 501 \\ & \mathrm{~L} 502 \end{aligned}$ |  |  |
| C 10C 108 |  | $\begin{aligned} & \mathrm{C} 320 \\ & \mathrm{C} 327 \end{aligned}$ |  |  |  |  |  |  |  |  |  |
|  |  | ${ }_{\text {C328] }}^{\text {C329 }}$ |  | C501C 502 |  |  |  |  |  |  |  |
| ${ }_{C 1109}^{C 1}$ |  |  | Nol Userd |  |  |  |  | Ratio Detector Transformer............. 72 |  |
|  | Not Used | ${ }_{C} \mathbf{C 3 3 0}$ |  | C503 |  |  |  | Audio Outpui Transiormer............... 79 |  |
| C 11 | 6.8 mmfd, $3 \%$, ceramic NPO temp. coeff. ..94D 47.53 | C332 |  |  |  |  | T302 | 2nd IF Transormer (includes R309) ...... 72 | D 111.1 |
| $\mathrm{Cl13}^{1}$ |  | Сз33 | 51 nmifd, $5 \%$. ceramic. N080 tenly. coeff. . . Part of M301 | C504 |  |  | T303 | 3rd IF Transformer................ | B 113.1 |
|  | 800 mmid, min. ceramic, feed.thru......... 944 C 37.90 | С334 | $10 \mathrm{mmfd}$. ceramic, , PO temp. coeff. .... Part of M301 |  |  |  |  |  | Verr. Blocking Osc. Transformer......... 79 | A 18.5 |
| C11 | 800 mmfd , min. ceramic, disc. ...........94C 93 C 37.91 |  | . 001 mifd. ceranic. .................. Part of 13301 |  |  |  |  | Vert. Output Transformer .............. 79 | 43.2 |
| C11 | 800 mmdd min. ceramic, feed.thru . . . . . . 944 C 3 37.90 |  | $24 \mathrm{mmfd}, 3 \%$, ceramic, N080 temp. coeff. .. Part st M301 $.005 \mathrm{mff}, 450$ wolts, ceranic. ............... 65C 10.1 |  | COILS, | TRANSFORMERS |  | Deflection Yoke (includes R412, R413, R445, C430) |  |
| $\mathrm{Cll}^{1}$ | 800 mmfd min. ceramic, feed thru. . . . . . 994 C 800 C 37.90 37.90 |  |  |  |  |  |  | for 24TP4/24CP4A picture tube ....... 94 |  |
| ${ }_{C 12}$ |  | ${ }_{\text {§C402 }}$ | . 0005 midd, ovo volts, paper.................64B 5.12 |  | RF Choke (gray don |  |  | for 2iRP4 pic. tuhe (includes plug) ..... 94. | 74.1 |
|  |  |  |  | L3 | $\mathrm{RFF}_{\text {Choke ( } \mathrm{tray} \text { d }}$ | (ot) …................. i3A 6.4 |  | Horizontal Output Transtorner........ | D8.1 |
|  | + May be part of couplate 63C6.5. Rep | ew coup | 隹 | 1.4 | Rr Choke (red do | 1) ..................73A |  | (Power Transiormer (23E1AZ only) $\ldots$.... 80 |  |
|  | 为 be part of couplate 63C6.4. Repla | ew coul | late or individual components. | 1.5 | RF Choke (red do | ) |  |  |  |

OJohn F. Rider

Figure 1．Control Panel in 20D2；CHANNEL Knob Removed
（O）

Figure 2．Control Panel in 20A2 and 20A2Z； CHANNEL Knob Removed．

SPECIFICATIONS
Picture Tube
Direct View Electromagnetic．See Model Identifica－ tion Chart for different picture tubes used．

## Operating Voltoge

$110-120$ volts． 60 cycles，AC

## Wattag

195 watts for all models．
Input Impedence and Transmission Line 300 －ohm balanced（between antenna terminals）
Note that 72 ohm coaxial cable may be used by connect－ ing the outer conductor to the chassis and the inner conduc－ tor to either antenna terminal．In weak signal areas，the use of coaxial cable should be avoided．

## Antenna

All models equipped with a built－in TV antenna．TV－ Radio models equipped with a built－in radio antenna．

## Intermediate Frequencies

Video 25．75 MC．Sound 21．25 MC．
Intercarrier Sound 4.5 MC ．
Radio 455 KC．（TV－Radio models）．

## Fuse Location

The horizontal output circuit is fused with a $3 / 8$ amp．， 250 volt fuse，part number 84A4－3．The fuse is located at the rear of the high voltage compartment．

## Record Changer

The model RC600 record changer is used in combination models．The changer model number is on the top rear of the changer pan and also on the changer model label on the underside of the changer．

For complete service data on the RC600 record changer， refer to Service Manual No．S454．

## TUBE COMPLEMENT

| V101 | 6827 | RF Amplifior |
| :---: | :---: | :---: |
| V102 | 656 | Oscillator and mixer |
| V201 | 6 AU6 | Sound IF Amplifier |
| v202 | 6 6als | Ratio Defector |
| V203 | 6AV6 | （AM Detector，AVC， Sound Amplifier in \｛combination sets Sound Amplifier in TV lonly sets |
| V204 | t6Y6G or 6AS5 | Sound Output |
| V301 | ${ }_{6}^{6 C B 6}$ | Ist If Amplifior |
| V302 | 6CB6 | 2nd IF Amplifior |
| V303 | 608 | （3rd IF Amplifier \｛Sync．Inv． |
| V304 | 6AL5 | SVideo Detector， \｛AGC |
| V305 | 12 BY 7 | Video Amplifier |
| v306 | 5 | Picture Tube |
| V401 | 12AU7 | SSync Separator， Vertical Oscillator |
| V402 | 654 | Vertical Output |
| V403 | 6 Al5 | Hor．Sync．Disc． |
| V404 | 6SN7GT | Horizontal Oscillator |
| V405 | 6BQ6GT | Horizontal Output |
| V406 | 183GT | H．V．Rectifier |
| V407 | 6AX4GT | Damper |
| v501 | 5046 | Rectifier |
| ＊V701 | 6856 | Convertor（AM Radio） |
| ＊V702 | 6Ba6 | IF Amplifior（AM Radio） |

＋6Y6G tube used in combination sets．6AS5 tube used in TV only sets．
S Soe＂Model Identification Chart＂on front page for different picture tubes used．
＊V701 and V702 used in combination sets only


Figure 3．20A2 and 20A2Z Chassis View Showing


Figure 4．20D2 Chassis Viow Showing
Rear Adjustment Locations．

## HORIZONTAL OSCILLATOR \& DRIVE ADJ.

If the Horizontal Drive control (on rear of set) is not properly adjusted, it may be difficult to obtain sufficient picture width and brightness.
When switching channels, the Horizontal control (on font panel) should keep the picture in horizontal syn hrough at least three fourths of its range. If the picture oes not remain in horizontal sync, then adjust the rear panel controls as follows
a. Allow the receiver to warm up for a few minutes. Tune in a station, set the Brightness control at a lower than average setting. Turn Contrast control fully to the left. Important: Before proceeding, be sure that the DX Range Finder control (AGC) is adjusted according to the instructions given in this manual
b. Turn the Horizontal control (front panel) completely to the left. Turn the Horiz. Drive control fully to the right.
Turn the Horiz. Lock adjustment to the right until the picture falls out of sync. If the picture cannot be made to fall out of sync, momentarily interrupt the signal by switching the Channel control off channel and then back on.
d. With the picture out of sync, turn the Horiz. Lock adjustment slowly to the left until the picture just falls in sync.
e. Turn the Channel con trol to an unused chan nel. If a white vertical line(s) appears near the center of the screen slowly turn the Horiz Drive control to the left until the line(s) just disappears
f. If, in step "e", the

Horiz. Drive control
required readjustment, tune in a station and repeat step
" $c$ " and " $d$ " to be sure of proper Horizontal Oscillator adjustment.
g. Adjustment should now be satisfactory. However, check adjustment by slowly rotating the Horizontal control in either direction while interrupting the television signal by switching the Channel control of channel and then back on. The picture should automatically fall in sync through at least half of the range of the
Horizontal control. If necessary, repeat the above step
Do not use the Horiz. Drive control to obtain correct width or linearity. If necessary, make Width and Horizontal Linearity adjustments.

figure 5. Simplified Diagrom Showing $\mathbf{B}+$ Distribution in 20D2 Chassis.

igure 6. Simplified Diogram Showing B+Distribution in $20 A 2$ and $20 A 2 Z$ Chossis.

## TELEVISION ALIGNMENT PROCEDURE

## GENERAL

Complete alignment consists of the following individual procedures and should be performed in this sequence.
a. IF Amplifier and Trap Alignment.
b. IF Response Curve Check.
c. 4.5 MC Sound IF and Trap Alignment.
d. RF and Mixer Alignment.
e. Over-all RF and IF Response Curve Check.
f. HF Oscillator Adjustment.

## TEST EQUIPMENT

To properly service this receiver, it is recommended that the following test equipment be available.
IMPORTANT: Many service instruments do not meet the requirements given below. A list of recommended equipment is available from Admiral distributon

## Oscilloscope

Standard oscilloscope, preferably one with a wide band vertical deflection, vertical sensitivity at least .5 volt (RMS) per inch.

## Signal (Marker) Generator

4.5 MC frequency.

18 to 30 MC frequency range
50 to 90 MC frequency range
170 to 225 MC frequency range
Must have a built-in calibration crystal for checking dial accuracy.

## Sweep Generator

Sweep generator must provide sweep frequencies from 18 to 30 MC range: 50 to 90 MC range: with at least 170 to 225 MC range:

$$
10 \mathrm{MC} \cdot \text { sweep width }
$$

Output: adjustable; at least one-tenth volt maximum. Output impedance: 300 ohms balanced to ground.

A sweep generator not having constant output voltage over the swept range and linear sweep, will produce curves which are widely different from the ideal curves shown in the fol lowing pages. If repeated difficulty is encountered in obtaining these curves, the sweep generator should be checked. A simple check is to observe the response curve for a set that is in alignment.
Before suspecting the generator, be sure the alignment instructions in this manual have been followed carefully.

## Vacuum-Tube Voltmeter

Preferably with low range ( 3 volt) DC zero center scale and a high voltage probe ( 30,000 volt range).

## ALIGNMENT TOOLS

The following alignment tools are required. They can be obtained from the Admiral distributor under the part numbers listed below:
Metal alignment screwdriver, part number 98A30-9. Non metallic (fiber) alignment screwdriver ( $111 / 2^{\prime \prime}$ long, $1 / 8^{\prime \prime}$ diameter), part number 98A30-10.
Non-metallic alignment wrench ( $9^{\prime \prime}$ long, for hexagon core IF slugs), part number 98A30-12.

## © John P. Rider

## IMPORTANT ALIGNMENT HINTS

The following suggestions should be performed if difficulty is experienced during the alignment procedure.

1. IF CIRCUIT INSTABILITY: When spot frequency aligning
the IF amplifies, the VTVM pointer may swing when the hand is placed too near the IF transformers. When viewing the IF response curve on an oscilloscoper, the curve may change shape with
hand capacity, especilly when aligning A2 (3rd IF transformer T303). To correct either of these conditions, the following align
a) hints should be tried
(a) Check the generator output leads to be certain that the
unshielded portion (especially the grounded lead) be as short as practicable.
(b) Be sure that a decoupling network is used at the video
detector output and that the leads on the network are kept as detector output and that the loads on the network are kept as
short as possible (see figure 10). (c) Construct a special tube shield as shown in figure 7. This
is made from an ordinary tube shield and four 10,000 ohm re sistors. Keep the spacing between the two halves of the shield
at a minimum (1/s inch). at a minimum ( $1 / 8 \mathrm{inch}$ ).
(d) The use of a non-metallic alignment tool, approximately
eight inches long (part nunber 98A30-12), will permit adjust eight inches long (part number 98A30-12), will
ment without coming too near to the transformers.
2. RECEIVER OVERLOADING WHEN CHECKING THE sitivity of these receivers, it is very easy to cause overloading in the third IF amplifier stage. In some cases, generator leakage
alone is enough to produce a response curve on the oscilloscope alone is enough to produce a response cu
To prevent overloading, do the following:
(a) Be certai
at a minimum.
(b) Some generators have a buill-in pad in the output table
to be used when viewing the over-all response curve. Be sure that
the pad in the cable is properly connected in the circuit. Refer the pad in the cable is properly connected in the circuit. Refer
to the generator instruction manual for details. (c) lf a pad is not built in, the 12 db pad shown below in
figure 8 can be constructed and connected between the generato and the antenna terminals.


Figure 11. Bottom View of Chassis Showing Test Point Connections and IF Alignment Data.

## IF AMPLIFIER AND TRAP ALIGNMENT

- Connect bias battery; negative to test point ' $T$ ", see figure 11 , positive to chassis. A $41 / 2$ volt baltery is required for all steps below.
- Disconnect antenna. Connect a jumper wire across the antenna terminals.
- Set Channel Selector to channel 12 or other unassign-
ed high channel, to prevent interference during alignment.
- Set the Contrast control fully to the left (counlerclock wise).
- Allow about 15 minutes for receiver and test equipment to warm up
- Use lowest DC scale on VTVM

| Instructions | Adjust |
| :---: | :---: |
| Connect a $41 / 2$ volt bias battery to test point "T". <br> Use lowest DC scale on VTVM. When peaking, keep reducing generator output for VTVM reading of approx. 1 volt or less. If unstable, refer to section 1 of the "Alignment Hints" on page 8. | Al for minimum. |
|  | A2 and A3 for maximum. |
|  | A4 and A5 for maximum. |
|  | Repeat step 1 above. |

Before proceeding, be sure to check the signal generator used in alignment against a crystal calibrator or other frequency standard for absolute frequency calibration required for this operation.

## IF RESPONSE CURVE CHECK

(Using sweep generator and oscilloscope)

| Receiver Controls end Rins Rnttary | Sweep Generator | Marker Generator | Oscilloscope | Instructions |
| :---: | :---: | :---: | :---: | :---: |
|  | Connect high side to 616 mixer-osc. special <br> tube shield, see fig. 7. Connect low side <br> to bottom part of frequency to 23 MC , and sweep width approximately 7MC | If an external marker generator is used, loosely couple high side to sweep generafor lead on tube shield, low side to chassis. Marker frequencies indicated on IF Response Curve. | Connect to test point "V" through a decoupling filter, see figs. 10 and 11. Marker pips on scope will be more distinct if a capacitor from 100 mmfd . to 1000 mmfd . is connected across the oscilloscope input. | Check curve obtained against ideal response curve in fig. 12. Note tolerances on curve. Keep marker and sweep outputs at very minimum to prevent overloading. A reduction in sweep output should reduce response curve amplitude without altering the shape of the response curve. If the curve is not within tolerance or the markers are not in the proper location on the curve, touchup with IF slugs as instructed below. Important: If curve changes shape with hand capacity, see section 1 of "Alignment Hints" on page 8. |



Full skirt of curve will not be visible unless generator sweep width extends beyond 10 MC . Figure 14. RF Response Curve.

## A5 23.1 MC MAX. MIXER PLATE

Figure 15. Top of TV Tuner, Showing
Adjustment Location.
Figure 15. Top of TV Tuner, Showing
Adjustment Location.



Figure 1.3. If Response Curves, Incorrect Shape.
If it is necessary to adjust for approximate equal peaks and marker location, carefully adjust alignment slugs as instructed
under the above figures. It should not be necessary to turn the slugs more than one turn in either direction.
If the curve cannot be made to resemble the response curve
shown at left, repeat all steps - under "IF Amplifier and Tre shown at left, repeat all steps - under "IF Amplifier and Trap
Alignment" making sure that generator frequencies are accurate and adjustments are carefully made. If a satisfactory curve cannot be obtained after repeating these steps, it may be necessary to change IF amplifier tubes or check for a defective circ
component to be sure that each stage is operating properly.

### 4.5 MC SOUND IF AND TRAP ALIGNMENT

See page 6 for touch-up of ratio detector using television
signal without test equipment.
a. Connect signal generator high side to pin 2 of V304 (6AL5) through a .01 mfd . capacitor, connect low side to chassis.
b. Allow about 15 minutes for receiver and test equipment to warm up.
c. Set Contrast control fully to the left (counterclockwise)

| Step | Signal Gen. Freq. (MC) | VTVM Connections | Instructions | Adiust |
| :---: | :---: | :---: | :---: | :---: |
|  | When using a signal generator, be sure to check it against a crystal calibrator or other frequency standard for accurate frequency calibration at 4.5 MC . Accuracy required is within one kilocycle. <br> IMPORTANT: If a signal generator and frequency standard are not available, alignment can be made using a TV station signal. Tune in a station and follow steps 1,2 and 3 below. If necessary use a higher scale on the VTVM. |  |  |  |
| 1 | Set to exactly 4.5 MC | High side to test point "Y" common to chassis. | Use lowest DC scale on VTVM. | A6 and A7 for maximum (keep reducing generator output to keep VTVM at approx. 1 volt). |
| 2 |  | High side to test point " Z "; common to chassis. | Use zero center scale on VTVM, if available. | A8 for zero on VTVM (the correct zero point is located between a positive and a negative maximum). If A6 was far off, repeat step 1. |
| 3 |  | High side to test point " Y "; common to chassis. | Connect a 10 mmfd . capacitor from pin 7 of V305 (12BY7) to pin 7 of V201 (6AU6). <br> Use lowest DC scale on VTVM. | A9 for minimum. |

## RF AND MIXER ALIGNMENT

Connect negative of $41 / 2$ volt bias battery to AGC buss (test point "T"), positive to chassis. If it is difficult to obtain a curve of sufficient amplitude, remove battery and connect a wire jumper from test point " $T$ " to chassis.
b. Connect sweep generator (with 300 ohm output) to antenna terminals. If sweep generator does not have a buill-in marker generator loosely couple a marke
d. Use a non-metallic alignment tool. If Ratio Det Transformer (T201) has hollow core slugs, bottom slug adjustment A8 can be made from top of chassis, you use alignment tool, part number 98A30-12 ob tainable from Admiral distributor

When using a signal generator, be sure to check it against a crystal calibrator or other frequency standard for accurate frequency calibration at 4.5 MC . Accuracy required is within one kilocycle. IMPorl. Tune in a station and follow steps 1,2 and 3 below. If necessary use a higher scale on the VTVM.
signal

| Marker Gen. Freq. (MC) | Sweep Gen. Frequency |
| :---: | :---: |
| 193.25 MC (Video Carrier) 197.75 MC (Sound Carrier) | Sweeping channel 10. See frequency table. |
| 83.25 MC (Video Carrier) 87.75 MC (Sound Carrier) | Sweeping channel 6. See frequency table. |

Set the sweep generator to sweep Set the sweep generator to sweep
the channel to be checked. Set the marker generator for the corresponding video carrier frequency and sound carrier frequency
generator to the antenna terminals. To avoid distortion of the response curve, keep sweep generator output at a minimum, marker pips just barely visible Connect oscilloscope through a 10,000 ohm resistor
to test point "W" on tuner (figure 15). Keep scope leads away from chassis.
d. Allow about 15 minutes for receiver and test equipment to warm up.

OVER-ALL RF AND IF RESPONSE CURVE CHECK
(Using sweep generator and oscilloscope)

| Receiver Controls <br> and Bias Battery |
| :--- |
| Contrast control fully |
| to the left. Channel |
| Selector on channel 10 |
| or other Unassigned |
| high channel. Connect |
| negative of $41 / 2$ volt |
| bias battery to test |
| point ""T", positive to |
| chassis. |
|  |

Compare the response curve obtained
ogainst the ideal curve shown in figure against the ideal curve shown in figure
17. If the curve is not within tolerance, touch up the If slug as instructed below. It should never be necessary to
turn slugs more than one turn in either direction. If the curve is satisfactory on the channel checked, all other channels should also be satisfactory. IMPORTANT: When sweep output is reduced, response curve amplitude on
scope should also decrease, but curve scope should also decrease, but curve
shape should remain the same. If curve shape changes, reduce sweep output and/or the scope gain until the shape
does not change. does not change. See section 2 of "Alignment Hints", on
page 8. page 8.

gure 17. Ideal Over-all rf ond tF Response Curve.
Note that video carrier (marker) on the "Over-all RF-IF Re sonse Curve" will appear on the opposite side of the curve as mpared to "IF Response Curve" figure 12. This is due to n of the mixer tube.


Figure 18. Over-all RF and IF Response Curves, Incorrect Shape

## HF OSCILLATOR ADJUSTMENT

## (Using a signal generator)

It is always advisable to make HF oscillator adjustments using a Television Signal as instructed on page 3. If a Television Signal is not available HF oscillator adjustment can be mude using a crystal calibrated signal generator. Make adjustments as follows:

| Receiver Control Settings | Signal Generator | Instructions |
| :---: | :---: | :---: |
| Set Channel selector for each channel to be adjusted. Set "Tuning" control at half rotation. Turn Volume control fully to the right (clockwise). | Connect to antenna terminals. Set generator to exact frequency of HF oscillator. See frequency table on page 11. Set gen--rator for maximum output. | Connect a wire jumper from test point "W" on the tuner to test point " $Z$ ". See figure 11 . Remove the ratio detector tube V202 (6AL5). Carefully adjust the oscillator slug A13 on each channel until a whistle (beat) is heard in the speaker of the receiver. |

## DIAL STRINGING

Dial stringing for the gang tuning control is shown below.


Figure 19. Dial Stringing for 20D2 Chassis.


Figure 20. Radio Trimmer Locations.

## RADIO ALIGNMENT PROCEDURE

- Connect output meter across speaker voice coil.
- Use lowest output setting of signal generator that gives a satisfactory reading on meter.
- Use a non-metallic alignment tool for IF adjustments.
- Repeat adjustments to insure good results.
- Function switch in "Radio" position.

| Signal <br> Generator <br> Frequency | Recoiver <br> Dial <br> Setting | Adi. Trimmers <br> in Following <br> Order to Max. |
| :---: | :---: | :---: |
| 455 KC | Tuning gang <br> wide open | *A-8 (2nd IF) <br> *C-D (1st IF) |
| 1620 KC | $"$ | E (oscillator) |
| 1400 KC | Tune in <br> signal | \$F (antenna) |

* Adjustments $A$ and $C$ made from underside of chassis. See figure 20 for trimmer locations

SAN antenna trimmer may not peak if antenna leads are not properly routed or separated.

Figure 21. Schematic for 20D2 Chassis.


## WAVEFORM DATA

Waveforms taken with Contrast control set fully to the right, all other controls set for normal picture, (in sync). DX Range Finder control set fully the DX Range Finder control will cause waveform distortion
Waveforms at video and sync stages obtained with transmitted signal input to receiver.
The oscilloscope sweep is adjusted for 30 cycles (which is one-half of the vertical frequency), or for 7875 cycles (which is one-half of
.

The peak-to-peak voltage readings shown are subject to some variThe peak-to-peak voltage readings shown are subject to some
tions due to response of the oscilloscope and parts tolerances. Waveform at V407 can also be taken by clipping or twisting the
lead from the oscilloscope high side over the insulation on the lead ead from the oscilloscope high side over the insulation on the lead of waveform will be the same but the peak-to-peak voltage will be much lower, depending upon the degree of coupling.

## TV VOLTAGE DATA

## (Yoltages given on schematic)

- Contrast control turned fully clockwise. Channel Selector sel on an unused channel. Other front controls set at approximatel rotation. DX Range Finder control set fully to the left (at " 0 " position).
Antenna disconnected from set with terminals shorted.
- Line voltage 117 volts AC
- Voltages measured with a vacuum-tube voltmeter between tube socket terminals and chassis, unless otherwise indicated.
- Voltages at V101 and V102 (VHF Tuner) are measured with tub in socket. Use an adapter or lift tube out of socket just high enough to allow a needle point probe to contact tube pins. Vol ages at pins 1 and 8 of
- Voltages at V306 measured from top of socket with tube removed
- Vilase val in trol setting. In combination models, B+ voltages in TV chassi will be slightly higher when set is switched to radio position Alternate voltage readings for radio and TV are shown for soun output tube V204 ( 6 Y 6 G ) in 20 D 2 chassis.
Pulsed high voltages are present on the cap of V405, pin 3 of V407 and on the filament terminals and cap of the 1B3GT tube. NO
ATTEMPT SHOULD BE MADE TO TAKE MEASUREMENTS FROM THESE POINTS WITHOUT SUITABLE TEST EQUIP MENT.
Picture tube 2nd anode voltage can be measured from the 2nd anode connector a diloter or a vacuum.tube voltmeter with migh voltage probe. 2nd anode voltage is approximately 16.5 KV Proper filament voltage check of the 1B3GT tube may be made b observing flament brillia
a 1.5 volt
dry cell battery

Run numbers are rubber stamped at the rear of the chassis. (11), (12),.....(V), (I), etc. indicate alignment points and alignment

IMPORTANT: Before making waveform and voltage measure ments, see instructions on this page.

NOTE: To read schematic for 20A2 and 20A2Z chassis, use sections in eayy solid lines; to read schemati or 20D2 chassis, use sections in heavy dotted lines and connect appropriate points indicated by dots coded

B1 B2 etc.





OJohn F. Rider

## Figure 5. Illustration of 12 db Atrenuation Pad for Viewing Over-all RF-IF Response Curve.  <br> 

Figure 6.
Decoupling Filter.


Figure 9. Top viow of TV Tune

## IF AMPLIFIER AND TRAP ALIGNMENT

- Connect bias battery; negative to test point " $T$ ", see figure 8, positive to chassis. A $41 / 2$ volt battery is required for all steps below.
- Disconnect antenna. Connect a jumper wire across the antenna terminals.
- Set Channel Selector to channel 12 or other unassigned high channel, to prevent interference during alignment.

| Step. | $\begin{gathered} \text { Sigmal } \\ \text { Gen. Freq. } \end{gathered}$ | VTVM and Signal Gemerator Commections |
| :---: | :---: | :---: |
| ${ }^{1}$ | *47.25 MC | VTVM high side to test point "V" through a decoupling filter; see figures 6 and 8 , common to chassis. <br> Generator high side to 6 (V102) special tube shield. Connect low side to chassis near the tube shield, see figure 7. |
| 2 | 45.3 MC |  |
| 3 | 45.3 MC |  |
| 4 | 45.3 MC |  |
| 5 | 45.3 MC |  |
| 6 | 45.3 MC |  |
| 7 | 43.3 MC |  |
| 8 | 43.95 MC |  |
| 9 | 43.95 MC | Connect VTVM as above. Generator high side to antenna terminals; full output may be required. |

10 To insure correct alignment, repeat steps 1 and 6. Make the "IF Response Curve Check" given on page 9. Before proceeding with alignment, turn slugs A2 and A3 out fully (counterclockwise). Check the signal generato
a crystal calibrator or other frequency standard for absolute frequency colibration required for this aperatian.

Set th
wise)

- Allow about 15 minutes for receiver and test equipment to warm up.
- Use lowest DC scale on VTVM.

Note: Since A2 and A3 are adjustments of an overcoupled double tuned circuit, adiustment of A3 is first made at 43.3 MC (step 3) and then at 45.3 MC (step 5), to obtain proper peak
igure 8. Bottom Yiew of $20 L 2$ Chassis Showing Test Poin Connections and IF Alignment Data.

Figure 7. Tube Shield for
IF Alignment and If
Response Curve Check.


Connect signal generator high side to pin 2 of V304 (6AL5) through a .01 mfd . capacitor, connect low side to chassis.
b.Allow about 15 minutes for receiver and test equip ment to warm up.

IF RESPONSE CURVE CHECK
(Using sweep generator and oscilloscope)

| Receiver Controls and Bias Battery | $\begin{aligned} & \text { Sweep } \\ & \text { Generator } \end{aligned}$ | Marker Generator | Oscilloscope | Instructions |
| :---: | :---: | :---: | :---: | :---: |
| Set Channel Selector on channel 12 or an unassigned high channel. Contrast control fully to the left. Connect negative of $41 / 2$ volt bios battery to test point "T"; positive to chassis. | Connect high side to 6 U8 mixer-osc. insulated tube shield, see fig. 7. Connect low side to chassis neap tube shield. Set sweep frequency to 44.5 MC , and sweep width approximately 7 MC. | If an external marker generator is used, loosely couple high side to tube shield, low side to chassis. Marker frequencies indicated on IF Response Curve. | Connect to test point "V" through a decoupling filter, see figs. 6 and 8. Marker pips on scope will bopacitor from 100 mmfd. to 1000 mmfd . is connected across the oscilloscope input. | Check curve obtoined against ideal response curve in fig. 10. Note toler ances on curve. Keep marker and sweep outputs at very minimum to prevent overloading. A reduction in sweep output should reduce response curve amplitude without altering the shape of the response curve. If the curve is not within tolerance or the markers ore not in the proper location on the curve, touchup with IF slugs as instructed below. <br> Impertant: If curve changes shape with hand capacity, see section 1 of "Alignment Hints." |





arasuego froou meysi peas
Figure 10. Idaal If Respanse Curve.
Figure 11. If Response Curves, Incorrect Shapa.
If it is necessary to adjust for approximate equal peaks and correct
marker location, carefully adjust slug A2 and if necessary, adjust slug A3. It should not be necessary to turn the slugs more than one turn in either direction.
If the curve cannot be made to resemble the response curve shown at left,
Ifere repeat all steps under "IF Amplifier and Trap Alignment" making sure that
generator frequencies are accurate and adjustments are carefully made. If a satisfactory curve cannot be obtained after repeating these stepa, it may be necessary to change IF amplifier tubes or check tor a defective circui component to be sure that each stage is operating properly.

TOUCH-UP OF RATIO DETECTOR SECONDARY USING TELEVISION SIGNAL (AIO, BOTTOM SLUG OF T201)
Adjustment need be made on one channel only. Proceed as follows
a. Turn set on and allow about $\mathbf{1 5}$ minutes for warm up. b. Tune set for normal picture and sound.
c. Carefully insert a non-metallic alignment tool in the bottom slug of T201. An alignment tool with a screw driver blade or hexagonal end is required depending on the transformer used, see " note below. When the alignment tool engages the bottom tuning slug A10, adjust the slug for best sound with minimum buzz level. Do this carefully as only slight rotation in either direction

- If ratio detector transtormer (T201) has hollow hexagonal core slugs, bottom slug adjustment (A10) can be made from top of chassis, if you use alignment tool (part.
of the upper slug ( AB ).


## VHF TUNER RF AND MIXER ALIGNMENT

a. Connect negative of $41 / 2$ volt bias battery to $A G C$ buss (test point " $T$ "), positive to chassis. If it is dif ficult to obtain a curve of sufficient amplitude, re move battery and connect a wire jumper from tes point "T" to chassis.
b. Connect sweep generator (with 300 ohm output) to antenna terminals. If sweep generator does not have a built-in marker generator, loosely couple a marker
will generally be required. Correct adjustment point is located between the two maximum buzz peaks that will be noticed
$1 / 4$ to $1 / 2$ tur
ALIGNMENT OF 45 MC TRAP All, USING A

## TELEVISION SIGNAL

Beat interference ( 4.5 MC ) appears in picture as yery fine vertical or diagonal lines, very close together, having "gauze-like" appearance, the pattern will vary with speech, forming a very fine herringbone pattern.
The trap can be tuned by watching the picture and adjust ing slug All for minimum 4.5 MC interference. If greater accuracy is required, the trap should be adjusted as in structed in step 3 of the "4.5 MC Sound IF and Tra Alignment."
enerator to the antenna terminals. To avoid distortion of the response curve, keep sweep generato output at a minimum, marker pips just barely visible. Connect oscilloscope through a 10,000 ohms resistor test point "W" on tuner (figure 13). Keep scope eads away from chassis.
d. Allow about 15 minutes for receiver and test equip ment to warm up.

| Stop | Marker Gon. Freq. (MC) | Swoep Gen. Frequency |
| :---: | :---: | :---: |
| 1 | 193.25 MC (Video Carrier) 197.75 MC (Sound Carrier) | Sweeping Channel 10. See frequency table below. |
| 2 | $\begin{gathered} 83.25 \mathrm{MC} \\ \text { (Vide0 Carrier) } \\ 87.75 \mathrm{MC} \\ \text { (Sound Carrier) } \end{gathered}$ | Sweeping Channel 6. See frequency table belaw. |
| 3 | Sot the sweep generator to sweep the channel to be checked. Set the marker, generator for the carresponding video carrier fre quency and sound carrier frequency. |  |



Full skirt of curve will not be visible unless generator
figure 12 RF Rest location, see figure 12 operating in the serv
oppreciably affected.

Alternately adjust A12 and A13 (figure 13 ) as required to obtain equal peak amplitudes and symmetry, cansistent with flat top appearance, proper band width and correct marker
location

Adiuss Al4 as required to obtain curve having maximum amplitude and flat top appearance
consistent with proper bondwidth consistent with proper bandwidth and correct
pleting adiustment, recheck adiustment of step 1.

Check each channel aperating in the service area far curve shown below. In general, the
adiustment adiustment perfarmed in steps 1 and 2 are sufficient to give satisfactary response curves on
all channel all channels. Hawever, if reasonable alignment is not obtained an a particular channel,
(a) check to see that coils have not been intermixed, or (b) try replacing the pair af cails (a) check to see that coils have not been intermixed, or (b) try replacing the pair of cails
for that particular channel, or (c) repeat step 1 for a weak high channel as a compromise adjustment to favor the particular channel. Repeat stap 2 for the weak low channel to
favor the particular low channel. If a compromise adjustment is made, other channels favor the particular low channel. If a compromise adjustment is made, other channels
aperating in the service area should be checked to make certain that they have not been

|  | VHF FREQUENCY TABLE |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Channel Number | Channel <br> Freq., <br> MC | Video Carrier, MC | $\begin{aligned} & \text { Sound } \\ & \text { Currier, } \\ & \text { MC } \end{aligned}$ | $\begin{gathered} \text { HF } \mathbf{O s c e .}^{\text {MC }} \end{gathered}$ |
| 2 | 54.60 | 55.25 | 59.75 | 101 |
| 3 | 60.66 | 61.25 | 65.75 | 107 |
| 4 | 66.72 | 67.25 | 71.75 | 113 |
| 5 | 76.82 | 77.25 | 81.75 | 123 |
| 6 | 82.88 | 83.25 | 87.75 | 129 |
| 7 | 174-180 | 175.25 | 179.75 | 221 |
| 8 | 180.186 | 181.25 | 185.75 | 227 |
| 9 | 186.192 | 187.25 | 191.75 | 233 |
| 10 | 192.198 | 193.25 | 197.75 | 239 |
| 11 | 198.204 | 199.25 | 203.75 | 245 |
| 12 | 204.210 | 205.25 | 209.75 | 251 |
| 13 | 210.216 | 211.25 | 215.75 | 257 |




## IF PRE-AMPLIFIER RESPONSE CURVE CHECK AND ALIGNMENT

Important: This alignment is seldom required. It should be made only if UHF reception is poor and after usual causes of poor reception have been checked. This alignment should be made after completing preceding alignments.
a. Sel VHF Channel Selector at detent position midway between channeis 5 and 6.
b. Connect negative of $41 / 2$ volt bias battery to AGC buss (test point " $T$ "), positive to chassis.
c. Remove CRI (mixer crystal) from holder. Connect sweep generator high side through 100 ohm resistor to negative clip of mixer crystal socket, see figure 13 If sweep generator does not have a built-in marker generator, loosely couple a marker generator to the high side of sweep generator. To avoid distortion
of the response curve, keep sweep generator oufput at a minimum, marker pips just barely visible.
d. Connect oscilloscope through a $\mathbf{1 0 , 0 0 0}$ ohm resistor to test point "W" on tuner (figure 18). Keep scope leads away from chassis.
. Allow about 15 minutes for receiver and test equip ment to warm up.
f. Use a non-metallic alignment tool. If hollow core slugs are used, use alignment tool, part number 98A30-14.

| Stop | Marker Gen. Freq. (MC) | Sweep Gen. Frequency | Instructions |
| :---: | :---: | :---: | :---: |
| *1 | 45.75 MC (Video Carrier) 41.25 MC (Sound Carrier) | Set sweep at 43.5 MC, sweep width 12 MC . | Adjust A17 ta obtain maximum amplitude at center of curve. Alternately adjust A18 and A19 (figure 18) as required to obtain equal peak amplitudes and symmetry, consistent with flat top appearance, proper band width and correct marker location; see figure 17. |
| 2 | If curve cannot be made to resemble response curve, figure 17, check to be sure all instructions have been followed. Check tubes V101 and V102 and repeat alignment. <br> Important: After replacing tubes, it may be necessary to check "VHF Tuner RF And Mixer Alignment". |  |  |

* Before proceeding, detune slug A2 exactly 3 turns counter-clockwise. After completing this alignment, return slug A2 to its original setting by turning it exactly 3 turns clockwise.
Caution: Use extreme care to avoid damage to coils or slugs.



Figure 18. Bottom View of Tuners Showing

## PRODUCTION CHANGES

Production changes are coded RUN 1, RUN 2, etc., as given in the headings below. Run number (stamped on chassis) indicates that this chassis has the change(s) incorporated which are explained under that particular run number heading below, as well as all changes (lower run numbers) made prior to that time. At the start of production chassis were stamped RUN 1; a few chassis were not stamped with a Run number.

## CHANGE IN SYNC CIRCUITS

## Run 2 and higher

In sets stamped Run 2 and higher, R330 was changed from 18,000 ohms to 27,000 ohms, R416 was changed from
2.7 megohms to 3.3 megohms, R417 was changed from 47,000 ohms to 27,000 ohms. The above changes were made to improve vertical sync and correct bending at top of picture.




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4. If horizontal sync is still unsatisfactory, carefully repeat entire procedure. Try replacing tube V403. It may be necessary to make Complete Horizontal Oscillator Alignment (using an oscilloscope)

HORIZONTAL CONTROL (
(ON FRONT PANEL)


Figure 10. Rear View of Chassis Showing Horizontal Sync Adjustments.

Figure 11.
 ${ }^{4566}$

View of Chassis

Sync Adjustments.
Set the oscilloscope sweep to 15.75 KC or a sub-multiple of it.
. Adjust the Horizontal Lock slug (D) (see figure 11) until the oscilloscope waveform pattern appears as in figure 12. The rounded and pointed peaks of the waveform must have equal height. The picture must be kept form must have equal height. The picture must be kept tern. Keep the picture in sync by adjusting the Hori

## COMPLETE HORIZONTAL OSCILLATOR ALIGNMENT <br> (Requires Oscilloscope)

1. IMPORTANT: Set the DX Range Finder at " 0 " position and set the Contrast control (on front panel) for normal picture.
2. Connect oscilloscope high side through a 10 mmfd . capacitor to terminal marked " C " or " 2 " on the horizontal oscillator transformer T404 (see figure 11). It is important to use short leads and a very low capacity capacitor (at least 10 mmfd .) to avoid loading the cir-

## SERVICING RADIO T



Figure 12. Horizontal Oscillator Waveform.

## SERVICING RADIO TUBES AND DIAL LIGHT

The radio tubes and radio dial light can be serviced without complete removal of the radio tuner from the TV without removing the TV chassis from the cabinet. The chassis. To gain access to the underside of the radio tuner, radio tubes can be reached through the opening cut in the remove the tuning drive drum and remove the four self. underside of the chassis shelf.
The dial light can be serviced by removing the tuning knobs and plastic control panel. A number 47 dial light (part number 81A1-8) is used.

## REMOVING RADIO TUNER

The radio tuner is mounted at the front apron of the chassis. Alignment, taking voltage readings or an inspec tion of the underside of the radio tuner can be performed


## RADIO ALIGNMENT PROCEDURE

- Connect output meter across speaker voice coil.
- Use lowest output setting of signal generator tha gives a satisfactory reading on meter.
- Turn receiver Volume control fully on
- Use a non-metallic alignment tool for IF adjustments.
- Function switch in "Radio" position.
- Repeat adjustments to insure good results.

| Step | Connect Signal Generator | Dummy Antenna Between Radio and Signal Generator | Signal Generator Frequency | Receiver Dial Setting | Adj. Trimmers in Following Order to Max. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Gang capacitor antenna stator | . 1 MFD | 455 KC | Tuning gang wide open | $\begin{aligned} & \text { *A-B (2nd IF) } \\ & { }^{*} \mathrm{C}-\mathrm{D}(1 \mathrm{st} \mathrm{IF}) \end{aligned}$ |
| 2 | " | " | 1620 KC | " | E (Oscillator) |
| 3 | Place generator lead close to loop of set to obtain adequate signal. <br> No actual connection (signal by radiation). |  | 1400 KC | Tune in signal | §F (antenna) |

* Adiustments $A$ and $C$ made from underside cf chassis. See figure 44 for alignment locations.
\& AM antenna trimmer may not peak if antenna leads are not properly routed or separated.


## SERVICING 3DI RADIO CHASSIS

## ALIGNMENT OF 3DI KADIO CHASSIS

The 3Dl radio chassis should be aligned as instructed below.
Radio alignment adjustments are accessible without disassembly of the radio from the housing. Remove the radio escutcheon for aligning adjustments A and C . Adjust ments A and C are accessible through holes in chaseis hous. ing. Location of alignment adjustments is shown in figure


Figure 46. 3DI Radio Chassis
With Front Housing Remored

## 3D1 RADIO ALIGNMENT PROCEDURE

- Connect output meter across speaker voice coil. same relative position to the chassis as when in the
- Turn receiver Volume control fully on; Tone contro fully clockwise.
- Band switch in AM position
- AM antenna must be connected and placed in the

Figure 47. Trimmer Locations for 3D1 Radio. cabinet.

- Use lowest output setting of signal generator that gives a satisfactory reading on meter.
- Use a non-metallic alignment tool for IF adjustments.
- Repeat adjustments to insure good results.



Figure 44. Location of Radio Alignment Adjustments.
The radio tuner in television and radio chassis should be aligned as instructed under "Radio Alignment Procedure" below.
Radio alignment adjustments $\mathrm{B}, \mathrm{C}, \mathrm{D}$ and F are accessible without disassembly of the radio tuner from the TV chassis. Adjustments $A$ and $C$ are made from underside of chassis, see paragraph above on "Removing Radio Tuner". The figure at left shows the locations of radio alignment adjustments.

| Step | Connect Signal Generator | Dummy Antenna Between Rodio and Signal Genercitor | Signal Generator Frequency | Receiver Dial Setting | Adj. Trimmers in Following Order to Max. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Gang capacitor antenna stator | . 1 MFD | 455 KC | Tuning Gang wide open | $\begin{aligned} & \hline \text { *A-B (2nd IF) } \\ & { }^{-C-D}(1 \mathrm{st} \mid \mathrm{F}) \end{aligned}$ |
| 2 | " | " | 1620 KC | " | E (oscillator) |
| 3 | Place generator lead close to loop of set to obtain adequate signal. <br> No actual connection (signal by radiation). |  | 1400 KC | Tune in signal | §F (antenna) |

AM antenna trimmer adjustment " $F$ " in step 3 should be repeated after set and antenna have been installed in cabinet. Important: AM antenna trimmer may not peak if antenna leads are not properly routed or separated.

CHASSIS 19L2, Z, M2, Z, N2Z, R2, S2, T1, W1, W1A

## TELEVISION ALIGNMENT PROCEDURE

## GENERAL

Complete VHF and UHF IF Pre-amplifier alignment consists of the following individual procedures and should be performed in this sequence.
a. IF Amplifier and Trap Alignment.
b. IF Response Curve Check.
c. 4.5 MC Sound IF and Trap Alignment.
d. RF and Mixer Alignment.
e. Over-all RF and IF Response Curve Check.
f. VHF Oscillator Adjustment.
g. IF Pre-amplifier Response Curve Check and Alignment.

## TEST EQUIPMENT

To properly service this receiver, it is recommended that the following test equipment be available.

IMPORTANT: Many service instruments do not meet the requirements given below. A list of recommended equipment is available from Admiral Distributor.

## Oscilloscope

Standard oscilloscope, preferably one with a wide band vertical deflection, vertical sensitivity at least .05 volt (RMS) per inch.

## Signal (Marker) Generator

4.5 MC frequency.

40 to 50 MC frequency range.
50 to 90 MC frequency range.
170 to 225 MC frequency range
Must have a built-in calibration crystal for checking dial accuracy.

## Sweep Generator

Sweep generator must provide sweep frequencies from 40 to 50 MC range: with at least 50 to 90 MC range: $\} \quad 10 \mathrm{MC}$ sweep width. 170 to 225 MC range: $\quad$ Output: adjustable; at least one-tenth volt maximum Output impedance: 300 ohms balanced to ground.
A sweep generator not having constant output voltage over the swept range and linear sweep, will produce curves which are widely different from the ideal curve shown in the following pages. If repeated difficulty is encountered in obtaining these curves, the sweep gen erator should be checked. A simple check is to ob the response curve for a set that is in alignment.

Before suspecting the generator, be sure the alignment instructions in this manual have been followed carefully

## Vacuum-Tube Voltmeter

Preferably with low range ( 3 volt) DC zero center scale and a high voltage probe ( 30,000 volt range).

## ALIGNMENT TOOLS

The following alignment tools are required. They can be obtained from the Admiral Distributor under the part numbers listed below:
Metal alignment screwdriver part number 98A30-9. Non-metallic (fiber) alignment screwdriver (11 $1 / 2^{\prime \prime}$ long, $1 / 8^{\prime \prime}$ diameter) part number 98A30-10.

Non-metallic alignment wrench ( $9^{\prime \prime}$ long, for large hexagon core IF slugs) part number 98A30-12.

Non-metallic alignment wrench (9" long, for small hexagon core IF slugs) part number 98A30-13.

## IMPORTANT ALIGNMENT HINTS

The following suggestions should be performed if difficulty is experienced during the alignment procedure.

1. IF CIRCUIT INSTABILITY: When spot frequency aligning the IF amplifers, the VTVM pointer may swing when the
hand is placed to near the IF transormers. When viewing the IF response curve on an oscilloscope, the curve may change
shape with hand capacity, especially when aligning A6 (3rd shape with hand capacity, especially when aligning A6 (A) (3)
IF ransformer T303). To correct either of these conditions IF transformer T303). To correct either of the
the following alignment hints should be tried:
(a) Check the generator output leads to be certain that the
unshielded portion (especially the grounded lead) be as short as practicable.
(b) Be sure that a decoupling network is used at the video
detector output and that the leads on detector output and that the leads on the network are kept as
short as possible (See figure 21 ). (c) For injecting IF signal use an insulated tube shield (c) For injecting IF signal use an insulated tube shield
over V 102 bev8 Oscillator-Mixer tube. Insulate botom in
side of tube shield with masking tape; see figure 16 .
(d) The use of a non-metallic alignment tool, approximately.
cight inches long (part number 9830012 ), will permit ad. eight inches long (part number $98 \mathrm{~A} 30-12$ ), will per
justment without coming too near to the transformers. 2. RECEIVER OVERLOADING WHEN CHECKING THE
OVER.ALL RESPONSE CURVE: Due to the inherent high sensitivity of these receivers. it it is very easy to cause over.
loading in the third IF amplifier stage. In some cases, genoading in the third if amplifer stage. in some cases, gen-
erator leakage alone is enough to produce a response curve on the oscilloscope. To prevent overloading, do the following:
(d) Be certain that the generator output attenuators are set
at a minimum. at a minimum.
(b) Some generators have a buill-in pad in the output table
to be used when viewing the over-all response curve. Be sure o be used when viewing the over-all response curve. Be sure
that the pad in the cable is properly connected in the circuit. that the pad in the cable to the generator instruction manual for details.
(c) If a pad is not builh in, the 12 db pad shown below in
figure 17 can be constructed and connected between the generator and the antenna terminals.


Figure 16. Tube Shield for IF Alignment and

After becoming familiar with alignment procedure, some servicemen simplify subsequent alignment of sets by merely using the essential alignment data given in figures below.


Figure 21. Decoupling Filter.

Figure 20. Top View of TV Tuner
Showing Adjustment Locations.


Figure 22. Bottom View of 19T1, 19WI and 19WIA Chassis


Fikure ${ }^{22 A}$. Boitom View of $1992,19 \mathrm{Ma}$, $\mathrm{N2Z}$ and 19R2 Chassis Showing Test Po
Connections and IF Alignment Data.

## UHF TUNER ALIGNMENT

The UHF tuner has been carefully aligned at the factory and generally should never require realignment in the field. Also, since alignment of the UHF tuner is quite involved, for the present, it is not recommended for field service. If it has been definitely determined that complete tuner alignment is required, it should be returned to the Admiral distributor for replacement.
Important: Do not under any circumstances attemp adjustment of the tracking screws or bend the capacitor tuning plates in any way.

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## IF AMPLIFIER AND TRAP ALIGNMENT

- Connect bias battery; negative to test point "T", see figure 22 , positive to chassis. A $41 / 2$ volt battery is required for all steps below.
- Disconnect antenna. Connect a jumper wire across the antenna terminals.

Set Channel selcctor to Channel 12 or other unassigned - Set the Contrast control fully to the left (counterclockwise).

Allow about 15 minutes for receiver and test equipment to warm up.

- Use lowest DC scale on VTVM.

| *1 | * 47.25 MC | VTVM high side to test point "V" through a decoupling filter; see figs. 21 and 22, common to chassis. Generator high side to 6U8 (V102) special tube shield. Connect low side to chassis near the tube shield, see figure 16. |
| :---: | :---: | :---: |
| 2 | 45.3 MC |  |
| 3 | 43.3 MC |  |
| 4 | 45.3 MC |  |
| 5 | 45.3 MC |  |
| 6 | 45.3 MC |  |
| 7 | 43.3 MC |  |
| 8 | 43.95 MC |  |

VTVM high side to test point "V" figrough a decoupling filter; see
fland 22 , common to Generator high side to 6U8 (V102) special tube shield. Connect low
side to chassis near the tube shield, see figure 16.

Before proceeding with alignment, turn slugs A2 and A3 out fully (rounter-clockwise). Check the signal generator used in alignment
for his operation. for this operation.

aneasured fron migess reat

Figure 18. Ideal IF Response Curve.


Figure 19. IF Response Curves, Incorrect Shape. If it is necessary to adjust for approximate equal peaks and correct marker location, carefully adjust slug A 2 and if necessary,
adjust slug A3. It should not be necessary to turn the slugs more than one turn in either direction.
If the curve cannot be made to resemble the response curve
If
hown at left, repeat all steps under "IF Amplifier and Trap shown at left, repeat all steps under "IF Amplifer and Trap
Alignment" making sure that generator frequencies are accurate Alignment making sure that generator frequencies are accurate and adjustments are carefully made. If a satisfactory curve can-
not be obtained after repeating these steps, it may be necessary to change IF amplifier tubes or check for a defective cir
compont to be sure that each stage is operating properly.

### 4.5 MC SOUND IF AND TRAP ALIGNMENT

## See below for touch-up of ratio detector using television

 signal without test equipment.a. Connect signal generator high side to pin 2 of V304 d. Use a NON.METALLIC alignment tool. If Ratio Del

Connect signal generator high side to pin 2 of V304
( $6 \mathrm{ALL5}$ ) through a .01 mfd . condenser, connect low side 0 chassis.
b. Allow about 15 minutes for receiver and test equipment to c. Set Contrast control fully to the left (counterclackwise)

| Step | Signal Gen. Freq. (MC) | VTVM Connections | Instructions | Adjust |
| :---: | :---: | :---: | :---: | :---: |
|  | When using a signal generator, be sure to check it against a crystal calibrator or other frequency standard for accurate frequency calibration at 4.5 MC . Accuracy required is within one kilocycle. <br> IMPORTANT: If a signal generator and frequency standard are not available, alignment can be made using a TV station signal. Tune in a station and follow steps 1,2 and 3 below. If necessary use a higher scale on the VTVM. |  |  |  |
| 1 | Set to exactly 4.5 MC | High side to est point " $Y$ " common to chassis. | Use lowest DC scale on VTVM. | A8 and A9 for maximum (keep reducing generator output to keep VTVM at approx. 1 volt). |
| 2 |  | High side to test point "Z"; common to chassis. | Use zero center scale on VTVM, if available. | Al0for zero on VTVM (the correct zero point is located between a positive and a negative maximum). If $A 8$ was far off, repeat step 1. |
| 3 |  | $\begin{gathered} \text { High side to, } \\ \text { teas point "Y"; } \\ \text { common to chassis. } \end{gathered}$ | *Connect a 10 mmfd. capacitor from pin 5 of V305 (6CB6) to pin 7 of V201 (6AU6). <br> Use lowest DC scale on VTVM. | All for minimum. |

*In 19R2 chassis, connect 10 mmfd , capacitor from pin 7 of V305 (12RY7) to pin 7 of V201 (6Alf6)

## TOUCH-UP OF RATIO DETECTOR SECONDARY

 USING TELEVISION SIGNAL (A1O,BOTTOM
## SLUG OF T201

"Adjustment A10 is accessible through the $1 / 4$ " hole (just below T201) in bottom of the cabinet or the chassi mounting shelf, located toward the left side facing the rear of the set. See figure 22. Removal of the chassis is therefore not required. Adjustment need be made on one channel only. Proceed as follows:
a. Turn set on and allow about 15 minutes for warm up
b. Tune set for normal picture and sound.
c. Carefully insert a non-metallic alignment tool through the opening in cabinet bottom below T201. An align ment tool with a screwdriver blade or hexagonal end is required depending on the transformer used, see note below. When the alignment tool engages the bottom tuning slug A10, adjust the slug for best sound with minimum buzz level. Do this carefully as
only slight rotation in either direction will generally be required. Correct adjustment point is located be ween the two maximum buzz peaks that will be noticed when turning the slug back and forth about $1 / 4$ to $1 / 2$ turn.

## ALIGNMENT OF 4.5 MC TRAP All, USING A TELEVISION SIGNAL

Beat interference ( 4.5 MC ) appears in picture as very fine vertical or diagonal lines, very close together, havin a "gauze-like" appearance, the pattern will vary with speech, forming a very fine herringbone pattern.

The trap can be tuned by watching the picture and adjusting slug All for minimum 4.5 MC interference. If greater accuracy is required, the trap should be adjusted Trap Alignment"

If ratio detector transformer (T201) has hollow hexagonal core slugs, bottom slug adjustment A10 can be made from top of chassis,
 hole in the core of the upper slug (A8)


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## PARTS LIST

Electrical components have symbols in 100 series, 200 series, etc... according to location
on schematic. Order parts by part number and description from Admiral Distributor.

IF PRE-AMPLIFIER RESPONSE CURVE CHECK AND ALIGNMENT Important: This alignment is seldom required. It should be made only if UHF reception is poor and after usual causes of poor reception have been checked. This alignment should be made after completing preceding
alignments. alignments.
. Set VHF Channel selector at detent position midway be-
annels 5 and 6
b. Connect negative of $41 / 2$ volt bias battery to AGC buss (test
point " T "), positive to chassis.

generator high side through from holder. Connect sweep senerator high side through 100 ohm resistor to negative
clip of mixer crystal socket, see figure 24. If sweep generator does not have a builh. in marker generator, loosely couple a marker generator to the high side of sweep gen-
erator. To avoid disiortion of the response curve, keep

## sweep generat berely yisible.

d. Connect oscilloscope through a $10,000 \mathrm{ohm}$ resistor to test point on tuner (figure 29). Keep scope leads away from chassis.
Allow about 15 minutes for receiver and test equipment
Use a non-metallic alignment tool. If hollow core slugs are
used, use alignment tool, part number 98 A 30.14

| Stap | Marker Gen. Freq. (MC) | Sweep Gen. Frequency |
| :---: | :---: | :---: |
| *1 | 45.75 MC (Video Corrier) 41.25 MC (Sound Corrier) | Set sweep at 43.5 MC, sweep width 12 MC. |

Adjust A17 to obtain maximum amplitude at center of curve. Alternately
adjust A18 and A19 (fisure 29) as required to obtain equal peak amplitudes
and symmen

If curve cannot be made to resemble response curve, figure 28 , check to be sure all
instructions have been followed. Check tubes V101 and V102 and repeat alignment.
mportant: After, replacing tubes, it may be necessary to check "VHF Tuner RF And
ixer Alignment"
Aefore proceeding, detune slug A2 exactly 3 turns counter-clockwise. After completing this alignment, return Cantion: Use extreme care to avoid delly 3 turna clock wise.


Full skirt of curre will not be visible unless senerato sweep width extends beyond 12 MC.
Figure 28. IF Pre-amplifier Response Curve.


Fisure 29. Bottom View of Tuners Showing
29. Botiom View of Tuners
If
Pre-amplifier Adjuctmentis.


RESISTORS


[^0]§ May be part of couplate, part number 63c6-8. Replace with exact part or individual components.

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## Schematic for 19N2Z VHF-UHF Television Chassis and 3D1 Radio.

Run numbers are rubber stamped at the rear of the chassis.
3DI RADIO
(41), (12), .....(V), ( Z), etc. indicate alignment points and alignment connections. (al), (12),..... (1). etc. indicate alignment points and alignment connections.

$\sum_{\text {vise }}^{5 \times 15}$

## TV VOLTAGE DATA (Voltages given on schematic)

 (20):

$$
\operatorname{Hon}_{\frac{0}{501}}^{501}
$$



Contrast control turned fully clockwise. Low-Channel Seloetor
sel on an unused VHF channel. High Channel Selector in the sel on an unused VHF channel. High Channel Solector in the
"VHF" position. Oher front controls set at approximately halif rotation. Vert. Lin. and Height set at approximately halif rota.
tion. DX Range Finder control set fully to the left (at " 0 " position).
Line Antenna disconnected from set with terminal ahorted.

- Line voltage 117 volts AC.
- Voltages measured with a vacuum-tube voltmeter between tube
socket terminals and chassis, unless otherwise indicated.
- Voltages at V101 and V102 (VHF Tuner) are messured with tube
in socket. Use an adapter or lift tube out of socket just high enough to allow a needle point probe to contact tube pins. Voltages at pins 1 and 8 of V101 ( $6 \mathrm{BZZ7}$ ) muat be paiken as
scribed above or no - Voltages at V306 measured from top of socket with
- B+ voltage at terminal of VHF-UHF switch taken with tuner in UHF position.
- Voltages marked with an asterisk (*) will vary widely with con.
trol setting. In combination models, $\mathrm{B}+$ voltages in TV chassis trol setting. In combination models, B+ voltages in TV chassis
will be slightly higher when set is switched to radio position. will be slighty higher when set is switched to radio position.
Alternate voltage readings) for radio and TV are shown for sound
output tube V204 6 Y 6 G ).
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Run numbers are rubber stamped at the rear of the chassis.
(III). (12), .....(V), ( 2 ), etc. indicate alignment points and alignment connections.

IMPORTANT: Before making waveform and voltage measurements, see instructions



O UHF TUNER 94066-I ${ }^{2} z_{y}$ VHF TUNER 94D64-2

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## (C) John F. Rider




## specifications

Power Supply Rating.
Audio Power Rating. Antenna Input Impedance. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 300 ohms
Video Response. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 4 MC

Focus. . Magnetic

Deflection.
n. . . .

Picture Carrier $\qquad$
$\qquad$ - Magnetic Sound Carrier. 45.75 MC Sound Carrier. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 7 M 7 MC
Adjacent Channel Sound Traps.
47.25 MC

## TUBE COMPLEMENT

| V1 | 6AU6 | Intercarrier Sound Amp. | V12A | 6SN7GTA | Sync Splitter |
| :---: | :---: | :---: | :---: | :---: | :---: |
| V2 | 6BN6 | Sound Limiter Det. | V12B | 6SNTGTA | Horiz. Phase Compare |
| V 3 | 6BK5 | Audio Output | V13 | 6W6GT | Vertical Output |
| V4 | 6CB6 | First Picture I. F. Amp. | V14 | 6SN 7GTA | Horizontal Oscillato |
| V5 | 6CB6 | Second Picture I. F. Amp. | V15 | 6CD6G | Horizontal Output |
| V6 | 6CB6 | Third Picture I. F. Amp. | V16 | 6AX4GT | Damper |
| V7 | 6AU6 | First Video Amp. | V17 | 1B3GT | High Voltage Rectifier |
| V8 | 6AQ5 | Second Video Amp. | V18 | 21AMP4 | Picture Tube 21" $90^{\circ}$ |
| V9A |  | R.F. AGC Clamp | V18 | 21AMP4A | Picture Tube $21^{\prime \prime} 90^{\circ} \mathrm{Alum}$. |
| V9B | Gsingita | Vertical Oscillator | V19 | 6BZ7 | Tuner R.F. Amp. |
| V10 | 6AU6 | AGC Amp. | V20 | 6X8 | Tuner Mixer Oscillator |
| V11 | 6BY6 | Sync Separator | V21 | 6AF4 | UHF Oscillator |

The Yoke Vertical Adjustment ( 2 hex head screws each side) allows centering of the yoke coaxially with the tube neck. Proper positioning of the yoke is important so that picture corner-cutting and side -shadows can be readily removed by the centering control.

## WIDTH AND HORIZONTAL LINEARITY

These controls (L404 and L403) are adjusted by clips which slide in vertical slots located on the right of the rear flange of the chassis. They should be adjusted simultaneously to provide good width and linearity with the picture extending approximately $1 / 4^{\prime \prime}$ beyond the edges of the mask.

## HORIZONTAL DRIVE

Adjust the Horizontal Drive Trimmer (C410B) to the point where "overdrive' lines (vertical white line near the center of the picture) just disappear. Turning this control to the right increases the Horizontal Drive.

## HORIZONTAL FREQUENCY

Adjust the Horizontal Hold control to the center of its range. Adjust the Hori zontal frequency trimmer (C410A) until picture will break sync at both ends of the Horizontal Hold range. When components are replaced the following procedure is to be used.

1. Short nut horizontal lock lock coil (L401) and set the Horizontal hold control to the center of its range
2. Adjust the horizontal frequency trimmer (C410A) for zerovolts on the grid (pin 4 of V14) of the horizontal oscillator
3. Remove the short from the Horizontal lock coil (L401) and adjust this coil for zerovolts on the grid (pin 4 of V14) of the horizontal oscillator.

One side of the a-c line is connected to the chassis through C5 and L405. The other side of the a-c line is connected to the chassis through R420, SR 1 , and ClA in series. Grounding the chassis will result in a short circuit across one $r$ the other of these two branches in the voltage-doubler circuit. During sezricg and alignment it is desirable that an a-c line isolationtransformer capable f handling at least 300 watts be used. Failure to use anisolation transformer will greatly increase the shock hazard, and may result in damage to the test equipment or receiver, or both.

## BUZZ CONTROL

This control (R104) is provided to adjust the AM rejection characteristics of the sound system (sync buzz, noise, or hiss). Since this control basbeer ad justed for an optimum setting at the factory, do not attempt to alter this adjustment unless sync buzz, noise, or hiss is present. Caution: Turn this control slowly from the present preset position--usually not more than 30 degrees rotation in either direction will be necessary

## YOKE ADJUSTMENT

The picture tube cone should fit snugly into the large front hole rimmed in rubber in the Yoke Mount Frame.
The Yoke Radial Adjustment (top wingscrew) allows the yoke to be rotated right or left--rotating the picture right or left.

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MODELS 21-550, -551, -552, -553, Ch. "D" 379-UHF, "D" 382-VHF

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## SPECIFICATIONS

125 watts, $105-120$ volts
Power Supply $\qquad$ Audio Power Rating $\qquad$ 1.4 watts maximum 1.1 watts undistorted Antenna Input Impedance . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 300 ohms Video Response. . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 3. 3 MC
Focus .......... Electrostatic
Focus.
70 Magnetic
Deflection. 45.75 MC

Picture Carrier 45.75 MC

## Sound Carrier

 41.25 MC
## WARNING

One side of the AC line is connected directly to the metal chassis. During servicing and alignment an ACisolation transformer ( 150 watts or more) must be used to decrease the shock hazard and to prevent damage to the test equipment, receiver or both. The control mounting panel and the metal cabinet (Model 21-555) are isolated from the chassis by a 220 K resistor and an. $01 \mu \mathrm{f}$ capacitor. A slight "shock" may be felt between earth ground an any of the crews at the rear of the cabinet. This "shock" is not dangerous as the current is limited by the isolation components. Care must be taken to prevent anything from shorting the control mounting panel or the cabinet to the chassis. HEIGHT AND VERTICAL LINEARITY
These controls ( R 312 and R318) are a accessible only when the rear cover is removed. They should be adjusted simultaneously for proper height consistant with good vertical linearity. The picture should extend approximately $1 / 4^{\prime \prime}$ beyond the edges of the mask.

## BUZZ CONTROL

This control (R103) is provided to adjust the AM rejection characteristics of the sound system (sync buzz, noise, or hiss). Since this control has been ad justed for an optimum setting at the factory, do not attempt to alter this adjustment unless sync buzz, noise, or hiss is present. Caution: Turn this control slowly from the present preset position---usually not more than 30 degrees rotation in either direction will be necessary.

## YOKE ADJUSTMENT

The picture tube cone should fit snugly into the large front hole rimmed in rubber in the Yoke Mount Frame.

The Yoke Radial Adjustment (top wingscrew) allows the yoke to be rotated right or left--rotating the picture right or left.

The Yoke Vertical Adjustment ( 2 hex heąd screws each side) allows centering of the yoke coaxially with the tube neck. Proper positioning of the yoke is important so that picture corner-cutting and side -shadows can be readily removed by the centering control.

## HORIZONTAL OSCILLATOR ADJUSTMENT

1. Adjust horizontal hold control ( R 404 ) maximum clockwise and connecta jumper from terminals $C$ to D of Horizontal Oscillator transformer (T401).
2. Adjust top of T40l to get picture in Horizontal sync
3. Remove jumper from terminals $C$ to $D$ and connect oscilloscope (lead isolated with 10 K ohms) to terminal C of T 40 l .
4. With picture in sync (it may be necessary to readjust top of T401) adjust bottom of T401 for curve with equal peaks as shown below.

( Make all adjustments at
117 volts AC line voltage)
5. Remove oscilloscope. Readjust top of T40l so picture will break horizontal sync with 2 diagonal bars when hold control is turned to max. clockwise position.

## TUBE FAULTS

It is possible to quickly locate a tube with a burned out filament by using a procedure such as this

1. Remove the back and connect an ohm meter from one side of the fusing resistor to the chassis ground. An open circuit indicates a burned out filament.
2. Remove Vl (6AW8) and check continuity from pin 4 (counterclockwise from top of chassis) to fusing resistor. An open circuit here indicates an open filament V2,V7,V8, V9, V10,V11 or NTC resistor R418.
3. V3 can then be removed to find wheather the open filament is in the string consisting of V9, V10, Vll or NTC resistor R418 or in the string consisting of V3, V8, V7 or V2.
Thus the tube with an open filament can be singled out using a system such as this with out checking each tube or removing the complete chassis.


DISASSEMBLY INSTRUCTIONS

1. Remove back which includes the AC line cord. Note: two screws must be removed from the bottom of each rearcornerto release the back on model 21-555.
2. Unsolder red and green-white yoke leads from the terminal strip on the high voltage housing. Unsolder green and yellow vertical output transformer leads from the terminal strip on the left side of the yoke housing.
3. Remove screw holding ground strap from high voltage housing and unsolder speaker leads.
4. Pull off knobs. Loosen the three screws that hold the slotted tuner mounting bracket to the chassis and slide the tuner assembly to theright. Thisallows the shaft to clear the cabinet when the chassis is pulled to the rear.
5. Remove the five copper colored screws from the bottom. This allows the chassis to be removed.
6. The cover on the high voltage housing may be removed by taking out two screws, sliding the cover to the rear and pulling the rear edge of the cover to the left. The high voltage housing may be removed by taking out four screws holding it to the chassis.
7. The second detector (1N64 part of $T$ 203) may be uncovered by removing two screws and lifting the transformerhousing from the top of the chassis.



PRODUCTION CHANGES of the horizontal oscillator

2. C417, $4700 \mu \mu \mathrm{f}$; C418, $22 \mu \mu \mathrm{f}, 3 \mathrm{KV}$ and L403, $10 \mu \mathrm{~h}$ added in damper circuit to improve the sync stability
3. R330, 470 K added above HEIGHT CONTROL.

NOTE: On early schematics horizontal deflection yoke connections were in correctly numbered.
stagger-tuned h.f. alignient procedure

1. Sel tuner to chamel $9-10$ or 11
2. Connect varible biat oupply to jonction R211 C C207. Adjuet biat tor -2 volte


| STEP | Frequency | adjustment | instructions |
| :---: | :---: | :---: | :---: |
| 1. | 41.25 Mc | 2201 for min. |  |
| 2. | 42.9 Mc | Tuner coil for max. | 27 (iop of tuner) |
| 3. | 45 Mc | L202 for max. | Recheck steps 2 and 3 |
| 4. | 42.9 Mc | T201 for max. |  |
| 5. | 45.3 Mc | T202 for max. |  |
| 6. | 44 Mc | T203 for max. |  |
|  |  |  | Recheck teepe 4, 5 and 6 |




$$
\overbrace{\text { To cha sit }}
$$

|  | adjustment | instructions |
| :---: | :---: | :---: |
|  | $\begin{gathered} { }_{c}^{T 202} 201 \\ 120 \end{gathered}$ | T202 positiona 45.75 marker <br> T201 poeitione 42.75 <br> T203 adjuste tilt of curve |
|  | Note: if desired curve cannot be obtained, slight adjuotment of tuner coil and L202 may be necesaary. |  |

Sound and 4.5 mC trap alignment





| Step | Equipment | Connection | frequency | adjustment | instructions |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | Det. jig * | Input of jig to pin 2 of $V 2$ |  |  | Keep lead between 15 K reoistor and pin 2 ab hort as posible |
| 2. | vtvm | Output of jig | Tune in available changel | $\begin{aligned} & L 101 \text { and } L 102 \\ & \text { for max. } \end{aligned}$ |  |
| 3. |  | Remove jig | Same | Qundrature coil (L103) for max. sound | Set buzz control in middle of ita range before adjuti $L 102$ |
| ง. |  |  | Same | Buzz control for minimum buez <br> R103 | Correct adjuatment of buiz control i approx, middle of ite range |
| 5. | Det jis * | $\begin{aligned} & \text { Junction C316 } \\ & \text { and R325 } \end{aligned}$ |  |  | Connect VTVM to output of Jig |
| 6. | $\begin{aligned} & \text { RF ignal } \\ & \text { generator } \end{aligned}$ | Pin 7 (vi) | 4.5 mc | Tune 4. 5 Mctrap <br> 1.204 for min |  |
| - Defector jis |  |  |  |  |  |

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[^1]

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## FRODUCTION CHANGE T14-15 \& T14-16

Several reports from our factory field representatives indicates the vertical hold adjustment on the T14-15 and T14-16 chassis is rather critical in fringe operation. Improved "lock-in" may be had by slight reduction of the vertical height and linearity control settings.

The following production change has been incorporated at the factory and is suitable for field use where cases warrant:

1. The blue lead from R100, 2200 ohms, in the vertical plate return circuit, that formerly ran to the fuse, is now pulled down through the chassis and runs to the junction of R7LAA and R7LB , the power supply filter resistors.
2. R73, the 47K plate resistor in the sync limiter and noise gate 6CS6 tube, V15, is disconnected from the 150 volt supply and
connected instead to Pin 6 of V12, the 6 AU 6 keyed A.G.C. amplifier.
The charts attached have been compiled over These charts are not intended to imply that the past year from information relayed to Bendix through our Field Service Engineers Weekly Field Reports. The actual field defects, together with corrective measures taken, are listed. the defect associated with a particular symptom is necessarily the only possible defect causing an identical symptom. Rather, it should serve as a guide to indicate most probable cause, based on actuality.


UHF TUNER NOT INCLUDED IN T14-15 CHASSIS



## TOP VIEW

(Arrows Indicate Tube Keyways)


[^2]
## TROUBLE SHOOTING THE BENDIX PONER MASTER CHASSIS (T-14 SERIES)

I. RECEIVER DEAD - (No Sound or Raster)

1. Check AC power cord for good connection in AC outlet of known voltage source,
2. Check interlock on back of the chassis.
3. Check Sl on volume control R37R.
4. Check line cord for continuity to primary of power transformer T6.
5. Open primary on T6.
6. Check power transformer T 6 secondary. For voltage and/or continuity each side of center tap.
7. Check for shorts in filament circuits and $B \not \subset$ shorts in low voltage


Figure 8a-Component Identification 114-15
8. Gassy or open V17 (5U4G). Insure V17 is well seated in socket. II. SOUND BUT NO RASTER

1. Check ion trap adjustment. (See Service Manual for procedure.) This check should be a "must" in initially setting up a new receiver. 2. Examine filament of V 24 (1B3GT), high voltage rectifier; if lighted, this is good indication of second anode high voltage.
2. Examine connection to second anode, on picture tube.
3. Check to see if filament of picture tube (V1L) is lignted. 5. Insure that plate cap for V22 (6BQ6GT or 6CU6) is making goo connection.

4. Check for shorted or open V22 (6BQ6GT or 6CU6).
5. Cheak V23 (6J4GT or 6AX4) damper by replacement
6. Check C94 (250 uuf) capacitor for leakage,
7. Check T8 horizontal output transformer for open primary and secondary Do not overlook possibility of transformer breaking down under load.
8. Check V21 horizontal generator (6SN7GT) by replacement.
9. Check L2? 3 horizontal oscillator coil.
10. Check C82, 330 uuf and C75, 3900 uuf for leakage.
III. PICTURE BUT NO SOUND
11. Check L9 for open.
12. Check connection to terminal \#4 of T3.
13. Cheok Vi, V8, V9 and VIO.
14. Checi for open voice coil or open secondary on T5
15. Check for open voice coil or open secondary on T5c
16. Check for possible cpen connections or shorted turns in T4, ratio detector transformer.
17. Check R37R volume control for open circuit.
18. Insure correct voltages at tube socket connection in sound channel. If $B f$ voltage is low at any point, check for shorted by-pass condensers.
IV. WEAK SOUND, NORMAL PICTURE
19. Check V7, V8, V9 and V10.
20. Check for possible high resistance connections in T4 ratio detector transformer.
21. Check sound channel alignment. Do not overlook possibility of TL secondary being misaligned at cross-over.
V. HUM IN SOUND
22. Check alignment of ratio detector transformer secondary (T4). Refer to Service Manual.
23. Check C35 for leakage.
24. Check V9, (6AL5), for cathode to filament leakage.
25. Insure that plate lead of vertical output transformer $T 7$ is dressed as close to chassis as possible.
26. Keep AC switch lead dressed away from leads to volume control.
VI. HIGH VOLTAGE AND SOUND, BUT NO RASTER
27. Insure to see that picture tube V16 filament is lighted. Don't overlook possibility of a shorted picture tube.
28. Check to see that lead to second anode of picture tube is making good connection.
VII. NO HIGH VOLTAGE, BUT NORMAL SOUND
29. Check possibility of plate cap clip being disconnected from V22 (6BQ6GT or 6CU6) horizontal output tube.
30. Check V21, V22, V23 and V24.
31. Check L23 and C75.
32. Check C94, 250 uuf, capacitor.
33. Check T8 for open windings.
VIII. NO VERTICAL SWEEP APPEARING ON FACE OF PICTURE TUBE
34. Check for open primary of vertical output transformer T7.
35. Check V18 and V19.
36. Check C63 for short. (If shorted check value of R92.)
*Certain tubes are not found in the $T 14-15 \quad \&-16$ chassis and should be disregarded.
IX. NO CONTROL OF VERTICAL SYNCHRONIZATION BY ADJUSTIENT OF THE VERTICAL HOLD
37. Check V18 and V19.
38. Check waveform with 'scope on both connections of C49, or its equiva lent in $114-15$ \& -16 chassis.
39. Check for sync pulses on pin 1 and pin 3 of 118 , ( 6 SNTGT) sync clipper,
40. Check components in intergrating network C54, C57, R86, R87, R88, C58, C59.
X. EXCESSIVE VERTICAL SIZE
41. Check V18 and V19.
42. Check R97 for value change.
XI. INSUFFICIENT VERTICAI SIZE output transformer.
43. Check V18 and V19.
44. Check T7 vertical output transformer.
45. Check 063 for leakage.
XII. NO CONTROL OF HORIZONTAL SYNC
46. Check V14, VI5, VI8, V20 and V21.
47. Check C7O, C71, C73, C88 and C87.
48. Check C49 or its equivalent in T14-15, \& -16 chassis.
49. Check C49 or its equivalent in T14-15
XIII. NO CONTROL OF HORTZONTAL OR VERTICAL SYNC
50. Check V13, V14, V15, and V18.
XIV. RECEIVER BLOWS FUSES
51. Check V21, V22 and V23.
52. Check for shorted winding in T8.
53. Check for short in yoke.
54. Check for short in vertical output transformer T7.
55. Shorted or gassy V19.
56. Check C63 for short or leakage.
XV. SMEAR
57. Check L2 for correct alignment at 42.0 mc .
58. Check C812 for leakage (Standard Coil) or its equivalent in the Sarkes Tarzian.tuners.
59. Check L7, L8, L15 and L16 for open.
60. Check XI video detector for poor front to back ratio.
61. Check by replacement V3, V4, V5, V6 and V13.
XVI. NOISE IN PICTURE
62. Arcing of high voltage or corona in the cage.
63. Intermittently open R131 (arcing).
(Not present in T14-15 \& -16 chassis)
64. Noisy contrast potentiometer RLIR.
XVII. PICTURE BLOOMS
65. Possibility of picture tube being "gassy".
66. Gassy V19, V22 and V24.
67. Check value of Rl31. (Not present in T14-15 \& -16 chassis)
68. Check horizontal danper tube V23, ( $6 W 4 G T$ or $6 A X L G T$ ) by replacement.
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OJohn F. Rider
television alignment procedure
Aligning a television receiver is an exacting procedure and involves the use of bench space, test equip
ment and skilled personnel at the service shop, as well a the cost of making two trips to the customer's home. Before deciding that the chassis must be pulled and. aligned at the shop, the serviceman should check these ver

1-The antenna and installation.
2 - Front panel and rear chassis controls, including
3 - Reception on all available channels.
4 - Tube failures. Substitute from your kit of known good replacements.

5 - Visual inspection of underside of chassis for
obvious faults, such as loose connections, etc. EST EQUIPMENT REQUIRED FOR ALIGNMENT

The equipment specified below is desirable, but in cases where this equipment is not available, it is possible to align the receiver by use of a 20 to 30 mc . modulated $r$-f signal generator, using the picture and speaker as in

1-Signal Generator with an output variable between 100 and 100,000 microvolts, and crystal controlled or crystal-calibrated at the following frequencies:
a- 4.5 megacycles
b- 22.8 megacycles
c- 25.4 megacycles
d- 21.25 megacycles
2-DC Vecuum Tube Voltmeter with 5 volt and 10 volt scales.

3 - A pair of balanced ( $\pm 1 \%$ ) 100 K carbon resistcrs.
TEST EQUIPMENT
REQUIRED FOR SWEEP ALIGNMENT CHECK

- R-F sweep generator with frequencies ranging from 40 to 220 megacycles, having sweep width of approximately 10 megacycles, and having adjustable output to approximately 0.1 volt.
2 - Crystal-controlled or crystal-calibrated markers for the picture and sound cartiers of each channel.

3 - Cathode Ray Oscilloscope with good low frequency response

CAUTION: The SECOND anode lead to the picTURE TUBE hAS A HIGH POTENTIAL. DURING THIS alignment it is advisable to hemove the horiZONTAL OUTPUT TUBE FROM ITS SOCKET, THUS
ELIMINATING THIS HIGH VOLTAGE HAZARD.

## I.F. Alignment procedure

1-Connect "high" lead of signal generator to the test point located on the top of the RF tuner unit (Refer to the R-F tuner location diagram located on inside of cabinet). Connect ground to

- Connect DC VTVM lead (through 10K isolating Connect DC VTVM lead (through 10K isolating
resistor) to 4.7 K diode load resistor (R113); ground to chassis. Set VTVM to 5 volt scale, negative polarity.
3-Set I.F. generator to 25.4 megacycles with sufficient output to read approximately 3 volts on the VTVM.

4 - Carefully adjust L101 and L104 (see tube and tuner location) for maximum deflection on VTVM. Adjust sweep generator output to keep meter reading approximately 3 volts.

- Set I.F. signal generator to 22.8 megacycles with sufficient outp

6 - Carefully adjust L406, L103 (see tube and tuner location) for maximum deflection on VTVM. Adjust signal generator output to keep meter reading approximately 3 volts.
7-Set I.F. signal generator to 21.25 megacycles, set VTVM to 10 volt scale (negative polarity), and adjust signal generator output for convenient deflection on VTVM.
B - Adjust L114 for minimum deflection on VTVM.
Smeep alignment check
Although not essential, a sweep alignment check is a desirable verification of good R-F and I.F. response. Propepd as follinwa:

1-Connect R-F sweep generator to antenna terminals (antenna impedance 300 ohms.)
2 - Calibrate oscilloscope for convenient 5 volts peak-to-peak verical deflection ( 5 volts peak-
to-peak is approximately $1 / 4$ of the peak-to-peak to-peak is approximately $1 / 4$ of the
voltage of the $6.3 V$ A.C. filament).
3 - Connect vertical input of oscilloscope (through 10K isolating resistor) to 4.7 diode load resistor put of oscilloscope to "scope ${ }^{*}$ terminals of R-F generator; adjust for convenient hor izontal sweep.
4 - Set R-F sweep generator to channel 3, television receiver to channel 3 , and if necessary, adjust sweep generator output, sweep width, and scope
horizontal setting for convenient band-pass display having 5 volts vertical deflection as previously calibrated. (If you must touch scope verticel seltings during these adjustments recaliabove).
5 - Couple crystal-controlled R-F carrier markers very loosely to antenna terminals, adjust receiver $1 / 2$ down on curve. Turn deo arter warper ill R-f sound carrier is visible on bandpass and adjust sound trap (L114) to minimize effect of sound carrier marker.

6 - Check all channels as above.
SOUND ALIGNMENT

- Connect 4.5 megacycle signal generator to pin 2
of 12 BH 7 (V7) video amplifier.

2 - Connect DC V.T.V.M. lead to pin 7 of 6AL5 (Vo) ratio detector, negative polarity.

3 - Adjust signal generator to precisely 4.5 megaycles; adjust output to read approximately volts on V.T.V.M.
4 - Adjust L113 and bottom of T100 for maximum de lection on V.T.V.M. Keep V.T.V.M. reading b low 10 volts at all times.

5 - Attach two series-connected $100 \mathrm{~K}( \pm 1 \%$ ) resistors across R 126 (Ratio Detector Load Resistor). Con nect DC V.T.V.M. to center-tap of 100 K resistors and connect ground wire of T.V.M. to junction

6 - Adjust top of Tl00 for zero reading on V.T.V.M. between a plus and a minus peak. video amplifier trap

When necessary, the video amplifier 4.5 mc trap (L1lo) should be adjusted as follows:

1-Connect 4.5 mc signal generator "high" lead to picture tube grid; pround to chassis.

2 - Connect DC V.T.V.M. to pin 7 of 6AL5. (V9) ratio detector, 10 volt scale, negative polarity
3 - Adjust L110 for minimum deflection on V.T.V.M.

## R-F OSCILLATOR

If all channels are not within range of FINE TUNIN control, adjust two screws located in front of r-f tune Do not touch adjustments on top of r -f tuner unit, othe Do not touch adjustments on top of r-f tuner unit, othe
than converter plate coil, L404, during IF Alignment.
horizontal oscillator alignment
If the Horizontal Hold control fails to maintain sync the horizontal oscillator should be reset. To reset this screwdriver adjustment, set the horizontal hold control in the center of its range and sync the picture with the horiontal A.F.C. adjustment screw. Check the hold contro ction on various as required to provide sync on all channels.


DEFLFCTION YOKE, ION TRAP ANDFOCIS ADJUSTMENT Following is the proper procedure for adjusting the Deflection Yoke, Ion Trap and Focus.

The receiver should be turned on but not connected to an antenna.
following order:

1-The Deflection Yoke should be moved as far

2 - The Brightness control should be turned to max imum (clockwise) and the Contrast control should e turned to minimum (counterclockwise)

3 - The Ion Trap should be totated and at the same time moved forward and backward to find th positio
screen

4 - The Deflection Yoke should be rotated so that the top and bottom edges of the raster are parallel to the top of the chassis.
5 - The Brightness control should now be reduced (ccw) to a point where the raster is slightly abov normal briliance.
6 - With Rrightness and Contrast controls at norma positions, adjust the Focus control (rear

HEIGHT, WIDTH AND LINEARITY
To adjust the overall size and linearity of the picture it is almost mandatory that a test pattern transmitted from a
local station be used. It should also be remembered that in areas where more than one station is being received, tha pictures transmitted from different stations will vary slight ly in size. The smallest transmitted picture should be made to fill the area outlined by the mask.

The Width control (rear of H.V. cage) should be ad justed to give a picture that will fill the mask horizontally

The Height and Vertical Linearity controls (both rear of chassis) should then be adjusted for a linear pictur
picture tube handling precautions
The picture tube oncloses o high vocuum ond with the lorge surfoce orea of gloss involved, the stresses set up, portcularly ot the front rim of the tube, are con-
sideroble. An obnormal handling stress, occidental blow at a highly stressed surfoce, or even a scrotch on the surfoce of the rube could
with destructive violence.

## high voltage warning

Oparation of this recelver outside the cobinat or with covers removed involves a shock hazard from the receiver power supplies. Work on the recoiver should not be atrampred by onyone who is nat thoroughly fomilior voltoge equipment.




## © John Y. Rider

## TELEVISION ALIGNMENT PROCEDURE

Aligning a television receiver is an exacting procedure and involves the use of bench space, test equipment and skilled personnel at the service shop, as well as the cost
of making two urips to the customer's home. Before deciding that the chassis must be pulled and aligned at the shop, the serviceman should check these very common sources of trouble:

- The antenna and installation.
- Front panel and rear chassis controls, including picture tube adjustments.
- Reception on all available channels.

4- Tube failures. Subatitute from your kit of known good replacements.

- Visual inspection of underside of chassis for obviour faults, such as loose connections, etc.
TEST EQUIPMENT REQUIRED FOR ALIGNMENT
The equiparent epecified below is desirable, but in to align the receiver by use of a 20 to 30 mc . modulated r-f aigal generator, using the picture and speaker as indica tion of alignment.

1-Sigaal Generator with an output variable between 100 and 100,000 microvolts, and crystal controlled or cryatal-calibrated at the following frequencies:
a. 4.5 megacycles
b. 22.25 megacycles
c. 25.4 megacycles
d. 23.6 megacycles
e. 21.25 megacycles

2 - DC Vacuum Tube Voltmeter with 5 volk and 10 volt scale
3 - A pair of balanced ( $\pm 1 \%$ ) 100 K carbon resistors.
TEST EQUIPMENT
REQUIRED FOR SWEEP ALIGNMENT CHECK

- R-F eweep generator with frequencies ranging from 40 to 220 megacycles, having sweep width of approximately 10 megacycles, and
outpot to approximately 0.1 volt.

2 - Cryetal-conarolled or crystal-calibrated markers for the picture and sonnd carriers of each channel, preferably 30\% Amplitude-Modulated.
3 - Cathode Ray Oacilloscope with good low frequency response.
4-3 volt bias bettery.
CAUTION: THE SECOND ANODE LEAD TO THE PICTURE TUBE HAS A HIGH POTENTIAL. DURING THI PLUG FROM ITS SOCKET, THUS ELIMINATING THIS high voltage bazard.

## I.F. ALIGNMENT PROCEDURE

- Consect "high" lead of signal generator to the teal point located on the top of the RF tuner anit (Refer to the R-F tuner location diagram located on the inside of cabinet). Connect ground to chassis.
2 - Coanect DC VTVM lead (through 10K isotating re sistor) to pin 1 of 6 AU6 1 at Vídeo Amplifier (V12), ground to che
tive polarity.
- Set 1.F. generator to 25.4 megacycles with sufficient output to read approximateiy 3 voits on the VTVM.

4 - Carefully adjust L201 and L203 (see tube and tuner location) for maximum deflection on VTVM. Adjust sweep generator output to keep meter reading ap proximately 3 volts.
5 - Set I.F. signal generator to 22.25 megacycles with sufficient output to read approximately 3 volts o the VTVM

6 - Carefully adjuat Lll, L202-top (see tube and trimmer location) for maximum deflection on VTVM Adjust signal generator output to keep mete reading approximately 3 volta.
7 - Set i-f signal generator to 23.6 mc . with sufficien output to read approximately 3 volts on the VTVM.
8 - Carefully adjust L205 (aee tube and trimmer loca(ion) for maximam deflection on VTVM. Adjuan signal generator out-put to keep meter reading approximately 3 volts.
9 - Set I.F. signal generator to 21.25 megacycles, set VTVM to 10 volt scale (negative polarity), and adjust signal generator output for convenient defection on VTVM.
0 - Adjust L202-bottom for minimum deflection on VTVM.

## SWEEP ALIGNMENT CHECK

Although not essential, a sweep alignment check is a desirable verification of good R-F and I.F. response. Proed as follows:

- Connect R-F sweep generatra to antrnna terminals
(antenna impedance 300 Ohms).

2 - Calibrate oscilloscope for convenient 5 volts peak-to-peak vertical deflection ( 5 volts peak-to-peak is approximately $1 / 4$ of the peak-to-peak voltage of the
$6.3 \mathrm{~V} \mathrm{A.C}. \mathrm{Filament)}$. 6.3V A.C. Filament

3 - Connect vertical input of oscilloscope (throughlok isolating resistor) to pin 1 of 6AU6 lst Vid. Amp. oscilloscope to "scope" terminals of R-F genera. tor; adjust for convenient horizontal sweep.
4 - Connect 3 volt battery positive terminal to chassis negative terminal to AGC buss (see schematic dianegativ
gram).
5 - Set R-F sweep generator to channel 3 , television receiver to channel 3, and if necessary, adjust sweep generator output, sweep width, and scope play (see figure 1) hor convenient band-pal defection as previously calibrated. (If you must touch scope vertical settings during these adjustments recalibrate scope for 5 volts peak-to-peak as in step 2 above).
6 - Adjust L205 slightly to even the height of peaks and to obtain an untilted bandpass.
7 - Couple crystal-controlled R-F carrier markers very loosely to antenna terminals, adjust receiver FINE TUNING control till video carrier marker is $1 / 2$ down on curve. Turn up marker output till R-f sound (L114) to minimize effect to sound carrier marker.
NOTE: If the fine tuning control is at end of range or out of range so that video carrier cannot be set at $50 \%$, follow
R-F OSCILLATOR ALIGMENT procedure outlined below. 8 - Check all channels.

## R-F OSCILLATOR ALIGNMENT

If all channels are not within range of FINE TUNING control (as evidenced by inability to eliminate sound dual oscillator slugs may require readjustment.

1 - Repeat the set-up as for SWEEP ALIGNMENT
Check, steps 1 limough 7.
2 - Set FINE TUNING CONTROL to center of range, and with long fiber screwdiver alignment tool, ad
just the individual oscillator slugs of each channel (Accessible through the fromi of the tuner) so that video carrier markers fall $50 \%$ down on curve. CAUTION: Do not touch adjustments on top of r-f cuner unit, other than the converter plate unit, L11, during I.F. aligament.

## SOUND ALIGNMENT

1 - Connect 4.5 mc . signal generator to pin 1 of 6 AU6 4.5 mc . amplifier (V13).

2 - Coanect DC V.T.V.M. lead to pin 7 of 6 AL5 (V15) Tio deleclor, regaive polariy.
3 - Adjust signal generator to precisely 4.5 megacycles; adjust outpat to read approximately 5 volts on
V.T.V.M

4 - Adjust L206, L101, and bottom of T102 for maximum deflection on KT.V.M. Keep V.T.V.M. reading below 10 vols al all times.
5 - Attach two series-connected $100 \mathrm{~K}( \pm 1 \%$ ) resistors across R106 (Ratio Detector Load Resistor). Con-
nect DC V.T.V.M. to centertap of 100 K resistors, and connect ground wire of V.T.V.M. to top of C109 (Audio take-Off of T102).
6 - Adjust top of Tl02 for zero reading on V.T.V.M. be tween a plus and a minus peak.

VIDEO AMPLIFIER 4.5 mc . TRAP
When necessary, the video amplifier 4.5 mc . trap (L104) d be adjusted es follows

1-Connect 4.5 mc . signal generator to pin 1 of $6 \mathrm{AU6}$ lst video amplifier (V12).

2 - Adjust signal generator ont put till 4.5 mc . dot pal tern is clearly visible on screen of picture tube.
3 - Adjust Ll04 to minimize the dot pattern.

hORIZONTAL OSCILLATOR ALIGNMENT
If the Horizontal Hold control fails to maintain aync, the horizontal oscillator should be reset. To reset this screwdriver adjnstment, etet the horizontal hold control in年e center of ita range and sync the picture with the horiaction A.F.C. adjustment screw. Cher the screw adjuatmen - required to provide syac on all chennels.

DEFLECTION YOKE,
ION TRAP AND FOCUS ADJUSTMENT
Following in the proper procodure for adjusting the $\mathrm{D}_{\mathrm{o}}$ lection Yoke, Ion Treap and Focere.
The receiver allould be turnod on bat mot consectod to an antenna. These atepe ahould thea be taken in the follow ing order:

1 - The Deflection Yoke ahould be moved minforwerd mas posaible on the seck of the CRT.
2 - The Brightiese control should be turred to maximam (clockwise) and the Contrast control should be tyraed to minimom (conaterclockwine).
3 - The loa Trap ahould be roteled and at the same time moved forward and beckwed to filad the posi
ald be rotated so tha top and bottom edges of the raster are parallel to the top of the chassis.
5 - The Brightness control should now be reduced (ccm) to a point where the raster is slightly above normal brilliance.

HEIGHT, WIDTH, LINEARITY, AND HORIZONTAL DRIVE
To adjust the overall size and linearity of the picture is almost mandatory that a test pattern transmitted from local station be used. It should also be remembered that that pictures transmitted from different stations will vary slighty in size. The smallest transmitted pictore should be
made to fill the area outlined by the mank.

1-Starting with the HORIZONTAL DRIVE control (renr of chasais) in exireme coanterclockwise pooiion, advance the control clockwise till the compression near the center of the pictare (a vertical
bright bar) is eliminated. bright bar) is eliminated.
2 - The Width and Horizontel Linearity controls (rear of will fill should be adjusted to give a picture that utretching or compression.
3 - The Height and Vertical Linearity controle (both citre the will hill the
picture tube handlimg precaution The plicture tube encloses e high vecuem end with the lorge unface aroe of slose Involved, the streasos sot un, purtio sulorly of the fromt rim of the tube, are censiderable. An abnormal hondling stross, eceldontal blow of a highly roessed suriace ar eving ecerech on the surfece of the tube could
RADIO ALIGNMENT CHART


| Stop | Band <br> Switch <br> in <br> Positio | Dummy <br> Antenna | Signal Gonerator |  | Dial Position |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | Freq. | Connection |  |
| 1 | AM | 0.1 mid. | 455 kc . | $\begin{aligned} & \text { Pin \#2 } \\ & 12 A T 7 \end{aligned}$ | 1620 kc . |
| 2 | AM |  | 1600 kc . | Rodiating <br> Loop | 1600 kc. |
| 3 | AM | $\ldots$ | 600 kc . | Rodiating <br> Loop | 600 kc . |
| 4 | AM | ........ | 1500 | Radiating Loop | 1500 kc. |
| 5 | AM | $\ldots$ | 600 kc . | Radioting Loop | 600 kc . |
| 6 | fm | 0.1 mfd . | $\begin{aligned} & 10.7 \mathrm{mc} . \\ & (0.1 \mathrm{volt}) \end{aligned}$ | $\begin{gathered} \text { VA } \\ \text { Pin } H_{1} \\ \text { anilk } \end{gathered}$ | ....... |
| 7 | fM | 0.1 mfd . | 10.7 mc . | $\begin{gathered} \text { V4 } \\ \text { Pin \#1 } \\ \text { OAUG } \end{gathered}$ | ....... |
| 8 | fm | 300 ohms | 1 n .7 mc . | Anl. | $\ldots$ |
| 9 | FM | 300 ohms | 108 mc. | $\underset{\text { Ierminal }}{\text { Ant. }}$ | 108 |
| 10 | fm | 300 ohms | 90 mc . | $\begin{gathered} \text { Ant. } \\ \text { Terminai } \end{gathered}$ | 90 |
| 11 | FM | 300 ohms | 90 mc . | $\begin{gathered} \text { Ant. } \\ \text { Terminol } \end{gathered}$ | 90 |


| Output Meter | Adiust |  | Remarks |
| :---: | :---: | :---: | :---: |
|  | cor L | For |  |
| Across Speoker | T5\& ${ }^{\text {\% }}$ | Maximum Reading |  |
| Across Speaker | $\begin{gathered} \mathrm{ClOc} \\ \mathrm{Osc} \text {. Trimmer } \\ \hline \end{gathered}$ | Maximum Reading |  |
| Across Speaker | $\begin{gathered} { }^{17} \\ \text { Osc. Coil } \end{gathered}$ | Maximum Reading | Repeot Nos. 2 \& 3 Until No Chonge Notlced |
| $\begin{aligned} & \text { Across } \\ & \text { Speaker } \end{aligned}$ | $\underset{\substack{\mathrm{ClOa} \\ \text { Ant. Trimmer }}}{ }$ | Moximum Reading | Repeot Nos. 4 \& 5 Until No Chonge Noticed |
| Across Speaker | Loop Ant. 2 Toped Wires | Moximum Reading |  |
| VIVM of A.v.c. | $\begin{aligned} & \text { Bottom } \\ & \text { of T6 } \end{aligned}$ | Moximum Reading | Soo Note A |
| $\begin{aligned} & \text { VTVM of } \\ & \text { Audio } \end{aligned}$ | $\underset{T 6}{\text { Top of }}$ | $\begin{gathered} \text { 2oro } \\ \text { Volm } \end{gathered}$ | Soe Notes ${ }^{\text {a }}$ |
| VTVM of A.v.c. | 14 3 T2 | Maximum Reoding | Soo Note A |
| VTVM ot | $\begin{gathered} \text { Clod } \\ \text { Osc. Trimmer } \end{gathered}$ | Moximum Reading |  |
| VTVM ot | $\stackrel{16}{\text { F.M. Osc. Coil }}$ | Moximum Reoding | Soe Note C |
| $\underset{\text { A.V.C. }}{\text { VTVM ot }}$ | $\mathrm{ClOb}^{\mathrm{Cl}}$ FM. Ant. | Maximum Reoding | Soc Note D |

The following equipment is necessary to properly align this receiver:
(a) With no records on the spindle shelf and record support over the spindle, turn "On-Off" Control go through shut-off operation.
(b) Turn Control Knob to "On" position. (Do not turn past " $\mathrm{On}^{\prime}$ " position.)
(c) Lift pickup arm and place needle in the starting groove of the record.
generator with frequency coverage from 455 kc. to 1700 kc .
2. FM or CW signal generator covering the FM band from 87 mc . to 109 mc . and 10.7 mc . for FM IF alignment.
3. Vacuum Tube Voltmeter (VTVM).
6. Voltume (first knob on left side of radio panel). The The treble and bass are automatically balanced throughout the range of this control to give the best listening tone.
4. Output meter-to match 4 ohms, 5 watts maximum.
7. TONE (second knob on left side of radio panel). Turning to left on mid (Normal) position reduces the treble en the treble tone
8. REJECTING. To reject a record during playing, simply move the playing control knob (on the changer) forward and release as in starting.
6. Dummy antenna- 0.1 mfd . capacity, 300 ohm carbon resistor and inductive loop (fashioned from aeveral turns
of wire). of wire).
The safety glass of this receiver is removable so that the face of the picture tube may be cleaned. To accomplish this remove power cord from wall socket. Remnve the upper strip that holds the safety glass in place by :emoving the five screws which secure the strip, supporting the safety glass so that it does not fall forward. Remove the safety glass by tilting it forward and lifting it out of



| capacitors |  |  |
| :---: | :---: | :---: |
| symb. | PART | description |
| $\mathrm{Cl}^{102}$ | A194 | Paper, $05 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ <br> Ceramic Tubular $470 \mathrm{mmf} 350 \mathrm{~V} \pm 10 \%$ <br> Ceramic Single Disc 1500 mmf GMV <br> Electrolytic 4 mfd 50 V <br> Paper, $05 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ <br> Ceramic Tubular, $1000 \mathrm{mmf} 350 \mathrm{~V} \pm 20 \%$ <br> (Noninsul) NPO |
|  | A55 |  |
| ${ }_{\substack{C 106 \\ C 107}}$ | A19148 ${ }_{\text {A }}$ |  |
| $\mathrm{Cl}^{108}$ | A194-160 |  |
| C109 | A5s5-136-2 |  |
|  |  |  |
| C111 | A19109 | Ceramic Single Dise 5000 mmf GMV <br> Ceramic Single Diec 5000 mn G <br> (Noninesul) NPO |
| C112 | A555-113-2 |  |
| $\mathrm{C}_{113}$ | A19109 | Ceramic Single Diac 5000 mms GMV |
| C114 |  | Electrolytic 10 mfd 250 lPaper, 05 mid $600 \mathrm{~V} \pm 20 \%$. |
| ${ }^{2} 115$ | A194-160 |  |
| ${ }_{C} 116$ | A19109 | Ceramic Single Dise 5000 mmf GMVCeramic Single Disc5000mmi |
| ${ }^{C} 117$ | A19109 |  |
| ${ }_{\substack{C 118 \\ C 119}}$ | ${ }^{\text {A } 20145}$ | Electrolytic 10 mid 250 V |
| C120 | ${ }_{\text {A20182 }}$ | Electrolytic 1 mdd 50 V |
| c121 | A194-A145 | Paper, 001 mid $600 \mathrm{~V} \pm 20 \%$ |
| ${ }^{122}$ | A190-125 | Mica, $120 \mathrm{mmon} 500 \mathrm{~V} \pm 10 \%$ |
| ${ }^{\text {c123 }}$ | ${ }^{\text {A55-123 }}$ |  |
| ${ }_{C 126}$ | A194-A145 | Ceramic Tubutar, 220mm <br> Paper . 02 m 触 $600 \mathrm{~V} \pm 20 \mathrm{~K}$ |
| C127 | A194-A156 |  |
| ${ }^{2} 201$ | ${ }^{19163}$ | Ceramic Shielded Dual Disc $\mathbf{5 0 0 0} \mathrm{mmf}$ GMV Ceramic Single 1500 mm GMV |
| C202 | Al9148 |  |
| C203 | ASSG-118-2 | Ceramic Tubular $100 \mathrm{mmf} 500 \mathrm{~V} \pm 20 \%$ (Inaul.) NPO |
| C204 | A19148 | Ceramic Single Disc 1500 mmf GMV Ceramic Tubular $100 \mathrm{~mm} 500 \mathrm{~V} \pm 20 \%$ (Insul.) NPO |
| C205 | As56-118-2 |  |
| 06 | A |  |
|  | A19148 | Ceramic Single Disc 1500 mm GMV Ceramic Tubular $100 \mathrm{mmf} 500 \mathrm{~V} \pm 20 \%$ |
| ${ }^{2} 208$ | A556-18-2 | (Insul.) NPO |
| C209 | A1916 |  |
|  |  |  |
| C211 | ${ }^{\text {A }} 1944155$ | 01 |
| c212 | A194- |  |
| C213 | A194-146 |  |
| C214 | A194186 | Paper, $022 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ \% |
| C215 | ${ }^{\text {A190-137 }}$ |  |
| C216 | ${ }^{\text {A }}$ 190-133 |  |
| C219 | A194-156 | Paper, $022 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ |
|  | A194-162 |  |
| C221 | ${ }_{\text {Al }} \mathbf{1} 922 \mathrm{l}$ | Mice, 22 mman 600 $\pm 10 \%$ ( |
| C301 | A19198 | Ceramic Shielded Dual Disc 0.01 mfd 500 V GMV |
|  |  | Electrolytic $80 \mathrm{mfd} 200 \mathrm{~V}, 120 \mathrm{~m} / \mathrm{d} 200 \mathrm{~V}$ Electrolytic 40-20-20-10 mfd 450 V |
| C304 | ${ }^{\text {A } 20168}$ |  |
| ${ }^{\text {c }} 305$ | ${ }^{\text {A20169 }}$ | Electrolytic 80 mdd 450 V , 100 mld s soV |
| C306 | ${ }^{\text {Al9 }} 1909$ | Ceramio Single Disc 5000 mmf GMV |
| C307 | A19109 |  |
| C308 | A19109 | Ceramic Singie Diac 5000 mmf GMV |
| C309 | A19109 | Ceramic Single Disc 5000 mmf GMV |
| ${ }^{3} 310$ | A19109 |  |
| ${ }^{\text {c311 }}$ | ${ }^{\text {A } 197-146}$ | Molded Tubulat. 0002 mpd 600V $\pm 20 \%$ |
| ${ }^{3} 12$ | A192-163 | Paper, 02 2 med $600 \mathrm{~V} \pm 20 \%$ |
| ${ }^{3} 313$ | A194-156 |  |
| C334 | A194157 | Paper, .025 mid $6000 \mathrm{~V} \pm 20 \%$ |
| ${ }^{2} 315$ | A194-1 | Paper, 1.1 mfd $600 \mathrm{~V} \pm 20 \%$ |
| C316 | A194-155 | Papar, $005 \mathrm{smf} 600 \mathrm{~V} \pm 20 \%$. |
| C317 | A194-151 |  |
| C318 | A194-151 | Paper, . $005 \mathrm{mdd} 600 \mathrm{~V} \pm 20 \%$ <br> Paper, $.01 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ <br> Electrolytic, 500 mfd 6 V (Non-Polarized) |
| C319 |  |  |
| C321 C326 | ${ }_{\text {A194-203 }}$ | Electrolytic, 500 mfd 6 V (Non-Polarized) Peper, $01 \mathrm{mfd} 1000 \mathrm{~V} \pm 20 \%$ |
|  |  |  |
| C402 | A194-145 |  |
| ${ }_{C} \mathbf{C} 03$ | A194-145 |  |
| C404 | A197-148 | Moided Tubuler $0033 \mathrm{mld} 600 \mathrm{~V} \pm 20 \%$ |
| C405 | ${ }^{\text {A } 194-160}$ | Silver Mice 3900 mmt S00V $\pm 10 \%$ |
| C40 | ${ }^{\text {A195-261 }}$ |  |
| C407 | A190-139 | Micar $470 \mathrm{mms} 500 \mathrm{~V} \pm 10 \%$ \% |
| C408 | A190-133 |  |
| C409 | A190-129 |  |
| C411 | ${ }_{\text {A197-160 }}$ | Pappro. 0001 mfd $6000 \mathrm{~V} \pm 20 \%$ \% |
| $\mathrm{C}_{4} 12$ | A197-160 | Molded Tubular . 05 smd mo $600 \mathrm{~V} \pm 20 \%$ |
| C413 | A201 |  |
| $\mathrm{C}_{4} 14$ |  |  |
| C 415 | A197-156 | Molded Tubular $0.02 \mathrm{mtd} 600 \mathrm{~V} \pm 20 \%$ |
| $\mathrm{C}_{2} 16$ | A194-162 |  |
| C417 <br> C418 | A190-139 |  |



| Resistors |  |  |
| :---: | :---: | :---: |
| $\begin{gathered} \text { SYMB. } \\ \text { NO. } \end{gathered}$ | $\begin{aligned} & \text { PART } \\ & \text { No. } \end{aligned}$ | description |
| R401 | A $232-1885$ | Car |
| R403 | ${ }_{\text {A } 231-1197}$ | Carbon 100 K Ohm $1 / 2 \mathrm{w} \pm i \mathrm{c} \%$ |
| R404 | A231-1233 | Carbon 3.3 Megohm 1/2w $\pm 10 \%$ |
| R405 | A231-1213 | Carbon 470 K Ohm 1/2w $\pm 10 \%$ |
| R406 | A231-1157 | Carbon 2200 Ohm 1/2w $\pm 10 \%$ \% |
| R407 | ${ }^{\text {A231-1169 }}$ | Carbon 6800 Ohm 1/2w $\pm 10 \%$ |
| R408 | ${ }^{\text {A } 231-1165}$ | Carbon 4700 Ohm 1/2w $\pm 10 \%$ |
| 8409 | ${ }^{\text {A } 231-1197}$ | Carbon 100K Ohm 1/2w $\pm 10 \%$ |
| 8410 | ${ }^{\text {A231-1213 }}$ | Carbon 470K Ohm $1 / 2 \mathrm{w} \pm 10 \%$ |
| 8411 | ${ }^{\text {A } 231-1123}$ | Carbon 82 Ohm $1 / 2 \mathrm{w} \pm 10 \%$ |
| R412 | ${ }^{\text {A231-2209 }}$ | Carbon $330 \mathrm{~K} \mathrm{Ohm}{ }^{1 / 2 w}$ |
| $\mathrm{R}^{413}$ | A21134-26 | Wire Wound, 15 K ohm 5 w t10\% |
| 8414 | A23158 | Carbon 8.2 Ohm 1/2w $\pm 10 \%$ |
| R415 | A21134-10 | Wirewound 500 Ohm $5 \mathrm{w} \pm 10 \%$ |
| 8416 | A233-1209 | Carbon 330 K Ohm 2 w |
| R417 | ${ }^{\text {A } 231-1201}$ | Carbon 150K Ohm $1 / 2 w \pm 10 \%$ |
| R418 | ${ }^{\text {A } 231-1123}$ | Carbon $82 \mathrm{Ohm} \mathrm{1/2w} \pm 10 \%$ |
| R419 | ${ }^{\text {A } 233-1129}$ | Carbon 150 Ohm $2 \mathrm{w} \pm 10 \%$, |
|  |  |  |
| R421 | A231-1223 | Carbon, $1.2 \mathrm{Mogchm} \mathrm{1/2m} \pm 1$ |


| REPAIR PARTS LIST 703 AM-FM RADIOCAPACITORS |  |  |
| :---: | :---: | :---: |
| SCH. LOC. | PART No. | description |
| C1 | A16109 | AM FM Variabl |
| $\mathrm{C}_{2}$ | ${ }^{\text {A20 }} 148$ | Electrolytic 10 mid 450 V |
| $\mathrm{Cl}_{4}$ C8, C19, $\mathrm{C}_{2}$ | ${ }_{\text {Al }}^{\text {A }}$ A $90-130$ | Mica 470 mmim $\pm 10 \%$ |
|  | A1900-131 | Mices 2200 mind $\pm 10 \%$ |
|  | A19109 A1916? | Ceramic Disce 5000 mmf |
| C9 | A555-201 | Ceramic $10 \mathrm{mmf} \pm 10 \%$ |
| C10 | A1774 | Trimmer |
| C16b, c22, c22b, | A19163 | Ceramic Diec Dual 5000 mmf |
|  |  | Paper $05 \mathrm{mfd} 400 \mathrm{~V} \pm 20 \%$ |
|  | A19165 | Ceremic 2.2 mat |
| ${ }^{\mathrm{C} 12}$ | A194-108 | Pappr $02 \mathrm{mfd} 400 \mathrm{~V} \pm 20 \%$ |
| $\mathrm{C}_{21} \mathrm{C}^{\text {c }}$ 25 | ${ }^{\text {Al }} 19490-1107$ | ${ }_{\text {Paper }} .01 \mathrm{lmfd} 400 \mathrm{~V} \pm 20 \mathrm{x}$ |
|  | A194-98 | Paper $000 \mathrm{mfd} 400 \mathrm{~V} \pm 20 \%$ |
| C27. $\mathrm{C}_{28}$ | A190-135 | Mica 330 mom $\pm 10 \%$ |
| $\begin{gathered} \text { C29 } \\ \text { C30 } \end{gathered}$ | $\begin{aligned} & \mathbf{A}_{2} 20149 \\ & \mathbf{A} 90-119 \end{aligned}$ | Electrolytic 4 mit 50V <br> Mica 68 mmf 500 V 10\% |
| RESISTORS |  |  |
| R1 | A21114 | Resistor, Wiremound 2500 ohme 10 w |
| R2 | ${ }^{12529}$ | Control, Tone 230,000 ohm |
| R4, R24 | ${ }_{\text {A230, }}^{12117}$ | Conrrol, Volume 00,000 ohm |
|  | A230-2253 | Carbon 1500 ohm $1 / 4$ i $20 \%$ |
| R6 | ${ }^{\text {A231-2281 }}$ | Carbon 22,000 ohp $1 / 2 w \pm 20$ |
| ${ }_{\text {R8, }} \mathbf{R} \mathbf{R} 12$ | ${ }^{\text {R } 231-1161 ~}$ | Carbon 3300 ohm ${ }^{\text {a }} \pm 1000$ |
| R9, | ${ }_{12302313}$ |  |
| ${ }^{\text {R19 }}$ | ${ }^{1230-1123}$ | Carbon $82 \mathrm{ohm} \mathrm{y}^{\text {/m}}$ |
| ${ }_{\text {R13 }}$ | ${ }_{1230-2329}$ | Carboes 2.2 meg ohy $y_{\text {m }} \pm 20$ |
| R14 | 1230-2309 | Carbon 3301 obm $1 / 4{ }^{\text {a }}$ 20x |
| His | ${ }^{\text {2231-2313 }}$ | Carme 470, Mm ohm $= \pm 208$ |
| ${ }_{\text {R17 }}$ | ${ }_{\text {A } 230-1221}$ |  |
| H18 | ${ }^{1} 230-2345$ | Carbon 10 mos ohn $1 / \mathrm{m} \pm 20 \%$ |
| R19 | A232-1177 | Carbos 15000 dive $1 \mathrm{w} \pm 20 \%$ |
| R20 $\mathbf{R 2 1}$ | ${ }_{\text {A231-1217 }} \mathbf{1 2 3 2 2 5 7}$ | Carboen 2200 obe $6 \pm \pm 203$ |
| ${ }^{122}$ | A230-1183 | Carbon 27,000 ohm $1 / \mathrm{w} \pm 10 \mathrm{x}$ |
| R23 | A230-4 | Carbon 30,000 ohr |
| R25 | ${ }^{1230-89}$ | Carbon 47,000 ghma |
| R27 | ${ }_{\text {A } 23001203}^{\text {230. }}$ |  |
| SOCEETS |  |  |
| SCB. Loc. | Part no. | description |
|  |  | Socket, 7 Pin Miniat |
|  | 118174 | Socket, Phono liput |
|  |  | Socket, Octal |
| S1 | ${ }^{\text {A } 37102}$ | Switch, AM FM Phono, ${ }^{\text {a }}$ |
| ${ }_{\text {T }}$ | (13398 | Traniormer, FM ${ }^{\text {aras }}$ |
| T4 | Ass9\% | Tranoformer, FM LF 2nd |
| T5 | As399 | Transformer, MM IF 2nd |
| T6 | A3392 | Tranoformer, Ratio Detec |
| Ls, Le | ${ }^{128283}$ | Choke, FM One. |
| ${ }_{\text {L }}$ | ${ }^{\text {A28205 }}$ | Coil, AM Oec |
| Ls | A282\% |  |
|  | 128299 | Astenas, FM |
| 4 | A6229 | Antoma, AM Loop |

1. F. ALIGNMENT PROCEDURE 40 mc 1 F

Beforepulling a chassis for shop alignment, the serviceman should heck these points:

1 - The antenna and installation:
2 - Front panel and rear chassis control settings, including pic ture tube adjustments.
3 - Reception on all available channels.
4 - Tubes: Substitute known good tubes for suspected defective
5 - Wiring, connections and parts placement under the chassis,
for loose joints, and accidental shorts. TEST EQUIPMENT REQUIREMENTS
The equipment listed below is essential for the correct alignment The equipp
of this receiver.

1 - Signal Generator with an output Variable between 10 and
100,000 microvolts, and crystal controlled or calibrated at 180,000 microvolls, and cr
the following frequencie i:
$\begin{array}{lll}\text { a) } 4.5 \mathrm{mc} & \text { d) } 43.8 \mathrm{mc} & \text { g) } 39.75 \mathrm{mc} \\ \text { b) } 41.25 \mathrm{mc} & \text { e) } 45.2 \mathrm{mc} & \text { h) } 45.75 \mathrm{mc} \\ \text { c) } 42.3 \mathrm{mc} & \text { f) } 47.25 \mathrm{mc} & \text { i) } 44.75 \mathrm{mc}\end{array}$
$2-$ Signal Generator with an output Variable between from 30 to 230 mc , asweep width of at least 10 mc and an output ad-
juatable from 0 to. 1 volt. juatable from 0 to . 1 volt
3 - Marker Generator, crystal controlled or calibrated for video and sound carrier frequencies of each channel. (Can be the
same generator as in \#l if these frequencies are available.)
4 - Cathode Ray Oscilloscope with good low frequency response.
5 - D.c. Vacuur Tube Voltmeter with 5 volt and 10 volt ranges.

- Non metallic alignment tool, hexagonal bit, . 095 " across - ilats.

7 - One 3 volt battery.
$8-$ Two belanced $( \pm 1 \%)$ 100X resistors.
1 - Connect negative of 3V battery to AGC bus (Pin 7, test Cet), positive to chassis.
2 - Remove mixer tube shield, connect Signal Generator, to it
and replace over mixer tube so shield does not. contact chaosis.
3 - Connect VTVM negative lead to grid of first video amplifier Pia s, test socket) and positive lead to chassis.
4 - Plug line cord into receiver and electric outlet, turn receiver
4 - Plug line cord into receiver and electric o.
5 - Set VTVM on $\mathbf{- 5}$ volt range and signal generator to 44.75 mc
6 - Adjuant 5th IF transformer L205 top slug for maximum output, setting signal generator atten
3 volt reading on the VTVM.
7 - Set aignal generator to 47.25 mc unnodulated and adjust 8 - Set signal generator to 45.2 mc unnodulated and adjust top

- Set signal generstor to 39.75 mc unmodulated and adiuat trap

9 - Set signal generstor to 3 min mu unmodulated and ad.
L203, bottom slug for s minimum reading on VTVM.
10 - Set signal generator to 43.8 mc unmodulated and adjust top
slug of L203 for a meximum VTVM reading as in (6).
11 - Set signal generator to $\mathbf{t o} 41.25 \mathrm{mc}$ unmodulated and adjust
trap L202, bottom sug, for a minimum VTVM reading.
12 - Set signal generator to 42.3 me unmodulated and adjust the
2nd IF coil. L202, top slug, for a maximum VTVM reading as in (6).
13 - Set signal generator to 43.8 mc and adjuat L201, lat l.F. and
and List, tuner I.F. coil for an approximate maximum.
14 - Disconnect the aignal generator from the tube shield.
15 - Connect Sweep Signel Generator to mixer tube shield and an oscillos cope, calibrated for 3 volts seak to peak as reference
output level, in place of the VTVM.
16 - Loosely couple Marker Generator to input on the Sweep

17 - Adjust Sweep Signal Generator dial and attenuator to show DEFLECTION YOKE, ION TRAP AND FOCUS ADJUSTMENT
 calibrated oscilloscope screen. (Exceeding this value will Yoke, Following is trep and Focus.
give a distorted response curve.)
18 - Adjust tuner IF coil and lst IF coil L101 to obtain the Thes Adjust tuner IF coil and lat IF coil L101 to obtain the $\begin{gathered}\text { The receiver should be turned on but not connecte } \\ \text { response curve shown below. }\end{gathered}$ (the should then be taken in the following order:

1 - The Deflection Yoke should be moved as far forward as
possible on the neck of the CRT.
2 - The Brightness control should be set halfway and the Con-
3 - The Ion Trap should be rotated and at the same time moved Iorward and back ward to find the position which produces
the brighteat raster on screen. (Xeep Brightness control low)
4 - The Deflection Yoke should be rotated so that the top and
bottom edges of the raster are. parallel to the top of the chassis.
5 - The Brightness control should now be reduced (cew) to a
point where the raster is slightly above normal briliance.
6 - With Brightess and Contrast controls at normal positions,

- With Brightness and Contrast controls at normal positions,
adjust the Focus control (rear of chassis) for well-defined scanning lines.
HEIGHT, width and Linearity
To adjust the overall size and linearity of the picture it is almos
datory that a teat pattem transmitted from a local station be used. It mandatory that a teat patterm transmitted from a local station be used. I
should also be remembered that in areas whe should also be remembered that in areas where more than one atation is
being received, that pictures transmitted from different stations will vary slighty in size. The smalleast transmitted picture should be made
vo fill the aree oullined by the mate The width ouned by the mask.
The Width control L402, ahould be adjusted to give a picture
will fill the mask horizontally.
The Height and Vertical Linearity controls should then be ad-
for a linear picture that will fill the mask vertically. UHF TUNER ALIGMENT
Tuner PC54145S 41 mc . I.F. Coil Alignmen
Set the receiver channel selector for UHF.
1 - Connect the signal generator to the test point thru an isolat
ing resistor of approximately 100 K ohms.
- Connect VTVM to first video amplifier grid or to test socket pin 5.
3 - Set signal generator for 44.2 mc unmodulated. Tum receiver
on and allow a short wam up period.
4 - Adjust Tl for maximum response as indicated on the VTVM. ALIGNMENT PROCEDURE UHF TUNER PC541459
Alignment of the UHF Tuner is a simple procedure since its band-
pass is essentially predetermined by the fixed characteristics of pass is essentially predetermined by the fixed characteristics of origina
component design, physical layout and associated omponent design, physical layout and associated circuitry. Except as
tated otherwise in this procedure, bend-pass is not subject to serious change during alignment, however, repla cement of any component within
the O -F or IF circuits may dist the R-F or $1-\mathrm{F}$ circuits may disturb the band-pass characteristics
Accordingly, whenever parts within these circuits are replaced, electrical and physical specifications of the crigcuits are replaced, electri-
duplicated as componely as duplicated as closely as possible. Wheses, parts and other accessories
must be replaced in their fomer positions. Complicated or opeciell desi
Complicated or apecielly designed test equipment is not required
practical alignment of the UHF Tuner. Instruments VHP secta are asually satisfactory. However, the following instrumenta
vise

1 - VIIF signal generator with AM output.
2 - Oscilloscope or vacuum tube volt-ohmmeter for measurement of the relative signal.
The oscilloscope or VTVM should be connected to the TV set
firat video amplifier grid or to test socket pin 5 . The 1 in 5 ,
The procedure for alignment consists of the following steps.
1 - Positioning of the oscillator for proper band coverage.
2-Alignment of R-F circuits for maximum effectiveness.
tal oscillator shound be Hold control fails to maintain sync, the horizonthe horizontal hold control in the center of its range and sync the conte with the horizontal A.F.C. adjustment screw. Check the hold required to provide sync on all channels.




BOTTOM VIEW OF CHASSIS

tube a trimmer location

CHASSIS $1121,1121-$

| sCHEM. <br> LOC. CHASSIS | part no. | description |
| :---: | :---: | :---: |
| C101 | PA20182 | Electrol ytic 50 mfd 25 V |
| c102 | PE197-148 | Molded Tubular . $003 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ |
|  | PE194A-66 | dov |
| C104 | PE194A-145 | Paper 001 mfd 60 |
| ${ }_{\text {c10 }}$ |  | Ceramic Singie Disc 1500 mmf GMV |
| C107 | PA20149 | Electrolytic 4 mfd 50 V |
| C108 | PE194A-160 | Paper . 05 mfd 600 |
| C109 | PE556-136-2 | Ceramic Tubular, 1000 mmf $\pm 20 \%$ (Insul) |
| c1 | PE55-231 | Ceramic Tubular, 470 mmf 500 V 10\% (Insul) |
| ${ }^{\text {c } 111}$ | 09 | Ceramic Single Disc 5000 mmf |
| 1112 |  | Ceramicsin |
| 113 | PES55-113-2 | Ceramic Tubular, 47 mmf 500 $\pm 20 \%$ (Unins) |
| C114A, B | PA19163 | Ceramic Shielded Dual Disc 5000 mm GMV |
| C115 | PE $190-2$ | Mica, 100 mmf 500 V |
| C116 | PE194A-160 | Paper $05 \mathrm{mfdd} 600 \mathrm{~V}=209$ |
| c117 | PE $190-125$ | Mica, $120 \mathrm{mmf} 500 \mathrm{~V}=10$ |
| ${ }^{\text {c118 }}$ | PA20138 | Electrolytic 1 mfd 50 V |
| C201 | PEE194A-59 | Puper 01 mfd 200 V I20\% |
| ${ }^{\text {C202 }}$ |  | Paper Stic Tubula |
|  |  | ceramic (Iubul) |
| C205 | PA 19148 | Ceramic, Single Disc 1500 m |
| c206 | PE556-231 | Cera |
|  | PA19148 | ${ }_{\text {Ceram }}^{\text {f10 }}$ |
|  |  | gmv |
| c208 | 9148 |  |


| schem. <br> LOC. Chassis | Part NO . | description |
| :---: | :---: | :---: |
| L101 | PB28286 | Coil, 4.5 mc Trap |
| $L^{\text {L102 }}$ | ${ }^{\text {PCC } 28255-16 ~}$ | Coil, Peaking (Red/Yellow) |
| L103 | ${ }^{\mathrm{P} C 2} 28255517$ | Coill Peaking (Red/Blue) |
| L104 | ${ }^{\text {PB28286 }}$ | Coill 4.5 mc Trap |
| L105 | ${ }^{\text {PCC282555-1 }}$ | Coil, Peaking (R |
| L106 | $\mathrm{PC}^{\text {2 }} 8255$-13 | Coil, Peaking (Red |
| L107 | PC28255-11 | Coll, Peaking (Blue/whit |
| L201 | PB331118 | Trans., 1 st 1 IF 40 md |
| L202 | PC33107A | Trans., 2 nd IF w/Trap |
| L203 | PC 33107 A | Trans., 3 rd IF w/Tra |
| L204 | PC33109A | Trans., 4th $1 \mathrm{~F} \mathrm{w} / \mathrm{Tr}$ |
| L205 | PB33112B | Trant: Sth 1 F 40mc bifilar |
| L206 | PB28346 | Coil, Video Det. Peaking Coil Ass'y. |
| L301 | ${ }_{\text {PB14 }}{ }_{\text {P }}$ | Coil, Filter Choke |
|  |  | Coil, C |
| L303 | PA | Coil, Filament Choke |
| L306A, B | PC 28393 | Coil Deflection Yo |
|  | PC28263 |  |
| $\mathrm{L}_{402}$ | ${ }^{\text {PBE28390A }}$ | Coil, wid |
| 1403 | PB28327 | Coil, Horizontal Lineari |



| SCHEM. <br> LOC. Chassis | PART NO. | description | capactrors |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| R101 | PE232-1137 | Carbon, 330 ohm $1 \mathrm{~W}=10 \%$ |  |  |  | SCHEm. |  |  |
| R102 | PE231-1213 | Carbon, 470 K ohm 1/2W $10 \%$ | Loc. chassis | part no. | Descript |  |  |  |
| R103 $\mathrm{R104}$ | ${ }_{\text {PE P231-1 }}$ | Carbon, 5600 ohm $1 / 2 \mathrm{~W}=10 \%$ (atoon, 220 K ohm $1 / 2 \mathrm{w}=10 \%$ | C209 | PEs56-231 | Ceramic Tubular, 470 mmf 500 V | C307 | PA19148 | Ceramic, Single Diec 1500 mnf GMV |
|  | PC21134-12 | Wire-Wound 1500 ohm 10W $工 10 \%$ |  |  | ${ }^{ \pm 10 \% \%}$ (Insul) ${ }^{\text {a }}$ | C308 | PE194A-151 | Paper $.005 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ |
| R106 | PE231-1245 | Carbon, 10 megohm $1 / 2 \mathrm{~W}$ 工 $10 \%$ | C210 |  |  | C309 | PE194A-151 | Paper $0005 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ |
| R107 | PE231-1147 | Carbon, 820 ohm $1 / 2 W \pm 10 \%$ \% | C211 |  | Ceramic , Single Disc 1500 mm | $\mathrm{C}^{\text {C310 }}$ | PE194A-155 | Paper 01 mfd 600 V I20\%\% |
| R108 R109 | ${ }_{\text {PE }}^{\text {P } 2311111185 ~}$ |  | c212 | PE194A-21 | Paper, $1.0 \mathrm{mfd} 100 \mathrm{~V} \pm 20 \%$ | ${ }_{C} \mathbf{C} 312$ | ${ }_{\text {PE }} 1921$-1 63 | Paper, $4700 \mathrm{mmf} 500 \mathrm{~V}=10 \%$ |
| R110 | PE231-1197 | Carbon, 100K ohm 1/2W $10 \%$ | C213 | PE556-231 | Ceramic Tubular, 470 mmf 500 V | C313 | PE 197-146 | d Tubular $5002 \mathrm{mfd} 000 \mathrm{~V} \mathrm{I}_{20 \%}$ |
| R111 | PE231-1159 | Carbon, 2700 ohm $1 / 2 \mathrm{~W} \pm 10 \%$, | C214 | PA19148 | Ceramic, Single Disc 1500 mmf | C314 | PE 190-133 | Mica, $270 \mathrm{mmf} 500 \mathrm{~V}=10 \%$ |
| ${ }^{\mathrm{R} 112}$ | ${ }_{\text {PE } 23111197}$ |  | C214 |  | GMV | ${ }_{\substack{\text { C315 } \\ \text { C316 }}}$ | PE197-156 | Molded Tubular $02 \mathrm{mfd} 600 \mathrm{~V}=20 \%$ |
| R114 | PE231-1123 | Carbon, $82 \mathrm{ohm} 1 / 2 \mathrm{~W}$ + $10 \%$ | C215 | PE 556-234 | Ceramic Tubular, 680 mmI 500 V | ${ }_{C} 317$ | PE197-162 | Moided Tubular 1 mfd d 600 V I $20 \%$ |
| R115 | PE231-1173 | Carbon, 10 K ohm $1 / 2 \mathrm{~W} \pm 10 \%$ |  |  | ${ }^{1} 10 \%$ | C318 | PE194A-155 | Paper $01 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ |
| R116 | PE 231-1171 | Carbon, 8200 ohm $1 / 2 \mathrm{~W}$ +10\% | C216 | PA19148 | ${ }_{\text {Ceramic, single }}$ | C319 | PE197-115 | Moided Tubutar . 25 mfl 400 V I20\% |
| R117 | PE231-169 | Carbon, 6800 ohm 1/2W $+10 \%$ | C217 | PE194A-146 | Paper .002 mfd 600 V I $20 \%$ | ${ }_{\text {C32 }}$ | PE 197-155 | Molded Tubular 01 mfd 600V $\mathrm{I} 20 \%$ |
| R118 | PE231-1213 | Carbon, 470 K ohm $1 / 2 \mathrm{~W} \pm 10 \%$ | C218 | PE194A-156 | Paper 022 mfd 600V $\pm 20 \%$ | C401 | PE197-151 | Molded Tubular . 005 mfda 600 V 220\% |
| R120 | PE232-1135 | Carbon, 270 ohm $1 \mathrm{w} \pm 10 \%$ | C219 | PE 190-137 | Mica, 30 mmf 500V $\pm 10 \%$ | C402 | PE197-145 | Molded Tubular .001 mfd 600 V |
| R121 | PE231-1161 | Carbon, $3300 \mathrm{ohm} 1 / 2 \mathrm{~W} .10 \%$ | C220 | ${ }^{\text {PE E } 190-133 ~}$ | Mica, 270 mmf 500 V +10\%\% | ${ }^{\text {C403 }}$ | PE 197-145 | Molded Tubular $0001 \mathrm{mfd} 600 \mathrm{~V}+20 \%$ |
| R122 | PE233-171 | Carbon, 4700 ohm 1/2W $\pm 10 \%$ | ${ }^{\text {c22 }}$ | 194A-114 | Paper $1 \mathrm{mfd} 400 \mathrm{~V}=20 \%$ | C405 |  | Molded Tubular |
| R123 | PE231165 | Carbon, $6800 \mathrm{ohm} 2 \mathrm{~W}=10 \%$ | C223 | PE197-160 | Molded Tubular $.05 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ | C406 | PE 195-261 | Silver Mica $3900 \mathrm{mmf} 500 \mathrm{~V} \pm 10 \%$ |
| R124 | ${ }^{\text {PE E2331-1129 }}$ | Carbon, 2.2 megohm $1 / 2 \mathrm{~W} \pm 10 \%$ | C224 | PA20145 | Electrolytic 10 mid 250 V | C407 | PE190-137 | Mica, 390 mmf 500 V : |
| R126 R136 | PE233-1157 | Carbon, 2200 ohm $2 \mathrm{~W} \pm 10 \%$ | C301,A,B,C, D | PB20168 | Electrolytic $40-20-20-10 \mathrm{mid} 450 \mathrm{~V}$ | C408 | PE190-133 | Mica, 270 mmf 500 V |
| R201 | PE231-1221 | Carbon, 1.0 megohm $1 / 2 \mathrm{w} \pm 10 \%$ | C 302,A, B | PB20173A | Electrolytic 80 m | C409 | PE190-133 | Mica, 270 mmf 500 V |
| ${ }_{\text {R202 }}$ | PE231-1175 | Carbon, 330 ohm 1/2W $\pm 10 \%$ | C303,A,B | PB20169 | Electrolytic, $80 \mathrm{mfd} 450 \mathrm{~V} ; 100 \mathrm{mfd}$ | ${ }_{\text {C41 }}$ | PE190-139 | Mica, ${ }_{\text {Mica }} \mathbf{4 8 0 \mathrm { mmfm }} 500 \mathrm{~V} \pm 10 \%$ |
| ${ }_{\text {R204 }}$ | ${ }_{\text {PE } 231-1117}$ | Carbon, 47 ohm $1 / 2 \mathrm{~W} \pm 10 \%$ |  |  |  | $\mathrm{C}_{412}$ |  | Electrolytic 4 mfd 50V |
| R205 | PE231-1155 | Carbon, 1800 ohm $1 / 2 W \pm 10 \%$ | 304 | PA | ${ }_{\text {Ceramic }}^{\text {GMV }}$, Sin | C 413 | PE197-160 | Molded Tubular . $05 \mathrm{mfd} 600 \mathrm{~V} \pm 20$ |
| R206 | ${ }^{\text {PE E231-1175 }}$ | Carbon, 12 K ohm $1 / 2 \mathrm{~W} \ddagger 10 \%$ | c305 | PA19148 | Ceramic, Single Disc, 1500 mmf | C414 | ${ }_{\text {PE }}{ }^{\text {P } 1944 \text { A-114 }}$ | ${ }_{\text {Paper }} 1 \mathrm{mfd} 400 \mathrm{~V}$ 120\% |
| R207 | ${ }_{\text {PE } 231-1117}$ | Carbon, 47 ohm $1 / 2 \mathrm{~W} \pm 10 \%$ |  |  |  |  | PE197-160 | Molded Tubular $05 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ |
| R209 | PE231-1155 | Carbon, 1800 ohm $1 / 2 \mathrm{~W} \pm 10 \%$ | c306 | PA19148 | Ceramic, Single Disc 1500 mmf | C417 | PE197-156 | Molded Tubular, $.02 \mathrm{mfd} 600 \mathrm{~V} \pm 20 \%$ |
| transformers |  |  |  |  |  |  |  |  |
| SCHEM. <br> CHassis | S Part no. | description |  |  |  |  |  |  |
| T101 | PC1205-1 | Audio Output (Dual Spkrs.) |  |  |  |  |  |  |
| T102 | ${ }^{\text {PB1208 }}$ | Ratio Delector |  |  |  |  |  |  |
| T201 |  | Vert. Blocking Osc. |  |  |  |  |  |  |
| ${ }_{\text {T }}$ | ${ }_{\text {PC }} 10172$ |  |  |  |  |  |  |  |
| T401 | PC10176 | Horizontal Output |  |  |  |  |  |  |


| all chassis | description |
| :---: | :---: |
| PC541460B PC541459APC541502 C54150 | VHF Tuner 40 mc |
|  | UHF Tuner 40 mc |
|  | Tuner Mounting Bracket Assembly, Consititing of: |
|  | 1- PD541503 Tuner Mounting Bracket |
|  | 1. PB4697A Vernier Drive Shaft Bear |
|  | 1. PA46108B Drive Pulley Stop St |
| PB37120 PB541494A PB4599 <br> PB4599 | VHF/UHF Switch |
|  | Cam. (Actuat |
|  | Drive Shaft Assembl |
|  | 1. PA45100 1" Dri |
| PB46102 | 1. PB4686 Drive Sh |
|  | Dial Scale drive Tube Aus |
|  | 1. PA46103 1- PB45105B |
| PA541266 | Tuner Shaft Grounding Spring |
| PA46120A | Tuner Shaft Bearing Ple |
| ${ }_{\text {PA46104 }}$ | Tuner Mounting Bracket, Rear |
|  | Drive Shaft Retainer Spring |
| PA46105 | Vernier Drive Shaft Retainer Spring |
| ${ }_{\text {P P } 446107}$ | Mounting Hub, UHF Indicator Disc |
|  | Dial Cord Tension Spring |
| PA45107 | Dial Cord (Front) |
| PA45111 | Dial Cord |
| PP54925 | Dial Cord Clasp |
| PA45106 | Spur Gear Aasembly |
|  | Consisting of: |
|  | 1- PB45117A Spur Gear |
| PB4699 | 1-PA541505 Rollpin |
|  | Vernier Drive Shaft Assembly |
|  | Consisting of: |
|  | 1- Pb46100A Vernier Drive |
|  | 1- PA45 103 A |
|  | 1- PA45104A Spur Gear |
|  | 2- PA541470 Compression Spring (AntiBacklawh) |
| PB45101 | ${ }_{\text {1. PB46101 }}$ Verrier Drive Shaft Buzhing |
|  | Drive Pulley \& Hub Assembly, Front |
|  |  |
|  | 1- PB4698 Drive Pulley Hub, Front |
| PA4966 PA496 | Pilot Li |
|  | Pilot Lieht Shield |
| PP4947 | Pilot Light, Type $\mathbf{S 4 7}$ (Brown Bead-Bayon |
| PA46120A <br> PA541266 | Tuner Shaft Bearing Plate |
|  | Tuner Shaft Grounding Spring |
| ${ }_{\text {PA44588 }}$ or | Dial Cord Pulley |
|  |  |
| PP591116 | Stringing Diagram |

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## TELEVISION ALIGNMENT PROCEDURE

Aligning a television receiver is an exacting procedure and involves the use of bench space, test equipment and of making two trips to the customer's home. Before deciding that the chassis must be pulled and aligned at the shop, the serviceman should check these very common sources of trouble

- The antenna and installation.

2 - Front panel and rear chassis controls, including picture tube adjustments
3 - Reception on all available channels.
4 - Tube failures. Substitute from your kit of known good replacements.
5 - Visual inspection of underside of chassis for obvi-
TEST EQUIPMENT REQUIRED FOR ALIGNMENT
The equipment specified below is desirable, but in cases where this equipment is not available, it is possible
ans to align the receiver by use of a 20 to 30 mc .
ignal generator, using the picture and speaker as indicaion of alignment.

1 - Signal Generator with an output variable between 100 and 10,000 michovihs,
a. 4.5 megacycles
b. 22.25 megacycles
c. 25.4 megacycles
d. 23.6 megacycles
e. 21.25 megacycles

2 - DC. Vacuum Tube Voltmeter with 5 volt and 10 volt scales.
3 - A pair of balanced ( $(1 \%)$ 100K carbon resistors.

## TEST EQUIPMENT

REQUIRED FOR SWEEP ALIGNMENT CBECK
1-R-F sweep generator with frequencies ranging from 40 is 220 megacycles, baving sweep width of approximately 10 megacycles, and baving adjustable proximately
output to approximately 0.1 volt.
2 - Crystal-controlled or crystal-calibrated markers for the picture and sound carriers of each channel, pre
ferably $30 \%$ Amplitude-Modulated.

3 - Cathode Ray Oscilloscope with good low frequency response.
4-3 volt bias battery
CAUTION: THE SECOND ANODE LEAD TO THE PICTURE TUBE HAS A HIGH POTENTIAL. DURING THIS PLUG FROM ITS SOCKET, THUS ELIMINATING THIS higil voltace hazard.

## If. Alignment procedure

1 - Connect "bigh" lead of sigual generator to the test point located on the top of the RF tuner unit (Refer to the R-F tuner location diagram located on
side of cabinet). Connect ground to chassis.
2 - Connect DC VTVM lead (through 10K isolating re sistor) to pin 1 of 6AU6 1 st Video Amplifier ( ground to chas
tive polarity.

3-Set I.F. generator to 25.4 megacycles with sufficient output to read approximately 3 volts on the vTvM.
4 - Carefully adjust L201 and L. 203 (see tube and tuner location) for maximum deflection on VTVM. Adjust roximately 3 volts.
5 - Set I.F. signal generator to 22.25 megacycles with sufficient output to read approximately 3 volts on the VTVM

6 - Carefully adjust L11, L202-top (see tube and tuner location) for maximum deflection on VTVM. Adjust signal generator output to keep meter reading approximately 3 volts.
7 - Set i-f signal generator to 23.6 mc . with sufficient out put to read approximately 3 volts on the VTVM.
8 - Carefully adjust L205 (see tube and tuner location) lor maximum deflection on $V$ VM. Adjust signal generator out - -
mately 3 volts.
9 - Set I.F. signal generator to 21.25 megacycles, set VTVM to 10 volt scale (negative polarity), and adjust signal generator output for convenient defecion on VTVM.
10 - Adjust L202-bottom for minimum deflection on VTVM.
SWEEP ALIGNMENT CHECK
Although not essential, a sweep alignment check is a desirable verifit
ceed as follow

1 - Connect R-F sweep generator to antenna terminals (antenna impedance 300 Ohms ).
2 - Calibrate oscilloscope for convenient 5 volts peakapproximately $1 / 4$ of the peak-to-peak voltage of the approximately
6.3V A.C. Filament).
3-Connect vertical input of oscilloscope (through10K isolating resistor) to pin 1 of GAU6 lst Vid. Amp. (V12) ground to chassis. Connect horizontal input o scilloscope to "scope" terminals of R-F genera tor; adjust for convenient horizontal swee
4 - Connect 3 volt battery positive terminal to chassis egative terminal gram.
5 - Set R-F sweep generator to channel 3 , television receiver to channel 3, and if necessary, adjus horizontal setting for convenient band-pass display (see figure 1) having 5 volts vertical defection as previously calibrated. (If you must touch scope vertical settings during these adjustment ecalibrate sc
step 2 above).

- Adjust L205 slightly to even the height of peaks and to obtain an untilted bandpass.
7 - Couple crystal-controlled H -F carrier markers vet TUNING control till video carrier marker is $1 / 2$ down on curve. Turn up marker output till $\pi$-f sound carrier visible on bandpass and adjust sound trap (L114) to minimize effect to sound carrier marker. NOTE: If the fine tuning control is at end of range or out of range so that video carrier cannot be set at $50 \%$, follo.
R-F OSCILLATOR ALIGNMENT procedure outlined below.

8 - Check all channels.

R-F OSCILLATOR ALIGNMENT
If all channels are not within range of FINE TUNING control (as evidenced by inability to eliminate "sound bars" from picture or by poor picture quality), the indivi-
dual oscillator slugs may require readjustment.

1 - Repeat the set-up as for SWEEP ALIGNMENT
CHECK, steps 1 through 7 .
2 - Set FINE TUNING CONTROL to center of range, and with long fiber screwdiver alignment tool, adjust the individual oscillator slugs of eache) annel.
(Accessible through the fromt of the tuner) so that video carrier markers fall $50 \%$ down on curve. CAUTION: Do not touch adjustments on top of r-f tuner unit, other than the converter plate unit, L11, during I.F. alignment.

## SOUND ALIGNMENT

1 - Connect 4.5 mc . signal generator to pin 1 of 6 AU6 4.5 mc . amplifier ( ${ }^{(13)}$ ).

2 - Connect DC V.T.V.M. lead to pin 7 of 6 AL5 (V15) ratio detector, negative polarity.
3 - Adjust signal generator to precisely 4.5 megacycles; adjust output to read approximately 5 volts on ${ }^{\text {adjust }}$ V.T.V.M.
4 - Adjust L206, L101, and bottom of T102 for maximum deflection on V.T.V.M. Keep V.T.V.M. reading below 10 volts at all times.
5 - Altach two series-connected 100 K ( $\mathrm{A} 1 \%$ ) resistors across R 106 (Ratio Detector Load Resistor). Con nect DC V.T.V.M. to centertap of 100 K resistors, (Audio take-Off of T102)
6 - Adjust top of 102 for zero reading on V.T.V.M. between a plus and a minus peak.

VIDEO AMPLIFIER 4.5 mc . TRAP
When necessary, the video amplifier 4.5 mc . trap (L104) ould he adjusted as follows

1 - Connect 4.5 mc . signal generator to pin 1 of 6 AU 6
2 - Adjust signal generator output till 4.5 mc . dot patAdjust L104 to minimize the dot pattern


## HORIZONTAL OSCILLATOR ALIGNMENT

If the Horizontal Hold control fails to maintain sync, horizontal oscillator should be reset. To reset this the center of its range and sync the picture with the horiontal A.F.C. adjustment screw. Check the bold control action on various channels and after the screw adjuasment as required to provide sync on all channels.

DEFLECTION YOKE
ION TRAP AND FOCUS ADJUSTMENT

The receiver should be torned on bat not connected to an antenna. These stepe should then be taken in the follown antenna
ig order

1 - The Deflection Yoke shoold be moved an far for-
2 - The Brightness control should be turned to maxiould be

3 - The Ion Trap should be rotated and at the same time moved forward and backward to find the posita
4 - The Deflection Yoke should be rotated so that the top and bottom edges of the raster are parallel to

5 - The Brightness control should now be reduced ( $\mathrm{cc} w$ ) to a point where the raster is slightly above normal brilliance.

HEIGHT, WIDTH, LINEARITY, AND HORIZONTAL DRIVE To adjust the overall size and linearity of the picture it is almost mandatory that a test pattern transmitted from
a local station be used. It should also be remembered that in areas where more than one station is being received, that pictures transmitted from different stations will vary slightly in size. The smallest transmited picture should be

1 - Starting with the HORIZONTAL DRIVE control (rear of chassis) in extreme counterclockwise posi-
tion, advance the control clockwise till the compression near the center of the picture (a vertical bright bar) is eliminated.
2 - The Width and Horizontal Linearity controls (rear of chassis) should be adjusted to give a picture that will fill the mask horizontally, with the minimum of iretching or compression.
3 - The Height and Vertical Linearity controls (both rear of chassis) should then be adjusted for a linear picture that will fill the mank vertically.
picture tube handling precautions
The pleture tube oncloses a high vocuum ond with the lorge surfoce area of glose Involved, the stresses $s$ et up, parti-
cularly of the front ilm of the tube, ore consideroble. An bnormal the front rim of the cube, ore considaroble. An arrersed eurfines or even, a seratch on the surface of the tube could couse it to implode or collopse with destructive violence.

## high voltage warning

Opeotion of this recelver outside the cobinet ar with covers amoved involves a shock hozard from the recelver power supplies. Wark on the recolver should not be atfempted by nyone who is not thoroughly familior with the precoutions necessory when working on hlgh volioge equipment.


## (6) John I. Rider

The Width control (rear of H.V. cage) should be ad justed to give a picture that will fill the mask horizontally The Height and Vertical Linearity controls (both rear of chassis) should then be adjusted for a linear pictur
that will fill the mask vertically.

TELEVISION ALIGNMENT PROCEDURE, UHF
Alignment of the UHF Tuner is a simple procedure since its bandpass is essentially predetermined by the fixed characteristics of original component design, physical lay out and associated circuitry. Except as stated otherwise in this procedure, band-pass is not subject to serious change during alignment, however, replacement of any component Winin the R-F or $\mathrm{H}-\mathrm{F}$ circuits may disturb the band-pass circuits are replaced, electrical and physical specifica tions of the original components must be duplicated as closely as possible. Wires, parts and other accessories must be replaced in their former positions.

Complicated or specially designed test equipment is not required for practical alignment of the UHF Tuner. In tory. However, the following instruments are needed;

1-VHF signal generator with AM output and a sweep modulation of at least 12 megacycles.
-ohmmeter for measurement of the relative signal.

- An operating VHF television set. (The latter suggested as a practical amplifier for raising the output signal of the converter to a level which permits convenient observation.)
The UHF Tuner to be tested should be connected to the VHF television set in the usual manner. The oscillo scope or VTVM should then be connected to the TV set at a point which permits satisfactory observation of the relative intensity and character of the
signal introduced into the tuner

The procedure for alignment consists of the following steps in the suggested sequence given:

1-Positioning of the oscillator for proper band coverage

- Alignment of R-F-circuits for maximum effectiveness.


## OSCILLATOR ADJUSTMENT

1-Adjust UHF channel tuning control to extreme counter-clockwise position

- Feed a 465-megacycle AM signal UHF Tune antenna terminals through a resistive matching net work. The input impedance of the tuner is 300 ohms balanced. Adjust oscillator trimmer (C3) for maximum signal. (Use non-metallic alignment tool.) (When using a VHF signal generator, a fundamental of 93 megacycles may be employed to produce the 5th harmonic energy of 465 megacycles.)
Set signal generator for a00-mesise position (5th harmonic of 180 megacycles). Carefully spread or pinch together the legs of the oscillator end-inductor (L3) for a maximum sienal.

5 - Repeat above steps until no further improvement in gnal is apparent. (The oscillator alignment igures of 465 and 900 megacycles are only approximate, and may not fall precisely at the maxi num dial settings; however, in every case the ascillator must be aligned so that both frequencies an be tuned by normal
R.F. ALIGNMENT

1-Adjust UHF channel tune control to extreme counter-clockwise position.

- Feed at 465 -me gacycle signal into the converter scillator alignment).
3 - Adjust R-F trimmers ( $\mathrm{C} 1 \& \mathrm{C}_{2}$ ) for maximum signal.
4 - Readjust tuning control to extreme clockwise position.
5 - Set signal generator for 900 -megacycle output. 6 - Adjust end-inductors (L1\& L2) for maximum signal. 7 - Repeat above steps until no further improvement in signal is apparent.
PICTURE TUBE HANDLING PRECAUTIONS
The pleture tube encloses o high vocuum ond with the orge surfoce oreo of gloss involved, the stresses sel up, porticulorly at the front rim of the tube, ore considerable. An obnormal hondling stress, oceidentol blow o highly stressed surface, or even o scrotch on the with destructive violence.



The safety glass of this receiver is removable so that the face of the picture tube may be cleaned. To accomplish this remove power cord from wall socket. Remove the upper and side strips that hold the safety glass in place by removing the three screws which secure each of the strips, supporting the safety glass so that it does not fall forward. Remove the safety glass by tilting it forward and lifting it out of the slot found in the top edge of the
control panel. Be careful not to scratch or strike the surface of the picture tube with any object. Carefully clean face of picture tube and the inside surface of the safety glass with a soft, clean, dry cloth. DO NOT ATTEMPT TO REMOVE THE PICTURE TUBE MASK. Reassemble by inserting lower edge of glass in slot. Replace upper and side strips and tighten the screws securely.


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CHASSIS 821-10

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Aligning a television receiver is an exacting procedure and involves the use of bench space, test equip the cost of making two trips to service shop, as well as fore deciding that the chassis must be pulled and aligned at the shop, the serviceman should check these ver common sources of trouble:

1 - The antenna and installation.
2 - Front panel and rear chassis controls, including
3 - Heception on all available channels.
4 - Tube failures. Substitute from your kit of known good replacements.
5 - Visual inspection of underside of chassis for bbious faults, such a loose connections, et

TEST EQUIPMENT REQUIRED FOR ALIGNMENT
The equipment specified below is desirable, but in cases where this equipment is not available, it is possible to align the receiver by use of a 20 to 30 mc . modulated dication of aligument.

1 - Signal Generator with an output variable between 100 and 100,000 microvolts, and crystal co rolled or crystal-calibres
a- 4.5 megacycles
b- 22.8 megacycles
c- 25.4 megacycles
d- 21.25 megacycles
2 - DC Vacuum Tube Voltmeter with 5 volt and 10 volt scales.
3 - A pair of balanced ( $\pm 1 \%$ ) 100 K carbon resistors. TEST EQUIPMENT REQUIRED FOR SWEEP ALIGNMENT CHECK

1-R-F sweep generator with frequencies ranging from 40 to 220 megacycles, having sweep widt of approximately 10 megacycles, and having ad justable output to approximately 0.1 volt

2 - Crystal-controlled or crystal-calibrated markers for the picture and sound carriers of each channel.

3 - Cathode Ray Oscilloscope with good low frequency response.

CAUTION: THE SECOND ANODE LEAD TO THE PIC ture tube has a hich potential. during this ALIGNMENT IT IS ADVISABLE TO REMOVE THE HOR ZONTAL OUTPUT TUBE FROM ITS SOCKET, THUS Liminating this high vol tace hazard

## I.F. ALIGNMENT PROCEDURE

1-Connect "high" lead of signal generator to the est point located on the top of the BF tuner unit (Refer to the R-F tuner location diagram located on inside of cabinet). Connect ground to

- Connect DC VTVM lead (through 10K isolating resistor) to 4.7K diode load resistor (R113): ground to chassis. Set VTVM to 5 volt scale negative polarity.

3-Set I.F. generator to 25.4 me gacycles with sufficient output to read approximately 3 volts on the VTVM.
4 - Carefully adjust L101 and L104 (see tube and tuner location) for maximum deflection on VTVM. Adjust sweep generator output to keep meter reading approximately 3 volts.
5 - Set I.F. aignal generator to 22.8 megacycles with sufficient output to read approximately 3 volts on the VTVM.

6 - Carefully adjust L404, L103 (see tube and tuner location) for maximum deflection on VTVM. Adjust signal generator output to keep meter reading approximately 3 volts.

7 - Set I.F. signal generator to 21.25 megacycles, set VTVM to 10 volt scale (negative polarity), and adjust signal generator output for convenient deflection on VTVM.

8 - Adjust L114 for minimum deflection on VTVM. SWEEP ALIGNMENT CHECK
Although not essential, a sweep alignment check is a desirable verification of good R-F and I.F. response. Proceed as follows:

1 - Connect R-F sweep generator to antenna ter-
minals (antenna impedance 300 ohms.)
2-Calibrate oscilloscope for convenient 5 volts peak-to-peak vertical deflection ( 5 volts peak-
to-pak is approximately $1 / 4$ of the peak-to-peak to-peak is approximately $1 / 4$ of the
voltage of the $6.3 V$ A.C. filanent).

3 - Connect vertical input of oscilloscope (through 10 K isolating resistor) to 4.7 diode load resisto (R113); ground to chassis. Connect horizontal in put of oscilloscope to "scope" terminals of R-F generator; adjust for convenient horizontal sweep.

4 - Set R-F sweep generator to channel 3, television receiver to channel 3 , and if necessary, adjusi sweep generator output, sweep width, and scope horizontal setting for convenient band-pass display having 5 volts vertical deflection as pre-
viously calibrated. (af you must touch scope vertical settings during these adjustments recalibrate scope for 5 volts peak-to-peak as in step 2 above).
5 - Couple crystal-controlled R-F carrier markers FINE TUNING control till video carrier marker is $1 / 2$ down on curve. Turn up marker output till R-f sound carrier is visible on bandpass and ad ust sound trap (L114) to minimize effect of sound arrier marker.

6 - Check all channels as above.

1-Connect 4.5 megacycle signal generator to pin of 12BH7 (V7) video amplifier.

2 - Connect DC V.T.V.M. lead to pin 7 of 6 AL5 (V9) ratio detector, negative polarity
3 - Adjust signal generator to precisely 4.5 megacycles; adjust out
volts on V.T.V.M.
4 - Adjust L113 and bottom of T100 for maximum deflection on V.T.V.M. Keep V.T.V.M. reading be-

- Attach two series-connected $100 \mathrm{~K}( \pm 1 \%)$ resistors across R126 (Ratio Detector Load Resistor). Connect DC. V.T.V.M. to center-tap of 100 K resistors,
and connect ground wire of V.T.V.M. to junction of C119 and C120 (Audio Take-Off of T100).

6 - Adjust top of T 100 for zero reading on V.T.V.M. between a plus and a minus peak.

## video amplifier trap

When necessary, the video amplifier 4.5 mc trap (Ll10) should be adjusted as follows

1-Connect 4.5 mc signal generator "high" lead to picture tube grid; ground to chassis.

2 - Connect DC V.T.V.M. to pin 7 of 6ALS (Va) ratio detector, 10 volt scale, negative polarity
3 - Adjust L110 for minimum deflection on V.T.V.M.

## R-F OSCILLATOR

If all channels are not within range of FINE TUNING control, adjust two screws located in front of r-f tuner Do not touch adjustments on top of r-f tuner unit, other Do not touch adjustments on top of r-1 tuner unit, other
than converter plate coil, L404, during IF Alignment.
horizontal oscillator alignment
If the Horizontal Hold control fails to maintain sync, the horizontal oscillator should be reset. To reset this screwdriver adjustment, set the horizontal ho with the horizontal A.F.C. adjustment screw. Check the hold control ction on various channels and alter the screw adjustmen required to provide sync on all channels.




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300 SERIES CAPACITOR
101 PE190-133 Mica, $270 \mathrm{mmf} 500 \mathrm{~V} \pm 10 \%$, 1500 mm GMy
 Ceramic, Single Dioc 1500 mmf GMV
ELectrolytic, Imfd Sov
Ceramic, Shielded Dual Disc 5000 mmf GMV Mica, 510 mmf 500V $\pm 10 \%$
Mica, 22 mf 500 t
M
$\qquad$




Paper, 02 mid $600 \mathrm{~V} \pm 20 \%$
Paper, 05 mmd 600 V
Paper, 0101 mfd 600 V
$\pm 20 \%$


Ceramic Tubular, $1500 \mathrm{mmf} 350 \mathrm{~V} \pm 107$ (Insul)
Ceramic, Single Dinc 5000 mmf GMV
Electrolytic, $40-40-20-20 \mathrm{mfd} 450 \mathrm{~V}$



$$
\begin{array}{ll} 
\\
5 & \text { Mica, } \\
5 & \text { Paper } \\
5 & \text { Paper } \\
\hline
\end{array}
$$

SChem.
LOC.

## 101

SCHEM.
LOC.
transformers

| art no. | description |
| :---: | :---: |
| $\mathrm{A}_{1202}^{1201} \text { or }$ | Retio D |
| A10109 |  |
| A10106 | Vertical Oachat |
| A10152-1 | Vettical Output |
| ${ }_{\text {AlO }}$ A37 | Horizontal Out |

controls


$$
\begin{aligned}
& \text { SAFETY GLASS REMOVAL INSTRUCTION } \\
& \begin{array}{l}
\text { The safety glase of this receiver is re- } \\
\text { novable so that the face of the Picture }
\end{array} \\
& \text { Tube may be cleaned. Before proceeding. } \\
& \begin{array}{l}
\mathrm{c} \text { arefult } \\
\text { tions: }
\end{array} \\
& \begin{array}{l}
\text { 1- REMOVE THE POWER CORD FROM THE } \\
\text { WALL SOCKET }
\end{array} \\
& \text {-do not attempt to remove the } \\
& \text { PIX TUBE MASK UNDER ANY CIRCUM. } \\
& \begin{array}{l}
\text { 3-bE Careful not to scratch or } \\
\text { STRIEE THE SURFACE Of THE PIC. }
\end{array} \\
& \begin{array}{l}
\text { STRIKE THE SURF ACE OF TH. } \\
\text { TURE TUBE WITH ANY OBJECT. }
\end{array} \\
& \text { 4-CLEAN THE FACE OF THE PICTURE } \\
& \text { THE SAFETY GLASS WITH A SOFT } \\
& \text { CLEAN, DRY CLOTh. } \\
& \begin{array}{l}
\text { Remove upper strip secured by (S) screw s, } \\
\text { Tilt glass formard and lift out of slot of lowee }
\end{array} \\
& \begin{array}{l}
\text { glass retaining strip. Observing the above pre } \\
\text { cautiona, cerefully clean Pis Tube and Safet }
\end{array} \\
& \text { Glass. Reassemble by inserting glass in in slo } \\
& \text { flower strip, replecing upper strip and tighten }
\end{aligned}
$$

CABINET REPAIR PARTS LIST

| part name | $\begin{aligned} & \text { MODEL } \\ & \mathbf{2 2 K 3 8} \end{aligned}$ | Part name | MODEL <br> 22 K 38 |
| :---: | :---: | :---: | :---: |
| Cabinet | PE 60194 | Speaker | PC58121 |
| Trapdoor | ${ }^{\text {PD } 4497}$ |  | ${ }_{\text {PA } 39266}^{10.09}$ |
| Trepdoor, Base | ${ }^{\text {PD }}$ P6498857-13 | Knob, On-Off-Volume | PC39241-1 |
| Reteiner Strip, Upper | PC62410-1 | Knob, Channel Selector | PC 39242-1 |
| Reteiner Strip, Lower | PC 62427 -1 | Knob, Pix Control and AM |  |
| Mack Back Cover | ${ }_{\text {PC6 }}{ }^{\text {PC6 } 62431}$ | Knob, Vermier and Dial Aasembly |  |
|  |  | Record Changer | PC6426-6 |

GZ-bl 39Vd A1 VI8Wก10つ-S85

of trouble: ion of alignment. ent output to read approximately 3 volts on the

Aligning a television receiver is an exacting procedure and involves the use of bench space, test equipment and
skilled personnel at the service shop, as well as the cost skilled personnel at the service shop, as well as the cost
of making two trips to the customer's home. Before deciding that the chassis must be pulled and aligned at the shop, he serviceman should check these very common sources

1 - The antenna and installation.
2 - Front panel and rear chassis controls, including picture tube adjustments.
3 - Reception on all available channels.
4 - Tube failures. Substitute from your kit of known good replacements.
5 - Visual inspection of underside of chassis for obvi-
TEST EQUIPMENT REQUIRED FOR ALIGNMENT
The equipment specified below is desirable, but in ases where this equipment is not available, it is possible oo align the receiver by use of a 20 to 30 mc . modulated r-f

1-Signal Generator with an output variable between 100 and 100,000 microvolts, and crystal controlled orystal-calibrated at the following frequencies:
a. 4.5 megacycles
b. 22.25 megacycles
c. 25.4 megacycles
d. 23.6 megacycles
e. 21.25 megacycles

2 - DC Vacuum Tube Voltmeter with 5 volt and 10 volt scales.
3 - A pair of balanced ( $\mathbf{4}$ 1\%) 100K carbon resistors TEST EQUIPMENT REQUIRED FOR SWEEP ALIGNMENT CHECK

1 - R-F sweep generator with frequencies ranging from 40 to 220 megacycles, having sweep width of approxpuately 10 megacycles, and
2 - Crystal-controlled or crystal-calibrated markers for he picture and sound carriers of each channel preferably 30\% Amplitude-Modulated.
3 - Cathode Ray Oscilloscope with good low frequency response.
4-3 volt bias battery
CAUTION: THE SECOND ANODE LEAD TO THE PICTUK TABE HAS A HIGH POTENTIAL. DURING THIS PLUC FROM ITS SOCKET TBUS ELIMINATING THIS HIGH VOLTAGE HAZARD.

1-Connect"high" lead of signal generator to the test point located on the top of the RF tuner unit (Refer o the R-F tuner location diagram located on the in side of cabinet). Connect ground to chassis. istor) to pin of 6AU6 1 st Video Amplifier (V12), NOTE: If the fine tuning control is at end of range or out of ground
ive polarity. TM.

$$
\begin{aligned}
& \text { Carefully adjust L201 and L203 (see tube and tuner } \\
& \text { location for maximum deflection on VTVM. Adiust }
\end{aligned}
$$ location) for maximum deflection on VTVM. Adjus proximately 3 volts.

5 - Set I.F. signal generator to 22.25 megacycles with sufficient output to read approximately 3 volts o the VTVM.

- Carefully adjust Lll, L202-top (see tube and tune location) for maximum deflection on VTVM. Adjus signal generator output to keep meter reading approximately 3 volts.
7 - Set i-f signal generator to 23.6 mc . with sufficien out put to read approximately 3 volts on the VTVM
- Carefully adjust L205 (see tube and tuner location) for maximum deflection on VTVM. Adjust signal generator out-put to keep meter reading approx mately 3 volts.
Set I.F. signal generator to 21.25 megacycles, set VTVM to 10 volt scale (negative polarity), and adjust signal generator output for convenient defec just signal ge
tion on VTVM
- Adjust L202-bottom for minimum deflection on VTVM. Although not
ald essential, a sweep alignment check is a I.F. response. Pro ceed as follows: ${ }_{1}$ - Connect R-F sweep generator to antenna terminals (antenna impedance 300 Ohms ).
2 - Calibrate oscilloscope for convenient 5 volts peak to-peak vertical deflection ( 5 volts peak-to-peak is approximately $1 / 4$ of the peak-to-peak voltage of the 6.3V A.C. Filament).

3 - Connect vertical input of oscilloscope (through 10 K isolating resistor) to pin 1 of 6AU6 lst Vid. Amp oscilloscope to "scope" terminals of R-F generator; adjust for convenient horizontal sweep.
Connect 3 volt battery positive terminal to chassis negative terminal to ACC buss (see schematic dia gram).

Set R-F sweep generator to channel 3,televisio receiver to channel 3, and if necessary, adjus sweep generator output, sweep width, and scope play (see figure 1) having 5 volts vertical defec plan as previously calibrated. (If you must touch scope vertical settings during these adjustments recalibrate scope for 5 volts peak-to-peak as in step 2 above).
Adjust L205 slightly to even the height of peaks and to obtain an untilted bandpass.

- Couple crystal-controlled R-F carrier markers very loosely to antenna terminals, adjust receiver FIN TONIN control carrier visible on bandpess and adjust sound trap (Lll4) to minimize effect to sound carrier marker. tive polarity.
- Set I.F. generator to 25.4 megacycles with suffici

If all channels are not within range of FINE TUNING If the Horizontal Hold control lails to maintain sync control (as evidenced by inability to eliminate "sound the horizontal oscillator should be reset. To reset this from picture or by poor picture quality), the indivi-screwdriver adjustment, set the horizontal hold control in the center of its range and sync the picture with the hori
zontal A.F.C. adjustment screw. Check the hold - Repeat the set-up as for SWEEP ALIGNMENT ${ }^{\text {zontal }}$ A.F.C. adjustment screw. Check the hold contro

CHECK, steps 1 through 7 .
CHECK, steps 1 through 7 . as required to provide sync on all channels.

- Set FINE TUNING CONTROL to center of range, and with long fiber screwdriver alignment tool, ad(Accessible through the video carrier markers fall $50 \%$ down on curve CAUTION: Do not touch adjustments on top of r-f tuner unit, other than the converter plate unit, Lll during I.F. alignment.


## SOUND ALIGNMENT

- Connect 4.5 mc . signal generator to pin 1 of 6 AU 4.5 mc . amplifier (V13)

2 - Connect DC V.T.V.M. lead to pin 7 of 6AL5 (V15) ratio detector, negative polarity.
3 - Adjust signal generator to precisely 4.5 megacycles adjust output to read approximately 5 volts on V.T.V.M.

4-Adjust L206, L101, and bottom of T102 for maxi mum deflection on V.T.V.M. Keep V.T.V.M. reading below 10 volts at all times.
5 - Attach two series-connected 100K ( $\neq 1 \%$ ) resistors across RC V.T.M. (Ren and connect ground wire of V.T.V.M. to top of C 109 (Audio take-Off of T102).
6 - Adjust top of T102 for zero reading on V.T.V.M. be tween a plus and a minus peak.

VIDEO AMPLIFIER 4.5 mc . TRAP
When necessary, the video amplifier 4.5 mc . trap (L104) hould be adjusted as follows
1 - Connect 4.5 mc . signal generator to pin 1 of 6AU6 1 st video amplifier (V12).
2 - Adjust signal generator output till 4.5 mc . dot pat tern is clearly visible on screen of picture tube.

3 - Adjust Ll04 to minimize the dot pattern.


## ION TRAP AND FOCUS ADJUSTMENT

Following is the proper procedure for adjusting the D ction Yoke, Ion Trap and Focus.
The receiver should be turned on bat not connected to antenna. These steps should then be taken in the follow

- The Deflection Yoke should be moved
ward as possible on the neck of the CRT.
2 - The Brightness control should be turned to maximum (clockwise) and the Contrast control should be turned to minimum (counterclock wise).
3 - The Ion Trap should be rotated and at the same time moved forward and backward to find the position which produces the brightest raster on screen.
4 - The Deflection Yoke should be rotated so that the top and bottom edges of the raster are parallel to the top of the chassis.
5 - The Brightness control should now be reduced (ccw) to a point where the raster is slightly above norma EIGHT, WIIDTH, LINEARITY, AND HORIZONTAL DRIVE
To adjust the overall size and linearity of the picture is almost mandatory that a test pattern transmitted from local station be used. It should also be remembered that areas where more than one station is being received, lightly in size. Thmited from different picture should be made to fill the area outlined by the mask.

1-Starting with the HORIZONTAL DRIVE control (rear of chassis) in extreme counterclockwise posipression near the control clockwise till the combright bar) is eliminated.
2 - The Width and Horizontal Linearity controls (rear of chassis) should be adjusted to give a picture that will fill the mask horizontally, with the minimum of stretching or compression.
3 - The Height and Vertical Linearity controls (both ear of chassic) ahould then be adjusted for alinear picture that will fill the mask vertically.
PICTURE TUBE HANDLING PRECAUTIONS
The picture fube encloses a high vacuum and with the large surface area of glass involved, the strosses set up, perthclarly of the front rim of the tube, are considerable. An mormal hendling stress, accidental blow of a highly
 pube could
violence.
high voltage warning
Operation of this recelver outside the cabinet of with covers amoved involves a shock hazard from the recelver power supplies. Work on the recelver should not be atfompted by anyone who is not thoroughly familiar with the precautions necessary when working on high voltage equipment.


3-ADJUST THE MAGNET SPACING AND ROTATION, TO OBTAIN A STRAIGHT RASTER EDGE. TIGHTEN THE RETAINING SCREW.

## 4-REPEAT (1), (2), AND (3) FOR OPPOSITE EDGE OF RASTER.



The safety glass of this receiver is removable so that the face of the picture tube may be cleaned. To accomplish this remove power cord from wall socket. Hemove the upper strip that holds the safety glass in place by removing the five screws which secure the strip, supporting the safety glass so that it does not hall forward. Remove the safety glass by tilting it forward and lifting it out of
the slot in the lower glass retaining strip. Be careful not to scratch or strike the surface of the picture tube with any object. Carefully clean face of picture tube and the inside surface of the safety glass with a soft, clean, dry cloth. DO NOT ATTEMPT TO REMOVE THE PICTURE TUBE MASK. Reassemble by inserting glass in slot of lower strip. Replace upper strip and tighten the screws securely.


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TELEVISION ALIGNMENT PROCEDURE VHF Aligning a television receiver is an exacting procedur and involves the use of bench space, lest equipment and of making two trips to the customer's home. Before deciding
and that the chasais must be pulled and aligned at the shop, the ecrviceman should chect very common sources
1 - The antenna and installation
2 - Front pantl
2 - Front panell and reer chesstis controls, including
3- Recection on all available channels.

- Tube finilues. Substitute from your kit of known

Visual inspection of underside of chassis for
obvious faulta, such as loose connections, etc. TEST EQUIPMENT REQURED FOR ALIGNMENT The equipment specified below is desirable, but in coses where this equipment is not available, it is possible to align the receive by use of a 20 to 30 mc . modulated r -
signal generator, using the picture end speaker as indication of alignmen.

- Signal Generator with an output vasiable between
100 and 100,000 microvolits, and cryatal controlled or crystal-calibrated at the following frequencies:

- DC Vacuum Tube Vollmeter with 5 volt end 10 voll
$-\AA$ scales.
REQUIRED FOR SFEEP ALIGNMENT COHECK
1 - R-F sweep generator with frequencies ranging from
40 to 220 megecycles, having sweep width of ap
 output to approximately 0.1 volt.
the picture and sound carriers of each channel.
- Cethode Ray Osoilloscope with good low frequency
response.

AUTION: THE SECOND ANODE LEAD TO THE PICTURE CAUUION: The SECOND ANODE LEAD TO THE PICTURE
TUBE HAS A HIGH POTENTIAL. DURING THIS ALIGN. MENT IT IS ADVISABLE TO REMOVE THE HORIZONTAL OUTPUT TUBE FROM ITS SOCKET, THUS ELIMINATI.F. ALIGNMENT PROCEDURE

Connect "high"" Iend of signal Generator to the
VHF antenna. (Tasa point cannot be used for IF
 cille or
2 - Gonnect DC VTVM lead (trough loK ienolating esienor) to 4.7K diode lond resinitor (R113); Eround
to chamaie. Sel VTVM to 5 volt scale, negative polerity.

- Sell.F. generato to 25.4 megsacycles with gufficient
out paf to roed approximetely 3 volss on the VTVM.
Carefully adjuat Liot and Lio4 (see tabe and Caner location) lor maximum deflection on VTVM. Adane swoep genernior outpat to keep meter rend
ing approximately 3 volto.
 oufficient outpot to read appraximately 3 volts on
the VTvM. the VTVM
Cerefolly
Cenetilly edjort L2, LiO3 (see tabe end taner
loction) for maximum deflection on VTVM. Adjuat signal generator osetpat to koep meter rendiag ap-
coximately 3 volte.

 - Adjact Lllt for minimen deflection on VTvM. SWEEP ALIGNMENT CHECK
Although not ensential, a sweep aligument check in a desirable verification
ceed as followa: 1 - Connect
(antenna impedance gen othar

2 - Calibrate oscilloscope for convenient 5 volts peak topeak vertical deflection ( 5 volts peak-i-opealk
is approximately $1 / 4$ of the peak-to-peak voltage of
 - Conect vertical input of oscilloscope (throug
1 ik isolating resistar) to 4.7 K diode load rexisto (H113): ground to chass is. Connect horizonetel inp
of oscilloscope to "scope" terminals of B -F gene

 sweep generator output, sweep width, and scope
horizontal setting for convenient band, pass display horizontal setting for convenient band-pass display
having 5 volts vertical deflection as previously calibrated. (If you must touch scope vertical set-
tings during these adjustments recalibrate scope for 5 volts peak-to-peak as in step 2 above).

- Couple crystal-controlled R-F carrier mathers very
loosely to antenna terminala, adjust receiver FINE TUNING control till video carricr makker FIN down on curve. Turn up makker output till $\mathrm{k}-\mathrm{f}$ sound carrieer is visible on bandpass and adjust sound
rrap (L114) to minimize effect of sound carrier marker.
- Check all cha nnele as bove.
- Connect 4.5 megacycle simal generator to pin 2 of

ratio detector,
- Adjust signal generator to preciaely 4.5 megacycless; adjuat output io read approximately
5 volts on V.T.V.M.
- Adjust L113 and botiom of T100 for maximum do ecion on V.T.V.M. Keep V.T.V.M. reading below
Altach iwo series-connected look ( $\mathbf{1 \$}$ ) resisisors across R126(Ratio Detector Load Resistor). Con-
nected DC V.T.V.M. to center-tap of 100 K resistora, and connect ground wire of V.T.T.M. . 10 junction of Adi9 and Cis (AD Ho Take-Of of Ti00). between a pluas and a minus peak. VIDEO AMPLIFIER TRAP
When necessary, the video amplifier 4.5 mc rap (110) ould be adjumed as follows:

Connect 4.5 mc signal generator "high" lead to
picture tube grid; ground to chasci
picture tube grid; fround to chass is.

- Connect DC V.T.V.M. to pin 7 to 6 ALS (V9) ratio
detector, 10 volt scale, negative polerity.
- Adjust L110 for minimum deflection on V.T.V.M. r-F oscillator
If all chanels are not within range of FINE TUNING coural,
for adiustment of either low or high band. CAUTION: $D_{0}$ not touch adjustments on top of $r$-f tuner unit, other then coorverter plate coil, L 2 . during if Aligment.
horizontal oscillator alignment
If the Horizontal Hold control fails to maintain aync,
the borizontal oscillator should be reset. To reset this screwdive odjustment, set the horizontal hold coourol in the center of tis aige and syne che picture with the bori-
zontal A.F.C. adjustment screw. Check the hold coonrol action on verious channelse and aller the screw adjubsment as required to provide sync on all chanenels.
focus adjustment
Following is the proper procedure for adjusting the $\mathrm{De}^{2}$
floction Yoke, lon Trap and Fucus. The Re, ion Trap end Fucus.
an antenna. These steps shoold then be taken in the fol lowing order:
Lob in charetio 105 3-81706. 105-3-32104 a 105-382 106
1 - The Deflection Yoke ahould be moved as far for
ward as posibible on the neck of the CRT.
2 - The Brightinesn control should be turned
 be turned to minimum (counterclockw wise).
The fon Trap sbould be roated and
- The fon Trap should be roasted and at the sam
time moved forward and backward to lind the posi-
time moved forward and back ward to find the posi-
tion which produces the brightest raster on screen.
- The Deflection Yoke should be rotated so that
the top and botiom edgea of die raster are parallel to the top of the chassis.
The Brighness control should now be reduced
(ccw) to a point where the raster is slightly above normal brilliance.
6- With Brighness ond Conuast controls at normal bassis) lor wellodefined sccaning linee.
IIEIGIT, WIDTI AND LINEARITY
adjust the overall size and linearity of the picture it is almost mandatory that atess paticre cranamiuted from a locel station be used. It should aloo be remembered that in
arens where more than one station is being received, that pictures transmitted foom different stations will very slight-
ly in size. The smallest transmitted picture should be made ty in size. The smalilest tranamitted
to fill the rea outined by the mesk.

The Widtb conirol (rear of H.V. cage) should be ad justed to give a picture that will fill the maak borizonally. The Height and Verical Linearity controls (boou
rear of chassis) should then be adjusted for \& linear picture that will fill the mask vertically.

TELEVISION ALICNMENT PROCEDURE, UHF
 characteristics of original component desigm, physical lay-
out and associated circuitry. Except as asted otherwie out and associated circuitry. Except as stated otherwise in
this procedure, band-pass is not sub ject to serious chenge during Alignement, bowever, replacemean of san componeat within the R-F or I-F circnitu may disurb the bond-pass
characteristics. Accordingly whenever parts within these
 tions of the original componenas muet be duplicued as
closely as poasible. Wires, pats end other accesoris. closely as possible. Wires, pats. and on
must be replaced in their former positions.
 surumenis used for testing VHF sets are usually satiafictict
tory. However, the following inostrumenta are needed;

1 - VHF signal genertor with AM output and a sweep
modalation of at leat 12 megacycles.
2 - Oecilloscope or vacuum tube voil-obmmeter
${ }^{3}$ - An operating VHF teletevision seti. (The latter is sugseased as \& practical amplifier for reisiag the
output sigmal of the converter to output signal of the converter
permita convenient observation.)
picture tube handling precautions The picture tube enclosos o high vocuum and with the
large surface areo of gloss involved the stonses particulorly or the front rim of the tube, ore comss iderobile, An obnormal honding stress, occidental blow of a highly
stressed surface, or even a scratch on the surtace of the tube could cause it to implode or collopse with destruc-
high yoltage warning
Operotion of this receiver outside the cobinot or with
covers removed involves a shock hozord from the receiver power suplies. Work on the receciver should not bo the precautions necassary when working on high voltage

alignment procedure uhf tuner pcsalass
Alignment of the UHF Tuner is a simple procedure since
its bandpass is essentially predetermined by the fixed
 procedure, band-pass is not subject to serious change during
alignment, however, reoplacement of any alignnent, however, replacement,
the R-F or $L-F$ circuits may disturb the beomponent within stirs Accordingly, whenever parts within these circuits are eplaced, elecrical and physical specifications of the origihires, parts mnd other accessories must be replaced in their Tormer positions.

Complicated or specially designed test equipment is not required for practicsl alignment of the Ulif Tuner. Instry
ments used for testing viF sets are usually satisfactory, However, the following instruments are needed
$1-$ VIFF signal generator with AM output

1 - Viff signal generator with AM outpul.
2 - Oscilloscope or sscent
measurement of the relative signal.
The oscillosocope or VTVM should be connected across
TV set vide detector load resistor, R113 The procedure for aligrment consists of the following eps in the suggested sequence giveni

2-
2 ase.
Alignment of R-F circuits
ness. for maximum effective oscillatoh adjustment
1 - Turn drum to extreme CCH position.
2 - Correct the signal generator to the UHF tuner anterna terminals and adjust geeersior for a signal
between 459 and 466 megacycles. If no respone is observed, carefully squegeeze the short ends of th them apart until some frequency within the 459 to 466 mc range produces a reeponse
4 - Swing the signal genc ator thru clock fireque pos sition 894 to 903 megacycles. II itru repeonse fequency wathin this
tange is obe tinel Conge is obained, no adjustrent is necessary. If
response below 894 mc occurs, curefuly squeet response below 894 mc occurs, carefully squeeze
the long ends of the oscillator plates slightly to gether until a signal between 994 and 903 mc pro-
duces a response. If the duces a response. If the output occurs above 903
mc carefully spread the oscillator plates slightly at
the long end. me carefully
NOTE: Only a very slight amount of bending should be re-
quired in any case of incomplete band coverage, as this precision jie.

- Hith the signal generator and VTVM or oscilloscope connected as in the oscillator adjust ment, adjus
the signal generator to 470 mc and tune in this signal on the tuner. (nea
$\xrightarrow{\text { position. }}$
the plates of the to speread apart the short ends of until a maximum response is obtained.
- Set the signal generator to 10 got mc and
tion).
- Squeeze together or spread apart the long ends of the RF tuning conden
response is obtained.
These steps complete the UHF tuner alignment.


300 SERIES CAPACITORS

 19 Tube Tolovision Rocoivor chessis, including rectifiers, for $16^{" \prime}$ rectangular picture tube
20 Tube Tolovision Recoiver chassis, including rectifiers, for $16^{\prime \prime}$ rectangular picture tube
19 Tube Tolevisision Roceoiver chassis, including rectifiors, for $16^{\prime \prime}$ "rectangular picture tube. rectangular tube with provision for 20 Tubo Tolevision AM/FM chassis and rocord changor, 507 ( $6^{\prime \prime}$ rectangular tube with provision for 20 conneecting 507 AM/FM chasssis sond rocord changor. $14^{\prime \prime}$ rectangular picture tube

20 Tube Tololovision Recocoiver chassis, including rectifiers, for $16^{\prime \prime}$ Rectangular tube wlth provision for
20 Tube Tololovision Recoiver chassis, including rectifiers, for $16^{\text {con rectangular tube, with socket for color }}$ 20 adapter connoction. Telovision Recoiver chassis, including rectifiors, for $19^{"}$ round tube, with socket for color adap20 tube connoction. Recevision Recsiver chassis, including rectifiers, for $16^{\prime \prime}$ rectangular tube, with provision for connocting 703 AM/FM chassis and rocord changer, and socket for color adapter. 20 Tube Tolovision Recoiver chassis, including racther,
 20 Tube Tolovision Recoivar chossis, including rectifiers, for $20 "$ rectangula
connocting 703 AMM/FM record changor and sockot for color adapter.
connocting
20 Tube Tolovision Reaceiver chassis, including roctifiers, for 17 "rectangular tube, with socket for color
adapter connoction.

| MODEL | 17M1 | 171 | 1782 | 1787 | 1705 | 17C5-B | 17kI | 1981 | 2081 | $20 \subset 2$ | 20kı | 20 MI |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CHASSIS | 700.96 | 700.96 | 700.96 | 700.96 | 700.96 | 700.96 | 700.96 | 700-40 | 700.93 | 700.93 | 700.95 | 700.90 |
| TYPE | Table | Table | full door Console | Open-face Consolette | Opon-face Consolatte | Opon-face Consolatte | $\begin{gathered} \text { Console } \\ \text { Comb. } \\ 2 / 3 \text { doors } \end{gathered}$ | Opon-fact Consolette | Opon-face Consolette | Console $2 / 3$ door | $\begin{gathered} \text { Console. } \\ \text { Comb. } \\ \text { 2/3 doors } \end{gathered}$ | Table |
| Picture tube | ${ }_{\text {Rect. }}^{17{ }^{7}}$ | $\begin{gathered} 177^{\prime \prime} \\ \text { ect. } \end{gathered}$ | $\begin{aligned} & \mathbf{R}_{\text {Rect }} \end{aligned}$ | $\begin{gathered} 177^{\prime \prime} \\ \text { Rect. } \end{gathered}$ | $\begin{aligned} & 17 " 1 \\ & \text { Rect. } \end{aligned}$ | $\begin{aligned} & \text { Rect. } \\ & \text { Ine. } \end{aligned}$ | $\begin{gathered} 17{ }_{\text {Rect }} . \end{gathered}$ | $\text { Round }_{1901}^{19^{\prime}}$ | $\begin{aligned} & \text { Rect. } \end{aligned}$ | Rent. | 20" Rect. | Ren |
| cabinet | Metal | Mahog. | Mahog. | Mahog. | Mahog. | $\begin{aligned} & \text { Blond } \\ & \text { Wood } \end{aligned}$ | Mahog. Wood | Mahog. | Matiog. | Mahog. | Mahog. | Matal |
| AM/FM Chassis | none | none | none | none | none | none | 703 | nono | none | none | 703 | none |
| $\begin{aligned} & 3 \text { SPEED } \\ & \text { REC. CHANGER } \end{aligned}$ | none | none | none | none | none | none | VM 950 | none | none | none | VM 950 | none |
| BUILTIN ANTENNA | no | yos | yes | yes | yos | y 03 | yes | yos | ves | yes | yos | no |
| ANTENNA INPUT IMPEDANCE | $\begin{gathered} 75 \\ 300 \\ 300 \mathrm{ohm} \end{gathered}$ | $\begin{gathered} 75 \\ 300 \text { orm } \\ 30 \text { ohm } \end{gathered}$ | $\begin{gathered} 75 \\ 300 \text { ormm } \\ \end{gathered}$ | $\begin{gathered} 75 \\ 300 \text { orm } \\ 300 \end{gathered}$ | $\begin{gathered} 75 \\ 300 \% \\ 300 \mathrm{hm} \end{gathered}$ | $\begin{gathered} 7 \\ 300 \text { ormm } \\ 300 \end{gathered}$ | $\begin{gathered} 75 \\ 300 \\ 30 \mathrm{ohm} \end{gathered}$ | $\begin{gathered} 75 \\ 300 \mathrm{ohm}^{2} \end{gathered}$ | $\begin{gathered} 75 \\ 300 \mathrm{orm} \end{gathered}$ | $\begin{gathered} 75 \\ 300 \mathrm{chm} \\ 30 \mathrm{~h} \end{gathered}$ | $\begin{gathered} 75 \\ 300 \text { ormm } \\ \text { ohe } \end{gathered}$ | $\begin{gathered} 75 \\ 300 \mathrm{orm} \\ \hline 00 \mathrm{oh} \end{gathered}$ |
| Speaker | $5{ }^{\prime \prime}$ | $5{ }^{\prime \prime}$ | $10^{\prime \prime}$ | $5{ }^{\prime \prime}$ | $8^{\prime \prime}$ | ${ }^{8 \prime}$ | ${ }^{\prime \prime}$ | $10^{\prime \prime}$ | $8{ }^{\text {8' }}$ | ${ }^{\prime \prime}$ | $10^{\prime \prime}$ | $5{ }^{\prime \prime}$ |
| TOTAL POWER CONSUMPTION (IITv-60 Crc.) | 210 | 210 | 210 | 210 | 210 | 210 | 220 | 210 | 215 | 215 | 225 | 215 |
| AUDIO OUTPUT max. Watts | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Packed weight | 82 | 70 | 125 | 91 | 97 | 97 | 140 | 147 | 110 | 132 | 160 | 97 |
| CAB. WIDTH | 18-15/16 | 18 | 26.5/16 | 201/2 | 22 | 22 | 27 | 27/2 | 231/4 | 27\% | 27/2 | 21\%/ |
| CAB. DEPTH | 20 | 18-1/16 | 281/9 | 19 | 201/2 | 201/2 | 21-5/16 | 22 | 19 | 23.5/16 | 2334 | 21 |
| CAB. HEIGHT | $171 / 2$ | 16-15/16 | 361/2 | 351/4 | 361/4 | 361/4 | 36\% | 39 | 383/4 | 391/2 | 39/2 | 20\% |
| COLOR SOCKET | yos | yos | yos | yos | yos | yos | yes | yos | yos | yos | yos | yos |

GENERAL SPECIFICATIONS OF MODELS

| MODEL | 1271 | 1272 | 12 Cl | 1471 | $\begin{gathered} 16718 \\ 1671 i^{2} \end{gathered}$ | 16 Cl | $16 C^{2}$ | 16.5 | 16 KI | 16M1 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CHASSIS | 700 | 700 | 700 | $\begin{aligned} & 700 \cdot 1, .30 \\ & 700: 10 \\ & 70 \end{aligned}$ | $\begin{aligned} & 700-1,-1 \\ & -100.40 \end{aligned}$ | $\begin{aligned} & 700 \cdot 1 \cdot 10-10 \\ & -96 \end{aligned}$ | $\begin{aligned} & 700 \cdot 10, \\ & 700.90 \end{aligned}$ | $\begin{aligned} & 700.10, \\ & 700.90 \end{aligned}$ | $\begin{aligned} & 700.50 \\ & 700.92 \end{aligned}$ | ${ }_{7}^{700.100}$ |
| TYPE | тabl | Table | Open-face Consolatte | Table | Table | Open-face Consolette | Full-door Consol- | Open-face Consolette | $\begin{aligned} & \text { Console } \\ & \text { Comb. } \\ & \text { C/3 door } \end{aligned}$ | тable |
| picture tube | $121 / 2^{\prime \prime}$ <br> Round | $\begin{aligned} & 121 / 2{ }^{12} \\ & \text { Round } \end{aligned}$ | $\begin{aligned} & 121 / 2]^{\prime \prime \prime} \\ & \text { Round } \end{aligned}$ | $\begin{aligned} & 14^{14 \prime \prime}, \\ & \text { Ret. } \end{aligned}$ | $16^{16}$ | Rect. | $\begin{aligned} & \text { loc" } \\ & \text { lect. } \end{aligned}$ | $\begin{aligned} & 16_{0 c} 0^{\prime \prime} . \end{aligned}$ | Rect. | Rect. |
| cabinet | Mahog. | Mahog. | Mahog. | $\begin{aligned} & \text { Mohog. } \\ & \text { Ex, ixuth } \end{aligned}$ | Mahog. | Mahog. | Mahog. | Mahog. with Escutch. | Mahog. | Matal |
| AM/FM CHASSIS | none | none | nono | none | none | none | none | none | 703 | none |
| 3 SPEED <br> REC. CHANGER | none | none | none | none | none | none | nono | none | VM 950 | non* |
| BUILT-IN ANTENNA ANTENN | yos | yos | yes | yos | yos | yos | yos | yos | yos | no |
| ANTENNA INPUT IMPEDANCE | $\begin{gathered} 75 \\ 300 \text { orm } \\ \text { ohm } \end{gathered}$ | $\begin{gathered} 75 \\ 300 \mathrm{orm} \\ 30 \mathrm{hm} \end{gathered}$ | $\begin{gathered} 75 \\ 300 \mathrm{orm} \\ 300 \end{gathered}$ | $\begin{gathered} 75 \\ 300 \mathrm{orm} \end{gathered}$ | $\begin{gathered} 75 \\ 300 \text { ormm } \\ 30 \end{gathered}$ | $\begin{gathered} 75 \\ 300 \\ 300 \mathrm{omm} \end{gathered}$ | $\begin{gathered} 75 \\ 300 \mathrm{ohm} \\ 300 \end{gathered}$ | $\begin{gathered} 75 \\ 300 \mathrm{r} \\ 300 \mathrm{hm} \end{gathered}$ | $\begin{gathered} 75 \\ \\ 300 \\ \\ \hline 00 \mathrm{ohm} \end{gathered}$ | $\begin{gathered} 75 \\ \text { cor } \\ \text { 300 orm } \end{gathered}$ |
| TOTAL POWER CONSUMPTION ( $117 \mathrm{~V}-60 \mathrm{CYC}$.) | 200 | 200 | 200 | 210 | 210 | 210 | 210 | 210 | 220 | 210 |
| SPEAKER | $5{ }^{\prime \prime}$ | $5 \cdot$ | $5{ }^{\prime \prime}$ | $5{ }^{\prime \prime}$ | $5{ }^{\prime \prime}$ | $10^{\prime \prime}$ | $10^{\prime \prime}$ | $8{ }^{\prime \prime}$ | ${ }^{\prime \prime}$ | $5 \cdot$ |
| AUDIO OUTPUT MAX. WATTS | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| packed weight | 62 | 62 | 94 | 4 | 72 | 88 | 112 | 96 | 139 | 80 |
| CAB. WIDth | 17 | 17 | 181/2 | 18 | 18 | 22 | 26 | $211 / 2$ | 27 | 19 |
| CAB. DEPTH | 18\%\% | 18\% | 20\%4 | 191\% | 19/\% | 201/2 | 22 | 20-9/16 | 21-5/16 | 20 |
| CAB. HEIGHT | 15\%/4 | 15\% | 32\% | 17\% | 17\% | 361/4 | $361 / 2$ | 341/4 | 361/4 | 173/4 |
| COLOR SOCKET | no | no | no | no | yos | yos | yos | yos | yos | vos |


| CHASSIS | 700 | 700-1-2-5 | $\begin{gathered} \text { 700-10-20-90-91-92-93 } \\ 700-40.50-95-96 \end{gathered}$ |
| :---: | :---: | :---: | :---: |
| R.F. AMPLIFIER | VI - 6AG5 or 6CB6 | VI - 6AG5 or 6CB6 | VI - ${ }^{\text {A }}$ G5 or 6 CB6 |
| R.F. CONVERTER | V2 - blb | V2 - bl6 | V2 - 606 |
| 1st I.F. AMPLIFIER | V4 - 6AU6 | $\mathrm{V}_{4}$ - 6 AU6 | V4 - 6AU6 or 6BC5 |
| 2nd !.F. AMPLIFIER | v5 - bav6 | V5 - baub | v5 - baub |
| 3rd I.F. AMPLIFIER | V6 - 6AU6 | v6 - baub | Vb - baub |
| VIDEO DETECTOR | V7A - $1 / 2$ 6AL5 | V7A - 1/2 6AL5 | V7A - $1 / 2$ bAL5 |
| A.G.C. DIODE | V7B - $1 / 2$ 6AL5 | V7B - $1 / 2$ 6AL5 | V7B - $1 / 2$ 6AL5 |
| Ist VIDEO AMPLIFIER | V8 - 6CB6 | V8A - $1 / 2$ 12BH7 | V8A $-1 / 212 \mathrm{BH7}$ |
| 2nd VIDEO AMPLIFIER |  | V8B - $1 / 2128 \mathrm{H} 7$ | V8B - $1 / 2128 \mathrm{H} 7$ |
| RATIO DETECTOR DRIVER | v9 - 6AU6 | V9 - 6AU6 | V9 - 6AU6 |
| RATIO DETECTOR | VIOA - $1 / 26$ 6T8 | VIOA - $1 / 26$ 6T8 | VIOA - 6AL5 |
| AUDIO AMPLIFIER | V10B - $1 / 2$ iT8 | VIOB - $1 / 2$ 6T8 | V21 - 6597 |
| AUDIO OUTPUT | VII - 6V6 | VII - $6 \mathrm{~V}_{6}$ | VII - 6 Vb |
| PICTURE TUBE | V12-12LP4 | $V_{12}$ - 16RP4 | V12 - 16RP4, 17BP4A, 20CP4 |
| D.C. RESTORER \& SYNC CLIPPER | V13A - 1/2 $128 \mathrm{BH7}$ | V13A - 1/2 128 H 7 | $\mathrm{VI3A}-1 / 2 \quad 12 \mathrm{BH} 7$ |
| SYNC AMPLIFIER \& PHASE SPLIITER |  | V13B- $1 / 2128 \mathrm{CH7}$ | V13B-1/2 $128 \mathrm{H7}$ |
| VERT. SWEEP OSC. | V14A - $1 / 2128 \mathrm{LH7}$ | V14A - $1 / 2128 \mathrm{CH7}$ | $\mathrm{V14A}-1 / 2128 \mathrm{H7}$ |
| VERT. SWEEP OUTPUT | V14B-1/2 ${ }^{128 H 7}$ | $\mathrm{VI4B}$ - $1 / 2$ 128H7 | V14B - $1 / 2128 \mathrm{H7}$ |
| HOR. PHASE DETECTOR | VI5 - SAL5 | VI5 - 6AL5 | VIS - 6ALS |
| HOR. SWEEP OSC. | V16-128H7 | $V_{16}$ - 128H7 | V16-128H7 |
| HOR. SWEEP OUTPUT | V17-6896 | $\mathrm{V}_{17} \mathrm{v}$ - 6896 | V17-6896 |
| HI VOLTAGE RECTIFIER | V18 - IX2 | V18 - 1X2 | V18 - 1X2 |
| HORIZONTAL DAMPER | V19 - 6W4 | V19 - 6W4 | V19 - 6W4 |
| POWER SUPPLY RECTIFIER | V20 - 5U46 | V20-5U46 | V20-5U46 |




LOCATION OF OPERATING CONTROLS


391139



OJohn F. Rider

## PARTS REMOVAL

TO REMOVE THE CHASSIS FROM THE CABINET:
1 - Remove the screws holding the back to the cabinet.
2 - Remove the screws holding the antenna terminal strip to the cabinet.
3 - Remove the screws holding the interlock bracket to the cabinet.
4 - Reach into the cabinet from the rear and remove the speaker plug from the speaker socket.
5 - Remove all the knobs from the front of the cabinet by pulling them straight out.
6 - Remove the mounting screws from the base of the chassis. These screws will be found under the cabinet in the table models and under the chassis mounting board in the console models.
7 - Slide the chassis straight out being careful not to hit the picture tube.
8 - To replace the chassis reverse the operations listed above.

## CAUTION:

THE PICTURE TUBE ENCLOSES A HIGH VACUUM AND, DUE TO ITS LARGE AREA, IS SUBJECTED TO CONSIDERABLE AIR PRESSURE. THEREFORE, PICTURE TUBES MUST BE handied with extreme care.
DO NOT OPEN THE PICTURE TUBE SHIPPING CARTON, INSTALL, REMOVE OR HANDLE THE PICTURE TUBE IN ANY MANNER UNLESS SHATTERPROOF GOGGLES AND HEAVY gloves are worn. people not so equipped should be kept at a distance WHILE PICTURE TUBES ARE BEING HANDLED
the large end of the picture tube, particularly that part at the rim of THE VIEWING SURFACE, MUST NOT BE SUBJECTED TO ANY IMPACT, SCRATCH, OR MORE THAN MODERATE PRESSURE AT ANY TIME.
IN INSTALLATION OR REMOVING, IF THE TUBE STICKS OR FAILS TO SLIP SMOOTH. LY INTO ITS SOCKET OR DEFLECTION YOKE, INVESTIGATE AND REMOVE THE CAUSE OF THE TROUBLE. DO NOT FORCE THE TUBE.

FRONT PANEL OPERATING CONTROLS


REAR CHASSIS CONTROLS


## ANTENNA SYSTEM

All models covered in this manual, with the exception of the 16 MI , 17 MI and 20 MI feature a built-in antenna which is shipped connected to the receiver input. In those installations where an external antenna is de sired, it will be necessary to disconnect the built-in antenna from terminals I and 3, (shown below) and hook up the external antenna lead-in as follows:--

1 - Where the external antenna lead-in is 300 ohm ribbon, make connection to Terminals 1 and 3 on the antenna terminal strip, leaving the resistor and lug assembly from terminal
2 hanging free.
2 - Where the external antenna lead-in is 75 ohm coaxial line, connect the center conductor to terminal 1, the shield to terminal 2, and strap the Resistor supplied with terminal 2 between terminal 2 and 3 .

connection for
built- in antemaa


CONECTION FOR 300 OHM


CONMECTION FOR 75 OHM


BOTTOM VIEW - 700 CHASSIS (121/2")



TOP VIEW OF 700-10, 20, 40, 50, 90. 91, 92, 93. 30, 95. 96 CHASSIS


TUBE SOCKET VOLTAGES AS INDICATED ON V.t.V.M. FOR 12½" AND 14" SETS


TUBE SOCKET VOLTAGES AS INDICATED ON V.T.V.M. FOR 16", $17^{\prime \prime}, 19^{\prime \prime}$ AND 20" SETS


> FIG. 16 VOLTAGE CHARTS RESISTANCE TABLE FOR CHASSIS COVERED IN THIS MANUAL


## WAVE FORMS

Ground


OUTPUT OF SYNC. CLIPPER a AMPLIFIER PIN 6 OF VI 3 (TEAT) TO GROUND.
test scope set for vert. pulse rate

5. input to vertical sweep oscillator jct of rat, cub,
to ground.


OUTPut of Vertical sweep amplifier pin of via (12日h7) TO GROUND.

2. OUTPUT OF SECOND VIDEO AMPLIFIER. PIN 6 OF VB (12B HAn to ground.

4. OUTPUT of SYNC. CLIPPER a Amplifier. pin 6 of Vi b (128H7) to ground.

TEST SCOPE SET FOR HORIZ. PURE RATE

6. OUTPUT OF VERTICAL OSCILLATOR R42,C36, TO GROMNO


OUTPUT OF VERTICAL SWEEP TRANSFORMER. GREEN
LEAD TO GROUND

$$
ル
$$

9 input to horizontal phase detector vi (gal 5 )

and ground
 R62. TO GROUND

to ground


3 correction waveshape fed back from horizontal DAMPER TUBE. PIN 3 OF VI ( 6 W 4 ) TO GROUND

4. WAVESHAPE ACROSS A.F.C. HORIZONTAL LOCK CIRCUIT JCT OF LT. CCA2,RST, TO GROUND. SCOPE FREGUENC
15750 CP.

Q John F. Rider

## TELEVISION ALIGNMENT PROCEDURE

Aligning a television receiver is an exacting procedure and involves tying up bench space, test equipment and skilled personnel at the service shop, as well as the cost of making two trips to the user's home. Before deciding that the chassis must be pulled and aligned at the shop, the serviceman should check these very common sources of trouble;
I- The antenna and installation.
$\mathbf{2}$ - Front panel and rear chassis controls, including Picture Tube adjustments.
3 - Reception on all available channels.
4 - Tube failures. Substitute from your kit of known good replacements.
5 - Visual inspection of under side of chassis for obvious faults, such as loose connections, etc.
TEST INSTRUMENTS REQUIRED FOR ALIGNMENT
The equipment specified below is desirable but in cases where the service shop does not have it, it is possible to align the receiver by use of a 30 mc . generator, using the picture and speaker as indication of alignment.

1 - Signal Generator with an output variable between 100 and 100,000 microvolts, and crystal-controlled or crystal-calibrated at the following frequencies;
(a) 4.5 megacycles
b) 23.0 megacycles - See note below
(c) 25.4 megacycles - See note below

NOTE: On some of the models covered in this manual, the I.F. frequencies were 22.8 and 25.2 megacycles. In order to eliminate interference at certain locations, these frequencies were changed to 23.0 and 25.4 megacycles. Except for areas where interference prevents use of 22.8 and 25.2 megacycles, either set of frequencies can be used.

2 - R.F. Sweep Generator having a frequency range from 40 to 220 megacycles with a sweep width of 10 mega cycles, and an adjustable output of at least 0.1 volt, maximum.
3 - Crystal-controlled or crystal-calibrated markers for the sound carrier of each television channel 2 through 13 Picture carrier markers are desirable but not necessary.
4 - Cathode Ray Oscilloscope.
5 - Vacuum Tube Voltmeter-VTVM.
CAUTION: THE SECOND ANODE LEAD TO THE PICTURE TUBE HAS A POTENTIAL OF APPROXIMATELY 12,000 VOLTS. DURING THIS ALIGNMENT IT IS ADVISABLE TO REMOVE THE 6BQ6 TUBE FROM ITS SOCKET, THUS eliminating this high voltage hazard.

## SEQUENCE OF ALIGNMENT

It is recommended that the ratio detector driver be aligned first, followed by the ratio detector, I.F., and tuner align ments in that order unless the location of the misalignment is known

AIDS IN SERVICING:
In addition to step-by-step alignment procedures following, see the instrument connection figures, and voltages and waveshapes charts.

TEST INSTRUMENT CONNECTIONS FOR I.F. ALIGNMENT


FIG. 1A, BEC
TEST INSTRUMENT CONNECTIONS FOR RATIO DETECTOR ALIGNMENT


SIGNAL GENERATOR CONNECTION FOR RATIO DETECTOR ALIGNMENT

v.t.v.m. CONNECTION FOR DETECTOR DRI VER ALI GNMENT.

y.T.V.M. CONMECTION FOR RATIO detector alignment

## RATIO DETECTOR DRIVER AND RATIO DETECTOR ALIGNMENT

In aligning this section of the television receiver, the sound trap must be resonated at 4.5 mc . to separate the sound from the picture information, and the ratio detector transformer must be adjusted to complate balance in the secondary wind(V9). The discriminator transformer is T2, located between the detector driver (V9) and the ratio detector (VIOA). A 4.5 mc . signal is fed into the final video amplifier, and the sound trap and ratio detector are adjusted in proper sequence to obtain Sivna is feadings across the detector plate load resistor R23, as specified in the step-by-step procedure below:

1 - Connect the VTVM across R23, with the positive lead from the meter to the chassis and the negative lead to the other side of R23. On those chassis utilizing a 6T8 tube as the detector VIO, this latter connection will
be at pin 2 of the 6T8. On those chassis utilizing a 6AL5 as the detector, this connection will be at pin 7 be at pin 2 of the big. On those chassis utiilizing a
of the 6AL5. See figure $10 B$ showing these connections.
2 - Connect the signal generator output through a .001 mfd mica capacitor to the junction of $L 5$ and $L 6$ in the Connect the signal generator output through a dirst video amplifier, V8A. Ground the other side of the generator to the chassis. See figure 10A for this connection.
3 - Set the signal generator to 4.5 mc . and adjust its output to provide about 10 volts reading on the VTVM.
4 - Adjust sound trap TI for maximum reading on the VTVM. Two types of sound traps were used in the production of the models covered herein, i.e., a single-ended coil, and a double-ended coil. The single-ended coil
is adiusted from the top, and the double-ended coil, from the bottom, since the top half of this coil is is od used. Both of these coils can be peaked at two points, and the peak point selected should be the one closest to the full counter-clockwise position of the slug. This setting minimizes the possibility of intercarrier buz.
5 - Adjust the top slug on the discriminator transformer T2 for maximum reading on the VTVM.
6 - Connect two 100k resistors across R23 as shown in figure 10 C .
7 - Reconnect the VTVM, running one lead to the junction point of these two 100k resistors, and the other lead Reconnect the VTVM, running one lead to the junction point of these two look resistors, and the other lead
to the tertiary winding lug (pin 6 ) of the discriminator transformer $T 2$. See figure 10 C for these connections.
Adjust VTVM for zero center at 5 volts.
8 - Adjust bottom slug on T2. Note that during this adjustment, a point will be found where the VTVM will swing rather sharply from positive to negative, or vice versa. The correct setting of this adjustment is ob 9 -Repeat steps 4, 5, 6, 7, and 8. This completes the ratio detector alignment.

## IF. ALIGNMENT:

The I.F. alignment of the models covered in this manual is based on peaking one set of I.F. coils at 23.0 mc . and the other set of 1. . coils at 25.4 mc . A signal generator feeds these frequencies to the I.F. strip, and a VTVM connected across the video detector load resistor R16 in proper polarity, serves as a measuring device for this peaking operation,
The pair of 23.0 mc . coils are L40I on the tuner sub-chassis, and L2, located between the second and third I.F. The pair of 23.0 mc . coils are L401 on the tuner sub-chassis, and L2, located between the second and third I.F.
stages. The 25.4 mc . coils are LI, located between the first and second I.F. stages, and L4, located between the third I.F. and the video detector. A recommended step-by-step procedure is given below;

1 - Set front panel "CONTRAST" control $1 / 4$ turn clockwise.
2 - Connect the VTVM in proper polarity across the video detector (V7A) load resistor R16. One connection should be to the chassis, and the other to the junction of shunt peaking coil L6 and RI6. See Figure 9B.
3 - Connect the signal generator through a .001 mfd capacitor to the test loop located between the two tubes on top of the tuner sub-chassis. See Figure 9A.
4 - Inject minus 3 volt bias to A.G.C. terminal on tuner, Figure 13C.
5 - Set the signal generator to 23.0 mc . and adjust its output so that the VTVM shows a reading of 2.5 volts maximum.
6 - Adjust L2 and L401 for maximum reading on the VTVM
7 - Reset the signal generator to 25.4 mc . and adjust its output so that the VTVM shows a reading of 2.5 volts maximum.
8 - Adjust LI and L4 for maximum VTVM reading.
9 - Repeat steps 4, 5, 6 and 7 in sequence to achieve further peak readings on the VTVM. If the VTVM pointer goes off scale, lower the signal generator output accordingly.

TEST INSTRUMENT CONNECTIONS FOR TUNER ALIGNMENT

seep and marker conmections
sCope connection - mote that on $12 \frac{1}{2}$ " 700 Chassis vTA OUTPUT IS positive ano the diode OUTPUT IS TAKEM FROW THE CATHODE

FIG. 11
overall response - antenna to picture detector


FIG. 12
TUNER SUB CHASSIS

trimer location
trimerer location
tuner front view



## R.F. TUNER ALIGNMENT

The alignment of the R.F. bandpass was made at the factory and it is not desirable to readjust it in the field inasmuch as all adjustments must be made by moving and spreading coils. It any adjustment of the tuner must be made, it is recommended that the entire sub-chassis be replaced, and the defective unit returned to the source for repair.
nOTE: BEFORE ATTEMPTING TO ALIGN THE TUNER, it is NECESSARY THAT THE I.F. AMPLIFIER BE CORRECTLY ALIGNED. Sweep I.F. to make sure that it is the tuner and not the I.F. that needs alignment.

## PROCEDURE - LOCAL OSCILLATOR ALIGNMENT

1 - Connect the R.F. sweep generator to the antenna terminals. See Figure IIA. Put 3 volt bias between ground and an $A G C$ terminal.
2 - If the sweep generator is not provided with internal crystal-controlled or crystal-calibrated markers, connect a marker generator to the antenna terminals also. See Figure IIA
3 - Connect the cathode ray oscilloscope across the video detector load resistor RI6. See Figure IIB.
4 - Adjust the R.F. sweep generator for 10 mc . sweep width, with center frequency at approximately 213 mc .
5 - Adjust the marker generator for the picture carrier of channel 13 ( 2 II .25 mc .).
6 - Set the Channel Selector switch to channel 13, with the fine tuning control at the middle of its rotation range.

7 - Turn on the receiver and allow about 15 minutes for it to warm up and stabilize
8 - Set the oscilloscope gain control for a convenient size picture on the oscilloscope.
9 - Adjust the slug in channel 13 oscillator coil until the oscillator pip is at the middle of the picture side of the response curve on the oscilloscope, per Figure 12B.

10 - Set the Channel Selector switch to channel 12 and using the frequencies shown in Figure 14 below, adjust by displacing the channel 12 increment loop until the oscillator pip is at the middle of the picture side of the response curve on the oscilloscope, per Figure 12B.
11 - Repeat operation 10 above using the appropriate frequencies and increment loops for Channel Selector switch settings of $11,10,9,8$ and 7 in that order. This completes the high band oscillator alignment.
12 - Set Channel Selector switch to 6 , and proceed as in 9 above, using the proper slug and frequencies. See Figures 13 and 14 .

| Channel Switch <br> Setting | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Sweep Gen. | 57 | 63 | 69 | 79 | 85 | 177 | 183 | 189 | 195 | 201 | 207 | 213 |
| Marker Gen. <br> Settings <br> (Pix Carrier) | 55.25 | 61.25 | 67.25 | 77.25 | 83.25 | 175.25 | 181.25 | 187.25 | 193.25 | 199.25 | 205.25 | 211.25 |

PROCEDURE - R.F. TUNER BANDPASS ALIGNMENT
Do not attempt to align the RF bandpass unless you find it necessary. The procedure is as follows:

1 - Connect the R.F. Sweep Generator, Marker Generator, and Oscilloscope as in 1, 2, and 3, under R.F. Tune Alignment. Refer to table below for instrument settings for each channel alignment. Put 3 volt bias between ground and AGC.

2 - Set the R.F. sweep generator for 10 mc . sweep width, and its center frequency at 213 mc .
3 - Set the CHANNEL SELECTOR switch to channel 13, and the fine tuning control at the middle of its rotation range.

4 - Turn on the television receiver and allow about 15 minutes for the set to warm up and stabilize.
5 - Set the oscilloscope gain control for a convenient size picture on the oscilloscope.
6 - See permissable response curves, Figure 12. If the response curve on the oscilloscope does not fall within these limits, the picture on the oscilloscope can be made to approach the desirable form by either spreading or compressing the particular coils in the tuner circuit at channel 13 setting. Referring to the 5 decks on the master switch in the tuner, note that the deck nearest the front (shaff) end of the tuner contains those coils regulating the local oscillator, and these should NOT be touched during any bandpass adiustments. On the second, third and fourth decks of the master switch are the coils for the mixer grid, the R.F. amplifier plate, and the antenna coupling transformer, respectively, and the particular coils connected in the circuit for channel 13, on these three rear decks are the ones that should be compressed or expanded to achieve the desired bandpass characteristic. Note that too broad a curve results in loss of sensitivity, and rejection.

7 - Proceed with Channel Selector switch at 12, and with Sweep and marker generators set per Figure 15 below, repeat 6 above to achieve proper curve. Repeat for channel 11 , then 10,9 , etc. When completion of channel 2 is reached, the bandpass alignment is finished.

| Channel <br> Selector <br> Switch | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| R.F. Sweep <br> Gennerator <br> Setting | 57 | 63 | 69 | 79 | 85 | 177 | 183 | 189 | 195 | 201 | 207 | 213 |
| Marker <br> Generator <br> Setting <br> (Sound) | 59.75 | 65.75 | 71.75 | 81.75 | 87.75 | 179.75 | 185.75 | 191.75 | 197.75 | 203.75 | 209.75 | 215.75 |
| Marker <br> Generator <br> Setting <br> (Picture) | 55.25 | 61.25 | 67.25 | 77.25 | 83.25 | 175.25 | 181.25 | 187.25 | 193.25 | 199.25 | 205.25 | 211.25 |

Used with Model 16KI, 17KIAND 20KI Television Receiver


| TUBE | POSITION | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 12AT7 | Oscillator-Converter | 245 | 0 | 4.2 AC | 6.3 AC | 6.3 AC | 245 | -4.5 | 0 |
| 6AU6 | 1st IF. Amplifier | -0.5 | 0 | 0 | 6.3 AC | 250 | 155 | 1.1 | .. |
| 6AU6 | 2nd IF. Amplifier | 0 | 0 | 0 | 6.3 AC | 225 | 160 | 1.2 |  |
| 6SQ7 | AM Detector <br> 1st Audio (AM-FM) | 0 | 0.8 | 0 | 0 | -0.5 | 92 | 6.3 AC | 0 |
| 6AL5 | FM Detector | -1.6 | -1.4 | 6.3 AC | 0 | 0 | 0 | -2.5 |  |



## alignment procedure



The following equipment is necessary to properly align this receiver:

1. AM signal generator with frequency coverage from 455 kc . to 1700 kc .
2. $F M$ or $C W$ signal generator covering the $F M$ band from 87 mc . to 109 mc . and the 10.7 mc . for FM IF alignment.
3. Vacuum Tube Voltmeter (VTVM).
4. Output meter-to match 4 ohms, 5 watts maximum.
5. Insulated alignment screwdriver.
6. Dummy antenna-0.1 mfd. capacitor, 300 ohm carbon resistor and inductive loop (fashioned from several turns of wire).


DIAL STRINGING

## CIRCUIT CHANGES IN PRODUCTION ON CHASSIS 700-10, 20, 30, 40, 50

The following changes were made on the above chassis as production progressed, in order to make certain improvements. They are not retroactive. If you have an early production chassis which does not incorporate the changes below, do not make the change except to correct an actual complaint.
-TO REDUCE RESISTOR FAILURE ON ALL 110.700 SERIES CHASSIS:-
R48 was changed from a IW to a 2 W Resistor, 3.3 K $\pm 10 \%$
2-TO IMPROVE AGC STABILITY:-
C6 was changed from .1 mfd 200 V Capacitor to .25 mfd. 200r.
C9 was changed from .005 mfd .600 v to a Ceramic $22 \mathrm{mmf}, 600 \mathrm{v} . \pm 20 \%$.
R 77 - a Resistor $(270 \mathrm{~K}, 1 / 2 \mathrm{~W} \pm 10 \%$ ) was added be
twe Cathode of the Picture Tube and the arm of the brightness control.
3-TO IMPROVE VERTICAL SWEEP LINEARITY AND OPERATING POIN
OUTPUT TUBE:-
R49 was changed from 330 ohms to 1,000 ohms. R43 was changed from 3.3 meg ohms to 1.5 meg ohms.
R86 was added ( 3300 ohms $2 W$.) in series with the low end of the vertical output transformer primary. C35 was changed from .01 mfd to .02 mfd . 600 v .
4-TO INCREASE AUDIO SENSITIVITY:-
R20 was removed. junction of R69 and LII was changed to Pin 1 of 12 BH 7 video amplifier.

5-TO IMPROVE IMMUNITY OF VERTICAL TRIGGERING TO NOISE:-
C16 was changed from .01 mfd to .05 mfd , 600 v on all $16^{\prime \prime}$ and 19" chassis.
R26 was added 13900
R26 was added ( 3900 ohms $1 / 2 \mathrm{~W} \pm 10 \%$ ) between
6-TO INCREASE RANGE OF CONTRAST CONTROL ON ALL 16 CHASSIS:-
R10 was changed from 2.2 meg ohms to 1 meg.
R76 was changed from 1 meg ohm to 3.3 meg ohms.
7-TO IMPROVE HORIZONTAL LINEARITY ON ALL CHASSIS:-
C62 was changed from .1 mfd 600 v to $.05 \mathrm{mfd}, 600 \mathrm{v}$. C50 was changed from .25 mfd . to 25 mfd 12 v ., Electrolytic.
8-TO IMPROVE SYNC STABILITY:On all $16^{\prime \prime}$ Chassis:
R32 was changed from 3.9 k to 1.8 k .
R34 was changed from 3.3 megs to 1 meg.
R83 was added ( 1,000 ohms $1 / 2 \mathrm{~W} \pm 20 \%$ ) between side of Cl 4 and ground.
R17 was changed from 560 ohm to 330 ohm .

## CIRCUIT CHANGES IN PRODUCTION ON CHASSIS <br> \section*{700-90, 91, 92, 93, 95, 96}

The following changes were made on the above $16^{\prime \prime}, 17^{\prime \prime}$ and $20^{\prime \prime}$ Chassis as production progressed, in order to make certain improvements. They are not retroactive. If you have a previous production chassis which does not incorporate the changes below do not make the change except to correct an actual complaint.

1-R66-was removed in Picture Tube high voltage lead This resistor was removed in accordance with revi sion of Underwriters' specifications.
2-R8I-was removed in the Filament Supply of V-14 Design changes in the 1 SHis thbe Filament Supply.
3-Correction of Schematic:
The filament supply for the Tuner Tubes comes direct and no dropping resistor (shown on the Transtorme as R8 is in series filament supply of the Tuner Tubes.
4-Additional Capacitor required because of change Vertical Blocking Osc. Transformer T5: was used instead of A10106. The use of Blocking ransformer A10125 required an additional capacitor $\mathrm{C72-.001} \mathrm{mfd}$ ) between the red lead of this trans former and ground.
5-Changes required to improve Sync. Stability: a) R33 - changed from 270 K to 180 K .
(b) R36 - changed from 2700 Ohm to 3300 Ohm
(c) R82 - An additional Resistor (27K) connected between pins I and 3 of V13.
(d) C 69 - An additional Capacitor (. 002 mfd ) in-

6-Changes in Contrast Control: Some sets were manufactured with the Contrast Confixed resistor R14 in parallel beter, requiring a 1.8 K and ungrounded terminal of PL-a. If a 1.5 K potentiometer was used as PL-a in the chassis, this shunting resistor (R14) was omitted.

7-To Eliminate Horizontal Fold Over: C 61 was changed from .005 mfd 600 Volts to .01 mfd 600 Volts.
8-To minimize feed-back from Antenna on AM/FM TV Combination sets:
Circuit, connected A Capacitor, was added to the of R5 and C4-a.

## SERVICE NOTES

-We are now substituting the contrast and volume control, old part number A24109 (10,000 ohms), with similar control part number A24124 (1500 ohms). When using the new control
The substitution of the control A24124 in place of A24109 (10,000 ohms) is only applicable to our mod ls \#700-90-91-92-93 and 95. These models can easily be identified in the fied by the fact that the con trast control is in the cathode of the Ist video amplifier (V8A). This change is not applicable in th other 700 s
2-To increase vertical sync stability a 002 capacitor should be inserted between the 22,000 ohm re istor and plate (pin \#1) of the sync amplifier and phase splitting tube ( $V-13$ ) as shown in the draw ohm resistor to ground should be removed.
3-To further improve vertical sync stability in strong signal areas, change the 270,000 ohm cathode resisto of $\mathrm{V}-13$ to 180,000 ohms. These changes are now being incorporated in our current production


4-Field complaints have been received of an audio buzz or hum in some chassis of the 700 series due to poor contact of the aquadag coating of the Hytron 16RP4 tubes with the grounding strap. It has been
found that under certain conditions of humidity, the binder used in the aquadag will form a chalky coating which prevents proper contact between the aquadag and the grounding strap.
This can be corrected by carefully washing the area around and under the contact spring, using a cloth moistened with water. After the araa around the grounding spring has been washed and dried, it
should be blackened by the application of graphite from a very soft pencil. should be blackened by the application of graphite from a very soft pencil
CAUTION: The set must be shut off and the high voltage supply discharged when this is done. NO OTHER TYPE PICTURE TUBE SHOULD BE WASHED IN THIS MANNER BECAUSE MOST STAND
ARD AQUADAG COATINGS ARE WATER SOLUBLE AND WOULD
-Hum in the model 16 KI ( 6 way combination) can be corrected by shielding the following 2 leads:
a. There is an orange colored wire running rom the switch on chassis \#
Change this to a shielded wire and ground the shield close to the switch.
b. There is a wire, usually yellow, running from pin \#7 of the socket on the side of the chassis to the chassis. This lead must be shielded and the shield grounded at the end closest to the junction of the ${ }^{\text {two }}$ resistors.
Shielding of these two leads will eliminate or reduce the hum to an extremely low level. Referring to the $700-90$
the vertical sync stability:
a. Add a 27 K ohm resistor from pin \#I to pin \#3 of VI3
b. Change R36 from 2.7 K to 3.3 K ohms.

## Horizontal Foldover

7-When the AFC control is correctly adjusted in the Air King chassis $700-10$ or later series, the picture will fall into horizontal sync instantly when changing from station to station and it should be stable. Sometimes this cannot be done without causing a foldover on either the right or the left side of the picture. When this condition is present, it is an indication of unstable horizontal hold due to incorrect phasing from the transmitter. At certain adjustments of the AFC control the picture will jitter violently. if the foldover is on the left side of the picture or decreased to about IK if the foldover is on the right side of the picture.
8 - Buzzing - A small number of $700-93$ chassis have been shipped which were found to have a con siderable amount of hum or buzz. This can be corrected by putting a shield over the glass 65Q tube, providing the 6SQ7 is of the metal ring base type. (substitution of a metal 6SQ7 will have the same effect).


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| Specifications |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Picture Tube |  |  |  | Tube Complement |  |  |
| Type Dimensions |  | CBS Hytron 19VP22 19-inch round, all glass. Viewing area 205 square inches |  | Symbol | Type | Function |
|  |  |  |  | V1 | 6BZ7 | RF Amplifier |
| Operating Controls |  | Station Selector, Fine and UHF Tuning, Vertical and Horizontal Hold, Contrast, Volume, Tone, Chroma and Hue |  | V2 | 6N8 | Mixer and Oscillator |
|  |  | V3 | 6AF4 | UHF Oscillator |
|  |  | V4 | $6 \mathrm{CB6}$ | lst IF |
|  |  | v5 | 6BC6 | 2nd IF |
| Power Rating |  |  |  | V6 | 6BC6 | 3rd IF |
|  |  |  |  | v7 | $6 \mathrm{CB6}$ | 4th IF |
| Source <br> Consumption |  |  |  | $\begin{aligned} & \text { 105-120 volts } 60 \text {-cycle AC } \\ & 500 \text { Watts } \end{aligned}$ |  | V8 | $6 \mathrm{CL6}$ | 5th IF |
|  |  | v9 | 6AU6 |  |  | Sound IF Amplifier |
| Number of Tubes |  |  |  | 41 tubes plus 3 rectifiers, 2 selenium rectifiers and 3 crystal diodes |  | V10 | 6AU6 | Driver |
|  |  | Vil | 6AL5 |  |  | Ratio Detector |
|  |  | V12 | 6AU6 |  |  | Audio Amplifier |
| Ant. Input Impedance |  |  |  | V13 | 6AQ5 | Audio Output |
| UHF |  |  |  |  |  | V14 | 6CL5 | lst Video Amplifier |
|  |  | V15 | 6AN8 |  |  | 2nd Video Amplifier-Q Phase Splitter |
| Frequency Range |  | 300 ohms balanced |  | V16 | 6AN8 | Band Pass Amp.-Color Killer |
|  |  | Channels 2 through 82 |  | V17 | 6CB6 | Burst Amplifier |
|  |  |  |  | V18 | 6AL5 | Phase Det. |
| Intermediate Frequencies |  |  |  | V19 | 6AN8 | Reactance Tube-3.58 nic Oscillator |
| Video IF <br> Sound IF |  |  |  | V20 | 12AT7 | Horizontal Phase Splitter |
|  |  | 41.25 mc |  | V21 | 6AN8 | 1 Amplifier-AGC Clamp |
| Color Subcarrier Freq. |  | 42.17 mc |  | V22 | 6BY6 | Q Demodulator |
| Adjacent Channel SoundTrap Freq. |  | 39.75 mc |  | V23 | 6BY6 | I Demodulator |
| Adjacent Channel Video |  |  |  | V24 | 6AN8 | I Amplifier-I Phase Splitter |
| Accompanying Channel Sound for less than $10 \%$ distortion |  | 47.25 mc |  | V25 | 12BH7 | Green Adder-Green Output |
|  |  | 41.25 mc |  | V26 | 12BH7 | Blue Adder-Blue Output |
|  |  | V27 | 12BH7 | Red Adder-Red Output |
| Crt High Voltage |  |  |  | 26 kv adjusted |  | V28 | 6BC7 | Green Red Blue DC Restorers |
|  |  | V29 | 6AN8 |  |  | AGC Amp-Horiz. Sync Separator |
| Loudspeakers |  |  |  | V31 | 12AT7 | Vert. Sync Separator-Sync Clipper |
| Size ${ }_{\text {Soil }}$ |  | Two, $61 / 2$ in $\times 91 / 4$ in. speakers 3.2 ohms at 400 cycles |  | V32 | 6BL7 | Vert. Oscillator-Vert. Output |
| Voice Coil |  | 3.2 ohms at 400 |  | V34 | 12AU7 | Horizontal Oscillator |
| Focus |  | Electrostatic |  | V35 | 6CU6 | Horizontal Output |
|  |  |  |  | V36 | 6AU4 | Damper |
| Deflection |  | Electromagnetic |  | V37 | 3A3 | HV Rectifier |
|  |  |  |  | V38 | 3A3 | HV Rectifier |
| Convergence |  |  |  | V39 | 3A3 | HV Rectifier |
| Static Dynamic | PM Magnetic Electromagnetic | PM Magnetic Electromagnetic |  | V40 | 6BD4 | HV Regulator |
|  |  |  |  | V41 | 6BL7 | Convergence sawtooth Gen-Blue conv. Output |
| Cabinet Dimensions |  |  |  | V42 | 6BL7 | Green conv. Output-Conv. Cathode Follower |
| Model | Width | Height | Depth | V43 | 6BL7 | Pulse Shaper-Red. Conv. Output |
| 205CI Console <br> 205C2 Console w/Doors | 3414 | 42-11/16 | 26-1/16 | V44 | 19VP22 | Colorton CRT |
|  | $341 / 4$ | 42-11/16 | 26-15/16 | V46 | 6CU6 | Horizontal Output |

## Warning - High Voltage

potentials as high as 26,000 volts are present when this receiver is operating. operation of the receiver outside the cabinet or with covers removed involves a shock hazard from the receiver power supplies. WORK on the receiver should not be attempted by anyone who is not thoroughly familiar with the precautions necessary when working on high-voltage equipment

The CBS-Columbia Model 205 is an 82 channel VHF-UHF color television receiver employing a CBS-Hytron 19-inch round, direct-viewing Colortron. The receiver utilizes 44 tubes, 2 selenium rectifiers and 3 crystal diodes.

Features of the receiver include: 205 square-inch picture, CBS-Columbia " 360 " Full-Fidelity sound system, wide-band color reproduction, regulated high-voltage supply, five-stage picture i-f amplification, stabilized horizontal and vertical
sweep circuits, 3.58-mc crystal oscillator with afc, slide-out color tube mount, dual-chassis construction, and conveniently located service controls.

## Installation

## Antenna

The antenna requirements for color reception are somewhat more critical than for black-and-white reception. In general, outdoor antennas are pre ferred. The antenna used must have a flat response over the frequency range of the color channel being received, and the transmission line must be properly matched to the antenna and the receiver input ( 300 ohms).
Antenna orientation is more critical. Some antenna positions may provide black-and-white reception but no color reception. The antenna should be oriented for best color reception while receiving a color program. Where several stations are received from different directions an antenna rotator may be required.
Multiple antenna installations, particularly those employing distribution amplifier systems, may not provide satisfactory color reception. If such an in stallation is to be used, modification of the system may be required.
Many TV boosters do not have sufficient bandwidth for color reception. If a booster is to be used it should be checked to insure adequate results.
An antenna specially designed for color reception is available from your CBS-Columbia Distributor.

## Unpacking

The receiver and the color picture tube assembly are shipped in separate cartons. All controls are adjusted and the components on the neck of the picture tube are properly positioned at the factory. To avoid the need for complete adjustment of the receiver, the controls and the CRT components should not be disturbed during the unpacking and installation of the receiver.

The following procedure should be used to prepare the receiver for operation:

1. Remove the receiver and picture tube assembly from their cartons.
2. Remove the cabinet back cover.
3. Remove the staples fastening the CRT cup to the cabinet shelf.
4. Insert the rear end of the cup into the large hole in the back cover, from the front side of the cover. Tap the front edge of the cup with a mallet until it snaps into place.
5. Remove the four bolts fastening the picture-tube assembly to its shipping pallet and discard the pallet.
6. Slide the picture tube assembly carefully into place on the cabinet shelf and position it so that the picture-tube screen is properly centered and flush against the mask.
7. Insert the four bolts removed in step 5 through the slots in the picture-tube mounting board into the holes in the cabinet shelf, and tighten.
8. Insert the Field Neutralizing, Yoke, and Conver gence Assembly plugs into theic sockets on the deflection chassis. Connect the CRT high-voltage Connector to the deflection chassis high-voltage lead, insert the Video Output plug into its socket on the signal chassis, and fasten the CRT socket to the base of the picture tube.

## Initial Adjustment

After the receiver has been unpacked and installed, an initial check of performance should be made to determine whether or not the receiver requires adjustment. The room lighting should be subdued during the performance check.

The following procedure should be used:

1. Connect an antenna to the receiver and apply power.
2. Turn the set on and tune to the channel which provides the strongest signal available.
3. If overload occurs, adjust the AGC control. The customer control panel must be removed to provide access to the AGC control. Removal of the panel is described in steps 4 and 5 of the paragraph on Service Controls.
4. Check the action of the HORIZONTAL HOLD control and adjust the AFC (front of deflection chassis, Fig. 2) if required.
5. Check the size, linearity, and centering, and adjust if necessary.
6. If a drive line (bright vertical line near center of picture) is observed, turn the HORIZONTAL DRIVE control fully clockwise, then counterclockwise until the line just disappears.
7. Adjust the BRIGHTNESS and CONTRAST controls for a normal picture, then rotate the BRIGHT. NESS control throughout its range. If variation in picture size is noted at normal brightness settings, perform the High-Voltage Adjustment procedure. Note: The picture size should remain constant over most of the BRIGHTNESS control range. Loss of regulation, (indicated by a sudden increase in picture size) near maximum brightness setting, is normal. The BRIGHTNESS should always be operated within the range of regulation.
8. Adjust the BRIGHTNESS and CONTRAST controls for a normal picture. If two or three severely misregistered color images are observed, adjust the Static Convergence Magnets as described in steps 1 and 2 of the Convergence procedure.
9. Turn the CONTRAST control fully counterclockwise and the BRIGHTNESS control fully clockwise. The raster should be a a uniform dim neutral gray without signs of color contamination.
10. If the entire screen shows a uniform coloring, other than neutral gray, adjust the SCREEN controls (Fig. 2) as described in steps 2, 3 and 4 of the paragraph on White Adjustment.
11. If only portions of the screen show coloring in step 9, turn the CONTRAST, BLUE SCREEN and GREEN SCREEN controls fully counterclockwise and the BRIGHTNESS control fully clockwise. Set the RED SCREEN control for a barely visible red raster and adjust the FIELD NEUTRALIZING control for a pure red raster without signs of color impurity. If a pure red raster cannot be obtained, perform the Purity Adjustment Procedure.
12. Perform the White Adjustment procedure.


Fig. 1-Signal chassis front controls. 13. Adjust the BRIGHTNESS and CONTRAST controls for a normal picture. If severe misregistration is observed near the edges of the picture, perform the complete Convergence procedure.
14. Tune to a station transmitting a color signal, or a black-and-white signal with a color stripe. The color stripe is a narrow vertical bar (yellowishgreen in color) appearing at the left and right edges of the picture. To synchronize the color circuits when receiving the stripe adjust the AFC
control (Fig. 2) so that the picture moves to the left, placing the left-hand stripe in the horizontal blanking internal.
15. Adjust the HUE and CHROMA controls for proper hue and saturation.

## Service Controls

Access to the service controls and adjustments may be obtained as follows:

1. Remove the cabinet rear cover.
2. Remove the two large bolts located at the upper right and left hand corners of the cabinet back.
3. Pull the cabinet top back about two inches, toward the rear of the cabinet, and lift it off the cabinet.
Note: The receiver is provided with a Top Interlock, located directly above the customer controls. To operate the receiver with the top off, remove the a-c plug from the deflection chassis and apply power directly to the chassis using a space line cord. 4. Remove all front panel knobs.
4. Using a thin screwdriver, unfasten the two clips holding the customer control panel in place and pull the panel away from the cabinet. The clips are located at the bottoms of the holes through which the Channel Selector and Off-On Volume control shafts project.
5. Locate the recessed finger grips on the bottom of the board running across the lower edge of the cabinet front. If the board is held in place by a screw, remove the screw.
6. Grasp the board with both hands and pull it firmly away from the cabinet.

## Color Tube Adjustment Procedure

 Equipment Required1. High-Voltage Meter with a full-scale range of at least 50 KV .
2. White Dot Generator. The generator should supply round dots approximately $1 / 8^{\prime \prime}$ in diameter on a 19 -inch coolr CRT. The Hickock 650C is a suitable instrument.
3. Off-the-air test pattern, or a linearity bar or cross hatch generator. Most dot generators supply a suitable crosshatch pattern.
4. T-Connector for insertion in the high-voltage lead when making measurements.


## High-Voltage Adjustment

1. Turn the set off, open the CRT High-Voltage Connector, ("L" in Fig. 3) and insert a T-Connector in the lead.
Caution: To avoid an electrical shock ground the high voltage before touching the lead.
2. Connect a High-Voltage Meter ( 50 kv range) to the T-Connector.
3. Turn the BRIGHTNESS and CONTRAST controls fully counterclockwise and turn the set on.
4. After allowing sufficient time for the set to warmup, adjust the HIGH-VOLTAGE REGULATOR control (rear of deflection chassis) for a meter reading of 26 kv .
5. Turn the BRIGHTNESS control up to a high level and note the variation in high-voltage. The voltage should not drop more than 500 volts up to the point where loss of regulation occurs. If the BRIGHTNESS is advanced excessively loss of regulation, indicated by marked picture blooming, will occur. The brightness should always be operated within the range of regulation.
6. Turn the set off and disconnect the High-Voltage Meter.
Color Purity Adjustment
7. Connect a Dot Generator to the receiver antenna terminals.
8. Turn the set on and adjust the FINE TUNING BRIGHTNESS, CONTRAST and FOCUS controls for a clearly visible dot display.
Note: The room lighting should be subdued during the balance of the procedure. Set the BRIGHTNESS and CONTRAST controls at the lowest levels that give a clearly visible dot pattern.
9. Adjust the RED, GREEN and BLUE SCREEN controls to make the red, green and blue dots on the CRT screen approximately the same size.
10. Check the physical positioning of the Yoke, Convergence Coil Assembly; Purity Magnet (or coil) and the Blue Beam Corrector. The correct positioning of these components is shown in Fig. 3.
Note: If the above components are not properly positioned it may be impossible to set up the CRT correctly-
11. Adjust the Red, Green and Blue Static Convergence Magnets (Fig. 3) and the Blue Beam Corrector (" $S$ " in Fig. 3) to converge (superimpose) the group of dots, (a red, a green and a blue dot) located nearest the center of the screen. See Fig. 4B for adjustment procedure.
12. Turn the CONTRAST control and the GREEN and BLUE SCREEN controls fully counterclockwise,
and turn the BRIGHTNESS and RED SCREEN controls fully clockwise.
13. Set the FIELD NEUTRALIZING control at midposition.
Loosen the Yoke Positioning Screws ("N" in Fig. 3) and slide the Deflection Yoke back toward Fig. 3) and slide the Deflection Yoke back toward
the base of the CRT as far as possible without he base of the CRT as far as possibly.
ouching the Convergence Coil Assembly.
14. Rotate the Purity Magnet (or coil) around the neck of the tube, increasing the field strength in steps, until a large pure red area is obtained in the center of the screen. Disregard the size of the area -adjust for the purest possible red in the center of the screen.
Note: If the receiver uses a Purity Magnet, the field strength is increased by separating the tabs ( H in Fig. 3) on the magnet. If a Purity Coil is used the field strength is increased by turning the Purity
control clockwise. Use the weakest field that provides satisfactory results.
15. Slide the Deflection Yoke slowly forward on the neck of the tube until the largest uniform red field is obtained on the CRT screen. Lock the Yoke in position.
in position.
Note: The rear surface of the Yoke should be perNote: The rear surface of the Yoke should be per-
pendicular to the neck of the CRT, and the space pendicular to the neck of the CRT, and the space
between the inner surface of the Yoke and the tube neck should be uniform at all points.
16. If a completely uniform red field is not obtained in the previous step, readjust the Purity Magnet (or coil) slightly. If color contamination still exists at the edges of the screen, adjust the FIELD NEU. TRALIZING control to minimize it.
Note: If satisfactory purity cannot be obtained the yoke may be moved slightly out of alignment with the CRT neck to minimize contamination. This


Fig. 3-Picture tube assembly.
should be done only when good purity cannot be obtained as previously described.
12. Turn the RED SCREEN control fully counterclockwise and the GREEN SCREEN control fully clockwise. A uniform green field should be obtained over the entire face of the CRT.
13. Turn the GREEN SCREEN control fully counterclockwise and the BLUE SCREEN contro fully clockwise. A uniform blue field should be obtained over the entire face of the CRT.
Note: If neck shadow, due to improper Yoke positioning, or serious color contamination is noted in steps, 13,14 or 15 , repeat the purity adjustment from step 9.
14. Turn the BLUE SCREEN control fully counterclockwise and the RED SCREEN control clockwise until a barely visible red raster is obtained.
15. Turn up the GREEN SCREEN control until the raster turns yellow.
16. Turn up the BLUE SCREEN control until the raster turns a neutral gray (low-brightness white) Size and Linearity

1. Connect an antenna to the receiver and tune in a station transmitting a test pattern. If a test pattern is not available a suitable bar or crosshatch genera


Fig. 4-(A) Motions of the color dots produced by adjustment of the Red, Green, and Blue Static Convergence Magnets. (B) Procedure for converging group of dots using the Static Convergence Magnets and Blue Beam Corrector.
tor is required for the steps that follow.
2. Adjust the CONTRAST and BRIGHTNESS con trols in the normal manner for a black-and-white picture. Disregard any color fringing or contamination in the picture.
3. Adjust the HEIGHT, VERTICAL LINEARITY, and VERTICAL CENTERING controls to provide a linear picture that extends no more than $1 / 4$ inch above and below the mask opening.
4. Adjust the WIDTH, HORIZONTAL CENTER ING and HORIZONTAL LINEARITY controls to provide a linear picture that extends no more than $1 / 4$ inch beyond the left and right hand edges of the mask opening.

| $\therefore$ | $\circ$ | $\circ$ | $\circ$ | $\circ$ |
| :---: | :---: | :---: | :---: | :---: |
| $\therefore$ |  |  |  |  |
| $\therefore$ | $\circ$ | $\circ$ | $\therefore$ | $\therefore$ |
| $\therefore$ |  |  |  |  |

Fig. 5-Dots along horizontal through center of screen, (A) before adjustment of HORIZONTAL PARABOLA and TILT controls and, (B) after proper adjustment of HORIZONTAL PARABOLA and TILT controls.

## Convergence Adjustments

1. Connect a Dot Generator to the receiver and adjust the BRIGHTNESS and CONTRAST CONTROLS for a low brightness dot display.
2. Adjust the Red, Green, and Blue Static Convergence Magnets and the Blue Beam Corrector (neck of CRT, Fig. 3) until the group of dots nearest the center of the screen is converged (see Fig. 4B) and forms a single white dot.
Note: The objective in this step and those that follow is to position all of the dots on the screen in the form of small equilateral triangles of uniform size, each consisting of a red, a green and a blue dot, as shown in Figs. 5 and 6
3. Adjust the RED, GREEN and BLUE HORIZONTAL PARABOLA controls until all of the triangles along a horizontal line through the center of the screen are as uniform in size and shape as possible (see Fig. 5). Adjustment of the HORI ZONTAL PARABOLA controls causes the triangles at the left and right edges of the screen to decrease in size and those in the center to increase in size. Note: The movement of the dots produced by adjust ment of each of the PARABOLA and TILT control is shown in Fig. 7.


Fig. 7-Motions of colored dots caused by adjustment of PARABOLA and TILT controls. Dotted lines indicate effect of counterclockwise rotation, solid lines indicate effect of clockwise rotation. Effects of PARABOLA controls are shown for rotation from full counterclockwise to full clockwise positions.
4. Adjust the RED, GREEN and BLUE HORI ZONTAL TILT controls to eliminate any nonuni. formity in the triangles along the horizontal line through the center of the screen. Adjustment of the HORIZONTAL TILT controls increases or de HORIZONTAL TILT controls increases or de-
creases the sizes of the triangles at either side of creases the sizes of the triangles at either side of
the raster. They have little effect at the center of the screen. After completion of this step, adjust the Red,

| $\circ \circ$ | $\circ$ |
| :---: | :---: |
| $\circ \circ$ | $\circ$ |
| $\vdots \circ$ | $\circ$ |
| $\circ \circ$ | $\circ$ |
| $\circ \circ$ | $\circ$ |
| $\circ$ | 0 |
| $(1)$ |  |

Fig. 6-Dots along vertical line through center of screen, (A) before adjustment of VERTICAL PARABOLA and TILT controls and, (B) after proper adjustment of VERTICAL PARABOLA and TILT controls.

Green and Blue Static Convergence Magnets to pro vide approximately $1 / 16$ inch spacing between the dots in each triangular group along the horizontal
5. Adjust the RED, GREEN and BLUE VERTICAL PARABOLA controls until all of the triangles along a vertical line through the center of the picture are as uniform as possible (see Fig. 6). Adjustment of the VERTICAL PARABOLA controls causes the triangles at the top and bottom of the screen to decrease in size and those in the center to increase in size.
6. Adjust the RED, GREEN and BLUE VERTICAL TILT controls to eliminate any nonuniformity in the triangles along the vertical line through the center of the screen. Adjustment of the VERTICAL TILT controls causes the triangles at the top and bottom of the screen to increase or decrease in size. They have little effect at the center of the screen 7. The PARABOLA and TILT controls may interact to some extent. As a result, minor readjustment of these controls may be necessary to obtain small, uniform equilateral triangles over as large an area of the screen as possible
8. Adjust the Red, Green and Blue Static Conver gence Magnets, and the Blue Beam Corrector to converge (superimpose) the three dots in the group nearest the center of the screen. Refer to Fig. 4B for
adjustment procedure. With this final adjustment all of the groups of three colored dots should converge simultaneously to form white dots.

## White Adjustment

1. Connect an antenna to the receiver and tune in a tation transmitting a black-and-white program
2. Turn the CONTRAST, BLUE SCREEN and GREEN SCREEN controls fully counterclockwise.
. Turn the BRIGHTNESS control fully clockwise and adjust the RED SCREEN control for a barely visible red raster.
3. Turn the GREEN SCREEN control clockwis until the raster turns a greenish-yellow.
4. Turn the BLUE SCREEN control clockwise until he raster turns a neutral gray (low-brightness white).
. Advance the CONTRAST control to obtain a normal picture.
5. Adjust the BLUE and GREEN GAIN controls until the picture is black-and-white.
6. Turn the BRIGHTNESS control counterclock wise until the picture is just visible and adjust the BLUE and GREEN BACKGROUND controls for neutral gray picture.
7. Run the BRIGHTNESS and CONTRAST controls through their range. If tinting is observed in the picture repeat steps 7 and 8 until it is eliminated.


Fig. 8 Top vien of sigal

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PARTS LIST

| SYM. | Part N O. | description | SYM. | Part NO . | description |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | CAPACITORS | $\mathrm{Cl2}^{2} 2$ | 22017240 | Molded Tubular, 047 mid 400 V 200 |
| C4.4 | 23064640 | Ceramic Disc, 1500 mid 1000V GMV | ${ }_{\text {C122 }}$ |  | Molded Tubular, 0.0047 mld 400 V 20\% |
| C4.5 | 23064640 | Ceramic Disc., 1500 mid 1000V GMV | ${ }_{C 13} 12 \mathrm{l}$ | 21000881 |  |
| ${ }^{\text {c4, }}$ | 23064640 | Ceramic Disc., 1500 mid 1000V GMV |  |  | Eectra50/450/250V |
| ${ }_{\text {C5 }} \mathrm{C} .10$ | 23004640 2306510 | Ceramic Disc., 1500 mfd 1000 CMV | C13-2C | 2100088 | Electrolytic, 40/20/50/20 mid |
| ${ }_{\text {C5.3 }}$ | 23064640 | Ceramic Disce, 1500 mid 1000 V GMV |  |  |  |
| C5.4 | 23064640 | Ceramic Disc., 1500 mfd 1000 V GMV | ${ }_{\text {C14 }}$ | ${ }_{21}^{230006881}$ | Electrolytic $500 / 500 / 20$ mid 25/25/450V |
|  | ${ }_{2}^{23064640}$ | Ceramic Disc., 1500 mid 1000 V GMV | $\mathrm{Cl}_{14}$ | 23065920 | Ceramic Disc., 01 mid 600 V GMV |
| C6. 3 | 23064640 | Ccramic Disc., 1500 mid 1000V GMV | ${ }_{\substack{\text { C144 } \\ \mathrm{Cl4} \\ \\ \\ \text { d }}}$ | 20001370 200000 | Mica, 270 mmfd 5000 |
| C7.1 | 23064640 | Ceramic Disc., 1500 mid 1000 V GM | C14.7 | 23061170 | Ceramic Disc., 33 mmfd 1000 |
| C7.3 | 23064640 | Ceramic Disc., 1500 mid 1000 V GMV | C14.8 | 23060760 | Ceramic Disc |
| C7.4 | 23065510 | Ceramic Disc., $510 \mathrm{mfd} 1000{ }^{\text {d }} 10 \%$ GP | C14.9 | 26000141 | Air Yariable, |
| C7. | 23064640 | Ceramic Disc., 1500 mfd 1000 V GMV | C1410B | 21000881 | Electrolytic, 20/500/500 mfd 450/25/25V |
| C7.6 | 23064640 | Ceramic Disc.. 1500 mid 1000V GMV | ${ }_{C 14} 11$ | 23064640 | Ceramic Disc., 1500 mmidd 1000 V GMV |
| C8.1 | 23064640 | Ceramic Disc., 1500 mfd 1000 V GMV | C14.15 | 23065920 | Ceramic Disc.., 01 mid 600 V GMV |
| C8.2 | 23065510 | Ceramic Disc., $510 \mathrm{mfd} 1000 \mathrm{~V} 10 \%$ GP | C15A-1 | 22017280 | Molded Tubular, |
| $\mathrm{C}^{\mathrm{C} .3}$ | 23064640 | Ceramic Disc., 1500 mid 1000 V GMV | C15A.2 | 22017060 | Molded Tu |
| $\mathrm{C}^{\text {c. }} 4$ | 23064640 | Ceramic Disc., 1500 mfd 1000 V GMV | C15B. 2 | 23060840 | D |
| C8.5 | 23000421 | Ceramic, 1.5 mmid | C15B.3 | 21000672 | Electrolytic., 2 |
| C8.6 | 23064640 | Ceramic Disc., 1500 mfd 1000 V GMV |  |  | , |
| C9.2 | 23065910 | Ceramic Disc., 0055 mfd 6000 GMV | C16A.4 | 23061170 | Ceramic Disc., $33 \mathrm{mmptd} 1000 \mathrm{~V} 5 \%$ NPO |
| C9.3 | ${ }_{23}^{23065990}$ | Ceramic Disc,. 0055 mdd 600 VGMV | C16A.5 | 20003370 | Mica, $150 \mathrm{mmfd} 500 \mathrm{~V} 10 \%$ |
| ${ }_{\text {Cl }}^{\text {C9.4. }}$ | 23064640 23000110 | Ceramic Disc., 1500 mfd 1000 V GMV | ${ }_{\text {Cliber }}$ | 23065920 | Ceramic Disc., 01 mid 600 V GMV |
| C10-2 | 23065910 | Ceramic Disc., 005 mfd 600 V GMV | ${ }_{\text {Cliber }}$ | 22017580 | Molded Tubular, . 0022 mid $600 \mathrm{~V} 20 \%$ |
| C11-1 | 23001670 | Ceramic Tubular, $270 \mathrm{mmid} 500 \mathrm{~V} 20 \%$ | C168.4 | 20003830 | Mica, 100 mmid |
| C11-2 | 23000740 | Ceramic Tubular, $1000 \mathrm{mmid} 500 \mathrm{~V} 20 \%$ | C17-2 | 21000672 |  |
| C11-3 | 22016740 | Moded Tubular, 047 mid $200 \mathrm{~L} 20 \%$ | C17.3 | 23065920 | Ceramic Disc., 01 mid 600 V GMV |
| C11.4 | 23064600 | Ceramic Disc., 470 mmd 1000 V GMV | C 17.4 | 23065930 | Ceramic Disc., 02 mfd 600 V G |
| C11-5 | 21000671 | Electrolytic, 1 mfd 50 V | C17.5 | 23065920 | Ceramic Disc., 01 mid 600V GMV |

-John F. Rider


## INTERMEDIATE FREQUENCY:

Video Carrier - 26.4 mc .
Sound Carrier - 21.9 mc .
Intercarrier Sound - 4.5 mc .
U.H.F. Output - Channels 5 or 6.

DEFLECTION: Electromagnetic
FOCUS: Magnetic (P. M.)
ION TRAP: Single Permanent Magnet
HORIZONTAL SCANNING FREQ.: 15,750 c.p.s
VERTICAL SCANNING FREQ.: 60 c.p.s.
FRAME FREQUENCY: 30 c.p.s
SCANNING: Interlaced, 525 lines.
SPEAKER: 12" Permanent Magnet.
VOICE COIL IMPEDANCE: 3.2 ohms at 400 cycles.

## SOUND ALIGNMENT

1. Connect crystal controlled 4.5 mc .400 cycle a mplitude modulated signal, modulated $30 \%$ or greater, between grid of video amplifier and chassis.
2. Connect high side of scope through detector probe to the junction of R132 and C121 (picture tube cathode, pin me. trap, L111, for minimum 400 cycle deflection on scope.
3. Connect electronic voltmeter to lug 2 of ratio detector, V105, and adjust 4.5 mc . sound take-off (L115) and bot-
m of ratio detector transformer (T102) for peak reading on voltmeter. Adjust the input to make this peak reading 4 volts.
4. Adjust input to obtain 12 volts output. Transfer electronic voltmeter to junction of R135 and R136 (refer to Schebalance on electronic voltmeter.
5. Recheck steps 2, 3 and 4 above.
6. Remove input signal, scope and electronic voltmeter

## I. F. ALIGNMENT

All lead connections from the signal marker generator and sweep generator must be shielded. Keep exposed ends and ground leads as short as possible (about one inch). Always locate the ground lead connections as close as possible to
their respective "hot" leads in the television receiver chastheir respective hot leads in the television receiver chas-
sis. The sweep generator output, signal generator output, and contrast control must be kept low enough to prevent overloading the television receiver circuits.

CAUTION: One side of the chassis is connected to the power line. Therefore, test equipment should not be connected to the receiver unless an isolation transfor mer is used between the power line and
the receiver. DO NOT GROUND THE RECEIVER CHASSIS UNLESS AN ISOLATION TRANSFORMER IS USED.
2. Connect low side of scope lead to chassis and the high side of lead to the 6.3 volt fila ment circuit. This will provid
of 17.6 volts.
3. Adjust scope vertical gain control until the distance between the two horizontal lines equals one-half the peak to peak amplitude of the 60 cycle sine wave,
Leave the vertical gain in this position until the sweep generator attenuator has been set in step" $h$ "

Set channel selector knob to unused channel. Set fine tuning control and contrast control to maximum counterclockwise position. Set noise gate to maximum switch to "Local" position.
C. Remove RF amplifier tube (V1) from socket on VHF tune r .
d. Lift the shield of the Oscillator-Mixer tube V2 sufficiently to clear the socket ground clips. Connect the high side of lead from sweep signal generator to the ungrounded tube shield and the ground side of generato ead to the tuner chassis. Keep leads as short as pos sible (about 1 inch)
. Connect center tap of -4.5 volt variable bias supply to pin 1 of AGC amplifier (refer to sketch of "Variable

To Check I.F. Alignment (on Oscilloscope)
Equipment: Sweep Generator, Marker Frequency Generator, Control Assembly with $41 / 2$ volt battery.
a. Set up vertical gain control on scope to read approximately 8.8 volts peak to peak between arbitrary refe ence lines. This can readily be done as follows.

1. Draw two horizontal lines spaced approximately $3^{\prime \prime}$ apart (depending on size of tube).

Bias Control Assembly"). Connect high side lead of VTVM to the junction of C115, R107 and R110. Connec the common lead to the chassis. Adjust bias control to obtain $-3 v$. DC reading on the meter
. Set generator to sweep from 20 mc . to 32 mc .
. Transfer high side of scope lead to top of R116. Adjus he output of the sweep generator to obtain curve on scope of approximately 10 voits peak to peak. (Exces sive inpul will overlcad the circuit and cause distortion
in the wave form. Check for possible overload by tem porarily increasing and decreasing the signal input leve and noting any change in the wave form. Be sure to keep the input level below the overload point, indicated by a flattening of the peak).

Set the marker generator to the various frequencies given ( $20.8 \mathrm{mc}, 21.9 \mathrm{mc}$, etc.) and compare their relative position with those shown on the Nominal Response Curve. (Be sure to keep the marker at the minimum usable ampirtude. Exicessive signal will distort wave
shape.) Slight deviation in shape from the nominal response curve is permissable, but if any great deviation is noted, it will be necessary to re-align the $I F$ amplifie as in section 2. (NOTE: The response curve may vary with the type of sweep equent can be checked by comparing the resultant curve with that observed on a known good chassis.

MODELS F-24CDBH, MH, Ch. 412; F-24CDBU, MU, Ch. 412-1; F-2'/COBH, MH, Ch. 416; F-27COBU, MU, Ch. 416-1 Wनाव Rहतान Hisoyy

## I. F. ALIGNMENT (Cont'd)

 To plus (+) of $41 / 2 \mathrm{v}$. Battery VARIABLE BIAS CONTROL ASSEMBLY
a. Set channel selector switch to an unoccupied channel and the fine tuning control to the maximum counter-clock to 13) will allow easier adjustment of L 10 in step " o ".
b. Set contrast control to the maximum counter-clockwis position. Set noise gate to the maximum counter-clock position.
c. Remove RF amplifier tube (V) from socket on VHF tuner
d. Connect center tap of -4.5 volt Variable Bias Supply to pin \#1 of AGC amplifier (see sketch of "Variable Bia ontrol Assembly "). Connect high side lead of VTVM to the junction of C115, R107 and R110; connect the com-
mon lead to the chassis. Adjust the bias control for meter reading of -3.5 volt DC

Cornect high side of lead from signal (marker) generato through a 1000 mmf . capacitor to $\mathrm{TP}-2$ (wire protruding rom top of tuner hrough the insulatig grommet nex

Traisfer high side lead of VTVM to top of detector load resistor, R116.
g. Set signal (Marker) generator to 24.4 mc and set at tenuator of signal generator to produce a meter deflec-
tion of approximately -2 volts DC. Adjust top of T10 or maximum DC meter reading. (Be sure sweep gen erator is off.) Readjust output from signal generator it necessary to keep meter deflection at -2 volts DC maxi mum
. Set signal gene rator to 22.9 mc and adjust top of L 10 for maximum DC meter indication. Limit meter de
flection to approximately -2 volts $D C$ maximum by adjusting output attenuator on generator.
i. Set signal generator to 21.9 mc and adjust bottom of L103 for minimum DC meter deflection. Input should on meter. (If necessary, IF bias may be reduced for this step.)
j. Repeat steps " h " and " 1 ". Reset blas to -3.5 volts if necessary.
k. Reset IF bias at $\mathbf{- 3 . 5 v}$. Set generator to 25.5 mc and must op meter reaing output attenuator on generator

Reset signal generator to 24.4 mc . Adjust top of $\mathrm{L101}$ for maximum meter deflection. Limit meter reading output attenuator on generator.
m. Reset signal generator to 27.9 mc and adjust the bottom of L101 for minimum DC meter deflection. Signal gennull. (If necessary IF bias may be reduced for this step).
. Repeat steps " 1 " and " m . If blas has been reduced below -3.5 volts, reset to -3.5 volts for step " 1 ".
o. Transfer high side of signal generator lead to TP-1. Set signal generator to 25.5 mc . Set IF bias to - 3.5 Set signal generator to 25.5 mc. Set IF bias to - $\mathbf{i}$. sistor in series with a 1000 mmf capacitor) across L101 making connections to the two lugs on the coil form closest to the chassis. Adjust L10 for a maximum to obtain a usable deflection. Remove Swamping Network.
p. Disconnect alignment equipment.

VHF TUNER OSCILLATOR ADJUSTMENT

A turret type VHF tuner is used on this receiver, and there is an oscillator adjustment for each channel. When the reeach channel on which a station is operating in the area set the Channel Switch to the channel that is to be adjusted Turn the Fine Tuning control to the center of its range tuner shaft, and is accessible through a hole in the front of the chassis after the two VHF tuning knobs have been removed. Use a non-metallic screw driver and adjust the prop tuning point is in the center of the Fine Tuning range.

CHASSIS RRONT VIEW



VHF CHASSIS 412-1 416-1 TOP VIEW
(Tube and Alignment Locations)


VHF CHASSIS 412-1 416-1 BOTTOM VIEW
(Tube Socket and Alignment Locations)

## ALIGNMENT NOTES

CAUTION: This UHF converter unit is used with a VHF receiver that has one side of the chassis connected to the power line. DO NOT CONNECT TEST EQUIPMENT TO ANY PART OF THE RECEIVER OR GROUND THE CHASSIS UNLESS AN ISOLATION TRANSFORMER IS USED BE TWEEN THE POWER LINE AND RECEIVER.
chassis.
In order that the converter will operate with the tunin shaft in maximum CCW* position, it will be necessary to disengage the function switch shaft from the linkage which operates it and manually set the switch to the UHF position. To accomplish this, loosen the two setscrews which secure the arm and hub assembly to the
shaft. Turn the switch clockwise to the UHF position and leave it in this position while aligning
3. Connect the output leads of the UHF converter to the

Reconnect the B+ and filament leads of the tuner to the same points on the VHF receiver from which they were Connected. Connect UHF Converter chassis to B (VHF receiver chassis)
5. Keep all leads as short as possible. One suggested wa of doing this is to mount the UHF converter at righ angles to the TV chassis with one mounting screw Most of the leads on the UHF converter will then be o sufficient length that no additional length will need to b added.
6. Set VHF Tuner to Channel 6.
7. Alignment should be followed in the order shown.

## IF ALIGNMENT

1. Connect an electronic voltmeter or an oscilloscop
across the second detector load resistor.
2. Turn on the power
3. Apply an 82 mc . signal (amplitude modulated if a scope sused) to the crystal terminal (B) at the junction o Cl3 and L9 through the resistor network shown in Sketc

CW = Clockwise
CCW = Counter-clockwise


## SKETCH A-12

4. Adjust plate coil ( T 1 ) and grid coil ( T 2 ) for maximum indication on the electronic voltmeter or scope.
. Disconnect the resistor network from the crystal terminal.

## OSCILLATOR ALIGNMENT

1. With the electronic voltmeter or scope connected across the second detector load resistor, apply a 460 mc . sigantenna terminals through the resistor network shown in Sketch B.
Resistor Matching Network for Osc. \& R.F. Alignment


NOTE - Lood bngith shauld be kepp to on obsodite minimum,
SKETCH 8-12
2. With the tuner shaft at maximum CCW* position, adjust the oscillator trimmer C6 for peak reading on the elec-
tronic valtmeter or maximum tronic voltmeter or maximum indication on the scope frequency).
3. Set the signal generator to 904 mc
4. Rotate the tuner shaft to the maximum CW position and adjust the oscillator end inductor LA up or down for maximum reading on the voltmeter.
5. Open the ground connection on L10 and connect an 0-10 ma. D.C. meter between the open end of the crystal return choke L10 and ground.

## UHF ALIGNMENT (Cont'd)

6. Adjust the oscillator coupling coil L11 for maximum crystal current when the tuner shaft is rotated to th maximum CW position. When operating at normal line voltage ( 117 volts, 60 cycles), the maximum current
should not exceed 5 ma. at any setting of the tuner shaft. When operating at low line voltage ( 105 volts, 60 cycles) the minimum crystal current must not be less than 0.3 ma . at any setting of the tuner shaft.
7. Repeat steps 1 through 4 until maximum reading is obtained.

## R-F CIRCUIT ALIGNMEN

1. With the electronic voltmeter or scope connected across the second detector load resistor of the VHF receiver appiy a 460 mc . signal (a mplitude modulated if a scope is used) to the UHF antenna terminals through the resistor network shown in Sketch B.
2. With the tuner shaft at the maximum CCW position, ad just the antenna trimmer C4 for maximum meter reading or for maximum scope indication.
3. Reset signal generator to 904 mc
4. Rotate the tuner shaft to maximum CW position. Adjust the antenna end inductor L3 by forming larger or smaller

## obtained.

5. Repeat steps 1 through 4 util maximu obtained.
6. Turn the power switch to the "OFF" position.
7. Disconnect the generator, the electronic voltmeter or scope, and the resistor network. Disconnect the 0-10 chassis.
8. Re-engage the toggle coupling in the pin on the arm and hub assembly and tighten the set-screws that secure the collar to the switch shaft.
9. The Function Switch should be checked for proper operation under conditions of customer use. At full CCW must be fully and firmly made and all UHF position contacts must be fully broken. All UHF position contacts must be fully and firmly made and all VHF position contacts must be fully broken, when the tuner shaft is $71 / 2^{\circ}$ or more from full CCW, as tuner shaft is rotated in a
10. Replace the UHF Converter on the VHF receiver chassis


TOP VIEW-UHF Converte

bottom view-uhf Converter


## 412, 412-1, 416 \& 416-1 (See note *)


A), capacitor C146 is connected as shown in Figure 2. The ematic is made in later production sets to eliminate the possi
*Note: Chassis schematic printed here is for chassis coded as follows: 412 (Code D) and 4 also show. Figures 3 and 4 also show circuits used on chassis 412 (Code A \& B), 412-1 (Code A), and 416 (Code A). In later production sets Fig 3) mis. capacitor (see horizontal omitted to reduce horizontal distortion at high samehtness levels. At the same time a 4.7 megohm resistor (see full chassis schematic) was added to im prove sync stability with action

On chassis 412 (Codes A, B, \& C), 412-1 (Code A), and 416 (Code A \& B), the coupling between the Audio Amplifier and Audio Output stages is direct coupling, as shown in Fig. 2. The circuit which appears in later production sets (shown on the complete schematic) is a production change only, not a design im-
$412-1($ Code B)
$416 \quad($ Code C)
$416-1($ Code A)

For circuit variations found in chassis with earlier code letters, see page 20.
 of the AGC switch. provement.
$\left\{\begin{array}{l}\text { R155 } \\ 220 K\end{array}\right.$


|  |
| :---: |

## NOTES:

. ALL VOLTAGES MEASURED WITR AN ELECTRONC VOLTMETER
CONNECTED FROM SOCEET LUG TOCRASSIS.
SUPPLY VOLTAGE 117 VOLT8 BO CYCLE AC.
3. KEIOD
4L CAPACTIANCE VALUES IN MMF.
DN OHMS UNLESS OTHERWSE NOTED.

IN OHMS UNLESS OTHERWSE NOTED.
5. I-104 IS USKD ON 412 \& 410 C CRASSIS.
5. $1-101,1-102,1-103$, USED ON $412-1 \& 418-1$ CHASSS.
7. R165 USED ON $412-1$ \& 418 -1 CHASSIS.
8. 168 USED ON 412 \& 416 CFASsRs.
8. R186 USED ON $412 \& 418$ CFASSBS. 10. R202 USED ON 412 \& 412-1 CRASSE.


## SCHEMATIC WIRING DIAGRAM-CHASSI.



On chassis 412 (Code A \& B), 412-1 (Code A), and 416 (Code change from this circuit to that shown in the full chassis sc'

Chassis 412 (Codes A, B \& C), 412-1 (Code A) 416 (Codes A \& B )

CODE LETTER CHANGES

## CHASSIS 412, 412-1, 416 \& 416-1

IMPORTANT
Chassis 412 (Code A) and 412-1 (Code A) are furnished with a double cathode 6CD6G tube. In all later models a single cathode type 6CD6G is used. It has since been found that some manufacturers single cathode types will not perform as satisfactorily as those tubes used in factory production. Therefore, when replacing the 6CD6G in these chassis, use only the double cathode type. Crosley Service Parts Department will stock only 6CD6G's with double cathodes.

Chassis 412 (Codes A \& B), 412-1 (Code A)


TO TIOB
Fig. 1
Chassis 412 (Codes A 8 B), 412-1 (Code A)
In these chassis, R 202 is omitted in the screen circuit of the 6 CD 6 G . It is added in later production chassis to reduce excessive high voltage.


Fig: 3

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## I. F. ALIGNMENT

All lead connections from the signal marker generator and sweep generator must be shielded. Keep exposed ends and
ground leads as short as possible (about one inch). Always locate the ground lead connections as close as possible to their respective 'hot" leads in the television receiver chassis. The sweep generator output, signal generator output, and contrast control must be kept low enough to
CAUTION: One side of the chassis is connected to the power line. Therefore, test equipment shoul ot be connected to the receiver unless a power line and the receiver. DO NOT GROUND THE RECEIVER CHASSIS UNLESS AN ISOLATION TRANSFORMER IS USED
To Check I. F. Alignment (on Oseilloscope):
Equipment: Sweep Generator, Marker Frequency GeneraBias Control Assembly with $41 / 2$ volt battery.

POWER SUPPLY:

| WER CON |  |
| :---: | :---: |
| VHF Television Position | 175 w |
| UHF Television Position | 180 watts |
| AM-FM Radio | 65 watts |
| Phonograph Position | 5 w |


| AUDIO POWER OUTPUT: |  |
| :---: | :---: |
| Television | watts maximum |
| Radio or Phonograph | 2 watts undistorted |
| ANTENNA INPUT IMPEDANCE: |  |
| Television | 300 ohms balanced |
|  | 75 ohms balanced |

intermediate frequency (am-FM Chassis) AM - 455 kc.
$\mathrm{FM}-10.7 \mathrm{mc}$

## ntermediate frequency (tV. CHASSIS):

Video Carrier- 26.4 mc
Sound Carrier- 21.9 mc .
Intercarrier Sound- 4.5 mc .
U. H. F. Output-Channels 5 or 6.

DEFLECTION: Electromagnetic.
FOCUS: Magnetic (P. M.)
ON TRAP: Single Permanent Magnet.
HORIZONTAL SCANNING FREQ: 15,750 c.p.s.
VERTICAL SCANNING FREQ: 60 c.p.s.
frame frequency: 30 c.p.s
SCANNING: Interlaced, 525 lines
SPEAKER: 12" Permanent Magnet
VOICE COIL IMPEDANCE: 3.2 ohms at 400 cycles.

Connect center tap of -4.5 volt variable bias supply pin \#1 of AGC amplifier (refer to sketch of "Vari able Bias Control Assembly'). Connect high side都 of VTVM to the junction of C115, R107 and
 meter
Set generator to sweep from 20 mc . to 32 mc .
g. Transfer high side of scope lead to top of R116. Adjust the output of the sweep generator to obtain curve n scope of approximately 10 volts peak to peak. distortion in the wave form. Check for possible verload by temporarily increasing and decreasing he signal input level and noting any change in the aver. Be sure to kep attening of the peak)
h. Set the marker generator to the various frequencies given ( $20.8 \mathrm{mc}, 21.9 \mathrm{mc}$, etc.) and compare their elative position with those shown on the Nominal ind stort wave shape.) Slight deviation in shape from nominal response curve is permissible, but if any great deviation is noted, it will be necessary to -align the IF amplifier as in section 2. (NOTs. quipment used. Such variations due to equipment都 hat observed on a known good chassis.)

## F. Alignment Procedure

(Using Signol Generator and VTVM):
quipment: Signal (Marker) Generator, VTVM (electronic oltmeter, 1000 mmf . capacitor, Swamping Network (see step "0"), Variable Bias Control Assembly with $41 / 2$ volt battery.
a. Set channel selector switch to an unoccupied channel and the fine tuning control to the maximum counterlockwise position. A channel in the upper band lonels adjustment of

Set contrast control to the maximum counter-clockwise position. Set noise gate to the maximum counter-clockwise position.
switch to "Local" position.
c. Remove $\mathbf{R F}$ amplifier tube (V1) from socket on VHF tuner.

nominal overall i. F. response cur
d. Connect center tap of -4.5 volt Variable Bias Supply to pin \#1 of AGC amplfier (see sketc of "Variable Bias Control Assembly"). Con nect high side lead of VIVM to the junction of C115, R107 and R110; connect the common ead to the chassis. Adjust the bias contro for meter reading of -3.5 volt DC.
e. Connect high side of lead from signal (marker) generator through a 1000 mmf . capacitor to TP- 2 (wire protruding from top of tune through the insulaling grommet next to L10). Connect the ground lead to the RF tuner case
f. Transfer high side lead of VTVM to top of detector load resistor, R116.
g. Set signal (marker) generator to 24.4 mc . and set attenuator of signal generator to produce a meter deflection of approximately -2 volts DC Adjust top of T101 for maximum DC mete reading. (Be sure sweep generator is Readjust output from signal generator essary to DC maximum.
h. Set signal generator to 22.9 mc . and adjust top of L103 for maximum DC meter indication Limit meter deflection to approximately volts DC maximum by adjusting output atten uator on generator
i. Set signal generator to 21.9 mc . and adjus bottom of L103 for minimum DC meter deflection. Input should be high enough to per mit a definite null to be observed on meter (If necessary, IF bias may be reduced for this step.)
j. Repeat steps " h " and " i ". Reset bias to -3.5 volts if necessary
k. Reset IF bias at -3.5 v . Set generator to 25.5 mc . and adjust top of L 102 for maximum neter deflection. Limit meter reading to approximately -2 volts DC maximum by adjusting output attenuator on generator

1. Reset signal generator to 24.4 mc . Adjust top of L101 for maximum meter deflection Limit meter reading to approximately -2 volts DC maximum by adjusting output attenuator generator.

## I. F. ALIGNMENT (continued)

o. Transfer high side of signal generator lead to TP-1. Set signal generator to 25.5 mc . Set IF bias to -3.5 volts. Connect the Swamping Network (a 1000 ohm resistor in series with a 1000 mmf . capacitor) across L101 making connections to the two lugs on the coil form closest to the chassis. Adjust L10 for a maximum meter reading. IF bias may be reduced if necessary to obtain a usable deflection. Remove Swamping Network.
p. Disconnect alignment equipment
m. Reset signal generator to 27.9 mc . and adjust the bottom of L101 for minimum DC meter deflection. Signal generator output must be sufficient to produce a definite null. (If necessary IF bias may be reduced for this step).

Repeat steps " 1 " and ' $m$ ". If bias has been reduced below -3.5 volts, reset to -3.5 volts for step "l".


BOTTOM VIEW, CHASSIS 414-1
(Tube and Alignment Location)

## SOUND ALIGNMENT

1. Connect crystal controlled 4.5 mc .400 cycl amplitude modulated signal, modulated $30 \%$ or greater, between grid of video amplifier (pin 1, V109) and chassis
transformer (T102) for peak reading on voltmeter. Adjust input to make this peak reading 4 volts.
2. Adjust input to obtain 12 volts output. Transfer high side of voltmeter to junction of R135 and R136 (refer to Schematic Wiring Diagram). Adjust top of T102 for zero balance on electronic voltmeter
Connect high side of scope through detector probe to the junction of R132 \& C121 (picture tube cathode). Connect low side of scope to chassis. Adjust 4.5 mc . trap, L111, fo minimum 400 cycle deflection on scope.
3. Connect electronic voltmeter to pin 2 of ratio detector tube, V107, and adjust 4.5 mc .6 . Remove input signal, scope and electronic sound take-off (L115) and bottom of ratio voltmeter.


TOP VIEW, CHASSIS 414-1
(Tube and Alignment Location)

## UHF ALIGNMENT

UHF ALIGNMENT（continued）

## ALIGNMENT NOTES：

CAUTION：This UHF converter unit is used with a VHF receiver that has one side of the chassis connected to MENT TO ANY PART OF THE RECEIVER OR GROUND THE CHASSIS UNLESS AN ISOLATION TRANSFORMER IS USED BETWEEN THE POWER LINE AND RECEIVER
Remove the UHF Converter from the VHF receiver chassis．

In order that the converter will operate with the tuning shaft in maximum CCW＊position，it will be necessary to disengage the function switch shaf from the linkage which operates it and manually se the switch to the UHF position．To accomplish this loosen the two set－screws which secure the arm and
hub assembly to the shaft．Turn the switch clock

CW－Clockwise
CCW－Counter－clockwis

## wise to the UHF position and leave it in this po－I．F．ALIGNMENT sition while aligning．

Connect the output leads of the VHF Tuner
4．Reconnect the B＋and filament leads of the tuner to the same points on the VHF receiver from which they were disconnected．Connect UHF Converter 3 chassis to B －（VHF receiver chassis）．

5．Keep all leads as short as possible．One suggested way of doing this is to mound the UHF converter a right angles to the TV chassis with one mounting screw．Most of the leads on the UHF converter wil then be of sufficient length that no additional length will need to be added．

6．Set VHF Tuner to Channel 6.
7．Alignment should be followed in the order shown．
Turn on the power． shown in Sketch A．

Connect an electronic voltmeter or an oscilloscope across the second detector load resistor

Apply an 82 mc ．signal（amplitude modulated if a scope is used）to the crystal terminal（ $B$ ）at the junction of C13 and L9 through the resistor network


SKETCH A

4．Adjust plate coil（T1）and grid coil（T2）for maxi－ mum indication on the electronic voltmeter or scope
5．Disconnect the resistor network from the crystal terminal．

## OSCILLATOR ALIGNMENT：

1．With the electronic voltmeter or scope connected across the second detector load resistor，apply 460 mc ．Signal（amplitude modulated if a scope is istor network shown in Sketch B．


．Open the ground connection on L10 and connect an 0－10 ma D．C．meter between the open end of the $0-10 \mathrm{ma}$ ．D．C．meter between the ope．

6．Adjust the oscillator coupling coil L11 for maxi－ mum crystal current when the tuner shaft is rotated to the maximum CW position．When operating at normal line voltage（ 117 volts， 60 cycles），the max－ imum current should not exceed 5 ma ．at any setting of the tuner shaft．When operating at low line volt－ age（ 105 volts， 60 cycles），the minimum crystal of the tuner shaft．

Repeat steps 1 through 4 until maximum reading is obtained

## R．F．CIRCUIT ALIGNMENT

1．With the electronic voltmeter or scope connected across the second detector load resistor of the VHF receiver，apply a 460 mc ．signal（amplitude modu－ lated in a sch the resistor network shown in Sketch $B$ ．

2．With the tuner shaft at the maximum CCW position， adjust the antenna trimmer C4 for maximum meter reading or for maximum scope indication．

3．Reset signal generator to 904 mc ．
4．Rotate the tuner shaft to maximum CW position Adjust the antenna end inductor L3 by forming larger or smaller loop until maximum reading on the meter（or scope）is obtained．

5．Repeat steps 1 through 4 until maximum reading is obtained．

6．Turn the power switch to the＂OFF＂position．
7．Disconnect the generator，the electronic voltmeter or scope，and the resistor network．Disconnect the $0-10$ ma．meter．，and solder the open lead of L10 to the chassis．
8．Re－engage the toggle coupling in the pin on the arm and hub assembly and tighten the set－screws that secure the collar to the switch shaft

9．The Function Switch should be checked for proper operation under conditions of customer use．At full CCW rotation of the tuner shaft，all VHF po－ sition contacts must be fully and firmly made and all UHF position contacts must be fully broken． All UHF position contacts must be fully and firmly made and all VHF position contacts must be fully rom full CCW as tuner shaft is rotated in a clock－ wise direction．

0．Replace the UHF Converter on the VHF receiver chassis．

ALIGNMENT CHART
For alignment locations see photograph on page 14 and chart on page 19

| ALIGNMENT SEQUENCE | SIGNAL GENERATOR OUTPUT |  |  | POSITION OF |  | ADJUST | $\begin{aligned} & \text { TYPE OF } \\ & \text { SELECTIVITY } \\ & \text { CURVE } \end{aligned}$ | REMARKS |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | FREQUENCY | $\begin{aligned} & \text { IN SERIES } \\ & \text { WITH } \end{aligned}$ | то | FUNCTION SWITCH | TUNING DLAL OR TUN. CAP. |  |  |  |
| 1 | 455 KC | . 05 mfd | V301 grid pin 7 | AM | Open | $A \& B$ | Single peak |  |
| 2 | 455 KC | . 05 mfd | V301 grid pin 7 | AM | Open | $C \& D$ | Single peak | Retouch <br> A \& B |
| 3 | 10.7 MC | . 05 mfd | v304 grid pin 1 | FM | Closed | E | Single peak | $\begin{aligned} & \text { See notes } \\ & 1 \& 2 \end{aligned}$ |
| 4 | 10.7 MC | . 05 mfd | V304 grid pin 1 | FM | Closed | F | --------- | Balance to zero volts Notes $1 \& 3$ |
| 5 | 10.7 MC | . 05 mfd | V303 plate pin 5 | FM | Closed | E \& G | Single peak | See note 4 repeat adj. of $E \& G$ for max. align. |
| 6 | 10.7 MC | . 05 mfd | V303 grid pin 1 | FM | Closed | H | Single peak | Note 4 |
| 7 | 10.7 MC | . 05 mfd | stator center gang section | FM | Closed | $\underset{\&}{\mathbf{J}, \mathbf{K}}$ | Single peak | Notes 4 \& 5 |
| 8 | 98 MC | FM Dummy Antenna | FM Ant. Term. | FM | $\begin{gathered} 98 \mathrm{MC} \\ \text { Mark } \end{gathered}$ | L | -------- | Note 6 |
| 9 | 104 MC | FM Dummy Antenna | FM Ant. Term. | FM | 104 MC | M | --- | Note 7 |
| 10 | 92 MC | FM Dummy Antenna | FM Ant. Term. | FM | $92 . \mathrm{MC}$ | P | ---------- | Note 8 |
| 11 Repeat steps 9 and 10 until no further improvement is noted. |  |  |  |  |  |  |  |  |
| 12 | 1400 KC | 200 mmf . | Ext. Ant. Term. | AM | $\underset{\text { mark }}{1400 \mathrm{KC}}$ | R | ------ | Adjust to peak |
| 13 | 1400 KC | 200 mmf . | Ext. Ant. Term. | AM | 1400 KC | s | ---------- | Note 9 |

## ALIGNMENT CHART NOTES

1. Use an unmodulated signal with generator output of approximately 100,000 microvolts output.
2. Connect an electronic voltmeter across the 27,000 ohm diod esilor, R30.
3. Connect two 100,000 ohm carbon resistors, matched within $2 \%$ in series. Connect resistors across the 4 midd. stabilizing
capacitor, c 320 in the diode circuit.
Connect the electronit capacitor, C320 in the diode circuit. Connect the electronic
voltmeter between the output of the I. F. bypass network, C316 and the midpoint of the two 100 , ou0 ohm resistors. Align secondary core ( $F$ ) of T 303 for zero volts, first using a high scale
on the voltmeter and then switching to the lowest scale for bal ance.
4. Use an unmodulated signal. Connect electronic voltmeter
across the 27,000 ohm load resistor R309. Limit output of sig across the 27,000 ohm load resistor R309. Limit output of sig-
nal generator so that the DC. reading on the voltmeter does nal generator so that the DC. reading on the voltmeter does no
exceed 5 volts. Reduce signal generator output when necessary to hold the 5 volt alignment level. Shift gang capacity slightl to remove interfering spurious FM oscillator signal during FM F. alignment.
5. Remove the two 100,000 ohm resistors and the electronic voltmeter after alignment.
6. Adjust turn spacing on FM oscillator coil by spreading o 8 meging silg so that the 98 megacycle signal falls on the
7. Rock gang while adjusting the FM R. F. trimmer until maximum output meter reading is obtained or align for maximum nois level at zero signal.
8. Adjust turn spacing on FM R. F. coil until maximum outpu meter reading is ob
frequency" setting.
9. Receiver and loop antenna should be in place in the cabine when aligning the antenna trimmer " S " on the loop support

| $\begin{aligned} & \text { SIGNAL } \\ & \text { GE NERATOR } \\ & \text { TERMINALS } \end{aligned}$ | F. m. dummy antenna |  |
| :---: | :---: | :---: |
|  | 39 omm | $\begin{aligned} & \text { DIPOLE } \\ & \text { ANTENNA } \\ & \text { TERMINALS } \end{aligned}$ |
|  | cargon resistors |  |
|  | $\bigcirc \longrightarrow$ |  |

## AM-FM TUNER ALIGNMENT PROCEDURE

NOTE: As the radio dial is mounted in the cabinet, it will be necessary to mark oscillator alignment points on the dial background when the chassisis removed from the cabinet, before proceeding with alignment. II will be noted that the dial background has an indentation
near the eftt-hand end. With the tuning gang in full mesh, set the dial pointed to center over this indentation.
Using the indentation 2 as 2 reference point, measure off $229 / 32$ " to the right and make a pencil mark on the dial background close to the bottom. This mark


1. Connect an isolation transformer between the power line and the power cord of the television receiver.
2. With the radio tuner power and heater cables and the speake connected to the television receiver, set the function
the position indicated on the ALGNMENT CHART.
3. Connect output meter across the secondary of the output transformer or voice coil leads to speaker ( 3.2 ohms ).
4. All Amplitude Modulated Input signals are modulated $30 \%$ at 40 c.p.s. with the high side of signal generator connected to the
receiver as indicated in the ALIGNMENT CHART and the low
side of the generator connected to the receiver chassis.
5. All Frequency modulated signals are modulated $30 \%$ at 400 c.p.s.; $\mathbf{3 0 \%}$
kilocycles.
6. Turn the volume control knob to maximum clockwise position Turn the volume control knob to maximum clockwise position
and adjust signal generator output to produce a noticeable output meter reading. Keep signal generator output as low as
possible to prevent AVC action in the receiver.
7. Alignment sequence must be followed.

VHF OSCILLATOR ADJUSTMENT - A turret type VHF tuner is used on this receiver, and there is an oscillator adjustment for each channel. When the receiver is installed, the oscillator should be adjusted for each channel on which a station is operating in the area. Set the Channel
Switch to the channel that is to be adjusted. Turn the Fine Tuning control to the center of its range. The oscillator trimmer screw is directly to the right of the tuner shaft, and is accessible through a hole in the front of the chassis after the two VHF tuning knobs have been removed. Use a on-metallic screwariver and adjust iscillator trimmer is in the center of the Fine Tuning range


AM-FM SOCKET VOLTAGE CHART


## HASSIS 414 \& 414-1 (Code B)


:HASSIS: 414 (Code A) 414-1 (Code A)


## EPLACEMENT PARTS LIST <br> VHF Tuner (see note)

| ription | $\begin{aligned} & \text { 8ymbol } \\ & \text { No. } \end{aligned}$ | Part No. | Description |
| :---: | :---: | :---: | :---: |
| Feed Thru | 15 |  |  |
| t., disc ceramic | 180 | 156908-* | R. F. \& Oscillator Coll Assembly |
| '1008, disc ceramic | L8 | 156906-51 | Choke, Filament, Mixer |
| ., Trimmer, ceramic | L9 | 156906-52 | Choke, Plate, Mixer |
| disc ceramic | L10 | 156906-53 | I. F. Assembly |
| $\because$ Trimmer, ceramic | 1 |  | R. F. Amplifier (V1) |
| , $\pm .25 \mathrm{mmi}$., | 2 |  | Mixer Oscillator (V2) |
| $\pm .25 \mathrm{mml} .$, | 3 | 156906-23 | Tube Shield (V1) |
|  | 5 | -156906-24 | Tube Shield (V2) |
| $\pm .25 \mathrm{mmt}$., | 6 | 156906-28 | Shield (Bottom) |
|  | 7 | 156908-27 | Roller, Detent |
| ${ }^{\text {ing }}$ 10\%, disc ceramic | 8 | 156906-28 | Spring, Detent |
| 10\%, disc ceramic | ${ }^{9}$ | 156906-29 | Spring, Shaft Retaining |
| 5\%, disc ceramic | 10 12 | $156906-29$ $156906-32$ | Spring, Shaft Retaining Plate, Fine Tuning Grounding |
| , 10\%, disc ceramic | 13 | 156908-33 | Plate, Fine Tuning Grounding |
| , Trimmer, ceramic | 14 | 156906-54 | Fine Tuning shatt Assembly |
| , Feed Thru <br> , Feed Thru | 15 | 156906-35 | Ceramic Bushing \& Lead Assembly (Fine Tuning) |
| , Feed Thru | 181 |  |  |
| $\begin{aligned} & \text { Feed Thru } \\ & \mathrm{m}, 10 \%, 1 / 2 \mathrm{w} . \end{aligned}$ | $\left.\begin{array}{l}17 \\ 18\end{array}\right\}$ | See C5, C7, C16 | Capacitor, Ceramic Tube |
| (m, $10 \%, 1 / 2 \mathrm{w}$. | 19 | 156906-39 | Nut (Spring), Trimmer |
| 10\%, $1 / 2 \mathrm{w}$. | 20 | 156906-40 | Screw, Trimmer |
| $\mathrm{n}, 10 \%, 1 / 2 \mathrm{~m}$. $\mathrm{mm}, 10 \%, 1 / 2 \mathrm{w}$. | 21 | 156906-41 | Contact bracket Assembly |
| m (m, $10 \%, 1 / 2 \mathrm{w}$. | 22 28 | 156906-45 | Coll Support Assembly a Insulated Shatt |
| $n, 100$, $1 / 2=$ | 40 | See L10 | I. F. Assembly |
| 3, 10\%, $1 / 2 \mathrm{~m}$. $0,10 \%, 1 / 2 \mathrm{w}$. | 41 |  |  |
| $\begin{aligned} & 0,10 \%, 1 / 2 \mathrm{w} . \\ & 0,10 \%, 1 / 2 \mathrm{~m} \end{aligned}$ | thru ${ }_{52}$ | See L1, L2 | Antenna Coll Assembly |
| dy | $\left.\begin{array}{l}53 \\ \text { thru } \\ 64\end{array}\right\}$ | See L5, Le, 1 L7 | R. F. 4 Osclulator Coil Assembly |
| F. Amplifier |  | 156189 | VhF Tuner Complete |


notes:
all voltages measured with an electronic voltmeter conNECTED FROM SOCKET LUG TO CHASSIS.
SUPPLY VOLTAGE 117 VOLTS 60 CYCLE AC
SUPPly VOltage 117 VOLTS 60 Cycle ac.
all capacitance values in mmf. and all resistance values IN OHMS UNLESS OTHERWISE NOTED.
R106 IS USED ON 414 CHASSIS.
1104 IS USED ON 414 CHASSIS.
R165 IS USED ON $414-1$ CHASSIS
R165 LS USED ON 414-1 CHASSIS.
I101, 1102 . 1103 IS USED ON 414-1 CHASSIS
I101, 1102 . I103 IS USED ON 414-1 CHASSIS. WHEN SERVICING THE TELEVISION CHASSIS WITH THE RADIO TUNER
DISCONNECTED, A DUMMY PLUG MUST BE INSERTED IN THE 9 PIN SOCKET ON THE REAR APRON OF THE TV. CHASSIS, AND A WIRE STRAP MUST BE CONNECTED ACROSS THE OUTSIDE TERMINALS OF
COIO3 AND A GROUND STRAP FROM CENTER TERMINAL TO CHASSIS COIO3 AND A GROUND STRAP FROM CENTER TERMINAL TO CHASSIS 10. EARLY PRODUCTION CHASSIS USED A CONTR

RESISTANCE ELEMENT OF 1500 OHMS. A 3300 OHM, $10 \%$. $1 / 2$ WATT FIXED RESISTOR (PART NUMBER 39374 -31) WAS CONNECTED BETWEEN TERMINAL LUG 1 AND LUG 3 OF THE CONTROL. THE 1500 OHM
CONTROL HAS THE SAME PART NUMBER (155580-1) AS THE 1000 OHM CONTROL HAS THE SAME PART NUMBER ( $155580-1$ ) AS THE 1000 OHM
CONTROL. THE SERVICE DEPT. WILL FURNSH ONLY THE 1000 OHM CONTROL. THE SERVICE DEPT. WILL FURNISH ONLY THE 1000 OHM
CONTROL. WHEN USING THIS CONTROL, DO NOT USE THE 3300 OHM RESISTOR SHUNT. (NO CODE LETTER IS USED TO DESIGNATE THIS
SEE PAGE 20 (CODE Changes for circuits that were changes SEE PAGE 20 (CODE ChANGES FOR CIRCUITS THAT WERE Changes


The figure at the right shows the audio amplifier and the audio Chassis 414 (Code A) and $414-1$
Chassis (Code B) have the circuit Chassis (Co


OJohn F. Rider

(C)John F. Rider
SCHEMATIC REPLACEMENT PARTS LIST

REPLACEMENT PARTS LIST

| $\begin{aligned} & \text { Symbol } \\ & \text { No. } \end{aligned}$ | Part No． | Description | $\begin{gathered} \text { Symbol } \\ \text { No. } \end{gathered}$ | Part No． | Description |
| :---: | :---: | :---: | :---: | :---: | :---: |
| C1 | 152997－6 | Capacitor，． 68 mmf ．，10\％， 500 v ． | 19 | 155510 | Choke，R．F．（145 microhenries） |
| $\mathrm{c}^{2}$ | 152997－6 | Capacitor， 68 mmf ．， $10 \%$ ， 500 v ． | ${ }^{2} 10$ | 148936－5 | Choke，R．F．（ 2.7 mic rohenries） |
| $\mathrm{c}^{\text {c }}$ | ${ }^{152997}{ }^{\text {2 }}$ | Capacitor， $68 \mathrm{mmf} ., 500 \mathrm{v}$ ． | L11 | 157135－1 | Inductance（Variable），Choke，oscillator |
| ${ }_{C 5}^{C 4}$ | ${ }^{1518800-3}$ |  | 12 | 157473－1 | Coupling Coil，Cathode Neutralizing |
| c6 | 156078－1 | Capacitor， $2-7 \mathrm{mmf}$ ，Oscillator Trimmer | CA1 |  | Transmission Line，Antenna（ $300 \mathrm{ohm} \mathrm{)}$ |
|  |  | Assembly | col | 155604 | Terminal Board，UHF Antenna |
| C7 | 137727－104 | Capacitor， 470 mmf ．，ceramic | co2 | 155431－1 | Strap，Oscillator Plate |
| ${ }^{\text {c8 }}$ | 152997－15 | Capacitior， $39 \mathrm{mmi},$.100 ， 500 v ． | CR1 | ${ }^{157690-1}$ | Crystal，Mixer（K3D） |
| $\stackrel{\text { c9 }}{\text { cı }}$ | 152997－8 |  | sw1 | $156170-1$ 155495 | Switch，Function ${ }_{\text {Arm }}$ \＆Hub Assembly，Function Switch |
| C11 | 137727－104 | Capacitor， 470 mmI ．，ceramic |  | 155561 | Arm，Toggle |
| ${ }^{\text {c12 }}$ | ${ }^{152997-6}$ | Capacitor， 68 mmf ．， $10 \%$ ， 500 v ． |  | ${ }^{155441}$ | Bracket，Antenna |
| ${ }_{C 14}^{\text {C13 }}$ | ${ }_{152997-11}^{152997-1}$ |  |  | 1547368 155488 |  |
| C15 | 137727－104 | Capacitor， 470 mmf ．，ceramic |  | 155427 | Clip \＆Board Assembly，Crystal |
| C16 | 137727－104 | Capacitor， 470 mmf ．，ceramic |  | 154803 | Cotter Pin（External） |
| ${ }^{\text {c17 }}$ | 137727－113 |  |  | ${ }^{155893}$ | Eyelet（3 used to hold Rotors to Shaft） |
| ${ }_{C 19}^{\text {C18 }}$ | －${ }_{\text {137727－104 }}$ | Capacitor， 1.0 mmI ．， $10 \%$ ， 500 v |  | 156788 |  |
| c20 | 156201－1 | Capacitor， 470 mmf ， 2 k ．v．，disc ceramic |  | 155466－1 | Guard，Fishpaper |
| R1 | 39374－57 | Resistor， 470,000 ohm， $10 \%, 1 / 2 \mathrm{w}$ ． |  | 137939－1 | Ider Pulley |
| R2 | ${ }^{39374-218}$ | Resistor， $27,000 \mathrm{ohm}, 10 \%, 2 \mathrm{w}$ ． |  | 155491 | Pin，Drive Cord Guide |
| ${ }_{84}$ | －${ }_{\text {39374－37 }}$ | Resistor， 27,000 ohm， $10 \%, 2 \mathrm{w}$ ． Resistor， $10,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$ |  | ${ }^{156672}$ | Pulley，Drive Cord |
| （R4 | － $\begin{array}{r}39374 \\ \text { 39374－57 }\end{array}$ | Resistor， Resistor， 470,000 ohm， $1000,1 / 2 \mathrm{w}$ ． |  | $137940-1$ $137940-8$ | Rivet， Rivet，Toger Pulley Togle Arm |
| ${ }^{\text {R6 }}$ | 39374－30 | Resistor， 2700 ohm， $10 \%, 1 / 2 \mathrm{w}$ ． |  | 155481－1 | Screw，Nylon（used to mount C6） |
| R7 | 39374－57 | Resistor， $470,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$ ． |  | 39311－2 | Set Screw，Arm \＆Hub Assembly |
| R8 | 39374－12 | Resistor， $82 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$ ． |  | 155898 | Shart \＆Stop Assembly，Inductuner |
|  | Part of $\mathrm{L1}$ | Resistor， 390 ohm， $10 \%, 1 / 2 \mathrm{w}$ ． |  | 153804 | Shield（Lid），Oscillator |
| R10 | Part of L8 | Resistor， $330 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |  | 153806 | Shield，Oscillator |
| ${ }^{\text {R11 }}$ | － 39374 －49 | Resistor， $100,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$ ． Inductuner，UHF |  | ${ }^{154677}$ | Shield，Tube（V1） |
| ${ }_{\text {L1 }}$ | 155158－1 | lindectuner，UHF |  | ${ }_{152053-1}^{15443}$ | Shield（Fish Paper Disc），Drive Cord |
| $\mathrm{L}^{2}$ | Part of C4 | Inductance |  | ${ }_{\text {12078－1 }}$ | Socket，Tube（V1） |
| L4 | Part of C6 | Inductance |  | 51752 | Spring，Drive Cord Tension |
| 1.5 | 148936－2 | Choke，R．F．（． 82 microhenries） |  | 156930 | UHF Converter Complete |
| ${ }^{16}$ | 156167－1 | Choke，R．F．（ .182 microhenries） |  | 155895 | Washer（1 used），Shaft \＆Stop Assembly |
| ${ }_{\text {L8 }}$ | $148936-4$ $157134-1$ | Choke，R．F．（ 1.2 microhenries） Choke，Oscillator Filament |  | 148206－1 | Washer（Spring Tension），Toggle Arm |

## I. F. ALIGNMENT

All lead connections from the signal marker generator and reep generator must be shielded. Keep exposed ends and
round leads as short as possible (about one inch). Alway locate the ground lead connections as close as possible to their respective "hot" leads in the television receiver output, and contrast control must be kept low enough to prevent overloading the television receiver circuits.
CAUTION: One side of the chassis is connected to the power line. Therefore, test equipment should isolation transformer is used between the power line and the receiver. DO NOT GROUND THE RECEIVER CHASSIS UNLESS AN ISOLATIO TRANSFORMER IS USED.

## to Check I. F. Alignment (on Oscilloscope)

Equipment: Sweep Generator, Marker Frequency Genera or, Oscilloscope, VTVM (electronic voltmeter), Variabl ias Control Assembly with $41 / 2$ volt battery

variable bias control assembly
a. Set up vertical gain control on scope to read approxi mately 8.8 volts peak to peak between arbitrary
reference lines. This can readily be done as follows:

1. Draw two horizontal lines spaced approximately $3^{\prime \prime}$ apart (depending on size of tube).
2. Connect low side of scope lead to chassis and the high side of lead to the 6.3 volt filamen circuit. This will provide a signal with a pea . Adjur vore

Adjust scope vertical gain control until the distance between the two horizontal lines equals one-half the peak to peak amplitude of the 60 position until the sweep generator attenuator has been set in step " $h$ ".
ancer $\qquad$

NORMAL OVERALL I. F. RESPONSE CURVE
NOTE: Rosponse os Seen by Means of Swoep Genorotor

POWER SUPPLY: 117 volts, 60 cycle, a.c.
POWER CONSUMPTION: 160 watts VHF.
AUDIO POWER OUTPUT: 1.4 watts maximum.
ANTENNA INPUT IMPEDANCE: 300 ohms balanced.
BLOCK DIAGRAM:

intermediate frequency:
Video Carrier-26.4 mc
Sound Carrier-21.9 mc.
Intercarrier Sound-4.5 mc.
U. H. F. Output-Channels 5 or 6.

DEFLECTION: Electromagnetic.
FOCUS: Magnetic (P. M.)
ION TRAP: Single Permanent Magnet.

## HORIZONTAL SCANNING FREQ: 15, 750 c c.p.s.

## VERTICAL SCANNING FREQ: $60 \mathrm{c} . \mathrm{p} . \mathrm{s}$

FRAME FREQUENCY: $30 \mathrm{c} . \mathrm{p} . \mathrm{s}$.
SCANNING: Interlaced, 525 lines.
SPEAKER: 12" Permanent Magnet.
VOICE COIL IMPEDANCE: 3.2 ohins at 400 cycles.
b. Set channel selector knob to unused channel. Set fin tuning control and contrast control to maximum counter-clockwise position. Set noise gate to naximum counter-clockwise position. Set Local-Distanc
switch to "Local" position.
. Remove RF amplifier tube (V1) from socket on VHF tuner.
d. Lift the shield of the Oscillator-Mixer tube V2 sufficiently to clear the socket ground clips. Connect the higg sounded lead from sweep signal generator to the ator lead to the tuner chassis. Keep leads as shor as possible (about 1 inch).
e. Apply -3.0 volts D. C. bias to I-F Bias line, junction C113") and R115 (see "Variable Bias Control As sembly ).
f. Set generator to sweep from 20 mc . to 32 mc
g. Transfer high side of scope lead to top of R116. Adjust the output of the sweep generator to obtain curve scope of approximately 10 volts peak to peak distortion in the will overioad the circuit and cause load by temporarily increasing and possible over signal input level and noting any change in the wave rm. Be sure to keep the input level below the overload point, indicated by a flattening of the peak).
(c) John F. Rider

## I. F. ALIGNMENT (continued)

h. Set the marker generator to the various frequencies given ( $20.8 \mathrm{mc} ., 21.9 \mathrm{mc}$., etc.) and compare their relative position with those shown on the Nomina Response Curve. (Be sure to keep the marker at the distort wave shape.) Slight deviation in shape from the nominal response curve is permissible, but if any great deviation is noted, it will be necessary to re align the IF amplifier as in section 2. (NOTE: The response curve may vary with the type of sweep can be checked by comparing the resultant curve with that observed on a known good chassis.)

## \section*{I. F. Alignment Procedure} <br> Using Signal Generator and VIVM)

Equipment: Signal (Marker) Generator, VTVM (electronic voltmeter), 1000 mmf . capacitor, Swamping Network (Se step "o
battery.
a. Set channel selector switch to an unoccupied channe and the fine tuning control to the maximum counterclockwise position. A channel in the upper band in step " 0 ".
b. Set contrast control to the maximum counter-clock wise position. Set noise gate to the maximum
counter-clockwise position. Set Local Distance switch to "Local" position
Remove RF amplifier tube (V1) from socket on VHF tuner.
d. Apply -3.0 volts D.C. bias to I-F Bias line, junction sembly").
e. Connect high side of lead from signal (marker) generator through a 1000 mmf . capacitor to TP-2 (wire protruding from top of tuner through the insulating
grommet next to L10). Connect the ground lead to the RF tuner case.
Transfer high side lead of VTVM to top of detector load resistor, R116.
g. Set signal (Marker) generator to 24.4 mc . and set at tenuator of signal generator to produce a meter de flection of approximately -2 volts DC . Adjust top of
T101 for maximum DC meter reading. (Be sure T101 for maximum DC meter reating. (Be surn generator if necessary to keep meter deflection at -2 volts DC maximum
h. Set signal generator to 22.9 mc . and adjust top of L103 for maximum DC meter indication. Limit meter dejusting output attenuator on generator

1. Set signal generator to 21.9 mc . and adjust bottom of L103 for minimum DC meter deflection. Input should on meter. (If necessary, IF bias may be reduced for this step.)

Repeat steps " h " and " i ". Reset bias to -3.5 volts if necessary
k. Reset IF bias at -3.5 v . Set generator to 25.5 mc . and adjust top of L102 for maximum meter deflection. Limit meter reading to approximately -2 vols DC maximum by adjusting output attenuator on generator

1. Reset signal generator to 24.4 mc . Adjust top of L10 for maximum meter deflection. Limit meter reading o approximately -2 volts DC maximum by adjusting output attenuator on generator.
m . Reset signal generator to 27.9 mc . and adjust the bottom of L101 for minimum DC meter deflection a definite null. (If necessary IF bias may be reduced for this step).
n. Repeat steps " 1 " and " m ". If bias has been reduced Repeat -3.5 volts, reset to -3.5 volts for step " 1 ".
2. Transfer high side of signal generator lead to TP-1 Set signal generator to 25.5 mc . Set IF bias to -3. resistor in series with a 1000 mmf . capacitor) across L101 making connections to the two lugs on the coil form closest to the chassis. Adjust L10 for a maximum meter reading. I-F bias may be reduced i necessary to obtain a usable deflection. Remov Swamping Network.
. Disconnect alignment equipment.

## SOUND ALIGNMENT



VHF CHASSIS (4II-4) TOP VIEW
(Tube and Alignment Locations)


VHF CHASSIS (4II-4) BOTTOM VIEW
(Tube Socket and Alignment Locations)

1. Connect crystal controlled 4.5 mc .400 cycle amplitude ALIGNMENT NOTES: modulated signal modulated $30 \%$ or greater, between grid of video amplifier and chassis.
2. Connect high side of scope through detector probe to the picture tube cathode (pin 11). Connect low side of scope to chassis. Adjust 4.5 mc . trap, L109, for minimum orycle deflection on scope
3. Connect electronic voltmeter to pin 2 of ratio detector tube, V104, and adjust 4.5 mc . sound take-off (L112)
on voltmeter. Adjust input to make this peak reading 4 volts.
4. Adjust input to obtain 12 volts output. Transfer electronic voltmeter to junction of R129 and C128 (refer to Schematic Wiring Diagram). Adjust top of T102 for
. Recheck steps 2,3 and 4 above
5. Remove input signal, scope and electronic voltmeter.

CAUTION: This UHF converter unit is used with a VHF receiver that has one side of the chassis connected to the Dower line. DO NOT CONNECT TEST EQUIPMENT TO ANY PART OF THE RECEIVER OR GROUND THE
CHASSIS UNLESS AN ISOLATION TRANSFORMER IS USED BETWEEN THE POWER LNE AND RECEIVER Remove the UHF Converter from the VHF receive chassis. shaft in maxdmum CCW* position, it will be necessary which operates it and manually set the switch to the UHF position. To accomplish this, loosen the two setscrews which secure the arm and hub assembly to the shaft. Turn the switch clockwise to the UHF positio and leave it in this position while aligning R. F. input terminals of the VHF Tuner.
. Reconnect the $\mathrm{B}+$ and filament leads of the tuner to the same points on the VHF receiver from which they wer disconnected. Connect UHF Converter chassis to B CW - Clockwise
ise
5. Keep all leads as short as possible. One suggested way doing this is to mount the UHF converter at righ angles to the TV chassis with one mounting screw. Mos cient length that no additional length will need to be added.
. Set VHF Tuner to Channel 6.
Alignment should be followed in the order shown

## I. F. Alignment

1. Connect an electronic voltmeter or an oscilloscope across the second detector load resistor.
2. Turn on the power
3. Apply an 82 mc . signal (amplitude modulated if a scope is used) to the crystal terminal (B) at the junction of C13 and L9 through the resistor network shown in Sketch A.

UHF ALIGNMENT (continued)


SKETCH A
4. Adjust plate coil (T1) and grid coil (T2) for maximum indication on the electronic voltmeter or scope
5. Disconnect the resistor network from the crystal

## OSCILLATOR ALIGNMENT

With the electronic voltmeter or scope connected across the second detector load resistor, apply a 460 mc signal (amplitude modulated if a scope is used) to the UHF antenna terminals through the resistor network shown in Sketch B.
Resistor Matching Network for Osc. \& R. F. Alignment


## SKETCH B

2. With the tuner shaft at maximum $\mathrm{CCW}^{*}$ position, adjust the oscillator trimmer C6 for peak reading on the elec tronic voltmeter or maximum indication on the scope (oscillator frequency is set to 84 mc . below the carrier frequency).
Set the signal generator to 904 mc .
Rotate the tuner shaft to the maximum CW position and nd inductor L4 up or down fo
3. Open the ground connection on L10 and connect an 0-10 ma. D.C. meter between the open end of the crysta return choke L10 and ground.
*W - Clockwise
4. Adjust the oscillator coupling coil Lll for maximum crystal current when the tuner shaft is rotated to the maximum CW position. When operating at normal line oltage ( 117 volts, 60 cycles), the maximum current should not exceed 5 ma. at any setting of the tuner shaft.
When operating at low line voltage ( 105 volts, 60 cycles), the minimum crystal current must not be less than 0.3 ma . at any setting of the tuner shaft.
5. Repeat steps 1 through 4 until maximum reading is ob-

## R. F. CIRCUIT ALIGNMENT

1. With the electronic voltmeter or scope connected across the second detector load resistor of the VHF receiver, apply a 460 mc . signal (Amplitude modulated if a scope s used) to the UHF antenna terminals through the re-
2. Sistor network shown in Sketch B.
just the antenna trimmer C4 for maximum meter reading or for maximum scope indication.
3. Reset signal generator to 904 mc .
4. Rotate the tuner shaft to maximum CW position. Adjust the antenna end inductor L3 by forming larger or maller loop until maximum reading on the meter (or
5. Repeat steps 1 through 4 until maximum reading is ob-
6. Tained. the power switch to the "OFF" position.
7. Disconnect the generator, the electronic voltmeter or scope, and the resistor network. Disconnect the 0-10
ma. meter, and solder the open lead of L10 to the chassis.
8. Re-engage the toggle coupling in the pin on the arm and hub assembly and tighten the set-screws that secure the collar to the switch shaft.
9. The Function Switch should be checked for proper oper-位年 under conditions of customer use. At full CCW otation of the tuner shaft, all VHF position contacts must be fully and firmly made and all UHF position contacts must be fully broken. All UHF position contacts must be fully and firmly made and all VHF position
contacts must be fully broken, when the tuner shaft is $71 / 2^{\circ}$ or more from full CCW, as tuner shaft is rotated in a clockwise direction.
10. Replace the UHF Converter on the VHF receiver chassis.

SOCKET VOLTAGE CHART



OP VIEW - UHF Converter


BOTTOM VIEW - UHF Converter

| Chassis: 4ll-4 \& 4ll-5 |  |  |  |  |  | Chassis: 4ll-4 \& 411-5 |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { Symbol } \\ & \text { No. } \end{aligned}$ | Part No. | Description | $\begin{gathered} \text { Symbol } \\ \text { No. } \end{gathered}$ | Part No. | Description | Symbol No. | Part No. | Description | Symbol No. | Part No. | Descriptio |
| C101 | 15620 | Capacitor, | C140C | 155910 | Capacitor, 30 mfd ., 150 v . Electro- | R116 | $\begin{aligned} & 39375 . \\ & 39374 . \end{aligned}$ | Resistor, $4700 \mathrm{ohm}, 5 \%, 1 / 2 \mathrm{w}$. Resistor, 470,000 ohm, $10 \%, 1 / 2$ | R175 | 39374- | Resistor, $\mathbf{0} 80$ ohm, $10 \%, 1 / 2 \mathrm{w}$. (Part of L113) |
|  |  |  | $\mathrm{C}_{\mathrm{C}} \mathrm{C} 140 \mathrm{D}$ |  | Capacitor, 200 mfd ., $150 \mathrm{v} . \quad$ lytic Capacitor, . 0005 mfd ., 600 v ., paper | R118 | 39374-61 | Resistor, 1 megohm, $10 \%$ | R176 | 39374-135 | Resistor, $68,000 \mathrm{ohnm}, 10 \%$, 1 w |
| 02 | 156201 | Capacitor, ceramic | ${ }_{\text {C141 }} \mathrm{C} 142$ | $\begin{aligned} & 39001-5 \\ & 154104 \end{aligned}$ | Capacitor, 0 | R119 | Part of L108 | Resistor, $8200 \mathrm{ohm}, 10 \%$, | R177 R179 | 39374-25 | stor, $1000 \mathrm{ohm}, 1$ |
| 04 | 137499-37 | Capacitor, | C143 | 144675-2 | Capacitor, .005 mfd , 500 v. , disc | $\begin{aligned} & \mathrm{R} 120 \\ & \mathrm{R} 121 \end{aligned}$ | $\begin{aligned} & 39374-219 \\ & \text { Part of L110 } \end{aligned}$ | Resistor, 33,000 ohm, $10 \%, 2$ Resistor, 6800 ohm, $10 \%, 1 / 2$ | R179 R180 | $39374-42$ $39374-60$ | sistor, $27,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. <br> esister, $820,000 \mathrm{ohm}, 10 \%, 1 / 2$ w. |
| C105 | 14 | Capacitor, . $001 \mathrm{mfd} ., 10 \%, 500 \mathrm{v}$. , disc ceramic | C | 39001-13 | Capacitor, . 01 mfd ., 600 | R122 | 39375-361 | Resistor, 4700 ohm , $5 \%, 2 \mathrm{w}$. | R181 | 39374-53 | esistor, 220,000 ohm, $10 \%, 1$ |
|  |  |  | C145 | 39001-82 | Capacitor, . $03 \mathrm{mfd} ., 600 \mathrm{v}$. , pape | ${ }^{\text {R123 }}$ | Part of L111 | Resistor, 3300 ohm, $10 \%$, 1 | $\begin{aligned} & \text { R182 } \\ & \text { R183 } \end{aligned}$ | $39374-13$ $39374-219$ | stor, $100 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. stur, $33,000 \mathrm{ohm}, 10 \%, 2$ w |
| C106 | 144675-28 | ```Capacitor, . 001 mfd., 10%, 500 v., disc ceramic``` | ${ }_{C 146}$ | ${ }_{155911}^{39001-14}$ | Capacitor, ${ }^{\text {c }}$. 015 mdd , , 600 v ., paper Capacitor, 200 mfd , 150 v , | $\begin{aligned} & \text { R124 } \\ & \text { R125 } \end{aligned}$ | $\begin{aligned} & 39374-37 \\ & 39374-15 \end{aligned}$ | Resistor, $10,000 \mathrm{uhm}, 10 \%, 1 / 2$ <br> Resistor, $150 \mathrm{ohm}, 10 \%, 1 / 2$ w. | R184 | $\begin{aligned} & 39374 \\ & 15584 \end{aligned}$ | Resistor, 33,000 ohm, $10 \%, 2$ w. Control, Horizontal Centering (75 ohm |
| C107 |  |  | C147 |  | Capacitor, 200 mfd , , 150 v , Electrolytic | R125 R126 | $\begin{array}{\|l\|l\|} \hline 39374-15 \\ 39374-49 \end{array}$ | Resistor, 100,000 ohm, $10 \%, 1 / 2$ | R185 | 39374-37 | Cestristor, Horizontal $1000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
|  | 144 | Capacitor, $.001 \mathrm{mfd} ., 10 \%, 500 \mathrm{v} .$, disc ceramic | C148A | 155426 | Capacitor, $200 \mathrm{mfd} ., 150 \mathrm{v}$.$\} Elec$ | R127 | 39374-29 | istor, 2200 ohm, |  |  | (Part of T108) <br> Resistor, 1800 ohm, 10\% 2 w |
| 08 | 144675-28 | $\begin{aligned} & \text { Capacitor,. } 001 \mathrm{mfd} \text {, } 10 \%, 500 \mathrm{v} . \text {, } \\ & \text { disc ceramic } \end{aligned}$ | C148 |  | Capacitor, 5 mfd , , 150 v . lytic | R128 R 129 | $39374-18$ $39374-43$ | Resistor, 270 ohm, $10 \%, 1 / 2 \mathrm{w}$. Resistor, $33,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. | $\left\lvert\, \begin{aligned} & \text { R186 } \\ & \text { R187 } \end{aligned}\right.$ | $\begin{aligned} & 39374-204 \\ & 39374-56 \end{aligned}$ | tor, 1800 ohm, $10 \%, 2 \mathrm{w}$. tor, $390,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
|  |  |  | C149 | 137727-1 | Capacitor, 1000 mmf , 500 v ., ceramic | R129 R130 | $\begin{aligned} & 39374-43 \\ & 39375-73 \end{aligned}$ | Resistor, $33,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$ Resistor, $10,000 \mathrm{hm}, 5 \%, 1 / 2 \mathrm{w}$. | ${ }_{\text {R188 }}$ | 39374-60 | Resistor, 390,000 ohm, $10 \%, 1 / 2 \mathrm{w}$. Resistor, $820,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| C109 | 137499-33 | Capacitor, $68 \mathrm{mmf} ., 10 \%, 500 \mathrm{v}$. , mica | $\begin{aligned} & \text { C150 } \\ & \text { C151 } \end{aligned}$ | $\begin{aligned} & 137727-132 \\ & 39478-114 \end{aligned}$ | Capacitor, $1000 \mathrm{mmf} ., 500 \mathrm{v} .$, ceram Capacitor, . $0033 \mathrm{mfd} ., 10 \%, 1000 \mathrm{v}$. | ${ }^{\mathrm{R} 131}$ | $393375-73$ <br> 15 | Resistor, $10,000 \mathrm{ohm}, 5 \%, 1 / 2 \mathrm{w}$ | R189 | 393 | Resistor, $100 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$ |
|  | 75-2 | Capacitor, . 005 mfd ., 500 v., disc ceramic |  |  | molded paper | ${ }^{\text {R132 }}$ | 155352 | Control, Brightness ( 5 megohm | ${ }_{\text {R190 }}$ | 39374-57 | 470,000 ohm, $10 \%, 1$ $180 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
|  |  |  | C152 | 146434-16 | Capacitor, 006 | ${ }_{\mathrm{R}}^{\mathrm{R} 133} \mathrm{H} 4 \mathrm{~A}$ | 39374-69 <br> 154085 | Resistor, 2.2 megohm, $10 \%, 1 / 2$ <br> Control, Volume ( 1 megohm) \| As | R193 | 39374-13 | sistor, $180 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. <br> istor, $1000 \mathrm{ohm}, 10 \%, 1 / 2 w$ |
| C111 | 144675-28 | Capacitor, . 001 mfd., $10 \%$, 500 v., disc ceramic |  |  | paper Capacitor, | ${ }_{\text {R134B }}$ |  | Control, Contrast (2500 ohm) | R194 | 39 | sistor, $470,000 \mathrm{ohm}, 10 \%$ |
| C112 | 137727-135 | Capacitor, 10 mmf , $10 \%$, 500 v. , ceramic | ${ }_{C}^{C 153}$ | $\begin{aligned} & 39001-76 \\ & 137727-134 \end{aligned}$ | Capacitor, Capacitor, a | R135 |  | Resistor, 220, $000 \mathrm{ohm}, 10 \%$, 1 | R195 | 39374 | cor, |
|  |  |  |  |  |  | R136 |  | Resistor, 2.2 megohm, 10\% | 96 | 39374 | sistor 4.7 |
|  | 154157 | Capacitor, $.5 \mathrm{mfd} ., 10 \%$, 25 v , paper |  |  | Capacitor, . 015 | R137 | 39 | Resistor, 1 megohm, $10 \%$, |  |  | mic |
|  |  |  | C156 |  | Capacitor | 139 |  | Resistor, Resistor, $47,000 \mathrm{ohm}, 10 \%, 1 / 2$ | L102 | 155319 | microhenries) |
|  | 727-10 | Capacitor, 5 mmf , $10 \%, 500 \mathrm{v}$. , ceramic | 157 | 137499-3 |  | R140 | 39374-31 | Resistor, $3300 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. | L103 | 155348 | 2nd IF |
|  | 19 |  |  |  | mica | R141 | 39374-31 | Resistor, $3300 \mathrm{ohm}, 10 \%$, $1 / 2$ | L104 | 154376 | il, Choke Diode ( 15.5 micr |
| C116 | 39001-86 | Capacitor, . 2 mfd., 600 v ., paper | C158 | 137499-32 | Capacitor, 680 mmf , 10\%, | R142 | $39374-30$ $39374-41$ | Resistor, 2700 ohm, $10 \%, 1 / 2 \mathrm{w}$. Resistor, $22,000 \mathrm{ohm}, 100 \%, 1 / 2 \mathrm{w}$. | $\begin{aligned} & \text { L105 } \\ & \text { L106 } \end{aligned}$ | 156714 154184 | Coil, Video Peaking ( 90 microhenr |
| $\left\lvert\, \begin{aligned} & C 117 \\ & C 118 \end{aligned}\right.$ | 154100-4 | Capacitor, 2.2 mmf , $500 \mathrm{v} .$, ceramic |  |  |  | R143 | 39374-41 | Resistor, $22,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$ Resistor, $10,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. | L107 | 155256 | Choke, RF Filament ( .576 microhe |
|  | 144675-2 | Capacitor, . 005 mfd , 500 | C159 | 144675-2 | Capacitor, 005 | R145 | ${ }_{39374-53}$ | Resistor, $220,000 \mathrm{ohm}, 10 \%, 1 / 2$ | L1 | 154 | Coil, Video Peaking ( 412 microhe |
|  | 137727-126 | Capac | C160 | 39001-19 | Capacitor, 1 mfd., 600 v ., paper | 146 | 155610 | Control, Vertical H | L109 | 155446 | Coil, 4.5 MC . Trap (27-57 microher |
|  |  |  | C161 | $39001 / 9$ | Capacitor, . 1 mfd., 600 | 147 | 154086 | Control, Height ( 5 megohm) | 10 | 154206 | Coil, Video Peaking ( 106 microhenries) |
| C120 | 390 | Capacitor, . 1 mf | C162 | 39001-13 | Capacitor, . 01 mfd ., 600 v ., paper | 148 | 39374-125 | Resistor, $10,000 \mathrm{ohm}, 10 \%$, | L111 | ${ }_{154174}^{1546}$ | Coil, Video Peaking ( 840 microhenries) |
| C121 | 137727-133 | Capacitor, 68 mmf ., $500 \mathrm{v} ., 10 \%$, disc ceramic | C164 | 156054 | Capacitor, $10 \mathrm{mfd} ., 10 \mathrm{v}$., Electrolytic |  | 1488 | Control, Vertical Linearity | L112 |  | microhenries) |
|  | 144675-6 |  | C165 | 155939 | Capacitor, 11 mdd ., $5 \%$, $200 \mathrm{v}$. , paper |  |  |  |  | 156839-1 | Deflection Y |
| C122 |  |  | $\begin{aligned} & \text { C167 } \\ & \text { C168 } \end{aligned}$ | 39001-19 <br> 144675-2 |  | R151 | 1555 | Control, Noise Gate (90,000 |  |  | Deflection Yoke |
|  |  |  |  |  | ceramic | R152 | 15551 | Control, Yertical Linearity ( 750 oh | L1 | 1542 | Coil, Horizontal Oscillator (18- |
|  | Part of T102 |  | C169 | 39001-17 | Capacitor, . 05 mfd ., 600 v ., paper | R153 | ${ }_{39374-13}$ | Resistor, 560 ohm , $10 \%, 1 / 2 \mathrm{w}$. |  |  | rk, Yoke Coupling (10 |
| C123 |  | Capacitor, 10 mmf . <br> Capacitor, 100 mmf . | C17 | 144675-2 | Capacitor, . $005 \mathrm{mfd} ., 500 \mathrm{v} .$, disc ceramic | R154 | $\begin{array}{\|l\|l\|} \hline 39374-13 \\ 39374-27 \end{array}$ | Resistor, Resistor, 1500 ohm, $10 \%, 1 / 2 \mathrm{w}$ | L1 | 156035 | icrohenri |
| ${ }_{\text {C124 }}$ | $\begin{aligned} & \text { Part of T102 } \\ & 154103 \end{aligned}$ |  |  | 156569 | Capacitor, 120 mmf ., $10 \%$, 5 kv ., disc ceramic | R156 |  | Control, 'Tone (250,000 | L117 | 156575 | il, RF Choke ( 16 microhenries) |
| C126 | 137727-129 | Capacitor, 330 mmf ., 500 v . , ceramic | C171 |  |  | R157 | 39374-4 | Resistor, 33, $000 \mathrm{ohm}, 10 \%$ | T101 | 155594 |  |
| C127 | 144675-2 | Capacitor, . 005 mfd ., 500 v ., disc ceramic | C172 |  | Capacitor, 5 mfd , 600 v , , pape | R159 |  | Resistor, $7.50 \mathrm{ohm}, 10 \%, 5 \mathrm{w}$. wire w Resistor, $100000 \mathrm{ohm}, 10 \%, 1 / 2$ | T102 | ${ }_{155255}$ | Transformer, Vertical Oscillat |
|  |  |  | C173 | 154 | $\underset{\text { Capacitor, }}{\text { ceramic }}$, 120 mmf , 10 | R160 |  <br> $39374-49$ | Resistor, 100, 000 ohm, $10 \%, 1 / 2$ | T104 | 155966 | ransformer, Vertical Output |
|  |  | Capacitor, . 001 mfd , $10 \%, 500 \mathrm{v}$. , disc ceramic | 74 | 14467 | Capacitor, . 005 mfd , , 500 y. , disc | R161 | 39374-41 | Resistor, $22,000 \mathrm{ohm}, 10 \%$, | T105 | 154109 | ansformer, Audio Output |
| C129 | 137727-131 | Capacitor, 220 mmf., $10 \%, 500$ v., ceramic |  |  | ceramic ${ }^{\text {c }}$ | R162 | 39 | Resistor, ${ }^{\text {Resistor }}$ 68, | $\begin{aligned} & \mathrm{T} 106 \\ & \mathrm{~T} 107 \end{aligned}$ | 15 |  |
|  |  |  | C176 | 15602 | Capacitor, 20 | R164 | $39374-77$ <br> $39374-77$ | Resistor, 4.7 megohm, $10 \%, 1 / 2 \mathrm{w}$. Resistor, 4.7 megohm, $10 \%, 1 / 2 \mathrm{w}$. | T108 | 155445- | Transformer, Horizontal Deflection |
| C130 |  | Capacitor, . $0047 \mathrm{mfd} ., 600 \mathrm{v} .$, molded paper | C177 | 137727-134 | Electrolytic <br> Capacitor, 75 mmf , $10 \%$, 500 v. , | R165 | 39374-26 | Resistor, $1200 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. | CO102 | 138352 | cket, Speak |
| C131 | 137727-26 |  |  |  |  | R166 | 39374-34 | Resistor, $5600 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. | C | 154114 |  |
| C132 | 39001-17 | Capacitor, .05 mfd., 600 v ., paper | C178 | 39001-82 | Capacitor, 03 mfd ., 600 v ., paper | R167 R168 | 39374-33 <br> 39374-46 | Resistor, ${ }^{\text {a }} 4700 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. Resistor, $56,000 \mathrm{hm}, 10 \%, 1 / 2$ | SW102 | ${ }^{\text {Part of }}$ | Switch, Rotar |
| C133 | 39477-39 | ```Capacitor, . }0047\textrm{mfd}., 600 v., molded paper``` | $\begin{aligned} & \text { R101 } \\ & \text { R102 } \end{aligned}$ | $39374-57$ $39374-57$ | Resistor, $470,000 \mathrm{ohm}$. $10 \%$, $1 / 2 \mathrm{w}$. <br> Resistor, 470,000 ohm., $10 \%, 1 / 2 \mathrm{w}$. | R169 | 155511 | Control, Horizontal Hold | CR101 | 154111 | N64 (Part of T10 |
| C134 | 39477-39 | Capacitor, . 0047 mfd ., $600 \mathrm{v} .$, molded paper | R103 | 39374-17 | Resistor, 220 ohm , $10 \%, 1 / 2 \mathrm{w}$. | R17 | 39374-39 ${ }^{3937}$ | Resistor, 15,000 ohm, $10 \%, 1 / 2$ Resistor, 68,000 ohm, $10 \%, 1 / 2$ |  | $\begin{aligned} & 155575-1 \\ & 155575-1 \end{aligned}$ | Selenium Rectifer |
|  |  |  | R104 | 39375-63 | Resistor, $3900 \mathrm{ohm}, 5 \%, 1 / 2 \mathrm{w}$. | R1 | ${ }_{39} 39$ | Resistor, 68,000 Resistor, 1 megohm | SP101 | ${ }_{138762-6}$ | eaker, P.M. (12 |
| C135 | 39478-41 | Capacitor, . 01 mfd , $10 \%, 600 \mathrm{v}$., molded paper | $\begin{aligned} & \mathrm{R} 105 \\ & \mathrm{R} 106 \end{aligned}$ | $\begin{aligned} & 39374-9 \\ & 39374-33 \end{aligned}$ | Resistor, $47 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. <br> Resistor, 4700 ohm, $10 \%, 1 / 2 \mathrm{w}$. | ${ }^{\text {R173 }}$ | 39374-218 | Resistor, $27,000 \mathrm{ohm}, 10 \%, 2 \mathrm{w}$. | CA101 | 20-6 | able \& Plug, AC Powe |
| C136 | 39001-78 | Capacitor, . 006 mfd ., 600 v ., paper | R107 | 39375-73 | Resistor, $10,000 \mathrm{ohm}$, | 74 | 39374-23 | Resistor, 680 ohm, $10 \%, 1 / 2$ | P101 | 154125 | Receptacle, interlock |
| C137 | 39478-45 | Capacitor, .047 mfd ., $10 \%, 600 \mathrm{v}$, molded paper | R108 R109 | $\begin{aligned} & 39374-25 \\ & 39374-25 \end{aligned}$ | Resistor, 1000 ohm, $10 \%, 1 / 2 \mathrm{w}$. Resistor, $1000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |  |  |  |  |  |  |
| C138 | 39478-45 | Capacitor, . 047 mfd , $10 \%, 600 \mathrm{v}$. , molded paper | R110 | 39374-11 | Resistor, $68 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$ |  |  |  |  |  |  |
|  |  |  | R111 | 39374-25 | Resistor, 1000 ohm, $10 \%$, |  |  |  |  |  |  |
| C139 | 144675-2 | Capacitor, . 005 mfd ., 500 v., disc ceramic | R112 R113 | $\begin{aligned} & 39375-75 \\ & 39374-15 \end{aligned}$ | Resistor, 12,000 ohm, $5 \%, 1 / 2 \mathrm{w}$ Resistor, 150 ohm, $10 \%, 1 / 2$ w. |  |  |  |  |  |  |
| C140A | 155910 | $\left\|\begin{array}{l}\text { Capacitor, } 10 \mathrm{mfd} ., 300 \mathrm{v} . \\ \text { Capacitor, } 200 \mathrm{mfd} ., 150 \mathrm{v} .\end{array}\right\|$Electro <br> lytic | R114 | 39 |  |  |  |  |  |  |  |
|  |  |  | \| R115 | 393 | Resistor, 1.5 megohm, $10 \%, 1 / 2 \mathrm{w}$. |  |  |  |  |  |  |




On chassis 411-4 (Code A or B), 411-5 (Code A), T108 Horizontal Deflection Transformer, Part No. 155455-1 is used. R Chers R173 and R183 are 15, 000 , $10 \%$ as shown in Figure 2. The Transformer T108 and Resistors R173 Resistors R18 which appear in the complete schematic apply to chassis 411-4 (Code C or later) and to chassis 411-5 (Code B or and R183

On chassis 411-4 (Code A or B), 411-5 (Code A) Resistor, R135 is 470, 000 ohm. On chassis 411-4 (Code C or later), 411-5 (Code B or later) Resistor, R1 35 is $220,000 \mathrm{ohm}$. This resistor was changed to improve the Vertical Sync stability.

CHASSIS 411-4, 411-5


UHF Converter

| ${ }_{\substack{\text { Symbol } \\ \text { No. }}}$ | Part No. | Description | Symbol No. | Part No. | Description |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | ${ }^{152997-6}$ | Capacitor, 688 mmf ., 108 , 500 v . |  | 155510 | Choke, R.F. (1455 micronenries) |
| c2 <br>  <br> C 3 |  |  | 210 $L 11$ | ${ }^{148936-5}$ | Choke, R.F. (2.7 micronenries) |
| ${ }_{C 4}$ | ${ }_{151880-3}$ | Capacitor, 25.25 .5 mmf . |  |  | ${ }^{\text {In }}$ coupling |
| c5 | ${ }_{\text {1 }}^{155603989-1}$ |  | ${ }_{\text {cai }}^{\text {LI2 }}$ | 157473-1 | Coin, cathode Neutraizing |
|  | ${ }^{137727-104}$ | Capacitor, 470 mmf ., ceramic | $\mathrm{c}_{\text {coi }}^{\text {coi }}$ |  | ${ }_{\text {Terminal }}^{\text {Strap }}$ Oscil |
| ${ }^{\text {c8 }}$ | $152997-15$ | Capacitor, $39 \mathrm{mmf}$. , 109 , 500 v . |  | ${ }^{157690-1}$ |  |
| ${ }^{\text {c9 }}$ | $152997-8$ $156201-1$ |  |  | ${ }_{\text {cker }} 156170-1$ |  |
| ${ }_{\text {C11 }}^{\text {C11 }}$ |  | Capacitior, ${ }^{\text {a }}$ |  | ${ }^{15559561}$ |  |
| ${ }^{\text {c12 }}$ | ${ }^{1529997-6}$ |  |  | ${ }_{155441}$ | Aracket, Antenna |
| ${ }_{\text {C14 }}^{\text {C13 }}$ |  |  |  | 154736 <br> 155488 |  |
| c15 | ${ }^{137727-104}$ | Capacitor, 470 mmit, ceramic |  | ${ }_{155427}$ | Clip \& Board Assembly, Crystal |
| ${ }_{C 17} 16$ | ${ }^{1337277104}$ | Capacitor, $470 \mathrm{mm}$. . ceramic |  | ${ }^{155883}$ | Coter Pin (Exterral) |
|  |  | Capacitor, 1.1500 mmf C, 500 vo . |  | 155893 156788 | Fibre Hub, $S_{\text {m }}$ |
| ${ }^{\text {c19 }}$ | ${ }_{\text {137727-104 }}$ | Capacitor, 470 mmi., ceramic |  |  | 8 Outer Shaft Assembly |
| ${ }_{\text {R12 }}^{\text {R20 }}$ | $\underset{\substack{156201-1 \\ 3934-57}}{1}$ | Capactior, $470 \mathrm{mmf},{ }^{2} \mathrm{k}$. V., d, disc ceramic |  | ${ }_{\substack{15466-1 \\ 137939-1}}$ | Cuard, Fisipaper |
| ${ }_{82}$ | ${ }_{\text {cole }}^{39374-218}$ |  |  | ${ }^{1555991}$ | Pin, Drive Cord Gu |
| ${ }_{\text {R4 }}^{\text {R3 }}$ | ${ }_{\text {cole }}^{\text {393374--37 }}$ | Resistor, $27,000 \mathrm{ohm} 1067,,2 w$. |  | ${ }_{\substack{15672 \\ 137940-1}}^{1}$ | (euliey, prive cord |
| ¢ | - $\begin{aligned} & \text { 39374-57 } \\ & 39374-30\end{aligned}$ |  |  | ${ }_{\substack{137940-8 \\ 155481-1}}^{\substack{\text { a }}}$ | Rivet, Toggle Arm ${ }_{\text {chem }}$ Screw, Nylon (used to mount C6) |
| ${ }_{\text {R8 }}^{\text {R7 }}$ | - ${ }_{\text {39374-57 }}$ | (Resistor, 470,000 ohm, $10 \%, 1 / 2$ |  |  | Set Screw, Arm\& Hub Assembly |
| ${ }_{\text {R99 }}$ | Part or L1 | Resisfor, $390 \mathrm{omm} ,\mathrm{10} \mathrm{\%} ,1 / 2 \mathrm{w}$. |  | ${ }_{1}^{1533804}$ | Shield (Lide), osililator |
| ${ }_{\text {R11 }}$ | ${ }_{\text {cha }}^{\text {Parl-49 }}$ | ${ }^{\text {Resem }}$ |  | ${ }_{154577}^{15856}$ | Shield, (ube (V1) |
| ${ }_{12}^{21}$ | ${ }_{\substack{155158-1 \\ 15742-1}}$ |  |  | ${ }_{1}^{15242933-1}$ | Shiel (Fish Paper Disc), Drive Cord |
| ${ }_{5}^{2}$ | ${ }^{\text {Part of }} \mathrm{C4}$ | Inductance |  | ${ }_{\substack{\text { a }}}^{15202781}$ | Sockel, Tube (V2) |
| ${ }^{24}$ |  |  |  |  |  |
| ${ }_{\text {L7 }}^{16}$ | (156677-1 |  |  | ${ }_{\substack{158898 \\ 188206-1}}^{1}$ |  |
|  |  |  |  |  |  |



REPLACEMENT PARTS LIST

| $\begin{gathered} \text { Symbol } \\ \text { No. } \end{gathered}$ | Part No. | Description | $\xrightarrow[\substack{\text { Symbol } \\ \text { No. }}]{\text { cose }}$ | Part No. | Description |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Cl | 156906-1 | Capacitor, 800 mmf ., Feed Thru | L5 |  |  |
| ${ }_{\text {c2 }}$ | $1569906-2$ 156906-3 | Capacitor, 1000 mmf , , disc ceramic Capacitor, 1.5 mmf , disc ceramic |  | 156908-* | R. F. \& Oscillator Coil Assembly |
| C4 | $1565906-4$ <br> 1 | Capacitor, 47 mmi ., $10 \%$, disa ceramic | L8 | 156906-51 | Choke, Friament, Mixer |
| C5 |  | Capacitor, 5 , 5 -3mmi, , Trimmer, ceramic | ${ }_{\text {L10 }}$ | (1569006-53 | Choke, Plate, Mixer |
| ${ }_{\text {c7 }}^{\text {C6 }}$ | -156906-4 |  | ${ }^{1} 10$ |  | I.F. As. Amplifier (VI) |
| $\mathrm{CB}_{8}$ | ${ }_{156900-8}$ | Capacitor, 6.8 mmf., $\pm .25 \mathrm{mmf}$., | 2 |  | Mixer Oscillator (V2) |
| c9 | 156908-9 |  | ${ }^{3}$ | ${ }_{\text {l }}^{1569906-23}$ | Tube Shield (1) |
|  | 156906-8 |  | 5 | 156906-25 | Shield (side) |
| C10 | 156908-10 | Capacitor, disc ceramic mi., | ${ }_{7}^{6}$ | ${ }_{1569066-27}^{15696}$ | Stineld (Botiom) |
| C11 | See Rel. 15 | Capacitor, Fine Tuning |  | ${ }^{1565906-28}$ | Spring, Detent |
| ${ }_{\text {C13 }}{ }_{\text {C13 }}$ |  |  | ${ }_{10}$ | ${ }_{\text {cke }}^{1569906-29} 1$ | Spring, Shatt Retaining |
| $\mathrm{C14}$ | ${ }_{1} 588906-14$ | Capacitor, 51 mmf ., 5 \%, disc ceramic | 12 | ${ }^{1568906} \mathbf{3 2}$ | Plate, Fine Tuning Grounding |
| $\mathrm{ClP}^{15}$ | 156906-15 | Capacitor, 120 mmf , $10 \%$, disc ceramic | 1 | 156906-33 15680065 | Mounting Strap, Ceramic Bushing |
| ${ }_{\text {c17 }}$ | ${ }_{\substack{\text { l } \\ 1569906-16-17}}$ | Capacitior, 800 mmf ., Feed Thru | 15 | 156906-35 | Ceramic Bushing \& Lead Assembly |
| C18 | 156906-17 | Capacitor, 800 mml ., Feed Thru |  |  | (Fine Tuning) |
| C19 | ${ }_{\text {l }}^{156906-17} 1$ |  | $\left.{ }_{17}^{16}\right\}$ | See C5, C7, \& C16 | Capacitor, Ceramic Tube |
| R1 | ${ }_{39394}$ | Resistor, $330,000 \mathrm{ohm}, 109,1 / 2 \mathrm{w}$. |  |  |  |
| ${ }_{\text {R2 }}$ | - ${ }_{3933444-27}$ |  | 19 20 |  | ( $\begin{aligned} & \text { Nut (Spring), } \\ & \text { Screw, Trimmer }\end{aligned}$ |
| ${ }_{\text {R } 5}$ | 156906-47 | Resistor, $10,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. | ${ }^{21}$ | ${ }^{156906-41}$ | Contact Bracket Assembly |
| ${ }_{\text {R7 }}$ | ${ }_{3} 39374-53$ | Resistor, $220,000 \mathrm{hm}, 100 \% 1 / 2 \mathrm{~m}$. | ${ }_{28}^{22}$ |  | Coil support Assembly \& Insulated Shatt |
| ${ }_{\text {R88 }}^{\text {R7 }}$ |  | Resistor, 10,000 ohm, $10 \%$, $1 / 2 \mathrm{~m}$. | 28 40 | ${ }_{\text {See L10 }}^{156906-44}$ | I. F. Assembly |
| ${ }^{\text {R9 }}$ | ${ }_{39374-45}$ | Resistor, 47, $000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{~m}$. | ${ }^{41}$ |  |  |
| R10 | - $3933744-39$ | Resistor, 15,000 ohm, $10 \%, 1 / 2 \mathrm{w}$. Resistor, 15,000 ohm, $10 \%, 1 / 2 \mathrm{w}$. | ${ }_{52}^{\text {thru }}$ \} | see L1, L2 | Anterna Coul Assembly |
|  | 156907-* | Antenna'Coil Assembly | ¢ $\left.\begin{array}{c}53 \\ \text { thru }\end{array}\right\}$ | See L5, Le, \& L7 | R. F. \& Oscllator Coil Assembly |
| $\stackrel{L 3}{L 4}$ | 156906-49 156906-50 | Choke, Cathode <br> Choke, Fllament, R. F. Amplifier | 64 | 156189 | VHF Tuner Complete |

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## POWER SUPPLY: <br> Y: . . . . . . 117 volts, 60 cycle, a.c.

## POWER CONSUMPTION

VHF Position.
150 watts
UHF Position. . . . . . . . . . . . . . 155 watts

AUDIO POWER OUTPUT: . . . . 1.4 watts maximum
ANTENNA INPUT IMPEDANCE: . 300 ohms balanced

## INTERMEDIATE FREQUENCY:

Video Carrier-26.4 mc
Sound Carrier- 21.9 mc
Intercarrier Sound-4.5 mc.
U. H. F. Output-Channels 5 or 6 .

DEFLECTION: Electromagnetic
FOCUS: Magnetic (P.M.) on 404-4 \& 404-5 chassis Electrostatic on 402-4 \& 404-5 chassis ION TRAP: Single Permanent Magnet HORIZONTAL SCANNING FREQ: 15, 750 c.p.s. VERTICAL SCANNING FREQ: 60 c.p.s.

FRAME FREQUENCY: 30 c.p.s.
SCANNING: Interlaced, 525 lines.
SPEAKER: 10' Permanent Magnet console models. 5 1/4" Permanent Magnet table models.

VOICE COIL IMPEDANCE: 3.2 ohms at 400 cycles
$\underset{\substack{\text { Of.21cOMH } \\ \text { (Mahogony) }}}{ }$


f.21colu


ond)

GR21CDLH
(Mohoong
Gf-21CDBH $\underset{\substack{\text { Gf.21COLB } \\ \text { (Blond) }}}{(2)}$


## I. F. ALIGNMENT

All lead connections from the signal marker generator and sweep generator must be shielded. Keep exposed ends and
ground leads as short as possible (about one inch). Always ground leads as short as possible (about one inch). Always locate the ground lead connections as clese as
their respective "hot" leads in the television receiver chassis. The sweep generator output, signal generator output, and contrast control must be kept low enough to prevent overloading the television receiver circuits.
CAUTION: One side of the chassis is connected to the power line. Therefore, test equipment should
not be connected to the receiver unless an not be connected to the receiver unless an line and the receiver. DO NOT GROUND THE RECEIVER CHASSIS UNLESS AN ISOLATION TRANSFORMER IS USED.

To Check I. F. Alignment (on Oscilloscope) :
Equipment: Sweep Generator, Marker Frequency GeneraEquipment: Sweep Generator, Marker Frequency GeneraBias Control Assembly with $41 / 2$ volt battery.

a. Set up vertical gain control on scope to read approximately 8.8 volts peak to peak between arbitrary reference lines. This can readily be done as follows:

1. Draw two horizontal lines spaced approximately ${ }^{3}$ " apart (depending on size of tube).
2. Connect low side of scope lead to chassis and the high side of lead to the 6.3 volt filament
circuit. This will provide a signal with a peak circuit. This will provide a s.
3. Adjust scope vertical gain control until the distance between the two horizontal lines equals one-half the peak to peak amplitude of the 60 cycle sine wave. Leave the vertical gain in this position until the sweep generator attenuator has been set in step " $h$ ".

variable bias control astembly

NORMAL OVERALL I. F. RESPONSE CURVE

## I. F. ALIGNMENT (continued)

b. Set channel selector knob to unused channel. Set fine tuning control and contrast control to maximum counter-clockwise position. Set noise gate to maximum counter-clockwise position. Set Local-Distanc switch to "Local" position uner.
d. Lift the shield of the Oscillator-Mixer tube V2 sufficiently to clear the socket ground clips. Connect the grounded lead from sweep signal generator to the ngrounded tube shield and the ground side of gener-
tor lead to the tuner chassis. Keep leads as shor as possible (about 1 inch).
e. Apply -3.0 volts D. C. bias to I-F Bias line, junction of C113 and R115 (see "Variable Bias Control As sembly").
f. Set generator to sweep from 20 mc . to 32 mc
g. Transfer high side of scope lead to top of R116. Adjust the output of the sweep generator to obtain curve n scope of approximately 10 volts peak to peak. (Excessive input will overload the circuit and cause distortion in the wave form. Check for possible overload by temporarily increasing and decreasing the
signal input level and noting any change in the wave signal input level and noting any change in the wave
form. Be sure to keep the input level below the overload point, indicated by a flattening of the peak)
$h$. Set the marker generator to the various frequencies given ( 20.8 mc ., 21.9 mc ., etc.) and compare thei Response Curve. (Be sure to keep the marker at the minimum usable amplitude. Excessive signal will distort wave shape.) Slight deviation in shape from the nominal response curve is permissible, but if any great deviation is noted, it will be necessary to
alig
amplifier as in section 2. (NOTE: The response curve may vary with the type of sweep equipment used. Such variations due to equipment can be checked by comparing the resultant curve with that observed on a known good chassis.)

## F. Alignment Procedure

Using Signal Generator and VTVM)
Equipment: Signal (Marker) Generator, VTVM (electronic voltmeter), 1000 mmf . capacitor, Swamping Network (See
step "o"), Variable Bias Control Assembly with $41 / 2$ vol battery.
a. Set channel selector switch to an unoccupied channe and the fine tuning control to the maximum counter (channels 7 to 13) will allow easier adjustment of L10 in step " 0 ".
b. Set contrast control to the maximum counter-clock wise position. Set noise gate to the maximum switch to "Local" position.
c. Remove RF amplifier tube (V1) from socket on VHF uner.
. Apply -3.0 volts D.C. bias to I-F Bias line, junction of C113 and R115 (see "Variable Bias Control As sembly").
e. Connect high side of lead from signal (marker) generator through a 1000 mmf . capacitor to TP- 2 (wire prommet next to L10). Connect the ground lead to the RF tuner case.
. Transfer high side lead of VTVM to top of detector load resistor, R116.
g. Set signal (Marker) generator to 24.4 mc . and set at tenuator of signal generator to produce a meter de T101 for maximum DC meter reading. (Be sure sweep generator is off.) Readjust output from signal generator if necessary to keep meter deflection at volts DC maximum.
h. Set signal generator to 22.9 mc . and adjust top of L103 for maximum DC meter indication. Limit meter dejusting output attenuator on generator.
i. Set signal generator to 21.9 mc . and adjust bottom of L 103 for minimum DC meter deflection. Input shoul on meter. (If necessary, IF bias may be reduced for this step.)
j. Repeat steps " h " and " i ". Reset bias to $\mathbf{- 3 . 5}$ volts if necessary.
k. Reset IF bias at -3.5 v . Set generator to 25.5 mc and adjust top of L102 for maximum meter deflection Limit meter reading to approximately -2 volts DC

Reset signal generator to 24.4 mc . Adjust top of $\mathbf{L} 10$ for maximum meter deflection. Limit meter reading to approximately -2 volts DC maximum by adjusting output attenuator on generator
m. Reset signal generator to 27.9 mc , and adjust the bottom of L101 for minimum DC meter deflection. ignal generator output must be sufficient to produce a definite null.
for this step).
n. Repeat steps " 1 " and " $m$ ". If bias has been reduced below -3.5 volts, reset to -3.5 volts for step " 1 ".

Transfer high side of signal generator lead to TP-1 Set signal generator to 25.5 mc . Set 1 F bias to -3 . set signal generator to 25.5 mc . Set resistor in series with a 1000 mmf . capacitor) across L101 making connections to the two lugs on the coil
form closest to the chassis. Adjust L 10 for a maximum meter reading. I-F bias may be reduced if necessary to obtain a usable deflection. Remove Swamping Network.
Disconnect alignment equipment

 (Tube Socket and Alignment Locations)

## VHF CHASSIS (404-5 \& 402-5) TOP VIEW

(Tube and Alignment Locations)

## SOUND ALIGNMENT

Connect crystal controlled 4.5 mc .400 cycle amplitude modulated signal, modulated $30 \%$ or greater, between grid of video amplifier and chassis.
2. Connect high side of scope through detector probe to the picture tube cathode (pin 11). Connect low side of scope to chassis. Adjust 4.5 mc . trap, L109, for minimum 400 cycle deflection on scope.
3. Connect electronic voltmeter to pin 2 of atio detector tube, V104, and adjust 4.5 mc. sound take-off (L112) and bottom of
ratio transformer (T102) for peak reading on voltmeter. Adjust input to make this peak reading 4 volts
4. Adjust input to obtain 12 volts output. Transfer electronic voltmeter to junction of R129 and C128 (refer to Schematic Wiring Diaram). Adjust top of T102 for zero balance on electronic voltmeter
5. Recheck steps 2, 3 and 4 above.
6. Remove input signal, scope and electronic voltmeter.

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## UHF ALIGNMENT（continued）

## alignment notes

CAUTION：This UHF converter unit is used with a VHF re－ ceiver that has one side of the chassis connected to the power line．DO NOT CONNECT TEST EQUIPMENT TO
ANY PART OF THE RECEIVER OR GROUND THE ANY PART OF THE RECEIVER OR GROUND THE USED BETWEEN THE POWER LINE AND RECEIVER．

Remove the UHF Converter from the VHF receiver chassis．
In order that the converter will operate with the tuning shaft in maximum CCW＊position，it will be necessary to disengage the function switch shaft from the linkage UHF operates it and manually set the switch to the screws which secure the arm and hub assembly tothe shaft．Turn the switch clockwise to the UHF position and leave it in this position while aligning．
Connect the output leads of the UHF converter to the
Reconnect the $\mathrm{B}+$ and filament leads of the tuner to the same points on the VHF receiver from which they were disconnected．Connect UHF Converter chassis to B （VHF receiver chassis）．

CW－Clockwise

5．Keep all leads as short as possible．One suggested way doing this is to mount the UHF converter at right of the leads on the UHF converter will then be of suffi－ ient length that no additional length will need to be added．
6．Set VHF Tuner to Channel 6
7．Alignment should be followed in the order shown．

## I．F．ALIGNMENT

1．Connect an electronic voltmeter or an oscilloscope across the second detector load resistor．

2．Turn on the power．
3．Apply an 82 mc ．signal（amplitude modulated if a scope is used）to the crystal terminal $(B)$ at the junction of
C13 and L9 through the resistor network shown in Sketch A．
$\frac{1-F \text { INPUT COLL }}{\text { ADJUS＇T．B2MC．}}$
bOtrom view－UhF Converter


$\underset{\substack{\text { B＋LEAD（RED）} \\ \text { TO }+250 V}}{\text {（ }}$

TOP VIEW－UHF Converter

Resistor Matching Network for I．F．Alignmen ？niciov

Adjust the oscillator coupling coil L11 for maximum crystal current when the tuner shaft is rotated to the
maximum CW position．When operating at normal line maximum（ 117 volts， 60 cycles），the maximum current should not exceed 5 ma．at any setting of the tuner shaft． When operating at low line voltage（ 105 volts， 60 cycles），the minimum crystal current must not be less than 0.3 ma ．at any setting of the tuner shaft． Repeat steps 1 through 4 until maximum reading is ob－ tained．

## R．F．CIRCUIT ALIGNMEN

1．With the electronic voltmeter or scope connected across the second detector load resistor of the VHF receiver， apply a 460 mc ．signal（Amplitude modulated if a scope
is used）to the UHF antenna terminals through the re－ sistor network shown in Sketch B．
2．With the tuner shaft at the maximum CCW position，ad－ just the antenna trimmer C4 for maximum meter read－ ing or for maximum scope indication
3．Reset signal generator to 904 mc ．
4．Rotate the tuner shaft to maximum CW position．Adjust the antenna end inductor L 3 by forming larger or smaller loop until maximum reading on the meter（or scope）is obtained．
Repeat steps 1 through 4 until maximum reading is ob－ tained．
6．Turn the power switch to the＂OFF＂position Disconnect the generator，the electronic voltmeter or scope，and the resistor network．Disconnect the $0-10$ ma．meter，and solder the open lead of L10 to the chassis
8．Re－engage the toggle coupling in the pin on the arm and hub assembly and tighten the set－screws that secure the collar to the switch shaft．
9．The Function Switch should be checked for proper oper－ ation under conditions of customer use．At full CCW rotation of the tuner shaft，all VHF position contacts must be fully and firmly made and all UHF position con－ must be fully and firmly made and all VHF position contacts must be fully broken，when the tuner shaft is $71 / 2^{\circ}$ or more from full CCW ，as tuner shaft is rotated in a clockwise direction．
10．Replace the UHF Converter on the VHF receiver chassis．

SOCKET VOLTAGE CHART
$\frac{\text { OSC TRIMMER（C18）}}{\text { ADOSST }}$


| $\underset{\substack{\text { Symbol } \\ \text { No. }}}{\text { Nos. }}$ | Part No. | Description |
| :---: | :---: | :---: |
| c1 | 152997-6 | Capacitor, . 68 mmf ., $10 \%$, 500 v . |
| ${ }^{\text {c2 }}$ | 152997-6 | Capacitor, 68 mml ., $100 \%$, 500 v . |
| ${ }^{\text {c3 }}$ | ${ }^{152997-8}$ | Capacitor, $88 \mathrm{mmm} ., 500 \mathrm{v}$. |
| C4 | 151880-3 |  |
| ${ }_{6}$ | 156078-1 | Capacitor, $2-7 \mathrm{mmf}$, Oscillator Trimmer |
| C7 | 137727-104 | ${ }_{\text {A }}^{\text {Assembly }}$ Capaitor, $470 \mathrm{mmf}$. , |
| c8 | 152997-15 | Capacitor, . 39 mmf ., $10 \%$, 500 v . |
| c9 | 152997-8 | Capacitor, 68 mmf |
| C10 | 156201-1 | Capacitor, 470 mmf , , $2 \mathrm{k} . \mathrm{v}$. , disc ceramic |
| ${ }^{\text {c11 }}$ | 137727-104 | Capacitor, 470 mmf ., ceramic |
| C12 | 152997-6 | Capacitor, . 68 mmi ., 1086 , 500 v . |
| ${ }^{\text {c13 }}$ | 152997-1 | Capacitor, 2.2 mmf , $10 \%, 500 \mathrm{v}$. |
| C14 | 152997-11 | Capacitor, 10 mmf ., $10 \%$, 500 v . |
| C15 | ${ }^{137727-104}$ | Capacitor, 470 mmf ., ceramic |
| ${ }^{\text {c17 }}$ | 13727-104 | Capacitor, 470 mmf ., ceramic |
| C17 | 137727-113 | Capacitor, 1500 mmf ., 500 v . |
| C18 | 152997-2 | Capacitor, 1.0 mmf , $10 \%, 500 \mathrm{v}$. |
| C19 | 137727-104 | Capacitor, 470 mmf ., cera |
| c20 | 156201-1 | Capacitor, 470 mmf., 2 k.v., disc ceramic |
| ${ }^{\text {R1 }}$ | 39374-57 | Resistor, $470,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$ |
| ${ }^{\text {R2 }}$ | 39374-218 | Resistor, $27,000 \mathrm{ohm} 10 \$,$% , 2 \mathrm{~m}$. |
| ${ }^{\text {R3 }}$ | 39374-218 | Resistor, 27,000 ohm, $10 \%, 2 \mathrm{~m}$. |
|  | - $\begin{aligned} & 39374-37 \\ & \text { 39374-57 }\end{aligned}$ | Resistor, 10,000 ohm, $10 \%$, $1 / 2 \mathrm{w}$. |
| ${ }_{\text {R } 6}$ | - $\begin{array}{r}\text { 39334-57 } \\ \text { 3934-30 }\end{array}$ |  |
| R7 | 39374-57 | Resistor, $470,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| R8 | 39374-12 | Resistor, $82 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| R9 | Part of L1 | Resistor, $390 \mathrm{ohm}, 10 \mathrm{p}, 1 / 2 \mathrm{w}$. |
| R10 | Part of L8 | Resistor, $330 \mathrm{ohm}$, , $10 \%, 1 / 2 \mathrm{w}$. |
| ${ }_{1}{ }_{1}$ | $39374-49$ $155158-1$ | Resistor, 100,000 Ohm, $10 \%, 1 / 2$ |
| $\mathrm{L}_{2}$ | 157472-1 | Coil, Grid Neutralizing |
| L3 | Part of C4 | Inductance |
| L4 | Part of C6 | Inductance |
| L5 | 148936-2 | Choke, R. F. (. 82 microhenries) |
| ${ }^{\text {L6 }}$ | 156167-1 | Choke, R. F. (. 182 microhenries) |
| ${ }^{2}$ | 148836-4 |  |
| 18 | 157134-1 | Choke, Oscillator filament |


| $\begin{aligned} & \text { Symbol } \\ & \text { Nyol } \end{aligned}$ | Part No. |
| :---: | :---: |
| ${ }^{\text {L9 }}$ | 155510 |
| L10 | 148936-5 |
| L11 | 157135-1 |
| T1 | 156934-1 |
| T2 | 156933-1 |
| L12 | 157473-1 |
| CAI |  |
| ${ }_{\text {co2 }}$ | ${ }_{155431-1}^{15604}$ |
| ${ }_{\text {SW1 }}$ | 157690-1 |
|  | ${ }^{156170-1}$ |
|  | ${ }_{155495}$ |
|  | 155561 |
|  | ${ }^{155441}$ |
|  | 154736 |
|  | 155488 |
|  | 155427 |
|  | 154803 |
|  | 155893 |
|  | 156788 |
|  | 155466-1 |
|  | 137939-1 |
|  | 155497 |
|  | 156872 |
|  | ${ }_{\substack{\text { c } \\ 13794940-8}}$ |
|  | 155481-1 |
|  | 39311-2 |
|  | 155898 |
|  | 153804 |
|  | ${ }^{153806}$ |
|  | 154677 15474 |
|  | ${ }_{152053-1}^{1547}$ |
|  | 152078-1 |
|  | 51752 |
|  | 156930 |
|  | 148206-1 |



| $\begin{gathered} \text { Symbol } \\ \text { No. } \end{gathered}$ | Part No. | Description | $\begin{gathered} \text { Symbol } \\ \text { No. } \end{gathered}$ | Part No. | Description |
| :---: | :---: | :---: | :---: | :---: | :---: |
| C1 | 158906-1 | Capactior, 800 mmf ., Feed Thru | ${ }^{2}$ |  |  |
| c2 c 3 | ${ }_{15}^{1569066-2}$ | Capacitor, 1000 mmf ., disc ceramic Capacitor, 1.5 mm ., disc ceramic | 26 12 12 | 156908-* | R. F. \& Oscillator Coil Assembly |
| ${ }^{\text {c }}$ |  | Capactior, 47 mmpt., 100 , disc ceramic | ${ }_{\text {L8 }}$ | 156900-51 | Choke, Fllament, Mixer |
| c8 | 1588006-5 |  | $\underset{L 10}{29}$ |  | Choke, Prate, yixer |
| ${ }^{\text {c7 }}$ | 155800-5 |  | ${ }_{1}^{210}$ |  |  |
| c8 | 156806-8 |  | 2 |  | Mixer ${ }^{\text {mpcillator (V2) }}$ |
| cs | 156808-9 | Capacitor, 3 mml , $\pm .25 \mathrm{mmf}$., | ${ }_{4}^{4}$ | (1568906-24 | Tube Shiedd (V1) |
| c10 | 159008-10 | disc ceramic |  | 156906-25 | Shield (idde) |
|  | 156806-10 | Capacior, 5 mml , $i .25 \mathrm{mmf}$., | ${ }^{6}$ | -156906-26 | Shield (Botom) |
| c11 | See Ref. 15 |  | ${ }_{8}^{7}$ | - | Roller, Detent |
| $\mathrm{Cl}^{12}$ | ${ }^{1568008-12}$ | Capacitor, 10 mmf ., $10 \%$, disc ceramic | 9 | ${ }_{156900-29}$ | Spring, Shant Retaining |
| $\mathrm{Cl}^{\text {c14 }}$ | (156906-14 | Capacitor, 1000 mml . disc cerramic | 10 | ${ }^{1565006-29}$ | Spring, Shatt Retaining |
| C15 | ${ }_{156906-15}$ | Capacitor, 120 mmit ., 105 , disce ceramic | ${ }_{13}^{12}$ | - | Plate, Fine Tuning Grounding |
| ${ }^{\text {c17 }}$ | 156906-16 | Capacitor, ${ }^{\text {3-9 mmi., }}$ Trimmer, ceramic | 14 | ${ }_{156906-54}$ | Moue Tuning Shatt Assembly |
| ${ }_{\text {c18 }}$ | -156906-17 |  | 15 | 156908-35 | Ceramic Bushing \& Lead Assembly |
| c19 | 156908-17 | Capacitor, 800 mmfi,', Feed Thru |  |  | (Fine Tuning) |
|  | -156906-17 | Capacitor, ${ }^{\text {B00 }} \mathrm{mmf}$., Feed Thru | 17 \% | See cs, c7, \& ${ }^{\text {c16 }}$ | Capacitor, Ceramic Tube |
| ${ }_{\text {R2 }}$ | - 399374 -53 | Reesitor, 330,000 ohm, $1096,1 / 2 \mathrm{~m}$. | 18 |  |  |
| R4 | ${ }^{39374-27}$ |  | 19 20 | - 15 15690606-39 | Nut (8pring), Trimmer |
| ${ }_{\text {R }}^{8}$ | - $19380896-47$ | Reeistor, $10,000 \mathrm{ohm}, 100 \% 1 / 2 \mathrm{~m}$. | ${ }^{21}$ | 156808-41 | Contact Bracket Assembly |
| ${ }_{\text {R }}$ | - $3933744-37$ | Resistor, 220,000 ohm, 109 , $1 / 2 \mathrm{w}$. | ${ }_{26}^{22}$ | ¢ | Coil Support Assembly \& Mnsulated Shatt |
| ${ }_{\text {R8 }}^{\text {R8 }}$ |  | Resistor, 115,000 ohm, $108,1 / 2 \mathrm{~m}$. | 40 | See L10 | 1. F. Assembly |
| R10 | 39374-39 | Reastor, 15,0000 ohmm, $100 \%, 1 / 2 \mathrm{~m}$. |  | See L1, L2 |  |
| ${ }_{\text {R11 }}$ | 39374-39 | Reilitor, 15,000 ohm, $10 \%$, $1 / 2 \mathrm{w}$. | 52 | See L1, L2 | Antenna Coil Assembly |
| ${ }^{13}$ | ${ }^{156807-*}$ | Anterna Coil Assembly | thru\} | See LS, Ls, \& L 7 | R. F. \& Oecllator Coill Aasembly |
| ${ }_{4}$ | 156906-49 156206-50 | Choke, Cathode <br> Choke, Filament, R. F. Amplifier |  |  | VHF Tuner Complete |

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SPECIFICATIONS
POWER SUPPLY: 117 volts, 60 cycle, a.c.
POWER CONSUMPTION 130 watts.
AUDIO POWER OUTPUT: 1.0 watts maximum.
ANTENNA INPUT IMPEDANCE: 300 ohms balanced (Channels 2 thru 13)

## NTERMEDIATE FREQUENCY:

Video Carrier-26.4 mc
Sound Carrier-21.9 mc
Intercarrier Sound- 4.5 mc
DEFLECTION: Electromagnetic
ON TRAP. Single Pe.
HORIZONTAL SCANNING
G FREQ: 15, 750 c.p.s.
FRAME FREQUENCY: $30 \mathrm{c} . \mathrm{p} . \mathrm{s}$
CANNING: Interlaced, 525 lines


## ION TRAP MAGNET ADJUSTMENT

The proper adjustment of the Ion Trap Magnet cannot be overmphasized, for it is not only important to obtain maximum brightness and a good quality picture, but also to the life expect

Place the lon Trap on the neck of the picture tube close to the ube base and over the internal pole pieces that are mounted on this side should be toward the tube face. There are two possible positions on the tube neck where the lon Trap will produce maximum brightness. ALWAYS SET THE ION TRAP IN THE PO-

If the picture tube has been installed or if the receiver has
been moved, it is imperative that the Brightness control be kept eeen moved, it is imperative that the Brightness control be kep at a low setting until after the initial adjustment of the lon rap
and also that the adjustment be made immediately after the receiver is turned on. It is important that the intensity of the beam be low when the receiver starts operating, if the magnet has not
is low enough that the electron beam is not likely to damage the anode top disc before the magnet is adjusted
TO ADJUST THE ION TRAP MAGNET- Set the Brightnes control completely counter-clockwise, then advance slightly clock wise (less than $1 / 4$ turn). Slide the trap forward or backward the neck of the tube and mum brightness. If no raster is obtained with this setting of the Brightness control, advance the control slightly clockwise and repeat adjustment of the trap until a raster appears. The fin
setting of the trap should be made with the Brightness to the maximum position with which good line focus can be ob tained. If neck shadow is encountered, or if the picture is o center, correction should be macke. Never use the Ion Trap correct neck shadow. Always set the trap to the position wher maximum brightness is obtained. After any adjustment of the de flection yoke or centering magnet the Ion Trap should always be checked and readjusted for maximum brightness.

IMPpuxiniv: When it is necessary to remove the cabinet from the cabinet base,
 be exercised to be sure that the correct screws are being loosened. . t is ad-
visazbe, when
the


Removing The Cobinet From The Cobinet Bose

1. Remove the control knobs, the cabinet back, the antenna terminal plate,
and the wires from the speaker (or the speaker from the cabinet). 2. Remove the tro wood scarews on the ninside rear corners that hold the cabinet tase to the wood supports on the botiom of each slde and the tio
screws that hold the chassis to the wood strip on the inside of the cabinet
above the chassis.

 4. through the base at the center front on

Removing The Chassis From The Cobinet Bas
Should it be necessary to trouble shoot or to replace parts in the IF strip,
ine ololowing procedures may be useful in servicing the chassis.

1. Remove the cabinet back and cabinet as outined above.
2. Remove the cabinet back and cabinet as
3. Remove the cRT socket and lon Trap.
4. Disconnect the TRT high voltage leadi
5. Remove the two hex head screws holding the interlock receptacle tothe 5. Rease. Remove the two nuts below the vertical controls (On the screws holding


## Replacing The Picture Tube

. Guide neck of tube through opening in the tube support bracke and deflection yoke, and place bottom of face plate agains stops on tube rests. Be sure the pads are in position betwee the tube and tube rests.
Place pad and strap over tube and insert the two hex hea
screws through the base and screw into the strap brackets but do not tighten.
Replace and tighten the two nuts on the scress that hold the tube support to the chassis. rods, apply the nuts and tighten. Bell of tube should rest against insulating ring on the tube support bracket

Chassis from around the CRT neck. DO NOT ALLOW PRESSURE TO BE
EXERTED ON THE NECK OF THE PICTURE TUBE.
Should it be necessary to use the CRT during service, proceed as follows

1. Remove the yoke wing nut and turn the yoke around.
2. Turn the chassis around and carefuly slide the yok
3. Use a shorl piifece of tape and tape the yoke to the bell of the CRT
Use a short jumper belween the high voltage lead and the CRT.
4. Replace lon Trap and CRT socket.

Removing The Picture Tube
HANDLING PRECAUTIONS - Do not remove or handle the picture tube in any
manner unless heavy gloves and protective gogzles are worn. KEEP TUBE AWAY FROM THE BODY WHLE HANDLNG.

1. Remove cabinet from the chassls and cabinet base as outlined above. 3. Dist tube. Loosen the wing screw on the defilection yoke br
2. Remove the nuls on oth tie rods that extend from the tube support bracket

 Raise tube slightly at the front so that it
rests, and pull the tube forward to remove.
do not allow pressure to be exerted on the neck of the
. Tighten the two screws that hold the strap to the base
. Connect second anode to the tube
. Push deflection yoke forward against flare of tube, and
. Replace ion trap on neck of tube and connect tube socket.
3. Make necessary adjustments on the ion trap and deflection
4. Replace the cabinet over the chassis and base, then follow instructions for "Removing The Chassis From The Cabi.. net", steps 1 to 3 in reverse order

| Step <br> No. | Station Selector | Oscilloscope | Bias | $\begin{aligned} & \text { Signal Generator } \\ & \text { To } \end{aligned}$ | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | Chan.\#10 | High side through a 10,000 ohm resistor to TP1 on Tuner. Ground lead to Tuner Case. | $-1.5$ <br> volts to white lead on tuner. | Signal Generator set to 195.5 MC., 400 cycle $30 \%$ AM modulated. Through Dummy Antenna to the Antenna lead-in. | C-3 for maximum 400 cycle response on scope. Remove signal Generator. |
| 2. | - | mur | - | Sweep Generator to Antenna lead-in through dummy antenna. Set Generator to sweep Channel 10 freq. Loosely couple Marker Generator to sweep output cable. Set marker to either 21.9 or 26.4 mc . | Adjust C5 \& C9, to produce a response curve similar to R.F. and Mixer Response Curve. |
|  |  |  |  |  |  |

Without disturbing the R.F. grid, R.F, plate, and mixer-grid trimmer, check the response on the other VHF TV channels by setting the station selector to the desired channel and changing the frequency of the sweep generator to correspond to the channel being checked. The response curve should be essentially the same on all channels and the markers should fall in similar positions on the response curve. A sligh amount of tilt can be tolerated. The amount of tilt indicated by the relative amplitudes of the respons curves where the picture and sound I.F. Markers rest should not exceed $30 \%$ of the over-all respons curve amplitude

MODELS G-21TOBH, MH, WH, Ch. 431

## 402-4, 402-5, 404-4 \& 404-5



REPLACEMENT PARTS LIST
(Schematic)
Chassis 402-4, 402-5, 404-4 \& 404-5

| $\begin{gathered} \text { Symbol } \\ \substack{\text { No. }} \end{gathered}$ | part No. | Description | $\begin{array}{\|c\|c\|} \hline \text { Symbol } \\ \text { No. } \\ \text { Nol } \end{array}$ | Part No. | Description |
| :---: | :---: | :---: | :---: | :---: | :---: |
| c101 | 156201-1 | Capacitor, 470 mmf ., 2 KV ., disc | $\mathrm{R}_{120}$ |  | Resistor, 33, |
| ${ }^{\text {c102 }}$ | ${ }^{156201-1}$ | Capacitor, 470 mmI ., 2 KV ., disc ceramic | ${ }_{8122} 8121$ | ${ }_{\text {Part of }} \mathbf{3 9 3 7 5 - 3 6 1 1}$ | Resistor, $68000 \mathrm{ohm}, 10 \%, 1 / 2{ }^{\text {R }}$ |
| ${ }^{\text {c } 104}$ | Part of L101 |  | R122 $\mathrm{R123}$ | - ${ }_{\text {3art of }}$ |  |
| ${ }_{\text {clob }}$ | -144675-28 |  | ${ }_{\text {R124 }}$ | 39374-37 | Resistor, $10,000 \mathrm{ohm}, 100 \% 1 / 2 \mathrm{w}$. |
| C107 | 144675-28 | Capacitor, . 001 mfd., $500 \mathrm{v.}$, disc ceramic | $\mathrm{Rl}^{125}$ | 39374-15 | Resistor, $150 \mathrm{ohm}, 10 \%, 1 / 2$ |
| C108 | 144675-28 | pacitor, . $001 \mathrm{mt} ., 500 \mathrm{v}$ v., disc ceramic | ${ }^{\mathrm{R} 126}$ | 39374-49 | Resistor, 100,000 ohm, $10 \%$, $1 / 2$ |
| C109 | Part of Li03 | Capacitor, $68 \mathrm{mmf}, \mathrm{l}$ 10\%, 500 v ., mica | ${ }^{\mathrm{R} 127}$ | 39374-29 | Resistor, 2200 ohm, |
| ${ }^{\text {c110 }}$ | 144675-2 |  | R128 $\mathrm{R129}$ | - $\begin{gathered}\text { 39374-18 } \\ \text { 3934-43 }\end{gathered}$ |  |
| ${ }_{C 111}$ | - $13472727-135$ |  | R130 | 39375-73 | Resistor, 10,000 oh |
| C113 | 154157 | Capacitor, . 5 mfd., 25 v ., paper | $\mathrm{R}^{131}$ | ${ }^{393755-73}$ | Resistor, 10,000 ohm, $5 \%, 1 / 2$ |
| C114 | 137727-10 | Capacitior, 5 mmi., 500 v ., ceramic | R132 | 155352 | Control, Brighness ( 5 megohm) |
| C115 | 39001-19 | Capacitor, 1.1 mfd , 600 v ., paper | R133 | 154094 | Control, For |
| ${ }^{1116}$ | 39001 -86 | Capacitor, ${ }^{2}$ mfd., 600 v ., paper |  |  | and $402-5$ chas8is only) |
| ${ }^{117}$ | 154100-4 |  | ${ }_{\text {R134B }}^{\text {R134 }}$ | 154085 |  |
| C118 | - ${ }_{\text {137727-126 }}$ | Capacitior, 005 mfd , $500 \mathrm{v.}$, | ${ }_{\text {R135 }}^{\text {R134 }}$ | 39374-53 | Resistor, $220,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| C120 | $39001-19$ | Capacitor, 11 mfd ., 600 v ., , paper | R136 | 39374 | Resistor, 2.2 megohm, |
| ${ }^{\mathrm{Cl21}}$ | 137727-133 | Capacitor, $68 \mathrm{mmf} ., 1090$, 500 v ., ceramic | R137 | 39374-61 |  |
| ${ }^{\text {c122 }}$ | 144675-6 | Capacitor, $004 \mathrm{mfd}, 400 \mathrm{v}$, Assembly | ${ }^{\text {R138 }}$ | ${ }_{\text {393 }}^{39374-146}$ |  |
| ${ }_{\text {C123 }}$ | Part of T102 | Capacitor, 10 mmf . | R140 | 39374-31 | Resistor, 330 |
| C124 | art of T | Capactlor, 100 mmf . | R141 | 39374-35 | Resistor, 6800 ohm, $10 \%, 1 / 2 \mathrm{w}$. |
| C125 | 154103 | Capacitor, 5 mfd., 50 v ., Electrolytic | R142 | 39374-29 | Resistor, 2200 ohm, $10 \%, 1 / 2 \mathrm{w}$. |
| C126 | 137727-129 | Capacitor, 330 mmf ., 500 v ., ceramic | ${ }^{\text {R143 }}$ | 39374-41 | Resistor, $22,000 \mathrm{ohm}, 106,1 / 2 \mathrm{w}$. |
| ${ }^{\text {c127 }}$ | 144675-2 | Capacitor, . 005 mfd , 500 v ., disc ceramic | ${ }^{\text {R144 }}$ | ${ }^{39374-37}$ |  |
|  | - ${ }_{\text {137627- }}$ | Capacitor, 0001 mfd ., 500 v ., disc ceramic | R145 R146 R18 | - | Resistor, Control, $V$ Vertical Hold |
| c129 | ${ }^{139477-39}$ | Capacitor, 2004 mld , $600 \%$ v., molded paper | R147 |  | Co |
| $\mathrm{Cl}^{131}$ | 137727-26 | Capacitor, 22 mmf . 500 v ., ceramic | R148 | 39374-125 | Resistor, $10,000 \mathrm{ohm}, 10 \%, 1 \mathrm{w}$. |
| C132 | 39001-17 | Capacitor, . 05 mid., $600 \mathrm{v}$. , paper | R149 | 39374-60 | Resistor, $820,000 \mathrm{ohm}, 10 \%, 1 / 2$ |
| C133 | 39477-39 | Capacitor, . 0047 mfd ., 600 v ., molded paper | R150 | 39374-33 | Resistor, 4700 oh |
| C134 | 39477-39 | Capacitor, .0047 mid , 600 v ., molded paper | ${ }^{\text {R151 }}$ | 155576 | Control, Noise Gate (90,000 ohm) |
| C135 | 39478-41 | Capacitior, . 01 mfd., 600 v ., $10 \%$, molded paper | ${ }^{\text {R152 }}$ | ${ }_{39374-215}^{15559}$ | Control, vertical Linearity |
| C136 | ( $\begin{array}{r}39001-78 \\ 39477-45\end{array}$ |  | R153 $\mathrm{R154}$ | ${ }_{\text {39374-14 }}$ | Resistor, ${ }^{\text {R }}$, |
| C138 | 39477-45 | Capactitor, . 047 mfd , 600 v. , molded paper | R155 |  | Resistor, 1500 ohn |
| C139 | 144675-2 | Capacitor, . 005 mfd., 500 v ., disc ceramic | ${ }^{\text {R156 }}$ | 155389 | Control, Tone (250,000 ohm) |
| C140A | 5438 | Capacitor, $10 \mathrm{mfd} ., 300 \mathrm{v}$ | ${ }^{\text {R157 }}$ | 39374-43 | Resistor, $33,000 \mathrm{ohm}, 108,1 / 2 \mathrm{w}$. |
| ${ }^{\text {C140B }}$ |  | apacitor, 200 mfd., 150 v . ${ }^{\text {a }}$ Electrolytic | R158 | 154089 | Resistor, $7.5 \mathrm{ohm} 10 \%,, 5 \mathrm{w}$. Wire Wound |
| C140C |  |  | R159 8160 | 39374-49 | Resistor, 100,000 ohrn, $10 \%$, $1 / 2 w$. |
| ${ }_{\substack{\text { C140D } \\ \text { C141 }}}^{\text {ciel }}$ | 154097 |  |  | - $\begin{array}{r}39374-49 \\ \text { 3934-41 }\end{array}$ | Resistor, 100,000 ohm, $10 \%, 1 / 2 w$. |
| C142 | 154104 | Capacitor, 10 mdd ., 50 v ., Electrolytic |  | 39374-139 | Resistor, $150,000 \mathrm{ohm}, 10 \%, 1 \mathrm{w}$. |
| ${ }^{\text {c } 143}$ | 144675-2 | Capacitor, . 005 mid., 500 v ., disc ceramic | 8163 | 39374-77 | Resistor, 4.7 megohm, $10 \%, 1 / 2 \mathrm{w}$. |
| ${ }^{\text {C144 }}$ | 39001-13 | Capacitor, . 01 midd , 600 v ., paper | ${ }^{8164}$ | 39374- | Resistor, 4.7 megohm, $108,1 / 2 \mathrm{w}$. |
| C145 | 39001-82 | Capacitor, . 03 midd, 600 v ., paper | 8165 |  | Resistor, 1200 ohm, $10 \%$, $1 / 2 \mathrm{w}$. |
| ${ }^{\text {C146 }}$ | 39001-80 | Capacitor, . 02 mfd., $600 \mathrm{v}$. ., paper | R166 | 39374-34 | Resistor, 5600 ohm, $108,1 / 2 \mathrm{w}$. |
| $\mathrm{Cl}^{147}$ | 155684 | Capacitor, 140 mid , 150 v ., Electrolytic | ${ }^{\text {R167 }}$ | 39374-33 | Resistor, $4700 \mathrm{ohm}, 10 \%, 1 / 2 w$. |
|  | 155426 |  | R168 $\mathbf{R 1 6 9}$ | ${ }^{39374-45}$ |  |
| C149 | 137727-132 | Capacitor, 1000 mml ., 500 v ., ceramic | 8170 | 39374-36 | Resistor, $8200 \mathrm{ohm}, 108,1 / 2 \mathrm{w}$. |
| C150 | 137727-132 | Capacitor, 1000 mmf ., 500 v ., ceramic | R171 | 39374-50 | Resistor, $120 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| ${ }_{6} \mathbf{C 1 5 1}$ | ${ }^{394748-108}$ | Capacitor, . 001 mfd., $108 \%$, 1000 v ., molded paper | ${ }^{\text {R172 }}$ | 39374-57 | Resistor, $470,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| ${ }_{\text {c }}{ }^{\text {c }}$ | 146434-16 | Capacitor, $0006 \mathrm{mid}, 10 \%, 600 \mathrm{v}$ | ${ }^{8173}$ | ${ }_{\text {13937-8 }}$ |  |
| ${ }_{\text {c }}$ | ${ }_{\text {137727-134 }}$ | Capacitor, 003 mla , $600 \mathrm{v.}$, |  |  | \& 404-5 Chassis only |
| ${ }^{\text {c15 }}$ | 39001-13 | Capacitor, 01 mfd , 600 v ., paper | ${ }^{\text {R17 }} 175$ | ${ }^{39303-12}$ | Resistor, 2.2 hhm , (Part of T108; |
| ${ }_{C}^{C 156}$ | $137499-30$ <br> $13799-36$ | Capacitor, 3900 mmf , 500 v ., mica | R176 | - ${ }_{\text {393374-139 }}$ |  |


| C158 | 137499-31 | Capacitor, 390 mmf , 500 v., mica |
| :---: | :---: | :---: |
| C159 | 144675-2 | Capacitor, . $005 \mathrm{mid}$. , 500 v ., disc ceral |
| C160 | 39001-17 | Capacitor, $.05 \mathrm{mid} ., 600 \mathrm{v.}$, |
| C161 | 144675-2 | Capacitor, . 005 mfd , , 500 v v., disc ceraı |
| C162 | 157046-1 | Capacitor, 100 mmf , $10 \%, 3 \mathrm{KV}$., disc |
| C163 | 39001-19 | Capacitor, . 1 mfd , 600 v., paper |
| C164 | 154211 | Capacitor, 47 mmf , 2 EV ., mica (Part |
| C165 | Part of L115 | Capacitor, . 1 mfd., 200 v., paper |
| C169 | 39001-17 | Capacitor, . 05 mtd , , 600 v ., paper |
| C170 | 144675-2 | Capacitor, . 005 mfd , , 530 v ., disc ceras |
| C171 | 39001-82 | Capacitor, . $03 \mathrm{mid} ., 600 \mathrm{v}$., paper |
| C172 | 39001-5 | Capacitor, 0005 mfd , 600 v ., paper |
| R101 | 39374-57 | Resistor, $470,000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| R102 | 39374-57 | Resistor, 470, $000 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| R103 | 39374-17 | Resistor, 220 ohm, $100 \% 1 / 2 \mathrm{w}$. |
| R104 | 39375-63 | Resistor, 3900 ohm, $5 \%$. $1 / 2 \mathrm{w}$. |
| R105 | 39374-9 | Resistor, $47 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| R106 | 39374-33 | Resistor, 4700 ohm, $10 \%, 1 / 2 \mathrm{w}$. |
| R107 | 39375-73 | Resistor, $10,000 \mathrm{hm}, 5 \% ; 1 / 2 \mathrm{w}$. |
| R108 | 39374-25 | Resistor, $1000 \mathrm{ohm}, 10 \mathrm{~S}, 1 / 2 \mathrm{w}$. |
| R109 | 39374-25 | Resistor, $1000 \mathrm{ohm}, 10 \mathrm{~S}_{5}^{\prime}, 1 / 2 \mathrm{w}$. |
| R110 | 39374-11 | Resistor, $68 \mathrm{ohm}, 10 \%, 1 / 2 \mathrm{w}$. |
| R111 | 39374-25 | Besistor, $1000 \mathrm{ohm}, 10 \mathrm{~S}, 1 / 2 \mathrm{w}$. |
| R112 | 39375-75 | Resistor, 12,000 ohm, ;\%, 1/2 w. |
| R113 | 39374-15 | Resistor, $150 \mathrm{ohm}, 10 \% 1 / 2 \mathrm{w}$. |
| R114 | 39374-25 | Resistor, $1000 \mathrm{ohm}, 10 ¢, 1 / 2 \mathrm{w}$. |
| R115 | 39374-65 | Resistor, 1.5 megohm, $10 \%, 1 / 2 \mathrm{w}$. |
| R116 | 39375-65 | Resistor, 4700 ohm, $5 \% 1 / 2 \mathrm{w}$. |
| R117 | 39374-57 | Resistor, 470, 00 C ohm, $10 \%, 1 / 2 \mathrm{w}$. |
| R118 | 39374-61 | Resistor, 1 megolum, 10\%, $1 / 2 \mathrm{w}$. |
| R119 | Part of L108 | Resistor, $8200 \mathrm{ohm}, 10 \mathrm{p}, 1 / 2 \mathrm{w}$. |

## REPLACEN

Chassis 402-4,

| Symbol | Part No, | Description |
| :---: | :---: | :---: |
| T102 | 154108 | Transformer, Ratio Detector |
| T103 | 155255-1 | Transformer, Vertical osclllator |
| T104 | 155572 | Transformer, Ve.tical dutput |
| T105 | 154109-2 | Transformer, Audio Output |
| T106 | 155390 | Transformer, Filament |
| T107 | 155529-1 | Choke, Filter |
| T108 | 157045-1 | Transformer, Horizontal Deflection |
| CO102 | 138352 | Socket, Speaker |
| CO103 | 154114 | Socket, Terminal Strip |
| SW101 | Part of R134A \& B | Switch, ON-OFF Power |

## I.F. ALIGNMENT

## SOUND ALIGNMENT

All lead connections from the signal marker generator and sweep generator must be shielded. Keep exposed ends and
 respective "hot" leads in the television receiver chassis. The sweep generator output, signal generator output, and contrast the alignment (Procedure A or B).
CAUTION: One side of the chassis is connected to the power line. Therefore, test equipment should not be connected to the Step
receiver unless an isolation transformer is used between the power line and the receiver. DO NOT GROUND No. THE RECEIVER CHASSIS UNLESS AN ISOLATION TRANSFORMER IS USED.

The front side of the chassis as referred to below means the side opposite the tubes.
The rear side of the chassis means the side on which the tubes are mounted.
VIDEO I. F. ALIGNMENT (with VTVM)
In the I.F. Alignment, limit input of signal generator so that reading on VTVM does not exceed $\mathbf{- 2}$ volts.
\(\left.$$
\begin{array}{|l|c|c|c|c|c|}\hline \begin{array}{l}\text { Step } \\
\text { No. }\end{array} & \begin{array}{c}\text { Connect Sig- } \\
\text { nal Generator } \\
\text { Through a .01 } \\
\text { Capacitor }\end{array} & \begin{array}{c}\text { Signal Gen. } \\
\text { Freq. MC. }\end{array}
$$ \& Connect <br>

VTVM\end{array}\right]\)| Miscellaneous <br> Connections and <br> Instructions |
| :---: |
| 1. |
| Test Point <br> No. 2 on Tuner <br> (closest to L9 <br> slug adjust- <br> ment). |



| Channel <br> Set To | Adjust |
| :--- | :--- |
| Any <br> unused <br> channel | Connect a crystal controlled 4.5 mc., 400 <br> cycle amplitude modulated signal ( $30 \%$ <br> or greater) between pin 8 of V104 and <br> chassis. Connect high side of scope <br> through a detector probe to cathode of <br> picture tube, low side to chassis. Adjust <br> L109 (rear slug) for minimum 400 cycle <br> indication on scope. |

Remarks
Connect a crystal controlled 4.5 mc ., 400
Remove signal generator and scope from the receiver.

Proceed with the remainder of the Sound Alignment, using either a signal from a TV station as in Procedure A, or alignment equipment as in Procedure B.
 L101 (front slug) fir Nonnerman clip end of coil.

VTVM. Use first null obtained frection on of turret type VHF tuner is used on this receiver, and there is an oscillator adjustment for each channel. When the receiver coil form opposite tinnerman clip. L9 (brass screw) on the Tuner for maximum. screw is directly below the tuner shaft, and is accessible through a hole in the front of the chassis after the two VHF tuning screw is directly below the tuner shaft, and is accessible through a hole in the front of the chassis after the two VHF tuning
knobs have been removed. Use a non-metallic screw driver and adjust the oscillator trimmer screw until the proper tuning


Note 1. This adjustment can be made only on receivers where the Adjacent Channel Trap has been added. For installation of this trap in areas where adjacent cha
TO CHECK I. F. ALIGNMENT (with scope)
Excessive sweep input will overload the circuit and cause distortion in the wave form. Check for possible overload by tem Excessive sweep input will overload the circuit and cause distortion in the wave form. Check for pos
porarily increasing and decreasing the signal input level and noting any change in the wave form.
Excessive signal from the marker generator will also distort the wave form. Be sure to keep the marker at the minimum Excessive signal
usable amplitude.
Sweep Gen.

| Scope Connected to | Bias | Sweep Gen. Set to | Remarks |
| :---: | :---: | :---: | :---: |
| High side of contrast control R120 and chassis. Contrast control at minimum contrast. | Connect 3 volt bias battery negative lead to white lead from tuner, positive lead to chassis. | Sweep from 20 to 30 megacycles. | Provide markers as shown on curve. <br> A slight deviation in response curve is tolerable, but if aty great deviation is noted, the I. F. stages will have to be realigned. |

Remarks
Set Buzz Control (R132) approximately $90^{\circ}$ from clockwise stop. peaks, remove the antenna from the receiver. This signal shouldbe weak enough to allow noise (hash) to come through along with the sound. be heard. be heard.

Ungrounded
Ungrounded
shield of V2 and chassis.

L9
ies
resistor in series across L101.

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## VHF OSCILLATOR ALIGNMENT



FRONT VIEW OF CHASSIS 431
(Tube \& Alignment Locations)


(Tube \& Alignment Locations \& Tube Filament Wiring) Mrénoox

## OSCILLATOR ALIGNMENT (using scope)

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | Oscilloscope | Channel Selector | Sweep Generator | Marker Generator | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | High side of scope to high side of R120 contrast control. Low side to chassis. <br> See Note. | Chan. *2 | To sweep Channel Crequencies. Connect Gen. output in series with dummy antenna to antenna lead-in. (See sketch of dummy antenna, page 6.) | 59.75 Sound <br> I. F. Carrier. | Channel 2 oscillator slug so that marker falls into bottom of valley on curve (the point corresponding to the 21.9 mc . marker as shown on Nominal Overall I. F. Response Curve sketch.) Be sure that the Fine Tuning Control is set to the center of its range. |

2. Repeat the above procedure for each of the remaining channels, by resetting the sweep generator and the marker generator to the correct frequencies for each channel that is to be adjusted.
Note: Apply a -3.0 volts negative bias to Junction of C111 and R117 or to white lead from VHF R. F. Tuner.

| PROCEDURE B (with alignment equipment) |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| Step <br> No. | Connect <br> Signal Gen. | Signal Gen. <br> Freq. MC. | Connect <br> Scope | Miscellaneous Instructions |

## HORIZONTAL BLOCKING OSCILLATOR ALIGNMENT

Tune Receiver to follows:

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | Contrast Control Set For | Miscellaneous | Adjust |
| :---: | :---: | :---: | :---: |
| 1. | Normal Picture | --------------------- | Horizontal Hold Control (R164) and Horizontal Frequency Adjustment (rear slug of T108) until picture is in sync. |
| 2. | " | Connect scope in series with 10 mmf . to lug 4 of T108. | Adjust Horizontal BTO Trap (front slug of T108) to obtain the waveform shown below. Keep the picture in sync at all times by readjusting the Horizontal Hold, Horizontal Frequency and/or Horizontal Lock Trimmer (C142). |



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| Symbol | Tube | Function | Symbol | Tube | Function |
| :---: | :---: | :---: | :---: | :---: | :---: |
| V1 | 6BC5 | R. F. Amplifier | V107 | 6SN7GT | Horizontal AFC \& Horizontal Oscill |
| v2 | 6 J 6 | VHF Oscillator \& Mixer | V108 | 25L6GT | Audio Output |
| V101 | 6CB6 | 1st I. F. Amplifier | V109 | 25CU6 | Horizontal Output |
| V102 | 6CB6 | 2nd I. F. Amplifier | V110 | 12BH7 | Vertical Oscillator \& Vertical Output |
| V103 | 6AM8 | 3rd I.F. Amplifier \& Video Detector | V111 | 12AX4GT | Horizontal Damper |
| V104 | 6AN8 | Video Amplifier \& Sync Clipper | V112 | 1 x 2 B | High Voltage Rectifier |
| V105 | $6 \mathrm{U8}$ | 4.5 mc . I. F. Amplifier \& Sync Amplifier | V113 | 17AVP4 | Picture Tube |
| V106 | 6BN6 | Limiter-Discriminator \& Audio Amplifier |  |  |  |


| UHF CONVERTER |  |
| :---: | :--- | :---: |
| (Used on "U" Models Only) |  |

R.F. AND MIXER ALIGNMENT

| $\begin{aligned} & \text { Step } \\ & \text { No. } \\ & \hline \end{aligned}$ | Station Selector | Oscilloscope | Bias | $\begin{gathered} \text { Signal Generator } \\ \text { To } \end{gathered}$ | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | Chan. \#10 | $\begin{aligned} & \text { High side } \\ & \text { through a } \\ & 10,000 \text { ohm } \\ & \text { resistor to } \\ & \text { TP1 on Tuner. } \\ & \text { Ground lead to } \\ & \text { Tuner Case. } \end{aligned}$ | $\begin{aligned} & -1.5 \\ & \text { volts to } \\ & \text { white } \\ & \text { lead on } \\ & \text { tuner. } \end{aligned}$ | Signal Generator set to 195.5 MC., 400 cycle $30 \%$ AM modulated. Through Dummy Antenna to the Antenna lead-in. | C-3 for maximum 400 cycle response on scope. Remove signal Generator. |
| 2. | - | - | - | Sweep Generator to Antenna lead-in through dummy antenna. Set Generator to sweep Channel 10 freq. Loosely couple Marker Generator to sweep output cable. Set marker to either 21.9 or 26.4 mc . | Adjust C5 \& C9, to produce a response curve similar to R.F. and Mixer Response Curve. |
|  |  |  |  | R. F. \& MIXER RESPONSE CURVE |  |

Without disturbing the R.F. grid, R.F. plate, and mixer-grid trimmer, check the response on the other VHF TV channels by setting the station selector to the desired channel and changing the frequency of the the same on all channels and the markers should fall in similar positions on the response curve. A slight amount of tilt can be tolerated. The amount of tilt indicated by the relative amplitudes of the response curves where the picture and sound I.F. Markers rest should not exceed $30 \%$ of the over-all response curve amplitude.
I.F. ALIGNMENT

All lead connections from the signal mark inch Always locate generator must be shielded. Keep exposed ends and ground leads as short as possible (aboureiver chassis. The sweep genernd lead connections as close as possible to their control must be kept low enough to prevent overloading the television receiver circuits.
CAUTION: One side of the chassis is connected to the power line. Therefore, test equipment should not be connected to the receiver unless an isolation transformer is used between the power line and the receiver. DO NOT GROUND receiver unless an isolation transiormer is used between the power line
THE RECEIVER CHASSIS UNLESS AN ISOLATION TRANSFORMER IS USED.

The front side of the chassis as referred to below means the side opposite the tubes.
The rear side of the chassis means the side on which the tubes are mounted.
VIDEO I. F. ALIGNMENT (with VTVM)

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | Connect Signal Generator Through a .01 Capacitor | Signal Gen. Freq. MC. | Connect VTVM | Miscellaneous Connections and Instructions | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | Test Point No. 2 on Tuner (closest to L9 slug adjustment). | 24.4 mc . | Junction of R11.8 and C113 and chassis. | Connect 3 volt bias battery negative lead to white lead from tuner, positive lead to chassis | T101 for maximum indication on meter, limit input to make peak less than -2 volts D.C. on VTVM. |
| 2. |  | 22.9 mc . | " | " | L103 (rear slug) for maximum. Use first peak from tinnerman clip end of coli. |
| 3. | " | 21.9 mc . | " | " | L103 (front slug) for minimum. Input level should be high enough to produce at least . 5 volts at null on VTVM. Use first null obtained from end of coil form opposite tinnerman clip. |
| 4. | Repeat steps 2 and 3. |  |  |  |  |
| 5. | " | 25.5 mc . |  |  | L102 for maximum. |
| 6. | " | 25.1 mc. | " | " | L101 (front slug) for maximum. Use first peak from tinnerman clip end of coil. |
| 7. | " | 27.9 mc . | " | " | See Note 1. <br> L101 (rear slug) for minimum deflection on VTVM. Use first null obtained from end of coil form opposite tinnerman clip. |
|  | Repeat step 6 (and 7, if adjacent channel trap is used). |  |  |  |  |
| 9. | Test Point No. 1 on Tuner (closest to C21 trimmer screw). | 25.1 mc. |  | Connect a 100 ohm resistor in series with a 1000 mmf . cap. across L101. | L9 (brass screw) on the Tuner for maximum. |

Note 1. This adjustment can be made only on receivers where the Adjacent Channel Trap has been added. For installation of this trap in areas where adjacent channel interference is prevalent, see page 4.

## TO CHECK I. F. ALIGNMENT (with scope)

Excessive sweep input will overload the circuit and cause distortion in the wave form. Check for possible overload by temporarily increasing and decreasing the signal input level and noting any change in the wave form.
Excessive signal from the marker generator will also distort the wave form. Be sure to keep the marker at the minimum usable amplitude.

| Sweep Gen. Connected to | Scope Connected to | Bias | Sẅeep Gen. Set to | Remarks |
| :---: | :---: | :---: | :---: | :---: |
| Ungrounded shield of V2 and chassis. | High side of contrast control R120 and chassis. Contrast control at minimum contrast. | Connect 3 volt bias battery negative lead to white lead from tuner, positive lead to chassis. | Sweep from 20 to 30 megacycles. | Provide markers as shown on curve. <br> A slight deviation in response curve is tolerable, but if any great deviation is noted, the I. F. stages will have to be realigned. |

## VHF OSCILLATOR ALIGNMENT

## OSCILLATOR ALIGNMENT (using scope)

| Step <br> No. | Oscilloscope | Channel Selector | Sweep Generator | Marker Generator | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | High side of scope to high side of R120 contrast control. Low side to chassis. See Note: | Chan. \#2 | To sweep Channel 2 Freq. Connect Gen. output in series with dummy antenna to antenna lead-in. | 59.75 Sound I.F. Carrier. | Channel 2 oscillator slug so that marker falls into bottom of valley on curve (the point corresponding to the 21.9 mc . marker as shown on Nominal Overall I.F. Response Curve sketch.) Be sure that the Fine Tuning Control is set to the center of its range. |

2. Repeat the above procedure for each of the remaining channels, by resetting the sweep generator and the marker generator to the correct frequencies for each channel that is to be adjusted.

Note: Apply a -3.0 volts negative bias to Junction of C111 and R117 or to white lead from VHF R.F. Tuner. Use whichever is the most convenient point.

## ALTERNATE OSCILLATOR ALIGNMENT

A turret type VHF tuner is used on this receiver, and there is an oscillator adjustment for each channel. When the receiver is installed, the oscillator should be adjusted for each channel on which a station is operating in the area. Set the Channel Switch to the channel that is to be adjusted. Turn the Fine Tuning conis accessible through a hole in the front of the chassis after the two VHF tuning knobs have been removed. Use a non-metallic screw driver and adjust the oscillator trimmer screw until the proper tuning point is in the center of the Fine Tuning range.


SOME MODELS DO NOT have
an oscillator tank trimmer

## VHF TUNER

## HORIZONTAL BLOCKING OSCILLATOR ALIGNMENT

Tune Receiver to TV signal, adjust contrast control for normal picture below limiting in the Video Amplifier, and proceed as follows:

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | Contrast Control Set For | Miscellaneous | Adjust |
| :---: | :---: | :---: | :---: |
| 1. | Normal Picture |  | Horizontal Hold Control (R164) and Horizontal Frequency Adjust ment (rear slug of T108) until picture is in sync. |
| 2. | " | Connect scope in series with 10 mmf . to lug 4 of T108. | Adjust Horizontal BTO Trap (front slug of T108) to obtain the waveform shown below. Keep the picture in sync at all times by readjusting the Horizontal Hold, Horizontal Frequency and/or Horizontal Lock Trinimer (C142). |
| 3. | " | Horizontal Hold set fully clock-wise. | Adjust Horizontal Frequency (rear slug of T108) by turning out until the picture is just out of sync. Then turn the control slowly in until the picture is just ready to fall into sync (indicated by a wide black vertical or diagonal horizontal blanking bar) |
| 4. | " | Horizontal Hold set fully counter-clockwise. | Picture should normally be in sync. Remove the signal by tuning off and then re-tuning to the station. If more than seven bars are present, adjust the Horizontal Lock Trimmer slightly counterclockwise until three or four bars appear when the receiver is tuned off and then re-tuned to the station (Horizontal Hold Control still set fully counter-clockwise). If less than three bars are present, adjust the Horizontal Lock Trimmer clockwise to obtain the three or four bars as described above. <br> Since the Horizontal Lock Trimmer adjustment affects the horizontal frequency, the adjustments of both the Horizontal Frequency Adjustment and the Horizontal Lock Trimmer must be repeated until the conditions outlined in steps 3 and 4 exist simultaneously at the extreme positions of the Horizontal Hold control. |
| 5. | Weak Picture |  | Set the Horizontal Hold Control so that when the receiver is tuned off and then re-tuned to the station, the picture returns completely in sync. |

table of socket voltages
The following voltages were measured with an electronic voltmeter while the set was operating on 117 volts, 60 cycle a.c. minimum setting. Electronic voltmeter connected between socket lug and chassis. $\#=A C$. voltages. Voltages may vary de pending upon the setting of other controls. D. C. current at junction of L108 and C132B, with contrast control in the minimum counter-clockwise position, 190 ma. With

| SYMBOL | TYPE | PIN 1 | PIN 2 | PIN 3 | PIN 4 | PIN 5 | PiN 6 | PIN 7 | PIN 8 | PIN 9 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| V101 | ${ }^{\text {8CB6 }}$ | -. 6 | +. 6 | *50.4 | *44.1 | +128 | +125 | 0 |  |  |
| V102 | ${ }^{6 C B 6}$ | -1.0 | +. 8 | *4.1 | *37.8 | ${ }_{+139}$ | +139 | 0 | --- | --- |
| V103 | 8AM8 | $\stackrel{+1.1}{+88}$ | $\cdots$ | +139 | *37.8 | *31.5 | +142 | 0 | -0.8 | 0 |
| V104 | 6AN8 | +88 +54 | 0 | +80 | *31.5 | *25.2 | +250 | +237 | +1.8 | +6.2 |
| V106 | 6BN6 | +2.8 | --- | ${ }_{* 44.1}$ | *37.8 | ${ }_{+}^{*}+18.9$ | +62 | ${ }_{+1.8}^{+100}$ | 0 | +0.1 |
| V107 | ${ }^{\text {BSN76T }}$ | -5.2 | $\begin{aligned} & +79 \text { to } \\ & +141 \end{aligned}$ | +8.6 | -80 | +214 | - | ${ }_{*}^{+12.6}$ | *-8.3 | --- |
| V108 | ${ }^{25 L 6 G T}$ | --- | *81.7 | +255 | +280 | +139 | --- | *56.7 | +150 |  |
| V109 | 25Cub | --- | *81.7 | --- | +130 | -23.5 | --- | *56.7 | +150 | Cap-- High |
| V110 | ${ }^{12 \mathrm{BH7}}$ | +63 | -19 | 0 | *18.9 | *18.9 | $\bullet+480$ | +64 |  |  |
| V111 | ${ }_{1 \times 2 \mathrm{~B}}^{12 \mathrm{AX}}$ | --- | --- | - +520 | 10.9 | +265 | -4880 | ${ }_{* 81.7}$ | ${ }_{* 94}^{+85}$ | * ${ }^{12.8}$ |
|  |  |  | --- | -- | - | --- | --- | --- | $\underset{\text { H. }}{\text { H }}$. |  |
| V113 | 17AVP4 | * 0 | --- | --- | --- | --- | Gnd or | (Pin 10) | (Pin 11) | (Pin 12) |
| V 1 | ${ }^{68 C 5}$ | --- | --- | *44.1 | *50.4 | +135 | +150 +128 | ${ }_{0}^{+300}$ | +150 | ${ }^{* 6.3}$ |
| V2 | 6J6 | +82 | +87 | *50.4 | *56.7 | +135 | ${ }_{-6.0}^{+128}$ | ${ }_{0}^{0}$ | ---- | ---- |

## SOUND ALIGNMENT

The 4.5 mc trap (front of L109) must be aligned first, regardless of which procedure is used for the remainder the alignment (Procedure A or B)

| Step <br> No. | Channel <br> Set To | Adjust | Remarks |
| :---: | :--- | :---: | :---: |
| 1. | Any <br> unused <br> channel | Connect a crystal controlled 4.5 mc., 400 <br> cycle amplitude modulated signal (30\% <br> or greater) between pin 8 of V104 and <br> chassis. Connect high side of scope <br> through a detector probe to cathode of <br> picture tube, low side to chassis. Adjust <br> L109 (rear slug) for minimum 400 cycle <br> indication on scope. | Remove signal generator and scope from the receiver. |

Proceed with the remainder of the Sound
alignment equipment as in Procedure B.
PROCEDURE A (with signal from station)

| Step <br> No. | Channel <br> Set To | Adjust | Remarks |
| :---: | :---: | :--- | :--- |
| 1. | Strong <br> signal | L106 for maximum sound output. | Set Buzz Control (R132) approximately $90^{\circ}$ from clock- <br> wise stop. |
| 2. | Weak <br> Wignal | L111 and L109 (front slug) for maximum <br> sound output. | If the signal in the area is too strong to obtain these <br> seaks, remove the antenna from the receiver. |
| 3. | Weak <br> signal | Buzz Control (R132) for minimum noise <br> (hash). | This signal should be weak enough to allow noise (hash) <br> to come through along with the sound. |
| 4. | Strong <br> signal | L106 again for maximum sound output. | Limit the volume control setting so that this peak can <br> be heard. |


| Step No. | Connect Signal Gen. | Signal Gen. Freq. MC. | Connect Scope | Miscellaneous Instructions | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | $\begin{aligned} & \operatorname{Pin}_{\text {P104. }} 8 \text { of } \\ & \text { V } \end{aligned}$ | 4.5 mc . <br> FM modulated 400 c.p.s., 25 kc . deviation. | Across secondary of output trans. T105. | Set Buzz Control (R132) to approximately $90^{\circ}$ from clockwise. stop. Set the Volume Control (R135) at a low level. | L106 for maximum 400 cycle indication on scope. |
| 2. | " | " | " | " | L111 for maximum response keeping input signal at a low level (below limiting). |
| 3. | " | " | " | " | L109 (front slug) for maximum response keeping input signal at a low level. |
| 4. | " | 4.5 MC. <br> AM modu- <br> lated <br> 400 c.p.s. | " | Use a high input level on signal generator. | Buzz Control (R132) for null (minimum 400 c.p.s. amplitude on scope). |
| 5. | " | 4.5 MC. <br> FM modu- <br> lated <br> 400 c.p.s., 25KC. <br> deviation. | " | $\begin{aligned} & \text { Set the Volume Control } \\ & \text { (R135) at a low level. } \end{aligned}$ | Re-peak L106 for maximum 400 cycle indication on scope. |


fRONT VIEW OF CHASSIS 432
(Tube \& Alignment Locations)


REAR VIEW OF CHASSIS 432
(Tube \& Alignment Locations
\& Tube Filament Wiring)

SCHEMATIC UHF CONVERTER
(Part No. 158116)





THIS CONVERTER, PART NO. 158116, MAY ALLO BE USED TO CONVERT NON-UHF RECEIVERS TO UHF, TRD SET,
PART NO. $158156-1$, CONTANS THE NECESARY KNOBS, HARDWRE \& INSTRUCTONS, ETC., REQURED FOR THIS

| Symbol No. | Part No. | Description |
| :---: | :---: | :--- |
| R6 | $158186-12$ | Resistor, 4000 ohm, 10 w., Wirewound |
| SW1 | $157867-1$ | Switch, VHF-UHF |
| T3 | $157915-1$ | Transformer, Filament |
| CA1 | 157982 | Transmission Line, (125 ohm) order in feet only |
| *CR1 | 158186-21 | Crystal Mixer, 1N82A |
|  | $158186-22$ | Crystal Mixer, 1N82 |
|  | $158186-23$ | Crystal Mixer, 4JB2C-9 |
|  | $157884-1$ | Bracket, Tuner and Resistor Mounting |
|  | 157896-1 | Bracket, Tuner and Transformer Mounting |
|  | $157783-1$ | Grommet (Nylon), 3 used |
|  | $158038-1$ | Insulator (Plastic sleeve), Pulley Hub |
|  | $157940-1$ | Standoff (Fibre), Antenna |

*When replacing the crystal, it is best to make the replacement with the same type crystal as the one originally used in the converter. Because of slight variations between crystals of the same part number, it is generally considered good practice to try several different crystals of a particular type to select the one that gives the best performance in that particular converter.


O John P. Rider


## NOTES

VHF TUNER

SCHEMATIC REPLACEMENT PARTS LIST
CHASSIS 432

1. All capacitance in mmf. and all resistance in ohms unless otherwise specified.

## . $K=1000$

3. TUNER STRIPS. One Antenna Coil Assembly and one R.F. and Oscillator Coil Assembly are necessary for each channel to be received (VHF or UHF). The dash number following the part number indicates the channel for which the assembly is designed.
Examples for VHF: 158021-2 is the Antenna Coil Assembly for Channel 2.
158022-13 is the R.F. and Oscillator Coil Assembly for Channel 13.
UHF coils are not furnished as part of the tuner. The two coil assemblies required for any UHF channel may be ordered as one part under part numbers 158023-14 (for channel 14) through ( tuner in this chassis.

## NOTES

1. All D.C. voltages measured with an electronic voltmeter connected from socket lug to chassis Some voltages are variable depending upon signal input. Voltages shown were measured with a signal voltage of 850,000 microvolts and with a normal picture on the picture tube and the con rast and brightness controls set for 50 volts peak to peak on the cathode (pin 11) of tube. Socket voltage tolerance $10 \%$. For table of socket voltages under no-signal conditions, see page 11.
2. Supply voltage, 117 volts, 60 cycle $A C$
3. $K=1000$.
4. All capacitance values in mmf. and all resistance values in ohms unless otherwise noted:
5. Lug 3 connected to boost voltage and Lug 3,8 and 5 connected internally.
6. Better focus may be obtained with replacement picture tubes if the electronic focus anode is connected to a point other than +150 volts. Suggested points to try are: chassis ground, $+\mathbf{2 6 0}$ volts, +285 (picture tube, pin 10) and +480 volts.
7. The Horizontal Hold control R164 used in chassis 432 has an overall resistance of 145,000 ohms with a 70,000 ohm stop. This control is marked with Part No. B-157802-1-2 or B-157802-1-3. It is directly interchangeable with an earlier control marked B-157802-1-1, which has an overal resistance of $170,000 \mathrm{ohms}$, with a $70,000 \mathrm{ohm}$ stop. It will be noticed, however, that the control with the lower overall resistance gives a somewhat wider hold range.
8. On the Vertical Integrating Network C131, leads 2 and 3 are closely spaced, and lead 2 is the middle lead. On the Sync Take-Off Network C129, leads 1 and 2 are closely spaced, and lead 2 is the middle one. When replacing either of these units, the leads must be connected as shown in the schematic in order to obtain satisfactory operation.
9. The yellow lead wire from pin 11 CRT is taped to the rest of CRT lead wires in late models. This was done to reduce the possibilities of regeneration due to the yellow wire getting too close to the I.F. input coil.
If regeneration occurs in early model sets, the taping of the yellow lead wire will help to reduce
10. In some early production chassis 432 (not designated by a code letter), C139 is a 140 mfd . 300 v., electrolytic capacitor, Part No. 157837-1. For replacement purposes, use either Par No. 157837-1 or 158557-1, whichever may be available.
11. The inset at the lower left of the complete schematic wiring diagram shows a slight variation in circuitry which was used on some early production chassis 432. The code letter following the this change in circuitry, because of the relativel small number of chassis on which it was used.



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PARTS LIST


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| ITEM | DESCRIPTION |
| :---: | :---: |
| Voltage Rating | 115 V. - 60 Cycles A. C. |
| Power Consumption Frequency Range VHF | 205 Watts <br> $54-88 \mathrm{mc}$. $174-216 \mathrm{mc}$. |
| Frequency Range UHF | $470-890 \mathrm{mc}$. |
| Intermediate Frequencies | Video-45.75 mc. <br> Audio- (intercarrier) 4.5 mc . |
| Antenna Input Impedance | 300 ohms, Balanced |
| Channel Selection VHF | Twelve Position Rotary Turret |
| Channel Selection UHF | Continuous Tuning Channels 14 to 83 |



FIGURE 3 - UHF.VHF TUNER ASSEMBLY DRAWING
CHASSIS 120179-B \& $120200-B$

CHASSIS DIFFERENCES
UHF-VHF Chassis 120179-B and 120203-B are electrically similar. Different chassis numbers have been as signed due to the slightly different placement of the 5U4GT rectifier tubes.
VHF Chassis 120204-B and 120205-B are also electrically similar, but have been assigned different chassis numbers for the same reason as above.

|  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| visutron in Mry <br> EXTEPNAL IMDOOR <br> UMFENA USCD FO |  |  |  |  |  |

ALIGNMEN

## ALIGNMENT V.H.F.

0. Equipment Required - A swoep generator, (10 MC woep with center frequency of 44 MC . plus oll Toble), occcurate morker geneorator, oscilloscopo marker gene. are requirod for alignment. The $\mathrm{MC} ., 40$ to 48 MC . and 50 to 216 MC .
b. Alionment Points - The location of oll I.F. Trans-
formers, Tuned Circuits, and trimmers showis in
Fige figure 9
TVR F \& MIXER ALIGNMENT (N.H.F.)
Connoct 3 volt bias battory to both 1.F. and R.F.
AGC. circuits, positive torminal to chassis, nego
Add o iumper wire from this iunction to iunction
of $R-10, R-16, C-8$ so that the bias battery is also


Alignment of miracle picture lock (Horizontal A.f.C. \& Osc.)
Before proceeding be sure the Fringe Compensator Switch has been turned "OFF" (fully counter clockwise past click).

1. Tune set to a good channel.
2. Short phase coil (L-13) with a jumper wire, leads have been brought to top of chassis on terminal strip near $\mathrm{V}-13$
3. Short horizontal control grid to chassis. This point hare 11).
ed in Step 2 .
4. Rotate horizontal hold control (R-73) to center of its mechanical range. will sway from side to side)
5. Remove short from horizontal phase coil ( $L-13$ ) and adiust $L-13$ for same synchronous condition as 5 tep 5 above.
6. Remove short from horizontal control grid. Horizontal frequency circuits are now properly aligned
7. When properly adiusted (Steps 1 to 7 ) the horizontal hold control can be moved slowly over most of its range with-
8. Readiust harizontal hold control ( $\mathrm{R}-73$ ) so that the picture remains in sync when switching channels (near center of range).

ADJUSTMENT OF NOISE INVERTER (Fringe Compensator)

1) Be sure the miracle picture lock has been properly adiusted (horizontal hold circuits). See above.
2) Tune in a weak station. Turn fringe compensator switch to the "ON" position and adjust the fringe compensato control for best picture stability.
3) Try all channels and readiust fringe compensato if necessary for best overall picture stability

NOTE: In most locations this added profection will not be necessary and the fringe compensotor thould remain in the
"OFF" position, If this is not done, picture wiggle and or vertical roll might result in strong signal areas
6) Now that all the I.F. coils and transformers have been set, the overall response can be observed and

| SIGNAL GENERATOR INPUT |  |  | MEASURING INSTRUMENT | ADJUST | PROCEDURE |
| :---: | :---: | :---: | :---: | :---: | :---: |
| CONNECTION | frequency |  |  |  |  |
|  | SWEEP | MARKER |  |  |  |
| Connect terminated sweep and marker as shown in Fig. 8 | Center frequency 44 MC. 10 MC . Sweep | 45.75 MC | Scope connected to Video Test Point low side to chassis | T-4 | If 45.75 MC . doesn't lie from 60 to $70 \%$ down adjust T-4 (see fig. 7) for tolerances. |

Providing overall curve is within tolerances as shown below, no further adjustments are needed. If band width or Pilt is not as specified, repeat entire alignment procedure. If still out then a slight retouching is permissible. NG OVERALL I.F. RESPONSE CURVE
*keep output of signal generator as low as possible when observing the overall i.f. shape since TUBE OVERLOAD MIGHT RESULT AND THE RESPONSE WILL APPEAR INCORRE CTLY FLAT AND WIDE.

All instrument leads should be dressed as shown and input and output leads. Failure to do this may result in

NOTE: It is important that the output cable of the swee acter istic impeddonce which is us ually from 50 to 75 ohnis.
If this termination has not been built into the end of the If this termination has not been builr into the end of the
cable by the instrument manulacturer " then a resistor of cable by the instrument manulacturer then a resisto connected across the output of each generator cable as
shown above.


Figure 9. LOCATION OF ALIGNMENT POINTS (TOP VIEW)

## John F. Rider

R.F. OSCILLATOR ALIGNMENT (V.H.F.)

1. Connect maker ond sweep generator as shown in Figure 5, low side to chassis.
2. Connect scope to junction L-8, R-22, low side to chassis a video test point.
3. Connect 3 volt bias battery as described under R.F. alignmen
4. Before undertaking oscillator alignment be sure l.F. circuits are correctly aligned for band pass characteristic and trap
settings. etrings.
5. During oscillator alignment, it is necessary ta set tha fine funing centrol so that the tooth on the fine tuning com points
downord. On the 470712 tuner the flat of the fine tuning shoft should point downward with respect so the bottom of the
chass is. choss is.

| MARKER <br> SIGNAL generator EREQUENCY | SWEEP generator frequency | miscellaneous INSTRUCTIONS | $\begin{gathered} \text { TRIMMER } \\ \text { OR } \\ \text { SLUG } \end{gathered}$ | TYPE OF ADJUSTMENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \therefore 209.75 \mathrm{MC} \\ & \because 205.25 \mathrm{MC} \end{aligned}$ | $\begin{aligned} & \text { Channel } \\ & \text { 12 } \\ & \text { Center } \\ & \text { Frequency } \\ & 207 \mathrm{MC} . \\ & 10 \mathrm{MC} . \\ & \text { Sweep } \end{aligned}$ | Be sure that fine tuning contral hos been properly positioned (tooth on the cam pointing down) <br> NOTE <br> During this step and thru-out all succeeding steps it is necessary to: <br> 1. Keep output of sweep generator ot o level thot does not allow the reading on a VTVM to exceed minus I valt when cannected across video defector lood at minimum sweep width. <br> 2. Keep output of standard signol generator at a level thot provides a reodoble morker but does nat distort the curve that is being observed on the scope. | $\begin{aligned} & \text { Adiust } \\ & \text { sluyg } \\ & \text { A-12 } \end{aligned}$ | NOTE: Before making the fallowing adjustment, odvance the vertical goin control on the scope in order to magnify the sound trop portion of the response curve. <br> Then, use a non-metallic screwdriver to odjust channel ' 12 oscillator slug loccessible thru hole on front of $r$-f tuner unit) and shift response curve so that sound carrier morker is located at the position indicated below. <br> Now reduce gain control setting of scope to restore pattern to normal amplitude and observe position of picture corrier marker. This marker should oppeor on the high frequency side or characteristic curve. The amplitude of the piccharacteristic curve. The amplitude of the pic- ture carrier should be between 60 and $70 \%$ down from peak response. |
| -215.75 MC <br> **211.25 MC <br> 203.75 MC $*$ $* \quad 199.25 \mathrm{MC}$ **199.25 MC | Channel 13 <br> 213 MC . <br> Chonnel 11 <br> 201 MC. | Set Chonnel Selector to $\$ 13$ (See note abave) <br> Set Chonnel Selector to 11 (See note above) | Adjust the $r$-f sweep generator and marker generator for operotion on other television channels; set morker generotor to sound corrier frequency. After setting Channel Selector to corresponding chonnel, odjust oscillotar slug thru hole on front of $r-f$ tuner unit. ( $A-2$ fo $A-13$ ) |  |
| $\therefore 197.75 \mathrm{MC}$ <br> * 193.25 MC <br> - 191.75 MC <br> $\cdot 187.25 \mathrm{MC}$ | Channel 10 <br> 195 MC . <br> Channel "9 <br> 189 MC. | Set Chonnel Selector to 10 <br> (See note above) <br> Set Channel Selector to 19 (See note above) | This permits response curve to be shifted so that sound carrier marker will appear at the position indicated below. |  |
| $\begin{array}{r} * 185.75 \mathrm{MC} \\ * \quad 181.25 \mathrm{MC} \end{array}$ | Chonnel 8 183 MC. | Set $\begin{gathered}\text { Channel Selector to } \\ \text { (See note obove) }\end{gathered}$ /8 |  |  |
| $* 179.75 \mathrm{MC}$ $* 175.25 \mathrm{MC}$ | Channel 17 177 MC | Set Channel Selector to 17 (See note above) |  |  |
| $\begin{aligned} & \therefore 87.75 \mathrm{MC} . \\ & \therefore 83.25 \mathrm{MC} \end{aligned}$ | Channel 16 85 MC. | Set Channel Selector to " 6 (See note above) |  |  |
| $\begin{aligned} & * \\ & \because \\ & \cdots 1.75 \mathrm{MC} \\ & 77.25 \mathrm{MC} \end{aligned}$ | Channel 15 79 MC. | Set Channel Selector to 15 (See note above) |  |  |
| $\begin{aligned} & * 71.75 \mathrm{MC} \\ & \because \quad 67.25 \mathrm{MC} \end{aligned}$ | Channel/4 69 MC | Set Chonnel Selector to $/ 4$ (See note obove) |  |  |
| $\begin{aligned} & * 65.75 \mathrm{MC} \\ & \because 61.25 \mathrm{MC} \end{aligned}$ | Channel 13 63 MC . | Set Channel Selector to $\$$ (See note obove) |  | TYpical overall response curve |
| $\begin{aligned} & \quad 59.75 \mathrm{MC} \\ & \because \quad 55.25 \mathrm{MC} \end{aligned}$ | Channel 2 57 MC . | Set Channel Selector to $\%$ (See note above) | moins properly positioned during this step (tooth on the cam pointing downword). |  |

NOTE: If on unsatisfactory averall response is obtained for a particulor channel, observe $\mathrm{R}-\mathrm{f}$ amp. and Mixer response curve for thot channel (ar described in $R$-F Amp. ond Mixer Alignment Table). If characteristic curve
does not conform reasonably well within the typicol curve shown in Figure 0 , then do the following things:
. Check methad of connecting scope, voltmeter and generator leads to eliminate possible distortion of
2. Abtermpt to obobroin a better compromise for R.F. response on all channels by realigning R-F Amp. and

Mixer circuits, or:
3. Try replacing Antenna, R-F and Oscillator coils for the porticular channel
*Sound Carrier Morker
*. Picture Corrier Morker


Figure 8. CONNECTIONS FOR I.F. ALIGNMENT

## SOUND ALIGNMENT

(A) USING 4.5 mc UNMODULATED SIGNAL GENERATOR

1) Short pin $\$ 1$ of V - 3 Chassis with short iumper wire.
2) Keep output of signal generator low so as to pro vide a sharp meter indicotion with adjustment of
(B) USING TRANSMITTED TV AIR SIGNAL
3) Connect antenna and tune to a gaad on the air TV

| STEP | SIGNAL GENERATOR INPUT |  | MEASURING INSTRUMENT | ADJUST | Procedure |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | CONNECTION | FREQUENCY |  |  |  |
| 1 | Morker Gon. through V1 MF to Pin 70 V. 4 low sido to chassi chassis. <br> Connoct ontonna and tune in a good trans. (any channol) | 4.5 MC <br> (Unmoduloted) - or <br> A good on the oir TV. channel | Conntec D.C. V.T.V.M. negative scale) through IOK Resistor <br> R.35, R. 36 - low side to chassis. | $\begin{aligned} & \text { T.5 } \\ & \text { Top } \\ & \text { or } \\ & \text { B offom } \\ & \text { T. } 6 \\ & \text { Top and } \\ & \text { Botiom } \end{aligned}$ | Peok for moximum volioge. Adjust oupput of signal generafor to produce about o one voli D.C. Pise on meier <br> If T.V. signal is used adjust ont. coupling to ceiver to produce about the some valiage rise. |
| 2 | Same as above. | Some os | Connect V.T.V.M. <br> through 10 K <br> Resistor to <br> Junction of R.44, <br> to chassis. | $\begin{gathered} \text { T. } 7 \\ \text { Top ond } \\ \text { Bottom } \\ \text { (Dis: } \\ \text { cimi. } \\ \text { notor on } \\ \text { top) } \end{gathered}$ | A) Deture Discriminator secondary T. 7 for moximum negative meter reading. <br> B) Adiust primory T. 7 for moximum negotive mefer reoding. <br> C) Readiust Discriminator secondory (towords originol setting) for zero D.C. read. ing on V.T.V.M. <br> D) Check Audio, if distorted repeot steps A - C. |

The noise voltoge is meosurod under no signal conditions (ontenno torminols shortod directly
of o short iumper wire; or dis connect 4.5 MC . generotor if procedure ( A ) obove is followed.)
4.5 MC VIDEO TRAP ALIGNMENT (L-12)

1. Connect crystal controlled 4.5 mc . signal generata through a .01 mf . condenser to the grid of the video amplifier tube (Pin 1 of $V-5$, CCB6) low side to chassis
2. Set cantrast contro. (or maximum contrast (fully clockwise).
3. Connect a V.T.V.M. (D.C. scale) through an R.F. probe to the cathode of the picture tube (Pin 11 , yellow lead)
low side to chassis.
If a cirystal controlled generator is not available the video trap can be adiusted in the field by setting the fine fun-
ing control for maximum 4.5 mc . in picture and odjusting the 4.5 mc . trap (L-12) until this 4.5 mc . beat note is reduced. Be sure that video ringing is not introduced from this adjustment since this indicates the trap was aligned at
too low ofrequency. oo low ofrequency. ALIGNMENT (UHF TUNER)

The alignment of the funer is factory set and will actually not require any additional adiustments other than to compensate for differences in $6 \mathrm{J6}$ oscillator tubes. Because of this
is trimmer $\mathrm{C}-7$ which is located next to the 6 J 6 oscillotor tube.
2) Adiust fine tuning cantral far best picture
3) Adiust antenno coupling for maderate signal so as to provide a shorp meter indication with odjustment of
tronstarmers. Honstarmers.
4) Meter reading may pulsote due to changos in signal Meter reading may pulsote due to changos in signal
strength; do not confuse with o peak adjustment






This trimmer is normally set at the factory to track the highest U.H.F. channel (83). This must be done with o
U. H. F. swoeep and marker generator. In the field hawever, this equipment is not readily available and C-7 should U. H.F. sweep and marker generator. In the field however, this equipment is not readily available and C-7 should
therefore be used to track the highest U. H. F. channel received in the area. It is usually best to try a few 6 J6 tubes therefore be used to track the highest U. H. F. channel received in the area. It is usually best ro try a few
until one is found which more nearly resembles the original, thus requiring only a slight adjustment of $\mathrm{C}-7$.
In the event T-A has been tampered with or replaced, it should be adjusted for best results on all U.H.F. channels received in the area. This I.F. sometimes normally has only a slight effect on the picture or sound.

Before doing any wark on this U.H.F. Puner, whether in the field $\alpha$ shop, be sure that the V.H.F. I.F. and R.F.


Figure 11. TUBE LOCATIONS DIAGRAM FOR CHASSIS 120179-B, 120203-B, 120204-B, 120205-B TUBE TROUBLE ANALYSIS CHART FOR CHASSIS 120179-B 120203-B, 120204-B, 120205-B

| SYMPTOM | CHECK |
| :---: | :---: |
| Weak or no sound nor video (picture), raster normal - UHF only | V-25, D-1, D-2 * |
| Weak or no sound nor video (picture), raster normal-UHF and or VHF | $\mathrm{V}-22, \mathrm{~V}-23, \mathrm{~V}-1, \mathrm{~V}-2, \mathrm{~V}-3, \mathrm{~V}-$ * $^{*}$ |
| Weak or no sound - Video and raster normal --- UHF and or VHF | $V-6, V-7, V-8, V-9, v-10$ |
| Weak or no video - Sound and raster normal ----UHF and $\alpha$ VHF | $\mathrm{V}-5, \mathrm{~V}-24$ |
| Poor or no horizontal nor vertical syne - sound and video normal (contrast control makes video darker <br> or lighter) -. ........................... UHF and or VHF | $\mathrm{V}-11, \mathrm{v}-17$ |
| Poor or no horizontal nor vertical sync - Video weak or distorted, raster normol - sound may or may not be <br>  | V-22, v-23, v-1, v-2, v-3, v-4 |
| Poor or no horizontal sync - raster normal and sound normal (picture locks in vertically) .......... UHF and or VHF | V-11, v-12, v-13, v-17 |
| Poor or no vertical sync - raster normal and sound normal (picture lacks in horizontally) ......... UHF and or VHF | $V-11, V-17, V-18$ |
| Horizontal line (no vertical sweep) - sound normal - UHF and or VHF | $V-18, \mathrm{~V}-19$ |
| Insufficient horizontal size, sound \& video normal - UHF and or VHF | V-14, V-16, V-20, V-21 V-26** |
| Insufficient vertical size, or white horizontal bor in picture horizontol size OK . ........- UHF and or VHF | V-19 |
| No sound, no raster - tubes lit-------- UHF and or VHF | Fuse, V-20, V-21 |
| No sound, no raster - tubes not lit-------UHF and or VHF | Plug connection in wall socket, ON-OFF switch, line cord. |

[^3]Another very common fault is a shorted or open circuit antenno connection to set.
** Some 120179-B chassis used two 6AX4GT tubes (V-16, V-26) instead of one 6AU4G (V-16).


Figure 10. DIAL CORD STRINGING


## 共 <br> StEP 2


-start


Figure 12. SCHEMATIC DIAGRAM OF TURRET TYPE TUNER USED ON VHF CHASSIS 120204-B, 120205-B REPAIR OF VHF TUNER

The moiority of tuner troubles which ore not due to defective tubes con usually be detected by o physicol examinotion of the tuner (turret removed), such os burnt resistors, broken ports, bent or dirty contoct fingers, cold solder joints,

If the funer checks out physicolly it should then be checked occording to the following trouble shooting chort.
It should olwoys be borne in mind thot a burnt resistor is usuolly the result of a shorted condenser or tube.
The port numbers of items which orenot generolly commerciolly ovoilable ore given on the tuner schemotic. When
replocing ports, leods should be kept os short os possible ond components reploced in the some position os the
original ports.
More detoiled generol informotion on turrel funer repoirs can be found in Service Note titled "Emerson Turret Type
uner 8470651 "releosed April l, 1951. TUNER TROUBLE SHOOTING CHART
Meosurements token under some conditions os listed To take meosurements from 6BQ7 socke remove 6807 tube but leove 656 tube in its socket, likewise when toking meosurements from the 6 J 6 socket leove
$6 \mathrm{BQ7}$ tube in its socket.

| V-22 |  | NORMAL READINGS |  | POSSIBLE TROUBLES IF READINGS NOT NORMAL |
| :---: | :---: | :---: | :---: | :---: |
|  | pinno. | voltage | RESISTANCE |  |
|  | Pin 1 | ov. | inf. | (C.9, 3.3 mm ) shoritod |
| $\begin{gathered} 6 B 07 \\ o \circ \\ 6 B a 7 A \\ \circ \circ \\ 6 B 27 \end{gathered}$ | Pin 2 | -. 27 V | 1.4 meg | (R-2, ISK) or (R-1, 47K) opon or shorrod |
|  | Pin 3 | ov. | $0 \sim$ | Cold oolder ioint |
|  | Pin 6 | +270V. | 20K |  |
|  | Pin 7 | +158V. | 200 K | (R-3, 330 K ), (R-4, 180 K ) or (R-5, 100 K ) open or shorted, ( $\mathrm{C}-15,1000 \mathrm{~mm}$ ) athortod |
|  | Pin ${ }^{\text {B }}$ | or. | inf. | ( $\mathrm{C} .9,9.3 \mathrm{mmf}$ ) that |
|  | Ping | ov. | $0 \sim$ | Coid rolder ioint |

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| V-23 | pin no. | normal readings |  | POSSIBLE TRDUBLES <br> IF READINGS NOT NORMAL |
| :---: | :---: | :---: | :---: | :---: |
|  |  | voltage | resistance |  |
| 616 | Pin 1 | +160V. | 17K |  |
|  | Pin 2 | +160V. | 30K | (L.13) opon, (C-21, 1000 mml$)$, ( $\mathrm{C}-22,6 . \mathrm{Ammf}$ or (C-23, 1000 mmf ) 2horiod, (R-11, 15 K ) opan or thotiod |
|  | Pin 5 | ov. | 230 K |  |
|  | Pin 6 | ov. | 10 K | (C.16, 10 muF) mortiod |
|  | Pin 7 | ov. | $0^{\sim}$ | Cold solder ioint |
|  | $\begin{array}{\|l\|l\|} \hline \begin{array}{l} \text { Point } \end{array} \\ \hline \text { ad } \end{array}$ | $\begin{aligned} & -1 \\ & -4 \mathrm{~V} . \mathrm{V}^{2} \end{aligned}$ | 210K | Oscilloter injection voltage varies between channela (low Fequency channels hove higher imiection voltoge about-4 v.) |

GENERAL TROUBLE SHOOTING INFORMATION
(UHF TUNER)
Since the operation of this tuner is dependent almost entirely on its mechanical configuration,
all component parts whether lumped constants or all component parts whether lumped constants or
transmission line sections, have been morufactur ed and mounted as rigid as possible. If it is necessary to replace a component, the exact replacement port should be used. Be sure it is mounted in the same position using the same lead lengths as
the original. This is very important since ot UHF frequencies a small piece of wire has an appreciable inductance. Stray capocitances between components and chossis also tend to effec

Due to the simplicity of design and manufacYure of this tuner, little trouble is to be expected any way, the trouble shooting chart in this note can be used to good advantage.
If the crystal D-2 is open or shorted, or the os cillator is inoperative, there will be no bias devectify this condition, then it can be assumed that the oscillator is not functioning.
Be sure that the harmonic generator coupling

oop ( $\mathrm{L}-7$ ) is not touching the shield. A voltage
If the correct bias is measured across the resistor R-2 and the set still operates paorly on UHF, then it can be assumed hat the mixer crystal D-1 is defective in scme way. This can easily be determined by lifting R-1 off chassis and insert ing a D.C. milliameter between it and chassis. In the event that the current readings are abnormally low or high, a new crystal known to be good should be inserted (see trouble shooting chart). If it is desired to localize the difficulty further, $\mathrm{C}-4$ and, or $\mathrm{C}-5$ can be disconnected. When soldering near crystals, be sure to use a small tipped, low wattage ir on, partant, since excessive heat can easily damage it.
Do not attempt to repoir or adjust this tuner by adiusting any of the coupling loops or by moving various components a new $6 J 6$ is used. The proper procedure for this is shown under alignment

Companents which are not a port of the R.F. or oscillator tuned circuits such as feed thru condensers, B plus resistors,
T-A, etc., can usually be reploced with litlle difficully providing the above precautions are observed.
NOTE: In the event that this tuner needs an overall alignment or service of ports, the defective tuner should be returned for repoirs through your Emerson distributor
PEPLACEMENTT OF TUNERS (UHF - VHF CHASSIS)
If it becomes necessary to return a UHF tuner to your distributor for repair or replacement, remove and retain the exension shaft and pulley. When returning the VHF tuner, remove and retain the VHF-UHF switch and the front plate which consists of a pulley and gear combination. This is important since replacement tuners will not come equipped with the

Urder no conditions ore both the VHF ond UHF tungrs to he returned as a unit. Before returning for replacement or re pair, an honest effort should be mode to repair the unit since all special and major parts will be available through your


Figure 14. SCHEMATIC DIAGRAM OF VHF TUNER 470712 USED ON UHF-VHF CHASSIS 120179-B, 120203-B

## repair of tuner

The majority of tuner troubles which are not due to defective tubes can usually be detected by a physical examina-
tion of the luner (furret removed), such as burnt resistars, braken parts, bent or dirty contact fingers, cold salder iaints, broken socket pins, etc.

If the tuner checks out physically it should then be checked occarding to the following trouble shating chort It should always be barne in mind that a burnt tuner resistor is usually the result af a shorted condenser or tube. The part numbers of items which ore not generolly commercially ovailable are given on the tuner schematic when replacing parts, leods should be kept as short as possible ond components replaced in the some position os the TUNER TROUBLE SHOOTING CHART
Measurements token under some conditions os listed To take measurements from 6BK7 socket, remove $6 B K 7$ tube but leove 656 tube in its socket. likewise when toking meosurements from the 616 socket leave

| V-22 | pin no. | normal readings |  | possible troubles if readinge not normal |
| :---: | :---: | :---: | :---: | :---: |
|  |  | voltage | resistance |  |
| $\begin{gathered} 6 \mathrm{BK7} \\ 60 \\ 6 \mathrm{Ba7} \\ \mathrm{of} \\ 6 \mathrm{~B} 7 \mathrm{~A} \\ \mathrm{or} \\ 6 \mathrm{BZ7} \end{gathered}$ | Pin 1 | 105V | 2 meg . | (c.92. 3.3 mmf ) hotiod |
|  | Pin 2 | -. 4 V . | 1.6 meg. | (R.2, ISK) or (R-1, 47K) opoon or shoriod |
|  | Pin 3 | ov. | $0 \sim$ | Cold solder ioint |
|  | Ping | +270V. | 24K |  |
|  | Pin 7 | +142V. | 1.6 meg. |  |
|  | $\mathrm{P}_{\text {in }} 8$ | +142V.. | 1.6 meg. | (c.9, 3.3 mm ) hatiod |
|  | Ping | ov. | 0 - | Cold solder ioint |


| V-23 | Pin no. | normal readings |  | POSSIBLE TROUBLES IF READINGS NOT NORMAL |
| :---: | :---: | :---: | :---: | :---: |
|  |  | voltage | resistance |  |
| 616 | Pin 1 | +160V. | 17K | (R-6, 4700 ohm) opon or shoriod, (C-12, 1000 mm ), ( $C$ - $16,10 \mathrm{mmf}$ or $(C-17,5 \mathrm{mmf}$ ) horiod |
|  | Pin 2 | +160V. | 25k | (L-13) open, (C-21, 1000 mmf ), (C.22, 6.8 mmf or (C.23, 1000 mm ) shorted, (R-11, 15 K) open or shorted |
|  | Pin 5 | ov. | 200 K |  |
|  | Pin 6 | ov. | 10 K | (C.16, 10 mmF ) shortod |
|  | Pin 7 | ov. | $0 \sim$ | Cold ooldee foint |
|  | $\begin{aligned} & \text { Toun } \\ & \text { Po:nt } \end{aligned}$ | $\begin{aligned} & -.5 \mathrm{~V} .10 \\ & -3.5 \mathrm{~V} . \end{aligned}$ | 180 k |  higher inicction voltage obsut - 4 v.) |


4. C-38.0047 mf condenser has been increased from 400 to 600 volts to reduce the possibility of failure in the event the set is operated with the speaker disconnected. Chassis incorporating this change are coded as follows. 120203-B A $120204-\mathrm{B}$ A
5. R-105 has been changed from 1 meg to $i .5$ meg to center the range of the vertical size control. Chassis incorporating this change are coded as follows.
120203-3 合 120204-B B

## CONDItIONS FOR taking voltage and resistance reading

The voltoge and resistance measurements listed were token on chassis 120205-B, coded with a triangle. $\mathbb{A}$
Due to component variations, voltage ond resistance readings may vary slightly from those given here. Slight variations may also be noticed if chassis is not coded as mentianed above. Slight variations may be noticed on chassis 120179-B, 120203-B \& 120204-B due
The deflection yoke and high valtage circuits were connected to take the following reodings and waveshapes,

1. Antenna disconnected and antenna terminals sharted on tuner and connected to chassis (use short leads)
. Line voltoge 117 volts (Disconnect pawer for resistance readings),
2. 3 valt bias bottery connected to A.G.C. circuit, positive terminal to chassis, negative terminol to iunction of R-10, C-8, R-16 BIAS BATTERY
USED FOR VOLTAGE READINGS ONLY.
3. All controls in position for normal picture. (Varied when it directly effects reading).
4. All measurements taken with a vacuum tube voltmeter and ohmmeter.
5. All readings listed in tables were taken between points shown and chassis.
6. Resistance reodings are given in ohms unless otherwise noted.
7. N.C. denotes no connection.

| srubol | tuge pim mumbers |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |
| v. 1 | -av. | .v. | 6.V.V. A.C. | ov. | 18 V . | 130 V . | av. |  |  |
| V. V .3 | -3v. | $\frac{.7 v .}{2.1 v .}$ | ci.sV. A.C. | ov. | 1596. | 1s00. | or. |  |  |
| $\underline{v-4}$ | or. | ${ }_{\text {L }}$ 2.v.rv. | C.v. | ov. |  | lov. | or. |  |  |
| v.s | -1.6v. | ov.iot $2 . y \mathrm{y}$. |  |  |  |  |  |  |  |
| v. 6 | -.2V. | ov. | ov. | c.av, a.c. | 135v. | issv. | 2.2v. |  |  |
| V.i | - 2.2 V . | $\xrightarrow{\text { or. }}$ | $\frac{\mathrm{OV}}{\mathrm{OV}}$ |  | 139\%\% | $3 \mathrm{3m}$ | ov. |  |  |
| r.9 | -.8\%. | or. | or. | .ivi.a.c. | -.25v. | -.25v. | -92V. |  |  |
| v.10 | nov. |  | $\xrightarrow{2385}$ |  | OV. |  | OV. | ISv. |  |
| v.12 | -.05v. |  |  |  | c.3v. A.c. | 30v. | $\stackrel{\text { c.ove }}{\text { cov. }}$ | ov. | ov. |
| V.13 |  | İzv. | \%.3V. | v.10.ave. | 130 V . | cos. | c.ov. A.C. | or. |  |
| V.14 |  |  | 19.sv. | 00 not | -21v. |  | c.sv. A.C. | nov. |  |
| v.16 |  | 00 not | ueasure | or nor | 273v. |  | caud | E USED |  |
| v.17 |  | 2.ar. | 12V. 1.3 sv . | ov. | ov. | 2.ov. | -206. | ov. | . .sv.a.c. |
|  | ov. | av. |  | - |  | s.ov. |  | OVV. |  |
| V.20 |  | Orov. | 2589.102755. |  |  |  | d.JV. A.c. |  |  |
| v.21 |  | 2200. |  | 280 V A.C. |  | 2eov. A.C.) |  | 2800. |  |


Resistance reaomas

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The voltages listed were taken with $B^{+}$inputs of 220 volts, 170 volts and a 3 volt AGC batrery connected directly to the AGC input of the tuner. A 6.3 volt AC filament source was also provided. Antenna terminals were shorted directly to the tuner chassis using short leads. A VTVM has been used for all voltage and resistance readings. In the event slightly different input voltages are applied to the tuner a proportionate voltage change will occur at the various pin numbers.
Resistance readings are taken with ressect to the tuner itself, therefore, disconnect the 220 volt, 170 volt, and AGC input lead from the receiver chassis to the tuner power input board. To assist you in easily localizing a defective component, the resistanc has been measured from the pin numbers with respect to three different points (place low side of ohmmeter to proper points). Note: Since readings are taken from the top side of the tube socket, remove only the required tube.

| $\begin{aligned} & \text { PIN } \\ & \text { NO. } \end{aligned}$ | $\begin{gathered} 6827 \\ \text { (6U8 and 6AF4 IN PLACE) } \end{gathered}$ |  |  |  | $\begin{gathered} 6 \mathrm{UB} \\ \text { (6BZ7 and 6AF4 IN PLACE) } \end{gathered}$ |  |  |  | $\begin{gathered} \text { 6AF4 } \\ \text { (6BZ7 and } 6 \cup 8 \mathrm{INPLACE} \text { ) } \end{gathered}$ |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Voltages | RESISTANCE TAKEN FROM PIN NO. TO: |  |  | Voltages | RESISTANCE TAKEN FROM PIN NO. TO: |  |  | Voltages $\dagger$ | RESISTANCE TAKEN FROM PIN NO. TO: |  |  |
|  |  | Chassis | 170 V . | 220 V . |  | Chassis | 170V. | 220 V . |  | Chassis | 170 V . | 220 V . |
| 1 | 220 V . | 450 ~ | INF. | 700~ | 170 V . | INF. | 3.3K | INF. | 165 V . | INF. | 30K | INF. |
| 2 | 130 V . | 270K | INF. | 180K | OV. | 200K | INF. | 650K | OV. | 10K | INF. | 500 K |
| 3 | OV. | INF. | INF. | INF, | 220 V . | 590K | INF. | 110K | FIL, | $1.0 \sim$ | INF. | 550K |
| 4 | FIL. | 0 ~ | INF. | 450K | FIL. | 1.2^ | INF. | 450K | FIL. | 0 | INF. | 550K |
| 5 | FIL. | 1.2^ | INF. | 450K | FIL. | 0 ^ | INF. | 450K | OV. | 0 ~ | INF. | 550K |
| 6 | OV. | INF. | INF. | INF. | 220 V . | 490 K | INF. | 8.2K | OV. | 10K | INF. | 500K |
| 7 | -3V. | INF | *47K | INF. | 0 V . | $0 \sim$ | INF. | 450K | 165 V . | INF. | 30K | INF |
| 8 | OV. | 0 ~ | INF. | 450K | OV. | $0 \sim$ | INF. | 450K | † Above readings taken with tuner set for UHF operation |  |  |  |
| 9 | OV. | $0 \sim$ | INF. | 450K | OV. | 10K | INF. | 460K |  |  |  |  |
| $\begin{array}{\|c\|} \hline \text { VHF } \\ \text { Looker } \\ \text { Point } \end{array}$ | -1.8V | 100K | INF. | 550K TAKEN WITH ALL TUBES OPERATING IN TUNER VOLTAGE READING WILL VARY FROM CHANNEL TO CHANNEL. | TAKEN WITH ALL TUBES OPERATING IN TUNER Voltage reading will vary from channel to channel. |  |  |  |  |  |  |  |

* Taken with respect to A.G.C. input to tuner.
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## SHOP ALIGNMENT INFORMATION

This tuner can be aligned and repaired in the receiver chassis or in a special iig. If a $j i g$ is made, it should supply the necessary $B^{+}$and filament voltages which are shown on the schematic. If step $2 D$ is performed (alternate procedure to 28 ) a regular chassis will have to be used or a $j$ ig which has at least one stage of I.F. and a sound trap.

1-Equipment Needed
(A) Oscilloscope with a vertical sensitivity of at least .05 volts per inch of deflection, (. 01 preferred).
(B) UHF sweep (fundamental preferred) with a sweep width of approximately 40 mc . ( $\pm 20 \mathrm{mc}$ ). Good inearity and flat output necessary. Generator should have at least.I volts output, (. 5 volts preferred)
(C) VHF sweep should have same characteristics as above except that only a 10 mc sweep width is required. This unit should have a 40 mc sweep position available.
(D) I.F. UHF and VHF marker generator. This could be two separate units or a combination. Fundamental operation preferred but not necessary. An output of at least .05 volts is desirable. Accuracy of marker should be of least $0.5 \%$.
2 - Alignment of UHF Tuner Section
(A) UHF R.F. Alignment (preselectors). Turn the set off during this alignment.

1-Remove the plug ( $\mathrm{P}-2$ ) from the VHF tuner. This is the plug which feeds the I.F. output from the UHF tuner into the VHF tuner. Insert a 100 ohm resistor between center conductor and ground of shielded lead (see figure " 8 ). Connect scope across 100 dm resistor. Note: If a test point is provided on UHF section (see figure 18) merely connect scope across this point.
2-Connect unbalanced 300 ohm UHF sweep generator to UHF antenno connections. If 300 ohm generator is not available, match output impedance similar to that shown in figure " 8 .
3- Turn tuner selector knob to channel 69.
4- Set UHF sweep generator to approximately 803 mc (center of channel 69) with a total sweep width of approximately 40 mc . In the event channel 69 is occupied in your area, use channel 59 for 2 A and $2 B$

5- Inject market at 803 mc (center of channel 69), as shown in figure 18.
6- Adjust capacitor $\mathrm{C}-3$ and $\mathrm{C}-6$ to obtain on overcoupled pattern with channel 69 marker in the center of the bandpass.


7- Turn the set back on.
(B) Tuner I.F. strip alignment (Rocking Horse). Using separate I.F. and UHF marker generators.

In the event you use a combination marker the alternate procedure (d) should be followed. Note: The complete UHF RF alignment (step 2A) should be attempted first. This insures the proper frequency selting of the UHF sweep generator on channel 69 (or 59 ) which should not be changed during the folsetting of the UHF
lowing alignment.

1-Remove 100 ohm resistor added in step 2A-1 above, and reconnect shielded lead to VHF tuner.
2- (a) Connect a 3 volt bias battery to tuner AGC and I.F. AGC if tuner is in a regular chassis instead of a iig.
(b) Connect the negative terminal of a 6 volt bias battery to the grid of the horizontal output tube to cut it off (positive terminal to chassis). This will allow for a clear sweep indication.

3- With sweep and UHF market input and setting as in RF alignment above, connect oscilloscope through 10 K resistor to test point on VHF tuner.

- Iniect IF marker 43.5 mc (center of IF band) to the insulation of the shielded lead going from the UHF to VHF section (see figure "9).

5- With the fine tuning at center of its mechanical range adjust oscillator slug (see C-3 below) for zero beat on oscilloscope (sef marker and scope gain ot or near maximum). Note: In the event the tuner IF strip is completely out of olignment, it might be difficult to get a beat pattern. If this is the case, adjust $\mathrm{L}-25$ a half turn at a time trying then to secure a beat pattern by adjusting the UHF oscillator slug. This beat pattern comes and goes very quickly so adjust slug very slowly keeping scope and marker gains at maximum. It is sometimes easier to observe the two markers on the response curve merely adjusting the UHF oscillator slug so the two markers coincide.

6- Now that the oscillator and sweep generator have been properly set, adjust L-19, L-25 and L-27 in the tuner I.F. strip (rocking horse) to obtain a symmetrical and flat IF bandpass. With I.F. marker connected as shown in Fig. 9 , check positions of 41.25 and 45.75 mc markers as indicated in diagram. These coils should be adjusted with a fibre alignment tool. Note: To be sure that the oscillator frequency has been set above and not below the UHF signal the image sweep higher (803 +8 be approxi, This sweep requency should cause some response on the oscilloscope providing the UHF sweep generator has sufficient output.
(C) UHF Oscillator Alignment

1-Repeat steps 1, 2 and 3 of section $2 B$ above using channel 14 . (Turn knobs to channel 14).

2- Set UHF sweep generator to opproximately center of channel $114(473 \mathrm{mc})$ and marker generator to 473 mc (sweep and marker connected to UHF input as in RF alignment figure 18).

3- With the fine tuning at center of its mechanical range adjust the oscillator slug from front end of tuner with a fibre alignment tool until an IF pattern is observed with the marker positioned in the center of the IF bandpass.

4- Leaving the fine tuning and generator connections as is, repeat steps 1,2 and 3 on channels 24, 34, 44, 54, 64, 74 and 80 (frequencies shown in figure 10 ). Note: As long as channel 69 had a flat response disregard relative filts of other channels providing it does not exceed about $40 \%$. In the event you wont optimum response on a particular weak channel, the UHF preselectors can be set up on that channel.
(D) Alternate Tuner IF Strip Alignment (Rocking Horse)

If only a combination IF, VHF and UHF marker is ovailable, we can make use of the sound trap alignment frequency ( 41.25 mc ) as a reference point. The complete UHF-RF alignment (step A) should be done first. This insures the proper setting of the sweep generator which should not be changed during this tuner IF strip alignment (rocking horse).

- Make sure the chass is IF circuits have been properly aligned especially with regard to the 41.25 mc sound trap which will be used as a reference.

2- Sweep and marker connected as in UHF RF alignment. Leave sweep frequency unchanged but change marker fre quency to sound carrier of channel $69(805.75 \mathrm{mc})$ or $59(745.75 \mathrm{mc})$.

3-Connect oscilloscope through 10 K resistor to output of video detector. Adjust sweep output and gain of scope for regular IF response curve (do not touch sweep frequency setting).

4- With fine tuning in center of mechanical range, adjust UHF oscillator slug to position 805.75 mc marker in dip of 41.25 me sound trap.
5- Now that the oscillator is properly set connect scope through 10 K resister to VHF test point and proceed with step 16 under IF strip alignment (2B).
(B) Connect sweep generator to VHF antenna terminals and connect oscilloscope through 10 K decoupling resistor to VHF test point.
(C) Turn the tuner selector knob to channel 10 or 12 (VHF) whichever is not $\propto$ cupied in area.
(D) Set VHF sweep and marker to center of channel 10 band ( 195 mc ) or 12 band ( 207 mc ).
(E) Adjust C-26, C-31 dnd C-15 for response shown. It will be noted that the bandpass characteristics can be broadened by sacrificing amplitude. It is un desirable to overly broaden the curve as this results in a loss of sensitivity.
(F) Adjust ascillator slug from front end of tuner with a lang insulated alignment tool to correct frequency. A clearance hole is provided through the UHF nit when the UHF drum is rotated to VHF position.

The individual oscillator slugs can be set up using on "on the air" TV station or by using a marker generator as indicated in any of our current service notes (mode is 740-792). In the event the bU8 oscilloror tube is replaced, he oscillarormimmere 7 metrode capacities.

figure 8


FIGURE


FIGURE 9

All ins
To minimize standing waves it is inportant that the sweep generator and tuner be propaly matched This can bed a the type of pad shown in figure \%. Use short leads and make direct solder connections to sweep and tuner to obtain a good match. Non-inductive high frequency resistors should be used
In the ovent the sweep pattern is unstable when touching sweep cable (standing waves) try moving equipment leads and ground connections for best stability.


EXPLODED DRAWING OF TUNER
The above drawing shows the part numbers and locations of those mechanical parts which may at some time require replace ment. When needed, these parts should be ordered through your local Emerson distributor making reference to the tuner part

In the event a part is needed for which we have not assigned a part number, order by mechanical description, purpose and tuner part number.

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## V.H.f TUNER

The V H.F tuner in this set is a low radiation tuner, having an improved noise factor. The low radiation characteris ics greatly reduce local oscillator radiation. The improved noise factor becomes apparent in fringe areas where it is of prime importance. From the customer point of view this means a viewable picture with less hash or snow
The new design features of this tuner are confined to the R.F. amplifier stage (V-22, 6BK7 or 6BQ7 or 6BZ7). The os cillator and mixer section (V-23, 6J6) remain substantially identical to the earlier turret type tuners except that now a or UHF position has also been added to this tuner.

The improved noise factor of this tuner is the result of the development of a circuit permitting the use of a dual triode as an R.F. amplifier which has much less tube noise than pentodes. Previously triodes with useful gain were not used as R.F. amplifiers because of their higher grid to plate capacitance which resulted in excessive oscillator radiarion, and overall instability. The dual triode oBK consists of two triades in a single en which is controlled by the A.G.C. applied to the grid. The second triode section is used as a grounded grid amplifier and is directly coupled to the first section. Neutralization of the first section is accomplished by the use of $\mathrm{C}-10$ and $\mathrm{C}-9$.

The combined operation of both triode sections of V-22 (6BK7 or 6BQ7, 6BQ7A or 6BZ7) yield an overall gain which is superior to that of a single well designed pentode stage, (6AG5, 6BC5, 6CB6) and yet the noise generated (snow) is equival ent to that of a triode stage. Due to the use of a 40 mc . I.F., it is necessary to neutralize the mixer voltage fed
$\mathrm{V}-23,616$ ). This is accomplished by means of a bridge circuit composed of $\mathrm{C}-23, \mathrm{~T}-1$ and $\mathrm{C}-21$. The R.F. voltag $V-23,6 \mathrm{~J} 6$ ). This is accomplished by means of a bridge circuit composed of C -23, capacitance thus neutralizing this stage. In the 13th or U. H.F. position the V.H.F. turret tuner is designed to act as a 40 mc . amplifier for the converted 40 mc . U.H.F. signal.

The V.H.F. antenna input circuit incorporates a high pass filter circuit (L-5) to reduce any interference from nearby ransmitters which are operating in the 40 mc . I.F. band. The output of this high pass filter then feeds into the tuner's balanced 300 ohm input circuit. For circuit diagram see Pages 4 and 21
DESCRIPTION OF UHF TUNER
The tuned elements in this tuner are of the modified coaxial transmission line type. As you can see from the schematic on Page 20, the incoming U.H.F. signal is tuned by means of two R.F. preselectors.
Those preselectors are quarter wave end tuned coaxial lines. Capacitive tuning is employed at the open ends to electrically adjust the line to $1 / 4$ wave length and, therefore, effect a resonant condition at any frequency within the U. H. band. Two identical proselector circuits are coupled together to provide the proper and pastional low frequency circuits.
variable copacitors adjust the two preselector lines and are similar to those used in convention Each line is tuned by four rotor plates. Capacitor trimmers are located behind the coaxial line to preset the high frequency and of the R.F. preselectors. The antenna input in this tuner is coupled to the lst preselector circuit and is designed to match a balanced 300 ohm transmission line. The output from the preselector stages is fed through an R.F. choke (L-5) to the mixer crystal D-1.

The U. H.F. local oscillator uses a 6 J 6 (V-25) in a conventional push pull circuit using lumped circuit constants. This oscillator operates at $1 / 2$ the deisred frequency which greatly stabilizes the circuit and permits the use of a thoroughly field rested and debugged ry

The output from this oscillator is loop coupled to the oscillator doubler section through L-7. A crystal diode (D-2) is amployed in series with this coupling loop to provide rectification of the oscillator signal and ins ofre more oficien doubling action. The output from this doubler is fed through L-6 to the mixer crystal D-1 where it beats with the preselected incoming U. H.F. signal. A picture I.F. of 45.75 mc . and a sound I.F. of 4 ) is mc. aie generated inserted in series with the B plus fashion. When the receiver is tuned to any V. H.F. channel a 4 of this note. This is done to prevent weak operation of the U.H.F. oscillator after long periods of inoperation (set used on V.H.F.)

C-7 is used to set the high end of the oxcillator and can be used in the field to compensate for slight variations in 6J6s. The range of this trimmer has been limited so as not to effect funer tracking. Because of his, severai bjos may have to be tried if adjustment of C-7 does not produce the desired rosults. Complete tuner shielding is provided to reduce oscillator radiation and stray pickup to a, minimum.

The advantage of using a crystal mixer is its simplicity of design. Since a crystal generally has a higher conversion loss and U.H.F. will be of similar magnitudes.

This is accomplished by feeding the I.F. output from the U.H.F. tuner (T-A) to the input of the V.H.F. tuner. In the 13th or U.H.F. position, the V.H.F. tuner becomes a two stage low noise cascode I.F. amplifier. The tuner input changes from 300 ohm balanced to a 72 ohm unbalanced tine to mo . H.F. oscillator, plate voltage is removed from this U. H.F. strip (13th position) does not have any coil

OPERATION OF VHF-UHF SWITCH
This switch is automatically operated by a cam located on the V.H.F. tuner shaft. This cam changes the switch from its V.H.F. position to U.H.F. whenever the V.H.F. tuner is set for U.H.F. operation.
The following diagram and description should make the operation of this switch elear.


VHF POSITION
The V.H.F. antenna is connected through the switch to the input of the high pass filter L-5. The output of this filter is connected to the input of the V.H.F. tune through this same switch. B+ is supplied to the U.H.F. tuner through a 100 K ohm resistor ( $\mathrm{R}-6$ ) preventing it from oscillating but allowing some current to flow through the $6 J 6$ so that its cathode will not be poisoned during long periods of inoperation (N.H.F. reception.)
Y. H.F. TUNER OUTPUT-I.F. INPUT, I.F. CIRCUITS \& TRAPS

The output of the 656 mixer tube which contains the video and audio I.F. carriers ( 45.75 mc and 41.25 mc ) are fed to the first I.F. tube through a low impedance link coupled circuit $T-1$ and $L-3$ (T-1 is mounted on tuner while L-3 is mounted on chassis). R-4 which is a 15 chm resistor determines the coupling between $T-1$, and L-3 so that they act like a single tuned circuit same frequency without a sweep. generator. Because of the low impedance coupling ( $R-4$, 15 ohms) dressing the lead length in this input circuit, which would ordinorily be very critical, have very little effect upon the response curve.
The I.F. signals are then further amplified through
$\mathrm{V}-1, \mathrm{~V}-2$, and $\mathrm{V}-3$ which are all stagger tuned by the $V-1, ~ V-2$, and $V-3$ which
use of Bi Filar transformers.
Both the adjacent sound and sound carrier traps (L-1 and L-2 respectively) are connected across the 15 chm $(R-4)$ coupling resistor in the low impedance link circuit
feeding the first I.F. tube.


UHF POSITION
The VHF antenna or combination VHF-UHF antenna is disconnected from the VHF tuner and connected ta the input of the UHF tuner through the switch and terminals 3 \& 4 (providing they are connected, see installation instructions for more information). If a separate lead is is used for UHF, then terminals 3 ,

The single ended output of the UHF tuner is fed through the switch to the input of the VHF tuner.
The 100K resistor $R-6$ is shorted out by the switch so The 100K resistor $R-6$ is shorted out by
that full $B+$ is applied to the UHF tuner.

Since the VHF mixer tube functions as a 40 mc amplifier when tuned to UHF, fixed grid bias is applied to it (test point VHF tuner) through the switch (SW-3).


FIGURE 3 - TUNER OUTPUT AND I.F

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At each of these sound frequencies (odjacent and carrier) one of the traps (L-1 or L-2) will be in series resononce, thus effectively shorting out the 15 ohm coupling resistar (R-4) and the signal. The adiacent channal sound trap in this chassis is extremely efficient, and as a result appreciably a problem.
When using a 40 me I.F. tube neutralization is necessary. This is occomplished by not fully by-passing the R.F. voltthe from the screen grid of the video I.F. tubes. This voltage tends to cancel the R. F. signol which is fed back to the grid, through the grid to plate capocity, thus preventing the tube from oscillating. When replacing components in this circuit make sure they are of the same values, types and placed in their original positions with leads cut as short as possible.
A. G.C. is applied to the grids of $V-1$ and $V-2$ so that picture contrast will remain fairly constant over wide variaions in received signal strength.

The sound carrier level is maintained just below the point of interference with the video I.F. but is not completely ejected as the audio I.F. must hetrodyne with the video I.F. in the detector ( $N-4$, A A S 5 ) to produce the 4.5 mc inter carrier audio I.F. The 4.5 mc beat is abtained across the tuned 4.5 mc trap $\mathrm{T}-5$ and is fed to the first I.F. amplifier ( $V-6,6 A \cup 6$ ).
A.G.C. WITH TUNER DELAY

This A.G.C. system is designed to give superior performance of the receiver in very weak and strong signal areas. It is accomplished by separate A. G.C. control of the R.F. tube, namely keeping this tube at optimum gain at weak sigFor For best operation, a larger variotion of R.F. A.G.C. voltage than I.F. A.G.C. voltage is required. This can be d-
tained by using the D.C. output of the video detector for I.F. A.G.C. and using a circuit which rectifies the peak carrier with a suitable delay for R.F. A.G.C.
This is accomplished by an A.G.C. detector (V-4, Pins 2 and 5 ), which is used to rectify the positive half of the modulation envelope and is keyed with the negotive sync pulses above the average D.C. The D.C. voltage thus obtained across $R-18$ is equal to the approximate peak to peak carrier voltage less the average of $1 / 2$ the negative modulation envelope. This voltage is superimposed on the negative average D . C. Voltage deveoped bey
1 and 7 ) across $\mathrm{R}-22$ which results in a D.C. voltage approximately equal to the peak to peak carrier To operate the R.F. amplifier at maximum gain at low signal level, a positive delay voltage is applied to the A.G.C
buss by means of $R-43$. A clamping diode ( $V-9$, Pins 2,5 and 6 ) is used to keep the $A$. G. C. voltage on the buss equal tass the tube contact potential (approximately minus -0.7 volts) until the incoming signal is strong enough to develop sufficient bias to overcome the positive dolay voltage.
VIDEO DETECTOR
One half of a type 6AL5, (V-4, Pins 1 and 7 ) is used as the video detector. The demodulated composite video signol is fed to the video amplifier $(V-5,6 C B 6$ ) through the primary of the transformer ( $T-5$ ) tuned to 4.5 mc (which minimizes the effect of 4.5 mc in the picture and serves as a sound takeoff). The frequency response of the video detector is ex-
tended to the amount necessary for good picture definition by using a low value of load resistor ( $R-22,4700$ ohms) and tended to the amount necessory for good picture definition by using a low value of load resistor ( $R-22,4700$ ahms) and
series-shunt peoking (primary T-5, R-20, L-8). An R.F. choke L-9 ( 20 uh ) is used to further isolate the I.F. from the series-shunt peo
video signals.

## VIDEO AMPLIFIER

The output of the video detector (V-4) is coupled through T-5, L-9 and C-21 to the grid of the video amplifier which consists of a single high gain stage ( $N-5,6 C B 6$ ). Since only one tube is used, the output of the video amplifier is connected to the cathode of the kinescope so that correct picture phase is realized. Fixed bias, developed across $R-51$ is applied to the grid of this stage, (V-5, 6CB6). The contrast control varies the tube operating bias and the amount of degeneration thus changing its gain. Series-shunt peaking ond a low lord resistance
circuit to extend the frequency response of this tube to that necessary for good picture response.

SYNC AMPLIFIER AND SEPARATOR
The composite negatively phosed video signal is fed to the grid of the sync amplifier V-11A (Pin 12, 12AU7) where it is amplified and fed to the grid of the syne seporator ( $V-11 B, 12 A U 7$ ).
The sync separator is operated in such a manner (low 8 , high grid leak bias) that the picture and blanking information are kept below tube cutoff while the sync pulses which are of greater amplitude will cause the tube to conduct. This effectively separates the vertical and horizontal sync pulses from the picture information.
The horizontal and vertical sync pulses are fed to the verticol cascaded integrating network (R-95, C-71, R-96, C-72). y filters out horizontal pulses while allowing the vertical sync pulses to trigger the vertical oscillator ( $N-18,65 N 7$ ) keeping it in synchronism.

SYNC AMPLIFIER AND SEPARATOR (Continued)
Due to the relatively short time constant of C-42 ( 82 mmf ) $R-60(330 \mathrm{~K})$ only the horizontal sync pulses develop a pulse voltage across $R-60$ which operates the horizontal phase inverter. Since the vertical sync pulses are serrated at a even during vertical retrace improving the overall stability of the circuit.

These pulses do not actually trigger the horizontal oscillator as in the case of the vertical pulses but are used as a equency and phase reference by mears of the phase inverter (V-12A) and phase detector (V-12B) for "Harizontal Auto matic Frequency Control." This is explained in further detail under "Horizontal Automatic Frequency Control."

## NOISE INVERTER, SYNC CLAMP AND FRINGE COMPENSATOR

In electrically noisy fringe areas it is quite possible that the amplitude of the externally caused electrical noise pulses
are greater than that of the video sync pulses. It is these relatively high amplitude noise pulses, which are of the same polarity as the sync, that cause picture instability since they upset the operation of the sync separator (V-118, 12AU7) can cause the loss of a few sync pulses (horizontal or vertical) until the sync separator grid circuit has discharged through $R-56$ ta its normal negative value which is determined by the peak sync amplitude. If these troublesome noise pulses $\mathrm{R}-56$ ta its normal negative value which is delermined by the peak sync amplitude. Ir thate troubleso
could be eliminafed or reduced ta a point below the sync level, stability would be greatly improved.


This reduction in the amplitude of the noise pulse is accomplished by the noise inverter ( $\mathrm{V}-178,12 \mathrm{AU7}$ ), as explained below. In extremely strong signol areas the noise inverter circuit should be made inoperative. This is accomplished by means of the switch mount od to the "Fringe Compensator Contral." This switch when "OFF" effectively increases the bias (inserts an additional 10K resistor R-91 in the cathode circuit) on the noise inverter keeping it wall below
off at all times thus effectively eliminating it from the circuit. Failure to keep this circuit beyond cut off in strong signal areas may result in vertical roll and or wiggle. The operation of the noise
inverter is as follows.
NOISE INVERTER
A composite video signal of positive polarity is taken from the sync amplifier plate (iunction $\mathrm{R}-53$ and $\mathrm{R}-54$ ) and fed to the grid circuit of the noise inverter tube through $\mathrm{C}-68$. The grid bias on this tube is set adiusting $\mathrm{R}-89$ (fringe compensator) which effectively varies the
positive voltage on the cathode of the tube (Pin $3 ; V-17 \mathrm{~B}$ ) so that the rube does not conduct (is just below the cut off) on sync or video information.
FIGURE 4 - BLOCK DIAGRAM OF
NOISE INVERTER CIRCUIT However oll positive noise pulses of greater amplitude than the sync pulses will cause this tube to conduct. The peak
of the sync pulses are clamped just below the cut off point of the noise inverter tube by the clamper (V-17A) to prevent their cousing conduction of the noise inverter, over wide voriations in signal omplitude. The operation of the clamp

Since positive going noise pulses of greater amplitude than the sync pulses undergo an additional stage of amplifica-號 As you can see by the block diogram the amplified negative going noise pulse is completely concel out the noise pulse. As you can see by the block diogram the amplified negative going noise pulse is of greater amplitude than the original

This system eliminates those noise pulses which would have otherwise adversely affected the operation of the sync a
YNC CLAMP
In order to keep the tips of the sync pulses below the cut off point of the noise inverter tube over wide variations in input signal level, the peaks of the horizontal sync pulses are clamped to approximately zero volts by autormatically input signal level, the peaks of the horizontal sync pulses are clamped to appraximately zero volts by automatically
varying the bias across $R-90(2.2$ meg. noise inverter grid resistor) in accordance with the strength of the horizontal
sync pulse. (See Figures 5 and 6 ).

This is accomplished by the sync clomp tube ( $V-17 A, 12 A U 7$ ) in the following manner: The first horizontal sync pulse (Figure 5, Item A) will cause plate current to flow ( 1 p ) charging $\mathrm{C}-68(.01 \mathrm{mf}$.) to the peak of the sync pulse.

Due to the relatively long time constant of $C-68$ and $R-90(2.2$ meg. ) the voltage developed across $R-90$ as a resulh of the discharge of $C-68(.01 \mathrm{mf}$.) will be equal to the peak of the sync. pulse, (Figure 5, Item B). Stronger signals wi ause more plate conduction thereby increasing the bias across $R-90$ while weak signals will cause less plate conduction thereby decreasing the bias across R-90. (See Figure 6 )


FIGURE 5

As you can see the clamp tube ( $V-17 A$ ) in conjunction with $\mathrm{C}-68$ automatically adjusts the bias across $\mathrm{R}-90$ so that the tips of the sync pulses will be clamped at approximately zero volts over wide variations in signal strength.

The grid to cathode bias of the noise inverter ( $V-17 B$ ) is then set by the "Fringe Compensator" so that the tips of the sync pulses (approximately zero volts to chassis) will be below the cut o point of the noise inverter.

As mentioned above this point is always maintained by the sync clamp tube ( $V-17 A$ ).

In order for the bias across R-90 to be dependent only on the sync amplitude and not noise pulses the sync clamp tube is kep
at cut off at all times except during the horizontal sync pulses ( 15,750 times per second). This is accomplished by triggering the grid of the sync clamp tube at a horizontal rate with a positive pulse from the H.O.T. (See Figure 5, Item C). This pulse (about pols. P. to P.) drives the grid of the sync clamp tube positive,
causing grid conduction.

This conduction charges the grid capacitor ( $\mathrm{C}-67,100 \mathrm{mmf}$.) up to the peak value of the positive pulse (approx. -30 V )
Due to the relatively long time constant of C-67 (100 mmf.) and R-87 (470K) the voltage across R-87 due to the dis harge of $C-67$ remains at about -30 V . until the next horizontal pulse comes along at which time the grid again draws urrent charging $\mathrm{C}-67$ back to -30 V . at which time the above process is repeated

This causes the tube to remain well below cut off except when the grid is driven positive 15,750 times per second (horizontal rate) see Figure 6 .
Since the transmitted horizontal sync pulses of the composite video signal which are fed to the plate of the sync clamp tube through $C-68(.01 \mathrm{mf}$.) occur at the same instant the grid of this tube is driven positive, plate conduction can only occur at this time. Noise pulses which occur between sync pulses cannot possibly cause this tube to conduct since the grid of the sync clamp tube is well below cut off at that time (See Figure 6). BECAUSE OF THIS FACT, TH NEGATIVE VOLTAGE DEVELOPED ACROSS THE NOISE INVERTER GRID RESISTOR (R-90) WILL BE DEPENDENT


FIGURE 6

## HORIZONTAL AUTOMATIC FREQUENCY CONTROL (MIRACLE PICTURE LOCK)

In modern day receivers it is necessary to use some form of automatic frequency control so that the horizontal sync ulses do not directly trigger the harizontal oscillator. This is necessary since occasional noise bursts may prematuraly igger the oscillator, causing the picture to either spear or tear out
By using A.F.C. the average of a group of sync pulses are used to control the frequency of the oscillator, therefore f aync is distared ar masked by noise little effect will be usserved ton the screen.

HORIZONTAL AUTOMATIC FREQUENCY CONTROL (Continued)
This type of system is especially useful in the fringe areas where the signal to electrical noise interference is very poor.
This particular chassis uses a comporison of phase between the sync signal and the generated sawtooth as a basis fo automatic frequency control (A.F.C.). Such a system is little influenced by changes in sync amplitude or occasional noise and, therefore, operates extremely well.
A Phase Detector V-12B compares the difference in phase between the transmitted horizontal sync pulse and the arizontal sowtooth voltage which is generated in the receiver. Whenever the phase of the horizontal multivibrator $(V-13)$ changes, the phase of the sowtooth generated by this tube also changes. This effect changes the phase between the sync and sawtooth voltages causing the sync pulse to ride higher a lawer on the sawtooth retrace portion changing the peak amplitude of this composite wave. (See Figure 7). This change in amplitude is detected by the phase detect $(V-128)$ by means of the grid leak voltage developed across $R-65, R-64$ and $R$ es ( See Figure 7 ).

When the frequency and phase of the sync and sawtooth is carect the negative grid leak voltage developed across -64 is equal to the positive cathode voltage developed across $R-63$ ( 100 K ), therefore, the net control voltage applied o the grid of the horizontal oscillator ( $V-13$ ) is zero. With zero voltage on the grid the oscillator is set to have

Just as soan as a phase difference develops between the horizontal sync and the sowtroth, a negative or positive ontrol voltage is generated, which immediately corrects the phase of the oscillator, returning the control voltage back to approximately zero (will be slightly positive or negative depending upon the setting of the horizontal hold control R-73).


The purpose of the phase inverter is to provide a positive and negative going sync pulse of equal amplitude so that The pusa ontrol voltage proportional only to phase differences.

R-75, $R-68, C-47, R-66$ and $C-46$ are used to couple and shape the positive pulse from the horizontal output trans former to a negatively phased sawtooth.
C-56 and C-55 reduce the amplitude of the generated horizontal sowtooth before it is fed to the grid of the phase detector by $\mathrm{C}-48$.

The network of R-67 (2.2 meg.) in porallel with C-49 (. 001 ) used in coniunction with C-50 (.015) tends to filter nwanted high frequency pulses, while permitting the low frequency control voltage to pass

FIGURE 8 - HORIZONTAL AUTOMATIC FREQUENCY CONTROL NETWORK


## HORIZONTAL OSCILLATOR, SWEEP, AND OUTPU

V-13, 6SN7 is a cathode coupled multivibrator whose freo running frequency and phase depends upon such factors as setting of R-71 (Horizontal Balance), R-73 (Horizontal Hold), adiustment of L-13 (Horizontal Phase Coil) and the applied plate and grid voltages. Since automatic frequency control is to be used in thens control' point its voltage will be varied automatically to control the oscillation frequency and phase of $\mathrm{V}-13$. The method of control is outlined under "Horizontal Automatic Frequency Control."

The horizontal phase coil ( $2-13$ ) is adiusted so that its natural resonant frequency is the same as the horizontal sync rate ( $15,750 \mathrm{CPS}$ ). The abrupt voltage changes in the plate circuit of $V-13 A$ shock this circuit into oscillation. Since the operation of the circuit by modulating the plate voltage of $\mathrm{V}-13 \mathrm{~A}$ with a 15,750 sine wave. The polarity and phase of this sine wave is such that it maintains the free running frequency at 15,750 C.P.S.

The sweep voltage which is developed across C-56, C-55 as a result of the charge through R-74 (47K) and discharge (V-13B) is coupled to the grid of the 6BQ6GT horizontal output tube. The 14) is used a power amplifier so as to supply the necessary horizontal deflection current to the deflection yoke. The horizontal output transformer ( $T-9$ ) matches the relatively low impedance of the horizontal deflection yoke winding ( $L-16$ ) to the plate circuit of the $6 B Q 6 G T(V-14)$ for maximum efficiency. The damper tube $V-16$
 of the horizontal scanning cycle. The resultant energy from these damped oscillations provides the boosted Bf voltage ERTICAL OSCILLATOR SWEEP AND OUTPUT

A cathode coupled multivibrator is used as the vertical oscillator ( $V-18,65 \mathrm{~N} 7$ ). The vertical hold control ( $R-100$ ) controls the free running frequency of $V-18$. The intergrated vertical sync pulse causes $V-18$ to lock in at the proper frequency. The amplitude of the sweep voltage is controlled by the vertical size control ( $R-103$ ). Since

The sweep voltage developed across $C-76$ in series with $R-104$ is coupled f.rough $C-77$ to the vertical output tube -19. The vertical output transformer (T-10) matches the low impedance of the vertical deflection yoke L-17, to the elatively high output impedance of $V-19$ for maximum efficiency. R-107 (vertical linearity control) changes the operating characteristics of the vertical output rube $V-18$, thus changing the vertical linearity of the picture

DEFLECTION
Spot deflection is achieved by means of a deflection yoke ( $\mathrm{L}-16$ horizontal deflection coil and $\mathrm{L}-17$ vertical deflecion coil), mounted arouind the neck of the picture tube. Vertical and horizontal deflection currents flowing through hese coils set cp a magnetic field within the tube which causes the spot to be scanned both vertically and horizontally. $R-111$ and $R-112$ damp out the vertical coils to prevent spurious oscillations. C-81 connected across one half -83 ( 8200 ohm ) cannected between the horizontal output transformer and the yoke help to eliminate yoke ringing (rippling of raster lines).
high Voltage supply
A voltage pulse in the plate circuit of the horizontal output amplifier ( $V-14,6 B Q 6 G T$ ) which is developed during A voltage pulse in the plare circuin outo-transformer type primary of the horizontal output transformer T-9. Approximately 15,000 volts are generated in this manner due to the high efficiency of this circuit. A $183(V-15)$ rectifies this pulse which is then filtered by C-61, ( 500 mmf .) and R-84, ( 100 K ). Filament power for this tube is obtained from a tap on the horizontal output transformer.
LOW VOLTAGE SUPPLY
Two dual rectifiers (V-20,5U4G, V-21,5U4G) are used to supply the proper D.C. voltages and currents to the receiver from the applied A.C. power
Although each tube is connected as a half wave rectifier, together they form a full wave rectifier circuit
Filtering is accomplished by a condenser input filter (C-64, 80 mf . ; L-18, filter choke and C-66, 40 mf .). Voltages of plus 245, 225 and 150 are available from this supply. The B plus 150 volts is further filtered through $R-86$,
 small negative voltage is developed which supplies a fixed bias to the video amplike ( $\mathrm{T}-11$ ) to protect the receiver slow blowing type fuse is placed in series with the center tap of the power tran

FOCUS AND CENTERING
The 21MP4 (V-24) is pre-focused electrostatically by means of a focus electrode in the gun assembly operating at别 possible focus.
Centering is accomplished by means of a centering unit placed on the neck of the picture tube slightly behind the yoke

This device consists of two magnetized rings which when rotated together cause the electron beam to shift thus entering the picture. Wf the centering range is not sufficient a sight rotation of one of the rings with respect to the other will vary the amount of range until the right point is reached. For further information on the use of this center-
ing unit see note on centering procedure.

## BEAM BENDER (ION TRAP)

A single magnet type of beam bender is used and should always be adjusted by sliding and rotating the unit for maximum brightness. Do not adjust the trap for removing corner shadows or improving focus if in so doing the bright ness is reduced.
If two positions of maximum brightness are found use the one closer to the picture tube socket.
ADJustment of noise inverter (Fringe Compensator)

1) Be sure the miracle picture lock has been properly adjusted (horizontal hold circuits). See Page 15.
2) Tune in a weak station. Turn fringe compensator switch to the "ON" position and adjust the fringe compensato control for best picture stability.
3) Try all channels and readjust fringe compensator if necessary for best overall picture stability

NOTE: In most locations this added protection will not be necessary and the fringe compensator should remain in the "OFF" position. If this is not done, picture wiggle and or vertical roll might result in strong signal areas.
CENTERING PROCEDURE

1. Set the unit, magnets forward, on the tube so that Set the unit, magnets forward, on the tube so that just the clamp so that the unit is a sliding fit on the
2. Set the magnets so that the adjusting arms are approximately 1200 apart (Figure 9).
3. Adjust the ion trap magnet for maximum brightness.
4. Rotate the whole unit, this will cause the picture to move around a circle. Stop where the picture is most nearly centered.
5. Rotate the magnets separately, in equal distances but in opposite directions to complete the centering
b. Repeat steps 3, 4 and 5 if necessary.
6. Tighten clamp.

FIGURE 9 - CENTERING UNIT LOCATION DRAWING
8. Readjust the ion trap magnet to give maximum OCATION DRAWING
 brightness.

CAUTION: It is important that the centering magnets not be operated too close to the yoke as the A-C field from the yoke may cause the centering magnets to become demagnetized.

## SETTING OF TUNING KNOBS

1) Make sure chassis has been adjusted in the cabinet so that the tuning shafts are perfectly centered through the cabi2) net hole.
2) Insert fine tuning knob on shaft and rotare fully counter clockwise (no further rotation of outer U.H.F. dial shaft) ) Remove fine tuning knob and insert the U. H.F. dial (contains U.H.F. channel Nos.) on U. H.F. dial shaft. Set line is a hair thickness and is located about $3 / 16^{\prime \prime}$ to the right of the heavy black line near 0 of channel 20.
3) Place fine tuning and soloctor knobs on the ir rospective shafts.

NOTE: Leave enough space between knobs so that there will not be any binding.

## ALIGNMENT V.H.F.

a. Equipment Required - $A$ sweep generator, (10 MC sweep with center frequence of 44 MC. plus all.
necossory R.F. sweep froquencies as listed in R.F. able), accurate marker generatar, oscilloscope
and V.T.V.M. ore required for alignment. The ard.T.V.M. ore required for alignment. The MC ., 40 to 48 MC . and 50 to 216 MC .
b. Alignment Points - The location of all I.F. trans-
formers, Tuned Circuits, and trimmers shown in Figure is.

TV R.F. \& MIXER ALIGNMENT (V. H.F.)
Connect 3 valt bias battery to both I.F. and R.F. AGC. circuits, pasitive terminal to chassis, nego-
tive terminal to junction of $R-19$ C-19 C-1 Ade terminal to iunction of $\mathrm{R}-19, \mathrm{C}-19, \mathrm{C}-18$. Add o iumper wire from this iunction to iunction
of R-10, R-16 $C-8$ so . $h$ the the bios bottery is olso
applied to 1.F. AGC.


Figure 10. GENERATOR CONNECTIONS FOR TELEVISION
R.F. CHANNEL ALIGNMENT.


[^4]I.F ALIGNMENT

1) Tune receiver to unused Channel 10 or 12 .

Connect 3 volt bias battery with negative terminal to I.F. AGC. (Junction R-10, C-8, R-16) positive terminal to chassis.
3) Connect D.C. V.T.V.M. to video test point (see location in Fig. 13 and 14)
4) Connect terminated marker generator to floating shield of converter tube $V-236 J 6$. (Shield raised slightly so that it does not make contact with chassis). Use unmodulated marker. See Fig. 13.

| MARKER GENERATOR | ADJUST | PROCEDURE |
| :---: | :---: | :---: |
| 45.75 MC. Unmodulated | T-4 | Peak for maximum response. Adjust output of signal generator so that maximum response does not produce more than -2V. D.C. on V.T.V.M. |
| 43.2 MC. Unmodulated | T-3 |  |
| 42.0 MC . Unmodulated | T-2 |  |
| 45.0 MC . Unmodulated | $\begin{aligned} & \mathrm{L}-3 \\ & \mathrm{~T}-1 \end{aligned}$ |  |
| 41.25 MC. Unmodulated | L-2 | Adjust trap for minimum response. Increase output from signal generator so that a true minimum position can be found. |

5) Connect vertical input of an oscilloscope instead of V.T. V.M. to video test point with vertical scope gain set at, or near, maximum. (Horizontal scope sweep set at 400 cycles)

| MARKER GENERATOR | AD JUST | PROCEDURE |
| :---: | :---: | :---: |
| 47.25 MC . 400 Cycles Amp. Mod. | L-1 | With signal generator set at maximum output, adjust $\mathrm{L}-1$ for minimum vertical response on scope. |

) Now that all the I.F. coils and transformers have been set, the overall response can be observed and adjusted if necessary

| SIGNAL GENERATOR INPUT |  |  | MEASURING INSTRUMENT | ADJUST | PROCEDURE |
| :---: | :---: | :---: | :---: | :---: | :---: |
| CONNECTION | FREQUENCY |  |  |  |  |
|  | SWEEP | MARKER |  |  |  |
| Connect terminated sweep and marker as shown in Fig. 13. | Center frequency 44 MC . 10 MC . Sweep | 45.75 MC. | Scope connected to Video Test Point | T-4 | If 45.75 MC. doesn't lie from 60 to $70 \%$ down adjust T-4 (see fig 12) for tolerances. |

Providing overall curve is within tolerances as shown below, no further adjustments are needed. If band width or itt is not as specified, repeat entire alignment procedure. If still out then a slight retouching is permissible. ING OVERALL I.F. RESPONSE CURVE.
keep output of signal generator as low as possible when observing the overall i.f. shape since tube overload might result and the response will appear incorrectly flat and wide.

NOTE: It may be impossible to observe the 47.25 MC . marker with the average service equipment due to the high atrenuo
of trap L-1 (adiacent sound).


Figure 12. OVERALL I.F. RESPONSE CURVE


Figure 13. CONNECTIONS FOR I.F. ALIGNMENT.
All instrument leads should be dressed as directed and as short as possible to prevent interaction between input and output leads. Failure to do this may result in an unstable response indication.

NOTE: It is important that the output cable of the sweep and marker generator be properly terminated in their characteristic impedance which is usually from 50 to 75 ohms. If this termination has not been built into the end of the cable by the instrument manufacturer* then a resistor of the proper value (characteristic impedance) should be connected across the output of each generator cable as shown above.

* If in doubt check your instruction book which is issued by the test equipment manu-


Figure 14 - LOCATION OF ALIGNMENT POINTS (TOP VIEW)
R.F. OSCILLATOR ALIGNMENT (V.H.F.)

1. Connect marker and sweep generator as shown in Figure 10 , low side to chassis.
2. Connect scope to video test point (see location fig. 13 and 14).
3. Connect 3 volt bias battery as described under R.F. Alignment Page 11.
4. Before undertaking oscillator alignment be sure I.F. circuits are correctly aligned for band pass characteristic and trap settings.
5. During oscillator alignment, it is necessary to set the fine tuning control so that the tooth on the fine turning cam points
downward.

| MARKER SIGNAL GENERATOR FREQUENCY | SWEEP GENERATOR frequency | MISCELLANEOUS INSTRUCTIONS | $\begin{gathered} \text { TRIMMER } \\ \text { OR } \\ \text { SLUGG } \end{gathered}$ | TYPE OF ADJUSTMENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & * 209.75 \mathrm{MC} . \\ & * \\ & * 205.25 \mathrm{MC} . \end{aligned}$ | $\begin{aligned} & \text { Channel } \\ & \text { Cen } \\ & \text { Center } \\ & \text { Frequency } \\ & 207 \mathrm{MC} . \\ & 10 \mathrm{MC} \text {. } \\ & \text { Sweep } \end{aligned}$ | Be sure that fine tuning control has been properly positioned (tooth on the cam pointing down) <br> NOTE <br> During this step and thru-out all succeeding steps it is necessary to: <br> 1. Keep output of sweep generator at a level that does not allow the reading on a VTVM to exceed minus 1 volt when connected across video detector load at minimum sweep width. <br> 2. Keep output of standord signal generator at a level that provides a readable marker but does not distort the curve that is being observed on the scope. | $\begin{aligned} & \text { Adiust } \\ & \text { Slug } \\ & \text { A-12 } \end{aligned}$ | NOTE: Before making the following adjustment, advance the vertical gain control on the scope in order to magnify the sound trap portion of the response curve. <br> Then, use a non-metallic screwdriver to adjust charmel 12 oscillator slug (accessible thru hole on front of r-f tuner unit) and shift response curve so that sound carrier marker is located at the position indicated below. <br> Now reduce gain control setting of scope to restore pottern to normal amplitude cind observe position of picture carrier marker. This marker should appear on the high frequency side of the characteristic curve. The amplitude of the picture carrier should be between 60 and $70 \%$ down from peak response. |
| $\begin{aligned} & * 215.75 \mathrm{MC} \\ & * 211.25 \mathrm{MC} \\ & *=203.75 \mathrm{MC} \\ & *=199.25 \mathrm{MC} . \end{aligned}$ | Channel 13 213 MC . <br> Channel 11 201 MC. | Set Channel Selector to 13 (See note above) <br> Set Channel Selector to \$11 (See note above) | Adjust the r-f sweep generator ond marker generator for operation on other television channels; set marker generator to sound carrier frequency. After setting Channel Selector to corresponding chonnel, adjust oscillator slug thru hole on front of $r$-f tuner unit. (A-2 to A-13) |  |
| $\begin{aligned} & \text { * } 197.75 \mathrm{MC} \\ & * \\ & \text { * } 193.25 \mathrm{MC} \end{aligned}$ | Channel 10 195 MC . | Set Chonnel Selector to 10 (See note above) | This permits response curve to be shifted so that sound carrier marker will appear at the position indicated below. |  |



TYPICAL OVERALL RESPONSE CURVE NOTE: Make sure that cam on fine tuning control shaft remains properly positioned during this step (tooth on the cam

## SOUND ALIGMMENT

(A) USING 4.5 mc unmodulated sigmal gemerator

1) Short pin il of V-3 to Chassis with short
2) jumper wire.
3) Koep output of signal generator low so as
to provide a adjustment of transformers. adjustment of transformers.
(B) USIMg TRAMSMITTED TV AIR SIGMAL
4) Connect antenna and tune to agod on the air TV atation.
5) Adjust fine tuning control for best picture. as to provide a sharp moter indication with adjustment of transformers Moter roading may pulsate due to changes in adjustment.

| STEP | siemal gemerator imput |  | measuring instrument | ADJUST | PROCEDURE |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | COKNECTIOM | frequency |  |  |  |
| 1 | Marker emen. through $\mathrm{V}^{01} \mathrm{MF}$ to pin $7 \mathrm{O}^{\circ}$ chestis. <br> Connoct ant tenna end tuno in a mod tranamittod $\pi$. Al mal lany chennol) | 4.3 mc (Uneodulated) <br> - or - <br> A good on the air TV. chennel | Connect D.C. V.T.V.M. negetive scale) through 10k Resistor to Junction of C-30. R-35, n-36-102 side to chassis. | $\begin{gathered} \text { T-5 } \\ \text { Top } \\ \text { Top } \\ \text { oottom } \end{gathered}$ | Poak for maximun voltago. adjuat output of signal genorator to produce about a (1 volt above nolas " vol tage) <br> if T.v. sional is used adjuat ant. coupling to reciver to produce about the same voltage riso. |
| 2 | $\begin{aligned} & \text { sene es } \\ & \text { above. } \end{aligned}$ |  | Connect V.T.V.M. <br> through 10K <br> Resistor to <br> Junction of R-44. <br> C-34 - low side <br> to chassis. | $\begin{aligned} & \text { T-7 } \\ & \text { Top } \begin{array}{l} \text { nd } \\ \text { Bot tom } \\ \text { (Dis- } \\ \text { crimi- } \\ \text { nator) } \end{array} \end{aligned}$ | A) Detune Discriminator secondery T-7 (Top Pt. 4708018. 708151: Botton Pt. 700017) for maximum negetive meter reading. Adjust primary $T-7$ for <br> B) Adjuet primary T-7 for <br> C) Roximum negative motor reading. <br> Readjust Discriminator secondery ltowerds original setting) for zero D.C. reading Check V. V.M. <br> D) Check Audio. if diatorted repeet steps A - C. |


4.5 MC VIDEO TRAP ALIGNMENT (L-12)

1. Connect crystal controlled 4.5 mc . signal generator through a .01 mf . condenser to the grid of the video amplifier tube (Pin 1 of V-5, 6CB6) low side to chassis
2. Cot contrast contro. for maximum contrast (fully clockwise). low side to chassis.
3. Adjust the 4.5 mc . trap L-12 for minimum reading on the V.T.V.M.

If a cirystal controlled generator is not available the video trap can be adjusted in the field by setting the fine tuning control for maximum 4.5 mc . in picture and adjusting the 4.5 mc . $\mathrm{trap}(L-12)$ until this 4.5 mc . beat note is re too low a frequency.

## ALIGNMENT OF MIRACLE PICTURE LOCK (Horizontal A.F.C. \& Osc.)

Before proceeding be sure the Fringe Compensator Switch has been turned "OFF" (fully counter clockwise past
lick). click).

1. Tune set to a good channel.
2. Short phase coil ( $\mathrm{L}-13$ ) with a jumper wire, leads have been brought to top of chassis on terminal strip near V-13 horizontal oscillator (see tube location diagram Figure 19 Page 19).
3. Short horizontal control grid to chassis. This point has also been brought to top of chassis on same strip as mention-
4. Rotate horizontal hold control (R-73) to center of its mechanical range.
5. Adjust horizontal balance control (R-7I) (rear of chassis) until picture put
. Adjust horizontal balance control (R-71) (rear of chassis) until picture pulls into synchronism (in most cases picture
will sway from side to side). . Remove short from horizontol
6. Remove short from horizontal phase coil ( $L-13$ ) and adjust L-13 for same synchronous condition as Step 5 above.
. When shat from horizontal control grid. Horizontal frequency circuits are now properly aligned
aut throwing the picture out of sync.
7. Readjust horizontal hold cont of sync.
8. Readjust horizontal hold control ( $R-73$ ) so that the picture remains in sync when switching channels (near center
of range).

## ALIGNMENT (UHF TUNER)

The alignment of the tuner is factory set and will actually not require any additional adjustments other than to Tompensate for differences in 6 J 6 oscillator tubes. Because of this fact, the only adjustment to be made in the field is trimmer $\mathrm{C}-7$ which is located next to the 6 J 6 oscillator tube. (See Figure 2, Page 2)

This trimmer is normally set at the factory to track the highest U.H.F. channel (83). This must be done with a U. H.F. sweep and marker generator. In the field however, this equipment is not readily available and C-7 should
therefore be used to track the highest U. H.F. channel received in the area. It is usually best to try a few 6 J tubes theres ore is used to track the highest U. H.F. channel received in the area. It is usually best to try a fow
until one is found which more nearly resembles the original, thus requiring only a slight adjustment of $\mathrm{C}-7$.

In the event T-A has been tampered with or replaced, it should be adjusted for best results on all U.H.F. channels received in the area. This I.F. sometimes normally has only a slight effect on the picture or sound.

Before doing any work on this U.H.F. tuner, whether in the field or shop, be sure that the V.H.F. I.F. and R.F. circuits have been properly set up, (this can be checked by viewing an on the air V.H.F. channel or by instruments). Information pertaining to the use of instruments can be found on Pages 11,12 and 13
general installation instructions
ANTENNA
This chassis is designed to operate from either its built in UHF-VHF antenna, an external combination UHF-VHF antenna or separate UHF and VHF antennas using one or two sets of antenna
This set as
it in delivered is ready to operate from
its built in UHF-VHF antenna. In most strong
If it is necessary to install an external antenno. disconnect the built in antenna by removing the spade lugs ( 1 and 2) from the VHF antenna terminals.

If one antenna lead in is used for both UHF and VHF reception, it should be connected to the VHF inpur terminals. When the receiver is set for UHF
reception, the UHF-VHF switch automatically transfers the single antenna lead in to the input of the UHF tuner removing it from the VHF tuner. This transfer will only take place providing the jumper win lead connected to terminals and UHF input antenna terminal strip by means of spade lugs 3 and 4.

|  |  |  |
| :---: | :---: | :---: |
| usto foin vant <br>  |  |  |
|  |  |  |
|  |  | UNF-vMF ameas witm UMF GUMALE. |

Figure 15. ANTENNA CONNECTIONS

If separate UHF and, or VHF antenna lead in wires are used, they should be connected to their respective antenno input terminals. Under these conditions, spade lugs 3 and 4 must be removed from the UHF input antenna terminals.

For new installations, it would be desirable and economical to install a combination UHF-VHF antenna providing of course that a VHF station has been allocated to that area. In the event that the terrain is hilly or in a metropolitan area, ghosts may present quite a problem and it may be better to install separate UHF and VHF antennas. This may be necessary since combination antennas usually have poor directivity at UHF. Separate UHF and VHF an
be connected to one lead in if desired through a printed circuit filter, which is commercially available.
U H F ANTENNAS WHICH WILL TAKE CARE OF MOST PRESENT DAY INSTALLATIONS


SINGLE BOW TIE For use in strong signal areas where ghosts do not present a problem.


STACKED $V$ For use in weak signal areas where ghosts do not present also be used for strong VHF


BOW TIE SCREEN RELFECTOR
For use in strong or weak signal areas where ghosts present a problem.


FOLDED BOW TIE ORNER REFLECTOR For use in strong or ringe areas where hosts present a problem.

[^5]© John P. Rider

In UHF the use of free space terminals and rigid construction is an important detail．By free space terminals we mean air insulation between the terminals of each antenna section instead of bakelite or poly．The use of an insulation other than air，tends to collect moisture which creates a signal leakage path thus reducing the signal．

Since UHF frequencies have relatively short wave lengths，rigid elements are very important．The slightest movement could easily become an appreciable part of a wave length which may effect signal pickup．

## ANTENNA WIRE

The common type 300 ohm ribbon line will work out satisfactorily only in strong signal areas，since when wet hine losses increase by almost 8 times at the high end of the UHF band．The tubular 300 chm line is much better in this re－ spect as the leakage path is not as readily effected by moisture and it can therefore be used in most signal areas．When wet，tubular tine losses increase slightly more than two times af the high end of the Shrlband．in the exreme trans－ areas the use of open wire line may be best，but idis more these lines generally have a higher lass to start with and are comparatively expensive．


Transmission lines other than the shielded type should be mounted away（ 6 to 7 inches）from all nearby metal objects by use of stand offs，as the closer these lines are to metal，the greater will be the losses．In the event that it is imprachi－
 weather conditions．
If tubular line is used，be sure that the ends are sealed to prevent moisture from entering the line．This is easily done年 heoting the ends and pressing them together to form a good seal．It is also a good idea to use a small drain hole in the tubular line just before it enters the house so that condensed moisture may leak out

## HEIGHT AND ORIENTATION OF ANTENNAS ATU．H．F

Since the wave lengths at UHF are much shorter than at VHF，objects which did not appreciably reflect the VHF wave will now reflect UHF waves．Because of this，orientation and the use of directive antennas is much more important to minimize the pickup of reflected or ghost signals．

Another effect of these shorter wave lengths is to cause a more rapid variation of signal pickup with antinna height． Bocause of this fact，it is important that antenna height be probed for maximum signal pickup．A foot higher or lower may yield a marked increase in the signal pickup．

| Channel | Freq． | Video | Audio | $\begin{array}{\|c\|} \hline \text { Half } \\ \text { Wave } \\ \text { (Inches) } \end{array}$ | Channel | Freq． | Video | Audio | $\begin{array}{\|c\|} \hline \text { Half } \\ \text { Wave } \\ \text { (Inches) } \end{array}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 14 | ${ }^{100.76}$ |  | ${ }^{8} 8$ | ${ }_{12 .}^{12.5}$ | 31 |  | ${ }_{\text {coser }}^{60825}$ |  | ： 8.5 |
| $1{ }^{18}$ | ${ }^{17242}$ | ${ }^{21025}$ | ${ }^{31723}$ | $\underset{\substack{12.2 \\ 122}}{122}$ |  | coiction | coin | cose | i， |
| $\stackrel{\square}{\prime \prime}$ |  | ${ }^{40} 9$ | 边 | 12， | ss | coin | 永， 1125 | coin | ，${ }^{2}$ |
| ${ }_{20}$ | cose |  | sintir | 11.6 | \％ |  |  | cin | \％ |
| ${ }_{22}^{21}$ |  | cos | ， 31278 | i1： | $\infty$ |  |  | ， | ${ }_{8}^{8,0}$ |
| ${ }_{24}^{23}$ | come | ${ }_{\text {cis }}^{53,23}$ |  | 11：2 | ${ }^{\circ}$ | ，32735 | ${ }^{73235}$ | 7373 | \％ |
| ${ }_{26}^{25}$ | cos | cin 3 37．25 | Stins | 110．9 | 88 |  | $\xrightarrow[\substack{78923 \\ \\ 73823}]{ }$ | ${ }_{\substack{2 \\ 780973 \\ 78073}}$ | ， |
| 紮 | come | ${ }_{3}^{30,23}$ | cisen | 10．7 | \％ 8 | $\xrightarrow[\substack { \text { mont } \\ \begin{subarray}{c}{\text { ma，}{ \text { mont } \\ \begin{subarray} { c } { \text { ma，} } }\end{subarray}]{ }$ | $\xrightarrow{m 125}$ | cin | \％ |
| \％ | ${ }_{\text {cosem }}$ | coin | coss | ${ }_{10.4}^{10.5}$ | ${ }_{0}$ | ， | con |  | \％${ }^{\text {\％}}$ |
| 312 |  | ${ }_{\text {372，}}^{3723}$ | ${ }_{5}^{512,3,3}$ | 10.3 10.2 | 8 |  | （10．12， |  | ，${ }_{\text {，}}$ |
| 3 | cose | ${ }_{3}^{68,23}$ | S | 10.1 |  |  |  |  |  |
| ${ }_{3}^{4}$ | cose | ¢ | （in | \％9， | ， | 边 | （12， | （in | ， 2 |
| ， | （ta | cois | 边 | 9.8 | ${ }_{7}^{73}$ | coin | （in |  | ， |
| com |  | （in | （in | ：${ }^{3}$ | 仿 | ， | cisers | 边 | 7：0 |
| $\stackrel{\square}{4}$ | ${ }_{42} 8$ | 20323 | 20173 | 8 | \％ | ${ }^{235450}$ |  | Siss， | 80 |
| a | \％ | 20323 | coick | ：2 | \％ | coin | ciser | \％ | 8 |
| － | \％ | coin | coill | \％ |  | ${ }^{30} 80.1000$ | ${ }^{\text {che }}$ | ${ }^{818,78}$ | 8 |
| ${ }^{\prime}$ | － | cois |  | ． 1 |  |  |  |  |  |
| ${ }_{0}^{0}$ | mom | （cile | －1093， | 0. |  |  |  |  |  |



Figure 16 －TUBE LOCATIONS DIAGRAM FOR CHASSIS 120198－D




STEP 3


Figure 18 －DIAL CORD STRINGING CHASSIS $120174-$


Figure 19 - TUBE LOCATIONS DIAGRAM FOR CHASSIS 120174-B

TUBE TROUBLE ANALYSIS CHART FOR CHASSIS 120198-D \& 120174-B

| SYMPTOM | CHECK |
| :---: | :---: |
| Weak or no sound nor video (picture), raster normal - UHF only | V-25, D-1, D-2 * |
| Weak or no sound nor video (picture), raster normal - UHF and or VHF | V-22, V-23, V-1, V-2, V-3, V-4* |
| Weak or no sound - Video and raster normal ----UHF and or VHF | $V-6, V-7, V-8, V-9, V-10$ |
| Weak or no video - Sound and raster normal ----UHF and or VHF | $\mathrm{V}-5, \mathrm{~V}$-24 |
| Poor or no horizontal nor vertical sync - sound and video normal (contrast control makes video darker or lighter) | V-11, V-17 |
| Poor or no horizontal nor vertical sync - Video weak or distorted, raster normal - sound may or may not be <br>  | V-22, V-23, V-1, V-2, V-3, V-4 |
| Poor or no horizontal sync - raster normal and sound normal (picture locks in vertically) -........ UHF and or VHF | $V-11, V-12, V-13, V-17$ |
| Poor or no vertical sync - raster normal and sound normal (picture locks in horizontally) - - - - - UHF and or VHF | $v-11, v-17, v-18$ |
| Horizontal line (no vertical sweep) - sound normal - UHF and or VHF | $V-18, V-19, V-18$ |
| Insufficient horizontal size, sound \& video normal - UHF and or VHF | $\mathrm{V}-14, \mathrm{~V}-16, \mathrm{~V}-20, \mathrm{~V}-21$ |
| Insufficient vertical size, or white horizontal <br> bar in picture, horizontal size OK-.........- UHF and or VHF | V-19 |
| No sound, no raster - tubes lit-.-.-.-.-- UHF and or VHF | Fuse, V-20, V-21 |
| No sound, no raster - tubes not lit--------UHF and or VHF | Plug connection in wall socket, ON-OFF switch, line cord. |

By raster we mean the illuminated scanning lines

* Another very common fault is a shorted or open circuit antenna connection to set.
(UHF TUNER)

Since the operation of this tuner is dependent almost entirely on its mechanical configuration, all component parts whether lumped constants or transmission line sections, have been manufactured and mounted as rigid as possible. If it is necesment part should be used. Be sure it is mounted in the same position using the same lead lengths as the original. This is very important since at UHF frequencies a small piece of wire has an appreciable inductance. Stray capacitances between components and chassis also tend to effect

Due to the simplicity of design and manufacture of this tuner, little trouble is to be expected In the event that this funer becomes defective in any way, the trouble shooting chart in this note can be used to good advantage.

If the crystal D-2 is open or shorted, or the os cillator is inoperative, there will be no bias developed across $\mathbf{R - 2}$. If replacing $\mathbf{D - 2}$ does not rectify this condition, then it can be assumed that the oscillator is not functioning.
Be sure that the harmonic generator coupling loop (L-7) is not touching the shield. A voltage


Figure 20 - SCHEMATIC DIAGRAM UHF TUNER 4770713 and resistance check of the 6 J oscillator circuit should soon locate the trouble

If the correct bias is measured across the resistor R-2 and the set still operates paorly on UHF, then it can be assumed that the mixer crystal D-1 is defective in some way. This can easily be determined by lifting R-1 off chassis and inserting a D. C. milliameter between it and chassis. In the event that the current readings are abnormally low or high, a new crystal known to be good should be inserted (see trouble shooting chart). If it is desired to localize the difficulty further, placing the pliers between the crystal and the connection so as to absorb the heat thus protecting the crystal. This is im portant, since excessive heat can easily damage it.

Do not attempt to repair or adjust this tuner by adjusting any of the coupling loops or by moving various components The only adjustment that can be made in the field is $\mathrm{C}-7$ to compensate for a change in interelectrode capacities when a new $6 J 6$ is used. The proper procedure for this is shown under alignment, Page 16.
Components which are not a part of the R.F. or oscillator tuned circuits such as feed thru condensers, B plus resistors, -A, etc., can usually be replaced with little difficulty providing the above precautions are observed.

NOTE: In the event that this tuner needs an overall alignment or service of parts, the defective tuner should be returned for repairs through your Emerson distributor

## REPLACEMENT OF TUNERS

If it becomes necessary to return a UHF tuner to your distributor for repair or replacement, remove and retain the exension shaft and pulley. When returning the VHF tuner, remove and retain the VHF-UHF switch and the front plate which consists of a pulley and gear combination. This is important since replacement tuners will not come equipped with the above devices.

Under no conditions are both the VHF and UHF tuners to be returned as a unit. Before returning for replacement or re air, an honest effort should be made to repair the unit since all special and major parts will be available through your Emerson distributor.


NOTE: Voltages taken with receiver in UHF position under same conditions as listed on top of Page 22

General trouble shooting information (vhf tuner)


Figure 21 - SCHEMATIC DIAGRAM OF VHF TUNER 470712

## REPAIR OF VhF TUNER

The maiarity of tuner troubles which are not due to defective tubes can usually be detected by a physical examina tion of the tuner (turret removed), such as burnt resistars, broken parts, bent or dirty cantact fingers, cald solder ioints broken socket pins, otc.
the tuner checks out physically it shauld then be checked according to the fallowing trouble shooting chart.
theould always be borne in mind that a burnt tuner resistor is usually the result of a shorted condenser or tube. replacing parts, leads should be kept as short as possible and components replaced in the same position as the replacing parts,
original parts.
More detailed general information on turrat tuner repairs can be found in Service Note titled "Emerson Turret Type
Tuner m470651" released April 1, 1951.

## TUNER TROUBLE SHOOTING CHART VHF TUNER

Measurements taken under same conditions as listed on top of Page 22. To take measurements from 6BK7 socket, remove $68 \mathrm{BK7}$ tube but leave 6 J 6 tube in its socket, likewise when taking measurements from the 6 J 6 socket leave 6BK7 tube in its socket.

| v. 22 <br> 6BK7 <br> 6BQ7 <br> 6BQ7A <br> or $6 \mathrm{BZ7}$ | PIN No. |  |  | POSSIBLE TROUBLES IF READINGS NOT NORMAL |
| :---: | :---: | :---: | :---: | :---: |
|  |  | normal readings |  |  |
|  | Pin 1 | 130V. | 1 mog . | (c.9, 3.3 mm ) shortod |
|  | Pin 2 | -2.5 V. | 1.8 mm 9. | (R-2, 15K) or (R-1, 47K) open or thotred |
|  | Pin 3 | ov. | $0 \sim$ | Cold solderer ioint |
|  | Pin 6 | +215V. | 16 K |  |
|  | $\operatorname{Pin} 7$ | +130 V . | 1 mog . | (R-3, 330 K ), (R-4, 180 K ) $\alpha$ ( (R-5, 100 K ) open or shorrod, (C-15, 1000 mm ) zhoriod |
|  | $\operatorname{Pin} 8$ | +130 V . | 1 mog . | (C.9, 3.3 mmi ) hheotod |
|  | Pin 9 | ov. | $0 \sim$ | Cold solder ioint |
| v 23 | PIN MO | normal | eadings. | possible trouales |
| v.23 | prno. | voltage | RESISTANCE | IF READINGS NOT MORMAL |
|  | Pin 1 | 150 v . | 16 K |  |
|  | $\operatorname{Pin} 2$ | 150 V . | 20 K | (L-13) open, (C-21, 1000 mmH , (C-22, 6.8 mmf ) or (C-23, 1000 mmf ) shortod, (R-11, 15 K ) apen of shorted |
| 656 | Pin 5 | ov. | 190 K |  |
|  | Pin 6 | ov. | 8.5 k | (C-16, 10 muF) shertod |
|  | Pin 7 | ov. | $0 \sim$ | Cold solder ioint |
|  | $\begin{array}{\|l\|l\|} \hline \begin{array}{l} \text { Toin } \\ \text { Foint } \end{array} \\ \hline \end{array}$ | $\begin{aligned} & -1 \mathrm{v} .10 \\ & -\mathrm{s} \text { v. } \end{aligned}$ | 200 K | Oscillator injection voltoge varies between ehennels (low frequency chonnels hove higher injection valtoge obout -4 v .) |

## CONDITIONS FOR TAKING VOLTAGE AND RESISTANCE READINGS

The resistance measurements listed below are for chassis 120174B and 120198D with no triangle code markings.
Due ta component variatians, voltage and resistance readings may vary slightly from those given here. Slight variations may also be noticed if chassis is not coded as mentioned above.
The picture tube, deflection yake and high voltage circuits were connected to take the fallowing readings and waveshapes.

1. Antenna disconnected and antenna terminals shorted on tuner and connected to chassis (use short leads)
2. Line voltage 117 volts (Discannect power for resistance readings).
3. 3 volt bias battery connected to bath I.F. and R.F. A.G.C. circuits, positive terminal to chassis, negative terminal to junction of R-19, C.19, C-18. Add a jumper wire from this iunction to junction of $R-16, C-8, R-10$ so that bias battery is also applied to I.F. A.G.C. BIAS BATTERY USED FOR VOLTAGE READINGS ONLY.
4. All controls in position for normal picture. (Varied when it directly effects reading).
5. All measurements saken with a vacuum tube voltmeter and ohmmeter.
6. All readings listed in tables were taken between points shown and chassis.
7. Resistance readings are given in ohms unless otherwise noted.
8. N.C. denotes no connection.

## WAVE SHAPE ANALYSIS CHART FOR CHASSIS 120174B AND 120198D

The information listed below was taken from a chossis with no triangle code markings.
Slight peok to peak voltage differences may be noticed if chassis is not triangle code marked as mentioned above.
The wave shapes shown here are arranged so as to give the serviceman an easy method of signal tracing. The peak to peak voltage given may vary slightly depending on signal strength and companent variations.

To accurately abserve the wave shapes, the relatively high input capacity of an oscilloscope must be reduced so as not ta change the operating characteristics of therve the wave shapes, the reltelision will result in wrong wave shape readings. This is accomplished by using an Emerson low capacity probe as outlined previously in the service note for models $686 \mathrm{~L}, 68 \mathrm{~L}$, and 696 L using chassis 120142 - B which was issued at an eorlier date.

Connect antenna and tune recaiver to channel where best reception has been obtained in the past.
Low end of the probe is connected to CHASSIS and the contrast control is set at MAXIMUM CONTRAST.
The 30 and 7875 C.P.S. oscilloscope sweep settings are used so as to permit the serviceman to observe two cycles of the wave shape.
NOTE: A wave shape seen in your oscilloscope may be upside down from same wave shape shown here. This will depend on the number of stages of amplification in the oscilloscope used.

RESISTANCE READINGS FOR CHASSIS 120174-B AND 120198-D

| srmsa | tube pin numbers |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | M 11 | Mn 2 | $\sim_{\text {¢ }} 3$ | Pin 4 | Pin 5 | Pno | Pin 7 | $\mathrm{Pn}_{\mathrm{n}} 8$ | $\beta^{\circ}$, | $\kappa_{n} 10$ | Mn 11 | Pn 12 |
| $\frac{v-1}{v-2}$ | 1 mas. | 47 | $\frac{2}{2}$ | $\bigcirc$ | $\frac{15}{15 k}$ | ${ }_{1}^{1} 15 \mathrm{Lk}$ | $\bigcirc$ |  |  |  |  |  |
| $\frac{V-2}{v-3}$ |  |  |  |  | ${ }_{\text {ctisk }}^{\text {tisk }}$ | ${ }^{1} 155$ | $\stackrel{0}{4.7 \mathrm{~K}}$ |  |  |  |  |  |
| V-5 | ${ }^{1} \mathrm{mog}$. | $\frac{1 \text { mout }}{\text { Comber }}$ | $\frac{.}{}$ | $\bigcirc$ | ${ }_{\text {+ }}+1 \mathrm{k}$ | ${ }^{15 \mathrm{~K}}$ | ${ }_{\text {coskrat }}$ |  |  |  |  |  |
| $\underline{V-6}$ | 1 Tman |  | 0 | . 08 |  | $1{ }^{135}$ | ${ }_{220}^{220.5}$ |  |  |  |  |  |
|  |  | ${ }^{100 \%}$ | 0 | . 0.5 | ${ }_{170 \mathrm{~K}}$ |  | ${ }^{1006}$ |  |  |  |  |  |
| $\stackrel{v-9}{v-10}$ | N, ${ }^{10}$ maal | ${ }^{0} 0$ | ${ }_{+}^{0} 16 \mathrm{~K}$ | $\stackrel{.05}{+16 \mathrm{k}}$ |  |  | 0 | 470 |  |  |  |  |
|  |  | ${ }^{15 K}$ | 0 | , 08 | . 08 | - 0 -200k | 2.5 mmg . | ${ }_{0}$ | 0 |  |  |  |
| $\underset{V}{V-12}$ | ${ }_{2}^{2.2 \mathrm{mag}}$. |  | $\frac{11.0 \mathrm{~K}}{1.2 \mathrm{k}}$ | Horiz. Hold | ${ }^{150 \mathrm{~K}}$ |  |  | \% |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\frac{v-14}{v-15}$ | N.C. | 0 | N.E. | ${ }_{+22 \mathrm{~K}}+$ | $\frac{500 k}{\text { IN } 2 ~ A N D ~}$ | N.C.infini | CE, PLA | ${ }^{110}$ |  | Cop of 689 | 105 K |  |
| $\frac{v-16}{v-17}$ | N.C. | N.C. |  | N.C. | ${ }_{6}^{15 \mathrm{~K}}$ |  | ${ }_{\text {d }}+105 \mathrm{~K}$ | $f^{105 k}$ | . 05 |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
| v-18 | 100\% | ${ }^{180} \times$ | 2k | Vert. Hold | Vent. Size Control | 2.3k | . 08 |  |  |  |  |  |
| v-19 | N.c. | 0 | ${ }^{15 \mathrm{LK}}$ |  | 2.2 mmo | ${ }^{230 \mathrm{~K}}$ | . ${ }^{\circ}$ | $\xrightarrow{\text { Vor.t. Lin. }}$ |  |  |  |  |
|  | N. | +155 | N. | 2 | N.C | 22 | N.C. |  |  |  |  |  |
| $\frac{V-2!}{V-24}$ |  |  | N.C. | ${ }_{\text {N }}{ }^{22}$. | $\frac{10}{\text { N.C. }}$ |  | N.C. | N.C. | N.c. | 660\% |  | ${ }^{\circ}$ |



OJohn F. Rider


CABINET PARTS LIST - CHASSIS 120174-B \& 120198-D


PRODUCTION CHANGES
In the course of production various changes ware incorporated in the order shown below. Changes as listed under a particulor lotter also include changes as listod undor all provious lettors unless othorwise noted. All changes released after this note is printod will be sent out to our distributors in the form of field service bulletins. These should bo kept together with the service note ond ontored in the fol
lowing table for o quick reference. By utilizing this informotion the schamatic con be eosily modifiod to correspond to o chassis of any triangle code.

| Triangle <br> Code <br> Letter | F.S.B. <br> No. | Supp. <br> No. | Purpose |
| :---: | :---: | :---: | :---: |
| A. | Service <br> Note | 0 | See Schematic Page 23. |
|  |  |  |  |
|  |  |  |  |

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## ADDENDUM SERVICE NOTE

This information should be considered as part of the
Service Note for Models 752A, 755A, 784A, 753F, 785C
and 785 E using chassis $120174-\mathrm{B}, 120198-\mathrm{D}$

| Model Numbers | TV <br> Chassis | Tube <br> Size | TV <br> Tuner |
| :---: | :---: | :---: | :---: |
| 753D, 761C | $120180-\mathrm{D}$ | 17LP4 | $470712-\mathrm{VHF}$ <br> (Glass-Rect.) |

## MODELS 753D, 761 C

BUILT IN ALL CHANNEL UHF - VHF RECEIVERS
The above models incorporate Chassis $120180-\mathrm{D}$ which is electrically identical to Chassis 120198-D. The differences between the two chassis are in the physical placement of the 5 U 4 G tubes and the use of a different chassis base

With the exception of the Cabinet Parts List (below) and the Tube Location Diagram (other side), all technical information pertaining to the models listed above will be found in the Service Note covering Models 752A, 755A, $784 \mathrm{~A}, 753 \mathrm{~F}, 785 \mathrm{C}$ and 785 E using chassis $120174-\mathrm{B}$, 120198-D

CABINET PARTS LIST - Chassis 120180 -D

| Part Numbers |  | Description | $\begin{aligned} & \text { bist } \\ & \text { Price } \end{aligned}$ |
| :---: | :---: | :---: | :---: |
| Model 753D | Model 761C |  |  |
| 140468A |  | Cabinet - Table Model - Blonde | 61.00 |
| 140468 |  | Cabinet - Table Model - Mahogany | 61.00 |
|  | 140534 | Cabinet - Console - Mahogany | 100.00 |
|  | 140534 A | Cabinet - Console - Blonde | 106.00 |
| 460252B | 460252 B | Control Door - Mottle Ivory for ${ }^{140534 \mathrm{~A}}$ ] | 1.55 |
| 460253D | 460253D | Control Door Escutcheon - Mottle Ivory for 140468A $\}$ | er set |
| 587088 | 587088 | Springs for Door |  |
| 460252 | 460252 | Control Door - Gold -for 140468 f | 2.45 |
| 460253 | 460253 | Control Door Escutcheon - Gold -ior 140534 ) | r set |
| 445023 |  | Rubber Feet | 10 |
| 460476 | 460476 | Mask | 3.70 |
| 520159 | 520159 | Glass | 5.50 |
| 440051 | 440051 | Rubber Channel for Glass Fer ft. | 12 |
| 411294 | 411294. | Retaining Strip for Glass | 1.10 |
| 180095 | 180095 | Speaker - 6" | 4.40 |
| 411445 | 411445 | Tube Protector Cup | 60 |
| 560336 |  | Masonite Back | 90 |
|  | 560341 | Masonite Back | 90 |
| 583206 | 583206 | Line Cord | 80 |
| 460424 | 460424 | Knob - Contrast | . 70 |
| 460423 | 460423 | Knob - Fine Tuning | 70 |
| 460422 | 460422 | Knob - Off - On - Volume | 85 |
| 460421 | 460421 | Knob - Channel Selector | 1.80 |
| 460425 | 460425 | UHF Dial | 50 |
| 565273 | 565273 | Mask for UHF Dial | . 01 |



Model 753D


Model 761C

 TUBE LOCATION DIAGRAM CHASSIS 120180-D

## ADDENDUM SERVICE NOTE

This information should be considered as part of the Service Note for Models 752A. 755A, 784A, 753F, 785C and 785 E using chassis $120174-\mathrm{B}, 120198-\mathrm{D}$


Model 768A


Models 772A


Corrections to the 120174-B \& 120198-B Chassis Service Note
The following corrections should be noted directly on the schematic diagram Pages 23 and 24 of the Service Note:

1) C-34 should read. 0022 mf instead of .0022 mmf .
2) $R-23$ in cathode circuit of V-6 should be changed to $R-33$.
3) The wave shape shown going to the junction of R-76 and C-55 should be altered to look like wave shape shown here.


BUILT IN ALL CHANNEL UHF - VHF RECEIVERS
Chassis 120193-B are "ALL CHANNEL UHF - VHF RECEIVERS'. Combination UHF and VHF tuning is achieved through the use of two tuners which are connected to the same tuning knobs making VHF or UHF channel tuning very simple, The VHF cascode turret tuner has 13 positions (one more than the conventional type), 12 being used for VHF reception, (channels 2 to 13), while the 13 th or UHF position is used to activate the proper UHF circuits and provides additional amplification for the converted 40 mc . UHF signals. In this position, a window is provided to observe the continuous tuning of the UHF channels.
The 120193-B Chassis is electrically identical to the 120174-B Chassis of which this is an Addendum. Dual chassis numbers (120174, 120193) have been assigned since these chassis differ physically in the type of chassis base used and the placement of the 5 U 4 G rectifier tubes.

TUBE
LOCATION
DIAGRAM
CHASSIS
120193-B
*The Phase Coil side of the 4 lug terminal strip always has two wire: connected to it The other side has only the one Control Grid wire


Model 774A

| Part Numbers |  |  | Description |
| :---: | :---: | :---: | :---: |
| $\begin{gathered} \text { Model } \\ 768 \mathrm{~A} \end{gathered}$ | Model 772A | $\begin{gathered} \text { Model } \\ 774 \mathrm{~A} \end{gathered}$ |  |
| 140536 |  |  | Cabinet - Open Face Console - Mahogany |
| 140536A |  |  | Cabinet - Open Face Console - Blonde |
|  | 140537 |  | Cabinet - Console with Doors - Mahogany |
|  | 140537A |  | Cabinet - Console with Doors - Blonde |
|  |  | 140538 | Cabinet - French Provincial |
| 520192 | 520192 | 520192 | Glass |
| 411492 | 411492 | 411492 | Retaining Strip - Glass |
| 411493 | 411493 | 411493 | Retaining Strip - Glass |
| 460491* | 460491* | $460491 *$ | Mask |
| 411091 | 411091 | 411091 | Clips for Mask |
| 180120 | 180120 | 180120 | Speaker - 12 Inch |
| 560342 | 560342 | 560342 | Masonite Back |
| 411445 | 411445 | 411445 | Tube Protector Cup |
| 583206 | 583206 | 583206 | Line Cord |
| 460284 |  |  | Emerson Emblem |
| 460252 | 460252 | 460252 | Control Door - Gold |
| 460253 | 460253 | 460253 | Control Door Escutcheon-Gold for Mah. |
| 587088 | 587088 | 587088 | Spring - Door (abinet |
| 460252B | 460252 B |  | $\left.\begin{array}{l}\text { Control Door - Ivory } \\ \text { Control Door Escutcheon - Ivory }\end{array}\right\}$ for Blonde |
| 4602424 | 460424 | 460424 | Knob - Contrast |
| 460423 | 460423 | 460423 | Knob - Fine Tuning |
| 460422 | 460422 | 460422. | Knob - OFF-ON-Volume |
| 460421 | 460421 | 460421 | Knob - Channel Selector |
| 460425 | 460425 | 460425 | U. H.F. Dial |
| 565273 | 565273 | 565273 | Mask for Dial |

Changes to part no. 460511 when a glass shell picture tube (21YP4) is used. All other cabinet parts listed above will remain the same.

## O John Y. Rider




## sound ratio detector and if alignment

1. Connect proba of the VTVM to the diode plate of the ratio detector tube V2OB (6T8, pin 2). Common to ground. See Figure 11.
2. Connect high side of the signal generator to the grid of the ratio detector driver. V21 (6AU6. pin 1). Common to ground. See Figure 11.
3. Tune the signal generator to exactly 4.5 mc and attenuate
the generator so it does not exceed 8 volts on the VTVM generator so if does not exceed 8 volits on the
4. Peak L17 top core (FIG. 12) for maximum.
5. Adjust attenuator of signal generator to give exactly eight
volts on the VTVM. 7. Move probe of VTVM to junction of R28, C31 and C29.
(FIG. 11). 8. Adjust L 17 top core (FIG. 12) for exactly 4 volts on the
VTVM. 9. Move signal generator to video output tube V8 (6AG7.
pin 4) (FIG. 11) and repeat steps number 1 and 3 . 10. Peak L12 bottom (FIG. 11) and L13 top (FIG. 12) for maximum
6. Repeat with care steps 1 -3-4-5-6-7.8.

## ALTERNATIVE PROCEDURE FOR STEPS \&-7.8

1. Connect common lead of VTVM to junction of R29 and
R30 (FIG. 11). R30 (FIG. 11).
2. Connect probe of VTVM to junction of R28, C31, and C29.
(EIG. 11) (FIG. 11).
3. Adjust L17 top (FIG. 12) for zero reading on the VTVM.
4. Connect detector probe shown in figure ${ }^{6}$ between
kinescope cathode (junction of R37 and R38) and qround.
5. Rotate the contrast control to its maximum clockwise posi-
tion. Connect probe of VTVM to delector.
6. Adiust L 12 (bottom slug) for minimum output on VTVM.


FIG. 6. DETECTOR PROBE

1. Connect the bias battery as shown in fig. 11. The negative side of the bias battery to the junction of R8. R5, and C81. and the positive side to ground. Disconnect the white wire. har goes to the center terminal of the AGC switch (S2), froni
the junction of R8, R5, and C81. Connect the output of the signal qenerator between the test point on the R.F. unit (see fig. 12) and ground.
2. Connect the probe of the VTVM to the junction of L11 and 2. Connect the probe of the VTVM
R15 (fig. 11). Common to ground.
3. Set the signal generator to 21.6 mc . and adjust L 25 , cochannel sound trap, (fig. 12) for minimum output on VTVM 4. Reset the signal generator to 23.25 mc . Adjust the outpu of the signal generator for approximately 2.5 volts on the
VTVM. TTVM
4. Peak first Picture I.F. coil (located on R.F. Unit) and the third Picture I.F. coil L6 (fig. 12) for maximum. Maintain approximately 2.5 volts on the VTVM by adjusting the generato
output. output
5. Reset signal generator to 25.7 mc .
6. Peak second Picture I.F. coil L3 and the fourth Picture I.F. coil L9 (fig. 12) for maximum.

## picture if. (flat-topping

## 1. Remove signal generator and VTVM

2. Connect the sweep generator between the R.F. test point and ground.
3. Connect the oscilloscope probe to the function of L1I and R16.
4. Connect the hot side of the signal generator to the chassis side apron nearest the first I.F. stage. Leave the ground side
disconnected. disconnected
5. With most sweep generators, there is enough output to
give an I.F. response curve of sufficient height give an I.F. response curve of sufficient height on the oscillo-
scope. If there is insufficient oufput scope. If there is insufficient output use 3 volis bias instead
of 4.5 volts. In adiusting the output of the sweep generator make sure you do not overload the I.F.'s. This can be ascertained by noticing that the relative shape of the I.F. response does not change with small variations in sweep generator output.
6. Set the signal generator to 26.1 mc . and advance the output until a marker pip is visible on the Picture I.F. curve on the oscilloscope. Be careful not to distort the I.F. curve by advancing the generator output too far. Adjust L3 and L9 so that the marker pip is at the $50 \%$ point. See Fig. 7 Pieture 1.F. curves and Markers.
7. Set the signal generator to 22.7 mc . Adjust the first Picture
I.F. coil (located on the R.F. Tuner) and L6 so that the marker I.F. coil (located on the R.F. Tuner) and L6 so that the marker
pip is at the $50 \%$ point pip is the $50 \%$ point. See Fig.
8. Repeat steps 6 and 7 until an acceptabie curve is achieved.


FIG. 7. TYPICAL PICTURE I.F. CURVES AND MARKERS

## OSCILATOR AND R.F. ALGGMENT

The R.F. Unit is a turret type tuner with separate coil seg. ments for each channel. Normal channel sequence is progressive in a clockwise direction covering channels 2 to 13 . The R.F. amplifier is of the cascode type utilizing a 6BQ7 or 6BK7. The converter stage utilizes a $6 / 6$.

## oscillator alugnment

It should be posstble to tune in all channels with the fine tuning control C212 (see figs. 11 and 12) in the middle third of its range. When V3 ages, the oscillator may shift slightly in frequency requiring adjustment If V3 is defective and must be replaced, several tubes should be tried to find one that
requires the least oscillator adjustment.
If an accurately calibrated signal generator that covers all the R.F. frequencies is available then continue with step 1. If not go on to step 10 .

1. Remove tube shield on 6 J 6 . V3.
2. Modify a tube shield which will fit snugly over the $6 / 6$ and still remain ungrounded.
3. Rernove shorting wire from channel 11 oscillator coil and replace segment and R.F. unit bottom shield.
4. Turn channel selector to channel 12 .
5. Set generator to the oscillator frequency which is 231.35 mc. for channel 12 .
6. With reference to figure 8 connect the generator to one of the 10 mmt capacitors and connect the other 10 mmf capacitor to the ungrounded tube shield over the 6/6. Connec remaining terninal on probe to vertical input on oscilloscope. 7. Set fine tuning control C212 (fig. 12) to Eenter of its range. Adjust C211 foc zero beat pattern on the oscilloscope screen. (The oscillator coil slug which is accessible from the chassis front apron should be in its mechanical mid-position. If the slug should fall in during adjustment, the oscillator coil segment will have to be removed from the turret housing, the little wire spring which normally itts into the slug threads lifted up, and the slug brought forward to its mean position.) 8. Reset the generator for the oscillator frequency of channel 8. Reset the generator for the oscillator frequency of channel
7. Adjust the oscillator coil slug for zero beat on the oscilloscope screen. Use a non-metallic screw-driver in adiusting the scope screen. $\begin{aligned} & \text { se a } \\ & \text { oscillator coil slug. }\end{aligned}$.
8. Repeat step 8 for the remaining channels, making sure the signal generator is set for the proper frequoncy on each channe!
When an accurately calibrated generator is not available. then oscillator alignment can only be accomplished when the local T.V. transmitters are on the air.
9. Remove bias battery and replace AGC lead to junction of R8, R5, and C81 (fig. 11).
10. Set fine tuning control C212 (fig. 12) to center of its range. 12. Rotate channel selector control to one of the local T.V stations and adjust the oscillator coil slug, which is acces sible from the front chassis apron (fig. 12), for best picture. 13. Check remaining local stations by rotating the channel selector switch to, each channel in turn and adjusting the oscillaror slug for best picture.
11. If on one or two of the channels you do not have enough
ocillator range, readjust C211 and repeat steps 12 and 13 . It is possible to adiust the oscillator channel slugs without
removing the chassis from the cabinet. The slugs are made removing the chassis from the cabinet. The slugs are made
accessible by removing the channel selector and fine tuning accessibe by removing the channel selector and fine tuning
knobs and by moving the escutcheon plate to one side Use a long thin fibre or bakelite screwdriver for making adjust


FIG. 8.

## h.f. Alugnmint

1. Reconnect bias battery as in step 1. Picture I.F. (Rough
alignment). Disconnect white AGC wire. Set bias for 3 volts. 2. Connect oscilloscope through 10.000 ohms to test point on the sweep generator is not germinated for beilanced 300 ohms
insert the newwork shown in fig insert the network shown in fig. 9 below.


FIG. 9.
3. Set fine tuning control at approximately the midpoint of
its tuning range and rotate channel selector to channel 12 . 4. Adjust sweep generator to channel 12 and loosely couple signal generator to sweep generator in
lure carrier and sound carrier markers.
5. Adiust C206. C203, and C213 for flat top
See figure 10 for acceptable R.F. passbands.
6. Check remaining channels. If the response curves ob lained on any channel is not acceptable, it might be neces sary to return to channel 12 and make a compromise of its
osponse. It one channel is extremely out, that coil section response. It one channel is extremely out, that coil section
should be repaired or replaced. It is not necesscry to remove should be repaired or replaced. Id is nol necessary to remove
the tuner from the chassis in order to repair or replace a coil section.


ACCEPTABLE R.F. PASSBAND FIG. 10.


FIG. 11. BOTTOM VIEW OF CHASSIS


FIG. 12. TOP VIEW OF CHĀSSIS

## $\rightarrow$

PIN 7 (V7A) 6ALS
VIDEO DETECTOR (HORIZ. SCOPE) 3 VOLTS PP


PIN 8 (V8) 6AG7
VIDEO OUTPUT (HORIZ. SCOPE)
65 VOLTS PP


PIN 2 (V9A) 12AU7
SYNC. SEPARATOR (HORIZ. SCOPE) 45 VOLTS PP

## 

PIN 1 (V9A) 12AU7
SYNC. SEPARATOR (HORIZ. SCOPE) 16 VOLTS PF


PIN 6 (V9B) 12 AU7
SYNC. CLIPPER (HORIZ. SCOPE) 65 VOLTS PP


PIN 7 (V7A) 6AL5
VIDEO DETECTOR (VERT. SCOPE) 3 VOLTS PP

## $\frac{\text { WA }}{\sqrt{4}}$

PIN 8 (V8) 6AG?
VIDEO OUTPUT (VERT. SCOPE) 65 VOLTS PP


PIN 2 (V9A) 12AU7
SYNC. SEPARATOR (VERT. SCOPE) 45 VOLTS PP


PIN 1 (V9A) 12AU7
PIN 1 (V9A) 12AUT
SYNC. SEPARATOR (VERT. SCOPE) 16 VOLTS PP


PIN 6 (V9B) 12AU7
SYNC. CLIPPER (VERT. SCOPE)
65 VOLTS PP

## (

PIN 3 (VIBB) 6SN7GT SYNC. INVERTER (VERT. SCOPE) 25 VOLTS PP


PIN 6 (VIS) 6 S4 VERTICAL OUTPUT 48 VOLTS PP


PIN 1 (V10) 6AL5 HORIZ. PHASE DETECTOR


PIN 5 \& 7 (V10) 6ALS HORIZ PHASE DETECTOR
16 VOLTS PP


PIN 5 (V12) 6CD6G ${ }_{65}$ HORIZ OUTPU


PIN 4 (V18A) 6SN7GT VERTICAL OSCILLATOR 48 Volts PP


PIN 9 (VIS) 6 S4 VERTICAL OUTPUT 850 VOlTS PP


PIN 2 (V10) 6ALS HORIZ. PHASE DETECTOR 20 volts Pp

## $1 \square$

PIN 2 (VII) 6SN7GT
HORIZ. OSC. \& DISCHARGE
38 VOLTS PP


PIN 9 T4
HORIZ. WIDTH COIL
250 VOLTS PP

1. all capacitance values stateo in mmf.
2. R2OI a R202 MAY BOTH be CODED 220K, but are selected. 3. Interchange of tube trpe in r.f. amplifier requires REALIGNMENT OF C203,C206, a C213.


SCHEMATIC R.F. UNIT


G-61 39Vd $\wedge \perp \quad \forall O \forall 」$
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MODELS 21 T4, 21T6, 24C4, 215C, DL21T8, V21T, V213CD, V219C, V273T, President
Series;21C2,21T, $21 \mathrm{~T} 2,24 \mathrm{C} 5,24 \mathrm{~T} 2, \mathrm{DL} 21 \mathrm{~T}, \mathrm{~V} 211 \mathrm{CD}, \mathrm{V} 217 \mathrm{C}, \mathrm{V} 271 \mathrm{~T}$, Imperial Series


- John F. Rider


| ELECTRICAL SPECIFICATIONS |  |
| :---: | :---: |
| Power Supply . . . . . . . . . 117 Volts AC |  |
|  |  |
| Power Consumption ....... 250 Watts |  |
| Tuning Ranges | VHF - Channels 2 thru 13 <br> UHF - Channels 14 thru 83 |
| Power Output | 2.5 Watts (Max.) <br> 1.5 Watts 10\% Distortion |
| Intermediate Frequencies | .Picture - 45.75 MC |
|  | Sound - 41.25 MC |
| intercarrier Sound System | . 4.5 MC |
| Antenna Input Imp. ......300 Ohms Balanced |  |
| Focus . . . . . . . . . . . . . . . . Magnetic |  |
| Sweep Deflection ......... Magnetic |  |
| Loud Speaker . . . . . . . . . . 10" PM Dynamic |  |
| oice Coil Imp. | 3.2 Ohms 400 Cycles |



HORIZONTAL WAVE FORM ADJUSTMENT - This is a factory adjustment and it should not be necessary to re-adjust unless the setting has been disturbed. However, if it is found that re-adjustment is required, follow this procedure: With the picture in sync. connect an oscilloscope through about a 10 mmf isolation condenser to Terminal C of T-7. Adjust the horizontal wave form ( $\mathrm{T}-7$ inside chassis) until the two peaks of the wave form shown in Fig. 6 are equal. NOTE. Picture must be in sync. during this adjustment.

$\pi \sqrt{\text { INCORRECT SETTING }}$| OF HORIZONTAL |
| :--- |
| WAVEFORM |
| ADJUSTMENT |



CORRECT ADJUSTMENT PEAKS ARE EQUAL


Fig. 6 - Settings of Woveform Adi

HORIZONTAL LOCKING RANGE ADJUSTMENT - Set the hori zontal hold control to the extreme counter-clockwise posi tion. Momentarily remove the signal by switching off chan nel and then back. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync. If more than 3 bars are present just before the picture pulls into sync. adjust the horizontal locking range trimmer (C-66) slightly clockwise. If less than 2 bars are present, adjus the trimmer slightly counter-clockwise. Turn the horizontal hold counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 2 to 3 bars are present. Repea the adjustments under "Horizontal Frequency Adjustment" and "Horizontal locking Range Adiustment" until the con dition specified under each are fulfilled. When the horizontal hold operates as outlined under "Check of Horizontal Oscillator Alignment" the oscillator is properly adjusted.

WIDTH, DRIVE AND LINEARITY ADJUSTMENT - While receiv. ing a signal from a station (with picture locked in sync) turn contrast control fully counter-clockwise, turn the brightness control (R-65) up so that the picture appears washed out. Adjust width control (L-18) until the picture fills the mask. Turn the horizontal drive control (R-97) clockwise until white bars appear in the left center portion of the raster, then turn counter-clockwise until the white bars just disappear. This adjustment will allow the horizontal system to operate at maximum efficiency. Ad just horizontal linearity control (L-19) for best linearity If adjustment of the horizontal linearity control (L-19) is required, readjustment of the horizontal drive control ( $\mathrm{R}-97$ ) will be necessary. Adjust the picture centering device to align the picture with the mask.

## CHECK OF R-F OSCILLATOR ADJUSTMENTS

The oscillator is preset at the factory and normally needs no adjustment. However, if adjustments are required, they can be made without removing the chassis from the cabinet.

## ESt Procedure

1. Turn the large Channel Selector control knob until the letters VHF appear centered at top of the knob.
2. Turn the small Channel Selector to receive desired channel.
3. Remove the two Channel Selector knobs.
. Set Fine Tuning control in center of its range.
. With a $10^{\prime \prime}$ or longer bakelite type screwdriver adjust oscillator slug for best picture resolution.
4. Repeat steps 2, 4 and 5 on all Channels used.

NO RASTER ON PICTURE TUBE - If raster cannot be obtained check below for the possible causes.
2: No $+B$ voltage. Check $4 / 10$ ampere fuse. Replace if defective.
If fuse continually burns out, check
(A) Horizontal output tube V-20 (6CD6-G)
(C) Check horizontal oscillator tube V-19 (6SN7-GTA) for proper operation

> (D) proper operation. (D) ith an ohm meter,
terminal 3 of the horizock for a short between (T-8) and the chassis.
3: No high voltage. Check $\mathrm{V}-20, \mathrm{~V}-21$ and $\mathrm{V}-22$ tubes and circuits. If the horizontal deflection circuits are operat ing as evidenced by the correct voltage ( 600 V ) measured on terminal No. 3 of T-8, the trouble can be isolated to the high voltage rectifier circuit. Either the high voltage winding to the 6CD6-G plate and TB3 plate is R- 105 and C-86 defective or pix tube elements shorted internally.
4: Defective picture tube heater open or cathode return circuit open.
HORIZONTAL DEFLECTION ONLY - If only horizontal deflec tion is obtained as evidenced by a straight line across the face of the picture tube, it can be caused by the follow ing:
Vertical oscillator tube V-14B and vertical output tube V-15 inoperative. Check socket voltages.
2: Vertical oscillator transformer (T-4) defective.
3: Vertical output transformer ( $T$-5) open or shorted
4: Yoke vertical coils open or shorted.
5: Vertical hold, height or linearity controls may be defective.
POOR VERTICAL LINEARITY - If adjustment of the height and linearity controls will not correct this condition, any of the following may be the cause
1: Check variable resistors R-59 and R-60.
3: Capacitors $\mathrm{C}-44$ transformer ( $\mathrm{T}-5$ ) defective. R-56-57-61-64-62 defective.
4: V-8 defective, check voltages.
5: Low plate voltages. Check rectifier tube and capacitor in $+B$ supply circuits.
6: Vertical deflection coils (L-23) defective.
POOR HORIZONTAL LINEARITY - If adjustment of the Horizontal drive and linearity controls does not correct this zontal drive and linearity con
condition, check the following
1: Check or replace horizontal output tube V-20
2: Check or replace damper tube V-22 (6AX4-GT)
3: Check capacitors C-84, C-85, C-81 and horizonta linearity control (L-19) for defects.
4: Horizontal deflection coils (L-22) defective.
trapezoidal or nonsymmetrical raster
1: Defective yoke.
WRINKLES ON LEFT SIDE OF RASTER - This condition can be caused by:
1: Defective yoke, transformer T-8, or R-111.
2: V-22 (6AX4-GT) defective.

1: Low +B or line voltage. Check V-17 \& V-18 (5U4G
2: Insufficient output from horizontal output tube V-20 Replace tube.
3: Insufficient output from vertical oscillator ( $\mathrm{V}-14 \mathrm{~B}$ ) and vertical output tube V-15. Replace tubes.
4: Incorrect setting of horizontal drive control R-97.
5: V-22 (6AX4.GI) defective.
6: Incorrect setting of (L-18) width control and height and linearity controls.

RASTER; NO IMAGE, BUT ACCOMPANYING SOUND - This con dition can be caused by:
1: No signal on picture tube grid. Check V-8 (6AU6) and V-9 (6CL6) tubes and associated circuits.
2: Bad contact to picture tube grid (lead to socket broken) 3: AGC tube (V-11) may be defective. Check tube and its associated circuit.
signal appears on picture tube grid but imposilble to SYNCHRONIZE THE PICTURE VERTICALIY AND HORIZONTALL - A condition of this nature can be caused by

1: Defective sync separator $\mathrm{V}-10$ or sync amplifier V-14A
2: If tubes are O.K. check voltages, and associated circuits.
3: AGC system inoperative. Check V-11 (6AU6) AGC tube and associated circuits.

Signal on picture tube grid and horizontal sync only - If this condition is encountered, check:

1: Vertical integrating network defective
2: Vertical hold control (R-53) defective.
SIGNAL ON PICTURE TUBE GRID AND VERTICAL SYNC ONLY
1: V-19 defective.
2: Improper setting of (T-7) horizontal frequency control 3: Check V-19 socket voltages.
picture stable but with poor resolution - if the picture resolution is not up to standard, it may be caused by any of the following:
1: Defective pix I-F tubes V-4, 5 \& 6, (6CB6's).
2: Defective picture detector V-7A, (6AL5) or video amplifier
3: Defective picture tube
4: Open video peaking coil. Check all peaking coils L-9 L-10, L-13, L-14, L-15 and L-16 for continuity. Note
5. that L-9, L-14 and L-16 have shunting resistors.

5: Leakoge , , tound be defective, check the following citor is not found to be defective, check the following
2. Check picture tube grid circuit for poor or dirty contact.
3: Check and realign, if necessary, the picture I-F and R-F circuits.

## PICTURE SMEAR:

1: A smear can be attributed to phase shift at the low or high frequency end of the video characteristic. This can high frequency end of the video characteristic. This can
be caused by improper values of resisters and capacitors in the video circuits. Check for grid current on video output tube V-9 (6CL6), open or shorted peaking coils, video amplifier load resistors are of improper value (high).
2: This trouble can also originate of the transmitter Check reception from another station.

OJohn F. Rider

## SERVICE SUGGESTIONS-(continued)

3: Check and realign, if necessary, the picture I-F and R-F circuits.

MAN MADE NOISE IN SOUND (Ignition, etc.):
1: Check sound I-F tubes V-1, V-2 or V-3 and associated Culs.
Check sound I-F alignment.

## BENDING OR S—ING

: Check sync level control adjustment.
2: V-20 (6CD6-GT) defective or V-19 (6SN7-GTA) defective.
3: Check sync separator tube V-10 (6BE6) and V-8 (6AU6) Cleo amplier.
Check AGC threshold control.
PICTURE NORMAL - NO SOUND OR WEAK OR DISTORIED SOUND 1: Check sound I-F alignment.
2. Check V-1 (6AU6) V-2 (6AU6) V-3 (6AL5) V-13 (6AQ5) Check pix I-F alignment.

## raster on tube but no picture or sound

This condition can be caused by:
1: Defective pix i-F Amplifier tubes V-4, V-5 or V-6 2. Defective pix detector tube V-7A (6AL5). Check tube and its associated circuit.

## ALIGNMENT PROCEDURE

TEST EQUIPMENT - To service this receiver properly, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR meeting the following requirements: (a) Frequency ranges:

38 to $90 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
170 to $225 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
470 to $890 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
(b) Output adjustable with at least .1 volt maximum
all ranges.
(e) A source of the following Markers:
41.25 Mc Cathode Trap
42.25 Mc
42.50 Mc 1 st Pix I-F Coil (Bottom)
43.9 Mc 3rd Pix I-F Coil
45.3 Mc 2nd Pix I-F Coil
45.75 Mc nd Pix 1 F
47.25 Mc 1st Pix I-F Coil (Top)

CATHODE-RAY OSCILLOSCOPE with good low frequency response in vertical amplification and an input calibrating source.
BIAS BATTERY - 1.5 V \& - -5.5

## VTVM DIODE

DIODE DETECTOR

## 40 Mc I.F. ALIGNMENT

Connect sweep output to ungrounded shield of converter tube in tuner (6U8). With short leads connect crystal diode detector (Fig. 8) to plate of 1st I-F tube. Connect -1.5 $V$ to A.G.C. line (Junction of R-1, R-3 \& C-3A). Connect oscilloscope to detector output. Adjust sweep output to
give adequate deflection.

3: Defective R-F Amplifier or oscillator mixer tubes in the tuner.
4: UHF-VHF switch defective.

## POOR fOCUS

1: Improper setting of focus control or defective pix tube
PICTURE JITTER:
1: Horizontal instability may be due to unstable trans mitted sync.
2. Check receiver AGC system for proper operation.
: Check sync separator V-10 (6BE6) or sync amp V-14A Chec for improvits.
4. Check Cor improper setting of sync level control

6: Ceck AGC threshold control.
NO PICTURE OR SOUND OR WEAK PICTURE OR SOUND IN UH POSITION
If this condition is encountered
1: Check to see whether or not a UHF station is operating in the vicinity
2. The 6AF4 oscillator tube or the IN82 crystal may be defective.
3: Pre-selector in UHF section of tuner defective
4: Defective switch on UHF section of tuner.
A. FREQUENCY
47.25 Mc
2.

1st Pix I-F Coil (L-1 Top) to center notch over 47.25 Mc marker Converter Plate Coil (L-210 Top of Tuner) 1st I-F Grid Coil (L-4) and Input Coupling Coil (L-5) to give the 2 response shown in figure 9.
The converter plate and 1st 1-F grid coils control the shape of the top. The input coupling coil controls the position of the 41.25 marker. This adjustment must be made accurately or the sound rejection will not be correct ( 41.25 Mc 31 to 36
db down from top of overall P.I.F. response). 45.75 Mc db down from top of overall P.I.F. response). 44.50 Mc marker in the overall response curve will not be correct.


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## ALIGNMENT PROCEDURE-(continued)


B. When the input circuit is aligned place -4.5 V bias on the A.G.C. line. Remove the crystal detector and connect oscilloscope and VTVM to the 2nd Pix detector load detector.
fREQUENCY
42.5 Mc
45.3 Mc
43.9 Mc
41.25 Mc These adjustments may be made with a single frequency ( H is more convenient to do so.
C. After these adjustments have been made recheck the peak to peak output on the oscilloscope. If the shape of the curve is not as shown in figure 12, it will be necessary to retouch the adjustments. A small fraction of a furn is all that is necessary if the strip is operating correctly. The position of the 44.5 Mc marker is critical $98 \%$ ). The 43.9 Mc transformer ( 3 rd I-F) controls the symmetry of the top. The 45.3 Mc transformer (2nd I-F) controls the height of the 45.75 Mc marker. The 43.5 Mc
transformer (1st I-F) controls the height of the 42.25 Mc marker. This adjustment will very seldom need retouching. adjustmen wilv seldom need

DO NOT RETOUCH the converter plate coil or the input grid coil. These coils MUST be adjusted correctly with the diode detector. Recheck position 41.25 Mc and 47.25 Mc markers. Reset if necessary.

## VIDEO

With 4.5 MC unmodulated signal from a high impedance source, ( 10,000 ohms in series with the generator) into plate of the picture detector tube (Pin 2-6AL5) and VTVM on picture tube grid, tune 4.5 MC trap (L-12 Top) for


Fig. 11 - Bottom Chossis Adj.

minimum response. VTVM on 0-10 V AC scale. This adustment can also be made while observing a picture from a station. Tune trap for least 4.5 MC beat in picture

## AUDIO I-F

: With signal generator set to 4.5 MC and de VTVM connected to junction of R-17 and C-23, adjust sound take-off coil (L-11 Top) and sound l-F transformer slugs ( $\mathrm{T}-1$ Top \& Bottom) for maximum.
2: With VTVM connected to pin 7 of V-3 (6AL5) adjust the ratio detector primary (T-2 Bottom) for maximum. In the above adjustment to avoid limiting or overloading of the amplifiers, use as little output from signal generator as possible.
3: With VTVM connected to junction of R-21, R-24 and $\mathrm{C}-27$, adjust ratio detector secondary (T-2 Top) for cross over (zero voltage) on lowest scale.
NOTE - If desired, the procedure above may be folowed by funing in a station and using the 4.5 MC beat between picture and sound carrier.


Fig. 13 - Top Tuner Adjustment.

## VHF TUNER ALIGNMENT

A. Sweep generator with balanced 300 ohm output to antenna terminals. Marker generator output to antenna terminals. Oscilloscope to "test point" (Figure 13) on tuner. Connect -3 V bias to AGC line at junction of R-45, R-47 and C-36 on the receiver
B. RF AND CONVERTER ADJUSTMENT.

1. With channel selector on Channel 12, adjust C-204 slightly favoring the Pix carrier, then adjust C-206 and C-210 for response as in Figure 14. Picture and sound markers at $90 \%$ maximum response.
2. Check response on all channels. If markers are below $70 \%$ on any channels, readjust C-204, $\mathrm{C}-206$, and C-210. Recheck all channels.
C. OSCILLATOR ADJUSTMENT.
3. Apply -4.5 volts on I-F AGC line at junction of R-3 and C-3A.


Fig. 14 - Pix \& Audio Markers.
2. Connect oscilloscope to output of video detector. Place fine tuning in center of range. Check response on all channels. Sound marker should be in notch and picture marker at $50 \%$. (See Figure 2).
3. If markers are off, individual oscillator coil slugs will require adjustment. Adjust each channel slug,
accessible through hole in front of chassis with a accessible through hole in front of chassis with a non-metallic screwdriver to bring sound marker to
correct position.

## UHF TUNER ALIGNMENT

Aligning or servicing the UHF section of the 82 position tuner is not recommended in the field because replacement of any component within the R-F circuit may disturb the band pass characteristics of the tuner. However the tubes and the $\mathbb{N} 82$ crystal may be replaced in the tuner if found to be defective.
Antenna trap $L-200$ is a trap to reduce interference caused by signals which fall within the pix I-F pass band (40-48 Mc ). It is best tuned by observing the interference in the picture and tuning the slug for minimum interference. This trap is located in the shield can to which the VHF antenna lead is conneeted.
Do not adjust the UHF oscillator slugs unless the fine tuning control cannot be tuned through the point of best picture resolution. Before attempting to adjust any of the slugs, check to see if the UHF oscillator tube (6AF4) is firmly seated and straight in the socket. Each coil strip in the UHF section tunes 10 channels. For example, strip 20B covers channels 20 through 29 etc. If there are two UHF channels in the vicinity, perhaps channels 20 and 26 , the oscillator slug should be adjusted so that the fine tuning control will tune both channels through the point of best picture quality. The position of the fine tuning control will not necessarily be the same for all channels. Always use a bakelite type screwdriver for the oscillator slug adjustments.

## IMPORTANT

## HORIZONTAL OUTPUT TRANSFORMERS

In early production the $53 \times 337$ horizontal output transformer did not have a center tap on the winding coupling the deflection yoke. All service orders for the $53 \times 337$ transformer will be filled with a $53 \times 338$ transformer which will necessitate removing two 83 mmf ceramic condensers from the deflection yoke socket. These condensers will no longer be required because the $53 \times 338$ transformer has a center tap at terminal number six (6) which should be connected to pin 5 on the deflection yoke socket. The schematic diagram shows the circuitry of the $53 \times 338$ transformer together with all the latest circuit changes listed below.
Various changes were made during production in the Power Supply and R-F Chassis. Each change can be identified by a color code mark on the back of the chassis.

## CHANGE NO. I

## TO INCREASE SYNC STABILITY

## RED PAINT MARK ON BACK OF R-F CHASSIS

1. The sync separator tube ( $\mathrm{V}-10$ ) was changed from a type 6BE6 to a type 6CS6.
2. The sync separator grid condenser (C-31) was changed in value from .01 mf 400 V to .047 mf 400 V . 3. Condensers C-91, C-92, C-93, C-94 and resistor R-112 were added to the circuit.

## CHANGE NO. II

## TO IMPROVE NOISE IMMUNITY

## ORANGE PAINT MARK ON BACK OF R-F CHASSIS

1. The AGC filter (C-34) 4 mf dry electrolytic was changed to a 1000 mmf ceramic condenser.
2. A. 47 mf condenser (C-95) was added to the I-F AGC circuit.

CHANGE NO. III
TO REDUCE JITTERS AND BENDING IN PICTURE ORANGE PAINT MARK ON BACK OF POWER SUPPLY CHASSIS

1. R-80 (Sync Amp plate resistor) was changed in value from 4.7 K ohms to 10 K ohms.
2. R-51 formerly a 3.9 K ohm sync plate resistor was changed to a 820 K ohm sync amp cathode resistor. 3. C-68 (sync coupling condenser) was changed in value from 36 mmf to 18 mmf .
3. C-90 a 220 mmf condenser was added to the circuit.

## CHANGE NO. IV

## SO THAT ANY MANUFACTURERS 6AU6 TUBES CAN BE USED FOR REPLACEMENT PURPOSES YELLOW PAINT MARK ON BACK OF R-F CHASSIS

1. R-15 (1st Sound I-F cathode resistor) was changed in value from 68 ohms to 100 ohms.

## FRONT OF CHASSIS

（Accessible Atter Opening Front Panel Control Cover） Horizontal Hold Height Brightness Vertical Hold one Vertical Linearity

## NON－OPERATING CONTROLS REAR OF CHASSIS



## IMPORTANT

## HORIZONTAL OUTPUT TRANSFORMERS

In early production the $53 \times 337$ horizontal output transformer did not have a center tap on the wind－ ing coupling the deflection yoke．All service orders for the $53 \times 337$ transformer will be filled with a $53 \times 338$ transformer which will necessitate removing two 83 mmf ceramic condensers from the deflec－ tion yoke socket．These condensers will no longer be required because the $53 \times 338$ transformer has a center tap at terminal number six（6）which should be connected to pin 5 on the deflection yoke socket． The schematic diagram shows the circuitry of the $53 \times 338$ transformer together with all the latest circuit changes listed below．

Various changes were made during production in the Power Supply and R－F Chassis．Each change can be identified by a color code mark on the back of the chassis．

## CHANGE NO．I

## TO INCREASE SYNC STABILITY

## RED PAINT MARK ON BACK OF R－F CHASSIS

．The sync separator tube（ $\mathrm{V}-10$ ）was changed from a type 6BE6 to a type 6CS6．
2．The sync separator grid condenser（C－31）was changed in value from .01 mf 400 V to .047 mf 400 V ．
3．Condensers C－91，C－92，C－93，C－94 and resistor R－112 were added to the circuit．

## ChANGE NO．II

## TO IMPROVE NOISE IMMUNITY

ORANGE PAINT MARK ON BACK OF R－F CHASSIS
1．The AGC filter（C－34） 4 mf dry electrolytic was changed to a 1000 mmf ceramic condenser．
2．A ． 47 mf condenser（C－95）was added to the I－F AGC circuit．

## CHANGE NO．III

## TO REDUCE JITTERS AND BENDING IN PICTURE

 ORANGE PAINT MARK ON BACK OF POWER SUPPLY CHASSIS1．R－80（Sync Amp plate resistor）was changed in value from 4.7 K ohms to 10 K ohms．
2．R－51 formerly a 3.9 K ohm sync plate resistor was changed to a 820 K ohm sync amp cathode ：${ }^{\text {sistcr．}}$ 3．C－68（sync coupling condenser）was changed in value from 36 mmf to 18 mmf ．
4．C－90 a 220 mmf condenser was added to the circuit．

## CHANGE NO．IV

## SO THAT ANY MANUFACTURERS $6 A U 6$ TUBES CAN BE USED FOR REPLACEMENT PURPOSES YELLOW PAINT MARK ON BACK OF R－F CHASSIS

1．R－15（1st Sound I－F cathode resistor）was changed in value from 68 ohms to 100 ohms．


John F. Rider

## OSCILLOSCOPE WAVEFORM PATTERNS


#### Abstract

The waveforms shown on the schematic diagrams were taken with the receiver tuned to served on the oscilloscope with a poor high frequency response, the corners of the pulses


 a normal picture. The voltages shown on each waveform are the approximate peak to peak amplitudes. The frequency accompanying each waveform indicates the repetition rate of the waveform not the sweep rate of the oscilloscope. If the waveforms are ot
REPLACEMENT PARTS LIST

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## TELEVISION ALIGNMENT PROCEDURE

Aligning a television receiver is an exacting procedure and involves the use of bench space, test equipment and skilled personnel at the service shop, as.well as the cost of making two trips to the customer's home. Before deciding that the chassis must be pulled and aligned at the shop, the serviceman should check these very common sources of trouble:

1 - The antenna and installation.
2 - Front panel and rear chassis controls, including picture tube adjustments.
3 - Reception on all available channels.
4 - Tube failures. Substitute from your kit of known good replacements.
5 - Visual inspection of underside of chassis for obviour faults, auch as loose connections, etc.
TEST EQUIPMENT REQUIRED FOR ALIGNMENT
The equipasent specified below is desirable, but in cases where this equipment is not available, it is possible to align the receiver by use of a 20 to 30 mc . modulated rsignal generator, using the picture and speaker as indicaon of alignment.
1-Signal Generator with an output variable between 100 and 100,000 microvolts, and crystal controlled or cryatal-calibrated at the following frequencies:
a. 4.5 megacycles
b. 22.25 megacycles
c. 25.4 megacycles
d. 23.6 megacycles
e. 21.25 megacycles

2 - DC Vacuum Tube Voltmeter with 5 volt and 10 vol cales.
3 - A pair of balanced ( $(1$ 1\%) 100K carbon reaistors. TEST EQUIPMENT REQUIRED FOR SWEEP ALIGNMENT CHECK
1-R-F sweep generator with frequencies ranging from 40 to 220 megacycles, having sweep width of apputput to approximately 0.1 volt.

2 - Crystal-controlled or crystal-calibrated markers for the picture and sound carriers of each channel, preferably 30\% Amplitude-Modulated.

3 - Cathode Ray Oacillos cope with good low frequency response.

- 3 volt bias battery.

CAUTION: THE SECOND ANODE LEAD TO THE PICTURE TUBE HAS A HIGH POTENTIAL. DURING THIS alignment it is advisable to remove the color plug from its socket, teus eliminating teis HIGH VOLTAGE HAZARD.

- Connect ALhGNMENT PROCEDURE
- Connect "high" lead of signal generator to the test point located on the top of the RF tuner unit (Refe side of cabinet). Connect ground to chassis.
- Connect DC VTVM lead (through 10K isolating re sistor) to pin 1 of 6AL6 1 st Video Amplifier (V12), ground to chassis. Set VTVM to 5 volt scale, negative polarity.

3 - Set IF generator to 25.4 megacycles with suffici ent output to read approximately 3 volts on the VTVM.
4 - Carefully adjust L201 and L203 (see tube and tune location) for maximum deflection on VTVM. Adjust sweep generator output to keep meter reading approximately 3 volts.
5 - Set I.F. signal generator to 22.25 megacycles with sufficient output to read approximately 3 volts on the VTVM.
6 - Carefully adjust LIl, L202-top (see tube and tuner location) for maximum deflection on VTVM. Adjust signal generator output to keep meter reading approximately 3 volts.
7 - Set i-f signal generator to $\mathbf{2 3 . 6} \mathbf{~ m c}$. with sufficient output to read approximately 3 volts on the VTVM.
8 - Carefully adjust L205 (see tube and tuner location) for maximum deflection on VTVM. Adjust signal enerator out-put to keep meter reading approxi ately 3 volts.

9 - Set I.F. signal generator to 21.25 megacycles, se VTVM to 10 volt scale (negative polarity), and adjust signal generator output for convenient defec
tion on VTVM. tion on VTVM
10 - Adjust L202-bottom for minimum deflection on VTVM. SWEEP ALIGNMENT CHECK
Although not essential, a sweep alignment check is a desirable verification of good R-F and I.F. response. Proceed as follows:

1 - Connect R-F sweep generator to antenna terminale
(antenna impedance 300 Ohms).
2 - Calibrate oscilloscope for convenient 5 volts peak-to-peak vertical deflection ( 5 volts peak-to-peak is approximately $1 / 4$ of the peak-to-peak voluage of the 6.3V A.C. Filament)

3 - Connect vertical input of oscilloscope (through 10K isolating resistor) to pin 1 of 6AU6 lst Vid. Amp. (V12) ground to chassis. Connect horizontal input of oscilloscope to "scope" terminals of R-F genera tor; adjust for convenient horizontal sweep.
4 - Connect 3 volt battery positive terminal to chassis negative terminal to AGC buss (see achematic diagram).
5 - Set R-F sweep generator to channel 3,television receiver to channel 3, and if necessary, adjus sweep generator output, sweep width, and scope horizonal setting for convenient band-pass display (see figure 1) having 5 volts vertical defec
tion as previously calibrated. (If you must touch scope vertical settings during these adjustments recalibrate scope for 5 volts peak-to-peak as in step 2 above).
6 - Adjust L205 slightly to even the height of peaks and to obtain an untilted bandpass.
7 - Couple crystal-controlled R-F carrier markers very loosely to antenna terminals, adjust receiver FINE TUNING control till video carrier marker is $1 / 2$ carrier visible on bandpass and adjust sound trap (Lll4) to minimize effect to sound carrier marker.

NOTE: If the fine tuning control is at end of range or out of range so that video carrier cannot be set at $50 \%$, follow range so that video canier cannot be set at som, foll
R-F OSCILLATOR ALIGNMENT procedure outlined below.

8 - Check all channels.
f-F OSCILLATOR ALIGNMENT
If all channels are not within range of FINE TUNING control (as evidenced by inability to eliminate "sound bars" from picture or by poor picture quality), the individual oscillator slugs may require readjustment.

1 - Repeat the set-up as for SWEEP ALIGNMENT CHECK, steps 1 through 7
2 - Set FINE TUNING CONTROL to center of range, and with long fiber screwdriver alignment tool, adjust the individual oscillator slugs of each channel. (Accessible through the front of the tuner) so that CAUTION: Do not touch adjuatments on top of r-i tuner unit, other than the converter plate anit, L11, during I.F. aligament.


1 - Connect 4.5 mc . signal generator to pin 1 of 6 AU6 4.5 mc amplifier (V13).

2 - Connect DC V.T.V.M. lead to pin 7 of 6AL5 (V15) ratio detector, negative polarity.
3 - Adjust signal generator to precisely 4.5 megacycles; adjust output to read approximately 5 volts on v.T.V.m.




4-Adjust L206, L101, and bottom of T102 for maximum deflection on V.T.V.M.
5 - Attach two series-connected 100K ( $\alpha 1 \%$ ) resistors across R106 (Ratio Detector Load Resistor). Connect DC V.T.V.M. to centertap of 100 K resistors, and connect ground wire of V.T.V.M. to top of C 109 (Audio take-Off of Tl02).
6 - Adjust top of T102 for zero reading on V.T.V.M. beween a plus and a minus peak.

VIDEO AMPLIFIER 4.5 mc . TRAP
When necessary, the video amplifier 4.5 mc . trap (L104) hould be adjusted as follows

1 - Connect 4.5 mc . signal generator to pin 1 of 6 AU 6 lst video amplifier (V12).
2 - Adjust signal generator output till 4.5 mc . dot pattern is clearly visible on screen of picture tube.

3 - Adjust Ll04 to minimize the dot pattern. horizontal oscillator alignment
If the Horizontal Hold control fails to maintain sync, he horizontal oscillator should be reset. To reset this crewdriver adjustment, set the horizontal hold control in the center of its range and sync the picture with the horizontal A.F.C. adjustment screw. Check the hold control位 required to provide sync on all channels.

PICTURE TUBE HANDLING PRECAUTIONS
The pleture rube onclozez e high vecuum and with the large urfoce oree of gloss involved, the strosses sef up, pertlcularly of the tront rim of the rube, ore considorable. An abnormal hendiling strose, aceidomal blow of ehighly iroseod surfoce, or oven a seretch on the surfoce of the ube could couse it to implode or collapse with destructive lolenc.

## HIGH VOLTAGE WARNING

Operafion of this recelver outzide the cablnet of with covera comoved involvas a shock hasard trom the recolver power uppllos. Wark on the recolver should not be attempted by

TURE \& TRIMMER LOCATION PC. 541215 TUNER


## 






## ELECTRICAL SPECIFICATIONS

Power Supply
117 Volts AC 60 Cycles Only
Power Consumption ....... 200 Watts
Power Output
Tuning Range
Intermediate Freq. (Tel.) 1.8 Watts ( $10 \%$ Distortion) VHF-Channels 2 thru 13 Picture-45.75 MC Sound-41.25 MC
Tel. Antenna Input Imp. Intercarrier Sound System 4.5 MC

Loud Speaker ............ See Parts List
Voice Coil Impedance ......3.2 Ohms 400 Cycles
Focus
Magnetic
Sweep Deflection............ Magnetic
DEFLECTION YOKE ADJUSTMENT - The deflection yoke should be positioned as far forward on the neck of the tube as the zontal or squared with the picture mask, rotate the deflec tion yoke until this condition is obtained. Upon completion of this adjustment, tighten the yoke adjustment wing screw. ADJUSTMENT OF SYNC STABILITY CONTROL - When receiving strong ( 500 MV or more) signals, set hold controls so that the picture is locked in. Turn the sync control slowly clockwise until bending occurs at top of picture.
Then turn the control a few degrees counter-clockwise until bending disappears. If the control is set incorrectly bending, tearing, etc., will be present and when switching from channel to channel the picture will not lock in quickly. in weak signal areas the control should be set for maximum picture stability. In general the weaker the signal The more clockwise the control should be turned. When the sync stability control is correctly adjusted the receiver will hold sync without tearing or rolling under
even the most adverse noise conditions. CHECK OF HORIZONTAL OSCILIATOR ALIGNMENT antion horizontal oschator alignment - Tune in a station and adjust the horizontal hold control until the
picture falls into sync. Momentarily remove the signal by switching off channel and then back. The picture should pull into sync over a range of $90^{\circ}$ rotation of the horizontal hold control. If in the above check the receiver fails to hold sync or the pull-in range is at the extreme end of the control, it will be necessary to make the following adjustment


Fig. 1-Tube Layout
fig. 2-Removal of Picture Tube and Rear Chassis Controls
For replacement purposes a 6BQ7 tube may be used in place of a 6 BZ7 tube.

HORIZONTAL FREQUENCY ADJUSTMENT - With the horizonta hold control set to the center of its range of rotation,
adjust the horizontal frequency control (L-14) until the picture pulls into sync. Recheck the "Horizontal Oscillator Allgnment."
height and vertical linearity adjustment - Adjust the height control (R-54) until the picture fills the mask the picture is symmetrical from top to bottom (R-49) until picture centering device to align picture with the mask Adjustment of any control will require a re-adjustment the other control.

WIDTH, DRIVE AND LINEARITY ADJUSTMENTS - While receiv ing a signal from a station (with picture locked in sync) urn contrast control fully counter-clockwise, turn the brightness control (R-25) up so that the picture appears washed out. Adjust width control (l-15) until the picture wise until the Tun he horizontal drive control (C-69) clock turn the control counter-lowise until the center then appears. This adjustment will allow the horizontal system to operate at maximum efficiency. Adjust horizontal linearity control (L-16) for best linearity. If adjustment of the horizontal drive (C-69) or horizontal linearity (L-16) is required, usually will be necessary to recheck the horizontal oscil lator alignment. If adjustment of the horizontal linearity ontrol (L-16) is required, readjustment of the horizontal drive control (C-69) will be necessary. Adjust the picture In alth the mask.

ANTENNA TRAP ADJUSTMENT-Antenna trap L-50 is a trap oo reduce interference caused by signals which fall within serving the interference in the picture and tuning the obfor minimum interference. This trap is located in the shield can to which the VHF antenna lead is connected.

CHECK OF R-F OSCILLATOR ADJUSTMENTS
The oscillator is preset at the factory and normally needs no adjustment. However, if adjustments are required, they Remove the channel selector and fine tuning the cabinet. funing shaft and slide the pilo light socket off brack TEST PROCEDURE:

1. Set channel selector to receive desired station
2. Set fine tuning control in center of its range.
3. Adjust oscillator slug, with bakelite type screwdriver, for best picture resolution
4. Repeat steps 1,2 and 3 on all channels used.


## SERVICE SUGGESTIONS

NO RASTER ON PICTURE TUBE - If raster cannot be obtained check below for the pussible causes.
1: ton trap magnet adjustment is incorrect.
2: $N o+B$ voltage. Check $4 / 10$ ampere fuse. Replace if defective. If fuse continually burns out, check
(A) Horizontal output tube V-17 (6BQ6-G
(B) Check damper tube V-18 (6AX4-GT).

Check horizontal oscillator tube V-16 (6SN7-GTA)
(D) With an ohm meter terminal 1 of the horizental a short between (T-9) and the chassis.
(E) Check DC resistance of T-9

3: No high voltage. Check V-17, V-18 and V-19 tubes and circuits. If the horizontal deflection circuits are operating as evidenced by the correct voltage ( 600 V ) measured on terminal No. 1 of T-9, the trouble can the high voltage winding to the $6 B Q 6-G T$ plate and IB3 plate is open, tube V-19 is defective, its filament circuit is open, R-99 and C. 78 defective, or pix tube elements shorted internally.
4: Defective picture tube heater open or cathode refurn circuit open

## HORIZONTAL DEFLECTION ONLY - If only horizontal deflec

 tion is obtained as evidenced by a straight line acros he face of the picture tube, it can be caused by the1: Vertical
Vertical oscillator and vertical output tube V-8 inoper ative. Check socket voltages.
. Vertical oscillator transformer (T-4) defective.
Yekeal output transformer (T-5) open or shorted.
5: Vertical hold, height or linearity controls may be de fective.
poor vertical linearity - If adjustment of the heigh and linearity controls will not correct this condition, any of the following may be the cause.
1: Check variable resistors R-49 and R-54.
: Vertical output transformer (T-5) defective.
3: Capacitors C-35A or C-70 defective
5: Excess leakage or incorrect value of capacitors C-37 \& C-38 or open or incorrect value of resistors R-55 \& R-56 6: Low plate voltages. Check rectifier tube and capacitors in $+B$ supply circuits.
7: Capacica C - 36 defective
POOR HORIZONTAL LINEARITY - If adjustment of the Hori zontal drive and linearity controls does not correct this condition, check the following:
: Check or replace horizontal output tube V-17.
2: Check or replace damper tube V -18 (6AX4-GT),
: Check capacitors C-74, C-76, C-77 and horizontal
linearity control (L-16) for defects.
4: Horizontal deflection coils (L-17) defective

## tPAPEZOIDAL OR NONSYMMETRICAL RASTE

1: Defective yoke.
WRINKLES ON LEFT SIDE OF RASTER - This condition can be aused by

2: V-18 (6AX4-GT) defective.
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SMAIL RASTER - This condition can be caused by:
: Low $+B$ or line voltage. Check V-20 (SU4G).
Insufficient output from horizontal output tube V-17.
Replace tube. Replace tube.
3: Insufficient output from vertical oscillator and vertical output tube V -8. Replace tube.
4: Incorrect setting of horizontal drive control C-69.
6: Incorrect setting of (L-15) width control.
SIGNaL ON PICTURE TUBE GRID AND VERTICAL SYNC ONLY
1: V-15 or V-16 defective.
2: Improper setting of (L-14) horizontal frequency control.
3: Check setting of horizontal drive control and horizontal linearity control.

16 socket voltages.
PICTURE STABLE BUT WITH POOR RESOLUTION - If the picture resolution is not up to standard, it may be caused by
1: Defective pix I-F
Defective picture detector $V$ \& 4 , ( (GCB6's).
Defective picture detector $V-4 A$, , (6AL5), or video am-
Plifier $V-5 A$ or video output $V-6$ (12BY7)
Defective picture tube.
4: Open video peaking coil. Check all peaking coils $\mathrm{L}-5, \mathrm{~L}-6, \mathrm{~L}-8, \mathrm{~L}-9, \mathrm{~L}-10$ and $\mathrm{L}-11$ for continuity. Note that $L-5, L-9$ and $L-10$ have shunting resistors.
5: Leakage in $\mathrm{V}-6$ (12BY7) grid capacitor $\mathrm{C}-11$. If the capacitor is not found to be defective, check the fol lowing:
Check all potentials in video circuits
2: Check picture tube grid circuit for poor or dirty
3: Check and realign, if necessary, the picture l-F and R-F circuits.

## PICture smenr:

1: A smear can be attributed to phase shift at the low or high frequency end of the video characteristic. This can be caused by improper values of resistors and capacitors in the video circuits. Check for grid current on video output tube $\mathrm{V}-6$ (12BY7), open or shored peaking coils, video
This trouble can also originate at the transmitter Check reception from another station.
3: Check and realign, if necessary, the picture I-F and R-F circuits.

## an made Noise in sound (Ignition, etc

1: Check sound I-F tubes V-10, 11 \& 12 and associated circuits.
2: Check sound I-F alignment.

## raster on tube but no picture or sound

This condition can be caused by,
1: Defective pix I-F Amplifier tubes V-1, V-2 or V-3
2: Defective pix detector tube $\mathrm{V}-4 \mathrm{~A}$ (6AL5). Check tube and its associated circuit.
3: Defective R-F Amplifier or oscillator mixer tubes in

## the tuner.

1: Check sound I-F alignment.
2: Check V-10 (6AUG) V-11 (6AU6) V-12 (6AL5) V-13 (6AV6) V-14 (6AQ5) and associated circuits.

## ENDING OR S-ING

1: Check sync stability control adjustment.
2. Check capacitors $\mathrm{C}-35 \mathrm{~B}$ and C -798.

3: $\mathrm{V}-17$ (6BQ6-GT) defective or V -16 (6SN7-GTA) de fective.
4: Check sync separator tube $\mathrm{V}-7$ (6CS6) and phase splitter V-5B (12AT7) and V-5A (12AT7) video amplifier.
5: Check AGC threshold control
POOR FOCUS
1: Improper setting or defective focus magnet.
2: Defective picture tube

## PICTURE JITTER

1: If regular sections at left of the picture are displaced, replace the horizontal oscillator tube V-16.

2: Vertical instability may be due to loose connections or noise received with the signal.
3: Horizontal instability may be due to unstable trans mitted sync.
4: Check receiver AGC system for proper operation.
5: Check phase splitter V-5B, (12AT7) and sync separator V-7 (6CS6).

6: Check for improper setting of sync stability control.
7: Picture tube grid lead not held in position by support spring, ie: close proximity of grid lead to sync and horizontal tubes will cause picture to jitter at high contrast setting.

## 8: Check AGC threshold control.

ALIGNMENT PROCEDURE
TEST EQUIPMENT - To service this receiver properly, it is recommended that the following test equipment be available:

## R-F SWEEP GENERATOR meeting the following requirements:

 (a) Frequency ranges:38 to $90 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
170 to $225 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
(b) Output adjustable with at least .1 volt maximum
(c) Output constant on all ranges.
(d) Flat ouput in all attenuator positions.
(e) A source of the following Markers:
41.25 Mc Cathode Trap
42.25 Mc
42.50 Mc 1st Pix I-F Coil (Bottom)
43.9 Mc 3rd Pix I-F Coil
44.5 Mc
45.3 Mc 2nd Pix I-F Coil
$\begin{array}{ll}\text { 47.25 Mc } & \text { 1st Pix I-F Coil (Top) }\end{array}$
CATHODE-RAY OSCILLOSCOPE with good low frequency res-
ponse in vertical amplification and an input calibrating
source.
BIAS BATTERY - $1.5 V$
DIVM DIODE DETECTOR

## 40 Mc I.F. ALIGNMENT

Connect sweep output to ungrounded shield of converter tube in tuner (6U8). With short leads connect crystal diode detector (Fig. 6) to plate of 1 st I-F tube. Connect -1.5 $V$ to A.G.C. line (Junction of R-1, R-4 \& C-21A). Connect oscilloscope to detector output. Adjust sweep output to give adequate deflection.

C. After these adjustments have been made recheck the peak to peak output on the oscilloscope. If the shape of the curve is not as shown in figure 8 , it will be necessary to retouch the adiustments. A small fraction of a turn is all that is necessary if the strip is operating cor-
rectly. The position of the 44.5 Mc marker is critical ( $98 \%$ ). The 43.9 Mc transformer ( 3 rd I-F) controls the symmetry of the top. The 45.3 Mc transformer (2nd I-F) controls the height of the 45.75 Mc marker. The 43.5 Mc transformer (1st l-F) controls the height of the 42.25 Mc marker. This adjustment will very seldom need retouching.
DO NOT RETOUCH the converter plate coil or the input grid coil. These coils MUST be adjusted correctily with the diode detector. Recheck position of 41.25 Mc and 47.25 uc markers. Reset if necessary.


Fig. 7-input Circuii Rosponso VIDEO
With 4.5 MC unmodulated signal from a high impedance Wource, ( 10,000 ohms in series with the generator) into plate of the picture detector tube (Pin 2-6AL5) and VTVM on response. VTVM on $0-10 \mathrm{~V}$ AC scale. This adjustment can also be made while observing a picture from a station. Tune trap for least 4.5 MC beat in picture.

## AUDIO I-F

: With signal generator set to 4.5 MC and dc VTVM connected to junction of R-62 and C-46, adjust sound ake-off coil (L-13 Top) and sound I-F transformer slugs (T-6 Top \& Bottom) for maximum.


Fig. 9-Video \& Audio l-F Adjustments
2: With VTVM connected to pin 7 of V-12 (6AL5) adjust the ratio detector primary (T-7 Bottom) for maximum.
3. With VTVM connected to junction of R-66, R-69 and

C-50, adjust ratio detector secondary ( $\mathrm{T}-7$ Top) for cross over (zero voltage) on lowest scale.

NOTE - If no signal generator is available, the pro cedure above may be followed by tuning in a station and using the 4.5 MC beat between picture and sound carrier

## TUNER ALIGNMENT

A. Sweep generator with halanced 300 ohm output to antenna terminals. Marker generator output to antenna terminals. Oscilloscope to "test point" Figure 10 on tuner. Connect -3 V bias to AGC line at junction of $\mathrm{R}-33$ and $\mathrm{C}-20$ on the receiver.


1g. 10-Top Tuner Adjustments

## B. RF AND CONVERTER ADJUSTMENT

1. With channel selector on Channel 12, adjust C-204 slightly favoring the Pix carrier, then adjust C-207 and $\mathrm{C}-217$ for response as in Figure 11. Picture and sound markers at $90 \%$ maximum response.
2. Check response on all channels. If markers are below $70 \%$ on any channels, readjust $\mathrm{C}-204, \mathrm{C}-207$, and C-217. Reçheck all channels.


Fig. 11-Pix \& Audio Markers
C. OSCILLATOR ADJUSTMENT.

1. Apply -4.5 volts on I-F AGC line at junction of R-1 and C-21A.
2. Connect oscilloscope to output of video detector. Place fine tuning in center of range. Check response on all channels. Sound marker should be in notch and picture marker at $50 \%$. (See Figure 8).

## OSCILLOSCOPE WAVEFORM PATTERNS

The waveforms on this page were taken with the receiver tuned to a normal picture. The numbers on the waveforms correspond to the numbers on the schematic diagram which dentifies each test point.
the rok to pare the approximate peak to peak amplitudes. The frequencies shown indicate
the repetition rate of the waveform, not the sweep rate of the oscilloscope. If the waveforms are observed on the oscilloscope with a poor high frequency response, the corners of the pulses will tend to be more rounded than quency pulse will tend to be less.


## No. 1-bAL5 Pix Dat. Plate

No. 4-6CS6 Sync Sep.



No. 2-12AT7 Plate
4iv P.P 60 C.P.S. No. 2-128Y7 Grid
9.5V P.P 60 C.P.S.


No. 3-Pix Tube Grid
23.150V P.P 60 C.P.S.


No. $11-$ Vert. Dof. Coil
75 V P.p 60 C.p.s.
No. 17-68Q6 Grid
150V P.P 15.750 C.P.S.
3. If markers are off, individual oscillator coil slugs will require adjustment. Adjust each channel slug, accessible through hole in front of chassis with a non-metallic screwdriver to bring sound marker to correct position.
4. If fine tuning on all channels is off in the same direction, adjust the oscillator trimmer C-216.

## © John P. Rider




OJohn F. Rider

MODEL 45TV13-43-9081A
( $21^{\prime \prime}$ RECTANGULAR PICTURE TUBE)
GENERAL SPECIFICATIONS

DIMENSIONS

## Model

45TV13.43-9081A
WEIGHT (packed)
Model

45TV13-43-9081A
45TV13-43-9038A
SPEAKER

| Model | Type | Size |  |
| :--- | :--- | :--- | :--- |
| V.C. Imped. |  |  |  |
| 45TVI3-43-9081A | P.M. Dynamic | $6^{\prime \prime} \times 9^{\prime \prime}$ | 3.2 Ohms |
| 45TV13-43-9038A | P.M. Dynamic | $6^{\prime \prime}$ | 3.2 Ohms |

R. F. TUNER
Y.H.F.-Turret type.
U.H.F.-Continuous tuning type.
I.F. SYSTEM

Three Stages-overcoupled-for composite signal.

## DETECTOR

Sound-Ratio type
Picture-Germanium crystal type
U.H.F. Mixer-Silicone crystal type
RETRACE LINE SUPPRESSOR
Eliminates retrace lines thruout the normal range of picture brightness
and contrast.


## Cambridge

MODEL 45TV13-43-9038A (21" RECTANGULAR PICTURE TUBE)

INTERMEDIATE FREQUENCIES

## FOCUS

HORIZONTAL SYNCHRONIZATION Automatic frequency control provides excellent picture stability.
HIGH VOLTAGE POWER SUPPLY
"Fly-back" type. Completely enclosed in a shielded compartment

## BUILT-IN ANTENNA

Broad band dipole.

Sound Carrier -41.25 Mc .
POWER REQUIREMENTS
117 volts $\quad 60$ cycles $\quad 220$ watts

ANTENNA INPUT IMPEDANCE 300 ohms-balanced to ground.

PICTURE SIZE

## DEFLECTION <br> LECTION

Magnetic
TUBE COMPLEMENT

fig. il-LOCATIONS OF PRE-SEY CONTROLS

$1-ヤ 139 \forall d \wedge 1$ OWOOXS-378WVS

## ALIGNMENT PROCEDURE

INSTRUMENT CONNECTIONS FOR SOUND CHANNEL ALIGNMENT

## SOUND CHANNEL ALIGNMENT PROCEDURE

| 1. Short antenna terminals together with a jumper wire. <br> 2. Set receiver Channel Selector to any inactive television channel and Contrast control to its maximum counter-clockwise position; other controls may be left at any desired setting. <br> 3. A small screwdriver (preferably non-metallic) can be used for alignment of Sound IF. The blade of this tool will fit the slot in the core of the transformer. |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| standard signal GENERATOR |  | $\underset{\text { VTVM }}{\text { CONNECTIONS }}$ | MISCELLANEOUS INSTRUCTIONS | TRIMMER OR SLUG | TYPE OF ADJUSTMENT AND OUTPUT INDICATION |
| CONNECTIONS | frequency |  |  |  |  |
| Connoet as shown in Fig. 1. |  | Connect ${ }_{\text {Fig. }}$ or ${ }^{\text {a }}$ 2. Shown in | 1. Set Controst control to io its maximum <br> 2. A spocial doetector must bo urilized whon aligning the a.s Mc. Sound Trap Coill. cordance with the information corn- lained in Fig. 3 . If a VTVM containing tainod in Fig. 3. If ac VTvM containing a high froquency $A . C$. probe is ovil able, this probe can be vililized in plig. 2 , of the crystal detector shown in <br> 3. During this adiustmont only, remove Ones (v1) V2 or v3). This will provent noise in the RF slages from affecting sound trop. | $\begin{aligned} & \# 1 \\ & \begin{array}{c} \text { 4.5 MC Sound } \\ \text { (Sooe fig. } \end{array} \\ & \text { (sig. } \end{aligned}$ | Adiust for minimum reading |
| Same as above | Same as above. | Connect as shown infig. | A "swishing". sound may be heard in the speaker during Sound Channel Alignment.This sourious oscillation is caused by horizontal sweep rollage being picked up in the audio system thru stray coupling ofinstrument leads: it should be dissegarded as it will have no effect on alignment of the sound channel. | $\begin{gathered} \text { \#2 } \\ \text { Discriminator } \\ \text { Secondary } \\ \text { (Sne Fig. } 10 \text { ) } \\ \hline \end{gathered}$ | Adiust for maximum reading |
|  |  |  |  | $\begin{gathered} \# 3 \\ \text { Diseriminato: } \\ \text { Primary } \\ \text { (See Fig. 8) } \end{gathered}$ | Adiust for maximum ${ }_{\text {on }}^{\text {VTVM. }}$. |
|  |  |  |  | $\begin{gathered} \# 4 \\ \text { Sound if } \\ \text { Transformer } \\ \text { (See Fig. 10) } \end{gathered}$ | Adiust for maximum reading |
| Same at above. | Same above. | Connect fis. as. shown in | To obtain zero bolance of the discriminator circuit, two 68,000 ohm resistors will be reauired. These reistors must be matched so that their respective resistonces do not differ by more than $\%$, the accuConnect the two resisiors in series from pin 2 of the fig as shown in Fig. 5. | \#2 <br> Discriminator Secondary (See Fig. 10) | Note thot at slug \#2 is rolated, ao point will be tound where the volimeter will swing rather sharpvo from a positive ${ }^{\text {No }}$ a ${ }^{\text {a }}$ negative <br>  when the moter reads zero as |
| Replace the type 6CB6 tube previously removed in the above procedure and turn set on. Tune in to a local channel and should there be an unusual |  |  |  |  |  |

Replace the type 6CB6 tube previously removed in the above procedure and turn set on. Tune in to a local
amount of "Intercarrier Buzz" refer to procedure on adioining page to remove this aforementioned fault.


FIG. 1
Generator Connections
for Sound Channel and 4.5 Mc. Sound Trap
Alignment

FIG. 5
VTVM Connections
for Sound Discriminator
Alignment

| GENERATOR CONNECTIONS | GENERATOR FREQUENCIES | miscellaneous INSTRUCTIONS | TRIMMER OR SLUG | TYPE OF ADJUSTMENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: |
|  | STANDARD SIGNAL GENERATOR <br> 42 Mc. \& 45 Mc. $\qquad$ <br> sweep generator 45 Mc. Swoep Width 10 Mc . | $\underset{\substack{\text { Detune } \\ \text { iransformer } \\ \text { 2nd } \\ \text { by }}}{ }$ soldering a short piece of wire or connecting <br>  Amp.) Other end if wire or clip ioft Unconnected. | \# 5 and \# 6 <br> 3rd IF Trans. (Soo Fig. 9) |  |




FIG. 4 VTVM Connections for Sound IF Alignment

Alignment


FIG. 2
Detector and VTVM Connections


REDUCTION OF INTERCARRIER BUZZ
Under actual recepption conditions slight "dynamic" unbalance of the dit--
criminator secondary can emphasize intercarrier buzz due to incomplete criminator secondary can emphasize intercarrier buzz due to incomplete
amplitude modulation reiection. Therefore it is vitally important to obtain an accurate setting of the diseriminator secondary slug under these conditions.
Discannect all instruments (te sure that I.F. tube removed for the adiustment of Sound Trap has been replaced) and then conneat an antenna to
the receiver to obtain. program reception from a local station. If inter carrier buzz is promineng, am slight readiustment of the discriminato secondary slug (\#2) should be made to obtain the "dip" point for the
buzzing sound. Note that program sound will be clear and froe from distortion at this point. Buzz should now be at an acceptable minimum
is station transmission is not at foult.

## -John F. Rider



## VHF RF CHANNEL ALIGNMENT PROCEDURE

| STANDARD SIGNAL GENERATOR |  | sweep generator |  | VTVMCONNEC. TIONS | SCOPE CONNECTIONS | MISCELLANEOUS INSTRUCTIONS | trimmer or sLug | TYPE Of ADJUSTMENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CONNEC. TIONS | frequency | CONNECTIONS | frea. |  |  |  |  |  |
| RF AMPLIFIER AND MIXER ALIGNMENT |  |  |  |  |  |  |  |  |
| $\left\|\begin{array}{l} \text { Connect } \\ \text { ons } \\ \text { Fig. } \\ \text { Fig. } \\ \text { in. } \\ \text { in } \end{array}\right\|$ | $\begin{aligned} & 209.75 \mathrm{MC} \\ & \text { Sound Corrier } \\ & 203.25 \text { Mce } \\ & \text { Picture Carri- } \\ & \text { er Morker. } \end{aligned}$ |  | CHANNEI | Not used. | $\begin{aligned} & \text { Connect } \\ & \text { shos. } \\ & \text { sig. } \\ & \text { fig. } \\ & \text { Fin. } \end{aligned}$ |  |  |  |
| Some as |  | Same as above. |  | Not used. | Same as | $\left\|\begin{array}{l} \text { sel chanol solector } \\ \text { 1observec. } \\ \text { obil. } \end{array}\right\|$ | The RF bond settings of trim the other toleveri choracteristic of promise may be ond making sil $\# 16$, 17 ond 1 |  |
| OSCILLATOR ALIGNMENT <br> 1. IMPORTANT: Before undertaking oscillator alignment be sure IF circuits ore correctly aligned for band pass characteristic illustrated in IF alignment procedure. <br> 2. During oscillator alignment, it is necessary to sot the Fine Tuning control so that the tooth on the fiber fine tuning cam points downward (correct position for this control is shown in Fig. 17). <br> 3. During this step ond thru-out oll succeeding steps it is necessary to: keep output of sweep generotor at a level that does not allow reading on VIVM to exceed one volt. <br> 4. Keep oulput of standard signal generator at a level that provides a readoble marker but does not distort the curve that is being observed on the 'scope. |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| $\left\|\begin{array}{cc} \text { Connoct } & \text { as } \\ \text { sha h. } & \text { w. } \\ \text { fig. } & \text { in } \end{array}\right\|$ | 209.75 MC . Sound Carrier 205.25 MC . Picture Marker. |  | CHANNEL | Connoct shown in <br>  |  |  | Using o non-m oscillator slug Tuner Unit-see in Fig. 16. Position af sou dicated in Fig. | elallic scrowdriver to adiust channol \#12 <br> (accossible thru hole on front of RF marker is located of the position indicatod 16. |
| $\begin{aligned} & \text { Same as } \\ & \text { above. } \end{aligned}$ |  | Same as above. |  | ${ }_{\substack{\text { Same } \\ \text { above. }}}^{\text {as }}$ | Same as | $\begin{aligned} & \begin{array}{l} \text { sot channel seloctor } \\ \text { to channel } \\ \text { observed. } \\ \text { boing } \end{array} \end{aligned}$ | Adiust the RF ting Channel is on Ond ossili:ator slug Fig I7 thot picture and the position ind NOTE: Make s the cam pointin | swoep generotar and markkr, generator <br> Solector to coresponding chonnoll oadiust thru hole on front of RF Tuner Unit see <br> permins response curve to be shifted so <br> dicated in fig. 16 . <br> ure that cam on fine tuning control shaft Ing dositioned during this thes fisg (ty). (tooth on |
| If an oscillator slug "falls into" its cail form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make <br> the slug move toward the end so that its threads will be engaged by the Slug Retaining Spring when that spring is returned to its normal position. |  |  |  |  |  |  |  |  |
| If an unsatisfactory overall response is obfained for a particular channel, observe RF Amp. and Mixer response curve for that channol. If characteristic does not conform reasonably well within the typical curve <br> shown in Fig. 15, then, (1) attempt to obtain a better compromise for RF response on all channels by realigning RF Amp. and Mixer circuits, or (2) try replacing Antenna, RF and Oscillotor coils for the particulor chonnels. |  |  |  |  |  |  |  |  |


| CHANNEL <br> NUMBER | PICTURE CARIER <br> MARKER FREQ. | SOUND CARRIER <br> MARKER FREQ. |
| :---: | :---: | :---: |
| 13 | 211.25 MC. | 215.75 MC. |
| 12 | 205.25 MC. | 209.75 MC. |
| 11 | 199.25 MC. | 203.75 MC. |
| 10 | 193.25 MC. | 197.75 MC. |
| 9 | 187.25 MC. | 191.75 MC. |
| 8 | 181.25 MC. | 185.75 MC. |
| 7 | 175.25 MC. | 179.75 MC. |
| 6 | 83.25 MC. | 87.75 MC. |
| 5 | 77.25 MC. | 81.75 MC. |
| 4 | 67.25 MC. | 71.75 MC. |
| 3 | 61.25 MC. | 65.75 MC. |
| 2 | 55.25 MC. | 59.75 MC. |

FIG. 14


FIG. 15


FIG. 16


FIG. 13
VTVM and Oscilloscope Connections
for Oscillator Alignment


FIG. 17
Front View of
VHF RF Tuner Unit


FIG. 18 Trimmer Location of

## V.H.F.-U.H.F. TUNER SERVICING PROCEDURE



 When it is necessary to remove the tuning units for serice, it can be acWhen it his necessary to remove the tuning units for sericio, it can be oc-
complished by following the procedure given in the following paragraphs. complished by thowing the peocedure given in the tolowing paragrophs.
for simplicity, there is a separate removal procedure for each of the
. Tuners.
Instructions for replacing the U.H.F. tuning belt and the dial drive cord are instructions for ref
also given below.

## REMOVING U.H.F. TUNER

Numbers which appear ofter parts mentioned in
lext reerer to parts shown in illustration above.)
Disconnect leads marked $\mathrm{S}, \mathrm{R}$ and T on "Botiom View of Chasis Show-
 2. Remove Bracket ond Triangular Shoped Guard (7) shielding U.H.F.

Turn fine tuning knob until U.H.F. tuner shaft is folly counterclickwise,
then loosen two set screws and slide U.H.F. Diol Drive Pulley (0) off then loosen two set scews ond slide U.H.F. Dial Drive Puley (6) off
of shaft. (To ovoid he neessity of restringing U.H.F. dial drive cord hold Drive Pulley (6) so that cord doess not slip off and clamp cord tightly around pulter by wropping "scotch" tope around the two
strands of cord oas near as possible to the pulley. Also clamp cord strands of cord as near as possible eo the pulley.
around Dial Pulley and Shatt (12) in this manner.)
Remove the two U.H.F.F Tuner Mounting Screws (2) and a third screw
(not shown in illustration) Iocated underneath chasis on Mounting Bracket (1).
5. Loosen the two set screws on U.H.F. Tuning Gear (5) and free Iuner
 now be compleefly removed by sliding it tow ord rear of
disengaging unit from Eear (5) and pulley Brackets (10)
If tuner is returned to factory for repair it must be shipped with all parts If tuner is reterned to factory
removed os indicated above.

## REMOVING V.H.F. TUNER

(Numbers which appear ofter parts mentioned in
text refer to parts shown in illustration above.)

1. Remove U.H.F. tuner as decribed above.
2. Disconnect leads marked $M, N, N, P$, $Q$ and $U$ on "Bathom View of Chas sis Showing Connections of R.F. Tuners." Also disconnect the two
white ond yellow leads from the tuner ta the V.H.F. Selector Switch (17); at erminals 58 ond 517 .
3. Rotate Channel. Selector knob uniti V....F. Selector Switch Actuator Cam is campletely disengaged from Switch (17) and remove the two Remove channel Selecter knab, Fine Tuning knob and U.H.F. Dial

Remove Fiber Bracket (11) which supports tuner operating shafts
Also remove fiber dial lite shield which is fostened by one of the Also remeve fiber dial
fiber brocket mounting screws.
6. Remove the four Tunger Mounting Screws (15) ond lift V...F. fune (16) from chasis.
. Remove Clip (13) which retains U.H.F. Dioal Shaft and Pulley (12) Remove U.H.E. Tunieq Bell $(9)$ frome
8. Remove U.H.F.F. Tuning Belt (9) from pulloy
9. Loosen Iwo sel screws and remove U.H.F. Tuning Pulley (1).
10. Remove U.H.F. Tuning Pulley and Bracker Assembly ( 10 )
0. Remove U.H.F. Tuning Pulley and Bracket Assembly (10).

1. Remove Front Mounting Bracket (
(3) and Beer Mount
2. Loomeve front Mounting Brackert (3) and Rear Mounting Bracket (1). 12. Losen set screw and remove V.H.
mounted on rear of turret shaft.

If tuner is refurned to factory for repair it must be shipped with all parts
removed ss indicied above.

## REINSTALLING TUNERS

The reinstallation of the tuner can be made in the reverse order given in
the removal procedure, observing the following precoutions.

1. Remount V.H.F. Tuner (16) in mounting holes that place tuner as far
2. Position coaxial cable lead so that it completely clears the VHF Selector Switch Actuator Com. 3. When reinstlling U.H.F. Dial Drive Pulley (6), furn U.H.F. funing shoft to its extreme counter.clockwise position and turn Drive Pulley
(6) until lhe opening in its rim is os shown in lower illustrotion before (6) hntil the opening in its rim is as shown in lower ilustration betoro
tightening pulley see screws. When removing "ssolch" tape from U.H.F. dial drive cord, hold drive
puleys so that cord is suffienty
tout to prevent it from sliding off of pulleys.
3. Before replocing U.H.F. dial, be sure that "Fine Tuning" shaft is in o fully counterc-clockwise opsition or until U.H.F. dial shaft is is in top center position.

## REPLACING U.H.F. DIAL DRIVE CORD

As is is neessary to remove drive cord, when replacing U.H.F. Tuning Belt
(9), the belt should be replaced of this time if it is worn. The method of accone beit should be repicaed at his time if it is worn. The metho Remove Bracket and Triongular Shaped Guard (7).
Turn U.H.F. tuner shaft fully counter.clockwise and if necessary
loosen set screws and furn Drive Pulleys (6) ond (12) until) opening in their rims are located as shown in lower illustration.
3. String drive cord by placing ring at end of cord over tongue of Drive Pulley (6) and winding cord around pulleys as shown in lower illus.
tration. Replace U.H.F, dial by following procedure given in paragroph 5 in

## REPLACING U.H.F. TUNING BELT

Follow steps 2 and 3 in procedure entitled "Removing U.H.F.F
and step 4 in procedure entitled "Removing $v . M . F$. Tuner:"

. Instoll new belt by using reveres tron of chassis.


dial drive cord arrangemint

## SYNCROGUIDE TRANSFORMER ALIGNMENT

## (Chassis that do not inc'ude series " $E$ "' change)

Alignment of the Syncroguide transformer, circuir diagram \#128, which IMPORTANT: The first peak of the wave form should never be higher
used in the Horizontal Oscillator circuit on those receivers that do not than the second peak nor should the first peak be lower than the sernd Used in the Horizontal Oscillator circuit on those receivers that do not than the second peak nor should the first peak be lower than the sean
include the letter " $E$ " in the series designation at the rear of the chassis, peak by more than $3 \%$. Also when adiusting the "Bottom Slug," the an be accomplished by utilizing the procedure outlined below. To per-. picture must be in sync, therefore it may be neessary to turn the "Hori form this alignment, it will be neecessary to use an oscilloscope, preferably one that has a 2 megacycle response and a low input capacity probe100 mmfd . to ground.
Set the "Top Slug" and "Bottom Slug" of the Syncroguide trans-
former to their maximum counter-clockwise positions. . Short together terminals $C$ and $D$ of the Syncroguide transformer.

Set "Horizontal Hold" control, located at front of chassis to it
maximum counterclockwise position
5. Turn on receiver and tune in any local TV channel.
6. Adiust "Top Slug" clockwise until picture just locks in horizontally . Remove short from terminals $C$ and $D$. If picture does not hold syn when sho
locks in.
Connect 'scope to terminal $C$ of Syncroguide transformer and adiust sweep, "rate of 'scope until two cycles of osocillogram remain stationary.
Turn "Bottom Slug" clockwise until wave form peaks are equal in Turn "Bottom Slug"" clockwise until wave form peaks are equal in height as shown in Fig. 1 . aviutment has been completed, whisconnect 'scope from reeciver.
9. Set "Horizontal Hold" control counter-clockwise and adiust "Top Slug"" until picture is locked in and does not lose sync when
switthing "Channel Selector" knob. Then, furn "Top Slug" slowly counter.clockwise until picture is just ready to lose sync as shown in Fig. 4 .
a. Which holding action of receiver should now be as follows: a. When "Horizontal Hold" control is at its maximum counter-clock-
wise position and "Channel Selector" knob is switched, piture may appear as shown in Fig. 4 or be out of sync.
b. When "Horizontal Hold" control is at its maximum clockwise position, pitture may lose sync when swithhing "Channel Selector" When "Horizontal Hold" control is in the center or near the center of its ronge, picture remains stable when switching "Channe
Selector" knob. -
If the foregoing steps fail to correct for loss of horizontal holding (. 01 mfd.$)$ connected across operation, be sure that condenser 130 transformer is part 512311 , tubular, $C$ and $D$ of the Syncrogu 400 V . Do not use transtormer is part
a substitute part.


## correct

Fig. 2

## SYNCROGUIDE TRANSFORMER ALIGNMENT

## (Series "E" type chassis)

Alignment of the Syncraguide transformer, circuit diagram \#128, which
is used in the Horizontal Oscillator circuit can be accomplished by uilizing the procedure outlined below. To perform this alignment, it will be necessary to use an oscilloscope, preferably one that has a 2 megacycle

1. Set the "Top Slug" and "Bottom Slug" of the Syncroguide trans

Sor the "Op Slug" and "Bottom Slug" of the Synctar to their maximum counter-clockwise positions.
former
2. Short together terminals $C$ and $D$ of the Syncroguide transformer.
3. Adjust "Horizontal Drive" control, located on rear of chassis pan
one-half turn out from its maximum clockwise position. one-half turn out from its maximum clockwise position.
Set "Horizontal Hold" control, lacated at front of chassis, to its
maximum clackwise pasition.
5. Turn an receiver and tune in any local TV shannel.
6. Adiust "Top Slug" clockwise until picture just lacks in harizantally.
7. Remove shart from terminals $C$ and $D$. If pieture does not hald sync
when short is remaved, adjust "Battom Slug" clockwise until picture when shor
8. Connect'scope to terminal C of Syncraguide transformer and adjust
sweop rate of 'scope until twa cycles of ascillogrom remain sta-
tionary. Turr "Bottom slug" clockwise until wave form peaks are
equal in height as shown in fig. ent as shown in Fig.
MPORTANT: The first peak of the wave form should never be higher haa the second peak nor should the first peak be lower than the second
peak by more than $3 \%$. Also, when adjusting the "Bottom Slug," the picture must be in sync, therefore, if may be necessary to furn the "Horizontal Hold" control counter-clockwise when performing this step.
fter this adiustment ha
9. Set "Horizontal Hold" control counter-clockwise and adjust "Top
Slug" until picture is locked in and does not lose sync when switchSlug "Chniin picture is locked in and does not lose sync when switch ing "hannet selector" knob. Then, turn "op slug slawly caunter
clackwise until picture is iust ready to lose syne as shawn in Fig. 4.
10. Harizantal Holding action of receiver should naw be as fallows:
a. When "Horizantal Hold" cantrol is at its maximum caunter. picture may appear as shown in Fig. 4 or be out of sync.
When "Horizontal Hold" contral is at its maximum clockwise posi-.
tion, picture may lose sync when switching "Channel Selectar".
tion, picture may lose sync when switching "Channel Selectar",
knob.
When "Horizontal Hold" sontrol is in the conter or near the
center of ist range, picture remains stable when switching "Chan-
nel Selectros"

## PRODUCTION CHANGES

|  | The circuit shown on this page applies o "SERIES ABCDEFGMJK" chassi |
| :---: | :---: |
|  |  ection chongee columnn from which complete chonge information con bo |
|  | description of change |
| UNCODED | INITIAL PRODUCTION |
| "A" |  |



BOTTOM VIEW OF CHASSIS SHOWING CONNECTIONS TO RF TUNER UNITS

## PARTS LIST

| ( SCHE | PART. | DESCR |  | PaRT | descriprion |
| :---: | :---: | :---: | :---: | :---: | :---: |
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|  |  | CONDENSERS-Continued |
| :---: | :---: | :---: |
| $437 \ldots$ |  | Condensor-coramic 800 Mmid. |
| 438. |  | Condensor-ceramic 800 Mmfd. (frod |
| 439. |  | Condenser-ceromic ${ }^{\text {coo }}$ |
|  | 41 | Cindoser |
| 442 |  | Con |
|  | 513041 | Condenser-cer |
|  |  | Condonser |
| 506 |  | -r |
|  |  | Condonsor-Ceramic |
| 511. |  |  |
|  |  | donser-ceramic $100 \mathrm{Mmfd}. \pm 10 \% 50$ |
|  |  | Condons |
| 518. |  | Cor |
| 519 |  | Condenser-Coramic 2.2 Mmfd . $\pm 10 \%$ |
|  |  | Condonsor-Seramic 0.61 |
|  |  | ar |
| 530 |  | Condonsor-cramic 0.0 M |
|  | $\pm$ | Condenser-ceramic 68 Mmfd. 500 v |







Vidco-25.1 Mc
Sound-20.6 Mc
Audio strip - 4.5 Mc
Receiver input impedance 300 - ohms
Speaker voice - coil impedance
3.2 ohms at 400 cps
ower supply input
117 volts, 60 cps , a.c.
Power'consumption
170 watts
Tube complement
18 tubes -2 selenium rectifiers
and 1 crystal diode as follows:
R-F amplifier -6 BK 7 A or $6 \mathrm{BZ7}$
Mixer-oscillator - 6 J 6
Ist video i-f amplifier - 6CB6
2nd video i-f amplifier -6CB6

Tube complement - con't
3rd video i-f amplifier - 6CB6
3rd video i-t amplifier - 6CB6
Crystal video detector -1 N 64
Video amplifier - 6CB6
Sound driver-amplifier - 6AU6 Sound detector-amplifier - 6BN6 Audio output - 25L6
Sync clipper and sync splitter - 12AU7
Vertical sweep oscillator and
d.c restorer - 12AU7
dectical output amplifier - 25L6
Vertical output amplifier-25L6
Horizontal afc phase detector -6AL5
Horizontal afc phase detector-6AL5
Horizontal sweep oscillator - 6SN7
Horizontal swecp output amplifier - 25 BQ 6
Horizontal damper - 25W4
High voltage rectifier - 1B3G
Picture tube - 17BP4,21EP4, or 21ZP4
Low voltage rectifiers (selenium) - SR-300



Fig. 8. Video, sync, and sweep waveforms chart inclicating the tube pin number where each waveform exists and the


## VOLTAGE MEASUREMENTS

All voltages measured with a 20,000 Ohm per volt meter with the receiver connected to a 117 volt 60 cycle power supply.
Tuner set to an inactive channel with antenna terminals shorted and connected to ground.
Controls set for normal reception-Contrast control completely counterclockwise.
Voltages marked with an asterisk (*) will vary widely with control settings.
R.F. tuner voltages were measured with tubes removed from socket.
No voltage reading at a tube element indicate zero voltage or voltage which cannot be accurately measured with a $20,000 \mathrm{Ohm}$ per volt meter.



MODELS 45 TV11-43-9027A, 28A, 85A, 86A, 87A, 88A, 89A, $90 \mathrm{~A}, 91 \mathrm{~A}, 92 \mathrm{~A}, 93 \mathrm{~A}, 94 \mathrm{~A}, 95 \mathrm{~A}, 96 \mathrm{~A}, 97 \mathrm{~A}, 98 \mathrm{~A},-9130 \mathrm{~A}, 31 \mathrm{~A}$; XT-100 Series


## Test Equipment

The test equipment required for the alignment of this receiver is as follows:

Marker Generator (RCA WR39B or equivalent) Sweep Generator (RCA WR59B or equivalent) Oscilloscope (RCA WO55B or equivalent) VTVM (RCA WV97A or equivalent) The marker generator is an r-f signal generator used for peaking the i-f coils and also to supply marker pips on the response pattern. The required frequency range of this generator should be approximately from 20 to 30 Mc . The accuracy of the frequency calibration of this generator is very important.
The sweep generator should have its output continually variable in frequency. In this alignment, only one output sweep signal is needed, that sweeping be tween 20 to 30 Mc . The oscilloscope used should be a high-gain, general-purpose type employed for test purposes. The frequency response and size of the screen is unimportant. The VTVM is of the standard type with a high input impedance. It should have provision with a high input impedance. It should have provision for a-c and d-c measurements. The use of test equip-
ment for sound and oscillator alignment is not rement for sound and oscillator alignment is not re-
quired. For all adjustments use a good insulated screwdriver alignment tool.

## Alignment

For the alignment points of the different sections of the receiver refer to the figure indicated in the discussion. Aside from the oscillator adjustments most of the other alignment points are located on top of the chassis as indicated in the top chassis view of Fig. 9. It is recommended that the order of alignment in the following procedure be adhered to if alignment is found necessary. The ground leads of the test instruments should be connected to the top chassis plate ( B minus) of the receiver.

## Video I-F Alignment

Connect the oscilloscope or the VTVM to the junc tion of R118 and L5. Adjust the contrast control to its minumum setting. Feed the output signal of the marker generator through a tube shield placed over the mixer tube. Be certain that this shield is not grounded.
Set the marker generator at 22.4 Mc , amplitude modulated 30 per cent at 400 cycles. Adjust TLPI, the first
video i-f coil, which is located on top of the tuner, for maximum deflection on the oscilloscope or VTVM. Repeat this process with the third video i-f coil $L 2$. Leaving the generator connected as is, reset its frequency to 24.6 Mc and tune the second and fourth video i-f coils, $L .1$ and $L 3$ respectively, for maximum response on either indicating device. The screwdriver adjustments for all the above i-f coils are located on the top of the chassis as shown in Fig. 9.

## Over-all Picture Response

With the sweep generator adjusted for a $10-\mathrm{Mc}$ sweep with a center frequency of about 25 Mc (i.e., sweeping $20-30 \mathrm{Mc}$ ) connect the sweep output cable to the mixer tube similar to the method in the video i-f alignment. Loosely couple the marker generator to the same mixer tube. Inject individual markers of 25.1 $\mathrm{Mc}, 22 \mathrm{Mc}, 20.6 \mathrm{Mc}$, and 26.6 Mc in the order indicated and note the position of the marker pips on the response curve for each case. If necessary, readjust the four video i-f coils for an over-all picture response as indicated in Fig. $10(\mathrm{~A})$. The solid line at the top of the curve is the ideal straight line response. The dotted portions of this part of the curve indicate the possible limitations and variations that usually exist and which are permissible for correct alignment. In part (B) of Fig. 10 is an actual over-all video i-f alignment curve taken on a "XT-100" chassis

NOTE: The 25.1-Mc and 22-Mc markers should fall approximately halfway down the slope on either side of the curve. The $20.6-\mathrm{Mc}$ marker should be well down on the base of the low side of the curve. (This is the frequency of the sound i-f output from the mixer tube.) Coil TLP1 will effectively peak the low side, while coils $L 1$ and $L 3$ affect the high side of the curve. Coil $L 2$ should be used as the final adjustment for a symmetrical pass-band.

## Sound Alignment

This is the alignment of the $4.5-\mathrm{Mc}$ section of the receiver. For the quickest method of aligning this secticn, an actual station transmission is used as the basic signal instead of any meter or visual nethod of alignment. No measuring or indicating devices are needed for this method of alignment.

In order to correctly align coils L6 and L20, an input television signal must be used that is below the
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FREQUENCY $\longrightarrow$
(A)

(B)

Fig. 10. Over-all video i.f response: (A) drawing showing marker points, and allowable variations in shape, (B) an
limiting level of the 6BN6 gated-beam tube. This level can easily be identified by the "hiss" which appears in the sound output. Some method of attenuation must be employed to reduce this signal. Although various methods are possible some sort of attenuator between the antenna and input terminals is preferred. A simple resistance pad similar to that indicated in Fig. 11 will resistance pad
suffice. If not enough attenuation is secured with one pad, add another or more until there is sufficient attenuation. Conversely, in order to properly align the quadrature coil $L 9$ and the a-m rejection control, P12, a signal above the limiting value is necessary.

The sound alignment is as follows:

1. Tune in a station that has a steady signal with no fading. A station with a tone signal (test pattern)


Fig. 11. A typical attenuation pad.
on the air is preferred, otherwise any available signal will do.
2. Adjust the attenuator until the signal coming in is reduced to the level where a "hiss" is heard with the sound output. Next adjust the primary and secthe sound output. Next adjust the primary and sec-
ondary of the $4.5-\mathrm{Mc}$ sound take-off coil L6. The ondary of the $4.5-\mathrm{Mc}$ sound take-off coil L6. The
secondary adjustment of $L 6$ is made from the undersecondary adjustment of $L 6$ is made from the under-
side of the chassis as indicated in Fig. 12; the-primary adjustment is made from the top of the chassis. The 4.5-Mc sound driver coil $L 20$ is adjusted next for maxi mum sound output regardless of any hiss or buzz. If any of these sound adjustments may cause the "hiss" to disappear, the attenuator should be readjusted so that the "hiss" reappears.
3. When the maximum sound output is attained, adjust the attenuator in the opposite direction so that the "hiss" disappears. This raises the signal above the limiting level of the 6BN6 gated-beam tube.


Fig. 12. Underside of chassis indicating location of 16 primary.
tion control first to the right and then to the left o the final setting. Whatever happens in one direction such as the appearance of buzz or decrease of the $f-m$ output, should also occur in the opposite direction. If this does not happen, then realign once again in the same manner as set forth above.
Alternate Method. An a-m or marker generator may also be used to align the takeoff transformer L6, and the sound driver coil $L 20$.
Set the generator to 4.5 Mc , amplitude modulated $30 \%$ at 400 cycles. Connect the output cable of the generator to the junction of the .05 mf capacito (C118) and the two peaking coils $L 4$ and $L 5$ in the grid circuit of the 6 CB 6 video amplifier. Place the vertical input terminals of an oscilloscope or VTVM across the voice coil or the volume control PD10. Set the volume and contrast controls at maximum.
Adjust the $a-m$ rejection control for the first maxi Adjust the a-m rejection control for the first maxi-
mum response on the oscilloscope or VTVM as the control is turned in a clockwise direction. Lower the generator output until a "hiss" is heard from the speaker. Next peak the primary and then the secondary of the takeoff transformer L6 for maximum re sponse on the oscilloscope or VTVM. If the "hiss" disappears," lower the generator output until it re appears. Then adjust the sound driver coil L20 in the same fashion
The quadrature coil $L 9$ can then be aligned either by ear as in the first method, or by use of a tone modulated pattern transmission from an actual station. If the latter is available, the input is set above the limiting level of the 6BN6 (no hiss in the output) and the quadrature coil is peaked for maximum response on the oscilloscope or VTVM.

## Oscillator Alignment

As far as the r-f tuner is concerned only the oscillator alignment is discussed here. Alignment of the r-f section is not included because it is felt that very seldom will it require alignment. If any trouble is sus pected in the r-f section it is suggested that the receiver or tuner be returned to the manufacturer or an authorized service agency.

This tuner employs the principle of incremental inductances as you move from channel 13 down to channel 2. Oscillator adjustments, therefore, are made sequentially from channel 13 through channel 2. No instruments are needed for this alignment, station transmissions on each channel are the only signal sources. The alignment procedure is as follows:

The fine tuning control is first set to the midrange of its adjustment. Set the channel selector switch to channel 13. Adjust the oscillator slug for this chan nel (see Fig. 13) until the best picture and sound is received. Bear in mind that the a-m rejection control must be properly adjusted beforehand for the clearest sound as discussed in alignment of the sound section. Next, repeat this procedure for channel 12, then channel 11 and so on down the line.

Fig. 13. Oscillator alignment points.


There is no oscillator adjustment for channel 7 alignment of the channel 8 oscillator automatically assures proper alignment of the channel 7 oscillator. After the high-frequency channels are aligned (13 through 7), although each low frequency can be aligned individually, the oscillator slug for channel 6 can be used to shift the complete low-frequency band if desired. Position of all the oscillator slugs for both bands are indicated in Fig. 13.
4. Next adjust the quadrature coil, $L 9$, for maximum sound output. For this, it is recommended that a station of average signal strength in your area be used. The a-m rejection control PI2 is then adjusted until the intercarrier buzz is eliminated. Then repeat the $L 9$ and $P 12$ adjustment.
Proper alignment of the sound system can be checked easily at any time by turning the a-m rejec-


The UHF Tuner found in the XT- 100 series receivers may be either a Mallory Inductuner of a Radio Receptor UHF Because of the criticol nature of the UHF Tuners, field servicing other thon replocemont of tubes or cry stol mixer is
not recommiended. If moior rouble thot connot be corrected by tube or crystol replocement occurs, remove the UHF Tuner unit only ond return to the foctory for repoir.


MALLORY INDUCTUNER




Dial cord stringing data.
Since the tuning section of the converter is conSinuous, a dial cord drive and pulley system is tinuous, a dial cord drive and pulley system is
required. Figure 1, illustrates two different types of required. Figure 1, illustrates two different types of
dial cord stringing diagrams. Part (A) shows arrangement which may be found on some converters,
and Part (B) is the arrangement which will be found on most converter units. On the latter type, the dial-cord arrangement varies slightly (shown by the dotted lines) for 21 -inch picture tube receivers.


Figure 1.


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## -F TUNER UNIT

## GENERAL DESCRIPTION

The r-f amplifier, converter and local oscillator are constructed as a complete subassembly unit which can be easily dismounted educe oscillator radiation to a minimum.
The $r-f$ tuner unit uses two $r-f$ amplifiers, a converter and a oscillator. The intermediate output frequencies are: 45.75 mega-
cycles for picture and 41.25 megacycles for sound. The circuits are tuned by series coils and their distributed capacity, the tube capacity, and the capacity of three trimmers As the channel selector is switched to lower channels, coils are
added in series to lower the frequency. The oscillator section has a tuning adjustment for each channel so that the oscillator requency may be correctly adjusted for every channel with one setting of the fine tuning control at the center of its range:
The antenna is coupled to the cathode of the first $r$-f amplifier by a balanced input transformer to reduce noise pick-up. The r-f tuner unit includes an intermediate frequency trap in frequencies, in the intermediate frequency pass-band, which may be picked by the antenna system. The trap is connected into he circuit when the receiver is tuned to the critical Channels, 2
hrough 6 . Late production tuners incorporate a tunable cathode through 6 .
coil, L100.
Two major versions of tuners were used during the production run "EE" version which uses a $6 \mathrm{AB4} 4$ tube as 1st $\mathrm{r}-\mathrm{f}$ tube, while the 2nd and 3rd production receivers incorporate a "BK" version using a 6 BK 7 tube as a ist r -1 amplher. Refer to pages 14 and
25B for further details. Delayed automatic gain control bias is applied to the second r-f amplifier. The i-f output of the converter is applied to the irst i-f amplifer through a low-impedance coupling line to the
if input coil. A test point " I " is added at the converter grid i-f input coil. A test point " I " is added a
which is isolated from the grid by a resistor

## SERVICE ON R-F TUNER UNIT

The $\mathrm{r}-\mathrm{f}$ tuner unit has been carefully designed for trouble-free wafers with the coils mounted are readily replaceable. It is recommended that any trouble be definitely located before removing the $r$-f tuner unit. Make the following checks to help 1. If video or sound is present this usually eliminates the r-f tuner unit as a source of trouble. If both video and sound are if stages as well as in the r-f tuner unit 2. If a noise pattern is evident on the screen, it usually indicates that the $r$-f tuner unit, the video i-f and the video amplifier
circuits are operating normally. Check for a short or an open cuit in the antenna or antenna input circuits or first r-f stage. 3. Replacer-f tuner tubes with known good tubes. Note: When a new tube is used, slight differences in interelectrode capacities
between tubes may cause a slight detuning of r - circuits. If an oscillator tube is replaced, the fine tuning range should be checked. 4. Check for proper AGC bias voltage at test point No. X.
A normal signal should produce approximately -3 volts VTVM A normal signal should procuce approximately 3 volts $V{ }^{\text {read }}$ reading.
5. The oscillator may be checked by measuring the voltage at
test point No. I. If the oscillator is functioning it should develop test point No. I. If the oscillator is functioning it should develop
approximately -3 volts as measured by a vacuum tube voltapproximately -3 voits as measured by a vacue
meter. If the oscillator is inoperative the voltage at test point No. I will drop below 1 volt.
6. Check the i-foutput coupling for open or short circuit.
7. Couple a 44 -megacycle 400 -cycle amplitude modulated signal to test point No. I. If the 400 -cycle modulation is present at the output of the video amplifier plate as seen on an oscilloscope or observed on the screen of the picture tube in the form of
horizontal bars, it is highly probable that the trouble lies somehore in the r-f tuner unit ahead of the converter, V103B,
where grid (pin 7). However, should this $400-$ cycle information fail to
appear in the receiver output, a check should be made of the appear in the receiver output, a check should be made of the
video i-f amplifier stages, the crystal diode and the video amplifiers.
8. Check $r$-f tuner socket voltages shown in Fig. 27, page 24. removal of tuner unit from chassis-

1. Disconnect the antenna transmission line and the tuner out put i-f coupling at the i-f assembly.
2. Remove self-tapping screws holding the tuner to the mounting brackets at the front and rear of the tuner.
3. Disconnect the following leads from the r-f tuner terminals
AGC, 6.3 -volt heater, high B+ and low Be, see Fig. 19 .

4. Disconnect the black phenolic coupling from the r.f tuner
switch shaft. The tuner assembly is -
replacement of switch wafers-See Fig. 12 and 13.
5. Remove the r-f tuner unit from the chassis and remove its 2. Loosen setscrew ( E ) which holds Textolite switch shaft into
the brass coupling KMK-007 and slide shaft out of the rear of he switch. 3. Remove the spring clips (B) which secure the switch wafer
the Textolite side rails (C). There are six of these springs on each side. These may be removed by lifting the tab out of the hole in the Textolite side rails.
(C) to the shields. The hex nuts (D) which secure the side rails afers. 5. Unsolder the connections to the wafer to be removed and
to remove the oscillator wafer oniy-See Fig. 12 and 13
6. Remove the r -f tuner from the chassis and remove the r -f 2. Loosen the Allen setscrew (E) which holds the Textolite switch shaft to the coupling and pull the shaft out of the oscil3 wafer.
7. Remove the four spring clips ( $B$ ) which secure the Textolite
ide rails (C) to the $r$-f tuner unit front apron and the oscillator 4. Remove the two self-tapping screws (A) which hold the 4. Remove the two self-tapping screws ( $A$ ) which hold the $r$-f
tuner unit front apron to the chassis, and pull the front apron forward so that the oscillator wafer may be removed. Use care
not to break the connection to the tuning capacitor Clis. not to break the connection to the tuning capacitor, C118. it by springing up the Textonite side rails (C). When reassembling the $r$-f tuner unit and replacing switch
wafers, use care not to dar age or distort any of the coils mounted wafers, use care not to dan nage or distort any of the coils mounted
on the switch wafers. Reassemble the $r$ - $f$ tuner unit in the reverse order that it was disassembled. REMOV
and 13.
8. Remove the $r-f$ tuner unit from the
9. Remove the r-f tuner unit shield. 3. Remove the two spring clips (B) which hold the Textolite side rails. into the brass coupling (RMK-007) and slide the Textolite shaft out of the coupling.
5pron to the r-f tuner unit chassis.
10. Spring up the
11. Spring up the Textolite side rails (C) to rele
12. Unsolder the tuning capacitor lead at the 12 AT 7 socket.
13. Tnsoder the tuning capacitor lead at the 12 AT 7 socket.
14. To remove the detent assembly, remove the "C" washer on



Fig. 17. R-F Tuner Adiustment, Side View
notes:
R-F Alignment

1. The r.f tuner may be aligned without removing it from the main chassis. Disconnect the 300 -ohm transmission line from
the antenna input transformer, T100 and disconnect the $\mathrm{B}+$ to the oscillator, see Fig. 19. To remove B+ from the oscillator, clip the jumper between the center terminal lugs and transpose
250 -volt lead from top feed through capacitor to lug No. 3
(reading left to right, looking down at top of tuner). Be sure (reading left torimht, opooking down at top of tuner). Be sure
to replace jumper and properly connect 250 -volt lead after to replace jumper and properiy connect 250 -voit lead after
alignment.
2. Connect the sweep generator to the r.f tuner antenna 2. Connect the sweep generator to the r.f tuner antenna
input transformer using the G-E ST-8A balanced adapter to obtain 300 ohms output, see Fig. 14. The adapter should be con-
nected to the r - f tuner through approximately three feet of 300 nehm transmission line and a resistor pad, as shown in Fig. 16A. When using other test equipment of the unbalanced output type,
a pad as shown in Fig. 16B should be used instead. a pad as shown in Fig. 168 should be used instead. cuner, see Fig. 19 , with the positive lead of the battery connected
to the tuner chassis. 4. Should it become difficuit to obtain proper tracking on Channels $7-13$ with the indicated adjustments, proper tracking
may be achieved by dressing the coil L122. This coil is available may be achieved by dressing the coil L122. This coil is available
through the opening of the tuner shield as shown in Fig. 17. This through the opening of the tuner shield as shown in Fig. 17. This
coil should be dressed with an insulated tool to prevent a B+ short.
3. It is possible to obtain two different settings of C105, Fig. 17, that will give the proper r.f. bandwidth. The correct setting
may be determined by switching from Channel 13 to Channel 12 and observing the change in bandwidth. The correct setting will result in a slightiy greater bandwidth on Channel 12 .
4. When proper tracking on the low chanes be
achieved with the provided screw adjustments, the inductance achieved with the provided screw adjustments, the inductance
of the coils L110, L111, L117, L118, L125 and L126 (Fig. 13) may be varied by inserting a knife blade between the windings. shield, a procedure which will detune the circuits. However, in most cases the provided screw-type adjustments will suffice to
achieve proper tracking through all channels after the shield has been replaced.
5. The picture and sound carrier marker should not be less
than $75 \%$ of the peak of the $r-f$ response curve. Refer to the "han $75 \%$ of the peak of the $r$-f response curve. Refer to the 8. Seal trimmer screw of C105 and the brass cores in the coils L114, L112, L109, L119, L116, L127 and L124, Fig. 17, with
wax to prevent detuning. Seal the tuning screws in trimmers
C104, C106 and C108, Fig. 18, with glue. Reconnect the B+ oscillator lead on the r-f tuner terminal board and connect the ransmission line to r-f tuner input transformer.
6. For receiver over-all alignment check, see page 19 (Step 3 and 4 of I-F Alignment Chart).


Fig. 18. R.F Tuner Adjustment, Top View ("BKer Adiustime
Version)
(a) Set generator sweep width to $10-15 \mathrm{~m}$
(a) Set generator sweep width to $10-15 \mathrm{mc}$.
(b) Signal input point at r -f tuner input transformer, T100
(c) Observe (c) Observe response curve at test point I, Fig. 18, through
$10,000-$ hm resistor. Connect test equipment ground lead 10,000 -ohm resistor.
to r-f tuner chassis.
(d) Adhere to following order when performing a complete

(e) When alignment.

When following the procedure below, an attempt should be made to obtain the indicated ideal response curves Minor deviations from the ideal curves may occur, the maximum limits of "tilt" and/or bandwidth being show STEP $\left|\begin{array}{c}\text { RECEIVER } \\ \text { AND } \\ \text { SWEE } \\ \text { GENERA. } \\ \text { TR } \\ \text { CHANNEL }\end{array}\right|$

No adjustments; check
tracking; obtain curve
"."; limits shown in last

L112, L114, L119 and flatness and 4.5 mc barve
width; see curve " ${ }^{\text {" }}$ "

No adjustments, check,

No adjustments, check
tracking; see curve " $B$ "

A. "EE" Vorssion Tuner

B. "BK" Vorsion Tunar Fig. 19. R-F Tunar Torminol Board Wiring
© John P. Rider



## VIDEO I-F ALIGNMENT

## ntroduction:

The following alignment data is divided into two separate
procedures. Because of the extremely high adjacent channel trap procedures. Because of the extremely high adjacent channel trap
attenuation, the conventional method of sweep observation of attenuation, the conventional method of sweep observation of
these traps becomes difficult. Hence all traps shall be pretuned by applying an amplitude-modulated signal and adjusted for minimum signal output.
The second portion the i-f response portion of this procedure involves the shaping of tion of a sweep generator signal. During this procedure, observe
the usual precautions regarding warm-up time, equipment cable the usual precautions regarding warm-up time, equipment cab
lead dress and generator output cable termination, see Fig. 15.

## TRAP ALIGNMENT

## general

As noted above, an AM signal is required for trap alignment. In many cases, the technician will have a suitable AM signal generator available. It should cover the range of 37 to 48 mega-
cycles at fundamental frequency, with available internal $400-$ cycle modulation. When this type of signal is used, the traps
should should be adjusted for minimum 400 -cycle signal as observed
on the oscilloscope.
Owners of General Electric sweep alignment equipment may on the oscilloscope.
Owners of General Electric sweep alignment equipment may
obtain the required amplitude-modulated carrier frequencies by a simple manipulation of the equipment controls as noted below.
Those technicians who do not have either of the above equipment available are advised to omit the trap alignment procedure. With the exception of the video amplifire 4.5 mc men trap L160, the
traps will not become seriously misaligned due to tube changes. traps will not become seriously misaligned due to tube changes.
The above-mentioned 4.5 mc trap may be swepe-aligned, if
desired, in which case 4.5 mc sweep signal should be used in The above-mentioned 4.5 mc trap may be sweep-aligned, if
desired, in which case a 4.5 mc sweep signal should be used in tep 3, of trap alignment chart. The trap may then be tuned to
minimum response at 4.5 mc which should be crystal marker

OBTANING AM OUTPUT FROM G-E SWEEP EQUIPMENT
The General Electric ST-4A Sweep Generator will provide 60 -
 ignal proceed as follows:

1. Turn the sweep gene
lockwise. This will provide a steady (zero sweep) carrier 2. Turn the sweep generator blanking switch "or." This will quare-wave-modulate the carrier at a 60 -cycle rate.
2. The next step is to calibrate the frequency of this AM
a. Turn the marker generator "on" and set the dial to the
desired frequency ( $4.5 \mathrm{mc}, 38.0 \mathrm{mc}, 41.25 \mathrm{mc}$.or 47.25 mc ). desired frequency ( 4.5 mc , $38.0 \mathrm{mc}, 41.25 \mathrm{mc}$ or 47.25 mc ).
b. Slowly tune the sweep generator through the desired frequenly tune the sweep generator through the desired
frequed As the desired frequency is approached, a strong beat signal will be observed on the oscilloscope. At exact renonance,
a zero beat condition will be noticed, on each side of which will a zero beat condition will be noticed, on each side of which wil
appear a beat pattern. Minor sweep generator back-and-forth
frequency drift may be noted. However, this drift is insignificant frequency drift may be noted. However, this drift is insignifican
and may be disregarded. and may be disregarded.
3. Apply this AM signal according to the instructions in the chart on page 19.
parallel lines When the trap the oscilloscope appears as two parallel lines. When the traps are properly tuned the distance
between these lines will be at a minimum. NOTE: It may be necessary to une full output of the sweep generator and near
maximum oscilloscope gain to observe proper trap tuning. maximum oscils
4. Remove V121 plate cap. Temporarily connect a 2500 -ohm 1. Remove V121 plate cap. Temporarily
25-watt resistor from $\mathrm{B}+260 \mathrm{~V}$ to Chassis.

5. Turn the Volume control to minimum and the Picture counterclockwise. 4. Set Channel Selector to
Channel 11 position. Set the fine Channel 11 position. Set the fine
tuning control to its maximum tuning control to its maximum
counterclockwise position.
5 . Connect 5. Connect oscilloscope to test
point $V$ (picture tube grid). point $V$ (picture tube grid).
6. Allow receiver and equipment to warm and test
minutes. Refer to 15 minutes. Refer to Fig. 22 for
alignment adjustrents iocation.


| STEP | AM-GENERATOR INPUT POINT | AM-GENERATOR FREQUENCY | ADJUST FOR MINIMUM OUTPUT | remarks |
| :---: | :---: | :---: | :---: | :---: |
| 1 | Through . 001 mf capacitor to junction of R178 and L154; connect generator cable shield to receiver chassis (see figure below) | 41.25 mc | L151 | May require maximum oscilloscope vertical gain. |
|  |  | 47.25 mc | L153 |  |
|  |  | 38.0 mc | L152 |  |
| 2 | Test Point IV (Diode Load) (see figure below) | 4.5 mc | L160 | Connect detector network between oscilloscope input and receiver test point V as shown in Fig. 23. Remove V107 during this step. |
|  |  |  |  |  |

## I-F SYSTEM SWEEP ALIGNMENT

## EnERAL:-

Now that the traps have been set at their proper frequencies
the $i$ i-f curve may be shaped. Nores:-

1. Turn Picture Contrast con2. Connect
2. Connect oscilloscope to test ${ }_{3} 165$ ). (Junction of R164 and 3. Apply a negative $41 / 2$-volt
$\qquad$

| STEP | CONNECT SWEEP generator | ADJUST | DESIRED RESPONSE | REMARKS |
| :---: | :---: | :---: | :---: | :---: |
| 1 | Into Test Point II and chassis through .001 mf capacitor. Center sweep frequency approx. 44.0 mc . Sweep width approx. 10 mc . | T151 for proper 42.0 mc response. <br> T153 for proper 45.75 mc response. <br> T152 \& L167 for zero "tilt" and maximum gain without "saddle-back." |  | Make indicated adjustments to obtain maximum gain con sistent with proper curve. Cor ners of curve peak must show slight rounding. Peak of curve may extend $10 \%$ (m yond 45.0 mc marker. |
| 2 | Into Test Point I and chassis through .001 mf capacitor Center sweep frequency ap prox. 44.0 mc . Sweep width approx. 10 mc . | L154 and T105 (R-F Tuner) for maximum gain and proper marker position. |  | Obtain maximum gain and proper marker positions. Peak of curve should extend $15 \%$ beyond 45.0 mc marker, with slight rounding. |
| 3 | Into R-F Tuner input through balanced adapter and 300 -ohm pad and line. Sweep Channels 2-13. Sweep width approx. 10 mc . | C108 (R-F Tuner) | Align for zero "tilt" on ch. 10. Check chs. 7-13 and make further compromise adjustment so that each channel will have no more than $\pm 20 \%$ "tilt" with the Fine Tuning adjusted to provide the proper sound and picture i-f markers. |  |
| 4 |  | L124 \& L127 (R-F Tuner) | Align for zero "tilt' 'on Channels 3 and 5. Check chs. 2-6 and make further compromise adjustment, so that each channel will have no more than $\pm 20 \%$ "tilt" with the Fine Tuning adjusted to provide the proper sound and picture i-f markers. |  |



DEFECTS OF THE HORIZONTAL DEFLECTION CIRCUITS (Cont'd)



Fig. 24. Bottom View of Chossis

## © John F. Rider






Fig. 34. Front Panel Control Wiring

## . VIDEO IF AMPLFER

During early production capacitor C151 in 38.0 mc trap circuit was changed from 75 to 8 mmf , capacitor C161 in 47.25 mc trap circuit was changed from 8 to 22 mmf . Together with this change
capacitor R182, 47 mmf and $\mathrm{R166}, 10$ ohms at the bottom end of the i-f grid coil, L154, were removed and the coil directly connected to the coaxial link from the r-f tuner.
In receivers bearing these changes, capacitor $\mathrm{C141,39mmf}$,
at the output of the $\mathrm{r} f$ tuner is omitted. For early production at the output of the $r$-f tuner is omitted. For
receivers use replacement $r$-f tuner RJX-056.

## 2. R-F TUNERS

During the 1st production of these receivers two different types of the "EE" version tuner were used. Both types incorpo rate a 6 AB4 tube as 1 Its r-f amplifier. The ecrly version incorpo-
rates the capacitor C 141 , see Fig. 27A; this type is used together rates the capacitor C141, see Fig. 27A; this type is used together
wint the early type traps L152 and L153 using R166 and C182 in the video input i.f circuit, see Fig. 35. Receivers using the later type traps without R166 and C181 in the input circuit use a
"EE" tuner without the capacitor C141.
During the 2 nd and 3 cd production
During the 2 nd and 3rd production the "BK" version tuner
was incorporated in the receiver, using a 6 BK 7 tube as 1 st r -f was incorporated in the receiver, using a 6 BK 7 tube as 1 st r -f
amplifier. Receivers with this tuner are stamped with the
number " 453 " or higher. The tuner is easily identifiable by the number " 453 " or higher. The tuner is easily identifiable by the tunable cathode choke co
former T100, see Fig. 18.
Early type tuners incorporate capacitor C141, so that they may be used with the early type traps 1152 and L153. This ca-


Early Production
. HORIZONTAL SWEEP OUTPUT CIRCUIT
The linearity of the horizontal sweep was improved by inorporatig a new circuit which used the foll ing new items

RLD-056 Horizontal Linearity Coil
RLD-058 Horizontal Width Coil
RTO-146 Horizontal Output Transformer
These items should not be used as replacement in earlier production chassis.
Chassis incorporating this production change bear a rubber tamp " 548 " and in most cases also bear a label on the high voltage cage which calls attention to the above listed electrical
4. Reduction of I- interference

To assist in the reduction of if interference chassis bottom
plate, RHS-119 and adjacent channel trap shield can RHS-112 was added during the production run.

## 5. VIDEO AMPLFIER

The video output tube 6AQ5 was changed to 6CL6 and the
circuitry has been slightly modified as illustrated in Fig. 35. Recircuitry has been slightly modified as illustrated in Fig. 3. 3 . Re-
ceivers incorporating this circuit may be identified by noting the ceivers incorporating this circuit may be identified by noting the
6 CL 6 tube type on the tube layout label affixed to the cabinet back.
6. brighiness control circuit

To provide greater consistancy of raster size with respect to changes in the brightness level a new brightness control circuit
was used in late production receivers. Refer to Fig. 33 for com. mas diagram of this circuit. The new brightness control Cat.
plete diand No. is RRC-245.



nores:
NOTES: Crystal polarity is important to r-f tracking. Crystal must be
2. "Lner" is a short vathode to front of chassis as shown in Fig. 43 2. Lhe tube socket and is varied by bending with a polystyrene rod through holes in bottom of converter chassis. varies extremely, change oscillator tube and recheck steps
and 2 .
As conver is should not fall below .5 ma or be greater than 4 ma.


Fig. 42. Attenuator Pad

ALIGNMENT CHART
Oscillator Alignment

| STEP | RF GEN. sEtting | UHF MARKER \& SWEEP | tune | $\begin{aligned} & \text { DESIRED } \\ & \text { RESPONSE } \end{aligned}$ | remarks |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | 82 mc | 460 mc | C521 |  | Set UHF tuner drum shaft fully counter clockwise. |
| 2. | 82 mc | 910 mc | "Le" oscillator |  | Set UHF tuner drum fully clockwise; also see note 2. |
| 3. |  |  | Repeat steps 1 and 2 |  | Tune across band \& check for note 3 . |

R. F. Alignment

| 1. | 550 mc | C503 \& C506 |  | Tune for maximum symmetrical response |
| :---: | :---: | :---: | :---: | :---: |
| 2. | 850 mc |  |  | Tune for max. symmetrical response. See Note 2. |
| 3. |  | Repeat steps 1 and 2 |  | Produce as near ideal curve as possible. |
| 4. | 910 mc | L502 | Check crystal current. | Connect meter between test point \& chassis. See Note 4. Disconnect R-F generator during current test. |

I-F Alignment

| 1. | 82 mc | 550 mc | See <br> "Remarks" |  | Adjust tuner shaft so that 550 mc marker coincides with 82 mc marker. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 2. | $\begin{aligned} & 76.5 \mathrm{mc} \& \\ & 88.5 \mathrm{mc} \\ & \hline \end{aligned}$ | 550 mc | $\begin{aligned} & \text { T501 } \\ & \text { T502 } \end{aligned}$ |  | Tune for max. response \& 12 mc bandwidth between peaks. |
| 3. |  | Check at 460 mc thru 910 mc | Check converter track ing from 460 mc to 910 mc . |  | Neither marker should fall below $30 \%$ at any, point thruout tuning range. If $30 \%$ "tilt" tolerance cannot be met, recheck steps $1 \& 2$. |




Fig. 44. Tube and Trimmer Location, Botlom Viow




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| snimot | cription | ARt No． | $\overline{\text { SLBol }}$ | description |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | 250209-112 | $\begin{gathered} \text { T400 } \\ \text { T50 } \end{gathered}$ | AFC Sawtooth <br> Power，（l06 \＆ 400 Series，Audio Version） <br>  | 360590－1 <br> 300067 |  | Mica， $560 \mathrm{mmp}, 500$ V．（ 106 Series） Paper， 0047 fid， 400 （ 400 Series） | 250160－61 250211－5 |  |  | 230094－169 ${ }^{230094-165}$ |
| ${ }_{\substack{\text { cosen } \\ \text { coios } \\ \text { coid }}}$ | Soted， |  |  |  | － |  |  |  |  |  |  |
|  | Molded， |  |  | corts |  |  |  |  |  |  |  |
| cosicos | $\xrightarrow{\substack{\text { Stentite }}}$ |  |  |  | $360535-1$ $360481-1$ |  |  | ${ }_{25160-6}$ |  |  |  |
| ${ }_{\text {Cobli }}^{\text {cold }}$ | coil |  | ${ }_{\text {L }}$ |  | － 360443 －23 |  | Electrolytic， 20 atd， 350 V ．（107 Sereftes） | －${ }_{270027-19}^{270027-19}$ |  | 22，000 ohm，＂w |  |
| ${ }_{\text {C6013 }}$ |  | － |  |  | $360443-19$ |  | 价 |  |  |  |  |
| ${ }_{6}^{6614}$ | $\xrightarrow{\text { ceramic }}$ | ${ }_{250197-1}^{25096}$ |  | Peaking，Green，Green Green，（All | － $3604343-334$ | ${ }_{C 419}{ }_{C 4}{ }_{4}$ |  | － 2 250201－3 |  | （1） | ${ }^{\text {230 }}$ |
| ${ }_{\text {cote }}^{6019}$ |  | $\xrightarrow{250200-137}$ | ${ }_{1}^{2055}$ |  |  |  |  | ${ }^{2552011-11}$ | R323 |  | ${ }_{230106-94}^{2300404}$ |
| C6020 |  | $\substack { 250175-8 \\ \begin{subarray}{c}{250175-8{ 2 5 0 1 7 5 - 8 \\ \begin{subarray} { c } { 2 5 0 1 7 5 - 8 } } \end{subarray}$ | L207 |  | ${ }^{306481}$ |  | ${ }_{\text {Poper，}}$ | － |  |  | ${ }_{\substack{230105-87}}^{230105-70}$ |
| ${ }_{\substack{\text { c622 } \\ 6023}}^{\text {c62 }}$ | Corate Ditce， 710 | ${ }_{\substack{\text { 250175－8 }}}^{250015}$ | ${ }_{1401}^{1201}$ | Horizontal Oscillator（1068 107 Serie | 3 300499－4 |  |  | （ $\begin{array}{r}250199-1 \\ 250199-2\end{array}$ | ${ }_{\text {R325 }}^{\text {R324 }}$ | 15，000 ohm，${ }^{\text {c／}}$ | ${ }_{2}^{23010505-76}$ |
|  | Cerame | － |  |  | 36057 | ${ }_{\text {c } 502}^{\text {csol }}$ |  |  |  |  |  |
|  |  |  | ${ }_{1402}^{1402}$ | $\xrightarrow{\text { Keyer and Horizontal }}$ Width | ${ }_{3}^{360553}$ |  | ctrolytic，40－20－5／350 $\mathrm{v}, 30 / 257$ |  | ${ }_{\text {R327 }}$ |  |  |
|  |  | 209－121 | L404 | derlection Yote（106 Sef | ${ }_{3}^{3605566}$ |  |  | 2702 |  | 68，000 ohm， | ${ }_{2} 230106-84$ |
|  | Carbon，12，000 obessist |  |  | Deficection Yote（107 Series） | 360556－5 | C504 |  | ${ }^{2700211-50}$ | ${ }_{\text {R3551 }}^{\text {R23 }}$ | 12，000 ohm， | ${ }^{230}$ |
| ${ }_{\text {hron }}^{\text {Roco }}$ | Carbon， 1500 ohas， | － | 1501 |  | ${ }_{\substack{\text { 320 }}}^{32006595-1}$ | csos | Ceramic， $2 \times .01 \mathrm{mtd}$ ， 1000 v ． | ${ }_{250219-3}$ | ${ }_{\text {R }}^{\substack{\text { R3SO2 }}}$ | （1） |  |
| ${ }_{\text {R }}^{\text {R }}$ |  | － |  | Hiler neactor $10{ }^{\text {a }}$ a ${ }^{\text {ma }}$ |  |  | 470，000 ohms，＇ı W $^{\text {RESISTORS }}$ |  | ${ }^{\text {R4002 }}$ |  | 边 |
| Remot | Carbon， Carbon， coso Somas |  | ${ }_{\text {clion }}^{\text {clo }}$ |  | ${ }_{\substack{250175-2}}^{25007-3}$ |  |  | ${ }_{22010}^{23010}$ |  | 40， |  |
| Retor | Corbon， 120,0 oon ohs | ${ }^{230104-87}$ | ${ }_{\substack{\text { c103 } \\ \text { c104 } \\ 108}}$ | Ceramic， 50000 orf， 50 | ${ }_{250}^{250}$ | ${ }_{\text {R105 }}^{108}$ |  | ${ }_{230104}^{230104}$ |  |  | ${ }^{230104-106}$ |
| Rent |  |  |  |  | ${ }_{\substack{250175-1}}^{250175-1}$ |  |  | － | ${ }^{\text {R405 }}$ | Sers | ${ }^{230004-92}$ |
| ${ }_{\text {R613 }}$ |  |  |  |  | ${ }^{250150159-70}$ | ${ }_{\text {R109 }}^{\text {R108 }}$ | 2,20 oh <br> 15,000 | － |  | ${ }_{5} 52000$ ohm， | － |
|  | for the 700220 unf |  | $\substack{c 109 \\ c 10 \\ c 10}$ |  | ${ }_{\substack{250175-1}}^{250175-1}$ | ${ }_{\text {R111 }}^{111}$ |  | ${ }_{2}^{23010404-84}$ | R407 |  | ${ }^{230104-929}$ |
|  |  |  | ${ }_{\substack{c 11 \\ \mathrm{Cl12}}}^{112}$ |  | ${ }_{\text {coser }}^{270027-4}$ |  |  | － | ${ }_{\text {R409 }}^{\text {R403 }}$ |  |  |
| ${ }_{\text {Leon }}^{1600}$ | $\xrightarrow{\text { RF }}$ coupling |  | ${ }_{\substack{c 113 \\ C 114}}^{\text {c11 }}$ |  | －${ }^{2500088-46}$ |  |  |  |  | （120， |  |
| ${ }_{\text {L609 }}$ | Crassap reme | ${ }_{3}^{3605522}$ | C115 |  | ${ }_{250201}^{250201-1}$ |  |  | ${ }_{2}^{230104}$ |  | ${ }^{\text {cosem }}$ |  |
| coil |  |  |  |  |  | ${ }_{\substack{\text { R122 } \\ \text { R12 }}}$ | 220，000 ohm，${ }^{\text {d70 }}$ | － |  |  |  |
| $\substack{\text { Li614 } \\ \text { L615 }}_{\text {L612 }}$ | Osce．cathote chote Oiil chote |  |  |  |  |  | Siso，omm， | ${ }_{2}^{2301064}$ |  |  | ${ }_{\text {2 }}^{23009095-179}$ |
| ${ }_{\text {Liol }}^{\text {Li6 }}$ |  | ${ }_{3}^{3005574-10}$ |  |  | and 250201－201－2 $250207-17$ |  | 10，000 oha， 1 \％ |  | R443 R415 R415 |  | － |
|  | apactros |  |  |  | － |  | 150，000 ohi | 230104 | ${ }_{\text {R416 }}$ | （10） |  |
| ${ }_{\text {Cobo }}^{6001}$ |  |  | － |  | 250175－9 |  | 1000 ${ }^{\text {oha }}$ | ${ }_{220104}^{2010}$ |  |  | ${ }_{2}^{2301005-73}$ |
| ${ }_{\substack{\text { C603 } \\ C 600}}$ | Triver 2.7 mo． |  |  |  | 250175－9 250175－9 | ${ }_{\text {R205 }}^{\text {R204 }}$ |  | ¢ | ${ }^{\text {R418 }}$ |  | ${ }_{\substack{230109-1}}^{230107-2}$ |
|  | Motimed |  |  |  | $\xrightarrow{250175-9}$ |  | ， |  | ${ }_{\text {R4420 }}^{\text {R41 }}$ |  | ${ }^{23010505-98}$ |
|  |  |  | cick |  | ${ }_{\text {250175－9 }}$ | $cR20) R209 R20$ |  | 230104 200104 204 |  | 1000 ohm，\％／w．（All other | － |
| ${ }_{\text {Cobli }}^{6}$ | $\underset{\substack{\text { Trineer } \\ \text { Tine } \\ \text { tuing trimer }}}{\text { dem }}$ | － | ${ }_{\substack{\text { C211 } \\ \text { c212 }}}$ |  | － $2501735-9$ |  | 56， 0000 onm，${ }^{\text {a }}$ | ${ }_{2}^{233104}$ | ${ }_{\text {R1501 }}^{\text {R12 }}$ |  | 边 |
| ${ }_{\text {cobl }}$ |  |  | $\underset{\substack{C 213 \\ C 214}}{ }$ |  | －${ }_{\text {250175－9 }}^{25018}$ |  |  |  |  | ${ }_{6}^{150}$ onmm， 10 m | 边 |
| ${ }_{\text {cobli }}$ | Ceraic disc， 470 mp | － 2501755 | C215 |  |  | ${ }_{\text {R212 }}^{\text {R214 }}$ | 180 |  | coick |  | 边 |
| ${ }_{6}^{6617}$ |  | ${ }_{\text {250175－8 }}^{250175-8}$ |  |  | ${ }_{250211-13}^{27027-24}$ | ${ }_{\text {R217 }}^{\text {R21 }}$ | 3900 oha | ${ }_{230104}^{2304}$ | ${ }_{\text {R，06 }}$ | 330 obm， 2 m． | 230106－56 |
| coib | Ceranic，disc，${ }_{\text {coso }}$ |  | cerce | Ceramic， 20,000 mint ${ }^{\text {a }}$ | $\xrightarrow{250175-7}$ | 1218 |  |  |  | ohm，controls |  |
|  |  |  | $\underset{\substack{C 219 \\ C 220}}{\substack{\text { cen }}}$ | Paper，0033 midd ${ }^{\text {Pos }}$ | ${ }_{\substack{250201-4 \\ 250201-7}}^{\text {250 }}$ |  |  | ${ }_{\substack{\text { a }}}^{2308105-180}$ | ${ }_{\text {R112 }}$ | （e） |  |
|  |  | ${ }^{\text {a }}$ |  |  |  | ${ }^{\text {R219 }}$ | （200 onm，${ }^{212000}$ |  |  |  | － |
| $\begin{gathered} \text { C625 } \\ C 626 \\ C 625 \end{gathered}$ |  | $250221-112$ $250221-125$ $250175-8$ |  |  |  | ${ }_{\text {R222 }}^{\text {R220 }}$ |  |  | $\underbrace{\substack{\text { R2204 } \\ \text { R204 }}}_{\text {R }}$ |  | － |
|  |  |  |  |  |  |  |  |  | $\substack{\text { R3314 } \\ \text { R316 }}$ | Vertical Linearitye 2.5 megohm， | ${ }^{2 \times 200076-56-32}$ |
|  | 100，000 ohas，${ }^{\text {c／}}$ \％： |  |  |  |  |  |  |  |  |  | 2200126－12 |
|  |  | ${ }_{\text {che }}^{23010505-63}$ | ${ }_{\substack{\text { case } \\ \text { caid }}}$ | Copemic， 1 uro mint 500 | ${ }_{2}^{2501759-56}$ | ${ }_{\text {R226 }}$ |  | ${ }_{2}^{2,310} 0$ |  |  | 220126－34 |
|  |  |  |  |  | － | ${ }^{\text {R228 }}$ | （e） | （2， | ${ }^{\text {R402 }}$ | Horizontal Hold，50，000 ohm．${ }^{\text {ate }}$ | 2201 |
|  |  | 边 |  |  | ${ }^{250201-5}$ |  |  |  |  |  | $220126-38$ |
| ${ }_{\text {R }}^{\text {R }}$ | Hoom ohas， | － | ci309 |  | ${ }^{25020021-11}$ |  | 18， 3 3，000 ohm |  |  | Series only） | 220120－41 |
| ${ }_{\substack{\text { nibl } \\ \text { Rot }}}$ | Sto， | － |  |  |  | ${ }_{\text {R234 }}$ | （ex |  |  | Printed Circuit misceltaneou |  |
|  | 10， |  | ${ }_{\substack{c \\ C 312}}$ | Electrolvic． $10-30-5 / 350 \mathrm{v}, 200 / 25$ | （ |  |  |  |  |  | $11804060-1$ <br> $180504-16$ |
|  | 150，000 ohas，と 4 r． crestal | ${ }_{230104-88}^{2304045}$ | ${ }_{6101}$ |  | 25521111 $250201-11$ |  |  | － 23310414.91 | ${ }_{3} 1191$ |  | （180476－1 |
| x601 | $1{ }^{124}$ | $530036-1$ | C402 |  |  | ${ }_{\text {R240 }}^{\text {R240 }}$ |  |  |  | Outiet．Ac | （180428－1 |
|  | transformers |  | $\mathrm{c}_{1}$ |  |  | R241 R242 R24， 24， |  | $230104-76$ $230104-69$ | Siol |  | comer |
| ${ }_{\text {T2001 }}^{\text {T101 }}$ | Mactio Deetector | 36018\％－1 | ${ }^{\text {c }} 104$ |  |  |  | 2， 22,000 ohm， |  |  |  |  |
| $\underset{\substack{\text { T20203 } \\ \text { T201 } \\ \text { T201 }}}{ }$ | 1snt if ond Trap |  |  |  | $2.0202-11$ $250159-81$ |  |  |  | 5113 |  | ${ }_{7}^{700379 \%-34}$ |
| ${ }_{\text {Tron }}^{\substack{\text { T20，}}}$ |  | 边 | C407 |  |  | ${ }_{\text {R305 }}$ | （e） |  |  |  | （7003597－24 |
|  | Vertical output（ 3 SBA，${ }^{\text {a }}$ ， | ${ }_{3} 300035$ |  | Mica， 6 mant， 500 l \％（100 8107 Series） |  |  |  | 230104－170 |  |  | 360569－1 |
| 1 |  | － | ${ }^{408}$ | Micatice |  |  |  | － |  |  | ${ }^{3}$ |
|  |  |  | C．109 |  | 20．599－5059 |  |  | ${ }^{230104-59}$ |  |  | ， |



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markers on the scope, determine which ers to move closer together. If it is clockwise, reset the vernier to the midrange position and close the channel 13 oscillator coil. If it is counter-clockwise open the coil. Adjust for atil high band channels. The channel 6 coil moves all low band channels.
Tune the sweep generator to channel 12. The signal generator to the channel 12 video carrier frequency. Set channel oscillator coil for a zero beat of the markers

Repeat the procedure for channels 11 through 2. Recheck channels 13 through 7. The high channel coils are adjusted
by moving them up or down and the low channel coils by spreading or pushing together.

## ANTENNA, R-F AMPLIFIER AND CONYERTER ALIGNMENT

The desired pattern to be applied to the IF amplifiers is the result of three
variables. These three variables are the Variables. These (rear wafer), the RF COIL (second wafer from rear) and the C

These coils must be very carefully adjusted with only a slight movement. It is imperative that the following sequence of adjustment is followed to ob-
tain the desired pattern. Antenna coils first, RF coils second, and the converter coill last. The RF wafer has B+ on it
and should not be touched with the hand and should not be touched with the hand
or a metal tool. The oscillator coils $\underset{\text { (fourth mafer from rear) are properly }}{\text { or }}$ adjusted and should not be touched.
The RF tuner has been properly aligned at the factory and should not require any additional adjustment except when
tubes are replaced in the tuner. proper selection of the replacement tube will coil adjustments. Try several tubes while observing their effects on the pattern. It is important that the tuner cover be in place when observing th pattern.

## UHF TUNER

## OSCILLATOR ALIGNMENT

Turn on the receiver and turn UHF-VAF Switch to UHF. Connect oscilloscope to TP6yn, 300 ohm sweep cable to UFF anal generator to the preselector as in R. $F$. alignament.

Set the sweep generator center frequency to 553 mc . Turn channel selector to
channel 20 . Set marker signal to 56.5 mc , turn fine tuner fully clockwise and adjust C612 to place oscillator marker at $565 \mathrm{mc} \cdot \mathrm{Set}$ marker signal to 541 mc .
turn fine tuner fully counter-clockwise
and bend the fine tuner stop to place oscillator marker at 541 mc

Set the sweep generator to 895 mc ., turn tuner fully clockwise. Set marker signal to 907 mc ., and adjust L 610 inductance lead on oscillator grid by bending lead to center the oscillator marker at
907 mc . $\quad$ Set marker signal to 883 mc ., turn fine tuner fully counter-clockwise and carefully adjust L605, inductance and on the glass fine tuner, to center

Because of interaction between high end and low end oscillator adjustments, recheck the low frequency setting.

Set the channel selector to channel 50 and sweep generator frequency to 733 mc . Set marker signal to 743 mc and turn
fine tuner fully clockise. Oscillatar marker must be at 743 mc . or above. Set marker signal to 723 mc . then turn fine tuner fully counter-clockwise. oscillator marker must be at 723 mc . or below


## FIGURE 5 YIEW OF TUNER

## UHF CONVERTER

## OSCILLATOR ALIGNMENT

A. Remove the shield and $6 B K 7$ tube from its socket.
B. Connect the UHF marker generator, through a .5 mmf . capacitor, to the unction of X601, L605, C611 and C612.
C. Connect the oscilloscope to test point 602, through a 10,000 ohm isolating resistor.
D. Tune the converter to its lowest frequency
E. Set the marker generator frequency on 378 mc . and adjust the oscillator trimmer C615 for a beat on the scope.
F. Tune the converter to its highest freque
tion.
G. Set the marker generator frequency to 828 mc . and adjust the end inductor

Recheck both high and low frequency positions so the beats appear without further adjustment.

## SERVICE INFORMATION

## high voltage warning

The danger accompanying shocks is always present when the receiver is eperated cover is removed from the cabinet. Only a person familiar with the precautions o be observed when working with highreceiver. ${ }^{\text {pICtURE TUBE HANDLING }}$

Shatterproof goggles and heavy gloves should be worn at all times when han-
dling a picture tube. The tube should not be handled in the vicinity of any person not so equipped. When handling the tube, always keep it away from the


## figure 6

## TOP VIEW OF CHASSIS

Due to the large surface area of the tube and the high vacuum contained within. more than ordinary care is required
to prevent shattering the tube. The to prevent shattering the tube. The
large end of the bulb, particularly the rim of the viewing surface, must not be struck, scratched, or subjected to more than moderate pressure. If the tube termine the cause of the trouble. Do NOT FORCE THE TUBE.

## picture tube replacement

il becomes necessary to replare the picture tube, it should be done in the following manner:
Remove the tube socket from the rear of the pi
ion trap.
2. Remove the satety glass assembly by glass rail in position.
3. Loosen the muts that secure the lube
strap over the rim of the tube. and
. Remove the high voltage anode cont out the tube
5. Install the replacement picture tube when inserting through the deflection coil.
6. Install the $H V$ connector, replace the support strap, and fasten it down se-
curely with the nuts removed in Step 3.
7. Loosen the thumbscrew on top of the deflection yoke, so the yoke moves screws on each side of the hex-head yoke mounting bracket, and push the top section forward until the rubber bumper fits against the bell of the tube, all the way around. Then
tighten the screws. Then press the deflection yoke forward as far as possible, and tighten the thumbscrew.
8. Loosen the two screws which secure the focus magnet, and move it so the neck of the tube is properly centered
in it. Then tighten the screws and adjust the ion trap.
9. HORIZONTAL and VERTICAL CENTERING of the picture is accomplished by moving the centering device on the front side of the focus magnet. Readjustafter this plate has been adjusted. SERVICE HINTS
Improved high voltige transformers. 107 \& 500 SERIES CHASSIS
Always use \#360593-2 HV transformer when replacement becomes necessary. This has been used results.
trouble shooting sync circuits
separate DC hias supply consisting o 15 volt battcry across an approximate ly 50.000 ohm potentiometer is helpful nifier tube and connect the bias supply from the plate circuit of the GGC amplifirr to chassis. Try various values of bias and trace the sync pulse throllghou
the circuits with a scope. This will eiminate the effects of $\mathrm{i} C \mathrm{C}$ malfunction nd facilitate locating the troutlo hould it not be in the GCC system. INTERCARRIER BUZZ

1. Check alignment of secondary (top Adjust for minimum buzz on trans mitted signal
2. Check 4.5 me . sound alignment as out lined in service manal.
3. Check response curve on video IF. 1 lign if necessary
4. Buzz may be due to overmodulation at the transmitter. If more than one station is available, try all sta tions. Buzz on only one station will
confirm this condition.
F. Remove the short between terminals and connect oscilloscope through a
G. Adjust stabilizing coil (L401 inside chassis) so the sharp and the rounded peaks of the pattern obtained are of
equal amplitude. If necessary, adjust horizontal hold control to maintain sync.
Remove oscilloscope lead and turn horizontal hold to full clockwise.
Turn brightness control fully clockwise and adjust horizontal frequency coil until blanking bar appears at
left side of picture. Then back off until blanking bar and wiggle at top of picture is no longer present.
H. Adjust noise bias control for best noise immunity.
HORIZONTAL AFC
HORIZONTAL AFC, $400 \& 500$ CHASSIS
Tune receiver to an acceptable channel
Set noise bias control fully clockwise
A. Turn horizontal hold control to the center of its range.
B. Adjust horizontal frequency coil picture locks horizontally. The vertical lines near the top should not "hook" to the right or left.
C. Adjust horizontal drive control (in sweep until compression appears at center (drive lines), then back of control until compression is just
eliminated.
D. Adjust horizontal linearity coil (L403) on rear chassis apron, for
proper
linearity. If two positions proper linearity. If two positions
seem to be correct, use the one with sem to be correct,
the core farthest out
E. Adjust width control (L402) on rear chassis apron for proper size
F. Turn horizontal hold control fully Turn the control fully counter-clockwise and switch off channel. The pictire range of the horizontal hold control or should have the same number of blanking bars at each end of its range.
G. Adjust noise bias control for best noise immunity.

### 4.5 MC. TRAP ALIGNMENT

A. Remove V203 (6CB6) 3rd video IF amplifier or short 4 th video IF grid
(V204-1, ${ }_{6}$ CB6) to ground, to prevent noise from masking the output indication
B. Connect the 4.5 mc. signal to Terminal " D " of T205 video detector. The input
signal should not exceed 0.2 V . RMS.
C. Connect the crystal probe of the o-

## icture tube grid lead.

D. Turn contrast control fully clockwise.
E. Adjust the core of L 207 for minimum output.

SOUND I-F ALIGNMENT
A. Connect the 4.5 mc signal to Terminal " $D$ " of t205 video detector.
B. Connect probe of VTVM to high side of diode load resistor hlo9, 15 K ohm
(Vlo3-7) and negative lead to chassis ground. Adjust VTVM for zero center.
C. Adjust llo2 Sound If and primary of Tlor maximum reading. This reading must mot exceed -5.0 . $V$. at any time, to prevent possibility of overload.
D. Remove 4.5 mc . signal from Terminal D of T205 and connect it to junction of
R216 (3.9 K) and L203 (360 uh) with negative lead to chassis ground.
E. Adjust Llol, sound takeoff coil, for maximum reading. This reading must
not exceed -5.0 volts at any time to prevent possibility of overload.
F. Remove VTVM from high side of R109 and chassis ground. Connect two 100 K ohms 5\% resistors in series across Rlo9: Connect negative lead of VTVM and the probe to junction of Rlos and the probe to
(220 ohms) and Clit2 (470 mmi). Adjust
(top secondary of ratio de
core) for zero reading.
video I-f ALIGNMENT
A. Connect external bias to list IF grid
return (junction R2Ol,
1 K and C 201 ,

 Adjust If bias to minus ac. A battery
 be used.
 junction of R216 (3.9 K) and L203
$(360 \mathrm{uh})$ and chassis ground.
C. Connect the If signal to converter grid wafer lug (cut-out in VHF tuner
cover) and adjust the corresponding circuits for the DC output indicated below. During alignment, reduce the
signal inputif necessary so the designal input if necessary so the de-
tector output does not exceed -1.5 V .
$41.25 \mathrm{mc} \quad$ T201 \& L206 (top) Minimum $\begin{array}{llll}47.25 \mathrm{mc} . & \text { T202 \& T204 } & \text { (top) } & \text { Minimum } \\ 39.75 \mathrm{mc} . & \text { T203 } & \text { (top) } & \text { Minimum }\end{array}$ $\begin{array}{ll}39.75 \mathrm{mc} . & \text { T203 } \\ 43.3 \mathrm{mc} . & \text { T201 (bottom and }\end{array}$
$43.3 \mathrm{mc} . \quad \mathrm{L3}$ (on tuner)
$\begin{array}{lll}45.3 & \text { me. } & \text { T202 (bottom) } \\ 41.8 & \text { mc. } & \text { T203 (bottom) }\end{array}$
$\begin{array}{lll}41.8 & \mathrm{mc} . & \text { T203 } \\ \text { (bottom) } \\ 45.2 & \mathrm{mc} & \text { T204 (bottom) }\end{array}$
$\begin{array}{llll}45.2 & \mathrm{mc} & \text { T204 } & \text { (bottom) } \\ 43.1 & \mathrm{mc} & \text { T205 (bottom) }\end{array}$

## Maximum $\underset{\text { Maximum }}{\text { Maximum }}$ Maximum Maximum $\underset{\text { Maximum }}{\text { Maximum }}$

 Note: T201 and L3 comprise a doubletuned circuit and must be aligned as mum output.c. Adjust primary (L3) for maximum
d. Do not re-set secondary (T201). Recheck the $41.25 \mathrm{mc} ., 47.25 \mathrm{mc}$ and
39.75 mc. trap adjustments after com-
pleting peaking.
D. Remove signal from converter grid wafer lug. Connect IF sweep to con-
verter grid (test point $\#$ on tuner). verter grid (test point \#2 on tuner).
Loosely couple in If markers.
E. Check response for symmetry and band-


39 •25 IF SELECTIVITY CURVE
figure 2
If necessary, FIGURE $\begin{aligned} & \text { readjust slugs in T202 }\end{aligned}$ and T205 to set overall If response
to nominal limit (no tillt). Do not readjust t201 for any reason
F. If receiver has a UFF Tuner, remove If sween from converter grid and connect to UHF Tuner at the high side (front end) of the UHF crystal holder
Use a 1000 ohm isolation resistor in Use a 1000 ohm isolation resistor in
the very end of the hot side of the the very end of the hot side of the lif sweep cable, the 1ow side of the switch to UHF position.
Note: If balanced output cable for sweep generator is not available, the
impedance matching network shown beimpedance matching network shown be whould be used.

figure 3
antenna impedance matching network
G. Remove UHF tuner shield cover and ad-
just If amplifier plate coil
(L617) with insulated screw driver (using slot in bottom of iron core) for maximum gain while setting the 45.75 mc . $\underset{\text { marker at at }}{\text { at }} \begin{aligned} & \text { 50\%. Adjust IF amplifier }\end{aligned}$ $\underset{\text { tool for maxim mith short aligning }}{\text { for }}$ tilt. Check to see that the response
H. Remove IF sweep from UHF Tuner. Switch UFF-VHF switch to VHF if reCHF antenna terminals. Switch the sweep generator and the receiver to channel 13.
I. With RF oscillator on frequency, check overall rf-if response for symmetry and bandwidth as shown below. Note: Oscilloscope must be calibrated to provide accurate marker setting. peak-to-peak.


Swit Figure 4
J. Switch RF sweep and receiver channels sponse is within limits of overall selectivity curve on all channels when the RF oscillator is on fre quency. Do not readjust any IF coils

## HF TUNER

## TOUCH-UP OSCILLATOR ALIGNMENT

Oscillator alignment should be made only when the fine tuning control tunes in the extreme clockwise or counter-clock wise position, or if it will not tune at
all within its tuning range. If
If some channels do not tune at all, or not near enough to the center of the
fine tuning range, adjust the oscillator trimmer for the best compromise tuning on all channels. If, for example all channels tune near one side of the control, adjustments of the trimmer will bring them all near the center. However,
if some channels tune near one end and others tune at the other end of the control, adjustment will move some to the center and move the others beyond the range of the control. In this case the
oscillator coils will have to be adjusted individually as follows.

## COMPLETE OSCILLATOR ALIGNMENT

Connect a sweep generator to the antenna
terminals of the receiver. Connect an terminals of the receiver. Connect an tenna terminals and tune it to the channel 13 video carrier frequency. TV signals may be used.
Loosely couple an unmodulated signal generator to the first IF grid and tune
it to 45.75 mc . Connect anoscilloscope it to 45.75 mc . Connect an oscilloscope through a 10 K ohm resistor.
Turn on the receiver and set the vernier to the midrange position. When the re

## OJohn F. Rider

## DESCRIPTION \& SPECIFICATIONS

The Magnavox 106 , 107,400 and 500 Series Television Chassis are direct view receivers, each constructed on a single chassis. The 106 and 400 series are de-
signed to accomodate a 21 " rectangular picture tube. The 107 signed to accommode a 21 "rectangular picture tube. The 107 and 500 series will
allow the use of either a 24 " or 27 " picture tube without any change in circuitry.

Features of these Chassis include

- A low-noise VHF Tuner, with a cascode performance.
- A choice of VHF only, UHF Converter UHF Tuner. Each of the latter cover all UHF channels without the need of adaptors or other accessuries.
- A four-stage, stagger-tuned Intercarrier If section for good resolufrom the effect of oscillator drift.
- Push-pull Audio Amplifier.


## IMPEDANCE

300 ohm input.....Speaker Voice Coil 3.2 ohms

## POWER REQUIREMENTS

$\begin{array}{ll}106 \\ 106 & 400 \\ \& & \text { Series, TV } \\ \text { Sith Audio }\end{array}$ $\qquad$
$\qquad$

$\qquad$ 280 watts, $117 \mathrm{v}, 60 \mathrm{cps}$ $107 \& 500$ Series, TV with Audio..................................... 320 watts, 117v, 60cps

Maintenance information on the $106,107,400$ and 500 Series Chassis is so similar that it has been included in one service manual.
Prefix letters CT indicate the use of 700379 VHF Tuner only; CU uses the VHF Tune and a 700359 UHF Converter; while $C M U$ uses the VHF Tuner and a 700426 UHF Tuner

The basic chassis differences are as follows:

$$
106 \text { SERIES }
$$

BASIC CHASSIS NO.
PIX TUBE
CHASSIS DIFFERENCES
$\mathrm{CT}, \mathrm{CU}$ or $\mathrm{CMU} 381 \mathrm{AA}, \mathrm{AB}, \mathrm{AC}, \mathrm{AD}, \mathrm{BC} \& \mathrm{BD}$. $\mathrm{CT}, \mathrm{CU}$ or $\mathrm{CMU} 382 \mathrm{AA}, \mathrm{AB}, \mathrm{AC}, \mathrm{AD}, \mathrm{BC} \& \&_{\mathrm{BD}} \mathrm{BD}$.
$\mathrm{CT}, \mathrm{CU}$ or $\mathrm{CMU} 383 \mathrm{AA}, \mathrm{AB}, \mathrm{AC}, \mathrm{AD}, \mathrm{BC} \& \mathrm{BD}$. . .21". 107 SERIES
$\mathrm{CT}, \mathrm{CU}$ or $\mathrm{CMU358AA}, \mathrm{AB}, \mathrm{BA}, \mathrm{BB} \& \mathrm{CB}$.
$\mathrm{CT}, \mathrm{CU}$ or $\mathrm{CMU359AA}, \mathrm{AB}, \mathrm{BA}, \mathrm{BB} \& \mathrm{CB}$. $\mathrm{CT}, \mathrm{CU}$ or $\mathrm{CMU359AA}, \mathrm{AB}, \mathrm{BA}, \mathrm{BB} \&$
$\mathrm{CT}, \mathrm{CU}$ or $\mathrm{CMU} 385 \mathrm{AA}, \mathrm{AB}, \mathrm{BA}, \mathrm{BB} \&$ $\mathrm{CT}, \mathrm{CU}$ or $\mathrm{CMU} 385 \mathrm{AA}, \mathrm{AB}, \mathrm{BA}, \mathrm{BB} \& \mathrm{CB}$

## B.

$\qquad$ 27 "..
$244^{\prime \prime}$
$2{ }^{\prime \prime}$.

- Fast acting keyed Automatic Gain Control for instantaneous control of re-- Noise suppressor stage
- Vertical retrace blanking to eliminate retraings.
setin
- Three basic versions. For TV only, TV in conjunction with a radio chassis, radio tuner.
(Radio-TV Switch in TV Position)
320 watts, 117v, 60 cps


## CHASSIS DIFFERENCES



.....Audio on chassis Audio and radio input
...Audio on chassis Audio and radio input Aluminized Picture Tube

400 SERIES


500 SERIES
CTA, CUA or CMUA358DC $\&$ DD.
CTA, CUA or
OMUA359DC
CTA, CUA or $\begin{aligned} & \text { OMUA3559DC } \& \\ & \text { CTA, CUA }\end{aligned}$ or CMUA385DC $\&$ DD.
CTA, CUA or CMUA3B5DC $\&$ DD.
CTA,
CUA or
$\qquad$
27"...
$24 . "$. $\qquad$
Audio on chassis Audio and radio input Aluminized Picture Tube

## TUBE COMPLEMENT

| SYMBOL | TUBE | FUNCTION | SYMBOL | TUBE | FUNCTION |
| :---: | :---: | :---: | :---: | :---: | :---: |
| V1 | 6BZ7 6BQ7A | RF Amplifier, VHF | V204 | 6CB6 IN64 | 4th Video IF |
| V2 | 6U8 | Mixer, Osc., VHF |  | 6AU6 |  |
| V601 | ${ }_{6 \text { 6T4 }}$ | Osc., UFF Converter | V205 | ${ }_{6}^{6 C B 6} 6$ | Video Amplifier |
| X601 | 6AF7 | Crystal Mixer, UHF Conv. | V206 | ${ }_{\text {See }}{ }_{\text {SK6GT }}$ | Video Output Picture Tube |
| V602 | 6BK7 | If Amplifier, UHF Conv. | V208 | 6 6U6 | AGC Amplifier |
| V601 | ${ }_{\text {6BK7 }}^{681}$ | IF Amplifier, UHF Tuner | V301 | 12AX7 | Noise Inverter \& Sync Sep |
| V602 | 6 T 4 | Osc., UHF Tuner | V303 | 6SN7GT | C Amplifier ${ }^{\text {d }}$ Clipper |
| X 601 | IN124 | Crystal Mixer, UHF Tuner | V304 | 6W6GT | Vert. Output, 106 \& 400 |
| V101 | 6AU6 | Sound IF | V304 | 6AU5GT | Vert. Output, 107 \& 500 |
| V102 | 6AU6 | Limiter | V401 | 6SN7GT | Horiz. AFC \& Osc. |
| V103 | 6AL5 | Ratio Detector | V402 | 6BQ6GT | Horiz. Output, 106 \& 400 |
| V104 | 1:2AX7 | AF Amplifier \& Inverter | V402 | $6 \mathrm{CD6G}$ | Horiz. Output, $107 \& 500$ |
| V105 | 6V6GT | AF Output | V403 | IB3GT | HV Rectifier |
| V106 | 6V6GT | af output | V404 | 6AX4GT | Damper, 106, 400 \& 107 |
| V201 | $6 \mathrm{CB6}$ | lst Video IF | V405 | 6AX4GT | Damper, 107 \& 500 |
| V202 | 6 CB 3 | 2nd Video IF | V501 | 5 U 4 G | LV Rectifier |
| V203 | $6 \mathrm{CB6}$ | 3rd Video If | V502 | 5U4G | LV Rectifier |
|  | oke USTMENT | CEntering LEVER |  | ORIZONTA | ALIGNMENT L AFC, 106 \& 107 CHASSIS |

## HORIZONTAL AFC, 106 \& 107 CHASSIS

Tune receiver to weakest channel availble. Set noise bias control fully clockwise. Set horizontal drive trimmer bout $1 / 2$ turn from full clockwise posi
. Short out terminals "C" and "D" of horizontal stabilizing coil (L401),
and turn horizontal hold control and turn horizontal hold contro
. Adjust horizontal frequency coil picture on rear horizontally.
C. Adjust horizontal drive trimmer for maximum sweep. Turn counter-clockwise (drive compression appears at cente (drive lion is just eliminated
. Adjust horizontal linearity coil proper on rear chassis apron fo proper linearity. If two positions the core farthest out.
E. Adjust width control (L4O2)


| R No. | Value | Type | Watt Rate | Tolerance |  |  |  |  |  | 68 | 1 megohm | carbon | $\frac{1}{2} \mathrm{watt}$ | 10\% |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | ms | cerbon |  |  | 33 | 1 megohm | ca |  | 10\% | 69 | 100k ohms | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 1 | 3.9 k ohm |  |  |  | 34 | 47 k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 70 | 100k ohms | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 2 | 47 k ohms | carbon | $\frac{1}{2}$ Watt | $10 \%$ | 35 | 270k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 71 | 4.7 k ohms | carbon | $\frac{1}{2}$ watt | $10 \%$ |  |
| 3 | 10k ohms | carbon | $\frac{1}{2}$ Watt | 10 | 36 | 2.7 k ohms | carbon | $\frac{1}{2}$ watt | 10\% |  |  |  |  |  |  |
| 4 | 10k ohms | carbon | $\frac{1}{2}$ Watt | 10\% |  |  |  | 1 watt | 10\% | 72 | 33k ohms | carbon | $\frac{1}{2}$ watt | $\begin{aligned} & 10 \% \\ & 10 \% \end{aligned}$ |  |
| 5 | 4.7 k ohms | carbon | ${ }_{2}^{1} \mathrm{~W}$ att | 10\% |  |  |  |  |  |  |  |  |  | 10\% |  |
| 6 | 220k ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 38 | 1.00k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 74 | 3.3 k ohms | carbon | $\frac{1}{2} \text { watt }$ |  | , |
|  | 220 k ohms |  |  |  | 39 | 100k ohns | carbon | i watt | 10\% | 75 | 4.7 megohm | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 7 | L. 7 k ohns | carbon | $\frac{1}{2}$ Watt | 10\% | 40 | brightness <br> 33k ohms | carbon | $\frac{\text { potentio }}{\frac{1}{2} \text { watt }}$ | $10 \%$ | 76 | 470k ohms | carton | $\frac{2}{2}$ watt | 10\% |  |
| 8 | 15k ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 1 | 100k | carbon | $\frac{1}{2}$ watt | 10\% | 77 | 22k ohms | integrator | etwork |  |  |
| 9 | 8.2 k ohms | carbon | $\frac{1}{2}$ Watt | 10\% |  | 100k |  |  |  | 78 | 8.2.k ohms | integrator | etwork |  |  |
| 10 | 47 ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 42 | 18k ohms | carbon | $\frac{1}{2}$ watt | 108 | 79 | 8.2k ohms | integrator | twork |  |  |
|  |  |  |  |  | 43 | 27 k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 82 | 2.5 megohms | carbon | 1 watt |  |  |
| 11 | 10k ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 44 | 4.7 megohms | carbon | $\frac{1}{2}$ watt | 10\% |  | vertical size | control | potentio |  |  |
| 12 | 330 ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 15 | 150 ohms | wirewoun | 7.5 watt |  | 83 | 1 megohm | cargon | $\frac{1}{2}$ watt | 10\% |  |
| 13 | 120 ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 46 |  |  |  |  | 84 | 1 megohm | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 14 | 10k ohms | carbon | $\frac{1}{2}$ Watt | 5\% |  | focus contro | rkeostat |  |  | 85 | 1 megohm | carbon | 1 watt |  |  |
|  |  |  |  |  | 47 | 370 vilins | carbon | 2 watts | 10\% |  | vertical hold | ontrol | potentio |  |  |
| 15 | 47 ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 48 | 100k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 87 | 5.6 k ohm | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 16 | 8.2k ohms | carbon | $\frac{1}{2}$ Watt | 5\% | 49 | 300k ohms | carbon | $\frac{1}{2}$ watt | 5\% | 88 | 2.? megohm | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 17 | 120 ohms | carbon | $\frac{1}{2}$ Watt | 10\% |  |  |  |  |  | 89 | 2k ohm | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 18 | 8.2k ohms | carbon | $\frac{1}{2}$ Watt | 5\% | 50 | 180 K ohms | carbon | $\frac{1}{2}$ watt | 5\% | 90 | 5k ohms | wirewound | 2 watts |  |  |
| 19 | 8.2k ohms | carbon | $\frac{1}{2}$ Watt | 58 | 51 | 330 k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 91 | 560 ohms | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 0 | 68 ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 52 | 470k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 93 | 560 ohms | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 0 |  |  |  |  | 53 | 4.7 k ohms | carbon | $\frac{7}{2}$ wait | 10\% | 94 | 560 ohms | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 2 | 1 megohm | carbon | $\frac{1}{2}$ Watt | 10\% | 54 | 470k ohns | carbon | $\frac{1}{2}$ watt | 10\% | 95 | 680 ohms | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 22 | 680k ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 55 | 43k ohms | carbon | $\frac{1}{2}$ watt | 5\% | 96 | 18k ohms | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 23 | 120 ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 56 | 27k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 97 | look ohms | carbon | $1{ }_{1} 1$ watt |  |  |
| 24 | 6.8 k ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 58 | 500k ohms | carbon | 1 watt |  |  |  |  |  |  |  |
|  | 1 k ohms | carbon | $\frac{1}{2}$ Watt | 10\% |  | rolume contr | potentiom |  |  | 98 | 100k ohms | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 25 | 1 k ohns |  |  |  | 59 | 47 k ohms | carbon | $\frac{1}{2}$ watt | 10\% | $\begin{aligned} & 99 \\ & 100 \end{aligned}$ | 56 k ohms 50 k ohms | : l : ${ }_{\text {carbon }}^{\text {carbon }}$ | $\frac{1}{2}$ watt 1 1 | 10\% |  |
| 26 | 120 ohns | carbon | $\frac{1}{2}$ watt 2 watt | 10\% | 60 | 56 k ohms | carbon | $\frac{1}{2}$ watt | 10\% |  | horizontal hold | control | rheostat |  |  |
|  | 750 ohms | Potentio |  |  | 61 | 100k ohms | carbon | $\frac{1}{2}$ Watt | 10\% | 101 | 820 ohm | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 29 | 39k ohms | carbon | 1 watt | 10\% | 62 | 27k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 102 | 270k ohrm | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 30 | 39k ohms | carbon | 1 watt | 10\% | 63 | 1 k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 103 | 88 orm | carbon | $\frac{1}{2}$ watt | 10\% |  |
| 32 | 10k ohms | carbon | 1 watt | 10\% | 64 | 470k ohms | carbon | $\frac{1}{2}$ watt | 10\% | 104 | 100 ohm | carbion | 1 watt | 10\% |  |
| 32 | 10k ohms | carbon | 1 watt | 10\% | 65 | 4.7 K ohms | carbon | $\frac{1}{2}$ watt | 10\% | 105 | 15k ohm | carbon | l watt | 10\% |  |

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I. F. Alignment Procedure, IT-76R Chassis Models 776, 1176, and 1376

## REFERENCE:

Circuit Diagram E-734

## EQUIPMENT:

1. Sweep generator, 23.5 mc . center frequency, 10 mc . sweep width.
2. Marker generator, $21.25 \mathrm{mc} ., 22.0 \mathrm{mc}$, and 25.75 mc .
3. Crystal oscillator, variable output, 4.5 mc . unmodulated.
4. Oscilloscope.
5. 20,000 ohm per volt meter.

## PROCEDURE, VIDEO I.F.:

1. Connect oscilloscope to $\mathcal{J}$ test point.
2. MOve tuner between channels to disconnect coils.
3. Conne ct zweep generator, decoupled with 1000 uuf., to pin 1 of V5. Turn the slug on 117 until it is centered in the coil. (This narrows the band pass of this stage.) Adjust L12 and L16 until the pass appears as below:


Now adjust L 17 until pass is as pictured:
25.75
22.0

5. Move sweep generator to pin 1 of V4. Adjust Ll5 until pass balances, adjust Ll3 until pass balances. When properly adjusted, pass will look as pictured below:
6. Move sweep generator to pin 1 of V3. Adjust $L 1 l$ and $L 9$ as in above step.
Pass will now be as pictured:

7. Move sweep generator to test point on tuner (can be located as a loop of ware between V1 and V2 on top of tuner chassis); adjust L8 (square can on tuner) until the pass rocks through a tiIt and leave adjusted with a $10 \%$ tilt in the pass, as pictured below:


The video I.F. is now correctly aligned.

## INTERCARRIER SOUND SYSTEM:

1. Connect voltmeter, set on 10 volt scale across C46, observing polarity. 2. Insert 4.5 mc . generator, capacity decoupled, in Jl.
2. Reduce signal so that voltmeter reads a maximum of 3,0 volts, and continue to reduce as adjustments are made so as not to exceed this value.
Adjust in the order given, the following transformer slugs for maximum output:
a. Bottom slug, T3.
b. 123.
c. Top slug, TS.

Repeat to insure accurate setting.
Intercarrier sound system is now properly aligned.

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| TABLE III - TV ALIGNMENT PROCEDURE |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{array}{\|c} \text { STEP } \\ \text { NO. } \end{array}$ | $\left\|\begin{array}{c} \text { SIGNAL } \\ \text { GENERATOR } \\ \text { FREQUENCY, } \\ M C \end{array}\right\|$ | $\begin{aligned} & \text { CONNECT } \\ & \text { SIGNAL } \\ & \text { TO } \end{aligned}$ | output INDICATOR | ADJUST | INSTRUCTIONS | SPECIAL CONNECTIONS <br> AND SETTINGS |
| SOUND I. F. AND RATIO DETECTOR |  |  |  |  |  |  |
| 1 | $\begin{aligned} & 4.5 \\ & 6 W \end{aligned}$ | $\begin{gathered} \text { Pin } 2 \\ \text { of } \\ \text { v } 301 \end{gathered}$ | Meter across pin 7 of v102 and ground. | $\begin{aligned} & \text { T101 Pri } \\ & \text { (bottom) } \\ & \text { L101 } \end{aligned}$ | Tune for maximum reading on meter. | Signal level should be low enough to obtain approximately 4 to 7 volts on meter. Use isolation networks shown in Figures 2 and 3. |
| 2 | $\begin{aligned} & 4.5 \\ & \text { CW } \end{aligned}$ | " | Meter across ground and junction of R105 and C108. | $\begin{array}{\|l\|} \hline \text { T101 Sec. } \\ \text { (top) } \end{array}$ | Tune for zero meter reading; use same signal level as in step. 1 | Repeat tuning of T101 primary and secondary until adjustments do not change. |
| TRAPS AND PICTURE I. F. |  |  |  |  |  |  |
| 3 | $\begin{aligned} & 4.5 \\ & \text { CW } \end{aligned}$ | $\begin{gathered} \text { Pin } 2 \\ \text { of } \\ \text { v } 301 \end{gathered}$ | Meter connected through detector network to picture tube cathode lead. | L302 | Tune for minimum reading on meter. | Detector and isolating networks shown in Figures 2 and 4. |
| 4 5 | 41.25 CW <br> 43 CW <br> 44. 00CW <br> 42. 5CW <br> 45. 3CW | Mixer Grid <br> 11 <br> 11 <br> 17 <br> II | Voltmeter across R217. | $\begin{gathered} \mathrm{Z201} \\ \mathrm{~T} 204 \\ \mathrm{~T} 203 \\ \mathrm{~T} 202 \\ \mathrm{~T} 201 \end{gathered}$ | Tune for minimum reading on meter. <br> Tune for maximum. <br> Tune for maximum reading on meter. | Apply -4V bias to AGC buss. See text for connection to mixer grid. Keep generator output low. Set contrast control for maximum contrast. Adjust signal level throughoui I.F. alignment so that a 1 volt DC output is maintained across R217. |
| 6 | $\begin{aligned} & 45 \\ & C W \end{aligned}$ | " | " | L9 | Tune for minimum reading on meter. |  |
| 7 | $\begin{aligned} & 45 \\ & \mathrm{CW} \end{aligned}$ | " | " | L203 | Tune for maxdmum. |  |
| 8 | $39.75$ <br> CW | " | " | L201 | Tune for minimum. |  |
| 9 | $47.25$ | " | " | L202 | Tune for minimum, |  |
| 10 REPEAT STEP NUMBER 7 |  |  |  |  |  |  |
| 11 | $\begin{aligned} & 45 \\ & \hline \mathrm{CW} \end{aligned}$ | " | " | L9 | Tune for maxi mum. |  |
| 12 | Approximately 43.5 with 10 mc sweep. Marker required. | Mixer <br> Grid | High gain scope across R217 | Adjust <br> T201, <br> T202, <br> T203, T20 <br> if necessa | Set 45.75 mc marker at 50\% point. 4 ry. | See Figure 5 for isolation network. Use markers to determine bandpass between picture carrier and $50 \%$ point on opposite skirt. Bandpass should be between 3.65 mc and 3.85 mc . |


| TUBE | TYPE | FUNCTION | PLATE |  | Cathode |  | GRID |  | SCREEN |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | PIN | VOLTS | PIN | VOLTS | PIN | volts | PIN | volts |
| V101 | 6AU6 | Sound I. F. | 5 | 128 |  | 1.3 | 1 | 0 | 6 | 124 |
| V102 | 6AL5 | Ratio Det. | 7 | -11.5 | 1 |  |  |  | 6 | 124 |
| V103 | 6AV6 | Audio Amplifier | 7 | 100 | 2 | 12. ${ }_{0}$ | 1 | 0 |  |  |
| V104 | 6K6GT | Audio Output | 3 | 216 | 8 | 14 | 5 | 0 | 4 | 227 |
| V201 | 6CB6 | 1st Pix I. F. | 5 | 132 | 2 | 0 | 1 | -3. 9 | 6 | 140 |
| V202 | 6AU6 | 2nd Pix I. F. | 5 | 132 | 7 | -1.2 | 1 |  | 6 | 135 |
| V203 | 6CB6 | 3rd Pix I. F. | 5 | 133 | 2 | 0 | 1 | -4 | 6 | 140 |
| V204 | 1/2 6AS8 | 4th Pix I. F. | 9 | 107 | 3 | 2 | 2 | 0 | 1 | 135 |
| v205 | 1/2 6AS8 | Video Det. | 6 | -1. 5 | 8 | 0 |  |  |  |  |
| v301 | 12BY7 | Video Amp. | 7 | 118 | 1 | 1.6 | 2 | -1.5 | 8 | 140 |
| V401 | 1/2 6AN8 | AGC Keyer | 6 | -50 | 9 | 140 | 8 | 131 | $\checkmark 7$ | 250 |
| V501 | 6CS6 or 6BY6 | 1st Sync Sep. | 5 | 43 | 2 | 0 | 1 | -. 5 | 6 | 29 |
| V502 | 1/2 6AN8 | 2nd Sync Sep. | 1 | 95 | 3 | 42 | 2 | 43 |  |  |
| V601 | 6SN7GT | Vert. Osc. | 5 | 67 166 | 3 6 | 2.2 | 1 | -40 |  |  |
| V602 | 6S4 | Vert. Output | 9 | 420 | 2 | 27 | 6 | 0 |  |  |
| v701 | 6AL5 | Horiz. Phase Detector | $\begin{aligned} & 5 \\ & 7 \end{aligned}$ | 10 -11 | $\begin{aligned} & 2 \\ & 1 \end{aligned}$ | 0 |  |  |  |  |
| v702 | 6SN7GT | Horiz. Osc. | 2 | 220 137 | 3 | 7.5 | 4 | 0 -7 |  |  |
| V703 | 6BQ6GT | Horiz. Output | * |  | 8 | , | 5 | -26 | 4 | 137 |
| V704 | 6 W 4 GT $408-212$ | Damper 10-24 Cuassie | 5 | 250 | 3 | 470 |  |  |  |  |
| V103 | 12Ax7 | 1st Audio | 6 | 84 | 8 | 0 | 7 | -. 4 |  |  |
|  |  |  | 1 | 82 | 3 | 0 | 2 | -. 4 |  |  |
| V104 | ${ }^{6} 66$ | Audio Output | 3 | 258 | 8 | 15.8 | 5 | 0 | 4 | 260 |
| V105 | 6V6 | Audio Output | 3 | 258 | 8 | 15.8 | 5 | 0 | 4 | 260 |
|  | 410-24 CHASSIS ONLY |  |  |  |  |  |  |  |  |  |
| V602 | 6W6GT | Vertical Output | 3 | 240 | 8 | 29 | 5 | -29 | 4 | 240 |
| V703 | 6CD6GT | Horiz. Output | * |  | 3 | 18 | 5 | -18 | 8 | 135 |

* Do not measure with meter. Spikes of voltage may damage meter. D.C. value of voltage will be approximately 460 volta.
Boost voltage may be measured at width coll and will be about 550 volts on $410-24$ chassis and approxi-
mately 460 volte mately 460 volts on $407-21$ and $408-21$ chassis.

Voltages indicated in voltage chart were taken with Simpson Model 260 meter. Receiver was operating on 117 volt AC with all controls set for normal operation of channel received. Detected signal at plate of video detector developed negative $1 / 2$ volts. All voltages read to chassis ground. These voltages as maximum or minimum limits for operation. The normal allowable variations in component values, as well as line voltage and signal variation, will cause alight differences in voltages read on chassis of the rame model.

## IDENTIFICATION

The 407-21, 408-21 and 410-24 chassis are variations of the super deluxe chassis used in the above named models of Hoffman television receivers. The All-Wave models are identified by a "U" following the model number. Chassis 407-21 is a Super Deluxe chassis with single ended audio section. Chassis 408-21 and 410-24 have a push-pull hi-fi audio circuit. Chassis 410-24 is the same as 408-21, except the sweep circuits which are designed to accommodate a $24^{\prime \prime}$ picture tube. All three chassis have a four tage 40 mc I. F. strip and cascode tuner with negative bias supplied by a keyed AGC system. The low voltage power supply uses selenium rectifiers connected as a voltage doubler.
An unusual feature of the chassis is the addition of a secondary control for operation in noisy signal areas. This control is located under the plastic escutcheon plate on front control panel. Its use is explained under Operating Instructions.
Earphone jacks with speaker switch are used on above listed models. Reference to the schematics will show that the earphone jack is operative at all times, and that speakers can be either on or off depending upon the position of the peaker switch.
Some models using above chassis will have three speakers. Reference to the schematic will show that the two low frequency speakers are in parallel with each other. A single high frequency or tweeter speaker is used. A frequency divider network feeds the audio to the proper speaker for reproduction.

| table 1 electrical \& mechanical data |  | TABLE IIChassisTUBE407-21 |  | hoffman tube complemient chassis <br> 408-21 \& 410-24 FUNCTION |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Operating Voltage $\quad 115$ Volte AC, 60CPS |  | vi+ | 6807A | 6 BO 7 A | R. F. Amplifier |
|  |  | v2t | ${ }_{6}^{656}$ | ${ }_{6 T 4}^{636}$ or 6AF8 | Oicillator Mixer |
| Power Consumption | 407-21 170 Watts | V2** | 6B07A | 6B07A | VHF R.F. Amplifier UHF latif. |
|  | 408-21 180 Watts | V2* |  |  |  |
|  | 410-24 215 Watta | v3* | 6U8 | 6 68 | VHF Oscillator Mixer UHF 2nd I. F. |
| VHF Tuner Range | 2 through 13 | v101 | ${ }_{6 A U 6}$ | 6Au6 | Sound 1. F. Amplifier |
|  |  | V102 | 6AL5 | 6 AL5 | Ratio Detector <br> Audio Amp. \& AGC Delay |
| All-Wave Tuner Range | 2 through 83 | V103 | 6Av6 |  |  |
| Intermediate Frequencies | Picture Carrier 45, 75me Audio Carrier 41.25 mc | V103 | 6K6 | ${ }_{666}^{124}$ | Audio Driver |
|  |  | ${ }^{1} 105$ |  | 6 V 6 | Audio Output |
|  |  | v201 | ${ }^{6} \mathbf{C B 6}$ | ${ }^{6} \mathrm{CB6}$ | 18 P Picture 1. F. |
| Intercarrier Sound I. F. Freq. 4.5 mc |  | $v 202$ | 6AU6 | 6 6u6 | 2nd Picture I. F. |
|  |  | $v 203$ | ${ }^{6 C B 6}$ | ${ }^{6}$ CB6 | ${ }^{3} \mathrm{rd}$ Picture 1. F. |
| Audio Output Impedance | 407-21 3. 2 ohms | V 204 v 205 | 1/2 6AS8 | $1 / 26$ GS8 $1 / 2$ 6AS8 | 4th Picture 1. F. |
|  | 408-21 6.4 ohme center tapped | v205 | 1/2 6 AS8 | $1 / 2$ 6as8 | Video Detector |
|  | 410-24 6.4 ohmz center tapped | v301 | ${ }^{128 Y 7}$ | ${ }^{12897}$ | Video Amplifier |
|  |  | v401 | $1 / 26 \mathrm{AN} 8$ | $1 / 2$ ban | AGC Keyer |
| Maximum Undiatorted Audio Output | $\begin{array}{ll}408-21 & 10 \text { Watt } \\ 410-24 & 10 \text { Watt }\end{array}$ | V501 | $6 \mathrm{CS6}$ or 6 BY 6 | $6 \mathrm{CS6}$ or 6 BY 6 | ${ }^{1 s t}$ Sync Separator |
|  |  | V502 V 601 | 1/2 6AN8 6SNTG | $1 / 2 \mathrm{CaN8}$ | 2nd Sync Separator Vertical Oacillator |
|  |  | v602 | $6 S 4$ | ${ }_{6 S 4}(408-21)$ | Vertical Outputor |
| Antenna Input Impedance | 3.2 ohme balanced | v701 | 6AL5 | 6BJ7 or 6BC7 | Horizontal Phase Detector Horizontal Phase Detector \& AGC Delay |
| Picture Tube Size | 21" Rectangular 407-21, 408-2124" Rectangular 410-24 | v701 |  |  |  |
| Focus |  | V703 | ${ }^{\text {6Bgbat }}$ | ${ }^{6 C D G G T}$ | Horizontal Output |
|  | Electrotatic Focus 407-21 and 408-21 <br> Magnetic Focus 410-24 | V704 | ${ }^{\text {6/W4GT }}$ | ${ }_{183 \mathrm{GT}}$ | Damper H.V. Rectifier |
|  |  | $\times 801$ | Sel. Rect. | Sel. Rect. | L. v. Rectifier |
| Video Reaponse | to 3.75 mc | ${ }^{\times 802}$ | Sel. Rect. | Sel. Rect. | L. V. Rectifier |
|  |  | V302 | ${ }_{24 \mathrm{TP4}}$ | or $\begin{aligned} & \text { or } 249 \mathrm{CPPA}\end{aligned}$ | 407-21 40-24 Pix Tube |
|  |  |  | + VHF Tuner | $r$ Only | UHF 'runer Only |

## ALIGNMENT

The following discussion describes recommended methods and equipment to be used and precautions to be observed during the alignment procedure. Table III offers a ready reference alignment guide to be followed after the more detailed procedure has been studied.

For best results it is important that alignment be performed on a metal topped bench with all instrumente and equipment securely bonded together and to ground. All leads should be as short as is practicable, particularly in the input grid circuits. Allow about fifteen minutes for the test equipment and receiver to warm before beginning the alignment. Isolation circuits will be required for both the input and output connections. It is important that composition resistors, preferably the half-watt size, and disc type ceramic condensers be used in making up these isolation networks so that a minimum amount of external inductance is added to the tuned circuits being adjusted.

The following equipment will be required in order to align the picture and sound I.F. stages of the re civer properly.

1. Accurate CW aignal generator covering the following frequencies:

| 4.5 mc | 39.75 mc |
| :--- | :--- |
| 41.25 mc | 44.00 mc |
| 42.00 mc marker freq. | 45 mc |
| 43 mc | 45.3 mc |
| 42.5 mc | 45.75 marker freq. |
|  | 47.25 mc |

The generator must have an attenuation control which can be used to vary its output signal level.
2. Sweep frequency generator with a sweep center frequency of approximately 43.5 mc and a 10 mc sweep width.
3. Cathode ray oscilloscope with at least a moderately high vertical gain. Must have external sweep input or internal sweep frequency equal to the sweep generator sweep frequency and capable o phase control.
4. DC voltmeter with sensitivity of 20,000 ohms per volt or higher and voltage scale ranges which in clude approximately 10 volts and 3 volts (full scale deflection). VTVM with zero center scale adjustment is an ideal type.
5. -4 volt bias source such as a battery.
7. Detector network shown in $F$
005 uf isolating condenser
8. 1005 Khm is olating condenser. $1 / 2$ watt composition
9. . 001 uf condenser for shunting oscilloscope input.


Figure 2. Signal Generator Isolation UNING PICTURE I. F. COILS

Equipment: Instruments and setup remain the same $2 s$ for trap alignment during the first part of the procedure. For final adjustment the sweep frequency generator is also ueed and the voltmeter should procedure. For final adjustment the sweep frequency generator is also detila.

Procedure: Tune the I. F. colls by setting the coll frequency on the CW generator and adjuating the coll for maximum voltmeter reading. The CW generator output must be attenuated so that the DC output for maximum voltmeter reading. The CW generator output must be attenuated so that the DC output The order of tuning is from the last I. F. stage toward the tuner. Repeat the trap and I. F. allignment procedure until no additional change in adjustments is necessary.



Figure 3. Voltmeter Isolation



The procedure given below makes use of the picture I. F. stages common to the sound stages, the sound I $F$, stages and the ratio detector. Therefore, the accuracy of the oscillator setting is dependent upon the accuracy of the alignment of the aforementioned stages.

FOUIPMENT:
Connect the "hot" lead of the marker generator (CW source) to one antenna terminal and connect the generator ground lead to ground. Set the generator for unmodulated output. Connect the voltmeter to measure the ratio detector balance voltage at sound I. $F$. Use center scale of the voltmeter if avail PROCEDURE

Set the fine tuning control at the center of its tuning range. Set the tuner to Channel 12 and the signal generator to the sound carrier frequency of Channel 12 ( 209.75 mc ). Using a non-metalic alignmen screwdriver, adjust C12 for zero reading on the voltmeter. With C12 correctly adjusted, tune the brass slug through the hole in the front of the chassis and tuner for zero voltmeter reading on each of the other eleven channels, using a non-metalic screwdriver. Switch adjustment and should not be altered after adjusting it for Channel 12. If difficulty is encountered in obtaining a zero voltmeter reading on a particular channel, check the coil board containing the oscillator winding.

|  | PICTURE | SOUND | SWEEP |
| :---: | :---: | :---: | :---: |
| CHANNEL | Carrier | Carrier | GENERATOR |
| NUMBER | FREQ. MC | FREQ. MC | FREQ. MC |
| 2 | 55.25 | 59.75 | 57 |
| 3 | 61.25 | 65.75 | 63 |
| 4 | 67.25 | 71.75 | 69 |
| 5 | 77.25 | 81.75 | 79 |
| 6 | 83.25 | 87.75 | 85 |
| 7 | 175.25 | 179.75 | 177 |
| 8 | 181.25 | 185.75 | 183 |
| 9 | 187. 25 | 191.75 | 189 |
| 10 | 193.25 | 197.75 | 195 |
| 11 | 199.25 | 203.75 | 201 |
| 12 | 205.25 | 209.75 | 207 |
| 13 | 211.25 | 215.75 | 213 |



Figure 7. Schematic Diagram for VHF Tuner


| $\begin{array}{\|l} \text { TUBE } \\ \text { NO. } \end{array}$ | TUBE <br> TYPE | FUNCTION | Plate |  | CATHODE |  | GRID |  | SCREEN |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | PIN | Volts | PIN | VOLTS | PIN | VOLTS | PIN | volts |
| V101 | 6AU6 | Sound I. F. | 5 | 83 V | 7 | +0. 8 | 1 | 0 | 6 | +83 |
| V102 | 6AL5 | Ratio Det. | $\begin{aligned} & 7 \\ & 2 \end{aligned}$ | $\begin{array}{r} -6 \\ 4 \end{array}$ | $\begin{aligned} & 1 \\ & 5 \end{aligned}$ | ${ }_{+6}^{+1.3}$ |  |  |  |  |
| V103 | 6AV6 | Audio Amp. | 7 | 77 | 2 | 0 | 1 | -0.4 |  |  |
| V104 | $6 \mathrm{K6GT}$ | Audio Output | 3 | 157 | 8 | 8.3 | 5 | 0 | 4 | 167 |
| v201 | 6CB6 | 1st Pix I.F. | 5 | 127 | 2 | 0.4 | 1 | 0.2 | 6 | 130 |
| v202 | $6 \mathrm{CB6}$ | 2nd Pix I. F. | 5 | 125 | 2 | 0.4 | 1 | 0.2 | 6 | 130 |
| v203A | 1/2 6AS8 | 3rd Pix I. F. | 9 | 125 | 3 | 1. 5 | 2 | 0 | 1 | 130 |
| V203B | 1/2 6AS8 | Video Det. | 6 | -2. 5 | 8 | 0 |  |  |  |  |
| v301 | 6AH6 | Video Amp. | 5 | 133 | 7 | 1.0 | 1 |  | 6 | 153 |
| V501A | 1/2 12AU7 | 71st Sync Sep. | 6 | 34 | 8 | 0 | 7 | -5.6 |  |  |
| V501B | 1/2 12AU7 | 172 2nd Sync Sep. | 1 | 104 | 3 | 36 | 2 | 34 |  |  |
| V601 | 6 C 4 | Vert. Osc. | 1 | 117 | 7 | 0 | 6 | -18 |  |  |
| v602 | 6AQ5 | Vert. Output | 5 | 153 | 2 | 0 | 1 | -8 | 6 | 166 |
| V701 | 6AL5 | Hor. Ph. Det. | $\begin{aligned} & 7 \\ & 2 \end{aligned}$ | $\begin{gathered} -10 \\ 0 \end{gathered}$ | $\begin{aligned} & 1 \\ & 5 \end{aligned}$ | $\begin{aligned} & 0 \\ & 9.5 \end{aligned}$ |  |  |  |  |
| v702 | 6SN7GT | Hor. Osc. | $\begin{aligned} & 2 \\ & 5 \end{aligned}$ | $\begin{aligned} & 141 \\ & 89 \end{aligned}$ | 3 6 | $\begin{aligned} & 4.5 \\ & 4.5 \end{aligned}$ | 1 | $\begin{aligned} & -0.2 \\ & -2.3 \end{aligned}$ |  |  |
| v703 | 6BQ6GT | Hor. Output | Cap | * | 8 | 0 | 5 | -22 | 4 | 144 |
| V704 | 6W4GT | Damper | 5 | 166 | 3 | 405 |  |  |  |  |

oltages taken with Simpson \#260 meter on 303-21 chasbis operating as follows. AC line voltage 115 volts, receiver tuned to station with normal setting of all controls, negative 2.5 volts developed at plate of video detector by signal received. All voltages are positive D. C. unless otherwise indicated.
These readings are prepared as a service reference and should not be considered as minimum or maximum specifications for the operation of this chassis. Variations within limits will be noted, due to mum specifications for the operation of this chassis.

Fine tuning is accomplished by a shaft concentric with the channel selector shaft. Slight rubbing of the dielectric rotor against the grounded stator plate is intentional, in order to avoid vibration with result ing interference. However, the dielectric rotor should not be allowed to rub or contact the silvered ceramic disc riveted to the chassis. If the fine tuning shaft binds, it should be removed and cleaned with carbon tetrachloride (using a light canvas cloth) and both the dielectric bade and the drum shaft shoul be lubricated with switch grease or vaseline.

Erratic operation on any one channel requires checking of the coil boards for that channel. Both contact points and windings should be checked. Clean the contact points with a light canvas cloth dampened with carbon tetrachloride. If the operation is still unsatisfactory, press the contact springs lightly with an insulated screwdriver. If the tuner cannot be made to operate, more contact spring pressure is required. Conts borret end plate. Twist the blade away from the turret and lift the end of the coil隹 tact springs down slightly to cive increased pressure. With the coil boards removed, clean the contact surfaces of the contact springs with carbon tetrachloride (using a small stiff brush) and lubricate with a pure mineral oil. Replace the coil boards, and check all channels.

If oscillator slugs fall into the coil form, remove the coil board, move the slug retaining spring aside and tap the coil board until the slug slips forward. Reset the slug retaining spring.

Noisy channel switching may be due to the detent spring roller not rotating on the detent plate. Lubricate both surfaces with switch grease or vaseline.

For microphonism produced by tapping the tubes or tuner chassis, or in case of intermittent video and sound, first replace the tubes. If the trouble persists, clean contact surfaces and lubricate surfaces as explained above.

## TROUBLE SHOOTING

Tube substitution is recommended first for localizing the trouble. The presence of oscillator grid voltage is very important. Lack of it indicates that the oscillator is not operating. This voltage may be checked from pin 6 of the 6 J 6 tube to ground by using an isolating resistor of 25,000 ohms on the voltmeter test probe. The isolating resistor is required to prevent excessive loading of the oscillator circuit. Lack of voltage at test point, when the oscillator is operating, indicates trouble in the mixer grid circuit. This voltage should be at least 2 volts on the high channels and 3 volts on the low channels, measured with VTVM or 20,000 ohms per voltmeter between test point and chassis. Resis
reveal the source of trouble when incorrect voltage or abnormal operation is noted.

ALIGNMENT
The tuned circuits are very stable and normally do not require adjustment unless a tube or component part has been replaced or the adjustment of the trimmer condensers have been indiscriminantly changed part has been replaced or the a
by an inexperienced individual.
The following alignment procedure describes alignment of the R-F, mixer and oscillator stages of the tuner with the exception of the converter output coil, L9. The latter adjustment is described in the IF alignment procedure section of the individual chassis data bulletins. Table IV offers a ready reference guide to be followed after the detailed procedure has been studied.

The following equipment will be necessary in order to align the tuner. DO NOT ATTEMPT ANY ALIGNMENT BEYOND THE "FIELD ADJUSTMENTS OF OSCLLLATOR" UNLESS THE EQUIPMENT IS AVALL.ABLE.

1. Accurate AM signal generator covering the television picture and sound carrierfrequencies listed in Table IV, with low impedance output and calibrated attenuator.
2. R-F sweep generator covering the frequency band of the twelve television channels, preferably with 300 ohm balanced output to match its output to antenna input. Sweep width at least 12 mc wide.
3. D. C. voltmeter with at least 20,000 ohms per volt sensitivity and low range.
4. An oscilloscope with at least a moderate sensitivity.
5. A 3 volt bias battery.

Most sweep generators have an output impedance less than 300 ohms. In order to match the generator to its load (tuner input), a matching network is used. A suggested network can be made up from several inches of 300 ohm twin lead and three composition type, $1 / 2$ watt resistors of suitable value. Figure 5 shows the details. The length of lead 1 g should be as short as is practicable so as not to provide a 300 ohm line between network and generator. Lead $l_{a}$ should be just long enough to keep network and generator leads from shorting against TV chassis or tuner chassis. The network can be taped to further eliminate possible shorts. The values given for R1, R2 and R3 are the result of a compromise between making the network a universal one for all generators with output impedances of approximately 50 to 75 ohms, and availability of resistors of a desired value. More exact values for a particular generator are usually given in the instruction manual supplied with the generator.
The AM signal generator is used as a marker generator for the video and sound carrier frequencies, and it is also used as a CW source in adjusting the oscillator frequencies. Therefore, it is most desirable, from the standpoint of accuracy and alignment time, that the generator provide pairs of controlled are not for each step in the alignment procedure. A VTVM is recommende for sensitivity is very high and a zero-nerter scale available on most mold used for all connections. All ground leads and equipment should be well bond together. Composition resistors must be used in the matching and isolating networks. Before beginning the alignat proce dure, allow about 15 minutes for receiver and test equipment to warm up to operating temperature.
R.F. AND MIXER ALIGNMENT

## EQUIPMENT:

Disconnect antenna from the receiver if one is being used, and connect the sweep generator to the antenna terminals. Use matching network if necessary. Loosely couple marker generator to antenna terminal, using unmodulated signal to obtain marker pips of video and sound R. F. carriers. This may be done by clipping the marker generator "hot" lead to an insulated part of the sweep generator lead, or by coupling with a small capacitor ( 2 or 3 uuf). Avoid distortion of response curve by keeping the marker generator output at a minimum, marker pips being just barely visible. Temporarily disconnect the tuner AGC lead from the AGC buss and connect it to the negative terminal of the bias source. Connect positive terminal of bias source to chassis ground. Connect synchronized sweep voltage from the sweep generator to the horizontal input of the oscilloscope for horizontal deflection or set the scope to internal 60 cycle sweep if the sweep frequency of the generator is 60 cycles. Connect the vertical input lead of the scope through a 10 K ohm resistor to point T , the wire loop on top of the tuner. Tuner alignment adjustments are located as follows:

1. C12 is near front side of oscillator mixer tube socket.
2. C9 is between the two tuner tube sockets.
3. C2 is near back side of R.F. amplifier tube socket.
4. C 23 is beside C 2 adjustment.

## PROCEDURE:

Set the channel selector to Channel 12 (at this setting the coil boards marked "8" are at the bottom center position). Channel 12 is the reference channel for trimmer alignment. Set the fine tunins, conathe center of its tuning range. Set the sweep generator to approximately 207 mc . Insert the mark curve which should be located symmetrically betwe and C23 for an approx maximum amplitude See Figure 6 for appearance of curve. Normally this curve appears somewhat overcoupled (double humped) with a $10 \%$ or $15 \%$ peak to valley excursion, and the markers or ar In general the adjustment performed for Channel 12 is sufficient to give satisfactory response curves on all channels. Check the response of Channels 2 through 11 and Channel 13 by switching the receiver channel selector, sweep generator and marker generator to each of these channels and observe the response obtained. Curves obtained should approximate those shown in Figure 6, although variation is to be expected between different units. However, in general, the peak to valley excursion should never exceed $30 \%$, and the markers should never occur at points below $70 \%$ of the maximum amplitude of the curve. If reasonable alignment is not obtained on a particular channel, (a) check to see that coil boards have not been intermixed; (b) adjust C2, C9 and C23 as a compromise adjustment, favoring this particular channel and recheck all channels to see that they have not been seriously affected; (c) try replacing the coil board for the weak channel.

| ALIGNMENT <br> TABLE III - TV ALIGNMENT PROCEDURE |  |  |  |  |  |  | HF |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{array}{\|c} \text { STEP } \\ \text { NO. } \end{array}$ | SIGNAL GENERATOR FREQUENCY MC | $\begin{aligned} & \text { CONNECT } \\ & \text { SIGNAL } \\ & \text { TO } \end{aligned}$ | OUTPUT INDICATOR | ADJUST | INSTRUCTIONS | SPECLAL CONNECTIONS <br> AND SETTINGS | FIELD ADJUSTMENT OF RF OSCILLATOR <br> The following alignment procedure is intended only as a field operation, using television transmitter signals to correct minor misalignment of the oscillator on a few channels. This is generally evidenced by inability to peak the picture at or near the mid-point of the fine tuning control range. |
| SOUND I. F. AND RATIO DETECTOR |  |  |  |  |  |  | oils for each channel are independent of all other coils, and are switched in and out of the tuned |
| 1 | 4.5 CW | $\begin{aligned} & \text { Pin } 1 \\ & \text { of } \\ & \text { V301 } \end{aligned}$ | Meter across pin 7 of V102 and ground. | $\begin{gathered} \mathrm{L} 102 \\ \text { Pri. } \\ \text { (bottom) } \\ \mathrm{L} 101 \end{gathered}$ | Tune for maximum reading on meter. | Signal level should be low enough to obtain approximately 4 to 6 volts on meter. Use isolation networks shown in Figures 2 and 3. | circuits by rotating the turret. Access to the oscillator coil adjustment slugs is obtained through the hole above and to the right of the channel selector shaft with the fine tuning control in mid-range position. <br> To trim the oscillator on an individual channel, turn the selector switch to that channel and, using an insulated alignment tool, adjust the slug available through the access hole until the picture reception is peaked. This process may be repeated on all channels as required. |
| 2 | 4.5 CW | " | Meter across ground and junction of R105 and Cl08. | L102 <br> Sec. <br> (top) | Tune for zero meter reading; use same signal level as in step 1. | Repeat tuning of L102 primary and secondary until adjustments do not change. | If these adjustments do not correct the condition, or if either sound or picture reception on all channels is below normal, it may be necessary to perform the complete bench alignment procedure as outlined in the alignment section. |
| TRAPS AND PICTURE I. F. |  |  |  |  |  |  | TUNER MAINTENANCE <br> The entire turret drum, with coils in place, may be removed from the tuner chassis by removing the retaining springs at each end of the unit. This gives access to the components and tube sockets which are not accessible from the side of the tuner. |
| 3 | 4.5 CW | $\begin{gathered} \text { Pin } 1 \\ \text { of } \\ \text { V } 301 \end{gathered}$ | Meter connected through detector network to picturd tube cathode lead | L302 | Tune for minimum reading on meter. | Detector and isolating networks shown in Figures 2 and 4. |  |
| 4 5 | $\begin{gathered} 41.25 \\ \text { CW } \\ 47.25 \\ C W \end{gathered}$ | Mixer grid | Voltmeter across <br> Pin \#6 of V203 | $\begin{aligned} & \text { Top of } \\ & \text { L202 } \\ & \text { Top of } \\ & \text { L203 } \end{aligned}$ | Tune for minimum reading on meter. | Apply -3V bias to AGC buss. See text for connection to mixer grid. <br> Keep generator output low. <br> Set contrast control for | servicing tuners. Location and lead dress of components and wiring are very critical. At high frequencies, wiring leads tend to act as small inductances and stray capacities; consequently any change made may appreciably alter the electrical characteristics of critical circuits. Parts location and ground connections should be maintained as originally made. When replacing components, it is important that they be replaced with parts of identical electrical characteristics and physical size. |
| 6 | 44. CW |  | " | L204 | Tune for maximum. | maximum contrast. Adjust signal level throughout I. F. alignment so | TUBE REPLACEMENT <br> Replacement of tubes (especially 6 J 6 oscillator-mixer tubes) may cause excessive change in frequency of |
| 7 8 | 45.4 CW 43.25 CW | " ${ }^{\prime \prime}$ | " | L203 | Tune for maximum reading on meter. | that a -1 volt $D C$ output is maintained across video detector load. | tumer circuits. This is due to differences of inter-electrode capacitances, unavoidable in the manufacture of tubes. When replacing a 6 J 6 tube, it is recommended that several tubes be tried in order to select a tube which will cause the least oscillator frequency shift. This practice will in most cases eliminate the need for realignment of the tuner. |
| 9 | $\stackrel{43}{C W}$ | " | " | L9 | Tune for minimum reading on meter. |  | CLEANING AND LUBRICATION <br> 1. Remove the ground plate of the fine tuning assembly and slide the fine tuning shaft and blade off the |
| 10 | ${ }_{43}^{\text {CW }}$ | " | " | L201 | Tune for maximum. |  | drum shaft. Remove bottom cover plate. Remove the drum retaining springs at either end of the chassis. The complete drum may now be removed from the chassis. |
| 11 | ${ }_{45} \mathrm{CW}$ | " | $"$ | L9 | Tune for maximum. |  | 2. Clean the coil board contacts and stator contacts with carbon tetrachloride applied with a light canvas cloth and lubricate with a pure, sulphur-free, mineral oil, such as "Nujol". Clean all bearing surfaces and lubricate these with switch grease or white "Vaseline". CAUTION: No abrasive should be |
| Repeat steps 4 through 10 until adjustments do not change. |  |  |  |  |  |  | used in cleaning contacts as some of the abrasive material may become imbedded in the silver contact causing excessive wear and noisy contacts. |
| 12 | pproximate43.5 with 10-mc sweep. Marker reuired. | Mixer grid | High gain scope across Pin l of V301 and ground. | Adjust <br> L202, <br> L203 and <br> L204 if <br> necessary | Set 45.75 mc marker at $50 \%$ point with L202. Eliminate tilt with L204. | See Figure 5 for isolation network. Use markers to determine bandpass between picture carrier and $50 \%$ point on opposite skirt Bandpass should be between 3.15 mc and 3.35 mc. | MECHANICAL TROUBLES <br> Apart from tube failures, most troubles are likely to be mechanical. Firstly, if mechanical parts are broken, it must be determined whether to repair or replace the unit. <br> The turret drum, including coil boards may be removed from the tuner chassis by removing the turret retaining springs at each end. |

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## IDENTIFICATION

The 303 chassis series includes all deluxe chassis used in the above indicated models of Hoffman tele vision receivers. This service data applies to both VHF and All-Wave model receivers. Models using the All-Wave tuner are identified by a $U$ following the Model number. If the All-Wave tuner is refer to Service Data \#500 for service information. VHF tuner data is provided in this bulletin
he 303 chassis has a power transformer with an additional 130 volt tap in the primary. This feature may be utilized in areas where power supply varies from the normal 117 volt AC. If the eceiver perated with line voltage around 130 volts, this connection may be used to provide correct operatin
 operation in extreme fringe areas is a removable jumper across R711. This jumper is easil eached by removal of bottom cover and may be clipped loose at one end to provide a negative 2 vol bias to grid of the video amplifier. (See General Circuit Description)

| TABLE I <br> ELECTRICAL AND MECHANICAL DATA |  | TABLE II <br> HOFFMAN TUBE COMPLEMENT |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  |  | TUBE | TYPE | FUNCTION |
| Operating Voltage | 115 volts AC 60 cps | $\begin{aligned} & \text { V1 + } \\ & \text { V2 + } \end{aligned}$ | $\begin{aligned} & \text { 6BQ7A, 6BZ7 } \\ & \text { 6J6 } \end{aligned}$ | R. F. Amplifier Oscillator Mixer |
| Power Consumption | 125 watts | V1* | 6T4, 6AF4 | UHF Oscillator |
|  | Channels 2 through 13 | V2 * 6 | 6BQ7A, 6BZ7 | VHF R.F. Amplifier UHF I. F. Amplifier |
| All-Wave Tuner Range | Channels 2 through 83 | v3* | $6 \mathrm{U8}$ | VHF Oscillator Mixer UHF I. F. Amplifier |
|  |  | V101 6 | 6AU6 | Sound I. F. Amplifier |
| Intermediate Frequencies | Sound Carrier 41.25 MC <br> Picture Carrier 45.75 MC | V102 6 | 6AL5 | Ratio Detector |
|  |  | V103 | 6AV6 | Audio Amplifier |
| Intercarrier Sound I. F. | 4.5 MC | V104 | 6CB6 | Audio Output |
|  |  | V202 6 | 6CB6 | 2nd Picture I. F. |
| Audio Output Impedance | 3.2 ohms | V203A | 1/2 6AS8 | 3rd Picture I. F. |
|  |  | V203B 1 | 1/2 6AS8 | Video Detector |
| Audio Output | 1.5 watts | V301 6 | 6AH6 | Video Amplifier |
|  |  | V501A 1 | 1/2 12AU7 | 1st Sync Separator |
| Louds peaker | P. M. type 3.2 ohm V.C. | V501B 1 | $1 / 212 A U 7$ | 2nd Sync Separator |
|  |  | V601 6 | 6 C 4 | Vertical Oscillator |
| Antenna Input Impedance | 300 ohm balanced | V602 6 | 6AQ5 | Vertical Output |
|  |  | V701 6 | 6AL5 | Horizontal Phase Det |
| Picture Tube Size | $21^{\prime \prime}$ and $17^{\prime \prime}$ rectangular $70^{\circ}$ deflection | V702 6 | 6SN7GT | Horizontal Oscillator |
|  |  | V703 6 | 6BQ6GT | Horizontal Output |
|  |  | V704 6 | 6W4GT | Damper |
| Focus | Electrostatic | V705 1 | 183 | High Voltage Rectifjer |
|  |  | v302 | 21 YP 4 A or 17HP4A | Picture Tube |
| Video Response | To 3.25 MC | * All | Wave Tuner Only | + VHF Tuner Only |

The following equipment will be required in order to align the picture and sound I. F. stages of the eceiver properly.

1. Accurate CW signal generator covering the following frequencies:

| 4.5 mc | 43.25 mc |
| :--- | :--- |
| 41.25 mc | 45 mc |
| 42.5 mc marker freq | 45.4 mc |
| 45.75 mc marker freq | 47.25 mc |
| 43 mc | 44 mc |

The generator must have an attenuation control which can be used to vary its output signal level
2. Sweep frequency generator with a sweep center frequency of approximately 43.5 mc and a 10 mc sweep width.
3. Cathode ray oscilloscope with at least a moderately high vertical gain. Must have external sweep input or internal sweep frequency equal to the sweep generator sweep frequency and capable of phase control.
4. D. C. voltmeter with sensitivity of 20,000 ohms per volt or higher and voltage scale ranges which include approximately 10 volts and 3 volts (full scale deflection). VTVM with zero center scale adjustment is an ideal type.
5. 3 volt bias source such as a battery.
6. Detector network shown in Figure 1.
7. . 005 uf isolating condenser.
8. 10 K ohm, $1 / 2$ watt composition resistor.
9. . 001 uf condenser to shunt oscilloscope input.


Figure 1. Detector Network

10\% LIMIT ON -7-7-


FREQUENCY, mc

Before alignment is begun, tune the tuner off-channel by turning the tuner channel selector shaft so that the detent roller rests on one of the high points of the drum disc. In all steps of video I. F. alignment the input signal should be maintained to a level of approximately one (1) volt D. C. output across video detector load. This is to insure against false tuning due to overloading
It is important that the alignment be performed in order listed, with the exception of items 1 and 2 , because there is some interaction within the various stages.


## F-M SOUND CHANNEL ALIGNMENT

1. Connect 4.5 MC generator, 400 cycle $30 \%$ AM, to video amplifier grid (Pin 8 ).
2. Connect detector and oscilloscope (See Fig. 5 for circuit) to picture tube cathode.
3. Set contrast control to max. clockwise rotation, and volume control to one-half max. clockwise rotation.
. Turn slug in primàry (video amplifier plate winding) of ( $\mathrm{L}-\mathrm{-109} \mathrm{)} \mathrm{sound} \mathrm{take-off} \mathrm{transformer} \mathrm{completely} \mathrm{out} \mathrm{of}$
4. Turn slug in secondary ( 4.5 MC amplifier grid winding) of L-109 completely out of coil winding in direction away from chassis.
5. Turn slug in primary of L - 109 into coil until a minimum oscilloscope deflection is obtained.
6. Remove detector and oscilloscope from picture tube cathode.
7. Change 4.5 MC generator modulation from 400 cycles $30 \% \mathrm{AM}$ to 400 cycles 7.5 KC FM.

Set buzz control approximately $90^{\circ}$ from clockwise stop.
ere output limiting occurs.
. Starting with slug completely out of coil winding on chassis side, adjust quadrature coil (L-106) for maximum
. Adiloscope indication. Turn volume control down as required to maintain pattern size on scope.
to keep signal level below output limiting
mum output indication on oscilloscope. Reduce generator output as required to keep signal level below output limiting.
15. Increase signal generator output to level above output limiting.
19. Adjust buzz control R-132 for minimum indication on oscilloscope 400 cycles $30 \%$ AM
18. Change 4.5 MC generator modulation from 400 cycles $30 \%$ AM to 400 cycles 7.5 KC FM.
19. Readjust quad rature coil L -- 106 for maximum output indication.
20. Reduce generator output below level of output limiting and recheck steps 13 and 14.

## HORIZONTAL OSCILLATOR ALIGNMENT

Preset horizontal lock trimmer to one-half turn from full tight
Connect receiver antenna terminals to source of test pattern signal of approximately 10,000 microvolts
synchronization. Adjust all other controls for normal picture. Connect oscilloscope, with 10 mmf in series, to terminal 4 of horizontal oscillator transformer. Adjust hori-
zontal oscillator tray coil slug for waveform of Fig. 6 . Readust horizontal hold and/or horizontal frequency control as required to keep pattern in sync during this trap coil adjustment.
5. Disconnect scope lead.
6. Turn horizontal hold control fully counterclockwise.
6. Turn horizontal hold control fully counterclockwise.
7. Turn horizontal frequency adjustment out (counterclockwise) until picture is Turn horizontal irequency adjustment out (counterclockwise) until picture is
out of horizontal sync with diagonal bars sloping downward from left to right.
8. Turn horizontal frequency adjustment in (clockwise) until picture is just
ready to fall in sync, as indicated by a wide balck vertical or diagonal bar
pattern is still in sync at clockwise end of control, interrupt signal momentarily to knock picture out of sync.


Fig. 6. Response Curve ${ }^{98222}$
10. Turn horizontal hold control slowly counterclockwise

If number of bars in step 10 is more than three, adjust horizontal lock contrul sughily cluckwise. If number of bars in step 10 is less than two, adjust horizontal lock control slighlly counte:- - ilockwise.
2. Repeat steps 6 through 11 as required until number of bars in step 10 is two 0 three.
Check point on rotation of horizontal hold control at which picture just pulls in syac in step 10. Must be at least 60 degrees from maximum counterclockwise rotation.

fig. 7. Response Curve






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## SERVICE PARTS LIST FOR 12 POSITION 1 CI717 TUNERS <br> \section*{capacitors}

| SchematicSymbol | TRANSFORMERS AND COILS |  |  |
| :---: | :---: | :---: | :---: |
|  | Description | Mfgrs. Cross Reference | Hollicrafters Part Number |
| T-1 | Transformer, VHF antenna input | 1921-1 | 51A1684 |
| L-2 | Coil, R-F grid assembly; part of SIA |  |  |
| L-3 | Coll, R-F plate; Channel 13 Adj. | 1984-14 | 51A1885 |
| L-6 | Coil, Mixer grid; Channel 13 Adj. | 1785-52 | 51A1686 |
| L-7 | Coil, Osc. grid; Channel 13 Adj. | 2051-1 | 121A148 |
| L-8 | Coil, Osc. grid; Channel 6 |  |  |
| L-9 |  | ${ }_{1790-10}^{2051}$ | $121 A 147$ 1214148 |
| L-11 | Coil, cathode/plate coupling . | 1785-49 | 51A1690 |
| L-12 | Choke, heater | 1894-1 | 53A298 |
| L-13 | Choke, heater | . 1894-2 | 53A297 |
| L-14 | Coil, neutralizing | 1911-5 | 121A149 |
| tubes |  |  |  |
| v-1 | 6BZ7 Dual Triode R-F |  |  |
|  | Amplifier | 55 | 90x6BZ7 |
| V-2 | 6JB Dual Triode Oscillator/ Mixer. | 50. | 90x6J8 |



## SERVICE PARTS LIST FOR VHF 16 POSITION $1 E 1670$ \& $1 E 1718$ TUNERS

CAPACITORS

| C-1 | 800 mmf . GMV ceramic disc. . . . . . . . . . . . . . . . . 2033-2 . . . . . 47A355 |  |  |
| :---: | :---: | :---: | :---: |
| C-2 | 15 mmf . ceramic tubular, |  |  |
|  | part of S1A | 162-150 | 121A119 |
| C-3 | 22 mml . ceramic | 162-220 | 121A143 |
| C-4 | 3 mmf . ceramic tubular | 16 |  |
| C-5 | 1000 mmf . GMV. ceramic disc. |  |  |
| C-6 | 470 mmf . GMV ceramic |  |  |
|  | feed thru. | 2023 |  |
| C-7 | 470 mmf . ceramic tubular; part of S1C | 136-1 |  |
| C-8 | 15 mmf . ceramic tubular; part of S1D | 150 |  |
| C-9 | 36 mmf . ceramic gimmick; |  |  |
|  | part of S1D | 2101 | 121A132 |
| 10 | 1.6 mmf . ceramic gimm | 2101-169 | 121A133 |
| C-11 | . 30 mmf . ceramic gimmic | 2101-308 | 121 |
| -12 | . 75 mmf . ceramic gimmic | 2101-758 | 121 |
| C-13 | 10 mmf . ceramic tubular | 162-100 | 121 |
| 14 | 800 mmf . GMV. ceramic disc. . . . . . . . . . . . |  |  |
| C- | 1000 mmf . mini. ceramic |  |  |
|  | disc. | 2033-3 | 47A356 |
| C-16 | 1000 mmf . GMV |  |  |
|  | disc |  |  |
| C-17 | 1.5 mmf . ceramic tubular | 6-159 | 2 |
| C-18 | 10 mmf . ceramic tubular; |  |  |
|  | part of SIE | 163-100 | 121A136 |
| C-19 | 1.6 mmf . ceramic gimmick | 2101-169 | 121A133 |
| 20 | Fine tuning control; air trimmer. | 1713-502 | 121A117 |
| 21 | 1.5 mmf . ceramic gimmick; |  |  |
|  | part of SIE | 2101-159 | 121A136 |
|  | 110 mmf . ceramic tubul | 181-111 | 21A145 |
| C-23 | 7.5 mmf . ceramic gimmick | 2101-759 | 121A138 |
| -24 | 1000 mmf | $2033 .$ |  |


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Values and tolerances shown are nominal and varia. TIONS MAY BE FOUND. IT IS RECOMMENDED THAT THE VALUE
OF ANY REPLACEMENT CORESPOND TO THE NOMINAL VALUE OF ANY REPLACEMENT CORRES
OF THE PART BEING REPLACED
on all (-2) runs of all chassis the following changes abe made A. T-106 IS REPLACED BY T-106-1 (52C258) WHICH INCLUDES I2V. LEAD.


VHF-UHF

yalues and tolerances shown are nominal and varia TIONS MAY BE FOUND. IT IS RECOMMENDED THAT THE YALUE OF ANY REPLACEMENT CORRES

ON D. 13000 RUN 3-I CHASSIS A. THE $17 \mathrm{HP4}$ PIX TUBE IS REPLACED BY 21 AP4 METAL TUBE A. THE HIGH YOLTAGELEAD LPIN 7. Y- 1111115 CONNECTED TO R-168 (1) MEGOHM I WATP. CARRON). THE OTHER SIDE OF R-168 IS CONNECTED TO THE MEEAL CONE OF THE 2IAP4.
C. C-I54 ( 500 MMF. 20.000 v., CERAMIC) IS CONNECTED BETWEEN PIN 7 OF V- 111 AND
GROUND
D. R-189 ( 1.5 MEGOHMS) FOCUS CONTROL IS DELETED.
E. PIN 6 OF PICTURE TUBE SOCKET IS DELETED.

VHF-UHF


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A. T. 106 IS REPLACED BY
B. $V$ - 105 IS
REPLACED
BY



## PICTURE TUBE REMOVAL

1. Remove the chassis from the cabinet. Note that on chassis with the horizontal and vertical hold controls on the rear apron the knobs on the control shafts and the A.G.C. control switch must be removed before the cabinet back may be removed. These are push-on type knobs.
2. Insure the discharge of the high voltage power supply by disconnecting the anode plug and shorting it to the insure the discharge of the high volage power supply by disconnecting the ansis short the anode socket or metal cone of the picture tube to the chassis.
3. Remove the picture tube socket from the base of the tube
4. Slip the ion trap and the centering device from the neck of the tube. On some chassis, the centering device is an integral part of the deflection yoke assembly.
5. Carefully remove the rear support tension spring on each side of the picture tube. If a glass cone picture tube is involved, remove the metalized paper picture tube shield and ground by unhooking the springs on each side and th hook on the top center of the picture tube mounting strap.
6. Remove the mounting strap from the front rim of the picture tube.
7. Lift the front of the picture tube just far enough to clear the front mounting brackets and slip the tube forwar until the neck is clear of the deflection yoke and the rubber collar. Use a slight twisting pull to break the cone of the tube from the rubber collar if the two are stuck together. Loosen the deflection yoke adjustment screw if required for clearance when raising the front of the picture tube over the front mounting brackets.

CAU TION - IF THE TUBE FAILS TO SLIP OUT EASILY, INVESTIGATE AND REMOVE ThE CAUSE Of TROUBLE DO NOT USE FORCE AS THE NECK OF THE PICTURE TUBE IS EASILY BROKEN.

## SERVICE ADJUSTMENTS

VERTICAL AND HORIZONTAL HOLD CONTROLS - These two controls should be adjusted until a single steady picture is obtained. With average signal strength it should be possible to switch from one active channel to properly adjusted. These two controls will be found on the front apron of some chassis.

## CENTERING - (Cli300D \& DI300D Chassis only)

Place the horizontal centering control, located on the rear apron of the chassis, in the approximate cente of its range. Rotate the two ring magnets by the ear around the neck of the picture tube until the picture is properly centered. Slight readjustment of the ion trap may then be necessary. The horizontal centering contro may now be used for fine adjustment
(Al300D, B1300D, H1300D, \& JI300D Chassis only) Same as above except horizontal control on rear apron omitted.

## (E1300D \& F1300D Chassis only

Move the centering lever a short distance in any direc tion, up or down, or to either side. Slight readjustment of the ion trap setting may then be necessary.

## HEIGHT CONTROL AND VERTICAL LINEARITY ADJUST-

 MENT - A test pattern will be required for the proper adjustment of these two controls. The height control ha the pronounced the adjustment of this control will expand or contract the top of the picture more than the bottom. The vertical linearity control will affect the height some what but will have a more pronounced effect on the bot tom portion of the picture. The interaction between these two controls makes it necessary to adjust both for prop er picture height and vertical linearity

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A. T-105 IS REPLACED BY T-106-1 (52C258) WHICH INCLUDES I2V. LEAD.

ON JI300D CHASSIS THE fOLLOWING Changes have been made:
A. C-150 IS REPLACED BY C-150-2 (1000 MMF. 500 V., CERAMIC DISC.)

D. R-161 IS REPLACED BY R-161-1 WHICH IS IDENTICAL' TO R-I61 EXCEPT FOR DELETION
E. L-IIB DEFLECTION YOKE IS REPLACED BY L-II8-2 (53C320)

| VHF |  |  |
| :--- | ---: | ---: |
| 17" | CHASSIS | 17-21" |
| A1300D | J1300D |  |
| RUN 1 \& 1-2 | RUN 1\&1-2 |  |

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HORIZONTAL AMPLIFIER, DAMPER AND HIGH VOLTAGE RECTIFIER

Before endeavoring to view the following waveforms
read the notes and instructions at the beginning of this read the notes and instructions at the beginning of thls
section pertaining to waveforms. The high voltage section pertaining to waveforms. The high voltage
probe shown below must be used to prevent damage to the test equipment being used.


NOTE: When observing this test pattern the oscilloscope must not be grounded since the ground side of the scope is connected to $\mathrm{B}+$ of the power supply.
Do not touch the tv chassis and the scope during this Do not touch the tv chassis and the scope during thi
observation as a severe shock will result. The "ho observation 28 a severe shock will result. The ho
lead of the scope should be connected to the red wire lead of the scope should be connected to the red wire
and the other scope lead should be connected to the
red wire with black tracer.

## 



Fig. 50A. High Voltage Probe for Waveform Observations


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Before viewing the following waveforms set the and the paltern shown on page 1954-47.

V-104
Video Amp.
Plate pin 7
Sweep Freq.
${ }_{7875 \mathrm{cps}}$ Voltage P/P
set 60 volts

Adjust the contrast control to give a 60 volt peak to
peak reading. Do not change this setting when takine other waveforms.

SYNC. CLIPPER


VERTICAL OSCILLATOR AND VERTICAL AMPLIFIER

## (


$\begin{array}{r}\text { V-108B } \\ \text { Vert. Out. } \\ \text { Grid Pin } 7 \\ \begin{array}{c}\text { Sweep Freq. } \\ 30 \mathrm{cps}\end{array} \\ \begin{array}{c}\text { Voltage } \mathrm{P} / \mathrm{P} \\ 90 \text { volts }\end{array} \\ \hline\end{array}$
Junction of
$\mathbf{R}-138$, R-140
$\& \mathbf{C}-129$
Sweep Freq.
30 cps
St
Voltage $\mathrm{P} / \mathrm{P}$
45 volts


PIX TUBE GRID AND VERTICAL YOKE


Across Vert
Yoke
Green Leads
Sweep Freq.
Voltage $\mathrm{P} / \mathrm{P}$
30 volts

NOTE: When observing this test pattern the oscilloscope must not be grounded since the ground side
of the scope is connected to B of the of the scope is connected to $\mathrm{B}+$ of the power supply
Do not touch the tv chassis and Do not touch the te chassis and the scope during this
observation as a severe shock will result. The "hot"
lead of the sco lead of the scope should be connected to the green
wire and the other scope lead should pe connected to wire and the other scope lead should be connected to the green wire with black tracer.

HORIZONTAL OSCILLATOR AND HORIZONTAL AMPLIFIER DRIVE


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Fig. 43A. Voltage Chart for Chassis D1300 (Runs 3 \& 3-1)

ig. 44A. Voltage Chart for Chassis F1300D (Runs 5 \& 5-2)

- KEpemp Key
* depends upon the
- inoicates ground lugs.
tp me point.
nC No CONNECTIOA
hr not readable.
- Varies from 3 to 34 V . oepending on
setting of contrast control
3 VARIES FROM O-16 V. OEPENDING ON
SETTING OF COWTRASt CONTROL.
O for voltages of vhf tuner on vhf
SEE PAGE 1953-528.
§
ON RUN 5-2 CMASSIS V-105
IS REPLACED BY $v-109-1(12 S N 7 G T)$

```
voltage reaomg mofes
EONOITONS:
1. antennas disconnected, and
1. ANTENNAS DISCONNECTED, AND
2. ERIGHTNESS CONTROL MAXIMUM.
3. AGC CONTROL SET TO MAXIMUM COUNTER
    CLOCKWISE. POSITION.
4. all other controls set or normal raster
3. LINE VOLTAGE IITVGO ~AC.
    G. AlL voltages are oc and positive with
    RESPECT TO THE CHASSIS UNLESS OTHERWISE
    SPECIFIED.
    7. all readings taken with a vtvm
    B. CHANNEL SELECTOR SET TO UHF.
```



KEY

- vamies from so tomor oepenome urom tie
* vamies from so to hov oepenono setine of the height contao.
- inoicates ground lugs
tp TiE POINT.
nc no connection.
wh not reacable.

MOTES
VOLTAGE REAOING TAKEN UNOER THE FOLOMMG
CONOITROSS:
a antemmas oisconmected, and

- Antemmas olsconmec

2. aLl readines taken with a vtim
3. ARIGHTNESS COWTROL MAXIMm
4. CONTRAST CONTROL MINIMUM.
5. AGC CONTROL SET TO MAXIMUM COUNTER

- CLOCKWISE POSITIION.

6. all other controls set for
-. ALL VOLTAGES ARE DC ANO POSITIVE wIT ARESPELTT TO THE CHASSIS UNLESS OTHERWISE
SPECIFIED.

- datiss from so to mov oepending upon the
* SETTING OF THE HEIGHT CONTAOL
- inoicates ground lugs
tp tie point.
MC
NR
NO COT READABLE.

| MOTES |
| :--- |
| VOLTAGE REAOING TAKEN UNDER THE FOLLOWING |
| COKOTVONS: | ANTENNAS DISCONNECTLD, ANTENNAS DISCONNEC

TERMIMALS SHORTED.
2. all readings taken with a vtvm.
3. ERIGHTNESS CONTROL MAXIMUM
4. contaast control minimum.
5. AGC CONTROL SET TO
6. all other controls set for normal raster.
7. LINE VOLTAGE IITV $60 \sim$ ac.
6. ALL voltages ane oc and positive with
RESPECT TO TAE CMASSIS UNLESS OTHERWISE esprect to the chassis unless othenwise
SPECIFIED. SPECIFIED.



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## BAND PASS ALIGNMENT OF ICI7I7 TV TUNERS

## ALIGNMENT OF THE $1 E 1660$ AND 1E1855 UHF TUNERS

CAUTION: Band pass alionment is carefully made at the factory. Attempt this alionment only with proper equipment and set-up. The tube shields and the bottom cover for the tuner must be in place. The oscillator adjustment given on page 1954-29 must be completed before the band pass alignment is started.

1. Complete the ser-up procedure given on page 1954-29.
2. Connect the leads from the sweep and marker generators to the tuner antenna terminals
3. Turn the channel selector to channel 13. Adjust the generators to the correct frequencies for channel 13 as show in the chart on page 1954-25.
4. Adjust L-3 (channel 13 rf plate), and L-6 (channel 13 mixer grid) adjusting screws (see Fig. 29B) for a band pass characteristic containing both carriers with steep sides and maximum gain

If the factory adjustment of the incremental loops and coils has not been disturbed, alignment on the ri plate, rigrid, and mixer grid should be complete after the completion of step 4 unless extensive repairs have been made on the tuner Check the other channels for a similar band pass characteristic as shown in Fig. 30A. If they have the correct characteristics further alignment is not necessary.
pressing the turns of the coil before continuing with steps 5 and 6 .
5. Adjust the coils of the rf plate, rf grid, and mixer grid for channels 12 through 7 starting with channel 12. Adjust the signal generators for each channel to the frequencies given in the chart on page 1954-25. Pushing the hal turn coil loops towards the center of the switch so that they are closer to the switch wafer will increase the fre quency while pulling them out and away from the switch wafer will decrease the frequency. Adjust for a band pass characteristic containing both carriers with steep sides and maximum gain.
6. Adjust the coils of the rf plate, ri grid, and mixer grid for channels 6 through 2 starting with channel 6 . Adjust the signal generators for each channel to the frequencies given in the chart on page 1954-25. Spreading the turns of the coils will increase the frequency while squeezing the turns together will decrease the frequency. Adjust for band pass characteristic containing both carriers with steep sides and maximum gain. A tuning wand may be used to determine what change is necessary


Fig. 31A. Sweep Generator Coupling
Fig. 31 B. Detector Circuit
Fig. 30A. Typical Channel Response Curves for ty Tuners

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## BAND-PASS ALIGNMENT FOR 16 POSITION VHF TUNERS 1E1483, 1E1670, \& $1 E 1718$

do not attempt this alignment until the i-f alignment of the receiver has been checked and is known to be correct. the oscillator adjustment procedure given on page 1954-26 must also be completed before starting this alignment.

1. Connect the balanced sweep output from a signal generator to the VHF tuner antenna terminals through the 300 ohm pad shown in Fig. 26A. Set the sweep generator for 20 MC or maximum sweep.
2. Connect the negative side of the $1 \frac{1}{2}$ volt bias supply through a 1000 ohm resistor to terminal 8 of the VHF tuner Connect the positive side of the bias supply to the chassis
3. Connect the oscilloscope and band-pass detector circuit shown in Fig. 18A to Test Point TP-2 shown in Fig. 27B.
4. Set the VHF tuner channel selector to channel 13.
5. Loosely couple the high side of the marker generator to the band-pass detector circuit by clipping the lead over the germanium diode in the detector circuit. Connect the ground side of the generator to the chassis of the VHF tuner.
6. Set the sweep generator for channel 13 and turn the VHF tuner channel selector to channel 13
7. Adjust L-2 (channel $13 \mathrm{r}-\mathrm{f}$ grid), L-3 (channel $13 \mathrm{r}-\mathrm{f}$ plate), and L-6 (channel 13 mixer grid) adjusting screws (see Fig. 27B) for a band pass characteristic containing both carriers with steep sides and maximum gain. See regardless of the shape of the skirts. The slope and position of the skirts are primarily controlled by the $\mathrm{r}-\mathrm{f}$ plate adjustment ( $\mathrm{L}-3$ ) while the mixer grid adjustment ( $\mathrm{L}-6$ ) controls the slope of the flat topped portion of the curve. Always adjust to place the picture carrier marker on a peak of the curve.
If the factory adjustment of the incremental loops and coils has not been disturbed, alignment of the r-f plate, r-f grid and mixer grid should be complete after the completion of step 7, unless extensive repairs have been made on the
tuner. Check the other channels for a similar band-pass characteristic as shown in Fig. 27 A . If they have the cor rect characteristics further alignment is not necessary. If they do not, proceed with the following steps.
8. Adjust the coils of the r-f plate, r-f grid and mixer grid for channels 12 through 7 starting with channel 12 Adjust the signal generators for each channel to the frequencies given in the chart on page 1954-25. Pushing the half turn incremental loops toward the center of the switch so that they are closer to the switch wafer will Always adjust the r-f grid coils for maximum mid-band gain and the r-f plate and miver grid coil lined in step 7.
9. Adjust the coils of the r-f plate, r-f grid and mixer grid for channels 6 through 2 starting with channel 6 . Adjust he signal generators for each channel to the frequencies given in the chart on page 1954-25. Spreading th turns of the coils will increase the frequency while squeezing the turns together will decrease the frequency Always adjust thed
lined in step 7 .


Fig. 28A. Numbering of Tuner Terminals

Fig. 28B. Channel Selector Switch Positions


## ALIGNMENT FOR IE1483, IE1670, \& 1E1718 VHF 16 POSITION CASCODE TUNERS

These tuners have been carefully aligned at the factory by personnel using precision equipment. Minor adjustments of the tuner may be necessary after making tube or part replacements. When replacing tubes in a tuner use the same tube type as the original tube which was removed from the tuner and also try several different tubes and select the one which gives best performance. Realignment of the tuner probably will not be required if a selected tube is used for replacement. For those service engineers who are properly equipped as specified, the following align ment procedure is included. DO NOT ATTEMPT TUNER ALIGNMENT UNTIL THE TV RECEIVER IS KNOWN TO BE FUNCTIONING NOTE PROPERLY AND THE I-F ALIGNMENT OF THE RECEIVER IS CORRECT.

## EQUIPMENT REQUIRED FOR VHF TUNER ALIGNMENT

Sweep Generator
Marker Generato
Oscilloscope
Bias Source
Detector Circuit
RCA type WR-59B or equiv.
RCA type WR-39C or equiv
$\begin{array}{ll} & 1 \frac{1}{2} \text { volt battery or equiv. } \\ \text { Isolation } & \\ & \\ \text { See Fig. } 18 \mathrm{~A} .\end{array}$

OSCILLATOR ADJUSTMENT FOR 16 POSITION TUNERS

1. Connect the balanced sweep output from a signal generator to the VHF tuner antenna terminals through the 300 ohm pad shown in Fig. 26A. Set sweep generator for 20 MC or maximum sweep.
2. Connect the negative side of $1 \frac{1}{2}$ volt bias supply through a 1000 ohm resistor to terminal 8 of the VHF tuner Connect the positive side of the bias supply to the chassis.
3. Connect the oscilloscope and band -pass detector circuit shown in Fig. 18A to Test Point TP-2 shown in Fig. 27B.
4. Set the VHF tuner channel selector to channel 13.
5. Loosely couple the high side of the marker generator to the antenna input terminals by clipping the lead over the lusulatiun of une sweep generator lead. Connect the ground side of the generator to the chassis of the VHF the Insulaliun of set the marker generator to the channel 13 picture carrier frequency of 211.25 MC .
6. Carefully note the position of the marker pip on the response curve. Use a grease pencil if necessary to mark Carefully note the position the cathode ray tube.
7. Loosely couple the high side of the marker generator to the band-pass detector circuit by clipping the lead over the germanium diode in the detector circuit. Connect the ground side of the generator to the chassis of the VHF tuner. Set the marker generator to 45.75 MC .
8. Rotate the fine tuning control of the VHF tuner until the 45.75 MC marker is in the same spot as the marker in steps 5 and 6. If this cannot be accomplished by adjustment of the fine tuning control, adjust the channel 13 TUNING CONTROL AFTER THIS ADJUSTMENT
9. Switch the VHF tuner channel selector and sweep generator to channel 12
10. Repeat steps 5 and 6 except use the picture carrier frequency for channel $12(205.25 \mathrm{MC})$ in step 5 .
11. Repeat step 7 using the same marker frequency of 45.75 MC
12. Adjust the incremental oscillator coil for the channel until the 45.75 MC marker pip is in the same position on the curve as the marker pip for the picture carrier was in step 10
13. Repeat steps $9,5,6,7$ and 12 for channels $11,10,9,8$ and 7 in that order. In each case switch the channel selector and sweep generator to the channel being aligned. The marker generator frequency for step 5 wil e the picture carrier frequey for the channel being aligned. See the chart on page 1954-25 for the picture carrier frequency of each channel:

Switch the channel selector and sweep generator to channel 6 and repeat steps 5 and 6 except use the picture carrier frequency for channel 6 ( 83.25 MC ) in step 5 .
15. Repeat step 7 using the same marker frequency of 45.75 MC .
16. Adjust the channel 6 oscillator adjustment until the 45.75 MC marker pip is in the same position on the curve as the marker pip in step 14. See Fig. 27B.

Repeat step 9, 5, 6, 7 and 12 for channels 5, 4, 3 and 2 in that order. In each case switch the channel selector and sweep generator to the channel being aligned. The marker generator frequency for step 10 will be the picture carrier frequency for the channel being aligned. See the chart on page 1954-25 for the picture carrie frequency of each channel.
the piarker generators are available the alignment can be greatly simplified by using one generator th the picture carrier marker and the other for the 45.75 MC marker. Both generators are connected to the
receiver at all times as directed in the above instructions. The use of two generators will produce two pips on the pattern. The adjustments outlined above will make these two pips coincide on the oscilloscope pattern


EACH RESPONSE CURVE MUST FAL typical curves are shown below
$\qquad$


928:956


Fig. 278. Alignment Adjustments for 1E1483, 1E1670, or 1 E1718 Tuners

## ALIGNMENT OF 1E1846 \& 1B1969 CASCODE VHF TUNERS

## SET-UP PROCEDURE FOR TUNER ALIGNMENT

1. Set the channel selector switch to channel 13
2. Connect the oscilloscope through a $10,000 \mathrm{ohm}$ carbon resistor to the test point on the top of the tuner chassis.
3. Connect the negative side of the bias source through a 1000 ohm isolation resistor to the terminal where the AGC (green wire) lead from the tuner is connected. Connect the positive side of the bias source to the receiver chassis.
4. Set the fine tuning control at the approximate midpoint of its tuning range.
5. Connect the sweep generator to the antenna terminals through the balanced pad shown in Fig. 19B and adjust the output to sweep channel 13.
6. Couple the output from the marker generator to the antenna circuit by connecting the hot lead from the generator to the junction of the four 220 ohm resistors of the pad shown in Fig. 19B. Connect the ground lead to the r-f tube
shield in the VHF tuner. Use the minimum amount of signal from the marker generator required to give a good shield in the VHF tuner. Use the minimum amount of signal from the marker generator required to give a good marker or pip on the oscilloscope pattern

## NORMAL ANTENNA AND R-F CIRCUIT ADJUSTMENT

1. Complete the set-up procedure.
2. Adjust C-3, C-5, and C-10 for a flat-top response curve and maximum gain.
3. Check the position of the markers on all channels. They should fall in place automatically. Correct marker frequencies for each channel are given in the Picture Carrier and Sound Carrier columns of the chart on page 1954-25. The response curves in Fig. 20A are ideal curves and the adjustments should be made to approach these curves as nearly as possible.
4. If the proper response curves can not be obtained repeat steps 1,2 , and 3 with a different set of selected tubes in
the tuner.

## COMPLETE ANTENNA AND R-F CIRCUIT ADJUSTMENT

If the "Normal" adjustment described above does not give the desired response curves a complete realignment of the tuner will be required. Before this alignment can be completed it will be necessary to remove the tuner from the chassis without disconnecting the electrical connections to the tuner. It may be necessary to insert extention leads on the red, blue, black, and green wires from the tuner. Do not disturb the shielded output cable or attempt to insert an
extention in this cable. The side shield plate must also be removed from the tuner in order to get at the internal adjustments.

To prevent the possibility of the tuner circuits in the antenna input circuit from effecting the response curves obtained in the steps $1-10$ a 330 ohm , $\frac{1}{2}$ watt resistor may be connected across $\mathrm{L}-2$ while making these adjustments. However, this will introduce loss and the output of the signal generators or the gain of the oscilloscope used may not be high enough to obtain a useable oscilloscope indication. With this resistor in place the valleys of the response curves will
appear deeper and the band width will be wider than shown in the tuner response curves.

1. Set the channel selector switch to channel 5.
2. Connect the oscilloscope through a 10,000 ohm carbon resistor to the test point on the top of the tuner chassis
3. Complete steps 3 and 4 as given under SET-UP PROCEDURE.
4. Connect the sweep generator as given in step 5 of the SET-UP PROCEDURE and adjust the output to sweep channel 5.
5. Connect the marker generator as given in step 6 of the SET-UP PROCEDURE and adjust the output for channel 5 sound and picture carrier frequencies. See chart on page 1954-25

## ALIGNMENT OF lE1846 \& 1B1969 CASCODE VHF TUNERS

## COMPLETE ANTENNA AND R-F CIRCUIT ADJUSTMENT (Cont.)

6. Adjust $\mathrm{C}-22$ (wire gimmick) to change the bandwidth over a narrow range. Push the free end of $\mathrm{C}-22$ towards the contact terminals to increase the band width or pull it away to decrease band width. CAUTION -- THIS GIMMICK BURNED OUT
7. Switch the channel selector and the test equipment to channel 13
8. Adjust L-7 to control the till of the response curve and Capacitors C-8 and C-9 for the desired bandwidth. To reduce the picture carrier side of the response curve it is necessary to increase the inductance of L-7 by spreading or unwinding the turns. To increase the amplitude of the picture carrier side of the response curve it is necessary to decrease the inductance of L-7 by compressing or winding up the turns. Capacitors C-8 and C-9 are fixed disc ceramic units and they themselves are not adjustable. However, the physical distance between these two capacitors will effect band width on the higher channels. Moving the two capacitors together will narrow the
9. Adjust $\mathrm{C}-5$ and $\mathrm{C}-10$ for a flat-top response curve and maximum gain
10. Repeat steps 1 through 9
11. Check channels 7 to 13 for the depth of the valley in the center of the response curve and adjust $L-8$ for optimum results on these channels. Decreasing the inductance of L-8 by spreading the turns will decrease the depth results on the
of the
12. Remove the 330 ohm resistor if it has been used for the previous steps.
13. Set channel selector and test equipment to channel 13
14. Adjust C-3 for maximum gain and a flat top response curve
15. Disconnect all alignment equipment and replace the shield on the side of the tuner and air check the receiver on all active channels.
16. Remount the tuner in the chassis and check the alignment of the tuned circuits in the output circuit of the tune and the grid circuit of the first i-f amplifier stage. Instructions for this alignment are given under the i-f align ment procedure.

## OSCILLATOR CIRCUIT ADJUSTMENT

1. Set the fine tuning control at the approximate midpoint of its tuning range.
2. Place a non-metallic screwdriver through the openings provided in the front of the chassis and tuher assembly and adjust the oscillator coil slug for each active VHF channel to give the best possible picture.

NOTE -- If the slug in the oscillator coil does not have enough range on any channel, place the slug in the approximate center of its range and adjust C-17 for the best possible picture. It will then be necessary to adjust all of the oscil lator coils as directed in steps 1 and 2 . When replacing 6 J 6 tubes, $\mathrm{C}-17$ may be adjusted for the best possible pictur on any one active channel and thereby eliminate the necessity of adjusting each individual oscillator core.

## ALIGNMENT FOR THE $1 E 1852$ TV TUNER

## OSCILLATOR CIRCUIT ADJUSTMENT

1. Set the fine tuning control at the approximate midpoint of its tuning range
2. Place a non-metallic screwdriver through the openings provided in the front of the chassis and the tuner assembly and adjust the oscillator coil slug for each active VHF channel to give best possible picture
NOTE- Adjustment of the oscillator slugs may be accomplished on some models while the chassis is in the cabinet by removing the front knob escutcheon. An access hole for this adjustment is provided in the cabinets with removable front safety glass, but not in the knob escutcheons.

40 to 54 MC TRAP - The antenna input circuit of the VHF tuner contains a trap that may be adjusted to attenuate or eliminate interference within the range of 40 to 54 MC . If interference is encountered adjust C-23 on the top of the VHF tuner for minimum picture interference. Improper ad
channel 2. Care must be exercised that this does not happen.



Fig. 20A. Typical Response Curves for VHF Channels

## SERVICING AND ALIGNING THE IE1846 \& 1B1969 VHF CASCODE TUNERS

no attempt to realign the tuner should be made until the balance of the tv receiver is known to be in Proper operating conditions and is property aligned.
This tuner was carefully aligned at the factory and should not require complete realignment under normal operating conditions. When replacing tubes it is of utmost importance that several different tubes are tried and the one giving the best performance selected for use. The use of selected tubes will, in the majority of cases, eliminate the necesser When selecting tubes tune the receiver to the highest active channel as slight differences in the tube will show up more clearly on the high channels.

When the oscillator tube has been replaced it may be necessary to adjust the individual oscillator coil slugs even though a selected tube has been used. However, before adjusting the individual oscillator coil slugs try adjusting C-1 for the desired results. This capacitor is in parallel with the fine tuning capacitor and determans the cuning rang the fine tuning capacitor. C in is reception.

Whenever it is necessary to replace components within the tuner the following precautions must be observed to preven the necessity of tuner realignment after the service work has been completed. The physical location of all components and wires must not be changed. If a new component is installed it must have the same lead length as the old part and be placed in the same location. The position and settings of the various air core coils must not be changed. Note that the series coil (L-6) in the r-f plate/cathode circuit requires spec
caution should be used to prevent disturbing the setting of this coil.

In order to adjust L-6 a grid dip oscillator capable of tuning from 230 to 235 MC will be required. This coil must be resonated at a frequency between 230 and 235 MC in order to provide increased gain on the higher VHF channels. It is resonated by the plate to ground capacitance of the first triode section and the cathode to ground capacitance of the second triode section. With the plate voltage (blue wire) removed and the heater voltage applied to the cascode amp ${ }^{\prime \prime}$ ier the turns of L-6 may be compressed or expanded untid dip oscillator as an indicator

If the service work on the tuner is confined to components in the oscillator/mixer stage it is necessary to align only the oscillator/mixer stage. It will not be necessary to adjust $C-3$ in the grid circuit of the first triode section or the cascode amplifier. In the great majority of cases, if care is used when servicing the tuner, it will only be necessary to adjust C-5, C-10\& C-17 after working on the oscillator/mixer section

Similarly, if the service work has been done in the first triode section of the cascode amplifier an adjustment of C-3 only should restore the tuner to normal provided L-6 has been adjusted as outlined above.
nly should restore the tuner to normal provided ${ }^{-6}$ has been adiusted as outlined ab
EQUIPMENT REQUIRED FOR TUNER ALIGNMENT
QUIPMENT REQUIRED FOR TUNER ALIGNMENT

$$
\begin{aligned}
& \text { VHF Sweep Generator-- RCA type WR-59B or equiv. } \\
& \text { VHF Marker Generator-- RCA type WR-39C or equiv. } \\
& \text { Oscilloscope }-2 \text { RCA type WO-56A or equiv. } \\
& \text { Bias Source } \\
& \text { Input Pad }
\end{aligned}
$$

## ALIGNMENT OF THE CASCODE I-F AMPLIFIER IN UHF/VHF CHASSIS

NO ATTEMPT SHOULD be made to perform the following procedure until the balance of the TV RECEIVER IS KNOWN TO BE IN PROPER OPERATING CONDITION AND THE REGULAR I-F ALIGNMENT HAS BEEN COMPLETED. (See Fig. 33A or 33B for location of adjustments and Fig. 18B for response curve.)

## EQUIPMENT REQUIRED



Sweep Generator $\qquad$ RCA type WR-59B or equiv. Marker Generato
$\qquad$ RCA type WR-39C or equiv. Detector Circuit
$\qquad$ 2 Fig. 18A.

## PROCEDURE

1. Set the UHF/VHF switch to UHF position. Select an inactive channel between 35 and 45 .
2. Connect all test equipment and the television chassis to a common ground. Be sure to use an isolation transformer for the receiver chassis. Allow at least a 5 minute warm-up in this position.
3. Connect the hot lead of the sweep generator to pin 7 of V-401 (Cascode I-F amplifier). Set the generator to sweep from 40 to 48 mcs
4. Connect the oscilloscope to the plate circuit of V-101 through the detector circuit of Fig. 18A.
5. Loosely couple the hot lead of the marker generator to the hot side of the sweep generator through a 22 mmf . capacitor. This coupling may also be accomplished by clipping the hot lead from the marker generator over the crystal diode in the detector circuit in Fig. 18A.
6. Adjust L-403 to place the 45.75 marker on one peak of the response curve on the oscilloscope. Note the position of the 42.75 marker.
7. Adjust L-405 by compressing or spreading its turns to equalize the two peaks on the response curve on the scope.


Fig. 18B. Response Curve for Cascode

## ALIGNMENT FOR THE $1 E 1852$ TV TUNER

The tuner was carefully aligned at the factory and should not require complete realignment under normal operating conditions. A slight readjustment of the individual oscillator slugs may be required as the tubes in the tuner age or NO ATTEMPT Use of selected tubes is recommended to obtain the best possible results without aligning the tuner NO ATTEMPT TO REALIGN THE TUNER SHOULD BE MADE UNTIL THE BA LAN

## EQUIPMENT REQUIRED

VHF Sweep Generator__RCA type WR-59B or equiv VHF Marker Generator_RCA type WR-39C or equiv Oscilloscope $\qquad$ RCA type WO-56A or equiv. Bias source

SET-UP PROCEDURE

1. Set the channel selector switch to Channel 10
2. Connect the oscilloscope through a 10,000 ohm resistor to TP-9 shown in Fig. 19A.
3. Connect the negative side of the bias source through a 1000 ohm isolation resistor to the terminal where the AGC lead (white wire) from the tuner is connected. Connect the positive side of
4. Set the fine tuning control by placing widest point on cam on left side of shaft.
5. Connect the sweep generator to the antenna terminals through the pad shown in Fig. 19B. and adjust the output to sweep
6. Couple the output from the marker generator to the antenna circuit by connecting the hot lead from the generator to the unction of the four 220 ohms resistors in the pad shown in Fig. 19B. Connect the ground lead to the $r$-f tube shield in he VHF tuner. Use minimum amount of signal from generato necessary to obtain good pip in scope pattern.

## ANTENNA AND R-F CIRCUIT ADJUSTMENT

7. Adjust C-13, C-3, and C-6 for a flat-top response curve and maximum gain. Check the position of the markers on all channels. They should fall in place automatically on all chan-
nels. Correct marker frequencies for each channel are given nels. Correct marker frequencies for each channel are given on page 1954-25. The response curves shown in Fig. 20A. should be used as a guide to show the various shapes that the response curves may have and still be satisfactory. If necessary adjust C-25 (gimmick) to change bandwidth over a narrow range (approx. 2 mc .) on Channel 10 . To increase bandwidth,
push the gimmick closer to the contact terminals. CAUTION: This gimmick must not touch the tuner chassis as it is connected to the plate of the r-f stage
8. Disconnect the bias source and test equipment.
9. Air check the receiver on all active VHF channels. If it is possible to receive a normal picture on all active , further alignment is not absolutely necessary


Fig. 19A. Alignment Adjustments for


## I-F AMPLIFIER ALIGNMENT FOR 1300D CHASSIS

## EQUIPMENT REQUIRED


$\mathrm{i}-\mathrm{f}$ transformers, $\mathrm{L}-9$, and $\mathrm{L}-101$ according to the I-F AMPLIFIER ALIGNMENT CHART shown below. Readjust the signal generator output as required to maintain the two volt VTVM readin.

I-F AMPLIFIER ALIGNMENT CHART

| Signal Generator <br> Frequency <br> (No Modulation) | Adjustment | Transformer <br> nr Coil <br> Location | VTVM <br> Indication |
| :---: | :---: | :---: | :---: |
| 45.0 MC | $\mathrm{T}-101$ |  | Maximum |
| 42.8 MC | $\mathrm{T}-102$ (bottom) |  | Maximum |
| 44.0 MC | T-103 | See Fig. 13A or 14A | Maximum |
| 41.25 MC | T-102 (top) |  | Minimum |
| 42.8 MC | T-102 (bottom) |  | Maximum |
| 44.25 MC | $\S * \mathrm{~L}-101$ (top) or L-101-1 (bottom) |  | Maximum |
| 44.25 MC | \#L-9 |  | Maximum |

IMPORTANT - The wax in the end of the coil forms holding the iron core in position may be softened for adjustment of the core by means of a heated screwdriver or a small pencil type soldering iron inserted into the wax. Remelt wax after adjustment.
ax

* NOTE: Temporarily connect the series resistor-capacitor combination shown in Fig. 16A to the tuner test point TP-2 when making this adjustment on all tuners except the 1 E1852 or 1E1846. With the 1E1852, 1E1846, or
§ NOTE: Top adjustment of L-101-1 may be used in conjunction with L-9 of 1E1846 or 1B1969 tuner to give proper band width response.
\# NOTE: Temporarily connect the series resistor-capacitor combiation shown in Fig. 16A to the grid (pin 1) of V-101 the 6CB6 first i-f amplifier when making this adjustment.

- Disconet the VTVM and directed in steps $1,2,3$ and 6

9. Capacitively couple the high side of the sweep generator $r-f$ output to the osc./mixer tube by connecting to the tube shield which has been raised above its grounding clips. The ground side of the sweep generator should be connected o the receiver chassis. Adjust the generator to sweep from 40.5 to 46.5 MC
10. Loosely couple the high side of the marker generator to the high side of the sweep generator by clipping the marker Lenerator $r-f$ lead over the insulation of the sweep generator $r-f$ lead. The ground side of the marker generator hould be connected to the receiver chassis.

IMPORTANT - To prevent overloading of the i-f amplifier keep the output of the sweep and marker generators as low as possible. The marker generator output should be just high enough to produce visible pips on the pattern. In some cases the 41.25 MC pip will not be visible unless the $\mathrm{r}-\mathrm{f}$ output of the marker generator is increased to overcome the attenuation of the 41.25 MC signal by the trap in the top of ' $\mathrm{T}-102$
11. Connect the sweep output terminals on the sweep generator to the input of the horizontal amplifier in the os cilloscope.
12. Connect one side of a 47,000 ohm $1 / 2$ watt resistor to test point (D) shown in the schematic diagrams. Connect the other end of the resistor to the high side of the input terminals for the vertical amplifier in the oscilloscope. The scope ground terminal connects to the receiver chassis. Keep the scope leads away from the internal chassis wiring, particularly the horizontal output section
3. Reduce the $r$-f output of the sweep generator and increase the gain of the vertical amplifier in the oscilloscope as much as possible without introducing an excessive amount of noise on the test pattern. This will prevent over loading of the $i-f$ system
14. Check the position of the markers shown in Fig. 17A. Adjust only the bottom cores of T-101, T-102 and T-103 for a response curve of maximum amplitude with a slightly tilted flat topped appearance as shown in Fig. 17A. obtained will be flat when the pattern viewed on the oscilloscope has this tilt. The bottom core of T-103 will primarily control the tilt of this central portion of the curve
he bottom core of T-101 should be adjusted to position the 45.75 MC marker in the $50 \%$ position shown in Fig. 517A.
The bottom core of T-101 should be adjusted to determine the slope of the curve between 41.25 MC and 42.8 MC with the 42.25 MC marker down $50 \%$ on the curve as shown in Fig. 17A.
Under no circumstances should an attempt be made to adjust L-9, L-101 and the 41.25 MC trap in the top of T-10 by means of an oscilloscope and sweep generator. Maladjustment of these coils does not give a noticeable indica on on the oscilloscope. Align these coils by following the procedure given in steps 1 through 7 only.

## I-F AMPLIFIER SENSITIVITY

## MEASUREMENT

To determine the i-f amplifier sensitivity disconnect the $r$-f output lead from the tuner where it connects to L-101. Temporarily con capacitor to grid pin 1 of the first 6CB6 i-f amplifier tube $V-101$. Connect the unmodulated $r$-f output of a marker generator to the other side of the capacitor and the ground side of the generator to the TV chassis. Set the marker generator to 43.75 MC . Connect a VTVM as directed in step 5 of the alignment procedure. The 3 volt battery must be removed. If a gen-
erator output of 200 to 400 microvolts produces erator output of 200 to 400 microvolts produces sensitivity is normal.

fig. 17A. Typical Response for 41.25 to 45.75 MC I-F Amplifiers

[^6]


Fig. 9C. 21" Glass Pix Tube Mounting


Fig. 118. 21" Metal Pix Tube Mounting.


Fig. 11C. 21" Glass Pix Tube Mounting
fM SOUND CHANNEL ALIGNMENT FOR I300D SERIES CHASSIS

## EQUIPMENT REQUIRED

Signal generator covering 4 to 30 mc . unmodulated
Vacuum tube voltmeter (VTVM).
Sound alignment test circuit shown in Fig. 12A.
Power line isolation transformer.

## PROCEDURE



Fig. 12A. Sound Alignment Test Circuit

1. Connect all test equipment to a common ground. Connect the TV chassis to this same ground after installin an isolation transformer between the power line and the TV chassis. One side of the line cord connects directly to the TV chassis and an isolation transformer must be used for safety.
2. Set the channel selector to any vacant channel and the contrast control at minimum.
3. Connect the signal generator output through a .005 mfd capacitor to test point (D) shown in schematic diagram Ground the shield of the generator output cable to the chassis
4. Connect the sound alignment detector circuit and VTVM as shown in Fig. 12A. Adjust the 4.5 mc . generator output (unmodulated) to give a 1 volt reading on the VTVM
5. Adjust the 4.5 mc . trap adjustment ( $\mathrm{L}-107$ ) at 4.5 mc . for a minimum VTVM reading
6. Disconnect the test circuit and connect the VTVM to test terminal (B) (Pin 2 of FM detector, V-113). See schematic diagram.
7. Adjust the 4.5 mc . amplifier grid adjustment ( $\mathrm{L}-114$ ) and the primary of $\mathrm{T}-108$ (bottom core) at 4.5 mc . for a maximum VTVM reading.
8. Connect the VTVM to test terminal (C), shown in the schematic diagram. Adjust the secondary of T-108 (top cure) at 4.5 mc . for the zero reading which occurs hetween the positive and negative peaks. If the zero reading occurs at more than one setting, use the position nearest the top limit of the core.
9. Shift the signal generator an equal amount on either side of 4.5 mc . and touch up the primary of $\mathrm{T}-108$ (bottom core) for approximately equal peaks. Use just enough signal output to obtain one volt peaks for best results.

## HORIZONTAL OSCILLATOR ADJUSTMENT

If the horizontal hold control fails to restore synchronization, the horizontal stabilizer coil (L-113) should be adjusted. Procedure for this adjustment is as follows:

1. Set the horizontal hold control in the approximate center of the range over which it may be rotated.
2. Set the channel selector to an active channel and adjus the horizontal stabilizer for a single steady picture. Se Fig. 12B.
3. Rotate the horizontal hold control full clockwise. The pictur may or may not remain in sync. If it does, momentarily switch the channel selector to another channel and return it to the original channel. The picture should now be slightly out of sync.
4. Rotate the horizontal hold control full counterclockwise. The picture may or may not remain in sync. If it does, momenhe picture should now be to the original channel. The picture slightly out of sync.

When the horizontal stabilizer coil is properly adjusted the results outlined in steps 3 and 4 will be obtained. If the correct results are not obtained, repeat steps 2,3 and 4 until they are.


Fig. 12B. Horizontal Oscillator Horizontal Oscilla
Adjustment Point

9282

$$
\begin{aligned}
& \text { Fig. 12B. Horizontal Oscilla } \\
& \text { Adjustment Point }
\end{aligned}
$$

OJohn F. Rider


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SERVICE PARTS LIST
TRANSFORMERS AND COILS

| Schematic Symbol | TRANSFORMERS AND COILS Description | Hallicrafter Part Number |
| :---: | :---: | :---: |
| T-101 | Transformer, 1st - 2nd I.F. | 50B561 |
| T-102 | Transformer, 2nd - 3rd I.F. | 50B568 |
| T-103 | 'Transformer, 3rd I.F. - diode detector | 50B562 |
| T-104 | Transformer, vertical blocking oscillator | 55B190 |
| T-105 | Transformer, vertical output | 55 C 192 |
| * T-106 | Transformer, horizontal output | 55D193 |
| T-107 | Transformer, ratio detector | $50 \mathrm{C473}$ |
| T-108 | Transformer, audio output | 55C191 |
| * T-109 | Transformer, horizontal output | 55D197 |
| * T-110 | Transformer, heater | 52C258 |
| * T-111 | Transformer, heater | 52 C 290 |
| T-201 | Transformer, 1st - 2nd I.F. | 50B573 |
| T-202 | Transformer, 2nd - 3rd I.F. | 50B574 |
| T-203 | Transformer, 3rd. I.F. - diode detector | 50B575 |
| L-101 | Coil, converter i-f | $51 \mathrm{B1301}$ |
| L-102 | Coil, video peaking. | 51A1578 |
| L-103 | Coil, video peaking | 51A1579 |
| L-104 | Coil, video peaking (wound on R-119) | 51A1580 |
| L-105 | Coil, 4.5 MC trap | 51B1541 |
| L-106 | Coill, video peaking (wound on R-122) | 51 A 1581 |
| L-107 | Coil, video peaking (wound on R-123). | 51A1582 |
| L-108 | Coil, horizontal stabalizer | $51 \mathrm{B1642}$ |
| L-109 | Coil, yoke coupling (wound on C-148) | 53B264 |
| L-110 | Coil, 4.5 MC amplifier grid adjustment | 51B1542 |
| L-111 | Coil, speaker field (part of speaker) |  |
| L-112 | Deflection yoke | 53A271 |
| L-113 | Choke heater | 53B294 |
| L-114 | Choke, r-f (channel 5 tweet filter) | $53 \mathrm{B008}$ |
| L-201 | Coil, converter - I.F. | 51-1643 |
| L-202 | Filament choke | 53 A 282 |
| L-203 | Filament choke | 53 A 282 |
| L-204 | Filament choke | 53 A 282 |

330 mmf .500 V ., ceramic tubular 330 mmf .500 V. , ceramic tubular 330 mmf .500 V. , ceramic tubula 5000 mmf . 500 V., ceramic disc 4000 mmf .500 v , ceramic 1000 mmf .500 V., ceramic disc 5000 mmf .500 V ., ceramic dis 5000 mmf .500 V ., ceramic disc 1000 mmf .500 V ., ceramic disc $5000 \mathrm{mmf} .500 \mathrm{~V} .$, ceramic disc 5000 mmf .500 V ., ceramic disc 1000 mmf . 500 V ., ceramic disc 10 mmf .500 V. ., ceramic tubular $4.7 \mathrm{mmf} .500 \mathrm{~V} ., 10 \%$ ceramic tubular 5.1 mid .200 V ., paper tubula 2.2 mmf 500 V paper tubular $30 \mathrm{mmf} .500 \mathrm{~V} ., 10 \%$ ceramic tubular 100-10 mfd. 300 V ., 200-30 mfd. 150 V ., electrolytic $200-5 \mathrm{mfd} .150 \mathrm{~V}$. , electrolytic. 5000 mmf .500 V ., ceramic dis $.1 \mathrm{mfd} .400 \mathrm{~V} .$, paper tubular $220 \mathrm{mmf} .500 \mathrm{~V} ., 10 \%$ ceramic tubular $.005 \mathrm{mfd} .600 \mathrm{~V} .$, paper tubular .05 mfd .400 V ., paper tubular .0047 mfd. $400 \mathrm{~V} .$, molded paper tubula .0047 mfd .400 V ., molded paper tubula .01 mfd .400 V. , molded paper tubular 0.0047 mfd .400 V ., molded paper tubular .047 mfd .400 V ., molded paper tubular $.047 \mathrm{mfd} .400 \mathrm{~V} .$, molded paper tubular 5000 mmf .500 V ., ceramic dis $20 \mathrm{mfd} .450 \mathrm{~V} .$, electrolytic $140 \mathrm{mfd} .150 \mathrm{~V} .$, , electrolytic 1000 mmf . 500 V ., ceramic tubula 1000 mmf . 500 V ., ceramic tubular .006 mfd .600 V ., paper tubular 0.003 mfd .400 V., paper tubular .001 mfd .1000 V., molded paper tubula $.01 \mathrm{mfd} .400 \mathrm{~V} .$, paper tubular 3900 mmf . 500 V., $10 \%$ silver mica $390 \mathrm{mmf} .500 \mathrm{~V} ., 10 \%$ silver mica 5000 mm .500 V , 10 s silver mica 120 mmf . 3000 V ., ceramic disc 1 mfd .200 V ., paper tubular (part of L-109) 68 mmf. 500 V ., $10 \%$ ceramic tubular Dual 4000 mmf . 500 V ., ceramic disc 5 mfd .50 V ., electrolytic
330 mmf . 500 V ., ceramic tubular 1000 mmf . 500 V., ceramic disc 5000 mmf . 500 V ., ceramic disc

Hallicrafters
Part Number
47BUL20331M5 47BUL20331M5 7B20331M
47 A 218
47A218
47A230
7A168
47A168
47A230
47A168
47A168
47A230
47 B 20100 K 5
$47 \mathrm{~A} 160-6$
47 A160-6
$46 A U 104 J$
46A177
7A160
47X25PG300K
45 C 209
45 C 210
47A168
46AV104J
47B20221K5
6AY502J
7B20220M5
46AWS472L
46BS472L4
46BS103L4
46 BS 472 L 4
46BS473L4
46BS473L4
7A168
45 B 208503 J
45 B 207 J
47B20A102M5
47B20A102M5
46 AZ 602 F
46AW302J
46BS102L10
46AW103J
47X30D392K $47 \times 20 \mathrm{D} 41 \mathrm{~K}$ 47X20D471K 47A168
47A296 47A296 47X30TH680K 47A218 45B175 47B20331M5 7A230

* USE EXACT REPLACEMENT PART ONLY




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## ALIGNMENT FOR IE1483 VHF 16-POSITION CASCODE TUNER

These tuners have been carefully aligned at the factory by personnel using precision equipment. Minor adjustments of the tuner may be necessary after making tube or part replacements. When replacing tubes in a tuner use the same tube type as the original tube which was removed from the tuner and also try several different tubes and select used for replacement. For those service engineers who are properly equipped as specified, the following alignment procedure is included. DO NOT ATTEMPT TUNER ALIGNMENT UNTIL THE TV RECEIVER IS KNOWN TO BE FUNCTIONING PROPERLY AND THE I-F ALIGNMENT OF THE RECEIVER IS CORRECT.

EQUIPMENT REQUIRED FOR VHF TUNER ALIGNMENT
Sweep Generator $\qquad$ RCA type WR-59B or equiv Marker Generat RCA type WR-39C or equiv. Bias Source
$\qquad$
$\qquad$ $1 \frac{1}{2}$ volt battery or equiv. Detector Circuit
$\qquad$ 150 watt rating or higher.


Isolation Transformer

## OSCILLATOR ADJUSTMENT FOR 16 POSITION TUNERS

1. Connect the balanced sweep output from a signal generator to the VHF tuner antenna terminal through the $\mathbf{3 0 0}$ ohm pad shown in Fig. 20BA. Set sweep generator for 10 MC sweep.
2. Connect the negative side of $1 \frac{1}{2}$ volt bias supply to terminal 8 of the VHF tuner. Connect the positive side of the bias supply to the chassis.
3. Connect the oscilloscope and band-pass detector circuit shown in Fig. 20CA to Test Point TP-2 shown in Fig. 20 CB .
4. Set the VHF tuner channel selector to channel 13
5. Loosely couple the high side of the marker generator to the antenna input terminals by clipping the lead over the insulation of one sweep generator lead. Connect the ground side of the generator to the chassis of the VHF tuner. Set the marker generator to the channel 13 picture carrier frequency of 211.25 MC
6. Carefully note the position of the marker pip on the response curve. Use a grease pencil if necessary to mark the position on the face of the cathode ray tube.
7. Loosely couple the high side of the marker generator to the band-pass detector circuit by clipping the lead over the germanium diode in the detector circuit. Connect the ground side of the generator to the chassis over the germanium diode in the detector circuit. Connect
of the VHF tuner. Set the marker generator to 45.75 MC
8. Rotate the fine tuning control of the VHF tuner until the 45.75 MC marker is in the same spot as the marker in steps 5 and 6 . If this cannot be accomplished by adjustment of the fine tuning control, adjust the channel 13 me not disturb the setting of the fine TUNING CONTROL AFTER THIS ADJUSTMENT
9. Switch the VHF tuner channel selector and sweep generator to channel 12.
10. Repeat steps 5 and 6 except the picture carrier frequency for channel $12(205.25 \mathrm{MC}$ ) in step 5 .
11. Repeat step 7 using the same marker frequency of 45.75 MC .
12. Adjust the incremental oscillator coil for the channel until the 45.75 MC marker pip is in the same position on the curve as the marker pip for the picture carrier was in step 10.
13. Repeat steps 9, 5, 6, 7 and 12 for channels $11,10,9,8$ and 7 in that order. In each case switch the channe selector and sweep generator to the channel being aligned. The marker generator frequency for step 5 will be the picture carrier frequency for the channel being aligned. See the chart on page 1953-14 for the picture carrier frequency of each channel.
14. Switch the channel selector and sweep generator to channel 6 and repeat steps 5 and 6 except use the picture carrier frequency for channel $6(83.25 \mathrm{MC})$ in step 5.
15. Repeat step 7 using the same marker frequency of 45.75 MC
16. Adjust the channel 6 oscillator adjustment until the 45.75 MC marker pip is in the same position on the curve as the marker pip in step 14. See Fig. 20CB.
17. Repeat steps $9,5,6,7$ and 12 for channels $5,4,3$ and 2 in that order. In each case switch the channel selector and sweep generator to the channel being aligned. The marker generator frequency for step 10 will be the frequency of each channel.

NOTE: If two marker generators are available the alignment can be greatly simplified by using one generator for the picture carrier marker and the other for the 45.75 MC marker. Both generators are connected to the on the pattern. The adjustments outlined above will make these two pips coincide on the oscilloscope pattern.




Fig. 20A. Voltage Chart for AJI2000 Chassis with 1C1376 Cascode Tuner
ALI200D Run 2 ond AY12000 Chassis with IE1671 Cascode Tun
A21
Voltage Chart for AJ12000 Chassis with 1C1376 Cascode Tuner
AL12000 Run 2 ond AY1200 Chassis with 1 E1671 Cascode Tuner, ond
AZ12000 Chassis with $1 E 1380$ Cascode Tuner

## $1 E 1380$ CASCODE TV TUNER ALIGNMENT (ANT. \& RF CIRCUITS)

The tuner was carefully aligned at the factory and should not require complete realignment under normal operating conditions. A slight readjustment of the individual oscillator slugs may be required as the tubes in the tuner age or are replaced. In some rate cases it will be necessary to realign the tuner after replacing either of the two tubes. If any service work is performed on the tuner, realignment may or may not be required. NO ATTEMPT R REALIGN Te TUNER SHOLITO OPERATING CONDITION AND IS PROPERLY ALIGNED.

## COUIPMENT REQUIRED

1. Sweep generator covering all 12 television channels
2. Marker generator covering the same range as the sweep generator.
3. Oscilloscope.
4. Vacuum tube voltmeter (VTVM)

## SET.UP PROCEDURE



Fig. 20AA. IE1380 Cascode Tuner

92 Cl 1868
 Alignment Adjustments

1. Set the CHANNEL SELECTOR switch to channel 12.
2. Connect the vertical amplifier input of the oscilloscope through a $10,000 \mathrm{ohm}$ resistor to test point TP-9 on the tuner. (See Schematic Diagram and Fig. 20AA). The horizontal amplifier in the oscilloscope should be connected to the oscilloscope sweep voltage output from the sweep generator
3. Connect the negative pole of a 1.5 volt dry cell to the terminal where the AGC lead (white wire) from the tuner is Connect the negative pole of a 1.5 volt dry cell to the terminal where the AGC (Sead (white wire) from
connected. (Connect the positive pole of the dry cell to the receiver chassis. (See Schematic Diagram).
4. Set the FINE TUNING control at the approximate midpoint of its tuning range.
5. Connect the sweep generator to the antenna terminals and adjust to sweep channel 12. Keep the output of the sweep generator as low as possible to prevent overloading the r-f stage
6. Loosely couple the r-f output from the marker generator to the antenna terminals. Use the minimum amount of coupling and signal from the marker generator required to give a good marker on pipe on the oscilloscope pattern

## ANTENNA AND RF CIRCUIT ALIGNMENT

7. Adjust C-13, C-3 and C-6 for a flat-top response curve and maximum gain. Check markers on all channels. They should fall in automatically on each channel. Correct marker frequencies for each channel are given in the Picture Carrier and Sound Carrier columns of the chart on page 1953-14 Refer to Fig. 20AB
8. Disconnect the battery used to obtain negative bias.
9. Disconnect the test equipment and air check the receiver on all active channels. If it is possible to receive a nor mal picture on all active channels by adjusting the FINE TUNING control, further alignment will not be necessary.

## IE1380 CASCODE TV TUNER ALIGNMENT (OSC. CIRCUIT)

1. Set the FINE TUNING control at the approximate midpoint of its tuning range.
2. Place a non-metallic screwdriver through the openings provided in the front of the chassis and the tuner assembly and adjust the oscillator coil slug for each active channel to give the best possible picture



## BAND PASS ALIGNMENT OF 1C1345, IC1376, 1E1492,\& $1 E 1677$ TV TUNERS

CAUTION: Band pass alignment is carefully made at the factory. Attempt this alignment only with proper equipment and set-up. The tube shields and the bottom cover for the tuner must be in place. The oscillator adjustment oiven on page 1953-15 must be completed before the band pass alignment is started.

1. Complete the set-up procedure given on page 1953-15
2. Connect the leads from the sweep and marker generators to the tuner antenna terminals
3. Turn the channel selector to channel 13. Adjust the generators to the correct frequencies for channel 13 as shown in the chart on page 1953-14.
4. Adjust l-3 (channel 13 rf plate), L-2 (channel 13 rf grid), and L-6 (channel 13 mixer grid) adjusting screws (see Fig. 16A or 16B) for a band pass characteristic containing both carriers with steep sides and maximum gain. The 1C1376 cascode tuners do not require adjustmers.

If the factory adjustment of the incremental loops and coils has not been disturbed, alignment of the rf plate, rf grid, and mixer grid should be complete after the completion of step 4 unless extensive repairs have been made on the tuner. Check the other channels for a similar band pass characteristic as shown in Fig. 17A. Whey aligning the 1C1376 characteristics further alignment is not necessary. If they do not, procede with siep 5 . Whenessing the turns of the coil before continuing with steps 5 and 6 .
5. Adjust the coils of the rf plate, rf grid, and mixer grid for channels 12 through 7 starting with channel 12. Adjust the signal generators for each channel to the frequencies given in the chart on page 1953-14. Pushing the half tur coil loops towards the center of the switch so that they are closer to the switch waler wil Adjust for a band pass while pulling them out and away from the switch waler will derese the frequen char
6. Adjust the coils of the rf plate, rf grid, and mixer grid for channels 6 through 2 starting with channel 6 . Adjust the signal generators for each channel to the frequencies given in the chart on page 1953-14. Spreading the turns of the coils will increase the frequency while squeezing the turns together will decrease the frequency. Adjust for a band pass characteristic containing both carriers with steep sides and maximum gain. A tuning wand may be used to determine what change is necessary.


Fig. 17 A. Typical Channel Response Curves for IV Y̌uners


* 30 bRIGHTNESS MAX
$\triangle$ O FOCUS CONTROL MIN

| PIN NO | COLOR | ELEMENT |
| :---: | :---: | :---: |
| 1 | black | heater a gnd. |
| 2 | Green | GRID |
| 6 | blue | Focus Grid |
| 10 | RED | ANODE GRID |
| 11 | Yellow | cathode |
| 12 | BROWN | heater |



Fig. 18AA. Voltose Chort for 17" ALI200D IRuns I \& 1A) Choss with IC1345 Pentode Tuner
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## ALIGNMENT FOR IC1345 OR 1 E1492 PENTODE. <br> \& 1 Cl 376 OR $1 E 1677$ CASCODE TUNERS

These tuners have been carefully aligned at the factory by personnel using precision equipment. Minor alignment adjustments of the tuner may be necessary after making tube or part replacements. When replacing tubes in a tuner use the same tube type as the original tube which was removed from the tuner and also try several different tubes and is used for replacement. Use of an alternate tube may require a complete realignment of the TV tuner. For those service engineers who are properly equipped as specified, the following alignment procedure is included. Balance of TV receiver must be functioning properly before aligning tuner.

## EQUIPMENT REQUIRED FOR TV TUNER ALIGNMENT

1. Sweep generator $\qquad$ RCA type WR-59B or equiv.
2. Marker Generato $\qquad$ RCA type WR-39C Televisio
3. Oscilloscope $\qquad$ RCA type wo -56A
4. Bias Source
$\qquad$ 1.5 volt battery.
5. Isolation Transformer 150 watt rating or higher

## SET-UP PROCEDURE FOR TUNER ALIGNMENT



Fig. 15A. Numbering of Tuner Terminals

1. Check to be sure that the tube shields and the bottom cover for the tuner are in place.
2. Connect all test equipment and the television chassis to a common ground. Be sure to use an isolation transformer for the receiver chassis. Allow at least a 5 minute warm-up period for the receiver chassis.
3. Connect the negative terminal of a 1.5 volt bias source to terminal 8 of the TV tuner. See Fig. 15A for terminal numbering. Connect the positive side of the bias source to any convenient ground point on the chassis.
4. Connect the hot lead from the oscilloscope through a $10,000 \mathrm{ohm}$ carbon resistor to test point T.P. -1 (See page 1953-16). Connect the ground lead from the oscilloscope to any convenient ground point on the TV tuner chassis. Set the scope sweep oscillator to roughly 120 cycles.

## OSCILLATOR ADJUSTMENT

## 1. Turn the channel selector to channel 13.

2. Set the marker generator to 237.5 mc . and connect generator leads to the antenna terminals
3. Rotate the fine tuning control until a zero beat is indicated on the scope. When the fine tuning control is rotated a band will appear across the face of the scope. As the point of zero beat is approached this band will increase in amplitude and then decrease sharply until a minimum is reached which is the point of zero beat. If the fine
tuning control is rotated farther in the same direction the amplitude of the band will increase sharply and then decrease. The point of zero beat should fall in the approximate center of the range over which the fine tuning control may be rotated. If it does not, set the fine tuning control at the approximate center of its range and adjust I. 7 (Channel 13 Oscillator Adjustment) for the zero beat. Do not disturb the setting of the fine tuning control after this adjustment.
Set the channel selector to channel 6.
Set the marker generator to 109.5 mc .
4. Adjust L-8 (Channel 6 Oscillator Adjustment) for the zero beat indication on the scope.

NOTE: Adjustment of the channel 13 and channel 6 oscillator coils automatically brings all other channel into adjustment. The adjustment screws cover their entire electrical range within eight full revolutions counterclockwis from the tight position. Any further rotation of these screws may cause them to fall out. Counterclockwise rotation of the screws will decrease the oscillator frequency. Best results will be obtained if a non-metallic screwdriver is used


92C1797
Fig. 16A. 1C1345 or $1 E 492$ Pentode TV Tuner Alignment Adjustments


Fig. 168. IC1376 or $1 E 1677$ Cascode TV Tuner Alignment Adjustments



## 1-F AMPLIFIER ALIGNMENT FOR BAI200D CHASSIS

## PROCEDURE

1. Connect all test equipment to a common ground. Connect the TV chassis to this same ground after installing an isolation transformer between the power line and the TV chassis. One side of the line cord connects directly to the TV chassis and an isolation transformer must be used for safety. Allow a 15 minute warm up period
2. Set the AVC switch on the rear chassis apron to the 0-10 MILE (counterclockwise) position.
3. Connect the negative side of a 3 volt battery supply to test point (E). Connect the positive side of the supply to the TV chassis. See schematic diagram.
4. Connect a VTVM to test point (a) through a 47,000 ohm carbon resistor. Connect the ground side of the meter to the TV chassis. See Fig. 11C
5. Connect the high side of a marker generator to the shield of the osc./mixer tube. This connection will capacitively couple the generator output to the tube. Make sure the shield is ungrounded by raising it above the grounded clips that hold it in place.
©. Set the channel selector to channel 3 or 4, whirhever is vacant
6. Set the marker generator output (unmodulated) for a two volt negative dc reading on the VTVM and adjust the three $\mathrm{i}-\mathrm{f}$ transformers, $\mathrm{L}-9$, and $\mathrm{L}-201$ according to the I-F AMPLIFIER ALIGNMENT CHART shown below. Readjust the signal generator output as required to maintain the two volt VTVM reading.

I-F AMPLIFIER ALIGNMENT CHART

| Signal Generator <br> Frequency <br> (No Modulation) | Adjustment | Transformer <br> or Coil <br> Location | VTVM <br> Indication |
| :---: | :---: | :---: | :---: |
| 45.0 MC | T-201 (bottom) | See Fig. 11C | Maximum |
| 42.8 MC | T-202 (bttom) | Under Chassis | Maximum |
| 44.0 MC | T-203 botom) | See Fig. 11C | Maximum |
| 41.25 MC | T-202 (top) | See Fig. 11C | Maximum |
| 42.8 MC | T-202 (botom) | See Fig. 11C | Maximum |
| 44.25 MC | *L-201 | See Fig. 11C | Maximum |
| 44.25 MC | \#L-9 | See Fig. 11C | Maximum |

IMPORTANT - The wax in the end of the coil forms holding the iron core in position may be softened for adjustment of the core by means of a heated screwdriver or a small pencil type soldering iron inserted into the wax. Remelt wax after adjustment.

* NOTE: Temporarily connect the series resistor-capacitor combination shown in Fig. 12A to the tuner test point TP-2 when making this adjustment.
* NOTE: Temporarily connect the series resistor-capacitor combination shown in Fig. 12A to the grid (pin 1) of Temporarily connect the series resistor-capacitor combination
$\mathrm{V}-101$ the $6 \mathrm{CB6}$ first i -f amplifier when making this adjustment.

8. Disconnect the VTVM and marker generator connected in steps 4 and 5 . The balance of the set-up should be as directed in steps $1,2,3$ and 6 .
9. Capacitively couple the high side of the sweep generator $r-f$ output to the osc./mixer tube by connecting to the tube shield which has been raised above its grounding clips. The ground side of the sweep generator should be connected to the receiver chassis. Adjust the generator to sweep from 40.5 to 46.5 MC
10. Loosely couple the high side of the marker generator to the high side of the sweep generator by clipping the marke generator $r$-f lead over the insulation of the sweep generator $r-f$ lead. The ground side of the marker generator should be connected to the receiver chassis.

IMPORTANT - To prevent overloading of the i-f amplifier keep the output of the sweep and marker generators as low as possible. The marker generator output should be just high enough to produce visible pips on the pattern. In som cases the 41.25 MC pip will not be visible unless the r -f output of the marker generator is increased to overcome the cases 41.25 MC pip wil not be the
11. Connect the sweep output terminals on the sweep generator to the input of the horizontal amplifier in the os cilloscope.
12. Connect one side of a $47,000 \mathrm{ohm} 1 / 2$ watt resistor to test point (D) shown in the schematic diagrams. Connect the other end of the resistor to the high side of the input terminals for the vertical amplifier in the oscilloscope. The other end of the resistor to the high side or the input terminals for the vertical amphifier in the oscilloscope. The
scope ground terminal connects to the receiver chassis. Keep the scope leads away from the internal chassis wiring, particularly the horizontal output section
13. Reduce the $r$-f output of the sweep generator and increase the gain of the vertical amplifier in the oscilloscope as much as possible without introducing an excessive amount of noise on the test pattern. This will prevent over loading of the i-f system
14. Check the position of the markers shown in Fig. 14BA. Adjust only the bottom cores of T-201, T-202 and T-203 for a response curve of maximum amplitude with a slightly tilted flat topped appearance as shown in Fig. 14BA This tilt is required to compensate for the capacitive coupling used for the signal generators. The actual response obtained will be flat when the pattern viewed on the oscilloscope has this tilt. The bottom core of T-203 will primarily control the tilt of this central portion of the curve
The bottom core of T-201 should be adjusted to position the 45.75 MC marker in the $50 \%$ position shown in Fig. 14 BA .

The bottom core of T-202 should be adjusted to determine the slope of the curve between 41.25 MC and 42.8 MC with the 42.25 MC marker down $50 \%$ on the curve as shown in Fig. 14BA.
Under no circumstances should an attempt be made to adjust L-9, L-201 and the 41.25 MC trap in the top of T-202 by means of an oscilloscope and sweep generator. Maladjustment of these coils does not give a noticeable indication on the oscilloscope. Align these coils by following the procedure given in steps 1 through 7 only.

## I-F AMPLIFIER SENSITIVITY

## MEASUREMENT

 To determine the i-f amplifier sensitivity,disconnect the $r$-f output lead from the tuner where it connects to L-201. Temporarily connect one side of a .005 mfd mica or ceramic capacitor to grid pin 1 of the first 6CB6 i-f amplifier tube V-101. Connect the unmodulated $r$-f output of a marker generator to the other
side of the capacitor and the ground side of the generator to the TV chassis. Set the marker generator to 43.75 MC . Connect a VTVM as directed in step 4 of the alignment procedure. The 3 volt battery must be removed. If a generator output of 200 to 400 microvolts produces a 1 volt reading on the
sensitivity is normal.


Fig. 148A. Typical Response for $\mathbf{4 1 . 2 5}$ to 45.75 MC I.F Amplifiers

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## I-F AMPLIFIER ALIGNMENT

## EQUIPMENT REQUIRED

| SWEEP GENERATOR ___ RCA type WR-59B or equivalent. |  |
| :---: | :---: |
| MARKER GENERA TOR | RCA type WR-39C Television Calibrator or equivalent |
| OSCILLOSCOPE__RCA type WO-56A or equivalent. |  |
| VACUUM TUBE VOLTMETER (VTVM) ___ RCA type WV-97A or equivalent. |  |
| BLAS SOURCE |  |
| TEST CIRCUIT _ Shown in Fig. 12A. |  |
| LATION TRANSFORMER | 150 watt rating or higher. |

## PROCEDURE

1. Connect all test equipment to a common ground. Connect the TV chassis to this same ground after installing an isolation transformer between the power line and the TV chassis. One side of the line cord connects directly to the TV chassis and an isolation transformer must be used for safety. Allow a 15 minute warm up period.
2. Set the AVC switch on the rear chassis apron to the $0-10 \mathrm{MLE}$ (counterclockwise) position.
3. Connect the negative side of a 3 volt battery supply to test point (E) Connect the positive side of the supply to the TV chassis.
4. Connect a VTVM to test point (D) through a 47,000 ohm carbon resistor. Connect the ground side of the meter o the TV chassis.
5. Connect the high side of a marker generator to the shield of the osc./mixer tube. This connection will capacitively couple the generator output to the tube. Make sure the shield is ungrounded by raising it above the grounded clips that hold it in place.
6. Set the channel selector to any vacant channel.
7. Set the marker generator output (unmodulated) for a two volt negative dc reading on the VTVM and adjust the three i-f transformers, L-9, and L-101 according to the I-F AMPLIFIER ALIGNMENT CHART shown below. Readjust the signal generator output as required to maintain the two volt VTVM reading

I-F AMPLIFIER ALIGNMENT CHART

| Signal Generator <br> Frequency <br> (No Modulation) | Adjustment |  |  |
| :---: | :---: | :---: | :---: |
| 25.4 MC | T-101 (bottom) | Location | VTVM <br> Indication |
| 23.4 MC | See Fig. 11Aor B | Maximum |  |
| 24.5 MC | T-102 (bottom) | Under Chassis | Maximum |
| 21.75 MC | T-103 (bottom) | See Fig. 11 A or B | Maximum |
| 23.4 MC | T-102 (top) | See Fig. 11 A or B | Minimum |
| 24.75 MC | T-102 (bottom) | See Fig. 1 A or B | Maximum |
| 24.75 MC | *L-101 | See Fig. 11 A or B | Maximum |

IMPORTANT - The wax in the end of the coil forms holding the iron core in position may be softened for adjustment of the core by means of a heated screwdriver or a small pencil type soldering iron inserted into the wax. Remelt wax after adjustment.
*NOTE: On chassis with the 1C1345 or 1E1492 Pentode and 1E1376 or 1E1677 Cascode tuners, temporarily connect the series resistor-capacitor combination shown in Fig. 12A to the tuner test point TP-2 when making this adjustment. On chassis with the 1E1380 Cascode tuner, hold the channel selector between channels when making this adjustment.
*NOTE: Temporarily connect the series resistor-capacitor combination shown in Fig. 12A to the grid (pin 1) of V-101 the BCB6 first $\mathrm{i}-\mathrm{f}$ amplifier when making this adjustment

8. Disconnect the VTVM and marker generator connected in steps 4 and 5 . The balance of the set-up should be as directed in steps $1,2,3$ and 6
9. Capacitively couple the high side of the sweep generator r-f output to the osc./mixer tube by connecting to the tube shield which has been raised above its grounding clips. The ground side of the sweep generator should be connected to the receiver chassis. Adjust the generator to sweep from 19 to 29 MC
10. Loosely couple the high side of the marker generator to the high side of the sweep generator by clipping the marker generator r-f lead over the insulation of the sweep generator r-f lead. The ground side of the marker generator should be connected to the receiver chassis.

IMPORTANT - To prevent overloading of the i-f amplifier keep the output of the sweep and marker generators as low as possible. The marker generator output should be just high enough to produce visible pips on the pattern. In some cases the 21.75 MC pip will not be visible unless the r-f, output of the marker generator is increased to overcome the attenuation of the 21.75 MC signal by the trap in the top of T-102
11. Connect the sweep output terminals on the sweep generator to the input of the horizontal amplifier in the oscilloscope.
12. Connect one side of a $47,000 \mathrm{ohm} 1 / 2$ watt resistor to test point (D) shown in the schematic diagrams. Connect the other end of the resistor to the high side of the input terminals for the vertical amplifier in the oscilloscope. The scope ground terminal connects to the receiver chassis. Keep the scope leads away from the internal chassis wiring, particularly the horizontal output section.
13. Reduce the r-f output of the sweep generator and increase the gain of the vertical amplifier in the oscilloscope as much as possible without introducing an excessive amount of noise on the test pattern. This will prevent overloading of the i-f systems.
14. Check the position of the markers shown in Fig. 14A. Adjust only the bottom cores of T-101, T-102 and T-103 for a response curve of maximum amplitude with a slightly tilted flat topped appearance as shown in Fig. 14A. obtained will be flat when the pattern viewed on the oscilloscope has this tilt. The bottom core of T-103 will primarily control the tilt of this central portion of the curve.

The bottom core of T-101 should be adjusted to position the $\mathbf{2 6 . 2 5}$ MC marker in the $50 \%$ position shown in Fig. 14A.

The bottom core of T-102 should be adjusted to determine the slope of the curve between 21.75 MC and 23.4 MC with the 22.75 MC marker down $50 \%$ on the curve as shown in Fig. 14A.

Under no circumstances should an attempt be made to adjust L-9, L-101 and the 21.75 MC trap in the top of T-102 cation on of an osclloscope and sweep generator. Maladjustment of these colls does not give a noticeable indi-

## MEASUREMENT OF I-F AMPLIFIER SENSITIVITY

To determine the i-f amplifier sensitivity, disconnect the r-f output lead from the tuner where it connects to L-101. Temporarily connect one side of a .005 mfd . ceramic or mica capacitor to grid pin 1 of the $6 \mathrm{CB6}$ first $\mathrm{i}-\mathrm{f}$ amplifier tube V-101. Connect the unmodulated r-f output of a marker generator to the other side of the capacitor and the ground side of the generator to the TV chassis. Set the marker generator to 24.75 MC . Connect a VTVM as directed In step 4 of the alignment procedure. The three volt battery must be removed. If a generator output of 200 to 400
microvolts produces a 1 volt reading on the VTVM, the i-f amplifier sensitivity is normal

## FM SOUND CHANNEL ALIGNMENT FOR 1200 SERIES CHASSIS

## EQUIPMENT REQUIRED

Signal generator covering 4 to 30 mc unmodulated.

Vacuum tube voltmeter (VTVM).

Sound alignment test circuit shown in Fig. 10A.

Power line isolation transformer.

## PROCEDURE

. Connect all test equipment to a common ground. Connect the TV chassis to this same ground after installing an isolation transformer between the power line and the TV chassis. One side of the line cord connects directly to the TV chassis and an isolation transformer must be used for safety.
2. Set the channel selector to any vacant channel and the contrast control at minimum.
3. Connect the signal generator output through a .005 mfd . capacitor to test point (D) shown in schematic diagram Ground the shield of the generator output cable to the chassis.
4. Connect the sound alignment detector circuit and VTVM as shown in Fig. 10A. Adjust the 4.5 mc , generator output (unmodulated) to give a 1 volt reading on the VTVM.
5. Adjust the 4.5 mc . trap adjustment ( $\mathrm{L}-105$ ) at 4.5 mc . for a minimum VTVM reading.
6. Disconnect the test circuit and connect the VTVM to test terminal (B) (Pin 2 of FM detector, V-113). See schematic diagram.
7. Adjust the 4.5 mc . amplifier grid adjustment (L-110) and the primary of $\mathrm{T}-107$ (bottom core) at 4.5 mc . for a maximum VTVM reading.
8. Connect the VTVM to test terminal (C), shown in the schematic diagram. Adjust the secondary of T-107 (top core) at 4.5 mc . for the zero reading which occurs between the positive and negative peaks. If the zero reading occurs at more than one setting, use the position nearest the top limit of the core.
9. Shift the signal generator an equal amount on either side of 4.5 mc . and touch up the primary of $\mathrm{T}-107$ (bottom core) for approximately equal peaks. Use just enough signal output to obtain one volt peaks for best results.

fig. 11A. Top View Chassis Alignment Locations for Chassis AG1200D,
Ahti200D. AL12000 (Runs 1; 1A, 3, 4 ) AH1200D. AL1200D (Runs 1; 1A, 3, E4). AR1200D. \& AX1200D.


9201859-2
Fig. 118. Top View Chassis Alignment Locations for Chassis AJI200D. AL1200D (Run 2), AY12000 and AZ1200D.


## © John F. Rider


Fig. 5C. 21" Metal Pix Tube Mounting

Fig. 7A. 17" Glass Pix Tube Mounting


Fig. 7B. 20" Glass Pix Tube Mounting


Fig. 7C. 21" Metal Pix Tube Mounting.

LAYOUT OF CONTROLS


Fig. 9A. Front Controls for Chassis AG1200D, AH1200D, AR1200D, \& AY1200D

*THE PHONO INPUT SOCKET AND TV-PHONO SWITCH ARE USED ON CHASSIS AHI200d ONLY
Fig. 9B. Rear Controls for Chassis AG1200D, AH1200D, ARI200D, \& AY1200D


Fig. 9C. Front Controls for Chassis AJ1200D, ALI200D, AX1200D, AZ1200D \& BA1200D
$\qquad$ CHASSIS AG1200D, AH1200D, AJ1200D, AL1200D, AR1200D, AX1200D, AY1200D, AZ1200D, BA1200D


John F. Rider


Fig. 145A. Model 1088C, Mahogany


Fig. 137A. Models 1081C \& 1081E, Blonde


Fig. 141A. Models 1085C \& 1085E, Mohogony

## CHASSIS . . . BA1200D . BA1200D RUN NUMBERS . 1 . . . . . 2 \& 3 GENERAL SPECIFICATIONS

ANTENNA. . . . . . . . . . EXTERNAL OR BUILT IN ANTENNA INPUT IMPEDANCE . . . . ... 300 OHMS TUNING . . . . . . . . . . . . . . . 12 CHANNELS, $2-13$
 POWER INPUT . . . . . . . . . . . . . . . . . . . 145 WATTS
TUBES.
18, including plx tube
SPEAKER
PICTURE CARRIER iF 8" ELECTRODYNAMIC
 INT ERCARRIER SOUND SYSTEM 41.25 MC CABINET FINISH . . . . . . . . . . . . . . . . . . . BLONDE PICTURE TUBE . . . . . . 21" RECTANGULAR WITH TV TUNER....... 1 ELELECTROSTATIC FOCUS 16 POSITION CASCODE

## TUBE COMPLEMENT

| V-1 | * 6 BZ 7 or |
| :---: | :---: |
| V-2 | *6J6 |
| $\mathrm{V}-101$ | 6CB6 |
| V-102 | 6CB6 |
| V-103 | 6CB6 |
| V-104 | 6AH6 |
| V-105 | 6SN7GT |
| V-106 | 12BH7 |
| V-107 | 6AL5 |


| . . . R-FAMPLIFIER OSCILLATOR/MLXER |
| :---: |
| FIRST I-F AM PLIFIER |
| COND I-F AMPLIFIER |
| IRD I-F AMPLIF |
| VIDEO AMPLIFIER |
| R |
| RT. OSC. \& OUTPUT |
|  |


| V-108 | 6SN7GT | SC |
| :---: | :---: | :---: |
| V -109 | 6BQ6GT | HORIZONTAL OUTPUT |
| $\mathrm{V}-110$ | 12AX4 or §6AS4 | S4 . . . . . . . . . . . . DAMPER |
| $\mathrm{V}-111$ | *1B3GT | gh voltage rectifier |
| $\mathrm{V}-112$ | 6AU6 | SOUND I-F AMPLIFIER |
| V-113 | 6AL5 | RATIO DETECTOR |
| V -114 | 6C4 | AUDIO AMPLIFIER |
| $\mathrm{V}-115$ | 6W6 | AUDIO OUTPUT AMPLIFIER |
| V-116 | 21MP4 Metal (1081 | (1081C) . . . . P PICTURE TUBE |
| V-116 | 21FP4 Glass (1 | (1081E) . . . . . PICTURE TUBE |

## CHASSIS . . . . . AL1200D . . . ALI200D

RUN NUMBERS . 1 \& 1A . . . . . . . . 2

GENERAL SPECIFICATIONS
ANTENNA . . . . . . . . . EXTERNAL OR BUILT IN ANTENNA INPUT IMPEDANCE . SILVER VORTEX ANTENG 12 CHAD 300 OHMS TUNING $\operatorname{POWER}$ SUPPLY . . . . . . . . . . . 110-120 12 CHANNELS, 60 CYCLES POWER SUPPLY . . . . . . . $110-120$ V., 60 CYCLES TUBES. . . . . . . . . . . . . . . . 18, inČLUDiNG PIX TUBE SPEAKER . . . . . . . . . . . $6 \frac{1}{2} "$ ELECTRODYNAMIC PICTURE CARRIER IF . . . . . . . . . . . . . . 26.25 MC SOUND CARRIER IF . . . . . . . . . . . . . . . . 21.75 MC INTERCARRIER SOUND SYSTEM........ 4.5 MC CABINET FINISH. . . . MAHOGANY LEATHERETTE PICTURE TUBE ..... $17^{\prime \prime}$ RECTANGULAR GLASS V TUNER MODEL 1050. . . . . . . . 1C1345 PENTODE TV TUNER MODEL 1050A. . . . . . . 1 C1376 CASCODE

Fig. 117A. Models 1050 \& 1050A, Mahogany Leatherette

SEE SCHEMATIC DIAGRAMS FOR
THE DIFFERENCE BETWEEN CHASSIS USED IN MODEL 1050 AND CHASSIS USED IN MODEL 1050A

## TUBE COMPLEMENT

* These tubes may be replaced by removing the cabinet bottom without removing the chassis from the cabinet. Remove the high voltage compartment shield to replace $\mathrm{V}-111$.

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Fig. 119A. Model 1072A, Ebony


Fig. 129A. Model 1078A, Mahogany Grain

## CHASSIS <br> RUN NUMBERS

GENERAL SPECIFICATIONS
ANTENNA ANTENNA INPUT IMPEDANCE SILVER VORTEX TUNING . . . . . . . . POWER SUPPLY POWER INPUT TUBES. PICTURE CARRIER IF OUND CARRIER IF INTERCARRIER SOUND SYSTEM $\cdots{ }^{-} \cdot 21.75 \mathrm{MC}$ CABINET FINISH . . . . . . . . . . . . . EBONY PLASTIC PICTURE TUBE TV TUNER. WITH ELECTROSTATIC FOCUS 1E1492 PENTODE

## TUBE COMPLEMENT

V-108 6SN7GT
$\begin{array}{ll}\mathrm{V}-109 & 25 \mathrm{BQ} 6 \mathrm{GT} \\ \mathrm{V}-110 & 12 \mathrm{AX} 4\end{array}$
V-111 12AX4 v-112 6AU6. $\mathrm{V}-113$ 6AL5 V-114 6C4. V-115 25L6GT/C V-116 21XP4 $\begin{array}{ll}\mathrm{V}-1 & 6 \mathrm{BC} 5 \\ \mathrm{~V}-2 & 6 \mathrm{~J} 6\end{array}$ $\begin{array}{ll}\mathrm{V}-2 & 6 \mathrm{JC} \\ \mathrm{V}-101 & 6 \mathrm{CB} 6 .\end{array}$ $\mathrm{V}-102$ 6CB6. V-103 6CB6. V -104 6AH6. V-105 12SN7GT V-107 6AL5
horizontal oscillator HORIZONTAL OUTPUT HIGH VOLTAGE DECTIFER SOUND I-F AMPLIFIER SOUND I-F AMPLIFIER RATIO DETECTOR AUDIO OUTPUT AMPLIFIER PICTURE TUBE R-FAMPLIFIER OSCILLATOR/MIXER FIRST I-F AMPLIFIER SECONDI-F AMPLIFIER THIRD I-F AMPLIFIER VIDEO AMPLIFIER $\therefore$ SYNC CLIPPER ERT. OSC. \& OUTPUT


Fig. 125A. Model 1075A, Mahogany Brown Plastic.


Fig. 121A. Model 1074A Blonde Wood Grai


Fig. 143A. Models 1088B \& 1088D, Mahogany


Fig. 135A. Models 1081B \& 10810, Blonde


Fig. 139A. Models 1085B \& 1085D, Mahogany
CHASSIS . . . . AZ1200D . AZ1200D RUN NUMBERS . 2 . . . . . 1 \& $1 A$

## GENERAL SPECIFICATIONS

ANTENNA. . . . . . . . . . . EXTERNAL OR BUILT IN
NTENNA INPUT IMPEDANCE SILVER VORTEX NNI TUNING POWER SUPPLY . . . . . . . . . . 110-120 V., 60 CYCLES TUBES . . . . . . . . . 18 inCLUDING PIX TUBE SPEAKER $8^{\prime \prime}$ ELECTRODYNAMIC PICTURE CARRIER IF . . SOUND CARRIER IF . . . . . . . . . . . . . . . 21.75 MC INTERCARRIER SOUND SYSTEM . . . . . . . 4.5 MC CABINET FINISH . . . . . . BLONDE PICTURE TUBE . . . . . 21" RECTANGULAR WITH TV TUNER.................. 1 E1380 CASCODE

## YOUR INTRODUCTION TO ULTRA HIGH FREQUENCIES

The Federal Communication Commission, recognizing the need for many additional television stations, has set aside the ultra high frequency band ( 477 to 890 megaccycles) for
commercial television use. This action makes room for thousands of new stations through out the nation, which will transmit on channels 14 through 83 . Reception of these chan-
nels is beyond the normal range of your standard VHF television receiver which tunes nels is beyond the normal range of your standard VHF television receiver which tunes
only channels 2 through 13. In order to receive these higher channels, a UHF converter only channels 2 through 13. In
must be added to your receiver.

The Granco Coaxial Tuned UHF Converter Model MTV, has been specifically designed to permit reception of all UHF stations, present and future, on any standard VHF
relevision receiver. It does this by electronically converting the higher channels to chan. nels 5 or 6 which your set can receive. The conversion takes place simply and efficiently without effecting your normal VHF reception. Installation and operation is as simple as
a radio set, as explained in the following ind radio set, as expliared in the following instructions.

F16.


## NSTALLATION

The converter should be located as closely as possible to your television set. The most satisfactory location would be either on top or to the right side of your set because
these are closest to the set antenna terminals. All connections are made to the rear of the converter as shown in Figure 1. A label attached to the chassis rear clearly identifies each of the terminal connections, which are further defined as follows:

VHF ANT - Connects to the VHF antenna wire now used with your tele.
TV RCVR - Connects to your television set antenna terminals
PLUG IN TV SET - Your television set power line cord plugs in here. UHF ANT - Connect your UHF antenna twin lead here. If coaxial cable
wire to ANT terminal directly below GND terminal.
To insure proper installation the following procedure should be used, however, To insure proper installation the following procedure should be used, however,
before starting make sure that the power cord of the converter is not connected to an

Installation Procedure

1. Connect UHF antenna twin lead to terminals marked UHF ANT. If coaxial lead-in is used connect to terminal marked GND and adjacen
2. Disconnect wires from TV set antenna terminals and connect to $V H F$
$A N T$ terminals on converter.
3. Connect a short piece of twin lead cable between the TV set antenna ,
NOTE: In areas of strong local reception on channels 5 or 6 , it is
advisable to use shielded 300 ohm twin lead to avoid interference with UHF reception.
4. Remove TV set power cord plug from wall outlet and plug into conver ter receptacle marked PLUG IN TV SET.
on and leave in this position at all times.
5. Check all contuections to be sure that they are tight, and no loose
6. Turn the SELECTOR knob (see Figure 2) to OFF position and plug the converter power line cord into 117 volt 60 cycle wall receptacle.

## OPERATION

Your set has now been converted into a modern 82 channel television receiver capable of receiving any television transmission in your vicinity. Proper operation re-
qieses control of both the converter and television set knobs. The two converter knobs quires control of both the converter and television set knobs. The two
see Figure 2) control UHF tuning, and OFF-VHF $-U H F$ switching.

The Selector knob position functions are further explained as follows
OFF - Power to both converter and TV is turned off.
VHF - The TV set and the converter tube filaments are turned on. The VHF antenna is connected to TV by the internal switch. Channels through 13 may now be selected in the normal way.
UHF - Power to both converter and set is on. The VHF antenna is dis connected, shorted, and grounded, to prevent interference. The converte output is connected to the receiver antenna input terminals by the internal
witch. With the TV channel selector in channels 5 or 6 position any UHF switch. With the TV channel selector in channels 5 or 6 po
channel may be selected by turning the UHF tuning knob.
To insure proper operation the following procedure should be used. Be sure TV
perating Procedure

1. Turn "Selector" knob to VHF. Allow a few minutes for warm-up and then operate TV set in norma! way if programs on any of channels 2
2. To reseive programs on channels 14 through 83 turn "Selector" knob to UHF and set TV channel selector to either 5 or 6 . NOTE: Always
select the channel which is not being used by a local VHF televise sital select the channel which is not being used by a local VHF television sta-
tion. This will eliminate the possibility of interference with UHF reception.
3. Tune in the desired UHF channel by turning the "Tuning" knob on the converter and adjusting for best picture and sound. Tuning may be fur
4. To turn the converter and receiver off, rotate "Selector" knob on conver

## HOW TO GET THE MOST FROM YOUR GRANCO UHF CONVERTER

## Anenna

One of the most important a accessories required for satisfactory reception is a propselect and install an antenna best suited to your requirements.
Service Notes
Tube Replucement
The $6 \mathrm{X4} 4$ rectinier tube is readily accessible by removing back cabinet cover. The AF4 oscillation mpartment. For replacement of any of these proceed as follows:
. Remove knobs and back cover.
2. Remove 4 bottom mounting screws.
. Remove chassis.
using thumb and fore-fing compressing front and back flaps inward using thumb and fore-finger, simultaneously pulling straight up. This
action will release friction catches which retain top shield.
5. Replace tubes and reassemble chassis into cabinet, after replacing shield

NOTE: A plug button oppnsite the 6AF4 tube may be removed as an aid
in replacing this tube. Reinsert button after tube has been changed.
A tube change normally will not require realignment. However, be sure that all whes are firmly seated in their sockets. This is esperially true of the 6AF4 tube Componewt Replacement

All components, including those contained in the tuner compartment may be readily replaced. It is recommended, however, that where trouble is suspected in the tur
either the entire converter or the tuner section be returned to the factory for retest. Replacement parts may be ordered from the factory by using the symbol numbers
in Schematic, Figure 3, as well as the chassis serial number printed on rear tube label.
liven


| ${ }_{\substack{\text { stock } \\ \text { No. }}}$ | Chiptiom | ${ }_{\substack{\text { siocr } \\ \text { No. }}}$ | mon | ${ }_{\text {stock }}^{\text {spock }}$ | descaiption |  | REPLACEMENT PARTS |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ${ }^{77853}$ |  | $\left.\begin{aligned} & 33098 \\ & \text { 3390 } \\ & \text { 3304 } \\ & 73364 \end{aligned} \right\rvert\,$ |  | 7196 75217 | Capacitor-Mica trimmer: 5.70 mmi (Cl19) |  | deschiption |
|  | Capacitor-Ceramic. variable, tor fine tuning ca.pacitor-plunger type (C27) Capacitor-Adjustcble, mica: | 736476695 | $39 \mathrm{mmt}. \pm: 20 \% .500$ volta DC (Cl40) Capacitor-Fixed. mica: | 75218 |  | ( 512248 |  |
|  |  |  |  |  |  |  |  |
| 7616 |  |  |  | 2764 |  | 503282 |  |
|  |  |  |  | 76970 |  |  | 10.000 ohms. $\pm 5 \%$. $1 / 2$ wall (R107. (1108) |
| 763 |  | (39640 |  |  |  | ¢ 503312 | 10.000 ohms. $\pm 10 \%$. 1 wait (R217) |
|  |  | 73094 | (e) | 75643 |  | 503315 <br> 50318 | (12, |
|  |  |  | Capacitor Couramic: | come |  | S00322 | 18.000 ohms. $\pm 10 \%$. $1 / 2$ wall (R157. R172, R204) <br> 22.000 ohms, $\pm 10 \%$. //2 watl (R162. Ri66. R171. H201) |
|  |  |  | ${ }_{\text {a }} 500 \mathrm{mmt}$. . 20.000 volit | ¢ |  | ( 70331 | ${ }^{22.000}$ ohme $\pm 10 \%$. $1 / 2$ wan (RR162, R166. R171. R201) $39.000 \mathrm{obms}=.10 \% \% 1 / 2 \mathrm{wan}$ (RR206) |
|  | Capacior -Fixeed eramic High K- direc | 7293 |  | ${ }^{7} 73080$ | .0092 mida. 1000 volta (ciss) | ¢ | (tionem |
| ${ }_{7252}^{77295}$ |  | 17672 |  | ${ }_{7} 73561$ |  |  |  |
|  | (10,000 mmt. $+100 \%$. $0 \%$ \% 500 volta (C28) | ${ }^{72725}$ | $1000 \mathrm{mmL} .+100 \%$. |  |  | ${ }_{15}^{512356}$ |  |
|  |  |  |  | ${ }_{73811}$ |  | S03368 |  |
| ${ }_{\substack{78276 \\ 7599}}^{7}$ |  | 7691 |  | 73356 | .033 mid. $0000^{\text {volis (clit }}$ | ¢ 5 S0332 |  |
|  |  |  | 470 mmt , |  |  | S03412 |  |
| ¢ |  |  |  | 73792 |  | S |  |
| ${ }_{\substack{34207 \\ 72935}}$ |  |  |  | 73789 |  | ¢ 51214 |  |
|  |  |  | ${ }_{\text {Hra }}$ | 557 |  | ${ }_{\substack{\text { sin } \\ 503222 \\ \text { S22 }}}$ |  |
|  |  | 27609 | Himat Muer if. Hansiormer com | 96 | ${ }_{0}^{0.27}$ mid.) 200 volta (Clis) |  |  |
|  | mit $\pm 10^{\circ}$ \% 500 | 27610 |  |  |  |  |  |
| 715 | ${ }_{2}^{0.68 \mathrm{mmt}}{ }_{2}$ |  | Trup $\mathrm{tas}$. . |  |  |  |  |
|  |  |  | Hocilite-Gormanilim rectil |  |  |  |  |
|  | ${ }_{\substack{\text { capace } \\ 80 \\ 80 \\ \hline 0}}$ |  |  | ${ }^{73594}$ |  |  |  |
|  |  | cosile |  | $\xrightarrow{73787}$ |  | cosis |  |
| , 73391 | (eaile | Stande |  | 7642 |  | comis | 1.5 megohm. |
| ${ }^{781}$ |  | ${ }_{5}^{503322}$ |  | 76021 | Coil-Peaking coill (36 mun) (1102) | (503522 |  |
| 779 |  | S03410 |  | ${ }_{7}^{77925}$ |  | S03339 | (3.9 megobm, $10 \% / 1 / 2$ watt (R1) |
| ${ }_{7}^{79921}$ |  | ¢ |  | ¢ |  |  |  |
| $\xrightarrow[\substack{78224 \\ 72706}]{ }$ |  |  |  | ${ }_{7}^{76404}$ |  |  |  |
| ${ }_{7}^{7} 78$ |  | 77614 |  |  |  | 79982 |  |
| ${ }_{7}^{7858}$ | Coit 1.1. , inpul coil complete with dijutable cote (19) |  | Control-UHF oscillator injection adiuctment | 2764 | Conter |  | (T113) Transformer-Ratuo detectoz transiormet (T102. CiO5) |
| $\xrightarrow{765}$ |  | (77628 | Coillil | ${ }_{7}^{77924}$ |  |  | Transtomet Sound tif transormet coinpleie wih |
|  |  | 77629 |  | $\xrightarrow{76599}$ | Contol Hotrontral hola control (R200 | 536 |  |
| S03015 |  | $\xrightarrow{77632}$ | Coilloinillior hater coil (153) | (2742 |  |  |  |
|  | (120 ohms. $\pm 10 \%$ \% $1 / 2 \mathrm{watt}$ wat (R2) | $\xrightarrow[\substack{78324 \\ 77627}]{ }$ |  |  | Contoo Vertical linearty control (R866) Rosisiot- Wire wound: |  |  |
| (50347 |  |  |  | ctif696 |  |  | ${ }^{\mathrm{T}} \mathrm{T}$ Trintorer Trap 4.5 MC trap (Lios. Cli3) |
| 503233 |  |  | Capactior - Fixeded coramic. High "K. dise: | cintivic | (e) | ${ }^{779985} 7$ |  |
| (10328 |  | $\xrightarrow{77293}$ |  | $\substack{77671 \\ 7664 \\ \\ \hline}$ |  |  |  |
| (23312 |  |  |  |  | Resisors. Fixed, componition, |  | SPEAKER ASSEMbLIFS Hilioics <br> RMA 27 <br> For Model (17T352U) |
| S03310 |  |  | (10) | - 30793 |  |  |  |
| ${ }_{78}$ |  |  |  | S 303047 |  |  |  |
| 78399 76540 |  | 7766 |  | cose |  |  |  |
| ${ }_{7}^{76464}$ |  |  | Capacitot- Fixed. Coramic, noninaulard. Temp. | 5021218 5039 50 |  |  |  | SPEAKER ASSEMELIFS 971490.3 品 <br> RLIOSEC6 |
| ${ }_{76545}^{7641}$ |  | ${ }_{\substack{7210 \\ 7768}}^{\substack{\text { 2 }}}$ |  | ¢ |  |  |  |  |
|  |  | 77182 |  | ${ }_{5} 5131168$ |  |  | RMA-274 GMA-285 <br> Cone-Cone and voice conl i32 chnis, tos speakit Cone-Cone and voice conl ( 3.2 chms; for speainer $\left.\begin{array}{c}\text { Speaker - } \\ \text { voice coil P.M. speaket complele with cone and } \\ \text { voi. }\end{array}\right]$ ohs) |  |
|  | 4.40 mmt Capacior Clition |  | Capacior- Fixod. ceramic, nontinultated, Tomp. | 503 |  |  |  |  |
|  |  | ${ }^{1924}$ |  | ${ }_{\substack{512210 \\ 522218}}$ |  |  |  |  |
|  |  | 2769 |  |  | 2200 ohms. $\pm 10 \%$. $1 / 2$ watt (R145) |  |  |  |
|  | ${ }_{\text {cosem }}$ | (17690 |  |  |  |  |  |  |
|  |  |  | 1.5 mm m. $=10 \%$, 500 volis $\mathrm{DC}(\mathrm{C} 39$ ) | ( $\begin{gathered}502239 \\ 50239\end{gathered}$ |  |  |  |  |




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Figure 16-KRK29 R.F Ostillator Adiusteres


Figure $17-$ KRK29 Tuner Adjustments


Figure 18-KKK29 R.F Repoene




Figure 24-Horizomeal Oscillawor Wave Forms


Figure 25-Top Chasis Adjustments (KRK29 Twner Sbown)


Figure 26-Bottom Cbassis Adijustments (KRK29 Tuner Sboum)



Connect the oscilloscopo to the tont poinn TP2 on top of tho
tuner unit Set the oscllotacepe to maximum gain. Connect the output of the VHF wignal generator to tho outpu
of the antenna matching unit at the junction of LS and C4
at the botiom of the FM Iat 15 . the bottom of the FM Itap
Tune the signal generator 10.43 .5 me. and modulato it $30 x$
witho 400 cycle tine wave. Adjuat the nignal generator tor maximum output.
Adiuat C33 on top of the tunot, lor minimum 400 cycle indi-

 Connect the potentiometer arm of one of the biaz supplien
10 the $A G C$ Corminal on the tuner and ground the battiery poz


Proen C22 to rood - 3.0 volts ot the liont point TP1, as rood

Turn the fine tuning control fully clock wise.


 digni gonerator to 227 mce with cryatal accuracy. Insert on

 gnal generatior.
Turn C27 clockwine unt the beat nole iunt beging to change,
hen lurn one full lurn in the same clockwise direction. Alaturn the ind inning control to the mechanical center of it range.
 with thannel 13 and adiuat Lise to obtain propor chann



Sol the T2 core (lor maximum inductance (coro turned Connect the sweep generator through a suitablo attenuctor
at sthown in tigure 10 to the input terminals of the anienna
maitching unit Connect the signal generator loosely the the antend Set the sweep generator to cover channel Sot the osc:lloscope 10 maximum gain and una the minimum
input signal which will produce a utable pattern on the oscil-
 alignment and produce coneequent miealignment even though
he roxpones as zoen on the oncilloscope may look normal. Inebert markers of channel 18 picture carrier and wound
carrier, 181.25 mc and 185.75 mc . Adjust $\mathrm{C} 21, \mathrm{C} 16, \mathrm{C11}$ and $\mathrm{C7}$ lor approximatoly corroct
curve shape. Hequency, and band width as shown in tigure i8. The correct adjustment of C7 its indicated by maximum am-
phtude of the curve midway belween the markers. C11 tuno



Comad hivivionam:


Adjust tho signal generator to the channel 13 oselllator fio
auency 257 mect quancy 257 mc .
uning control fully clockwee.


Sel the awoop generator to channel 13
From the signal gonerarator, insort channol 13 sound and pic-
ture carrier marker. 211.25 mc. and 215.75 mc. 18 Adjuat L36 and L20 lor proper reaponse as anown in Egure
Turn of tho owoop and aignal generatore
Connect the "Vollobmyall" io the tuner tort point TP1.
Chock the ovecillator inioction volage it be within limits an
provioully
 Sei the receiver channol eiloctor wwitch to channol 8 and
readiual C27 lor proper orcillator froquency. 227 mc. Sot the sweep generatior and signal generator to channel Roadiust $\mathrm{C} 21, \mathrm{ClIF}_{1} \mathrm{Cl1}$ and $\mathrm{C7}$ for correct curve shape,
 the inilat selling of the oscilicior in, chion rimmer wa and response on channel 8, adiust the oscillatort injection of channel 13 and repeat the backing
before the proper setting is obtained
Turn of the aweep generator and awitch the receiver to Adjuat the nignal generator to the channel 6 oscillator tro
quancy 129 me. Sot the fine tuning control to the coner of its mechanica Adiuat LS4 for an audible beat. Adjuat L48 and L32 lor
proper curve zhape as shown in tigure 18 . Recheck the oscil
 If C22 required adiustment, ewith the reciver and the
 Check the reaponso of channele 2 through 6 by switchin



It the markens tail io tall within this requirement readiuas
Lit ind $L 32$ in order to obicin curves within the prope
limits Switch the channel selector, isignal generator and marke
generator through channels 710 io 13 and observe the reaponse

 osponse.

Wih the receiver and aignal generatar on channel 13 adiual
 ndadiusting the appropricien oscillator slug to obtrin the
 aotor iniection vollage on each chat
vollage $i$ within the speciliod lifitits.

## 

TUNER VHF ALIGNMENT--Remove the 654 voltage contril tube from its
he 64 in the adapler:
Connect the 0.50 milliampere meter to the adapter zock Remove the tuner cover shield
Rotate the channel solectior to a point midway betweo
hannels. disengaging the insert contactr, and observe the hon-azciliating plate curfont. Some tbest may oxillate ev is in a non-oscillatory state, short circuit the spring contactit
12 and 13 , the two contacte neareat the tuner tront.
(NOTE: The contacts are at zero d.c.c. potenticil) Should the
plate current ribe, keep the contacts shorted while adjuating he oscillator placte curtent. Adiust RG. oscillator voltag
control loo a 28 mill ${ }^{2}$ ampere reading on the meter.
Replace the tuner cover shield.

Conect the VHF weep generat to the antenna terminalu Connect the VHF zignal generator loosely to the antenn Connect the oacilloacope, through the preamplitier.
needed with oscilloscope used, to test point $T$ Pl. Ground the AGC biat ot the tuner terminal board uzing o
clip lead to insure that the bias will remain constiont. Tum oll the adapler switch, removing plate voltage from
the oscillotor. This is
required beccuse of $\mathrm{RF}-\mathrm{IF}$ interaction
 Set the channel selector and the awoep generator to
channel 2 . Insert markers of channel 2 picture carrier and zound
carrier, 55.25 mc. and 99.75 mc .

 Charccterititics. The limits tor the $100 \%$ response poinls aro shown in iguro on page 13 Ior detailed explanotion on odiust-

 Repeat the above sieps for all VHF channols adjusting the
appropriale ontenna. H amplifier plate and mixer alugs for a symmetrical
the pass band.
Turn oft the aweep generala
Remove the oscilloscope and preamplitier if used. from
test point TPL. Turn the AGC control fully clockwise.
Remove the clip load grounding the AGC biar on the
tuner terminal board. Connect the potentiometer arm of one of the bias zupplies
to the $A G C$ terminal on the tuner and ground the batiory positive eorninal to the tuner case Adjust the biae potient omoter to produce -3.5 volts of bias. as measured by th
"Voltohmyst" at the AGC terminal on the tuner.
Connect the potentiometer arm of the second biaz supply
to the iunction R147 and R148, and ground the poaitive battery

 Turn the ad
heo oscillator.
Turn the channel selector to channel 13
an cont io the certer of its rongo
 0 uee the signol generator asa $a$ heterodyne frocuuency mote




 generator, Adiunt $L 22$ oacil
wilh the aignal generator.
Turn on the swoep generator and sot to Channot 13 .
Adiuat Ti tor maximum gain on the oseilloscope. Adjuet

 hould be obtoined dimultunoo Adiuat the ostillator to trequency on all YHF channela by
witching the fectiver and hannel and adiusting the appropriate oscillator slug !

 1043.5 mc . and adjuzt the output of the zignal generator
 rap Cl6-L7 tor minimum indication on the oscillosco
Remove the signal generator and the osilloscope
TUNER UHF ALIGMENT-To align the UHF interts: Turn oft the odapter awitch, removing plate volage from Ground the AGC bias at the tuner terminal bacred Using a Connect the oxilloscopo, through the ptict
 Gannet the UHF signal genefator lo Set the channel selector to the desired position and the
weap generator to sweep the frequency of the insent being Insert markern of
for deaired channel.
Adiuat UHF antonna link coupling and mixer adiustment
or a y mmetrical curve, lor aymmencici
 Repeat the above ateps for all UHF inserts used adjusting
the appropriale ontionna. link coupling and miner sluga ior $y$ mmetrical curve, with maximum gain, centered about th past band
Remove the oscilloscope and preamplitier it used, from
leat point TPL Remove the clip load grounding the AGC bias on the tuner orminal board. Connect the polentiometer arm of one of the bias supplies
to the $A G C$ terminal ont the tuner ond ground the battery
 COotohmyal at the AGC, ,orming1)




## general description



 UHF channela desired.

## Electrical and mec

ncture size 146 inder inches on
television r-f frequency rang


(Any desired combination of 16 UHF and/or VHF channel may be ued.)
NTERMEDIATE FREQUENCIES
INTERMEDIATE FREQUENCIES
Picture I-F Carrier Frequency
picture 1-F Carrier Frequency
Sound 1 -F Carrier Frequency
POWER RATING
audio power output rating .int-36lu-230 wala
GDEO RESPONSE .......................... To 3.5 man ma
SWEEP DEFLECTION -
FOCUS
OCUS
ANTENNA INPUT IMPEDANCE
Model $17-$ - -36
Cboice: 300 ohms blacnoded or 72 homs unbalancal
UHF-300 ohms balanced.
VHF-300 ohms balanced.
RCA tube complement


1) RCA 6BO7A ${ }^{\text {2) }}$ RCA $6 \times 8$........................... A. Ampliber




## ical Specifications <br> ca tuic complement

Tube Used
Tuner KRK12B (17-T-352U \& 17.7-361U)

A 1 N82 crystal lis used at a mixer.
All Models.

chassis designation
KCS78F Model $17-$ T- 3611 omploying a KRK29 Tuno
KCS78) Modele 17 T-T-352U and 17-T-361U employing a KRK12

| dmensions |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Model |  | $\underset{\substack{\text { Shipping } \\ \text { Weight }}}{ }$ | Width | Height | Depth |
| 17.T.352U | 881 lb | 105 bs . | $21 / 2$ | 22\% | 22 |
| 17-T.361 | 87 lbs | 112 lba . | 24\% | 35\% | 22 |
| 17.7.361U | 921 ba . | 117 lb . | 24\% | 35\% | 22 |
| LOUDSPEAEERS |  |  |  |  |  |
| Model 17-T-352U ..... (971636-1) 5" PM Dynamic, 3.2 ohma |  |  |  |  |  |
| Model 17-T-361 ..... (971490-3) 8\% PM Dynamic, 3.2 ohms |  |  |  |  |  |
|  |  |  |  |  |  |
| scanning |  |  |  |  |  |
| HORIZONTAL SWEEP FREQUENCY .......... 15,750 cpa |  |  |  |  |  |
| Vertical sweep frequency ................ 60 cpa |  |  |  |  |  |
| frame frequency (Picture Ropotition Rato) |  |  |  |  |  |




Figure 2-Yoke and Focus Magnet Adjustmea


Fieure 3-Rear Chasis Adiusumens

OJohn P. Rider


## ALIGNMENT PROCEDURE

NOTE ON KRRI2B TUNER ALIGNMENT.-The use of a crystal mixer makes it necessary to observe the insert responses with the oscillator disabled. This is due to unde-
sirable $\mathrm{r}-\mathrm{/} / \mathrm{i} \mathrm{f}$ interaction if the oscillator was allowed to operate during alignment. Therefore, the responses shown in Figure 11 are not a strictly true representation of the inser using an oxcilloscope to observe the response, the curve shown in Figure 11 (b) will be the correct response for reference. In actual operation, the band pass will be such tha
the sound and picture carriers will be at the tips of the curve the sound and picture carriers will be at the tips of the curve
The adjacent channel picture and sound carriers will be in the valleys at each side. Care should be taken not to exceed the limita shown in Figure $11(a)$ and $11(c)$.
The valley, in the center of the response curve, may vary from 0 to $50 \%$ above the base line for VHF inserts. Adjust the signal input to the tuner. Excessive signal input will be indicated by the valley rising above the $50 \%$ level, particularly on the higher VHF channels.
Oscillator injection voltage is not adjusted on VHF inserts. A check may indicate variations from.$\rho 8$ to .3 volts at TPI, bu such readings should not be interpreted as an indication o should be adjusted to fall within the specified limits.

TEST EQUIPMENT.-To properly service the television chassis of these receivers, it is re
ing test equipment be available:
VHF Sweep Generator meeting the following requirements:

Frequency Ranges
35 to $90 \mathrm{mc} .11 \mathrm{mc}$. . to 12 mc . sweep width
170 to $225 \mathrm{mc} ., 12 \mathrm{mc}$. sweep widh
(b) Output adjustable with at least 1 volt maximum
(c) Output constant on all ranges.
(d) "Flat" output on all attenuator positions. with crystal accuracy:
(a) Intermediate freque
rmediate irequencies
47.5 mc ., $39.25 \mathrm{mc} ., 41.25 \mathrm{mc} ., 43.5 \mathrm{mc} .4$
45.75 mc. (b) Redi.25 mc.
(c) Output of these ranges should be adjustable and at leas VHF Heterodyne Frequency Meter with crystal calibrator if the signal generarar ith a frequency range of 470 mc to 890 me. RCA Types 40 A or 41 A or their equivalent. 10 UHF Signal Generator to provide the following frequencie
U.

Cathode Ray Oscilloscope.-An oscilloscope with a sen sitivity of $l$ millivivilt per inch is required. $A$ suitable pre-amp Electronic Voltmeter.-A voltmeter with a 1.5 volt DC scale Electronic Voltmeter.-A voltmeter witt ar equivalent. is required.
DC Milliammeter.-A milliammeter with $\alpha$ range of $0-50$
milliamperes full scale.

Adapter Socket.-An adapter socket is required to meter KRK12B Tuner. Wiring of adapter is shown in Figure 15 . RRR29 ANTENNA MATCHING UNIT ALIGNMENT.-The antenna matching unit is accurately aligned at the factory djustment of this unit should not be attemp in the cus serious attenuation of the signal especially on channel 2 . The -f unit is aligned with a particular antenna matching transormer in place. If for any reason, a new antenna matching
transiormer is installed, the $r-f$ unit should be realigned. The F-M Trap which is mounted in the antenna matching nit may be adjusted without adversely affecting the align ment of the unit.
To align the antenna matching unit disconnect the lead
from the F-M trap LS to the channel selector switch SI-E. With a short jumper, connect the output of the matchin nit through a 1000 mmin . capacitor to the grid of the second pix i-1 amplifier, pin 1 of V107. Replace the
adjustments.
Remove the first pix i-f amplifier tube V 10
Connect the positive terminal of a bias box to the chassis
and the potentiometer arm to the junction of R127 and R148, Set the potentiometer to produce approximately -5.0 volts as at junction of R127 and 2. V110 and set the oscil Connect an oscilloscope
loscope gain to maximum
Connect a VHF signal generator to the antenna inpul signal.
Tune the signal generator to 45.75 mc. and adjust the gen rator output to give an indication on the oscilloscope. Ad
ust L4 in the antenna matching unit for minimum audio ust $\mathrm{L4}$ in the antenno matching unit for minimum aud Tune the signal generator to 41.25 mc . and adjust Ll fo minimum audio indication on the oscilloscope.
Her the jumper from the output of the matching unit Connect a 300 ohm $1 / 2$ watt composition resistor from L5
to ground, keeping the leads as short as possible.
Connect an oscilloscope low capacity crystal probe from
L5 to ground. The sensitivity of the oscilloscope should be L5 to ground. The sensitivity of the oscilloscope should be
approximately 0.03 volts per inch. Set the oscilloscope gain to maximum.
Connect the VHF sweep generator to the matching unit
antenna input terminals. In order to prevent coupling reac antenna input terminals. In order to prevent coupling reac-
tance from the sweep generator into the matching unit, it is advisable to emplop a resistance pad at the matching unit
terminals. Figure 10 shows thre different resistance pads ior terminals. Figure 10 shows three different resistance pads for
use with sweep generators with 50 ohm co-ax output, 72 ohm use with sweep generators with 50 ohm co-ax output, 72 ohm
co-ax output or 300 ohm balanced output. Choose the pad to
match the output impedance of the particular sweep em-
ployed. ployed
Connect the signal generator loosely to the matching unit
Set the sweep generator to sweep from 45 mc . to 54 mc .
With RCA Type WRS9A sweep generators, this may be ac. With RCA Type WRS9A sweep generators, this may be ac.
complished by returning channel number 1 to cover this range. With WRS9B sweep generators this may be accomplished by retuning channel number 2 to cover the range In making these adjustments on the generator. be sure not
to turn the core too far clockwise so that it becomes lost to turn the core too far clockw.
beyond the core retaining spring.
Adjust $L 2$ and $L 3$ to obtain the response shown in figure
19. $L 3$ is most effective in locating the position of the shoulder 19. the is most efirective in locating the position of the shoud L2 should be adjusted to give maximum amplitude at 53 mc . and above consistent with the specified shape of the response curve. The adjustments in the procedure until no lurther adjustments are necessary.
Remove the 300 ohm resistor and crystal probe connec hions. Restore the cond SI-E. Replac PICTURE I-F TRANSFORMER ADJUSTMENTS.

$$
\begin{aligned}
& \text { OHMER ADJS } \\
& \text { Model } 7 \text { T-T- } 361
\end{aligned}
$$

Connect the i.f signal generator across the link circuit Connect the "VoltOhmyst" to the junction of R147 and R148 and to ground.

Obtain a 7.5 volt battery capable of withstanding appre-
ciable current drain and connect the ends of a 1,000 ohm potentiometer across it. Connect the battery positive terminal to chassis
and R148.
Set the bias to produce approximately -5.0 volt of bias at Set the bias to produce app.
the junction of R147 and R148.
Connect the "VoltOhmyst" to the juncture of R138 and L105 and to
Set the VHF signal generator to each of the following Irequencies and peak the specitied adiustment for maximum indication on the "VoltOhmyst". During alignment, reduce
the input signal if necessary in order to produce 30 volts of the input signal if necessary in order to produce 3.0 volits of
d-c at R138, L105 with minus 5.0 volts of i -f bias at the junction of R147 and R148.

## 44.5 mc. 45 mc. 43.0 mc.

Set the VHF signal generator to the following frequency and adjust the picture i-f trap for minimum d-c output at
R138, Lios. Use sufficient signal input to produce 3.0 volts of $\mathrm{d}-\mathrm{c}$ on the meter when the adjustment is made.
47.25 mc .
Models 17-T-352U \& 17-T-36IU

$$
\begin{aligned}
& \text { nace. } \\
& 104 \text { top core } \\
& U
\end{aligned}
$$

Connect the "V
R148 and to ground
Turn the AGC control fully clockwise
Obtain a 7.5 volt battery capable of withstanding appre-
ciable current drain and connect the ends of a 1.000 ohm ciable current drain and connect the ends of a 1,000 ohm to chassis and the potentiometer arm to the junction R147 and R148. Adjust the potentiometer for -5.0 volts indication
on the "Voltohmyst". on the "VoltOhmys
and to ground "VoltOhmyst" to the junction of R138 and L105 Connect the output of the signal generator to the front ter-
minal of the crystal mixer in series with a 1500 mml ceramic Set the VHF generator to each of the following frequencies and with a thin liber screwdriver tune the specitied adjustment for maximum indication on the "VoltOhmyst". In each instance the generator should be checked against a crys
calibrator to insure that the generator is on frequency.
During alignment, reduce the input signal if necessary
in order to produce 3.0 volts of d-c at R138. L105 with
volts of i. f bias at the junction of R147 and R148.
44.5 mc.
45.5 mc
43.0 mc.
$\underset{\substack{\text { IIIO } \\ \text { TiOs }}}{\substack{106}}$
Set the signal generator to the following frequency and
adjust the picture $i$ if trap for minimum d-c output at R138 adjust the picture i-f trap for minimum d -c output at Rl 138 ,
L105. Use sufficient signal input to produce 3.0 volts of $\mathrm{d}-\mathrm{c}$ on
meter when the adjustment is made. Tlop
47.25 mc . SWEEP ALIGNMENT OF PIX I-F.--
Model 17-T-36
To align T 2 and $T 104$, connect the sweep generator to the
mixer grid test point $T P 2$, in series with a 1500 mmi ceramic mixer grid test point TP, in series with a 1500 mmi ceramic capacitior. Use the shortest leads possible, with not more than
one inch of unshielded lead at the end of the sweep cable.
Connect the sweep ground lead to the r-t unit outer shield. Set the channel selector switch to channel 4 .
Clip 330 ohm resistors across terminals A and B of T10) and T108
Preset Cl19 to minimum capacity
Adjust the bias box potentiometer to obtain - -5.0 volts of bias as measured by a "Voltohmyst" at the
and R148. Set the AGC control fully clockwise.
Connect a 180 ohm composition resistor from pin 5 of V106 torminal A of T106. Connect the oscilloscope diode probe to in 5 of V106 and to ground
Couple the signal generator loosely to the diode probe in
order to obtain markers. Adjust T 2 (top) and Tl 104 (bottom) for m
with 45.75 mc at $70 \%$ of maximum response. Set the sweep output to give 0.3 volt peak-to-peak on the
oscilloscope when making the final touch on the above ad-

Adjust C119 until 42.5 mc . is at $70 \%$ response with respec to the
ure 22
Disconnect the diode probe, the 180 ohm and two 330 ohm esistors.
Connect the oscilloscope to the junction of R138 and L105. Leave the sweep generator connected to the mixer grid adin 12 win he shortest leads possible. 3.0 Adjust the output of the sweep generator to obtain 3.0
volts peak-to-peak on the oscilloscope. Couple the signal generator loosely to the grid of the first
pix itl amplitier Adjust the output of the signal generator to produce small markers on the response curve.
Retouch T106, T107 and T108 to obtain the response shown
Models 17-T-352U \& 17-T-361U
To align the crystal mixer plate circuit, T2 and T104 con
nect the VHF sweep generator to the front terminal of the ect the VHF sweep generator to the front terminal of th or. Use the shortest leads possible, grounding the sweep generator to the tuner cas.
Clip 330 ohm resistors across terminals A and B of T107 and T108.
Set the channel selector to channel 5 .
Connect a 180 ohm composition resistor from pin 5 of V106 o terminal A of T106. Connect
o pin 5 of V106 and to ground.
Couple the signal generator loosely to the diode probe in
der to obtain markers.
The shunt trimmer C119 across terminals A and B of T104 variable and is provided as a bandwidth adjustment. Prese he Thun (rimmer) to minimum capacity. Adjust T2 (top)
and 5.75 mc . at $70 \%$ of maximum response.

Adjust Tl for maximum gain. Readjust T 2 and T 104 if necesDisconnect the diode probe, the 180 ohm and the two 330 ohm resistors. Connect the oscilloscopetioneter obtain - 5.0 volts of Adjust the bias potentiometer to obtain -5.0 volts
bias as measured by $\alpha$ "VoltOhmyst" at the junction of R147 and R148
Leave the sweep generator connected to the front terminal of the 1N82 crystal holder with the shortest leads possible
and with not more than one inch of unshielded lead ai the end of the sweep cable. It these precautions are not observed, the receiver may be unsta
obtained may be unreliable.
Adjust the output of the sweep generator to obtain 3.0 Adjust the output of the sweep generato
to 5.0 volts peak-to-peak on the oscilloscope.
Couple the signal generator loosely to the grid of the first
pix i -f amplifier. Adjust the output of the signal generator to pix i-f amplifier. Adjust the output of the signal generator to
produce small markers on the response curve. Retouch T106, T107 and T108 to obtain the response shown in Figure 14.
Remove the oscilloscope, sweep and signal generator
connections. connections.
Remove the bias box employed to provide bias for align-

## RRE29 TUNER ALIGNMENT

Model 17-T-361
A tuner unit which is operative and requires only touch up adjustments, requires no preselling of adjustments. For such units, skip the remainder of this paragraph. For units which
are completely out of adjustment, preset C 27 all the way out.
俍 Se compmnely to to 13 oscillator slugs one turn from tight.
Surn $T 2$ slug all the way out. Do not change any of the adTurn T2 slug all the way out. Do not ch
Disconnect the link from terminals "A" and "B" of T104 and Turn the link with $a 39$ ohm composition resistor.
The 43.5 mc . trap is adjusted with zero bias. To insure that the bias will remain constant, take a clip lead and short circuit
the AGC terminal of the tuner at the terminal board to ground.
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Connect the oscilloscope to the test point TP2 on top of the
tuner unit. Set the ailoscope to maximum gain
Connect the output of the VHF signal generator to the output
of the antenna matching unit at the junction of L5 and C at the bottom of the FM trap L5.
Tune the signal generator to 43.5 me. and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator for with a 400 cycle
maximum output
Adjust C33 on top of the tuner, for minimum 400 cycle ind cation on the oscilloscope. If necessary, this adjustment can
be retouched in the field to provide additional rejection be retouched in the field to provide additional rejection to one
specific frequency in the $i$ i- band pass. However, in such cases specific frequency in the i-f band pass. However, in such cases,
care should be taken not to tune C33 into channel 2, thereby care should be taken not to tune
reducing sensitivity on channel 2 .
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery pos to the AGC terminal on the tuner and ground the battery pos
itive terminal to the tuner case. Adjust the bias potentiomete itive terminal to the tuner case. Adjust the bias potentiomete
to produce -3.0 volts of bias, as measured by the "Volt to produce - O .
Ohyst" at the AGC terminal on the tuner.
Set the channel selector switch to channel 8 .
Preset C22 to read, -3.0 volts at the test point TP1, as read
on the "VoltOhmyst." The limits for oscillator injection voltage on the
are 2 are 2.
volts.

Turn the fine tuning control fully clockwise.
Adjust C25 for proper oscillator frequency, 227 mc. This may be done in several ways. he eabies way and the way whic signal generator as a heterodyne frequency meter and bea signal generator as a heterodyne frequency meter and bea
the oscillator against the signal generator. To do this, tune th signal generator to 227 mc. with crystal accuracy. Insert on end of a piece of insulated wire into the tuner unit through
the hole provided for the adjustment of Cl6. Be careful that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscillator to shift. Connect the other end of the wire to the "r-1 in" terminal of the signa generator. Adjust
signal generator. Turn C27 clockwise until the beat note just begins to change
then turn one full turn in the same clockwise direction. Return the fine tuning control to the mechanical center of its range.
NOTE:-If on some units, it is not possible to reach the proper channel 8 oscillator riequency by adjustment of C2
switch to channel 13 and adjust L49 to obtain proper channe switch to channel 13 and adjust L49 to obtain proper channe
13 oscillator frequency as indicated in the table on page Thescillatitch irequency as indicated in the table on page 8
to
channel 12 and adjust L 60 to obtain prope channel 12 oscillator frequency. Continue down to channel 8 ,
adjusting the appropriate oscillator trimmer to obtrin the proper frequency on each channel. Then again on channel 8 adjust C25 to obtain proper channel 8 oscillator frequency Switch back to channel 13 and readjust $L 49$ and back to

Set the T 2 core for maximum inductance (core turned
counter-clockwise).
Connect the sweep generator through a suitable attenuator as shown in figure 10 to the input terminals of the antenn matching unit.
Connect the signal generator loosely to the antenna
terminals. terminals.
Set the sweep generator to cover channel
Set the oscilloscope to maximum gain and use the minimum input signal which will produce a usable pattern on the oscil
loscope. Excessive input can change oscillator injection during alignment and produce consequent misalignment even though the response as seen on the oscilloscope may look normal.
Insert markers of channel 8 picture carrier and sound
carrier, 181.25 mc . and 185.75 mc .
Adjust $\mathrm{C} 21, \mathrm{C} 16, \mathrm{Cl1}$ and C 7 for approximately correct
curve shape, frequency, and band width as shown in figure 18. The correct adjustment of C 7 is indicated by maximum am the r -f amplifier plate circuit and affects the trequency of the pass band most noticeably. C2l tunes the mixer grid circui and aftects the tilt of the curve most noticeably (assuming tha
C7 has been properly adjusted). C16 is the coupling adjust ment and hence primarily affects the reaponse band width.

Connect the "VoltOhmysst" to test point TP1. Adjust C22 read - 3.0 volts dc on the "VoltOhmyst" at TP1. Readjust C27, 21. C16 and C11 for proper response. Adjust C7 for maximum gain at midpoint of the curv.
Set the receiver channel switch to channel 13
Adjust the signal generator to the channel 13 oscillator freuency 257 me.
Turn the fine tuning control fully clockwise.
Adjust L49 to obtain an audible beat. Slightly overshoot the adjustment of L49 by turning the slug an additional turn in the lator to proper frequency by adjusting C27 to again oblain he bea
Set the sweep generator to channel 13
From the signal generator, insert channel 13 sound and picfure carrier markers, 21.25 mc . and 215.75 mc .
Adjust L36 and L20 for proper response as shown in figure
Turn of the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TP1
Check the oscillator injection voltage to be within limits as
previously specified. Adjust if necessary to bring within range. If it was necessary to readjust C22, turn the sweep and signal generators back on and recheck
response. Readjust L 36 and L 20 if necessary
Set the receiver channel selector switch to channel 8 and
readjust C27 for proper oscillator frequency, 227 me.
Set the sweep generator and signal generator to channel 8 Readjust C21, $\mathrm{Cl6}$, $\mathrm{Cl1}$ and C 7 for correct curve shape Requency and band width
Turn of the sweep and signal generators, switch back to
channel 13 and check the oscillator injection voltage at TPI channel 13 and check the oscillater iniection voltage at TP If the initial setting of the oscillator injection trimmer was far oft, it may be necessary to adjust the oscillator frequenc and response on channet 13 and repeat the tracking procedure several time before the proper setting is obtaine
Turn oft the sweep generator and switch the receiver to Adjust the signal generator to the channel 6 oscillator fre quency 129 mc
Set the line tuning control to the center of its mechanical range.
Adjust L54 for an audible beat. Adjust L48 and L32 for proper curve shape as shown in figure 18. Recheck the oscil lator injection voltage at TPl , to insure
limits specitied. Readjust C 22 it necessary
If C22 required adjustment, switch the receiver and th signal generator to channel 8 . Readjust C 21 tor correct curv
shape and recheck C27 and C25 for proper oscillato frequency.
Check the response of channels 2 through 6 by switching the receiver channel switch, sweep generator and marker gen erator to each of these channels and observing the respons
and oscillator injection voltage obtained. See ligure 18 to and oscillator injection voltage obtained. See higure typ ical response curves. It should be found that all thes channels have the proper response with the markers above $80 \%$ response.
If the markers fail to fall within this requirement readjus
L48 and L 32 in order to oblcin curves within the prope limits.
Switch the channel selector, signal generator and marke generator through channels 7 to 13 and observe the response
curves, referring to figure 18 for proper wave shape. Chec the injection voltage at ecch channel to be within limits. necessary readjust $\mathrm{C} 11, \mathrm{C} 21$ or Cl 6 to obtain the prope

With the receiver and signal generator on channel 13 adjus

Adjust the oscillator to frequency on all channels by switch Adust the oscilator to irequency on andard to each channel
ing the reiver and the frequency standiasting the appropriate oscillator slug to obtain the and adjusting the appropriate oscillator slug to obtain the audible beat. It should be possible to adjust the oscillator to
oblain the audible beat on each channel. Recheck the oscil lator injection voltage on each channel to verify that the voltage is within the specified limits.

## KRKI2B TUNER ALIGNMENT

## Models 17-T-352U \& 17-T-361U

TUNER VHF ALIGNMENT.-Remove the 654 voltage control the 654 in the adapter.
Connect the $0-50$ milliampere meter to the adapter socke leads and turn the adapter switch on
Remove the tuner cover shield.
Rotate the channel selector to a point midway between channels, disengaging the insert contacts, and observe the with the tuned circuits disengaged. To be sure the oscillato is in a non-oscillatory state, short circuit the spring contact 2 and 13 , the two contacts nearest the tuner fron
(NOTE: The contacts are at zero d-c potential.) Should the plate current rise, keep the contacts shoried while adjusting the oscillator plate current. Adjust oscillator voltag
Replace the tuner cover shield.
Connect the VHF sweep generator to the antenna terminals. Connect the VHF signal generator loosely to the antenn Conne
Connect the oscilloscope, through the preamplitier, if
weeded with oscilloscope used, to test point TPl. eoded with oscilloscope used, to test point TI.
Ground the AGC bias at the tuner terminal board using a
Turn oft the adapter switch, removing plate voltage from when a crystal is used as a mixe
Set the channel selector and the sweep generalor to Set the
channel 2.
Insert markers of channel 2 picture carrier and sound
carrier, 55.25 mc . and 59.75 mc .
Adjust antenna T6, r-1 amplifier plate L29 and mixer L130 adjustments for a symmetrical curve with maximum gain at
he center of the pass band. The curves will have a deep valley because of no crystal loading and nonlinear delector callay because of no crystai listics. The limits for the $100 \%$ responne points are shown in Figure 11 . The proper curve e hape is shown in Figure
11 (b). (See note on page 13 for detailed explanation of adjustments.) If the bandwidth is out of tolerance, it can usually be corrected by redressing the coupling capacitor of the double
luned circuit, C40 on insert A. Maximum bandwidth occurs tuned circuit, C40 on insert A. Maximum bandwidit
when the capacitor is centered in the insert chamber.
Repeat the above steps for all VHF channels adjusting the Repeat the above steps for all VHF channels adjusting the a symmetrical curve with maximum gain at the center of the pass band
Turn of the sweep generato
Remove the oscilloscope and preamplitier it used, from est point TPl
Turn the AGC control fully clockwise
Remove the clip lead grounding the AGC bias on the
tuner terminal board.
Connect the potentiometer arm of one of the bias supplies
to the $A G C$ terminal on the tuner and $g$ ground the battery to the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case. Adjust the bias potentipositive terminal to the
ometer to produce - -3.5 vorts of bias, as measured by the
"VoltOhmyst" at the AGC terminal on the tuner.
Connect the potentiometer arm of the second bias supply
to the junction R147 and R148, and ground the positive battery to the junction R147 and R148, and ground the positive batter
terminal. Adjust the bias potentiometer to produce - 5 volts terminal. Adjust the bias potentiometer to produce - S volt
of i-f bias as indicated on the "Voltohmyst" at the junction point

Connect the oscilloscope to the junction of RI38 and Ll0 Turn the adapter switch on to apply plate voltage to the oscillatior
Turn the channel selector to channel 13 .
Set the fine tuning control to the center of its range
Adjust the oscillator slug L22 to proper frequency, 257 mc . This may be done in several ways. The easiest way and the
way which will be recommended in this procedure will be to use the signal generator as a heterodyne frequency meter
and beat the oscillotor againit the signal generator . To do
this tune the signal his, tune the signal generator to 257 me. with crystal accu-
acy. Insert one end of a piece of insulated wire into the racy. insert one end of a piece of insulated wire indo the the holes next to the oscillator tube on the right front top corner of the tuner. Be carelul
that the wire does not touch any of the tuned circuits as it hat cause does nency of the oscillator to shift Connec the other end of the wire to the "r-fin" terminal of the signal generator. Adjust L22 oscillator elug to obtain an audio beat with the signal generator.
Turn on the sweep generator and set to Channel 13 mixer tank circuit L 21 for maximum gain and flat-topped curve. Recheck Tl for maximum gain at center of band with the proper response. Maximum gain and flat-topped response
should be obtained simultaneously. Adjust the oscillator to frequency on all VHF channels by
switching the receiver and signal generator to each VHF channel and adjusting the appropriate oscillator slug to abte mixer slug where necessary to obtain maximum gain and ate mixer sluy where neesssary to obtain
proper curve shape as explained above.
Adjust the tunable I-F Trap C16-L7. To do this connect
the signal generator to the fixed I-F Trap C2-L2 at the end the signal generator to the ixed to 43.5 mc . and adjust the output of the signal generator to obtain sutticient indication on the oscilloscope. Tune the
Trap C16-L7 for minimum indication on the oscilloscope.

## Remove the signal generator and the oscilloscope

TUNER UHF ALIGNMENT-To align the UHF inserts
Turn of the adapter switch, removing plate voltage from the oscillator
Ground the AGC bias at the tuner terminal board using a chip lead to insure that the bias will remain constan
Connect the oscilloscope, through the pre
with oscilloscope used, to test point TP1.
Connect the UHF sweep generator to the antenna terminals Use a 10 DB attenuator pad to assure proper alignment. Connect the UHF signal generator loosely to the antenn terminals.
Set the channel selector to the desired position and the sweep
used.
Insert markers of the picture carrier and sound carrie or desired channel.
Adjust UHF antenna link coupling and mixer adjustments for a symmetrical
the pass band.
The responses are shown in Figure 12. The curve shape will usually vary from Fig. 12 (a) to Fig. . . (c) (c) going highe
in frequency, however any of these responses are acceptable.

Repeat the above steps for all UHF inserts used adjusting the appropriate antenna, link coupling and mixer slugs for symmetrical
pass band.
Remove the oscilloscope and preamplifier if used, from lesi poim
Remove the clip lead grounding the AGC bias on the tuner
terminal board.
$\qquad$ Connect the potentiometer arm of one of the bias supplies ositive meter to produce the tuner case. Adjust the bias potent

## ALIGNMENT PROCEDURE

Connect the potentiometer arm of the second bias supply to the junction of R147 and R148, and ground the positive
battery terminal. Adjust the bias potentiometer to produce battery terminal. Adjust the bias, potentiomeler to produce -5 volts of i-f bias as indicated on the "VoltOhmyst" at the unction poin
Connect the oscilloscope to the junction of R138 and L105.
Use 3 to 5 volts peak-10-peak output on the oscilloscope.
Turn the adapter switch on to apply plate voltage to Turn the ad
the oscillator.
Turn the channel selector to the lowest UHF channel to
Set the fine tuning control to the conter of its range
Adjust the oncillator core to proper frequency. To do this, shortest leads possible. Insert a 45.75 mc . marker from the VHF generator.
Set the UHF sweep generator to aweep the desired channel,
and observe the output on the oscilloscope. If the sweep and observe the output on the oscilloscope. If the sweep generator is not sweeping the correct trequency range, it
may be necestary to readjust the sweep in order to place may be necensary to readjust the aweep in orid.
the 45.75 marker on the response curve as in Fig. 14.
Set the UHF marker gen. to the picture carrier of the
channel insert being adjusted and connect to teat point TPI. Channel insert
Adjust the oscillator core until the markers for 45.75 mc.
and the picture carrier coincide on the sweep pattern on the and the picture carrier coincide on the sweep pattern on the
Adjust mixer core for maximum gain with proper wave shape.
Connect the "VoltOhmyst" to test point TP1, using 1.5
volt D.C. scale.
Set oscillator injection adjustment to read .1 volts on the Set oscillator injection adjustment to read . 1 volts on the
"Voltohmyst." Repeat the above steps for all UHF inserts adjusting
he oscillator injection control only if the reading on the Voltohmyst" exceods 3 volts. Adjust as necessary to read .3 volis or lose at TPI $A$ COUSTMENT.-Disconnect all test equip. ment except the oscilloscope which should be connected to
pin 6 of Villo.
Connect an antenna to the receiver antenna terminals. Turn the AGC control fully counter-clockwise.

Tune in a atrong signal and adjust the oncillozeope to $\mathbf{3 0 0}$ the video waveiorm.
Turn the AGC control clockwise until the tips of sync begin to be comproseed, then counter-clockwise until no compression is obtained.
HORIZONTAL OSCILARTOR ADJUSTMENT. - Normally the adjuatment of the horizontal oscillator is not considered to wavelorm adjuatment mary require the use of an oscilloscope, it comnot be done conveniently in the field. The wavelorm adjustment is made at the factory and normally should not require readjuatmont in the field. Howevor, the waveiorm adjustment should be checred whenever the receivir is improper.
Horizontal Frequency Adjustment.-Tune in a station and sync the picture. If the picture cannot be eynchronized with quency core on the rear apron until the picture will synchronize. If the picture still will not sync, turn the T114 wavelorm adjustment core (under the chassis) out of the coil several
turns from its original position and readjust the T114 freturns from its original position and readju
quency core until the picture is synchronized.

Examine the width and linearity of the picture. If picture width or linearity is incorroct, adjust a horizontal drive control C174B, the width control L109 and the linearity control L111 until the picture is correct.

Horizontal Oscillator Wavelorm Adjustment.-The hori zontar oscillator wavelorm may be adjusted by oither of two method. The method outlined in paragraph $A$ below ma be. The service shop method outlined in paragraph B below requires the use of an oscilloscope.
A.-Turn the horizontal hold control completely clockwise. to make simultaneous adjuatments while watching the picture on the acreen. Firat, turn the T114 frequency core (on the rear apron) until the picture falls out of sync and three or four diagonal black bars sloping down to the right appear on the ucreen. Then, turn the wavelorm adjustment core (under the
chasais) into the coil while at the same time adjuating the fre quency core so as to maintain three or four diagonal black bars on the scroen. Continue this procedure until the oscillator begins to motorboat, then turn the waveiorm adjustment core out until the motorboating just stopa. As a check, turn
the Tllt trequency core until the picture is synchronized then reverse the direction of rotation of the core until the picture falls out of sync with the diagonal bars sloping down to the right. Continue to turn the frequency core in the same direction. No more than three or four bars should appear on the ucreen. Instoad, the horizontal oscillator should begin to
motorboat. Retouch the adjustment of the T114 waveform adjuatment core if necomary until this condition is obtainod.
B.-Connect the low capacity probe of an oscilloscope to quarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown in Figure 24. Adjust the waveform adjurtment core of T 114 until the two peake are at the same height. During this adjustment, the picture must be kept in sync by readjuating the
hold control if necescary.

This adjustment is very important for correct operation of
the circuit. If the broad poak of the wave on the oscilloscope the circuit. Ia the broad poak of the wave on the oocilloscope is lower than the sharp poak, the noise immunity becomos and dritt of the oscillator becomes more sorioun. On the other hand, if the broad peak is higher than the sharp peak, the oncillator is overstabilizod, the pull-in range becomen inadequate and the broad peak ann cause double triggering of position. Remove the oscilloscope upon complotion of this adjustment.
Horizontal Locking Range Adjusument.-Sel the horizontal hold control to the full countercloctwise position. MomenThe picture the signal by switching off channel then back. core slightly ayd momain in sync. If so turn the Thily switch ouf chamnel. Repeat until the picture falls out of sync with the diagonal lines sloping
down to the left. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into aync.
If more than 3 bars are present just belore the picture pulle into sync, adjust the horizontal locking range trimmer C174A C174A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in poini Repeat this procedure until 2 or 3 bars are present.

Turn the horizontal hold control to the maximum clockwise position. Adjust the Tll4 irequency core so that the diagonal barerse the direction of adjustment to that bar just moves to the left side of the screen loaring the picture in synchroniza tion.


Figure 8-KRK12B Oscillator Adjustment


Figure 9-KRK12B Tiuner Adjustment


Mins
Figure 10-Sweep Atsenuator Pads


Figure 11-KRK12B VHF Insert Responses


Figure 12-KRK12B UHF lusert Responses


Figure 13
KRK12B T2
and T104
Response

| Figare 14 |
| :---: |
| Over-all | I-F Res-aponse

with KRK12B


Figure 15-KRK12B Voltage Control Adapter

## OJohn P. Rider



Figure 16-KRK29 R-F Oscillator Adjustments


Figure 17-KRK29 Tuner Adjustments


Figure 18-KRK29 R-F Response


Figure 19—KRK29 Antenna Matching Unit Response



Figure 24-Horizontal Oscillator Wave Forms


Figure 2S-Top Cbassis Adjustments (KRK29 Tuner Shown)


Figure 26-Bottom Chassis Adiustments (KRK29 Tuner Shown)
VOLTAGE CHART

| VOLTAGE CHART |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| The following measurements represent two sets of conditions．In the first condition，a 15000 microvolt test pattern signal was fed into the receiver，the picture synced and the AGC control properly adjusted．The second condition was obtained by removing the antenna leads and short circuiting the receiver antenna terminals．Voltages shown are read with a type WV97A senior＂VoltOhmyst＂between the indicated terminal and chassis ground and with the receiver operating on 117 V olts， 60 cycles，a－c．The symbol＜means less than． |  |  |  |  |  |  |  |  |  |  |  |  | $\begin{aligned} & \text { Tube } \\ & \text { No. } \end{aligned}$ | $\begin{gathered} \text { Tubb } \\ \text { Typo } \end{gathered}$ | Function | OperatingCondition | E．Plato |  | E．Screon |  | E．Cathode |  | ${ }_{\text {E．Grid }}$ |  | Noter on Mosasuremolts |
|  |  |  |  |  |  |  |  |  |  |  |  |  | ${ }_{\substack{\text { Pin } \\ \text { No．}}}^{\text {din }}$ |  |  |  | Vollt | ${ }_{\substack{\text { Pin } \\ \text { No．}}}$ | Volts | ${ }_{\substack{\text { Pin } \\ \text { No．}}}$ | Voltr |  | Volts |  |
| TubeNo． |  | Function | OporatingCondition | E．Patat |  | E．Screon |  | E．Caltode |  | E．Grd |  | Notes on Mosuriemotit |  | v108 | ${ }^{6 C B 6}$ | 3rd Pix．I－F Amplifie | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | $s$ | 120 | 6 | 158 | 2 | 2.1 | 1 | － |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  | No Sigael |  |  |  | 5 | 130 | 6 | 141 | 2 | 1.9 | 1 | － |  |
|  |  |  |  | $\underbrace{\substack{\text { Pio } \\ \text { No．}}}_{\text {Pio }}$ | Volte | ${ }_{\substack{\text { Pin } \\ \text { No．}}}^{\text {chen }}$ | Valte | ${ }_{\substack{\text { R }}}^{\substack{\text { Rin } \\ \text { No．}}}$ | Volte | ${ }_{\text {Nor }}^{\substack{\text { Rin } \\ \text { No．}}}$ | Volu |  | v199a | $12 \mathrm{NU7}$ | Picture2nd Det | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | －21 | － | － | 3 | 。 | 2 | ${ }^{-3.8}$ |  |
| $\begin{aligned} & \mathbf{v}_{\mathrm{KRK}}^{1} 29 \end{aligned}$ | 6807a |  | $15000 \mathrm{Ma}$. V |  |  |  |  |  |  |  |  |  |  |  |  | No Signal | 1 | －10 | － | － | 3 | 0 | 2 | －0．4 |  |
|  |  | Ampliter | $\begin{gathered} \text { Signal } \\ \text { No Signal } \end{gathered}$ | 6 6 | $\begin{aligned} & 1720 \\ & 133 \end{aligned}$ | － | － | ${ }_{8}^{8}$ | $\begin{array}{\|l\|l} 0.1 \\ 1.1 \\ \hline \end{array}$ | ${ }_{7}^{7}$ | ${ }_{0}^{-}$ |  | v1098 | ${ }^{12 R U 7}$ | Vert．Sync． | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 6 | ${ }_{68}$ | － | － | ： | 。 | \％ | ${ }^{58}$ |  |
|  |  |  | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | 270 | － | － | 3 | ${ }_{133}^{172}$ | ${ }_{2}$ | 二 |  |  |  |  | No Sigal | 6 | 62 | － | － | － | － | 7 | －5．6 |  |
| kRK29 |  |  | $\begin{gathered} \text { No Signal } \\ 15000 \mathrm{Mu} . \mathrm{V} . \end{gathered}$ | 1 | 280 | － | － | 3 | 133 | 2 | $\stackrel{-}{-2.46}$ |  | v110 | ${ }^{\text {ccle }}$ | $\underset{\substack{\text { vidao } \\ \text { Anpilior }}}{ }$ | $\begin{gathered} 15000 \mathrm{Mu}, \mathrm{~V} \\ \text { Signal } \end{gathered}$ | ${ }_{6}$ | ${ }_{82}$ | 3.8 | 180 | 1 | 1.1 | 2.9 | －3．4 | $\begin{aligned} & \text { AGC control set } \\ & \text { for normal operation } \end{aligned}$ |
|  | 6x8 | Mirror | ${ }_{\text {Sigral }}$ S | $\bigcirc$ | 180 | － | 180 | 6 | $\bigcirc$ | 7 | -3.0 -2.80 -8.0 |  |  |  |  | No Sigal | ${ }_{6}$ | ${ }^{73}$ | 38 | 98 | 1 | 0.9 | 2.9 | －0．4 | AGC control set for normal operatio |
|  |  |  |  | $\bigcirc$ | 145 | － | 145 | 6 | － | 7 |  |  | vilik | ${ }^{12 R U 7}$ |  |  | 1 | 42 | － | － | 3 | 148 |  |  |  |
|  |  |  |  | 3 | ${ }^{95}$ | － | － | 6 | － | 2 | ${ }_{-9.5}$ |  |  |  |  |  | 1 | 42 | － | － | 3 | 148 | 2 | 115 |  |
|  |  |  | No Sigoal | 3 | 90 | － | － | 6 | 0 | 2 | ${ }_{-5.1}^{-3.010}$ |  |  |  |  | ${ }^{\text {No Stigal }}$ | 1 | 0 | － | － | 3 | 125 | 2 | ${ }^{82}$ |  |
| $\begin{aligned} & \mathbf{v} 1 \\ & \text { kRR122 } \end{aligned}$ | 68074 | ${ }_{\text {A．F }}^{\text {Amplibor }}$ |  | 6 | 143 | － | － | ： | 1.2 | \％ | 。 |  | v1118 | ${ }^{12 N U 7}$ |  | $\begin{gathered} 18000 \mathrm{Mu} \text { V. } \\ \text { Sigmal } \end{gathered}$ | 6 | 267 | － | － | $\stackrel{8}{8}$ | 171 | 7 | 101 |  |
|  |  |  |  | 6 | ${ }_{138}$ | － | － | 8 | 1.0 | 7 | － |  |  |  |  | No Signal | 6 | 259 | － | － | － | 118 | 7 | ${ }_{5}$ |  |
|  |  |  |  | 1 | 280 | － | － | ${ }^{3}$ | 143 | 2 | 97 |  | v112R | 6SNTGT | Syacidut | 15000 Mu. Signal | 1 | 60 | － | － | 3 | － | 2 | ${ }^{-2.7}$ |  |
|  |  |  | No Sigral | 1 | 250 | － | － | 3 | 137 | 2 | 97 |  |  |  |  | No stimal | 1 | ${ }^{58}$ | － | － | 3 | － | 2 | ${ }^{-2.1}$ |  |
| $\mathrm{v}_{2}$ | 6xf4 |  | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 147 | ${ }^{28}$ | － | － | 5 | $\bigcirc$ | 246 | ${ }^{-8}$ |  | v1128 | 6SNTGT | Vortical Oncillator Dischargo | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | 6 | 76 | － | － | － | － | 7 | －16 | Depends on setting of Vert． hold control |
|  |  |  |  | 187 | ${ }^{25}$ | － | － | 5 | 148 | 246 | -6 103 |  |  |  |  | Hosigal | ${ }^{6}$ | 75 | － | － | 8 | $\bigcirc$ | 7 | －15 | Woltages thown are synced pix adjustment |
| KRK12B | 68072 | ${ }_{\text {Amplibior }}^{\text {L．F }}$ | ${ }_{\text {S }}^{\text {Signal }}$ | ${ }_{6} 6$ | 270 <br> 260 | － | － | 8 | 148 <br> 142 | 7 | 103 |  | v113 | 6к6Gt | $\begin{aligned} & \text { Voritioal } \\ & \text { Outup } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 260 | 4 | 270 | 8 | 15.9 | 5 | ${ }^{-11}$ |  |
|  |  |  | $\begin{aligned} & 15000 \mathrm{Mu} . \mathrm{V} . \\ & \text { Signal } \end{aligned}$ | 1 | 148 | － | － | 3 | 1.4 | 2 | － |  |  |  |  | Hos Stranal | 3 | 250 | 4 | 260 | 8 | 18.5 | 5 | －10 |  |
|  |  |  | ${ }_{\text {Nos Sigal }}$ | 1 | 143 | － | － | 3 | 1.2 | 2 | $\bigcirc$ | －Dopends on adiurmort of RG， | v114A | 6SN7GT | $\underset{\substack{\text { Horiontal } \\ \text { Ooc．Coutrol }}}{\text { a }}$ |  |  |  |  |  |  |  |  |  |  |
| KRK12B | 6s4 | $\begin{aligned} & \text { Vetago } \\ & \text { Control } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 9 | 270 | － | － | 2 | 94 | 6 | ${ }^{68}$ |  |  |  |  | $\begin{array}{\|c\|} \text { Signal } \\ \hline \text { No Signal } \end{array}$ | ${ }_{2}^{2}$ | 172 | － | － | 3 | $\stackrel{-2.2}{1.5}$ | 1 | -25 -16 |  |
|  |  |  | No Sigat | 9 | 280 | － | － | 2 | － | 6 | －63 |  |  |  |  |  | 2 | 160 | － |  |  |  | 1 |  |  |
| v101 | 6nus |  | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | ${ }_{5}$ | 127 | 6 | 140 | ， | 1.0 | 1 | 。 |  | v148 | 6SN2GT | HorizontalOscillator | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 5 | 180 | － | － | 6 | － | 4 | ${ }^{-74}$ |  |
|  |  |  | No Sigal | 5 | 110 | － | 121 | 7 | 9 | 1 | 0 |  |  |  |  | No Sigal | 5 | 178 | － | － | 6 | － | 4 | $-66$ |  |
| v102 | 6AU6 | $\begin{aligned} & \text { 2nd Sound } \\ & \text { I-F Amp. } \end{aligned}$ | 15000 Mu. Signal | 5 | 125 | － | 136 | 7 | － | 1 | －13 |  | v115 | 6B86Gt | MorizontalOutput | $\begin{gathered} 13000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | ． | 4 | 180 | ： | 18 | s | －17．5 | ＊High Voltage |
|  |  |  | No Sigoal | 5 | 103 | － | 115 | ， | － | 1 | －0．8 | Unreliable measuring point． Voltage dependa on noine． |  |  |  | No Signel | Cap | ． | 4 | 175 | 8 | 17.5 | 5 | －17 |  |
| v103 | 6x15 | $\underset{\substack{\text { Ratio } \\ \text { Doioctor }}}{\text { ater }}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 7 | 0.3 | － | － | 1 | 7．2 <br> $\cdot 2.8$ | － | － |  | v116 | $\begin{gathered} 183 G T \\ \hline 8016 \end{gathered}$ | H．V． | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | cop | ． | 4 | ， | 247 | 14，000 | － | ， | ＊High Voltage <br> Pulee Presen |
|  |  |  | ${ }^{\text {No Siggal }}$ | 7 | － | － | － | 1 | ${ }^{2} .8$ | － | － | Unreliable measuring point． Voltage depends on noiee． |  |  |  |  | cap | ． | － | － |  |  | － | － | "High Voltage |
| v104 | 6Av6 | 1nt Audio Amplifier | $\begin{gathered} 15000 \mathrm{Mu}, \mathrm{~V} . \\ \text { Signal } \end{gathered}$ | 7 | ${ }_{87}^{89}$ | － | － | 2 | $\bigcirc$ | 1 | ${ }_{-0.8}^{-0.8}$ | ${ }_{\text {At min }} \mathrm{A}$ min．volume | v112 | ${ }^{\text {6WfGt }}$ | Dampor | $\frac{\text { No Signal }}{15000 \mathrm{Mu} . \mathrm{V}} \begin{gathered} \text { Signal } \end{gathered}$ | Cap | 270 | － | － | 247 | 13，000 | － | － |  |
| v10s | 688G7 | ${ }_{\text {and }}^{\text {Rudio }}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 217 | 4 | 225 | － | 15.2 | 5 | 。 | At min rolum． |  |  |  | No Signal | ${ }_{5}$ | 260 | － | － | 3 | ． | － | － |  |
|  |  |  | No Sigral | 3 | 210 | 4 | 219 | 8 | 15.0 | 5 | 0 | At min volum | v118 | 211P44 |  |  | － | 200 |  |  |  |  |  |  |  |
| v106 | ${ }^{6 C 76}$ | $\begin{aligned} & \text { 1at Pix. I-F } \\ & \text { Xmplifiar } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | s | 202 | － | 223 | 2 | －0．1 | 1 | －7．5 |  |  |  | Kineocopo |  | Cap | 12，000 13，000 | 10 | 430 | 11 | 120 | 2 | 78 | ${ }^{\text {At a vorago Brighmoun }}$ |
|  |  |  | No Signal | 5 | 100 | 6 | 112 | 2 | 0.9 | 1 | －－0．1 | Unreliable measuring point Make meanurement at T1 4 － |  |  |  | ${ }^{\text {No S Sqpal }}$ | Cap | 13，000 | 10 | 415 | 11 | 100 | 2 | ${ }^{88}$ | At arorage Brightae．t |
| v107 | ${ }^{\text {ccre }}$ | $\begin{aligned} & \text { 2nd Piz. I-F } \\ & \text { Amplifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 205 |  | 223 | 2 | －0．1 | 1 | －7．9 |  | $\begin{array}{\|l\|l\|} v_{112} \\ v_{120} \end{array}$ | ${ }^{5046}$ <br> sтзвт | Rectiort |  | 446 | － | － | －－ | $2 \pm 0$ | 285 | － | － |  |
|  |  |  | No Sigal | 5 | 100 | － | 111 | 2 | 0.5 | 1 | ${ }^{-0.1}$ |  |  |  |  | No Sigal | 446 | － | － | － | 248 | 274 | － | － |  |

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## ELECTRICAL AND MECHANICAL SPECIFICATIONS

e inches on a 21 AP4 Kinescope

## TELEVISION R-F FREQUENCY RANGE

Models 21-D-358 to 21-D.380 Incl
All 12 VHF channels...... 54 mc . to 88 mc .174 mc . to 216 mc .
Models 21-D.358U to 21-D.380U Incl
Any of 70 UHF channels................. 470 mc . to 890 mc . Any of 12 VHF channels. . 54 mc . to 88 mc ., 174 mc . to 216 mc . (Any desired combination of 16 UHF and/or VHF channels

INTERMEDIATE FREQUENCIES
Picture I.F Carrier Frequency
45.75 mc .

Sound I-F Carrier Frequency
POWER RATING............21-D. 358 to 21-D. $380 \quad 295$ watts
aUDIO POWER OUTPUT RATING................ . 4 watts max.

## rCa tube complement

Tube Used
Tuner KRK29 (21-D.358 to 21-D.-380 Ind)
unction
(1) RCA 6BQ7A.

R-F Amplitior

antenna input impedance
Models 21-D.358 to 21-D-380 Incl.
Choice: 300 ohms balanced or 72 ohms unbalanced
Models 21-D.358U to 21-D.380U Incl.
UHF-300 ohms balanced.
VHF - 300 ohms balanced.
CHASSIS DESIGNATIONS
KCS81F................In Models. 21-D.358. 21-D.368, 21-D.376,
21-D.377. 21-D.378. 21-D.379, 21-D.380 In Models 21-D.358U, 21-D.368U, 21-D.376U,
21-D-377U. 21-D.378U, 21-D-379U, 21-D.380U
21-D.377U. 21-D.378U, 21-D.379U, 21-D.380

| VIDEO RESPONSE............................ To 4 mc. |  |
| :---: | :---: |
| focus | Magnetic |
| sweep deflection | Magnetic |
| scanning. | .Interlaced, 525 line |
| horizontal scanning frequency | ......15.750 cps |
| VERTICAL SCANNING FREQUENCY | . . . 60 cps |
| frame frequency (Picture Repet |  |

## Tube Used

Fry Fun
Function



operating cont
Fine Tuning
Brightness
Sound Volume and On-OHt Switch
Picture Horizontal Hold .
Picture Vertical Hold
Picture
Tone Switch
NON-OPERATING CONTROLS
Horizontal Centering.....................top chassis adjustme Vertical Centering. ......................top chassis adjustment
AGC ................................ chassis adjustment Height ........................................ear chassis panel screwdriver adjustment Horizontal Linearity ..................... rear chassis adjustment Horizontal Locking ............ear chassis screwdriver adjustment Vertical Linearity . . . . . . . . . . . front panel screwdriver adjustment Horizontal Drive. ............rear chassis screwdriver adjustment Horizontal Oscillator Frequency . . . . . . .rear chassis adjustment Horizontal Oscillator Waveform ...... bottom chassis adjustment Width Link .
Focus. Trap M...........................top chassis adjustment Ion Trap Magnel . . . . . . . . . . . . . . . . . . . top chassis adjustment Deflection Coil ....................... .top chassis adjustment
Focus Magnet. . . . . . . . . . . . . . . . . .op chassis adjustment


 Mahogany, Oak playing attachment.


Madels 2l-D-377, 2l-D-37t: Red Cherry, Natural Cherry

## GENERAL DESCRIPTION

Au models are " 21 inch" television re
Ren ceivers. Model.s. 21-D.35B. 21.D.-368, 21-D.-.376.
21-D.377, 21-D.378, 21-D.379 and 21-D.380 are identical except for cabinets and speakers. These models feature full 12
channel VHF coverage. Models $21 . \mathrm{D}$-35GU.
 21-D.379U and 21-D. 380 O are identical except for cabinets and speakers. These models feature full 12 channel VHF cover-
age plus any 4 UHF channels desired. All age plus any 4 HF channels desired. All to permit the use of an external record


Figure 2-Yoke and Focus Muknet ddjustments

Models $21-\mathrm{D}-379,21-\mathrm{D-379U}$ Mohogony, म̈atnut



Models 21-D-380, 21-D-380U "Beaumont"
Mople, Red Cherry

Figure $4-K R K 29$ R.F Oscillator Adjustments


Figure 3-Rear Chassis Adjustments




Figure 5-KRK12B Oscillator Adjustmen
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ground, keeping the leads as short as possible.
Connect an oscilloscope low capacity crystal probe from 15 to ground. The sensitivity of the oscilloscope should be approximately 0.03 volts per inch. Set the oscilloscope gain o maximum
Connect the VHF sweep generator to the matching unit antenna input terminals. In order to prevent coupling reactance
from the sweep generator into the matching unit, it is advisable to employ a resistance pad at the matching unit terminals. Figure 10 shows three different resistance pads for use with
sweep generators with 50 orm co-a output. 72 ohm co-ax outsweep generators with 50 ohm co-ax output. 72 ohm co-ax out.
put or 300 ohm balanced output. Choosc the pad to match the putput impedance of the particular sweep employed. Connect the signal generator loosely to the matching unit antenna terminals.
Set the sweep generator to sweep from $45 \mathrm{mc}$. . 54 mc .
With RCA Type WR59A sweep generators, this may be accomWith RCA Type WR59A sweep generators, this may be accom plished by retuning channel number 1 to cover this range
With WR59B sweep generators this may be accomplished by retuning channel number 2 to cover the range. In making hese adjustments on the generator, be sure not to turn the core too far clock
retaining spring.
Adjust L2 and L3 to obtain the response shown in Figure 9. L3 is most effective in locating the position of the shoulder he curve at 52 mc . and L2 should be adjusted to give specified shape of the response curve. The adjustments in the
matching unit interact to some extent. Repeat the above promatching unit interact to some extent. Repeat the

Remove the 300 ohm resistor and crystal probe connections.
Restore the connection between L5 and S1-E. Replace V106.
PICTURE I-F TRAP ADJUSTMENT. - Connect the i.f signal enerator across the link circuit on terminals R 133 and C133B.
Obtain two 7.5 volt batteries capable of withstanding appreciable current drain and connect the ends of a 1,000 ohm potentiometer across each. Connect the positive terminal of one
battery to chassis and the potentiometer arm to the junction of battery to chassis
R133 and C133B.
Set the bias to produce approximately -1.0 volt of bias at he junction of R133 and C133B.
Connect the "VoltOhmyst" to pin 9 of VIIO, the 6CL6 video Set
Set the signal generator to each of the following frequencies
and adjust the corresponding circuit for minimum d.c output an pin 9 of V1to. Use sufficient sircuit for mininimum d.c output
d.c on the meter when the inal adjustment is made.
39.25 mc
41.25 mc
47.25 mc
T104 top core
T105 bottom cor
T106 bottom cor

PICTURE I-F TRANSFORMER ADJUSTMENTS.-
Models 21-D- 358 to 21-D. 380 Incl.
Set the signal generator to each of the following frequencies the "Voltohmyst." During alignment, reduce the input signal if necessary in order to produce 1.0 volt of d-c at pin 9 of V110
with -1.0 volt of $\mathrm{i}-\mathrm{b}$ bias at the junction of R133 and C133B.

## $43.7 \mathrm{mc}.$. 45.5 mc. <br> 45.5 mc. 41.8 mc. <br> T 109 T 108 T 107

To align T105 and T106, connect the sweep generator to the first picture i.f grid, pin 1 of V106 through a 1,000 mmf. ceramic
capacitor. Shunt R137, R141 and terminals "A" and " $F$ " 109 with 330 ohm composition resistors. Set the i - bias to
-1.0 volt at the junction of R133 and Cl3B. Connect the oscilloscope to pin 9 of V110.
Adjust T105 and T106 top cores for maximum gain and curve put of the sweep generator to produce 0.5 volt peak-to-peak a he oscilloscope terminals.

To align T 2 and T 104 , connect the sweep generator to the
mixer grid test point TP2. Use the shortest leads possible, with not more than pone inch of unshielded lead at the end of th sweep cable.

Adjust C121 until 41.25 mc . is at $85 \%$ response with respect
俍 to the low frequenc
shown in Figure 23 .
Disconnect the diode probe, the 180 ohm and three 330 oh resistors.

## Models 21-D. $\mathbf{3 5 8 U}$ to 21-D. 380 U incl.

Set the signal generator to each of the following frequencies
and peak the specified adjustment ior maximum indication on and peak the speciifed adjustment for maximum indication
the "Voltohmyst." During alignment, reduce the input signa if necessary in order to produce 1.0 volt of d.c at pin 9 of
V110 with -1.0 volt of i - f bias at the junction of R133 and V110
C133B.
43.7 mc.
$45.5 \mathrm{mc}.$.
41.8 mc
. $\mathrm{T109}$
To align T105 and T106, connect the sweep generator to
the first picture i.t grid, pin 1 of V106 through a 1.000 mm . ceramic capacitor. Shunt R137, R141 and terminals "A" and "F" of T 109 with 330 ohm composition resistors.
bias to -1.0 volt at the junction of R133 and C133B.
Connect the oscilloscope to pin 9 of V110, the 6CL6 video mpiner
Adjust T105 and T106 top cores for maximum gain and curve shape as shown in Figure 22. For final adjustment set the output of the VHF sweep generator
peak-to-peak at the oscilloscope terminals.

To align the crystal mixer and T 2 and T 104 , connect the
VHF sweep generator to the front terminal of the 1 N 82 crystal VHF sweep generator to the front terminal of the 1N82 crystal holder in series with a, 1,500 mmin. ceramic capacior. se the uner case.
Set the channel selector to channel 5 .
Connect a 180 ohm composition resistor bet
" C " of T 105 and the junction of R 131 and C 133 A .
Connect the oscilloscope diode probe to terminal "B" of Tlios probe in order to obtain markers.
The shunt trimmer C 121 across terminals " A " and " B " of T 104 is variable and is provided as a bandwidth adjustment. Preset the shunt trimmer to minimum capacity. Adjust T2 (top) and
T104 (bottom) for maximum gain at 43.5 mc . and with 45.75 r 104 (bottom) for maximum gain
mc. at $70 \%$ of maximum response.
Adjust the shunt trimmer C121 until 41.25 mc . is at $85 \%$ proximately 41.9 mc . as shown in Figure 13. Adjust TI for naximum gain. Readjust T2 and T104 if necessary to obtain
proper wave shape, see Figure 13 .
Disconnect the diode probe, the 180 ohm and the three 330
SWEEP ALIGNMENT OF PICTURE I.F.-
Connect the osalloscope to pin 9 of V1lo.
Adjust the bias potentiometer to obtain -6.0 volts of bias
as measured by a "VoltOhmyst" at the junction of R133 and C 133 B .
Leave the sweep generator connected to the mixer grid test
point TP2 on KRK29 Tuner or to the front terminal of the point TP2 on KRK29 Tuner or to the front terminal of the
N82 crystal holder on KRK12B Tuner. Use the shortest leads possible with not more than one inch of unshielded lead at the nd of the sweep cable. If these precautions are not observed. the receiver may be
may be unreliable.
Adjust the output of the sweep generator to obtain 3.0 volts peak-lo-peak on the oscilloscope.
Couple the signal generator loosely to the grid of the first
pix $i$ i. amplifier. Adjust the output of the signal generator to produce small markers on the response curve.

Retouch T 108 and T 109 to obtain the response shown in Fig is adjusted too low in frequency it will raise the level of the 41.25 mc. sound i-f carrier and may create interference in the picture. It will also cause poor adjacent channel picture rejec
tion. If T107 is tuned too high in frequency, the level of the 1.25 mc. sound i-f carrier will be too low and may produce oisy sound in weak signal areas.

Remove the oscilloscope, sweep and signal generator con
netions.
Remove the bias box employed to proviae bias for angnmen

## KRK29 TUNER ALIGNMENT

Models 21-D. 358 to 21-D. 380 incl.
A tuner unit which is operative and requires only touch up
adjustments. requires no presetting of adjustments. For such nits, skip the remainder of this paragraph. For units which are completely out of adjustment, preset C 27 all the way our.
Set channel 7 to 13 oscillator slugs one turn from tight. Turn 2 slug all the way out. Do not change any of the adjustments the antenna matching uni
Disconnect the link from terminals "A" and "B" of T104 and Turn the receiver channel selector switch to channel 2 .
The 43.5 mc . trap is adjusted with zero bias. To insure that the bias will remain constant, take a clip lead and short circuit
he AGC terminal of the tuner at the terminal board to ground.
 Connect the oscilloscope the the tuner unit. Set the oscilloscope to maximum gain
Connect the output of the VHF signal generator to the output of the antenna matching unit

Tune the signal generator 1043.5 mc . and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator for with a 400 cycle sine wave. Adjust the signal generator for maximum output.
Adjust C33 on top of the tuner, for minimum 400 cycle indication on the oscilloscope. II necessary, this adjustment can
be retouched in the field to provide additional rejection to one specific frequency in the i-f band pass. However, in such cases, care should be taken not to tune C 33 into channel 2, thereby reducing sersitivity on channel 2

Connect the potentiometer arm of one of the bias supplies the $A G C$ terminal on the tuner and ground the battery posi-
ive terminal to the tuner case. Adjust the bias potentiometer tive terminal to the tuner case. Adjust the bias polentiometer
to produce -3.0 volts of bias, as measured by the "Voltohmyst" at the AGC terminal on the tuner
Set the channel selector switch to channel 8 . Preset C22 to read. - 3.0 volts at the test point TP1, as read
on the "Voltohmyst." The limits or orcillator injection voltage
or on the 2 volts minimum and not exceeding a maximum of 5.5 volts. Turn the fine tuning control fully clockwise.
Adjust C25 for proper oscillator frequency, 227 mc . This may will be recommended in this procedure will be to use th signal generator as a heterodyne frequency meter and beat the oscillator against the signal generator. To do this, tune the sig
nal generator to 227 mc . with crystal accuracy. Insert one end of a piece of insulated wire into the tuner unit through the hol provided for the adjustment of C16. Be careful that the wire does not touch any of the funed to shift. Connect the other end of the wire to the " r - in " terminal of the signal generator djust C25 to obtain an audible beat with the signal generato Turn C27 clockwise until the beat note just begins to change Return the fine tuning control to the mechanical center of its range.
NOTE. - If on some units, it is not possible to reach the proper channel 8 oscillator frequency by adjustment of C25
switch to channel 13 and adjust L49 to obtain proper channel 13
oscillator frequency as indicated in the table on page 8. Then switch to channel 12 and adjust 60 to obtain proper channel 1 oscillanar irequency. Conimue to obtain the proper frequenc on each channel. Then again on channel 8 , adjust C 25 to obtain proper channel 8 oscillator frequency. Switch back to chan

Set the 72 core for maximum inductance (core turned counte clockwise

Connect the sweep generator through a suitable attenuato as shown in Figure 10 to the input minals of the antenn matching uni.

Connet the st anminals.
Set the sweep generator to cover channel 8
Set the oscilloscope to maximum gain and use the minimum input signal which will produce a usable pattern on the oscil loscope. Excessive input can change oscillator injection during alignment and produce consequent misalignmen look normal.
Insert markers of channel 8 picture carrier and sound carrier, 1.25 mc . and 185.75 mc .

Adjust C21, C16, C11 and C7 for approximately correct The correct adjustment of C 7 is indicated by maximum amhe rif amplifier plate circuit and affects the frequency of the pass band most noticeably. C21 tunes the mixer grid circuit and affects the tilt of the curve most noliceably (assuming tha C7 has been properly adjusted). C16 is the coupling ad.
Connect the "VoltOhmyst" to test point TP1. Adjust C22 10 VirOhmyst" at TPl. Readjust C27. in at midpoint of the cuve Repeat it necessary until the roper response is obtained.
Set the receiver channel switch to channel 13
Adjust the signal generator to the channel 13 oscillator frequency 257 mc
Turn the fine tuning control fully clockwise,
Adjust L49 to obtain an audible beat. Slightly overshoot the ajustment of L49 by turning the slug an additional turn in the same direction from the original selting, then reset the oscillator proper frequency by adjusting C 27 to again obtain the beat. Set the sweep generator to channel 13 .
From the signal generator, insert channel 13 sound and picfure carrier markers. 211.25 mc . and 215.75 mc .
Adjust L36 and L20 for proper response as shown in Fig. re 18.
Turn of the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TP1.
Check the oscillator injection voltage to be within limits as
IIr
Il it was necessary to readjust C22, turn the sweep and signal enerators back on and recheck the chand 13 response
l 10 suich 8 and Set the receiver channel selector switch to ${ }^{\text {cher }}$. mc .
Set the sweep generator and signal generator to channel 8 . Readjust C21, C16, C11 and C7 for correct curve shape quency and bandwidth.
Turn att the sweep and signal generators, switch back to
channel 13 and check the oscillator injection voltage at TP if 21 was adjusted in the recheck of channel 8 response.
If the initial setting of the oscillator injection trimmer was

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and response on channel 8. adjust the oscillator injection on
channel 13 and repeat the tracking procedure several times channel 13 and repeat the tracking
before the proper setting is obtained.
Turn of the sweep generator and switch the receiver to
channel 6 . Adjust the signal generator to the channel 6 oscillator frequency, 129 mc.
Set the fine tuning control to the center of its mechanical a
Adjust L54 for an audible beat. Adjust L48 and L32 for proper curve shape as shown in Figure 18. Recheck the oscillator injection voltage at TP1, to insure
limits specified. Readjust C22 it necessary.
If C22 required adjustment, switch the receiver and the signal generator to channel 8. Readjust C21 for correct curve shape and recheck C27 and C25 for proper oscillator frequency.
Check the response of channels 2 through 6 by swilching erator to each of these channels and observing the response and oscillator injection voltage obtained. See Figure 18 for typical response curves. It should be found that all thesi
channels have the proper response with the markers above channels have
$80 \%$ response.
If the markers fail to fall within this requirement readjust
L 48 and L 32 in order to obtain curves within the proper limits. Switch the channel selector, signal generator and marker curves, referring to Figure 18 for proper wave shape. Check the injection voltage at each channel to be within limits. If necessary readjust C11, C21 or C16 to obtain the proper response
With the receiver and signal generator on channel 13 adjust
L49 for an audible beat with the signal generator. 149 for an audible beat with the signal generatior.
Adjust the oscillator to frequency on all channels by switch-
ing the receiver and the frequency standard to each channel and adjusting the appropriate oscillator slug to obtain the audible beact. It should be possible to adjust the oscillator to obtain the audible beat on each channel. Recheck the oscilla.
tor injection voltage on each channel to verity that the voltage tor injection voltage on each
is wilhin the specified limits.

## fris12B tUNER ALIGNMENT

Models 21-D.358U to 21-D.380U incl.
TUNER VHF ALIGNMENT. - Remove the 654 voltage control tube from its

Connect the 0.50 milliampere meter to the adapter socket Connect the 0.50 milliampere meter
Remove the tuner cover shield.
Rotate the channel selector to a point midway between Rotale he channel selector to a point ald abserve the
channes, disengaging the insert contacts, and obsillating plate current. Some tubes may oscillate even
non-oscila with the tuned circuits disengaged. To be sure the oscillator is in a non-oscillatory statio, short circuit the sprin
12 and 13 , the two contacts nearest the tuner front.
(NOTE: The contacts are at zero d-c potential.) Should the plate current rose keep the contacts shotried while adjusting
the oscillator plate current. Adjust R 6 , oscillator voltage con plate current rise, keep the contacts shoried while adjusting
the oscillator plate current. Adjust R6, oscillator voltage con-
trol, for a 28 milliampere reading on the meter.

## Replace the tuner cover shield.

Connect the VHF sweep generator to the antenna terminals. Connect the VHF signal generator loosely to the antenno

Connect the oscilloscope through the preamplifier, If needed with oscilloscope used, to teat point TP1.
Ground the AGC bias at the tuner terminal board using a
clip lead to insure that the bias will remain contand dip lead to insure that the bias will remain conslant.

## ALIGNMENT PROCEDURE

Turn off the adapter switch, removing plate voltage from when a crystal is used as a mixer.
Ser the channel selector and the sweep generator to chan-
nel 2 . Insert markers of channel 2 picture carrier and sound car-
rier, 55.25 mc . and 59.75 mc .
Adjust antenna T6. r-f amplifier plate L29 and mixer L30 adjustments for a symmetrical curve with maximum gain at
he center of the pass band. The curves will have a deep valley because of no crystal loading and nonlinear detector characteristics. The limits for the $100 \%$ response points are shown in Figure 11. The proper curve shape is shown in Fig-
ure $11(b)$. (Refer to note on page 13 for detailed explanation of ure 11(b). (Refer to note on page 13 tor detailed explanation of ecorrected by redressing the coupling capacior of the double Uned circuil, C40 on insert A. Maximum bandwidth
when the capacitor is centered in the insert chamber.
Repeat the above steps for all VHF channels adjusting the Repeat the above steps for all VHF channels adjusting the
appropriate antenna, r.f amplifier plate and mixer slugs for a symmetrical curve with maximum gain at the center of the
pass band.
Turn oft the sweep generator.
Remove the oscilloscope and preamplifier if used, from test
point TP1. Turn the AGC control fully clockwise and remove the clip lead grounding the AGC bias on the tuner terminal board. Connect the potentiometer arm of one of the bias supplies to
the AGC terminal on the tuner and ground the battery positive erminal to the tuner case. Adjust the bias potentiometer to erminal to the tuner case. Adjust the bias potentiometer to
produce -3.5 volts of bias. as measured by the "Voltohmyst" the AGC terminal on the tuner.
Connect the potentiometer arm of the second bias supply io
he junction R133 and C133B, and qround the positive battery he junction R133 and C133B, and ground the positive battery terminal. Adjust he bias as indicated on the "Volithmyst" at the junction point. Connect the oscilloscope to pin 9 of V110. Use 3 to 5 volts peak-to-peak output on the oscilloscope
Turn the adapter switch on to apply plate valtage to the scillator
Turn the channel selector to channel 13.
Set the fine tuning control to the center of its range
Adjust the oscillator slug L22 to proper frequency, 257 mc. This may be done in several ways. The easiest way and the way which will be recommended in this procedure will be to
use the signal generator as a heterodyne frequency meter and use the signal generator as a heterodyne frequency meter and
beat the oscillator against the signal generator. To do this, tune he signal generator to 257 mc. with crystal accuracy. Insert ne end of a piece of insulated wire into the tuner through
ither of the two holes next to the oscillator tube on the right ither of the two holes next to the oscillator tube on the right
ront top corner of the tuner. Be careful that the wire does not ouch any of the tuned circuits as it may cause the frequency of the oscillator to shitt. Connect the other end of the wire to the "r-i in" terminal of the signal generator. Adjust L22 osci-
lator slug to obtain an audio beat with the signal generator.
Turn on the sweep generator and set to channel 13. Adjust T1 for maximum gain on the oscilloscope. Adjust mixier lank
circuit L 21 for maximum grin and flat-opped curve. Recheck circuit L 21 for maximum gain and flat-topped curve. Recheck
Tl for maximum gain at center of band with the proper re Tl for maximum gain at center of band with the proper re-
sponse. Maximum gain and flat-topped response should be sponse. Maximum gain
bblained simultaneousiy.
Adjust the oscillator to frequency on all VHF channels by switching the receiver and signal generator to each VHF channel and adjusting the appropriate oscillator slug to obtcin slug where necessary to obtain maximum gain and proper slug where necessary to obtain
curve shape as explained above.
Adjust the tunable I-F Trap C16-L7. To do this connect the
signal generator to the fixed I.F Trep C2.L2 at the end signal generator to the fixed I.F Trap CC2.L2 at the end opposite
the antenna terminal plug. Set the signal generator to 43.5 me. the antenna terminal plug. Set the signal generator to 43.5 mc . and adjust the output of the signal generator to obtain suffi-
cient indication on the osclloscope. Tune the I-F Trap C16-L7 or minimum marker indication on the oscilloscope
Remove the signal generator and the oscilloscope

TUNER UHF ALIGNMENT. - To align the UHF inserts: Turn oft the adapter switch, removing plate voltage from
the oscillator.
Ground the AGC blas at the tuner terminal board using a
clip lead to insure that the blas will remain constant. dip lead to insure that the bias will remain constant. Connect the oscilloscope, through the preamplifier it needed
with oscilloscope used, to test point IP1.
Connect the UHF sweep generator to the antenna terminals.
Use a 10 DB attenuator pad to assure proper alignment.
Connect the UHF signal generator loosely to the antenna
terminals.
Set the channel selector to the desired position and the
weat used. Insert markers of the plcture carrier and sound carrier for

Adjust the UHF antenna, link coupling and mixer adjustments Adjust the UHF antenna, link coupling and mixer adjustments
or a symmetrical curve, with maximum gain, centered about for a symmetrica
the pass band.
The responses are shown in Figure 12 . The curve shape
will usually vary from Figure 12 (a) to Figure 12 (c) going higher in frequency: however. any of these responses are acceptable.
Repeat the above steps for all UHF inserts used, adjusting
 pass band.
Remove the oscilloscope and preamplifier, if used, from test point TP1.
Remove the clip lead grounding the AGC bras on the iunes Rerminal board
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery positive terminal to the tuner case. Adjust the bias potenti. ometer to produce -3.5 volts of b
"Voltohmyst" at the AGC terminal.
Connect the potentiometer arm of the second bias supply
to the junction of R 133 and C 133 B , and ground the positive battery terminal. Adjust the bias potentiometer to produce - 5 tion point. Connect the oscilloscope to pin 9 of
peak-topeak output on the oscilloscope.
Turn the adapter switch on to apply plate voltage to the scillator.
Turn the channel selector to the lowest UHF channel to be
used, and set the fine tuning control to the center of its range . and set the fine tuning contro Adjust the oscillator core 10 proper trequency. To do this,
connect the VHF signal generator to test point TP1 with the connect the VHF signal generator to test point TP1 with the
shortest leads possible. Insert a 45.75 mc . marker from the shortest leads VHF generator.
Set the UHF sweep generator to sweep the desired channel, and observe the output on the oscilloscope. If the sweep gen-
erator is not sweeping the correct requency range, it may be erator is not sweeping the correct frequency range, it may be
necessary to readjust the sweep in order to place the 45.75 necessary to readjust the sweep in order to
marker on the response curve as in Figure 14.
Set the UHF marker generator to the picture carrier of the
Adjust the oscillator core until the markers for 45.75 mc . and the picture carrier coincide on the sweep pattern on the sellloscope.
Adjust the mixer core for maximum gain with proper wave hape.
Connect the "Voltohmyst" to test point TP1, using 1.5 volt
DC scale.
Set oscillator injection adjustment to read .1 volt on the
"Voltohmyst."
nmys."
Repeat the above stops for all UHF inserts adjusting the
oscillator injection control only if the reading on the "Volt-

Ohmyst" exceeds 3 volt Adjust as necessary to read

RATIO DETECTOR ALIGNMENT. - In order to obtain good atio detector dilgnment an AM modulad signal generac ployed. Set the signal generator at 4.5 mc . and connect it he second sound i-t grid. pin 1 of V102. Set the generator fo \% 400 cycle modulatio

As an alternate source of signal, the RCA WR39B or WR39C calibrator may be employed. If used, connect it the thrid of | calibrator to 45.75 (pix carrier) and modulate with 4.5 me |
| :--- | crystal. Also turn on the internal AM audio modulation. The

4.5 mc . signal will be picked off at T 110 A and amplified 4.5 mc signal will be picked
through the sound i - amplifier.

Connect the "VoltOhmyst" to the junction of R111 and C111 Connect the oscilloscope across the speaker voice coil and turn the volume control for maximum output.
Tune the ratio detector primary. T102 top core for maximum he signal generator for -10 volts on the "VoltOhmyst" whe inally peaked. This is approximately the operating level of
he ratio detector for average signals.
Connect the "VoltOhmyst" to the junction of R110 and Cl10. Adjust the T102 bottom core for zero d-c on the meter. Then,
turn the core to the nearest minimum AM output on the oscilloscope.
Repeat adjustments of T102 top for maximum DC and T102 djustment with the 4.5 mc . input level adjusted to adjustment with the 4.5 mc . input level adjusted to produce
volis d-c on the "Voltohmyst" at the junction of Rill and C1ll Connect the "VollOhmysi" to the junction of H11U and C11U and note the amount of d-c present. If this voltage exceeds
$\pm 1.5$ volts, adjust R108 by turning it in until zero d-c is obined. Readjust the T102 bottom core for minimum output on oscilloscope. Repeat adjustments of R108 and T102 bottom core until the voltage at R110 and C110 is less than $\pm 1.5$ oscilloscope.
Connect the "Voltohmyst" to the junction of R111 and C111 and repeak T102 top core for maximum d-c on the meter and
Repeat the adjustments in the above two paragraphs until 102 top core is set for maximum d.c at the junction of R111 nd C11 and the T102 bottom core is set for minimum indica ion on the oscilloscope.

SOUND I-F ALIGNMENT. - Connect the sweep generator to e first sound i-f amplifier grid. pin 1 of Viot. Adjust the 4.5 mc .

Insert a 4.5 me. marker signal from the signal generator into he first sound i.f grid. With the WR39B or WR39C calibrators rminal by turning signal may be oblained at the R.F out witch to 4.5 mc . and the volume control with mod. oft

Connect the oscilloscope in series with a 10,000 ohm resistor
io terminal A of Tlo1.
Adjust T101 top and bottom cores for maximum gain and ymmetry about the 4.5 mc . marker on the iff response. The
pattern oblained, should be similar to that shown in Figure 20 .
The output level from the sweep should be set 10 produce
approximately 2.0 volt peak-topeak at lerminal $A$ of $T 101$ when the final touches on the above adjustment are made. Itis neces. ary that the sweep output vollage should not exceed the pecified values otherwise the response curve will be broadened, permitting slight misadjustment to pa
possibly causing dislortion on weak signals.
Connect the oscilloscope to the junction of R110 and C1100
and check the linearity of the response. The pattern obtained Connect the oscilloscope to the junction of R110 and C110
and check the linearity of the response. The pattern obtained
should be similar to that shown in Figure 21.
rator in series with a 1,000 ohm resistor to to terminal ml . $\mathrm{C}^{\text {gen- }}$ of
110. The input signal should be approximately 0.5 volt.
Short the fourth pix i.f grid to ground, pin 1, V109, to prevent an ouput indieation.
As an alternate source of signal the RCA WR39B or WR39C calibrator may be used. In such a case, disregard the above
two paragraphs. Connect calibrator across link circuit, T104 wo paragraphs. Connect calibrator across
A, B, and modulate 45.75 with 4.5 mc. crystal.

Connect the crystal diode probe of a "VoltOhmyst" to the
Adjust the core of T110 for minimum output on the meter.
Remove the short from pin 1 V109 to ground, if used.
horizontal oscillator adjustment. - Normally the adjustment of the horizontal oscillator is not considered to be a orm adjustment may require the use of an oscilloscope. it can not be done conveniently in the field. The waveform adjust-
ment is made at the faciory and normally should not require readjustment in the field. However, the wavelorm adjustment hould be checked whenever the receiver is aligned or when-
ver the horizontal oscillator operation is improper.

Horizontal Frequency Adjustment. - Tune in a station and sync the picture. II the picture cannot be synchronized with the
orizontal hold control R210, then adjust the T114 frequency core on the rear apron until the picture will synchronize. If the icture still will not sync, turn the T114 waveform adjustment
core (under the chassis) out of the coll several turns from its original position and readjust the T114 frequency core until the
picture is synchronized.

Examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive con-
trol C186B, the width control Lio9 and the linearity control Lill until the picture is correct.

Horizontal Oscillator Wavetorm Adjustment - The horizontal scillator waveform may be adjusted by either of two methods. The method outined in paragraph A below may be employed
in the field when an oscilloscope is. not available. The service shop method outlined in paragraph B below requires the use an oscilloscope.
A.-Turn the horizontal hold control completely clockwise. to made simultaneous adjustments while watching the picture on the screen. First, turn the T114 frequency core (on the rear arck bar sloping down to the right appears on the screen. Then, turn the wavelorm adjustment core (under the chassis)
nto the coil while at the same time adjusting the trequeng core so as to maintain one diagonal black bar on the screen. Continue this procedure until the oscillator begins to motorboat. then turn the wavelon adjustment core out until the core until the picture is synchronized then reverse the direction In rotation of the core until the picture begins to fall out of ync with the diagonal bar sloping down o the right. Continue
o turn the frequency core in the same direction. Additional bars should not appear on the screen. Instead, the horizontal scillator should begin to motorboat. Retouch the adjustment of dition is obtained.
B.-Connect the low capacity probe of an oscilloscope to furn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown in Figure 25. Adjust the waveform adjustment core of T114 until the two peaks are at the same hight. During this adjustment, the pic-
lure must be kept in sync by readjusting the hold control if ocessary This adjustment is very important for correct operation of the
ircuit. If the broad peak of the wave on the oscilloscope is
 he slabilizing effect of the tuned circuit is reduced and drift of the oscillator becomes more serious. On the other hand, if he broad peak is higher than the sharp peak, the oscillator
is overstabilized, the pull-in range becomes inadequate and the broad peak, can cause double triggering of the ooscillator
when the hold control approaches the clockwise position.

Remove the oscilloscope upon completion of this adjustment. Horizontal Locking Range Adjustment. - Set the horizontal
hold control to the full counter-clockwise position. Momentarily remove the signal by switching off channel then back. The pic-
lure may remain in sync. If so turn the T114 frequency core lure may remain in sync. If so turn the T114 frequency core
slighty and momentarily switch off channel. Repeat until the picture falls out of sync with the diagonal lines sloping down the left. Slowly turn the horizontal hold control clockwise and picture pulls into sync.
If more than 3 bars are present just before the picture pulls ighly clockwise. If horizontal locking range trimmer C186A lighty clockwise. If less than 2 bars are present. adjust C186A
lightly
counter-clockwise. Turn the horizontal hold control unter-clockwise, momentarily remove the signal and recheck procedure until 2 or 3 bars are the pull-in point. Repeat this

Turn the horizontal hold control to the maximum clockwise oosition. Adjust the T114 frequency core so that the diagonal bar sloping down to the right appears on the screen and then the screen leaving the picture in synchronization

SENSITIVITY CHECK. - A comparative sensitivity check can be made by operating the receiver on a weak signal from a ained to that obtained on other receivera under the same conditions.

RESPONSE CURVES. - The response curves shown on pagos 14 and 15 and referred to throughout the alignment procedure were taken from a production set. Althou
ypical, some variations can be expected.

The response curves are shown in the classical manner of tesentation. The manner in which they will be and low frequency to set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted on polarity of the oscilloscope and the phasing of the dellec. generator.

NOTE ON KRR12B TUNER RLIGNMENT. - The use of a ystal mixer in the KRK12B Tuner makes it necessary to obdue to undesirable $\mathrm{r}-\mathrm{t} / \mathrm{i}$ - t interaction it the oecillator was allowed to operate during alignment. Therefore, the responses insert band pass during actual operation. When anion of the aligned. using an oscilloscope to observe the response, the urve shown in Figure 11(b) will be the correct response hat the sound actual operation, he band pass will be such harve thound and picture carriers will be at the tips of the
urve. The adjacent channel piture and sound carriers will be in the valleys at each side. Care should be taken not to exceed

The valley, in the center of the response curve, may vary
toom 0 to $50 \%$ above the base line for $V$ HF inserts. Adjust the sutput level of the sweep generator to prevent excessive signal output level of the sweep generator to prevent excessive signal
nput to the tuner. Excessive signal input will be indicated by input to the tuner. Exbessive signal input will be indicated by
the ralley rising above the $50 \%$ level, particularly on the higher VHF channele.

Oscillator injection voltage is not adjusted on VHF inserts but such readings should not be interpreted as an indicat TP1 ouble. On UHF channels, however, the injection voltage should be adjusted to fall within the specified limita.


Figure 8-KRK12B Oscillator Adjustment


Figure 9-KRK12B Tuner Adjustments


Figure 11-KRK12B VHF Insert Responses


Figure 12-KRK12B UHF Insert Responses

## Figure 13-T2 and Tl04 Response with

Figure 14-Over-all
I.F Response with KRK12B


MLLLAMMETER switch



Figure 10-Sweep Attenuator Pad




Figure 18-KRK29 R.F Response


Figure 26-Top Chassis Adjustments (KRK29 Tuner Shown)


Figure 27-Bottom Chassis Adjustments (KRK29 Tuner Shown)

VOLTAGE CHART
The following measurements represent two sets of conditions. In the first condition, a 5000 microvolt test pattern signal was fed the antenna leads and short circuiting the receiver antenna terminals. Voltages shown are read with a type WV97A senior

| $\underset{\substack{\text { Tube } \\ \text { No. }}}{ }$ | $\begin{gathered} \text { Type } \\ \text { Tyube } \end{gathered}$ | Function | OperatingCondition | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | $\underset{\substack{\text { Plote } \\(\text { ma. })}}{ }$ | $\underset{\substack{\text { Screen } \\(\text { ma. })}}{\mathrm{I}}$ | Notes on Measurements |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { Po } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{gathered} \text { Pin } \\ \text { Po } \\ \text { No. } \end{gathered}$ | Volts | $\begin{gathered} \mathrm{P}_{\mathrm{in}} \\ \mathrm{No}_{0} \end{gathered}$ | Volts |  |  |  |
| v1 KRK29 | 6BQ7a | $\begin{aligned} & \text { R-F } \\ & \text { Amplitier } \end{aligned}$ | $\underset{\text { Signal }}{5000 \text { Mu. }}$ | 6 | 170 | - | - | 8 | 0.1 | 7 |  | - | -- |  |
|  |  |  | Signol | 6 | 133 | - | -- | 8 | 1.1 | 7 | 0 |  | - |  |
|  |  | $\begin{aligned} & \text { R.F.F } \\ & \text { Amplifier } \end{aligned}$ | $\underset{\text { Signal }}{5000 \mathrm{Mu} .}$ | 1 | 270 | - | - | 3 | 170 | 2 | - | -- | - |  |
|  |  |  | $\begin{gathered} \text { Noo } \\ \text { Signal } \end{gathered}$ | 1 | 260 | -- | - | 3 | 133 | 2 | - | - | - |  |
| v2 KRK29 | 6x8 | Mixer | $\underset{\substack{\text { Signal }}}{5000 \mathrm{Mu}} \mathrm{V}$ | 9 | 160 | 8 | 160 | 6 | 0 | 7 | $\begin{aligned} & -2.410 \\ & -3.0 \end{aligned}$ | - | - |  |
|  |  |  | $\mathrm{S}_{\mathrm{ignal}}^{\mathrm{Noo}}$ | 9 | 145 | 8 | 145 | 6 | 0 | 7 | $\left\lvert\, \begin{aligned} & -2.810 \\ & -3.5 \end{aligned}\right.$ | -- | - |  |
|  |  | R.Ferillator | $\underset{\substack{5000 \mathrm{Mu} \\ \text { Signol }}}{ }$ | 3 | 95 | - | -- | 6 | 0 | 2 | $\begin{array}{r} -3.810 \\ -5.5 \end{array}$ | - | - |  |
|  |  |  | $\mathrm{Si}_{\mathrm{ignal}}^{\mathrm{Noo}}$ | 3 | 90 | - | - | 6 | 0 | 2 | $\begin{aligned} & -3.0 \text { to } \\ & -5.1 \end{aligned}$ | - | - |  |
| $\begin{aligned} & \text { v1 } \\ & \text { KRK12B } \end{aligned}$ | 6BQ7A | $\underset{\text { Amplifier }}{\text { R.F }}$ | $\underset{\substack{\text { Signai } \\ 5000 \mathrm{Mu} \\ \text { V. }}}{\text { V. }}$ | 6 | 143 | - | - | 8 | 12 | 7 | 0 | - | - |  |
|  |  |  | $\mathrm{Signal}_{\mathrm{N}}^{\mathrm{No}}$ | 6 | 138 | - | - | 8 | 1.0 | 7 | 0 | - | - |  |
|  |  | $\begin{array}{\|c} \hline \text { Amplitior } \end{array}$ | $\underset{\text { Signal }}{5000 \text { Mu. }} \begin{gathered} \text { S. } \end{gathered}$ | 1 | 260 | - | - | 3 | 143 | 2 | 97 | - | - |  |
|  |  |  | $\begin{gathered} \text { Soo } \\ \text { Signal } \end{gathered}$ | 1 | 250 | - | - | 3 | 137 | 2 | 97 | - | - |  |
| v2 | 6AF4 | $\begin{aligned} & \text { A.F.F.illator } \\ & \hline \text { Octila } \end{aligned}$ | $\underset{\text { Signai }}{5000 \mathrm{Mu} .}$ | 1\&7 | 78 | - | - | 5 | 0 | 286 | -8 | - | - |  |
|  |  |  | $\begin{gathered} \text { Signol } \end{gathered}$ | 187 | 75 | - | - | 5 | 0 | 246 | -6 | - | - |  |
| v3 KRK12B | 6BQ7A | $\underset{\text { Amplifier }}{\text { I.F }}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signol } \end{gathered}$ | 6 | 270 | - | - | 8 | 148 | 7 | 103 | - | - |  |
|  |  |  | ${ }_{\text {Sigoal }}^{\text {No }}$ | 6 | 260 | - | - | 8 | 142 | 7 | 99 | - | - |  |
|  |  | $\begin{aligned} & \text { I.F } \\ & \text { Amplifiox } \end{aligned}$ | $\underset{\text { Signal }}{5000 \mathrm{Mu}}$ | 1 | 148 | - | - | 3 | 1.4 | 2 | 0 | - | - |  |
|  |  |  | $\mathrm{S}_{\mathrm{Nignal}}^{\mathrm{Noo}}$ | 1 | 143 | - | - | 3 | 1.2 | 2 | 0 | - | - |  |
| v4 | 654 | $\begin{aligned} & \text { Voltage } \\ & \text { Control } \end{aligned}$ | $\underset{\substack{\text { Signai }}}{5000 \mathrm{Mu} .}$ | 9 | 270 | - | - | 2 | 94 | 6 | ${ }^{68}$ | - | - | $\begin{aligned} & \text { - Depends on } \\ & \text { adjutment } \\ & \text { of } R 6 \text {. } \end{aligned}$ |
|  |  |  | $\mathrm{S}_{\mathrm{Signal}}^{\mathrm{Noo}}$ | 9 | 260 | - | - | 2 | 90 | 6 | -65 | - | - |  |
| v101 | 6AU6 | 1at SoundI.F Amp. | $\underset{\text { Signal }}{5000 \mathrm{Mu} .}$ | 5 | 127 | 6 | 124 | 7 | 0.7 | 1 | -0.4 | 6.0 | 3.0 |  |
|  |  |  | $\mathrm{Signal}_{\text {No }}$ | 5 | 126 | 6 | 123 | 7 | 0.5 | 1 | -1.2 | 5.0 | 3.0 |  |
| v102 | 6au6 | 2nd Sound | $\underset{\substack{5000 \\ \text { Signai }}}{ } \mathrm{v} .$ | 5 | 132 | 6 | 60 | 7 | 0 | 1 | -10 | 2.8 | 1.2 |  |
|  |  |  | $\mathrm{S}_{\mathrm{ignal}}^{\mathrm{No}}$ | 5 | 131 | 6 | 65 | 7 | 0 | 1 | -5 | 2.0 | 1.0 |  |
| v103 | 6AL3 | Ratio Detector | $\underset{\text { Signal }}{5000 \text { Mu. }}$ | $\frac{2}{7}$ | -9.2 | - | - | $\begin{aligned} & \hline 5 \\ & 1 \end{aligned}$ | $\begin{aligned} & 1.0 \\ & 9.2 \end{aligned}$ | - | - | - | - |  |
|  |  |  | $\underset{\text { Signal }}{\mathrm{Noo}}$ | ${ }_{7}^{2}$ | $\begin{array}{\|c} \hline-8.0 \\ \hline \end{array}$ | - | - | ${ }_{1}^{5}$ | $\begin{gathered} 0.0 \\ 8.0 \end{gathered}$ | - | - | - | - |  |
| v104 | 6Av6 | 1at AudioAmplifier | $\underset{\substack{5 i g n a l}}{5000 \mathrm{Mu} .}$ | 7 | 90 | - | - | 2 | 0 | 1 | -0.7 | 0.65 | - | $\underset{\substack{\text { At min. } \\ \text { volume }}}{\text {. }}$ |
|  |  |  | $\begin{gathered} \text { Noo } \\ \text { Signal } \end{gathered}$ | 7 | 88 | - | - | 2 | 0 | 1 | -0.7 | 0.65 | - |  |
| v104 | 6Av6 | $\begin{aligned} & \hline \text { R.F Bias } \\ & \text { Clamp } \end{aligned}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \\ \hline \end{gathered}$ | 5.6 | -3.0 | - | - | 2 | 0 | - | - | - | - |  |
|  |  |  | $\mathrm{S}_{\mathrm{Nignal}}^{\mathrm{Noo}}$ | 5.6 | 0.3 | - | - | 2 | 0 | - | - | - | - |  |
| v10s | 6AOS | $\begin{aligned} & \text { Audio } \\ & \text { Output } \end{aligned}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 327 | 6 | 342 | 2 | 146 | 7 | 136 | 28 | 2.0 | $\begin{gathered} \text { At min. } \\ \text { Volum. } \end{gathered}$ |
|  |  |  | $\mathrm{S}_{\mathrm{No}}^{\mathrm{No}} \mathrm{O}$ | 5 | 323 | 6 | 338 | 2 | 143 | 7 | 133 | 28 | 2.0 |  |
| v106 | 6au6 | $\begin{aligned} & \text { 1at Pix. I-F } \\ & \text { Amplifior } \end{aligned}$ | $\underset{\substack{5000 \mathrm{Mu} \\ \text { Signal }}}{ } \mathrm{V} .$ | 5 | 160 | 6 | 215 | 7 | 0.17 | 1 | -6.6 | 1.4 | 4 |  |
|  |  |  | $\begin{gathered} \text { Noo } \\ \text { Signal } \end{gathered}$ | 5 | 85 | 6 | 115 | 7 | 0.98 | 1 | 0 | 6.5 | 3.3 |  |



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 Ebony, Broun Maroon

 Mabogany, Blonde

$\substack{\text { NBatron } \\ \text { Ebony }}$
Eb.

 Brouten Maroon




Models 21-5.362M, 21.5.362MI
Mabogany, "Oak

GENERAL DESCRIPTION


Electrical and mechanical specifications
227 square inches on a 21 AP4,
${ }_{21} 12 \mathrm{PP4A}$ or $21 Z \mathrm{ZPAA}$
Kinescope
television r-f frequency fange

$$
\begin{aligned}
& \text { Euffix (VHF only) } \\
& 88 \\
& 88 \\
& \hline \text { me }
\end{aligned}
$$

 Any of 70 UHF channels
Any of
12
VHF channels
$54 \mathrm{mc} .1088 \mathrm{mc} ., 474 \mathrm{mc}$.10216 mc . intermediate frequencies Picture 1 l. Carrier Frequency
Sound
POWER Corrier aUdIo POWER OUTPUT RATING VIDEO RESPONSE SWEEP DEFLECTION focus
ina input impedance

UHF-300 ohms balianced.
VHF- 300 ohms balanced.
RCA TUBE COMPLEMENT
Tube Used



CA TUBE COMPLEMENT
(1) RCA 6AF4 Tuner KRK29A/27 (UHF/VHF Models) Function (1) RCA 6AF4
(2) RCA 6 BQ 7 A







Figure 2-Ion Trap and Centering Magnet Adiustments

21-S-348 to 21-S-369G incl
21-S-348U to $21-\mathrm{S}-369 \mathrm{GU}$ incl. ELECTRICAL AND MECHANICAL SPECIFICATIONS (cont'd)

| CHASSIS DESIGNATIONS |  |  |  |
| :---: | :---: | :---: | :---: |
| CHASSIS | TUNER | $\begin{aligned} & \text { KINE- } \\ & \text { SCOPE } \end{aligned}$ | MODELS |
| KCS83 | $\begin{gathered} \text { KRK29 } \\ \text { (VHF only) } \end{gathered}$ | $\begin{aligned} & 21 \text { AP4 } \\ & \text { (Metal) } \end{aligned}$ | $\begin{aligned} & \text { 21-S-362M } \\ & \text { 21.S- } 367 \\ & \hline \end{aligned}$ |
| KCS83A | KRK29A/27 (UHF/VHF) | 21 AP4 (Metal | $\begin{aligned} & \text { 21-S.362MU } \\ & \text { 21-S.367U } \end{aligned}$ |
| KCS83C | $\begin{gathered} \text { KRK29 } \\ \text { (VHF only) } \end{gathered}$ | $\begin{aligned} & \text { 21EP4A } \\ & \text { (Glass) } \end{aligned}$ | $\begin{aligned} & \text { 21.S.S.35 } \\ & \text { 21.S.354 } \\ & \text { 21-S. } 355 \end{aligned}$ |
| KCS83C or KCS83PC."G" Models only Trans.) | $\begin{gathered} \text { XRK29 } \\ \text { (VHF only) } \end{gathered}$ | $\begin{aligned} & \text { 212P4 } \\ & \text { (Glass) } \end{aligned}$ | 21-S.353G 21-S.354G 21-S.355G 21.S.357G 21.S.359G 21-S.362G 21.S.367G 21-S.369G |
| KCS83D | $\begin{aligned} & \text { KRK29A/27 } \\ & \text { (UHF/VHF) } \end{aligned}$ | $\begin{aligned} & \text { 21EP4A } \\ & \text { (Glass) } \end{aligned}$ | $\begin{aligned} & \text { 21-S.353 } \\ & \text { 21-S. } 354 \mathrm{U} \\ & \text { 11-S. } 355 \mathrm{U} \end{aligned}$ |
| KCS83D or KCS83PD. "GU" <br> Models only (Printed I-F Trans.) | KRK29A/27 (UHF/VHF) | $\begin{aligned} & \text { 21ZP4A } \\ & \text { (Glass) } \end{aligned}$ |  |
| KCS83PJ (Printed I-F Trans.) | $\begin{gathered} \text { KRK29 } \\ \text { (VHF only) } \end{gathered}$ | $\begin{aligned} & \text { 21EP4A } \\ & \text { (Glass) } \\ & \text { 21ZP4A } \\ & \text { (Glass) } \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { 21-S-348 } \\ & \text { 21-S-348G } \end{aligned}$ |
| $\begin{aligned} & \text { KCS83PK } \\ & \text { (Printed I-F } \\ & \text { Trans.) } \end{aligned}$ | $\begin{aligned} & \text { KRK22C } \\ & \text { (VHF only) } \end{aligned}$ | $\begin{aligned} & \text { 212P4A } \\ & \text { (Glass) } \end{aligned}$ | 21-S.353G 21-S.354G 21-S.355G 21-S.357G 21-S.359G 21-S.362G 21-S.367G 21.S.369G |
| KCS83PL <br> (Printed I-F <br> Trans.) | $\begin{gathered} \text { KRK22C } \\ \text { (VHF only) } \end{gathered}$ | $\begin{aligned} & \text { 21ZP4A } \\ & \text { (Glass) } \end{aligned}$ | 21-S-348G |
| $\begin{aligned} & \text { KCS83 PM } \\ & \text { (Printed I-F } \\ & \text { Trans.) } \end{aligned}$ | $\begin{aligned} & \text { KRK29A/27 } \\ & (\mathrm{UHF} / \mathrm{VHF}) \end{aligned}$ | $\begin{aligned} & \text { 21ZP4A } \\ & \text { (Glass) } \end{aligned}$ | 21-S-348GU |


UHF Channel Selector and

VHF Fine Tuning and UHF Funing Tuning and
Brightness .................. Single Control under Panel Picture Horizontal Hold ....... Single Control under Panel Picture Vertical Hold .......Single Control under Panel Sound Volume and On-Off Switch
Picture ....Dual Control Knobs *TV.PH tone switch

$$
\begin{aligned}
& \text { One switch } \\
& { }^{*} \text { Except Models } 21-S \cdot 348(U)(G)(G U) \text { Single Control un }
\end{aligned}
$$

NON-OPERATING CONTROLS (under Front Panel) Heigh
Vertical Linearity
screwdriver adjustment
NON-OPERATING CONTROLS
(not including R-F and I.F adjustments)
Picture Centering
top chassis adjustment
 Horizontal Linearity ...............rear chassis adjustment Horizontal Oscillator Frequency . . . rear chassis adjustment Horizontal Oscillator Waveform . bottom chassis adjustment Horizontal Locking Range $\ldots .$. rear chassis adjustment
Focus ..........................top chassis adjustment Focus......................top chassis adjustment
Ion Trap Magnet..............top chassis adjustment Deflection Coil......................top chassis adjustment AGC Control rear chassis adjustment sCANNING Interlaced, 525 line HORIZONTAL SWEEP FREQUENCY .....15,750 cps VERTICAL SWEEP FREQUENCY ............ 60 cps frame frequency (Picture Repetition Rate) 30 cps


VHF Sweep Generator meeting the following require ments

Frequency Ranges
351090 mc... 1 mc .1012 mc . sweep width
170 to 225 mc .12 mc . sweep width (b) Output adjustable with at least . 1 volt maximum (c) Output constant on all ranges.
(d) "Flat" output on all attenuator positions VHF Signal Generator to provide the following frequencies with crystal accuracy:
(a) Intermediate frequ
4.5 me., 39.25 me., 41.25 mc., $43.5 \mathrm{mc} ., 45.75 \mathrm{mc}$.
47.25 mc. (b) Radio frequencie

| Channel Number | Picture Carrier Freq. Mc. | Sound Carrier Freq. Mc. | Receiver R-F Osc. Freq. Mc. |
| :---: | :---: | :---: | :---: |
| , | 55.25 | 59.75 | 101 |
| 3 | 61.25 | 65.75 | 107 |
| 4 | 67.25 | 71.75 | 113 |
| 5 | 77.25 | 81.75 | 123 |
| 6 | 83.25 | 87.75 | 129 |
| 7. | 175.25 | 179.75 | 221 |
| 8 | 181.25 | 185.75 | 227 |
| 9 | 187.25 | 191.75 | 233 |
| 10 | 193.25 | 197.75 | 239 |
| 11 | 199.25 | 203.75 | 245 |
| 12 | 205.25 | 209.75 | 251 |
| 13 | 211.25 | 215.75 | 257 |

(c) Output of these ranges should be adjustable and at least vir
if the signal generator is not crystal controlled. calibrator UHF Sweep Generator with a frequency range of 470 mc .
to 890 mc . RCA types 40 A or 41 A or their equivalent. UHF Signal Generator to provide the following frequencies
with crystal accuracy if RCA Type 41A is used.


Channel
Number



| Sound Carrier Freq. Mc. | Receiver R-F Osc. Freq. Mc |
| :---: | :---: |
| 475.75 | 517 |
| 481.75 | 523 |
| 487.75 | 529 |
| 493.75 | 535 |
| 499.75 | 541 |
| 505.75 | 547 |
| 511.75 | 553 |
| 517.75 | 559 |
| 523.75 | 565 |
| 529.75 | 571 |
| 535.75 | 577 |
| 541.75 | 583 |
| 547.75 | 589 |
| 553.75 | 595 |
| 559.75 | 601 |
| 565.75 | 607 |
| 571.75 | 613 |
| 577.75 | 619 |
| 583.75 | 625 |
| 589.75 | 631 |
| 595.75 | 637 |
| 601.75 | 643 |
| 607.75 | 649 |
| 613.75 | 655 |
| 619.75 | 661 |
| 625.75 | 667 |
| 631.75 | 673 |
| 637.75 | 679 |
| 643.75 | 685 |
| 649.75 | 691 |
| 655.75 | 697 |
| 661.75 | 703 |
| 667.75 | 709 |
| 673.75 | 715 |
| 679.75 | 721 |


| Channel Number |  |  | ALIGNME |
| :---: | :---: | :---: | :---: |
|  | Picture | Sound | Receiver |
|  | Carrier | Carrier | R-F Osc |
|  |  | Feq. | Preq. Mc. |
| 49 | 681.25 | 685.75 | 727 |
| 50 | 687.25 | 691.75 | 733 |
| 51 | 693.25 | 697.75 | 739 |
| 52 | 699.25 | 703.75 | 745 |
| 53 | 705.25 | 709.75 | 751 |
| 54 | 711.25 | 715.75 | 757 |
| 55 | 717.25 | 721.75 | 763 |
| 56 | 723.25 | 727.75 | 769 |
| 57 | 729.25 | 733.75 | 775 |
| 58 | 735.25 | 739.75 | 781 |
| 59 | 741.25 | 745.75 | 787 |
| 60 | 747.25 | 751.75 | 793 |
| 61 | 753.25 | 757.75 | 799 |
| 62 | 759.25 | 763.75 | 805 |
| 63 | 765.25 | 769.75 | 811 |
| 64 | 771.25 | 775.75 | 817 |
| 65 | 777.25 | 781.75 | 823 |
| 66 | 783.25 | 787.75 | 829 |
| 67 | 789.25 | 793.75 | 835 |
| 68 | 795.25 | 799.75 | 841 |
| 69 | 801.25 | 805.75 | 847 |
| 70 | 807.25 | 811.75 | 853 |
| 71 | 813.25 | 817.75 | 859 |
| 72 | 819.25 | 823.75 | 865 |
| 73 | 825.25 | 829.75 | 871 |
| 74 | 831.25 | 835.75 | 877 |
| 75 | 837.25 | 841.75 | 883 |
| 76 | 843.25 | 847.75 | 889 |
| 77 | 849.25 | 853.75 | 895 |
| 78 | 855.25 | 859.75 | 901 |
| 79 | 861.25 | 865.75 | 907 |
| 80 | 867.25 | 871.75 | 913 |
| 81 | 873.25 87925 | 877.75 883 | 919 |
| 82. | 879.25 | 883.75 | 925 |
| 83 | 885.25 | 889.75 | 931 |

Cathode Ray Oscilloscope.-An oscilloscope with a sen-
sitivity of 5 millivolts per inch is required. A suitable pre amplifier may be employed with oscilloscopes of lesse

Electronic Vollmeter.-A voltmeter with a 1.5 volt DC scale is required. RCA Senior "Voltohmyst" or equivalent. PICTURE I-F TRANSFORMER ADJUSTMENTS.-
Connect the i-f signal terminals A and B of T104. C142. Turn the AGC control fully clockwise C14. Turn the AGC control fully clockwise, appreciable current drain and connect the ends of a $a 1,000$ ohm potentiometer across each. Connect the battery positive
 used later.
Set the b
Set the bias to produce approximately -5.0 volt of bias ar the junction of R123 and C142,
Connect the "VoltOhmyst" to the junction of R135 and Li02 and to ground.
quencies and peak the specified adiustment following freindication on the "Volto hemyst." During alignment, reduce the input signal if necessary in order to produce 3.0 volts of
d-c at R135 and LLI 102 with - 5.0 volts of i-f bias at the junction of R123 and C142.
44.5 mc.
$45.5 \mathrm{mc}$.
43.0 mc.

T108
T107
T106
Set the VHF signal generator to the following frequency and adjust the picture i-f trap for minimum d-c output at R135, L102. Use sufficient signal input to produce 3.0 volts
of $\mathrm{d}-\mathrm{c}$ on the meter when the adjustment is made.


Models 21-S-348U to 21-S-369GU Incl
Connect the i-f signal generator across the link circuit on
terminals $A$ and $B$ of $T 104$. Connect the "Voltohmyst" to the junction of R123 and Cl42.
Turn the AGC control fully clockwise.
Obtain a 7.5 volt battery capable of withstanding appre-
ciable current drain and connect the ends of a 1,000 ohm
potentiometer across it. Connect the battery positive terminal to chassis and the potentiometer arm to the junction R123 and Cl42. Adjust the
Connech the "VoltOhmyst" to the junction of R135 and L102
then and to ground.
Set the VHF generator to each of the following frequencies and with a thim niber screwdriver tune the specified adjust
ment for maximum indication on the "Volthmyst" In eact ment for maximum indication on the "VoltOhmyst." In each instance the generator should be checked against a
calibrator to insure that the generator is on frequency.
During alignment, reduce the input signal if necessary in
order to produce 3.0 volts of d -c at $\mathrm{R135}$ and L 102 with - 5.0 volts of $i$-f bias at the junction of R123 and C142

$$
\begin{aligned}
& \begin{array}{l}
44.5 \mathrm{mc} . \\
45.5 \mathrm{mc} .
\end{array} \\
& \begin{array}{r}
\text { T108 } \\
\text { T107 } \\
\text { T106 }
\end{array}
\end{aligned}
$$

Set the signal generator to the following frequency and
adjust the picture $i-f$ trap for minimum d-c output at junction adjust the picture i-f trap for minimum d-c output at junction
of R135 and Lil02. Use sufficient signal input to produce 3.0


SWEEP ALIGNMENT OF PICTURE I-F.-
Models 21-S. 348 to 21 -S-369G Incl.
To align $T 2$ and $T 104$, connect the sweep generator to the
mixer grid test point TP2, in series with a 1500 mmf. ceramic mixer grid test point TP2, in series with a 1500 mmf. ceramic
capacilor. Use the shortest leads possible, with not more than one inch of unshielded lead at the end of the sweep cable.
Connect the sweep ground lead to the top of the tuner
Set the channel
Clip 330 ohm resistors across terminals A and B of T107
and T108. and T108.
Preset C122 to minimum capacity
Adjust the bias box potentiometer to obtain - 5.0 volts of bias as meassured by a "Voltohmyst" at the ju
and C 42 . Sel the AGC control fully clock wise.
Connect a 180 ohm composition resistor from pin 5 of V106 to terminal A of Tlo6. Connect the oscilloscope diode probe
Couple the signal generator loosely to the diode probe in Couple the signal gen
order to obtain markers.
45.75 Adjust $T 2$ (top) and 7104 (top) for maximum gain and with 45.75 mc at $75 \%$ of maximum response.

Set the sweep output to give 0.3 volt peak-to-peak on the
oscilloscope when making the final touch on the above oscilloscope
adjustment.
Adjust C122 until 42.5 mc . is at $70 \%$ response with respect
to the low frequency shoulder of the curve as shown in Figure
10. Maximum allowable till is
Disconnect the diode probe, the 180 ohm and two 330 ohm resistors.
Connect the oscilloscope to the junction of R135 and L102. Leave the sweep generator connected to the mixer grid test
point TP2 with the shortest leads possible.
Adjust the output of the sweep generator to obcin 30 volt Adjust the output of the sweep generator to obtain 3.0 volks
peak-to-peath on the oscilloscope.
Couple te signal Couple the signal generator loosely to the grid of the first
pix $i$-f amplitier. Adjust the output of the signal generator to produce small markers on the response curve


Figure $10-$
KRK22C or $K R K 29$
T2 and T104
T2 and T104
Response
Retouch T106, T107 and T108 to obtain the response shown

## Models 21-S.348U to 21-S.369GU Incl.

To align T2 and T104, connect the sweep generator to the
mixer grid test point TP2, in series with a 1500 mmf. ceramic capacitor. Use the shortest leads possible, with not more than one inch of unshielded lead at the end of the sweep c
Connect the sweep ground lead to the top of the tuner.
Set the channel selector switch to channel 4.
Clip 330 ohm resistors across terminals $A$ and $B$ of $T 107$ and T 108.
Preset C122 to minimum capacity
Adjust the biars box potentiometer to oblain - 5.0 volts of
bias as measured by a "Voltohmyst" at the junction of R123 biass as measured by a "Voltonermyt" at the jo
and C142. Set the AGC control fully clockwise.
Connect a 180 ohm composition resistor from pin 5 of V106 Connect a 180 ohm composition resistor rom pin 5 of V106
to terminal A of Tlo6. Connet the oscilloscope diode probe to terminal A of Tld to connect.
to pin 5 of V106 and to ground.
Couple the signal generator loosely to the diode probe in
order to obtain markers.
Adjust T2 (top) and T104 (top) for maximum gain and
with 45.75 mc. at $75 \%$ of maximum Set the ewe output to ive 03 onse.
Sel the sweep output to give 0.3 volt peak-10-peak on the
oscilloscope when making the final touch on the above adustment.
Adjust Cl 22 until 42.5 mc . is at $70 \%$ response with respect
to the low frequency shoulder of the curve as to the low f
Figure 12 .
Disconnect the diode probe, the 180 ohm and two 330 ohm resistors.


Connect the oscilloscope to the junction of R135 and L102. Leave the sweep generator connected to the mixer grid test
point TP2 with the shortest leads possible. point TP2 with the shoriest leads possible.
Adjust the output of the sweep generator to obtain 3.0 volts Couple the signe oscillozcope.
pix i-f amplified. Ad generator loosely to the grid of the first produce small markers on the response curve. Retouch 106 , 107 on the response curve
se shown
To align the I-F amplifier circuit of the KRK29A/27, con1N82 crystal holder in series with a 1000 ohm resistor and a 500 mmf . ceramic capacitor. Use the shortest leads possible, Set thin the sweep ground lead to the tuner casse. Set the UHF CHANGEOVER switch to the UHF position, and Connect a 180 ohm composition resistor and a 1500 mmf .
capacitor in series between test point TP3 and ground with the capacitor connected to TP3 and the resistor to ground. Connect the oscilloscope diode probe to the junction between the resistor and capacitor. (See Figure 25.)
Couple the VHF signal generator loosely to the diode probe
in order to obtain markers.
Connect the potentiometer arm of the second bias supply
the AGC terminal on the tuner and ground the battery o the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case. Adjust the bias potenti"meler to produce - 3.0 volts of bias, as measured by the VoltOhmyst" at the AGC terminal on the tuner
Set the sweep generator to produce 0.3 or less peak-to-peak
Adjust L307, on the KRK27 section, and L9, on the KRK29A section, of the tuner for maximum gain with picture and
sound carrier markers as shown in figure 14 .

Remove the resistor, capacitor and diode probe from TP3 and connect the oscilloscope to the junction
L102. Use 3.0 v . peak-to-peak on the oscilloscope
L102. Use 3.0v. peak-to-peak on the oscilloscop
Retouch L307 and L9 slightly, if necessary, to produce the
curve shown in figure 14. Do not retouch T2, T104, T106. Th0 curve sho
or Tliog.
Connect the VHF sweep generator to the antenna ter
minals. Keep the $A G C$ bias at -3.0 V and the $I . F$ bias at -5.0 volts.
Couple the signal generator loosely to the grid of the firs Switch through all VHF channels and check for prope curve shape as in figure 13 . Retouch T107 and T108 slightly to correct for any overall tilt that is essentially the same o
all channels. all channels
Disconnect the VHF sweep generator and connect the UHF
sweep generator to the antenna terminals. Check on all UHF channels for proper wave shape as shown in figure 13, re touching T107 and T108 if necessary to correct any overall tilt Remove the sweep and marker generators and the bia supplies.

## KRE22C TUNER ALIGNMENT.

Models 21-S-348 to 21-S-369G Incl.
A tuner unit which is operative and requires only touch up adjustments, requires no presetting of adjustments. For such are completely out of adjustment preset C 2 all the way out Set channel 7 to 13 oscillator slugs one turn from tight Turn T 2 slug all the way out. Do not change any of the ad in the antenna matching unit.
Disconnect the link from terminals "A" and "B" of T104 and terminate the link with a 39 ohm composition resistor Turn the receiver channel selector switch to channel 2. The 43.5 me. trap is adjusted with zero bias. To insure thai the bias will remain constant, take a clip lead and shor
circuit the AGC terminal of the tuner at the terminal board to ground.
Connect the oscilloscope to the test point TPI on top of the tuner unit. Set the oscilloscope to maximum gain
Connect the output of the VHF signal generator to the out-
put of the antenna matching unit at the junction of L53 and put of the antenna motching unit art
Tune the signal generator to 43.5 mc . and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator fo maximum output.
Adjust C19 on top of the tuner, for minimum 400 cycle indi cation on the oscilloscope. If necessary, this adjustment ca be retouched in the field to provide additional rejection to on
specific frequency in the $i$ if band pass. However, in such specific frequency in the i-f batd pass. However, in such
cases, care should be taken not to tune thereby reducing sensitivity on channel 2 .
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery to the AGC terminal on the tuner and ground the battery ometer to produce -3.0 volts of bicas, as measured by the "VoltOhmyst" at the AGC terminal on the tuner.
Set the channel selector switch to channel 8 .
Preset C5 to read - 3.0 volts at the test point TPl, as read on the "VoltOhmyst". The limits for oscillator injection voltage are 2 volts minimum and not exceeding a maximum of 5.5 T.
urn the fine tuning control fully clockwise.
Adjust C3 for proper oscillator frequency, 227 mc . This which will be recommended in this procedure will be to use the signal generator as a heterodyne frequency meter and
beat the oscillator against the signal generator. To do this, beat the oscillator against the signal generator. To do this,
tune the signal generator to 227 mc. with crystal accuracy. Insert one end of a piece of insulated wire into the tuner unit through the hole provided for the adjustment of ClO . Be careful that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscillator to shift
Connect the other end of the wire to the "r-f in" terminal of the signal generator. Adjust C 3 to obtain an audible bea with the signal generator

ALIGNMENT PROCEDURE
Turn C2 clockwise until the beat note just begins to change.


Return the fine tuning control to the mechanical center of its range.
Note.-If on some units, it is not possible to reach the proper channel 8 oscillator frequency by adjustment of C3, switch to channel 13 and adjust $L 42$ to obtain proper channel 13 oscillator frequency as indicated in the table on page
Then, switch to channel 12 and adjust L1l to obtain prope channel 12 oscillator frequency. Continue down to channel 8 , adjusting the appropriate oscillator trimmer to obtain the
proper trequency on each channel. Then again on channel 8 , proper frequency on each channel. Then again on channel 8 Switch back to channel 13 and readjust L42 and back to channel 8 and adjust C 3
Set the $\mathrm{T}_{2}$ core for maximum inductance (core turned counter-clockwise)
Connect the sweep generator through a suitable attenu-
ator, as shown in figure 16 , to the input terminals of the antenna matching unit.


Figure 16-Sueep Attenuator Pads
Connect the signal generator loosely to the antenna ter minals

Set the sweep generator to cover channel 8 .
Set the oscilloscope to maximum gain and use the minimur input signal which will produce a usable pattern on the oscilloscope. Excessive input can change oscillator injection
during alignment and produce consequent misalignment even though the response as seen on the oscilloscope may look normal.
Insert markers of channel 8 picture carrier and sound Insert markers of channe1
carrier, 181.25 mc . and 185.75 mc
Adjust C7. C10, C15 and C2O for approximately correct re shape, 1 The correct adjustment of C 20 is indicated by maximum
amplitude of the curve midway between the markers. Cl 5 amplitude of the curve mate circuit and aflects the frequency of the pass band mosit noticably. C7 tunes the mixer grid
circuit and affect the tilt tof the curve most noticeably (assum circuit and affects the tilt of the curve most noticeably (assum
ing that C 20 has been properly adjusted). C10 is the couplin ing that Cio has been properly adjusted. Cle is the coupling width.

Connect the "VoltOhmyst" to test point TP 1. Adjust C5 to read - 3.0 volts de on the "VoltOhmst" at TPl. Readjust C2
$\mathrm{C} 7 . \mathrm{C} 10$ and C 15 for proper response. Adjust C 20 for maximum gain at midpoint of the curve. Repeat if necessary until mum gain at midpoint of the curve


Figure 17-KRK22C. R-F Response
Set the receiver channel switch to channel 13
Adjust the signal generator to the channel 13 oscillato Adjust the sign
requency 257 mc.
Turn the fine tuning control fully clockwise
Adjust L42 to obtain an audible beat. Slightly overshoot
Ad adjustment of L42 by turning the slug an additional turr the adjustment of L42 by turning the slug an additional turn in the same direction from the original setting, then reset the
oscillator to proper frequency by adjusting C 2 to again oscillator to pr
obtain the beat.
Set the sweep generator to channel 13 . From the signal generator, insert channel 13 sound and
picture carrier markers, 211.25 me. and 215.75 mc.
Adjust L43 and L45 for proper response as shown in
figure 17 .
Turn of the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TPI. Check the oscillator injection voltage to be within limits as If it was necessary to readjust C5, turn the sweep and sig nal generators back on and recheck the channel 13 respons Readjust $L 43$ and L45 if necessary.
Set the receiver channel selector switch to channel 8 and radjust C 2 for proper oscillator frequency, 227 mc .
Set the sweep generator and signal generator to channel 8 . Readjust C7. C10, C15 and C20 for correct curve shape and band width.
Turn off the sweep and signal generators, switch back to channel 13 and check the oscillator injection voltage at TP
was adjusted in the recheck of channel 8 respons. If the initial setting of the oscillator injection trimmer was and response on channel 8 , adjust the oscillator injection 0 channel 13 and repeat the tracking procedure several time channel 13 and repeat the tracking pr
before the proper setting is obtained.

Turn off the sweep generator and switch the receiver to

Adjust the signal generator to the channel 6 oscillator frequency 129 mc.
Set the fine tuning control to the center of its mechanical range.
Adjust L5 for an audible beat. Adjust L44, L46 and L58 for proper curve shape as shown in figure 17. Recheck the oscillator injection voltage at TP1, to insure th
the limits specified. Readjust C5 if necessary
If CS required adjustment, switch the receiver and the
signal generator to channel 8. Readjust C7 for correct curve signal generator to channel 8. Readjust C7 for correct curve
shape and recheck C2 and C3 for proper oscillator frequency. Check the response of channels 2 through 6 by switching the receiver channel switch, sweep generator and marker generator to each of these channels and observing the re sponse and oscillator injection voltage obtained. See tigure
17 for typical response curves. It should be found that all these channels have the proper response with the marker bove $80 \%$ response.
If the markers fail to fall within this requirement readjust
L44, L46 and L58 in order to obtain curves within the proper limits. Switch the channel selector, signal generator and marker
generator through channels 7 to 13 and oserve the response
curves referring to tigure 17 for proper wave shape. Check curves, referring 10 tigure 17 for proper wave shape. Check
the injection voltage at each channel to be within limits. the injection voltage at each channel to be within limits
If necessary readjust C 15 , C , or ClO to obtain the proper response.
With the receiver and signal generator on channel 13 ad
iust L42 for an audible beat with the signal generator. just $L 42$ for an audible beat with the signal generator Adjust the oscillator to frequency on all channels by switch-
ing the receiver and the frequency standard to each channel ing the receiver and the requency standard to each channe
and adjusting the appropriate oscillator slug to obtain the and adjusting the appropriate oscillator slug to obtain the
audible beat. It should be possible to adjust the oscillator to
obtain the audible beat on each channel obtain the audible beat on each channel. Recheck the oscil
lator injection voltage on each channel to verify that the voltage is within the sperified limits


Figure 18-KRK22C Oscillator Adjustments
kRE22C ANTENNA MATCHING UNIT ALIGNMENT -The antenna matching unit is accurately aligned at the factory. Adjustment of this unit should no be attempled in th customer's home since even slight misalignment may cause
serious attenuation of the signal especially on channel 2 . The $\mathrm{r}-\mathrm{f}$ unit is aligned with a particular antenna matching trans former in place. If for any reason, a new antenna match
transformer is installed, the r - unit should be realigned.
The F-M Trap which is mounted in the antenno matching The F-M Trap which is mounted in the antenno matching
unit may be adjusted without adversely affecting the alignment of the unit.
To align the antenna matching unit disconnect the lead
men With a short jumper, connect the output of the matching pix i-f amplifier, pin 1 of V107.
Replace the cover on the matching unit while making all Replace the
adjustments.
Remove the first pix i-f amplifier tube V106

Connect the positive terminal ol a bias box to the chassis
and the potentiometer arm to the junction of R123 and C142. and the potentiometer arm to the junction of R123 and Cli42 Set the potentiometer to produce approximately - 5.0 volts of
bias at the junction of R123 and C142. Connect an oscilloscope to the junction
and set the oscilloscope gain to maximum. Connet a VHF signal generotor to the antenna input termi-
nals. Modulate the signal generator $30 \%$ with an audio signal nane the signal generator to 45.75 mc . and adjust the generator output to give an indication on the oscilloscope generatior output of give an incication on the oscilloscope
Adust $L 54$ in the antenna motching unit for minimum audio indication on the oscilloscope.
Tune the signal generator to 41.25 mc . and adjust L 57 fo
minimum audio indication on the oscilloscope minimum audio indication on the oscilloscope

Connect a 300 ohm $1 / 2$ watt composition the matching uni. Connect a 300 ohm $1 / 2$ watt composition resis.
ground, keeping the leads as short cas possable.
Connect an oscilloscope low capacity crystal probe from
153 to ground. The sensitivity of the oscilloscope should be approximately
gain to maximum.
Connect the VHF sweep generator to the matching un antenna input terminals. In order to prevent coupling reac tance from the sweep generator into the matching unit, it is
advisable to employ a resistance pad ot the motching unit advisable to employ a resistance pad of the matching uni
terminals. Figure 16 shows three different resistance pads for use with sweep generators with 50 ohm co-ax output, 72 ohn co-ax output or 300 ohm balanced output. Choose the pah to
match the output impedance of the particular sweep em match
ployed.
Connect the signal generator loosely to the matching unit antenna terminals.
Set the sweep generator to sweep from 45 mc . to 54 mc .
With RCA complished by retuning channel number 1 to cover this range With WR59B sweep generators this mary be accomplished by retuning chamnel number 2 to cover the range. In makin these adjustments on the generator, be sure not to turn the
core too far clock wise so that it becomes lost beyond the core too far clockwis.
core retaining spring.
19. Adjust L55 and L56 to obtain the response shown in figure of the curve at 52 mc . and $\mathrm{L56}$ should be adiusted to give
maximum amplitude at 53 mc. and above consistent with the specified shape of the response curve. The adjustments in the matching unit intiract to some extent. Repect the above
procedure until no further adjustments are necessary. Remove the 300 ohm resistor and crystal probe connections.
Restore the connection between L53 and S4. Replace V106.

33 mc. $100 \%$ Response crizs


Figure 19-KRK22A Antenna Matching Unit Response

## KRE29 TUNER ALIGNMENT

KRE29 TUNER ALLGNMENT
A tuner unit which is operetive and requires only touch up adjustments, requires no presetting of adjustments. For such
units, skip the remainder of this paragraph. For units which are completely out of ajdutment, preset C27 all the way out.
Set chanel 7 to 13 oscillator slugs one turn from tight. Turn T2 slug all the way out. Do not change any of the adantenna matching unit.
Disconnect the link from terminals "A" and "B" of $T 104$
and terminate the link with a 39 ohm composition resistor Turn the receiver channel selector switch to channel 2 .
The $43.5 \mathrm{mc}$. trap is adjusted with zero bias. To insure that
he bias will remain constant, take a clip lead and short
circuit the AGC terminal of the tuner at the terminal board
to ground. 10 ground.
Connect the oscilloscope to the test point TP1 on top of the
tuner unit. Sot the oscilloscion tuner unit.. Set he osciloscope to maximum gain
Connect the output of the VHF signal generator to the out
put of the ontenna mathing unit at the junction of LS and C
at the bottom of the FM trap L5.


Figure 20-KRK29 Tuner Adjustments
Tune the signal generator to 43.5 mc . and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator for Tune the signal
with a 40 cycle s
maximum output.
maximum output. Adjust C33 on top of the tuner, for minimum 400 cycle indi-
cation on the oscilloscope. If necessary, this adjustment can cation on the oscilloscope. If necessary, this adjustment can
be retouched in the field to provide additional rejection to
one specific frequency in the if band one specific frequency in the i-f band padss. However, in such
cases, care should be taken not to tune C33 into channel 2 , cases, care should be taken not to tune C33
thereby reducing sensitivity on channel 2.
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery positive terminal to the tuner case. Adjust the bias potentiometer to produce -3.0 volts of blas, as measure
"VoltOhmyst" at the AGC terminal on the tuner.
Set the channel selector switch to channel 8.
Proset C22 to read. $\mathbf{3 . 0}$ volts at the test point TP1, as read
on the "Voltohmyat." The limits for oscillator injection voltage on the "Voltohmyst." The limits for oscillator injection voltage
are 2 volts minimum and not exceeding a maximum of 5.5 are 2
volts.

Turn the fine tuning control fully clockwise.
Adjust C25 for proper oscillator frequency, 227 mc . This Adjuat
may be done in several warcy. The easiest way and the way
which will be recommended in the which will be recommended in this procedure will be to use
the signal generotor as a heterodyne frequency meter and the signal generator as a heterodyne frequency meter and
beat the oscillator against the signal generator. To do this,
tune the signal beat the oscillator against the signal generator.
tune the signal generator to 227 mc. with crystal accuracy
Insert one end Insert one end of a piece of insulated wire into the tuner uni
through the hole provided for the adjustment of Cl6. Be care through the hole provided for the adjustment of Cl6. Be care
ful that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscillator to shift
Connect the other end of the wire to the "r-f in" terminal ol Connect the other end of the wire to the "r-f in" terminal ol
the signal generator. Adjust C 25 to obtain an audible beat the signal generator. Adj
with the signal generator.
Turn the C27 clockwise until the beat note just begins to
change, then turn one full turn in the same clockwise diroc-
tion. tion.
Return the fine tuning control to the mechanical center
of its range. Note, -If on some units, it is not possible to reach the
proper channel 8 oscillortor frequency by adjustment of C25
switch to channel 13 and adjust L49 to obtain proper channel switch to channel 13 and adjust $L 49$ to obtain proper channe
13 oscillator frequency as indicated in the table on page 8 . 13 oscillator frequency as indicated in the table on page
Then, switch to channel 12 and adjust 160 to obtain proper channel 12 oscillator frequency. Continue down to channel 8 , adjusting the appropriate oscillator trimmer to obtcin the
proper frequency on each channel. Then again on channel proper frequency on each channel. Then again on channe
8 , adjust C 25 to obtain proper channel 8 oscillotor frequency Switch back to channel
channel 8 and adjust C25.

Set the T2 core
counter-clockwise). Connect the sweep generator through a suitable attenua-
tor, as shown in Figure ar, as shown in Figure
antenna matching unit.
Connect the signal generctor loosely to the antenna terminals.
Set the sweep generator to cover channel 8 .
Set the oscilloscope to maximum gain and use the minimum
input signal which input signal which will produce a usable pattern on the
oscilloscope. Excessive input can change oscillator injection during alignment Emd produce consequent miscalignment even though the response as seen on the oscilloscope may look

Insert markers of channel 8 picture carrier and sound
carrier, 181.25 mc . and 185.75 mc Insert markers of chamnel 8 picture.
carrier, 181.25 mc . and $185.75 \mathrm{mc}$.


Figure 21-KRK29 R-F Response
Adjust C21, C16, C11 and C7 for approximately correct
curve shape, frequency, and band width as shown in Figcurve
ure 21.
The correct adjustment of C7 is indicated by maximum
amplitude of the curve midway betwen the morkers Cl 1 amplitude of the curve midway betwen the markers. CII tunes the r-it amplitier plate circuit and affecta the frequency
of the pass band most noticeably. C2l tunes the mixer grid
circuit and attects the tile of the curve most noticeably circuit and attects the tilt of the curve most noticeably
(assuming that C 7 has been properly adjuated). C16 is the coupling adjustment and hence primarily affects the response band width.
Connect the "Voltohmyent" to tent point TP1. Adjust C22 to
read -3.0 volts dc on the "VoltOhm yat" of TPI. Readiuan C27,
 mum gain ot midpoint of the curve. Repeat if necesaary until he proper response is obtcined.
Set the receiver channel switch to channel 13
Adjust the signal generator to the channel 13 oscillator
frequency 257 mc. requency 257 mc.
Turn the fine tuning control fully clockwise.
Adjust L49 to obtain an audible beat. Slightly overshoot the adjuatment of L49 by turning the slug an additional turn in the same direction from the orign als senuting, C27 to again btain the beat.
ator to channel 13 . 13 sound and
From the signal generator, insert chamnel 13 sound and
picture carrier markers, 211.25 mc. and 215.75 mc.
Adjuat L36 and L20 for proper response as nown in
Figure 21 .

Turn off the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TP1 Check the oscillator injection voltage to be within limits as previo
range.
If it was necessary to readjust C22, turn the sweep and signal generators back on and recheck
sponse. Readjust L 36 and L20 if necessary
Set the receiver channel selector switch to channel 8 and Set the receiver channel selector switch to channel
readjust C27 for proper oscillator frequency, 227 mc Set the sweep generator and signal generator to channel
8. Readjust C21, C16, C11 and C7 for correct curve shape, frequency and bandwidth.
Turn of the sweep and signal generators, switch back to TP1 if C21 was adjusted in the recheck of channel 8 reaponse. If the initial setting of the oscillator injection trimmer was far oft, it may be necestary to adjust the oscillotor frequency
and response on channel 8 , adjuat the oscillotor injection on channel 13 and repeat the tracking procedure several times before the proper setting is obtained.
Turn off the sweep generator and switch the receiver to
channel 6 . annel 6
Adjust the signal generator to the channel 6 oscillator Set the fine tuning control to the center of its mechanical range.
Adjust $L 54$ for an audible beart. Adjuat L48, and L32 for proper curve shape aus how in igure 21 . hecheck the oscir ator injection voltage of TP1 to insure
limits specifiod. Readjuat C 22 if necestary.
If C22 required adjustment, switch the receiver and the ignal generator to channel 8 . Readjust C 21 lor correct curve hape and recheck C27 and C25 for proper oscillator fre Chek
Check the response of channels 2 through 6 by switching gen receiver channel switch, swoep generator and marke
gech of these channels and observing the re ponse and oscillotor injection voltage obtcined. See Fig ure 21 for typical response curves. It should be found that all
hese channels have the proper response with the marker hese channels have
If the markers fail to fall within this requirement readjust 48 and
limitr.
Switch the channel selector, signal generator and marker Senerator through channele 7 to 13 and observe the response curves. referring to figure 2 ach channel to be within limits. the injection voltage at each channel to be within limits.
If necessary readjuat C11, C21, or C16 to obtain the proper ruponse
With the receiver and aignal generator on channel 13 ad
just Lig tor am audible beat with the signal generator


Figure 22-KRK29 R-F Oscillator Adjustments

Adjust the oncillator to frequency on all channels by switching the receiver and the frequency atandard to each chan-别 and adjusting the appropriate oscillotor slug to obbain

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10 obtain the audible beat on each channel. Recheck the oscillator injection voltage on each channel to verify that the
voltage is within the specified limits. KRE29 OR RRE29A ANTENNA
MENT. - The antenna ANTENNA MATCHING UNIT ALIGNthe factory. Adjustment of this unit should not be attempted in the cusiomer's home since even slight misalignment may 2. The r-f unit is aligned with a particular antenna matching transformer in place. If for any reason, a new antenna match-
ing transiormer is installed, the r-f unit should be realigned. The F-M Trap which is mounted in the antenna matching
unit may be adiusted without adversely affecting the align ment of the unit.
To align the antenna matching unit disconnect the lead
from the F-M Trap L5 to the channel selector switch Sl-E. With $\alpha$ short jumper, connect the output of the matching
unit through $\alpha 1000$ mmif. capacitor to the grid of the second unit through a 1000 mmmf. cap
pix i-f amplitior, pin 1 of 107 .
Replace the cover on the matching unit while making all
adjustments.

Remove the first pix i-f amplifier tube V106.
Connect the positive terminal of a bias box to the chassis
and the potentiometer arm to the junction of R 123 and Cl 42 Set the potentiometer to produce approximately -5.0 volts of
bias at the junction of R123 and Cll4 bas at the junction of R123 and C142.
Connect an oscilloscope to the junction of R138 and L105
and set the oscilloscope gain to maximum. Co VHF gin
Connect a VHF signal generator to the antenna input
terminals. Modulate the signal generator $30 \%$ with an cudio signal.
Tune the signal generator to 45.75 mc . and adjust the gen-
erator output to give an indication on the oscilloscope. Adjust erator output to give ar indication on the oscilloscope. Adjust
L4 in the antenna matching unit for minimum audio indicaL4 in the antenna matc
tion on the oscilloscope.
Tune the signal generator to 41.25 mc . and adjust Ll for
minimum audio indication on the illoscope.
Remove the jumper from the output of the matching unit. Connect a 300 ohm $1 / 2$ watt composition resistor from L5 to ground, keeping the leads as short as possible.
L5 to ground. The sensitivity of the oscilloscope should for approximately 0.03 volts per inch. Set the oscilloscope gain 10 maximum
Connect the VHF sweep generator to the matching unit
antenna input terminals. In order to prevent coupling rit ance from the sweep generator into the matching unit, it advisable to employ a resisisance pad at the mattching uni
terminals. Figure 16 showw three difterent terminclis. Figure 16 shows three different resistance pads fo
use with sweep generators with 50 ohm co-ax output, 72 ohm co-ax output or 300 ohm balanced output. Chouse the pad to match the output impedance of the particular sweep em-
ployed.
Connect the signal generator loosely to the matching unit antenna terminals.
Set the sweep generator to sweep from 45 mc . to 54 mc
With RCA Type WR59A sweep generators, this may be accomplished by returning channel number 1 to cover thi range. With Wrisg sweep generators this may be accom making these adjustmennel number 2 to cover the range. In turn the core too farr clockwise so that it becomes lost beyond the core retaining spring


Figure 23--KRK29 or KRK29A Antenna Matthing

## ALIGNMENT PROCEDURE

23. Adjust L 2 and L 3 to obtain the response shown in figure ive maximum curplitude at 53 mc . and above consistent with the specified shape of the response curve. The adjustments in he maiching unit interact to some extent. Repeat the above procedure until no further adjustments are necessary.
Remove the 300 ohm resistor and crystal probe conne Restore the connection between L5 and S1-E. Replace V106.

## RRE29A/27 TUNER ALIGNMENT odels 21 -S 348 U to $21 . \mathrm{S}$-369GU Incl.

VHF ALIGNMENT,-A tuner unit which is operative and equires only touch up adjustments, requires no presetting requires only touch up cajustmenis, requires no preselting paragraph. For units which are completely out of adjustment slugs one turn from tight. Turn T2 slug all the way out. Do no change any of the adjustments in the antenna matching unit Disconnect the link from terminals " $A$ " and " B " of T104 and
terminate the link with a 39 ohm composition resistor Turn the receiver channel selector switch to channel
The 43.5 mc . trap is adjusted with zero bias. To insure that the bias will remain constant, take a clip lead and short circuit the AGC terminal of the tuner at the terminal board to Cone
Connect the oscilloscope to the test point TP2 on top of the Connect the output of the vHF maximum gain Connect the output of the VHF signal generator to the
C4 at of the bottom onna matching unit at the junction of LS and M trap L5.
Tune the signal generator to 43.5 mc . and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator maximum output.
Adjust C33 on top of the tuner, for minimum 400 cycle indication on the oscilloscope. If necessary, this adjustment can be retouched in inecific trequency in the it band pass. However, in such cases, care should be taken not to tune. C33 into channe
2, thereby reducing sensitivity on channel 2, thereby reducing sensitivity on channel 2 .
Connect the potentiometer arm of one of the bias supplies
to the $A G C$ terminai on the tuner and ground the battery positive terminal to the tuner case. Adjust the bias potent ometer to produce -3.0 volts of bias, as measured by the VoltOhmyst" at the AGC terrainal on the tun
ch to channel 8
Preset C22 to read -3.0 volts at the test point TP1, as
read on the "VoltOhmyst." The limits for oscillator injection voltago are 2 volts minimum and not exceeding a maximum of 5.5 volts.

Turn the fine tuning control fully clockwise.
Adjust C25 for proper oscillator frequency, 227 mc . This
may be done in several ways The may be done in several ways. The easiest way and the way
which will be recommended in this procedure will be to use the signal generotor as a heterodyne frequency meter and
beat the oscillator against the signal generator. To do this beat the oscillator against the signal generator. To do this
tune the signal generator to 227 mc . with crystal accuracy tune the signal generator to 22 mc . With crystal accuracy unit through the hole provided for the adjustment of C16. Be careful that the wire does not touch any of the tuned
circuits as it may cause the frequency of the tuner oscillato circuits as
to shift. Connect the other end of the wire to the "ryst in terminal of the signal generator. Adjust C25 to obtain an audible bear win he signal generator.
Turn C27 clockwise until the beact note just begins to
change, then turn one full turn in the same clockwise direction.
Return the fine tuning control to the mechanical center of NOTE:-II on some units, it is not possible to reach the proper channel 8 oscillator frequency by adjustment of C25. switch to channel 13 and adjus L499 o obtain proper channel
13 oscillator frequency as indicated in the table on page 8 13 oscillator frequency as indicated in the table on page 8
Then, switch to channel 12 and adjust L60 to obtain prope Then, switth to channel 12 ascillator frequency. Continue down to channel 8 , adjusting the appropriate oscillator trimmer to obtain the proper frequency on each channel. Then again on channel 8 ,
adjust C 25 to obtain proper channel 8 oscillator frequency SWitch back to channel 13 and readjust L49 and back to
channel 8 and adjust C 25 .

Set the T2 core
counter-clockwise)
Connect the sweep generator through a suitable attenu ator, as shown in figure 16 to the input terminals of the
antenna matching unit antenna matching unit.
Connect the signal generator loosely to the antenna minals.
Set the sweep generator to cover channel 8 .
Set the oscilloscope to maximum gain and use the minimum
input signal which will produce a usable pattern on the oscil input signal which will produce a usable pattern on the oscil-
loscope. Excessive input can change oscillator injection dur ing alignment and produce consequent misclignment eve though
Insert markers of channel 8 picture carrier and soun carrier, 181.25 mc . and 185.75 mc .
Adjust $\mathrm{C} 21, \mathrm{Cl16,C11}$ and $\mathrm{C7}$ for approximately correc
curve shape, frequency, and band width as shown in d width as shown in figur

The correct adjustment of $\mathrm{C7}$ is indicated by maximum am
plitude of the curve midwary between the markers. Cll tune the $r$-f amplifier plate circuit and affects the frequency of the pass band most noticeably. C21 tunes the mixer grid circui and affects the tilt of the curve moss noticeably (assuming
that $\mathrm{C7}$ has been properly adjusted). Cl6 is the coupling ad that C7 has been properly adjusted). Cl6 is the coupling ad-
justment and hence primarily affects the response band width.
Connect the "VoltOhmyst" to test point TP1. Adjust C22 to
read -3.0 volts de on the "Voltohmyst" at TPI. Readiust C27 ${ }^{\text {read }}$ - 3.0 volts dc on the "Volto hmysit" at TPI. Readjust C27 imum gain at midpoint of the curve. Repeat if necessary until the proper response is obtcined.

Set the receiver channel switch to channel 13
Adjust the signal generator to the channel 13 oscillator fre uency 257 mc .
Turn the fine tuning control fully clockwise
Adjust L49 to obtain an audible beat. Slightly overshoot th the same direction from the original setting, then reset the oscillator to proper frequency by acjusting C27 to again ob ain the beat
Set the sweep generator to channel 13
From the signal generator, insert channel 13 sound and pic
ture carrier markers, 211.25 mc. and 215.75 mc.
Adjust L36 and L20 for proper response as shown in fig
ure 24.
Turn off the sweep and signcl generators.

Connect the "VoltOhmyst" to the tuner test point TPI Check the oscillator inijection voltage to be within limits as previously specified. Adjust if necessary to bring within
If it was necessary to readjust C22, turn the sweep and signal generators back on and recheck the channel 13 re
sponse. Readjust $L 36$ and $L 20$ if necessary. Set the receiver channel selector switch to channel 8 and
readjust C27 for proper oscillator frequency, 227 mc . Set the sweep generator and signal generator to channel 8 Readjust C21, C16, C11 and C7 for correct curve shape frequency and band width.


Figure 24-KRK29A R-F Response

Turn off the sweep and signal generators, switch back to if C21 was adjusted in the recheck of channel 8 response. If the initial setting of the oscillator injection trimmer was
far oft it may be necessary to adjust the oscillator frequency

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## ALIGNM

top of the tuner. Ground the other end of the clip lead to the top of the t.
Connect the oscilloscope to the test point TP301, employing
the preamplitier if needed with the oscilloscope used. the preamplifier if needed with the oscilloscope used.
Connect the output of the UHF sweep generator, throu Connect the output of the UHF sweep generator, through
a 300 ohm attenuator pad, to the antenna terminals and a 300 ohm altenuator pad, to the antenna termincls and
set the sweep generator to sweep channel 83 , centered on 887.5 mc . Adjust the output of the sweep generator to full
sweep width. weep width.
A test dial made to fit over the split gear on the tuner shaf
is necessary for accurate alignment. Scribe morks at $0^{\circ}, 9^{\circ}$ is neeessary for accurate alignment. Scribe morks at a
and $168^{\circ}$ should be marked on the test dial for reference
The $0^{\circ}$ reference point is located with the capacitor plates The $0^{\circ}$ reference point is located with the capacitor plates
fully meshed. By placing $a 1 / 16^{\prime \prime}$ shim between the stop pin fully meshed. By placing a
on the turer and the stop plate on the gear assembly the
plates will be in the proper fully meshed position. plates will be in the proper fully meshed position.
Rotate the tuning dial to the $168^{\circ}$, Channel 83, position. Connect the VHF signal generator in series with a 1000
ohm resistor to the rear terminal of the crystal holder and ohm resistor to the rear terminal of the crystal ho
insert markers for 41.25 mc ., 43.5 mc . and 45.75 mc .
Connect the UHF marker generator loosely to the antenna terminals and insert a marker al 887.5 mc
Adjust R-F trimmer capacitors C315 and C316 for a max 887.5 mc . as shown in figure 27 (A).


Figure 27-KRK27 R-F Response

will cause crystal currents outside allowable limits and in such cases the oscillator tube should be replaced. Replace ment of the oscillator tube will require recalibration at the
high and low frequency ends of the band as previously high and
outlined.
RATIO DETECTOR ALIGNMENT.--Set the signal gen erator at 4.5 mc . and connect it to the first sound i-f grid.
pin 1 of V101. As an alternate source of signal. the RCA WR39B or As an alternate source of signal. In such a case, connect the calibr Set the frequency of the calibrator to 45.75 mc . (pix carrier)
and modulate with 4.5 mc. crystal. The $4.5 \mathrm{mc}$. signal
will be picked off at LiO3 and amplitited through the sound and modula
will be pick
i-f amplifier.
-f amplifier.
Connect the "VoltOhmyst" to pin 2 of V103
Connect the "VoltOhmyst to pin 2 of top core for maximum Tune the ratio delector primary. Ti02 top core for maximum the signal generator for 6 volts on the "Voltohmyst" when finally peaked. This is approximately
the ratio detector for average signals.
Connect the "VoltOhmyst" to the junction of R108 and C109. Tune the ratio detector secondary T102 bottom core for zero Tune the ratio delect
Repeat adjustments of T102 top for maximum d-c at pin 2
O $V 103$ and T 102 bottom for zero d -c at the junction of R108 V103 and T102 bottom for zero d-c at the function of Ric
and C109. Make the final adjustinents with the signal inp and lad. Make the final 6 ajustinents with ine signal inpul pin 2 of V103.
SOUND I-F ALIGNMENT.-Connect the signal generaior
to the firste sound i-f amplifier grid, pin 1 of V101. As an alternate source of signal, the RCA WR39B or As an alternate source of signal, the
Connect the "VoltOhmyst" to pin 2 of V103
Tune the T101 top core for maximum d-c on the "Vol hmyst.'
The output from the signal generator should be set to produce approximately 6.0 volts on the "Voltohmys
the final touches on the above adjustment are made
4.5 MC. TRAP ADIUSTMENT.-Connect the signal generator in series with a 4.5 mc . and modulate it $30 \%$ with 400 to ground pin 1. V108, to prevent Short the third pix i-1 grid to ground, pin
noise from masking the output indiagtion.
Connect the crystal diode probe of an oscilloscope to the plate of the video cmplifier, pin 9 of Adjust the core of 104 for
scope.
As an alternate method, this step may be omitted at this point in the alignment procedure and the adju
"on the air" after the alignment is completed.
If this is done, tune in a station and observe the picture on when the fine tuning control beat is present in the picture, quency, hen Llo4 requires no adjustment. If a 4.5 mc . beat is present, turn the fine tuning control slightly clockwise so as
to exaggerate the beat and then adjust Llo4 for minimum to exa
AGC CONTROL ADIUSTMENT.-Disconnect all test equipment except the oscilloscope which should be connected
pin 9 of V110. Turn the AGC control fully counter-clockwise
Tune in a strong signal and adjust the oscilloscope to see the video waveform.
Turn the AGC control clockwise until the tips of sync begin
to be compressed, then counter-clockwise until no compresto be compresse
sion is obtained.
HORIZONTAL OSCILLATOR ADJUSTMENT. - Normally the adjustment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since the oscil
lator waveform adjustment may require the use of an oscillo scope, it can not be done conveniently in the field. The
waveform adjustment is made at the factory and normally
wavelorm adiustment should be checked whenever the receiver is aligned
ation is improper
Horizontal Frequency Adjustment.-Tune in a station and sync the picture. If the picture cannot be synchronized with
the horizontal hold control R196, then adjust the T114 frequency core on the rear apron until the picture will synquency core on the ricture still will not sync. turn the Tlli
chronize. If the
wavelorm adiustment core (under the chassis) out of the coil wavelorm adjustment core (under the chassis) out of the coil
weveral turns from its original position and readiust the T114 several turns from its original pise is synchronized.
frequency core until the picture is
Examine the width and linearity of the picture. If picture
width or linearity is incorrect, adjust the horizontal drive width or linearity is incorrect, adjust he horizontal drive control Cli74B, the width control
Horizontal Oscillator Waveform Adjustment.-The horizontal oscillator wavelorm may be adiusted by either o two methods. The methed field when an oscilloscope is no may be employed in arice shop method outlined in paragraph B below requires the use of an oscilloscope
A.-Turn the horizontal hold control compietely clockwise
Place adjustment tools on both cores of T114 and be prepared Place adjustment tools on both cores of T114 and be prepared
to make simultaneous adjustments while watching the picture on the screen. First, turn the T114 frequency core lon the rea apron) until the picture falls out of sync and three or fou
diagonal black bars sloping down to the right appear on the diagonal black bars sloping down to the right appear on the
screen. Then, turn the wavelorm adiustment core (under the scren.
chassis) into the coil while at the same time adjusting the
trequency trequency core so as to maintain three or four diagonal black
bars on the screen. Continue this procedure untll the osil lator begins 10 motorboat, then iurn the waveform adjusimen core out until the motorboating just stops. As a check, turn
the Tllt frequency core until the picture is synchronized then the T114 frequency core until the picture is synchronized then
reverse the direction of rotation of the core until the picture reverse tre direction ol rotation of he core unil the picture
!cliss out of sync with the diagonal bars sloping down to the
right. Continue to turn the frequency core in the same direc right. Continue to turn the frequency core in the same direc
. No more than three or four bars should appear on the tion. No more than three or four bars should appear on the
screen. Instead, the horizontal oscillator should begin the
mel screen. Instead, the horizontal oscillator should begin the
moorboat. Retouch the adjustment of the T114 wavelorm
adiustment core if necessary until this condition is obtained.
B.--Connect the low capacity probe of an oscilloscope to erminal C of Thlu. Turn the horition so that the picture is in synce. Adiust the waveform adiustment core of T114 until he two peaks are at the same height. During this adjust ment, the picture must
hold control if necessary.
This adjustment is very important for correct operation o lower than the sharp park, the noise im inunity become poorer, the stabilizing effect of the tuned circuit is reduce and, if the broad peak is higher than the sharp peak, the hand, it the broad peak is thigher than here sherse becomes inade quate and the broad peak can cause double riggering of the position.
Remove the oscilloscope upon completion of this adjust
Horizontal Locking Range Adiustment.--Set the horizon. hold control to the full counter-clockwise position. Momen
arily remove the signal by switching off channel then back. The picture may remain in sync. If so furn the T114 fre quency core slightly and until the picture falls out of sync with the diagona lines sloping down to the left. Slowly turn the horizonta hold control clockwise and note he least number or diagonal
If more than 3 bars are present just before the picture pulls If more than bars are present syst adiust the horizontal locking range trimmer Clid4 slightly clockwise. If less than 2 bars are present udiust
Ci74A slightly counter-clockwise. Turn the horizontal hold C174A slightly counter-clockwise. Turn the horizontal hold rentrock the number of bars present at the pull-in point. Repeat this procedure until 2 or 3 bars are presen
Turn the horizontal hold control to the maximum clockwise
position. Adjust the T114 frequency core so that the diagonal position. Adjust the This rirequency core so that the diagonal
bar sloping down to the erght appears on the screen and then reverse the direction of adjustment so that bar just moves to



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production changes in zcesb series chassis
The schematics are shown in the latest condition. The notes below tell
how earry receivers differed from the schematics shown above and on
por In :ome receivers C7, in KRK29 and KRK29A tuners, was $0.8-3 \mathrm{mmf}$.
 In some receivers a 3.3 mml . capacitor, C32, was connected on SIB
rear, in KRK29 and KRK 29 A tuners. In some receivers C36 on S1B, in KRK29 and KRK29A tuners, was In some receivers C37 on S1A, in KRK29 and KRK29A tuners, was
omitted. omilted.
In some receivers C38 on SIE front, in KRK29 and KRK29A tuners, wa
omitted. In some receivers C 162 , at pins of V1128, was 047 mid.
In some receivers R9 was connected to terminal 2 of SIB rear in KRK 2 t ,
In some receivers a 39 ohm resistor F -18, was connected on SIC front In some receivers RI58, at pin 6 of V109B, was 6800 ohms.
In some receivers R185, at terminal 1 of the vertical linearity control
R183, was 470,000 ohms.
In some receivers R187, at pin 11 of the Kinescope, was 270,000 ohms.
In some receivers $\mathrm{T} 106, \mathrm{~T} 107$ and T 108 were individual transformers
see page 19 )
(see page 19).
In some receivers pin 6 of V110A was connected to the junction of R162
and Cl52.


The schematic is shown in the latest
All resistance value in ohms. $\mathrm{K}=1000$

All capacitance values less than 1 in
MF and above 1 in MMF unless otherwise MF and
noted.

Direction of arrows at controls indicate
lockwise rotation.

All voltages measured with "VoltOhm- Figure 31-Circuit yst" and with no signal input. Voltages $\begin{aligned} & \text { Schematic Diagram } \\ & \text { should hold within } \pm 20 \% \text { with } 117 \text { v. }\end{aligned}$ KC83PC a-c supply.

production changes in rcse3 series chassis
The schemarics are shown in the latest condition. The notes on pages 19 and 23 tell how early receivers ditlered from the

The schematic is shown in the latest
$\begin{gathered}\text { condition at the time of printing. } \\ \text { All resistance value in ohms. } \mathrm{K}\end{gathered}=1000$. $\quad \begin{aligned} & \text { MF a } \\ & \text { noted }\end{aligned}$

All capacitance values less than 1 in
Direction of arrows at controls indicates Direction of arrows
clockwise rotation.

All voltages measured with "Voltohm yst" and with no signal input. Voltages
should hold within $\pm 20 \%$ with 117 y should hold
a-c supply.

Figure 32-Circuit
Schematic Diagram



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## CHASSIS DESIGNATIONS

## WEIGHT \& DIMENSIONS

| Model |  | Shipping Weight | Width Inches | Height Inches | Depth Inches |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 17-S-350 | 83 lbs | 100 lbs . | $221 / 2$ | 22 | 22 |
| 17-S-351 | 91 lbs . | 115 lbs . | $211 / 2$ | 343/4 | 22 |
| 17-S-360 | 94 lbs . | 118 lbs . | $241 / 2$ | $351 / 2$ | 221/2 |
| 17-S-350U | 88 lbs | 105 lbs . | $221 / 2$ | 22 | 22 |
| 17-S-351U | 96 lbs . | 120 lbs . | $211 / 2$ | 343/4. | 22 |
| 17-S-360U | 99 lbs | 123 lbs . | $241 / 2$ | $351 / 2$ | 221/2 |
| LOUDSPEAKERS |  |  |  |  |  |

Models 17-S-350, 350U ( 971636.1 ) 5" PM Dynm., 3.2 ohms Models 17 -S-351, 351 U ( 971636 -1) 5" PM Dynm., 3.2 ohms Models 17-S-351, 350 (971636-1) 5' PM Dynm., 3.2 ohm SCANNING.............................erlaced, 525 line HORIZONTAL SCANNING FREQUENCY .... $15,750 \mathrm{cps}$ VERTICAL SCANNING FREQUENCY ....... 60 cps FRAME FREQUENCY (Picture Repetition Rate) 30 cps

OPERATING CONTROLS (front)
Models $17-5-350,351 \& 360$
$\left.\begin{array}{|c}\text { Channel Selector } \\ \text { Fine Tuning }\end{array}\right\} \ldots \ldots \ldots$....................... Control Knobs
Fine Tuning $\qquad$ dels 17.S-350U 351 U \& 360 U
VHF Channel Selector and VHF Fine Tuning and

Dual Control Knobs UHF Tuning
Picture
Sound Volume and On-Off Switch $\}$.. Dual Control Knobs Picture Horizontal Hold.............Single Control (Knurled) Picture Vertical Hold ............. Single Control (Knurled) Brightness . ............................... Control Knob NON-OPERATING CONTROLS
top chassis adjustmen Horizontal Centering
top chassis adjustmen Vertical Centering.... top chassis adjustmen
AGC. rear chassis adjustmen Height.
Horizont front panel screwdriver adjustment Horizontal Locking ..... rear chassis screwdriver adjustment
Vertical Linearity ........front panel screwdriver adjustment Vertical Linearity front panel screwdriver adjustment Horizontal Oscillator Frequency...rear chassis adjustmen Horizontal Oscillator Waveform. bottom chassis adjustmen
Width Link Width Link Focus. Ion Trap Magne Focus Magnet
top chassis adjustment
top chassis adjustment
top chassis adjustment top chassis adjustment

GENERAL DESCRIPTION
Models 17-S.350, 17-S-350U, 17-S-351, 17-S-351U, 17-S-360 and 17-S-360U are " 17 inch" television receivers. Models 17.S-350, 17.S-351 and $17 \mathrm{~S}-360$ are identical except for
Ros. kinescopes, cabinets, and speakers. Models 17-S-350U,
$17-S-351 U$ and $17-\mathrm{S}-360 \mathrm{U}$ are identical except for kinescopes, 17-S-351U and 17-S-360U are identical except for kinescopes,
cabinets, and speakers. Models 17.S.350, 17-S-351 and cabinets, and speakers. Models 17-S.350, $17-\mathrm{S}-351$ and
17-S-360 feature full 12 channel VHF coverage. Models

VHF coverage plus any UHF channels desired.
All models include intercarrier FM sound system; ratio
detector; improved picture brilliance; pulsed picture A.G.C. A-F.C horizontal hold: stabilized vertical hold; noise saturation circuits; improved sync separator ( 3.5 mc . band width for picture channel); and reduced hazard high voltage supply. An auxiliary audio input jack is provided
use of an external record playing attachment.

## ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE 146 sq. ins. on a 17 CP4 or a 17OP4 Kinescope TELEVISION R-F FREQUENCY RANGE

Models 17-S-350, 17-S-351 \& 17-S. 360
All 12 television channels, 54 mc . to $88 \mathrm{mc} ., 174 \mathrm{mc}$. to 216 mc .

$$
\begin{aligned}
& 2 \text { television channels, } 54 \text { mc. } \text {.o } 88 \text { mc., } 174 \text { mc. to } 216 \\
& \text { Models } 17 . S \text { - } 350 U, 17 . S-351 U \& 1 . S \text {. } 360 U
\end{aligned}
$$

Any of 70 UHF channels. $5 . . . . . .470 \mathrm{mc}$. to 890 mc . INTERMEDIATE FREQUENCIES
Picture I.F Carrier Frequency
POWER RATING
AUDIO POWER OUTPUT RATING
VIDEO RESPONSE
SWEEP DEFLECTION
ocus.
ANTENNA INPUT IMPEDANCE
Models 17-S-350, 17-S-351 \& 17-S. 360
Choice: 300 ohms balanced or 72 ohms unbalanced.
Models $17 . S-350 U, 17-S-351 U \& 17-S-360 U$
UHF-300 ohms balanced.
VHF-300 ohms balanced.

45.75 mc . 41.25 mc .
. 215 watts
4 watts max. To 3.5 mc. Magnetic

## RCA TUBE COMPLEMENT

 uner KRK29A/27 (17-S-350U, 17-S-351U \& 17-S-360U) (1) RCA 6AF4

VHF R-F Amplifier
(3) $6 \times 8 \ldots$ VHF R-F Oscillator and Mixer

A 1 N82 crystal is used as the UHF mixer.



Figure 1-Receiver Operating Controls (VHF Models)


Figure 2-Receiver Operating Controls (UHF-VHF Models)

## (©) John F. Rider




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Disconnect the diode probe，the 180 ohm and two 330 ohm Distors．
Connect the oscilloscope to the junction of R138 and L105 Leave the sweep generator connected to the mixer grid
test point TP2 with the shortest leads possible． Adjust TP
Adjust the output of the sweep generator to obtain 3.0
volts peak－to－peak on the oscilloscone Couple the signal generator loosely to the grid of the firs Couple the signal generator loosely to the grid of the first
pix i．f amplifier．Adjust the output of the signal generator
to produce small markers on the response curve． to produce small markers on the response curve．
Retouch T106，T107 and T108 to obtain the response shown
in Figure 13．
To align the I－F amplifier circuit of the KRK29A／27，con－
net the VHF sweep generator to the rear terminal of the crystal holder in series with 1000 ohms and a 1500 mmi ceramic capacitor．Use the shoriest leads possible，with
not more than one inch of unshielded lead at the end of the
sweep cable．Connect the sweep ground lead to the r－f unit sweep cable．
outer shield．
Set the UHF changeover switch to the UHF position，and
the UHF tuning to channel 47 at 670 mc． Connect a 180 ohm composition resistor and a 1500 mmf
capacitor in series between test point TP3 and ground with he capacitor connected to TP3 and the resistor to grownd．
Connect the oscilloscope diode probe to the junction between Connect the oscilloscope di
the resistor and capacitor．
Couple the VHF signal generator loosely to the diode
probe in order to obtain markers． probe in order to obtain markers．
Connect the potentiometer arm of the second bias supply
to the AGC terminal on the KRK29A tuner and ground the battery positive terminal to the tuner case．Adjust the bias potentiometer to produce－ 3.0 volts of bias，as measured Set the sweep generator to produce 0.3 volts or less peak－
Adjust L307，on the KRK27 section，and L9，on the KRK29A section of the tuner，for maximum gain with picture and
sound carrier markers as shown in Figure 14．
Remove the resistor，capacitor and diode probe from TP3．
Connect the oscilloscope to the junction of R138 and L105：
Use $3 v$. peak－to－peak on the oscilloscope．Retouch L307 and Use 3v．peak－to－peak on the oscilloscope．Retouch $L 307$ and
L9 slightly，if necessary to produce the curve shown in
Figure 14 ． Do not
Connect the VHF Sweep，generator to the antenna terminals．
Keep the AGC bias at－ 3.0 volts and the $1-F$ bias at -5.0 Keep the AGC bias at－ 3.0 volts and the 1 －F bias at－ 5.0
volts．Couple the signal generator loosely to the grid of the
first picture I－F amplifier，Pin 1 of V106．Switch through all iirst picture $1 . \mathrm{F}$ amplifier，Pin oo vope Switch through all
VHF Channels and check for proper curve shape as in
Figure 13．Retouch T107 and T108 slightly to correct for any overal the is essentially the same on all channels． Disconnect the VHF sweep generator and connect the UHF
sweep generator to the antenna terminals．Check on all
UHF channels for proper wave shape，as shown in Fiqure 13 sweep generator to the antenna terminals．Check on all
UHF channels for proper wave shape，as shown in Figure 13 ，
retouching T107 and T108 if necessary to correct any over－ retouch
all till．
Remove the sweep and marker generators and the bias
supplies．
KRK29 TUNER ALIGNMENT
Models 17－S－350，17－S－351 \＆17－S－360
A tuner unit which is operative and requires only touch up
adjustments，requires no presetting of adjustments．For such units，skip the remainder of this paragraph．For units which are completely out of adjustment，preset C27 all the way out．
Set channel 7 to 13 oscillator slugs one turn from tight． Turn $T 2$ slug all the way out Do not change any of the
adjustments in the antenna matching unit adjustments in the antenna matching unit
Disconnect the link from termingls＂ A ＂and＂ B ＂of Tl 104
and terminate the link with a 39 ohm composition resistor Turn the receiver channel selector switch to channel 2. The 43.5 mc．trap is adjusted with zero bias．To insure that The 43.5 mc．trap is adjusted with zero bias．To insure that
the bias will remain constant，take o cliplead and short circuit
the AGC terminal of the tuner at the terminal board to ground Connect the oscilloscope to the test point TP2 on top of the
tuner unit．Set the oscilloscope to maximum gain．
Connect the output of the VHF signal generator to the output
of the antenna matching unit at the junction of L5 and C4
at the bottom of the FM trap L5

Tune the signal generator to 43.5 mc ．and modulate it
$30 c i c$ with a 400 cycle sine wave．Adjust the signal generator for maximum outpu
Adjust C33 on top of the tuner，for minimum 400 cycle
idication on the oscilloscope．If necessary this adjustment can be retouched in the field to provide additional rejection oo one specific frequency in the i．f band pass．However，in such cases，care should be taken not to tune C．
2 ，thereby reducing sensitivity on channel 2 ．
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery to the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case．Adjust the bias poten－ positive terminal to the tuner case．Adjust the bias poten－
tiometer to produce 3.0 volts of bias，as measured by the
＂Vion Voltohymst＂at the AGC terminal on the tuner．
Set he channel selector switch to channel 8 ．
Set the channel selector switch to channel 8
Preset C22 to read－ 3.0 volts at the test point TP1，as read are 2 volts minimum and not exceeding a maximum of
5.5 volts． 5.5 volts．

Turn the fine tuning control fully clockwise．
Adjust C25 for proper oscillator frequency， 227 mc．This
may be done in several ways．The easiest way and the way may be done in several ways．The easiest way and the way
which will be recommended in this procedure will be to use the signal generammer as a heterodyne frequency meter and
beat the oscillator against the signal generator．To do this， une the signal generator to 227 mc．weth crystal accuracy． Insert one end of a piece of insulated wire into the tuner
unit through the hole provided for the adjustment of C16．Be careful that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscillator to shift． Connect ihe other end of the wire to the＂r－f．in＂terminal of
the signal generator．Adjust C25 to obtain an audible beat ith the signal generator
Turn C27 clockwise until the beat note just begins to
change，then turn one full turn in the same clockwise direction． Return the fine tuning control to the mechanical center of Refurn NOTE：－II on some units，it is not possible to reach the
proper channel 8 oscillator frequency by adjustment of C25， witch to channel 13 and adjust 449 to obtain proper channel Then，switch to channel as indicated in the table on padust L60 to obtain proper channel 12 oscillator frequency．Continue down to channel 8 ， adjusing the appropriate oscillator trimmer to obtain the
proper frequency on each channel．Then again on channel 8 ，
adjust C 25 to obtain proper channel 8 oscillator frequency． adjust C25 to obtain proper channel 8 ogcillator frequency，
Switch back to channel 13 and readjust L49 and back to Switch back to channel 13
channel 8 and adjust C 25
Set the T2 core for maximum inductance（core turned
counter－clockwise）． Connect the sweep generator through a suitable attenuator， as shown in Figure 19 to the input terminals of the antenna $\underset{\substack{\text { Connect } \\ \text { terminals．} \\ \text { Set the }}}{\text { ．}}$
Set the sweep generator to cover channel 8 ．
Set the oscilloscope to maximum gain and use the minimum loscope．Excessive input can change oscillator injection during alignment and produce consequent misalignment even though
the response as seen on the oscilloscope may look normal． the response as seen on the oscilloscope may look normal．
Insert markers of channel 8 picture carrier and sound Insert markers of channel 8 pi
carrier， 181.25 mc ．and 185.75 mc ．
Adjust $\mathrm{C2L}, \mathrm{Cl6}, \mathrm{C1l} \mathrm{and} \mathrm{C7} \mathrm{for} \mathrm{approximately} \mathrm{correct}$
curve shape，frequency，and band width as shown in Figure 18 ． The correct adjustment of C7 is indicated by maximum am－
plitude of the curve midway between the markers．Cll tunes plitude of the curve midway between the markers．Cll tunes
the r－f amplifier plate circuit and affects the frequency of the
pass band most noticeably．C2l tunes the mixer grid circuit pass band most noticeably．C21 tunes the mixer grid circuit C7 has been properly adjusted）．C16 is the coupling adjust－
ment and hence primarily affects the response band width． Connect the＂VoltOhyyst＂，ot test point TPI．Adjust C22 to
read－3．0 volts dc on the＂Volto hmyst＂at TPl．Readjust
C27，C21，C16 and C1t for proper response．Ajuust C7 for maximum gain at midpoint of the curve．Repeat it necessary until the proper response is obtained．
Adjust the signal generator to the channel 13 oscillator
frequency 257 mc．

Turn the fine tuning control fully clockwise Adjust L49 to obtain an audible beat．Slightly overshoot
he adjustment of L49 by turning the slug an additional turn the adjustment of L49 by turning the slug an additional turn the oscillator to proper frequency by adjusting C 27 to again

Set the sweep generator to channel 13 ．
From the signal generator，insert channel 13 sound and picture carrier markers， 211.25 mc ．and 215.75 mc ．
Adjust L36 and L2O for proper response as shown in
Turn off the
Turn of the sweep and signal generators．
Connect the＂VoltOhmyst＂to the tuner test point TPI．
Check the oscillator injection voltage to be within limits as
previously specified．Adjust if necessary to bring within range． If it was necessary to readjust C22，turn the sweep and
signal generators back on and recheck the channel 13
response．Readjust $L 36$ and $L 20$ if necessary． esponse．Readjust L36 and L20 if necessary．
Set the receiver channel selector switch to channel 8 and
readjust C27 for proper oscillator frequency， 227 mc ． Set the sweep generator and signal generator to channel 8. Set the sweep generator and signal generator to channel 8.
Readjust C21，C16，C1l and C7 for correct curve shape， Readjust $\mathrm{C2l}, \mathrm{Cl6}$,Cll and C 7 for correct curve shape，
frequency and band width． Turn off the sweep and signal generators，switch back to
channel 13 and check the oscillator injection voltage at TP1 was adjusted in the recheck of channel 8 response． If the initial setting of the oscillator injection trimmer was
far ofí it may be necessary to adiust the oscillator frequency and response on channel 8，adjust the oscillator injection on channel 13 and repeat the tracking procedure several times before the proper setting is obtained．
Turn off the sweep generator and switch the receiver to
channel 6 ．
Adjust the signal generator to the channel 6 oscillator requency 129 mc．
Set the fine tuning control to the center of its mechanical ange．
Adjust L54 for an audible beat．Adjust L48 and L32 for lator injection voltage at TPL，to insure that it is within the mits specitied．Readjust C22 if necessary
II C22 required adjustment，switch the receiver and the signal generator to channel 8 ．Readjust C 21 for correct curve shape and recheck
frequency．
Check the response of channels 2 through 6 by switching the receiver channel switch，sweep generator and marker
generator to each of these channels and observing the esponse and oscillator injection voltage obtained．See Figure
8 for typical response curves．It should be found that all hese channels have the proper response with the markers有
If the markers fail to fall within this requirement readjust
$L 48$ and $L 32$ in order to obtain curves within the proper limits．
Switch the channel selector，signal generator and marker
generator through channels 7 to 13 and observe the response urves，referring to Figure 18 for proper wave shape．Check he injection voltage at each channel to be within limits．
if necessary readjust C 11 ， C 21 or C 16 to obtain the proper esponse．
With the receiver and signal generator on channel 13
adjust L49 for an audible beat with the signal generator． djust L49 for an audible beat with the signal generator． Adjust the oscillator to frequency on all channels by switch－
ing the receiver and the frequency standard to each channel and adjusting the appropriate oscillator slug to obtain the audible beat．It should be possible to adjust the oscillator to btain the audible beat on each channel．Recheck the oscii． lator injection voltage on each ch
voltage is within the specitied limits．

KRK29A／27 TUNER ALIGNMENT
Models 17．S－350U，17－S－351U \＆17－S．360U
VHF ALIGNMENT．－A tuner unit which is operative and requires only touch up adjustments，requires no pre－
setting oi adjustments．For such units，skip the remainder of
ment，preset C27 all the way out．Set channel 7 to 13 oscillator ment，preset C27 all the way out．Set channel 7 to 13 oscillator
slugs one turn from tight．Turn T2 slug all the way out．Do not chang
ing unit．
Disconnect the link from terminals＂$A$＂and＂ B ＂of Ti04
and terminate the link with a 39 ohm composition resistor． Tum ther a
The 43.5 mc．trap is adjusted with zero bias．To insure that the bias will remain constant，take a clip lead and short circuit
the $A G C$ terminal of the tuner at the terminal board to ground． Connect the oscilloscope to the test point TP2 on top of the
tuner unit．Set the oscilloscope to maximum gain． Connect the output of the VHF signal generator to the
output of the antenna mathing unit at the junction of L5 and C4 at the bottom of the FM trap L5．
Tune the signal generator to 43.5 mc．and modulate it
$30 \%$ with a 400 cycle sine wave．Adjust the signal generator $30 \%$ with a 400 cycle
for maximum output．
Adjust C33 on top of the tuner，for minimum 400 cycle
indication on the oscilloscope．If necessary，this adjustment can be retouched in the field to provide additional rejection one specific frequency in the if if band pass．However，in
uch cases，care should be taken not to tune C33 into channel such cases，care should be taken not to tune C．
2 ，thereby reducing sensitivity on channel 2 ．
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery o the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case．Adjust the bias potenti－

Set the channel selector switch to channel 8 ．
Preset C22 to read－ 3.0 volts at the test point TP1，as
read on the＂VoltOhmyst．＂The limits for oscillator injection voltage are 2 olts ninimum and not erceeding a maximum voltage are
of 5.5 volts．
Turn the fine tuning control fully clockwise．
Adjust C25 for proper oscillator frequency， 227 mc．This may be done in several ways．The easiest way and the way he signal generator as a heterodyne frequency meter and
beat the oscillator against the signal generator．To do this， beat the oscillator against the signal generator．To do this，
une the signal generator to 227 mc ．with crystal accuracy． Insert one end of a piece of insulated wirie into the tuner unit through the hole provided for the adjustment of C16．Be
careful that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscillator to shift． Connect the other end of the wirre to the＂r．f in＂terminal of
the signal generator．Adjust C25 to obtain an audible beat the signal generator．Adju
with the signal generator．
Turn C27 clockwise until the beat note just begins to
change，then turn one full turn in the same clockwise direction． Return the fine tuning control to the mechanical center of its range
NOTE：－II on some units，it is not possible to reach the proper channel 8 oscillator frequency by adjustment of C25，
switch to channel 13 and adjust L49 to obtain proper channel 13 oscillator frequency as indicated in the table on page 8 ． Then，switch to channel 12 and adjust $L 60$ to obtain proper channel 12 oscillator frequency．Continue down to channel 8 ， proper frequency on each channel．Then again on channel 8 ， adjust C25 to obtain proper channel 8 oscillator frequency． Switch back to channel 13
Set the T 2 core for maximum inductance（core turned Connect the sweep generator through a suitable attenuator，
as shown in Figure 19 to the input terminals of the antenna matching unit．
Connect the signal generator loosely to the antenna Set the
Set the sweep generator tc cover channel 8.
Set the oscilloscope to maximum gain and use the minimum
nput signal which will produce a usable pattern on the oscil－ input signal which will produce a usable pattern on the osci－
oscope．Excessive input can change oscillator injection during alignment and produce consequent misalignment even though
the response as seen on the oscilloscope may look normal．

Insert markers of channel 8 picture carrier and sound Adjust C21, C16, C11 and C7 for approximately correct The correct adjustment of $\mathrm{C7}$ is indicated by maximum am the $r$-t amplitier plate circuit and affects the trequency of the
 and offects the till ot the curve most noticeably (assuming thal
C7 has been properly adiusted). C16 is the coupling adjual C7 has been properly adiusted). C16 is the coupling adjust
ment and hence primarily offects the response band width.
 C22, C21, C16 and Cll for proper response. Adjust C7 tor
maximum gain at midpoint of the curve. Repeat if necessary maximum gain at midpoint of the cur
until the proper response is obtained.

Set the receiver channel switch to channel 13
Adjust the signal generator to the channel 13 oscillator
frequency 257 mc. requency 257 mc .
Adjust L49 to obtain an audible beat. Slightly overshoot the adjustment of L49 by turning the slug an additional turn in the same direction from the original setting, then reset
the oscillator to proper frequency by adjusting C 27 to again the oscillator to
obtain the beat.

Set the sweep generator to channel 13 .
From the signal generator, insert channel 13 sound and
picture carrier markers, 211.25 mc . and 215.75 mic.
Adjust L36 and L20 for proper response as shown in
Figure 18 .
Turn off the sweep and signal generators. Connect the "Voltohmyst" to the tuner test point TPl. Check the oscillator injection voltage to be within limits as
previously specified. Adjust if necessary to bring within range. If it was necessary to readjust C22, turn the sweep and
signal generators back on and recheck the channel 13 signal generators back on and recheck
response. Readjust L36 and L20 if necessary.
Set the receiver channel selector switch to channel 8 and readjust C 27 for proper oscillator frequency, 227 mc .
Set the sweep generator and signal generator to channel 8
Readjust $\mathrm{C} 21 \mathrm{Cl6,C11}$ and C 7 for Readjust C21, C16, C11 and C7 for correct curve shape
frequency and band width.
Turn off the sweep and signal generators, switch back to
channel 13 and check the oscillator injection voltage at TPl channel 13 and check the oscillator injection voltage at TP1 If the initial setting of the oscillator injection trimmer was
far off, it may be necessary to adjust the oscillator frequency and response on channel 8, adjust the oscillator injection on channel 13 and repeat the tracking procedure several times
before the proper setting is obtained before the proper setting is obtained
channel 6 .
Adjust the signal generator to the channel 6 oscillato trequency 129 mc.
Set the fine tuning
control to the center of its mechanical range. A . L for an audible beat. Adjust L48 and L32 for
proper curve shape as shown in Figure 18 . Recheck the oscil. proper curve shape as shown in Figure 18 . Recheck the osci-
lator injection voltage at TPI, to insure that it is within the limits specified. Readjust C22 if necessary
If C22 required adjustment, switch the receiver and the shape and recheck C27 and C25 for proper oscillato frequency.
Check the response of channels 2 through 6 by switching the receiver channel switch, sweep generator and marke rensonse and oscillator injection voltage abtained. See Figure
18 for typical response curves. It should be found that all 18 lor typical response curves. It should be found that all
these channels have the proper response with the markers these channels have
above $80 \%$ response.
If the markers fail to fall within this requirement readjust
L 48 and L 22 in order to obtain curves within the proper limits.
Switch the channel selector, signal generator and marke generator through channels 7 to 13 and observe the response the injection voltage at each channel to be within limits. if necessary readjust $\mathrm{C} 11, \mathrm{C} 21$ or C 16 to obtain the prope

With the receiver and signal generator ALIGNMENT PROCEDURE
With the receiver and signal generator on channel 13
adjust L49 for an audible beat with the signal generator Adjust the oscillator to frequency on all channels by switch-
ing the receiver and the frequency standard to each channel and adjusting the appropriate oscillator slug to obtain the audible beat. It should be possible to adjust the oscillator to obtor injection voltage on each channel tocheck the orciis within the specified limits.
UHF ALIGNMENT.-Ground the I.F transtormer by inser ing a clip lead through the aperture provided in the top
of the tuner. Ground the other end of the clip lead to the of the tuner
tuner case.
Connect the oscilloscope to the test point TP301, using the
preamplitier if needed with the oscilloscope used.
Connect the output of the UHF sweep generator, through
a 300 ohm attenuator pad, to the antenna terminals and set the sweep generator to sweep channel 83 , centered on
887.5 mc . Adjust the output of the sweep generator to full sweep width.
A test dial made to fit over the split gear on the tuner shaft is necessary for accurate alignment. Scribe marks a
$0^{\circ}, 9^{\circ}$ and $168^{\circ}$ should be marked on the test dial. The 0 reference point is located with the capacitor plates fully meshed. By placing a $1 / h^{\prime \prime}$ shim between the stop pin on the
tuner and the stop plate on the gear assembly the plates will tuner and he stop plate on the gear a
be in the proper fully meshed position.
Rotate the tuning dial to the $168^{\circ}$, channel 83 , position Connect the VHF signal generator in series with a 1000
ohm resistor to the rear terminal of the crystal holder and ohm resistor to the rear terminal of the crystal hold
insert markers for 41.25 mc ., 43.5 mc . and 45.75 mc .
Connect the UHF marker generator loosely to the antenna Connect the UHF marker generator loosel
terminals and insert a marker at 887.5 mc .
Adjust trimmer capacitors C315 and C316 for a maximum
amplitude overcoupled response curve centered at 887.5 mc. as shown in Figure $11(\mathrm{~A})$.

Adjust the oscillator trimmer capacitor C 307 until the 43.5 me. marker coincides with the marker at 887.5 mc . The
markers for 41.25 and 45.75 should be symmetrically located markers for 41.25 and 45.15 should be symmetrica)
on the top of the response curve as in Figure $11(A)$.
Set the UHF sweep and marker generators to 473.5 mc
Rotate the tuning dial to the $9^{\circ}$, channel 14 , position.
Rotate the tuning dial to the $9^{\circ}$, channel 14, position.
Adjust L1 and L2 for a maximum amplitude overcoupled
curve centered at 473.5 mc. as shown in Figure $11(\mathrm{~B})$. Adjust the oscillator trimmer C308 until the 43.5 me. marker coin
cides with the 473.5 mc. marker, with the 41.25 and 45.75 markers as shown
Repeat the above adjustments, as necessary, until the proper responses are obtained. Tune through the entire range
and check the tracking. When perfectly tracked the thre markers will be on the top of the response curves, howeve
mistracking to the extent that the 41.25 mc . and 45.75 mc mistracking to the extent that the 41.25 mc . and 45.75 mc
ride down the sides of the curves to a point not less tha $700 ;$ will not seriously alfect the alignment. Should th markers fall below this level, it will be necessary to knit
the RF plates to correct the mistracking. The plates may b the RF plates to correct the mistracking. The plates may be
knited through the two holes provided on the left side of the tuner. Always knite the plates while tuning lower in frequenc to prevent aflecting the tracking above the point of kniting
Check which section requires knifing by touching the plate with the knifing tool while observing the response, then
proceed with the knifing of the proper section or of both proceed with the kk.
sections if required.
Connect the "VoltOhmyst" to test point TP301. Set the
"VoltOhmyst" to the 1.5 v . DC scale. Tune over the entire range observing the reading on the meter. A reading betwiee limits are an indication be obtained. Voltages outside thes limits are an indication of low +B voltage, low or high crysta
impedance or an oscillator tube outside allowable limits Connect the "VoltOhmyst" to the "bias" terminal of the
tuner (refer to Figure 9). A reading between 0.5 and 2.5 volts should be obtained. Readings above or below this rang
will cause crystal currents outside allowable limits and in such cases crystal cuscillatorts tube should be replaced. Replace ment of the oscillator tube will require recalibration at the high
and low trequency ends of the band as previously outlined.
RATIO DETECTOR ALIGNMENT.-Set the signal generator at 4.5 mc. and connect it to the first sound i -
grid, pin 1 of Viol.

WR an alternate source of signal, the RCA WR39B o the calibrator to the grid of the third puch a case, conne amplifiex, pin 1 of V108
Set the frequency of the calibrator to 45.75 mc . (pix
carrier) and modulate with 4.5 mc crystal. The 4.5 mc . carrier) and modulate with 4.5 mc . crystal. The 4.5 mc. signal will be pick
sound i-f amplifier.
Connect the "VoltOhmyst" to pin 2 of V103
Tune the ratio detector primary, Tl 102 top core for maximum d.c output on the "Voltohmysi". Adjust the signal level from
the signal generator for 6 volts on the "VoltOhmyst" whe finally peaked. This is approximately the operating level signals.
Connect the "VoltOhmyst" to the junction of R106 and C108 Tune the ratio detector secondary T102 bottom core for zero


Repeat adjustments of $\mathrm{TlO2}$ top for maximum d-c at pin 2
of V103 and TT102 bottom for zero d-c at the junction of R106 and Clos. Make the final adjustments with the signal inpu level adjusted to
at pin 2 of V103.
SOUND I-F ALIGNMENT.-Connect the signal genera
tor to the first sound i.f amplifier grid, pin 1 of VIol. As an alternate source of signal, the RCA WR39B or
WR39C calibrator may be employed as above.

Connect the "VoltOhmyst" to pin 2 of V103.
Tune the T1Ol top core for maximum d-c on the "Volt
The output from the signal generator should be set to
produce approximately 6.0 volts on the "VoltOhmyst" when produce approximately 6.0 volts on the "voltohmyst", when
the tinal touches on the above adjustment are made.
4.5 MC. TRAP ADJUSTMENT.-Connect the signal generator in series with a 1,000 ohm resistor to pin 2 of V109.
Set the generator to 4.5 mc. and modulate it 30 , with 400 ycles. Set the output to approximately 0.5 volts.
Short the third pix i.f grid to ground, pin 1, V108, to prevent
noise from masking the output indication. Connect the crystal diode probe of an oscilloscope to the
late of the video amplifier, pin 6 of Vllo. plate of the video amplifier, pin 6 of V110. Adjust
loscope.
Remove the short from pin 1, V108 to ground.
As an alternate method, this step may be omitted at this point in the alignment procedure and the
"on the air" after alignment is completed.
If this is done, tune in a station and observe the picture on he kinescope. II no 4.5 mc . beat is present in the picture, when the fine tuning control is set for proper oscillator-frequency,
then L105 requires no adjustment. If a 4.5 mc . beat is present, hen L1O5 requires no adjustment. If a 4.5 mc. beat is presen turn the fine tuning control slightly clockwise so as to e
AGC CONTROL ADJUSTMENT. - Disconnect all test equipment except
to pin 6 of Vllo.
Connect an antenna to the receiver antenna terminal
Turn the AGC control fully counter-clockwise
Tune in a strong signal and adjust the oscilloscope to see
Turn the AGC control clockwise until the tips of sync begin obe compressed, then counter-clockwise until no compression

HORIZONTAL OSCILLATOR ADJUSTMENT.-Nor mally the adjustment of the horizontal oscillator is not conoscillator waveform adjustment may require the use of an
oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the eceiver is adigned or whenever the horizontal oscillator

Horizontal Frequency Adjustment. - Tune in a station
and sync the picture. It the picture and sync the picture. If the picture can not be synchronize
with the horizontal hold control R200, then adjust the Tll frequency core on the rear apron until the picture wil synchronize. If the picture still will not sync, turn the Tll wavelorm adjustment core (under the chassis) out of the coil
several turns from its original position and readjust the Tll several turns from its original position and read.
frequency core until the picture is synchronized.
Examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive
conitrol Cli74, the width control L109 and the linearity control
Lill until the picture is correct.

Horizontal Oscillator Waveform Adjustment.-The two methods. The method outlined in paragraph A below be employed in the field when an oscilloscope is not available. The service shop method outlined in paragraph B below requires the use of an oscilloscop
A.- Turn the horizontal hold control completely clockwise
Place adjustment tools on both cores of Tll4 and be prepared Place adjustment tools on both cores of Tll4 and be prepared
to make simultaneous adjustments while watching the pictur on the screen. First, turn the T114 frequency core (on the rea apron) until the picture falls out of sync and three or fou diagonal black bars sloping down to the right appear on the
screen. Then, turn the waveform adjustment core (under the screen. Then, turn the waveiorm adjustment core (under the
chassis) into the coil while at the same time adjusting the frequency core so as to maintain three or four diagonal
black bars on the screen. Continue this procedure until the oscillator begins to motorboat, then turn the waveform adjusi ment core oout until the motorbooting just stops. As a check turn the Tll4 frequency core until the picture is synchronized
then reverse the direction of rotation of the core until the then reverse the direction of rotation of the core until th
picture falls out of sync with the diagonal bars sloping dow to the right. Continue to turn the frequency core in the. sam direction. No more than three or four bars should appear on
the screen. Instead, the horizontal oscillator should begin to motorboat. Retouch the adjustment of the Tllu wavelorm
adjustment core if necessary until this condition is obtained.
B.- Connect the low capacity probe of an oscilloscope to
terminal C of T114. Turn the horizontal hold control one B.- Connect C of Tl14. Turn the horizontal hold control one
quarter turn from the clockwise position so that the picture i quarter turn from the clockwise position so that the picture in
in sync. The pattern on the oscilloscope should be as shown
 until the two peaks are at the same height. During this
adjustment the picture must be kept in sync by readjusting adjustment, the picture must
the hold control if necessary.
This adjustment is very important for correct operation o
the circuit. If the broad peak of the wave on the oscillosco is circerut than the sharp peak, the noise immunity become pooier, the stabilizing effect of the tuned circuit is reduce and dritt of the oscillatar is higeorer more than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inade quale and the broad peak can cause double triggering
of the oscillator when the hold control approaches the of the oscillatior
clockwise position.
Remove the oscilloscope upon completion of this adjustment. Horizontal Locking Range Adjustment.-Set the hori Momentarily remove the signal by switching off channel then back. The picture may remain in sync. If so turn the TIl
frequency core slightly and momentarily switch off channel frequency core slightly and momentarily switch of channel
Repeat until the picture falls out of sync with the diagonal Repeat until the picture talls out or sync with the diagonal
lines sloping down to the left. Slowly turn the horizontal hold
control clockwise and note the least number of diagonal control clockwise and note the least number of d
bars obtained just before the picture pulls into sync.
If more than 3 bars are present just before the picture pulls silighty, clockwise. If less than 2 bars are present, adjust
C174A slightly counter-clockwise. Turn the horizontal hold Cl74A slightly counter-clockwise. Turn the horizontal hold
control
counter-clockwise, momentarily
remove the signal and recheck the number of bars present at the pull
Repeat this procedure until 2 or 3 bars are present.
Turn the horizontal hold control to the maximum clockwise bar sloping down to the right appears on the screen and then reverse the direction of adjustment so that bar just moves to the
left side of the screen leaving the picture in synchronization.

ALIGNMENT DATA


Figure 16-KRK29 Tuner Adjustments


Figure 17-KRK29 R-F Oscillator Adjustments


Figure 18-KRK29 or KRK29A R-F Response


Figure 19-Sweep Attenuator Pads


$$
\begin{gathered}
\text { Figure 23- } \\
\text { KRK29 } \\
\text { T2 and T104 } \\
\text { Response }
\end{gathered}
$$

Figure 25-Horizontal Oscillator Wave Forms




| VOLTAGE CHART |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ${ }_{\substack{\text { Tube } \\ \text { No. }}}$ | $\underbrace{\text { cen }}_{\substack{\text { Tube } \\ \text { Type }}}$ | Function | Operating | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements | $\begin{gathered} \substack{\text { stock } \\ \text { No. }} \end{gathered}$ | description | ${ }_{\substack{\text { stock } \\ \text { No. }}}^{\text {a }}$ | descriptio |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | Pin No. | Volts | $\begin{array}{\|l\|l\|} \hline \text { Pin } \\ \text { No. } \end{array}$ | Volts |  | $\begin{aligned} & 7839 \\ & \hline \end{aligned}$ |  |  | Shaft-Fine tuning shaft and cam Shiald-Front shiold Shield-Tube shield <br> chield-"U" shape hield for under-side of uni |
| vilo | 6CL6 | Video <br> Amplifier | $\underset{\text { Signal }}{1500 \mathrm{Mu} .}$ | 6 | 82 | 3.8 | 180 | 1 | 1.1 | 2.9 | -3.4 | AGC control set for normal operation |  |  Capacitor-Adjumatale, mica:- |  |  |
|  |  |  | $\mathrm{S}_{\substack{\mathrm{No} \\ \text { Signal }}}^{\text {cher }}$ | 6 | 73 | 3.8 | 99 | 1 | 0.9 | 2.9 | -0.4 |  | $\begin{aligned} & 77816 \\ & 77151 \end{aligned}$ | (C33 <br>  | 78272 |  |
| viliA | 12AUY | AGC Amplifier | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | 1 | 42 | - | - | 3 | 148 | 2 | 115 |  | $\begin{aligned} & 78813 \\ & 76532 \\ & 77084 \end{aligned}$ |  <br> $0.8-3.0 \mathrm{mmf}$. (C22) <br> 1.4 mmi. (C7) | $\begin{aligned} & 77911 \\ & 78398 \\ & 78274 \end{aligned}$ |  |
|  |  |  | $\mathrm{Signal}_{\text {So }}^{\text {No }}$ | 1 | 0 | - | - | 3 | 125 | 2 | 82 |  |  | Capacitor-Conic:- <br> Capacitor-Fixed, ceramic, non-insulated, Temp. coof. $=0$ |  |  <br>  |
| vill | 12AU7 | Hor. Sync Separator | $\underset{\text { Signal }}{15000 \mathrm{Mu} . \mathrm{V} .}$ | 6 | 267 | - | - | 8 | 171 | 7 | 101 |  | $\begin{aligned} & 77293 \\ & 77252 \\ & 73960 \\ & 75437 \\ & 78276 \\ & 75199 \end{aligned}$ |  |  |  |
|  |  |  |  | 6 | 259 | - | - | 8 | 118 | 7 | 85 |  |  |  |  |  |
| V112A | 6SN7GT | $\begin{aligned} & \text { Sync } \\ & \text { Output } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu} . \\ \text { Signal }}}{ }$ | 2 | 60 | - | - | 3 | 0 | 2 | -2.7 |  | $\begin{aligned} & 75199 \\ & 93096 \\ & 94207 \\ & 70935 \\ & 76739 \end{aligned}$ |  |  | Trap-IF trap ( 41.25 mc ) complete with core (LI) Trap-IF trap ( 4.75 mc ) complete with core (L4) Washer-Insulating washer (neoprene) for capacitor <br> RF UNIT ASSEMBLIES KRK29a |
|  |  |  | $\mathrm{S}_{\text {Signal }}^{\text {No }}$ | 2 | 58 | - | - | 3 | 0 | 2 | -2.1 |  |  |  | 78853 |  |
| v112B | 6SN7GT | $\begin{aligned} & \text { Vertical } \\ & \text { Oscillator } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} \mathrm{~V} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 76 | - | - | 6 | 0 | 7 | -16 | Depends on setting of Vert. hold control | 71504 71502 71503 |  |  | Board-Terminal board-6 contact <br> Bracket-Side bracket for mounting coil and statore <br> Cam-Actuating cam for antenna slide awitch |
|  |  |  | $\xrightarrow[\substack{\text { So } \\ \text { Signal }}]{\text { chem }}$ | 5 | 75 | - | - | 6 | 0 | 7 | -15 | Voltages shown are synced pix adjustment | come | $2.2 \mathrm{mmf} ., \pm 20 \%$. 500 volts (C31) <br> Capacitor-Mica trimmer:- 80.150 mmf . (Cl6) <br> - | $\begin{aligned} & 78417 \\ & 77816 \end{aligned}$ | Capacitor-Adjustable, mica:- 4.40 mmf (C33) <br> Capacitor-Adjuetable, steatite:- |
| v113 | 6K6GT | $\begin{aligned} & \text { Vertical } \\ & \text { Output } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 260 | 4 | 270 | 8 | 15.9 | 5 | -11 |  | ( | Coil-Antenna matching coil (Part of Tl) Coil-Channel \# 6 miser coil (La8) Coil-Chaniel \# 6 r.t. plate coil (L32) | $\begin{aligned} & 772515 \\ & 776532 \end{aligned}$ | $0.8-3.0 \mathrm{mmf}$ ( $\mathrm{Cl1}, \mathrm{C} 21, \mathrm{C} 25$ ) $.8-3.0 \mathrm{mmf}$. 1.4 mmf . (C7) |
|  |  |  | Sino $\begin{gathered}\text { No } \\ \text { Signal }\end{gathered}$ | 3 | 250 | 4 | 260 | 8 | 15.5 | 5 | -10 |  | ( 77919 |  | $\begin{aligned} & 77853 \\ & 77084 \end{aligned}$ | Capacitor-Coramic:-Food-thru, 1000 mmf (C5, C15, C17, C18, C19) Copacitor-Fixed coramic High "K" ditc:- |
| V114A | 6SN7GT | Horizontal Osc. Control | $\begin{gathered} 15000 \mathrm{Mu} \mathrm{~V} . \\ \text { Signal } \\ \hline \end{gathered}$ | 2 | 172 | - | - | 3 | -2.2 | 1 | -25 |  | $\begin{aligned} & 78224 \\ & 77206 \\ & 76763 \end{aligned}$ |  |  | $470 \mathrm{mmf}, \mathrm{t} \mathbf{1 0 0 \%},-0 \%, 500$ volte (C29, C34, C35, C51) $1000 \mathrm{mmf}+100 \%,-0 \%, 500$ volte (C8, C9, C14, C20) $10,000 \mathrm{mmf} ., \pm 100 \%,-0 \%, 500$ volte (C28) |
|  |  |  | $\mathrm{Signal}_{\text {No }}^{\text {Nor }}$ | 2 | 160 | - | - | 3 | 1.5 | 1 | -16 |  | (76831 |  | (1837 |  |
| V114B | 6SN7GT | $\begin{aligned} & \text { Horizontal } \\ & \text { Oscillator } \end{aligned}$ | $\begin{aligned} & 15000 \mathrm{Mu} \mathrm{~V} . \\ & \text { Signal } \end{aligned}$ | 5 | 180 | - | - | 6 | 0 | 4 | -74 |  |  |  |  |  |
|  |  |  | $\xrightarrow{\text { Signal }}$ | 5 | 178 | - | - | 6 | 0 | 4 | -66 |  |  | Connector-Single contact female connector for UHF connec- tion (J2) Connector-4 contact female connector-part of antenna match- ing transormer (J1) |  |  |
| v115 | 6BQ6GT | $\begin{aligned} & \text { Horizontal } \\ & \text { Output } \end{aligned}$ | $\underset{\text { Signal }}{15000 \mathrm{Mu} . \mathrm{V} .}$ | Cap | * | 4 | 180 | 8 | 18 | 5 | -17.5 | *High Voltage <br> Pulse Presen | $\begin{aligned} & 76460 \\ & 77852 \\ & 76543 \\ & 77916 \end{aligned}$ | Connector-4 contact iemale ing transformer (Jl) Contact-Test point contect <br> Core-Adjuatable core for fine tuning capacitor | 78847 | $10 \mathrm{mmf} ., \pm 10 \%$, 500 volthen (C24) <br>  |
|  |  |  | $\begin{gathered} \text { Noo } \\ \text { Signal } \end{gathered}$ | Cap | * | 4 | 175 | 8 | 17.5 | 5 | -17 | *High Voltage Pulse Present | $\begin{aligned} & 779164 \\ & 78291 \\ & 7829 \end{aligned}$ | Core- $1 / 4-20 \times 1 / 2^{\prime \prime}$ adjusting core for L48 Cort- 3 . $32 \times 2764$ adjustable core for <br> Detent-Detent mechanism and Ebre shaft | (71502 |  |
| v116 | $\begin{gathered} 183 G T \\ 8016 \end{gathered}$ | $\begin{aligned} & \text { H. V. } \\ & \text { Rectifier } \end{aligned}$ | $\underset{\text { Signal }}{15000 \mathrm{Mu} .}$ | Cap | * | - | - | 2\& 7 | 14,000 | - | - | *High Voltage Pulse Present | $\begin{aligned} & 77917 \\ & 77812 \\ & 787270 \\ & 78720 \\ & 78820 \end{aligned}$ | Form-Channel \#13 coil form complete with core Guide-Bakelite guide for fine tuning lever <br> Lever-Fine tuning lever | ( |  |
|  |  |  | $\mathrm{Signal}_{\substack{\text { No }}}^{\text {Sin }}$ | Cap | * | - | - | $2 \& 7$ | 13,000 | - | - | *High Voltage Pulse Present | $\begin{aligned} & \text { revr2a } \\ & 78234 \end{aligned}$ |  |  |  |
| v117 | 6W4GT | Damper | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 270 | - | - | 3 | * | - | - | *High Voltage Pulse Present |  |  |  | Coil-Filament choke coil (L33) <br> Coil-I F input coil complete with adjuetable core (IS) |
|  |  |  | $\begin{gathered} \text { No } \\ \text { Signal } \end{gathered}$ | 5 | 260 | - | - | 3 | * | - | - | *High Voltage Pulse Presen | (case | 1000 ohms. $\pm 10 \%, 1 / 2$ watt (R6, R20) 3300 ohms. $\pm 10 \%, 1 / 2$ watt (R9) <br> 6800 ohms, $+10 \%, 1 / 2$ watt (R1) |  | Coil-I.F input coil complete with adjustable core (L8) Coil-RF ampliter coupling coil (L?7) |
| v118 | $\begin{array}{\|r\|} \hline 17 \mathrm{CP4} \\ \text { or 17QP4 } \end{array}$ | Kinescope | $\begin{gathered} 15000 \mathrm{Mu} \cdot \mathrm{~V} . \\ \text { Signal } \end{gathered}$ | Cap | 14,000 | 10 | 430 | 11 | 120 | 2 | 78 | At average Brightness |  | $12,000 \mathrm{ohms}, \pm 10 \%, 2$ watt ( $R 13$ ) <br> 15,000 ohms, $\pm 10 \%, 2$ watte (R7) <br> 100,000 ohms, $\pm 10 \%$, $1 / 2$ watt (R3, R10, R11, R12) <br> 1 megohm, $\pm 10 \%, 1 / 2$ watt (R4, R5) |  |  |
|  |  |  | Signal | Cap | 13,000 | 10 | 415 | 11 | 100 | 2 | 58 | At average Brightness |  |  <br>  <br>  |  |  |
| $\begin{aligned} & \mathrm{V} 19 \\ & \mathrm{~V} 120 \end{aligned}$ | ${ }_{5 \times 3 \mathrm{GT}}^{5 \mathrm{U}} \mathbf{4}$ | Rectifiers | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | $4 ¢ 6$ | - | - | - | $2 \& 8$ | 285 | - | - |  |  |  |  |  |
|  |  |  | Signal $\begin{gathered}\text { No } \\ \text { Sin }\end{gathered}$ | $4 ¢ 6$ | - | - | - | 2\& 8 | 274 | - | - |  |  |  | $\text { 77ess }{ }_{7}^{2 s+3}$ |  |


| $\begin{gathered} \text { sTock } \\ \text { No. } \end{gathered}$ | description |
| :---: | :---: |
| 503015 |  |
| 503039 | 39 ohms. $\pm 100.11 / 2$ watt (R18) |
| ${ }_{5}^{503112}$ | 120 ohms. $\pm 10 \%$ \% $1 / 2 \mathrm{watt}$ (R2) |
| ${ }^{503147}$ | 470 ohme, $\pm 10 \% .1 / 2$ watt (R14. R54) |
| 503210 | 1000 ohms, $\pm 10 \%$, $1 / 2$ watt (R6, R20) |
| 503233 | 3300 ohms, $\pm 10 \%, 1 / 2$ watt (R9) |
| ${ }_{503268}$ | 6800 ohma, $\pm 10 \%$, 1/2 wott (R1) |
| 523312 | 12.000 ohms. $\pm 10 \% .2$ watta (R13) |
| 523315 523322 |  |
| 523322 |  |
| 503327 503410 | (enter |
| 503510 | $1 \mathrm{mogohm}, \pm 10 \%, 1 / 2$ watt (R4, R5) |
| 78396 | Transformor-Antenna matching transform |
| 78399 76540 | Traneformor-Convortor traniformor (T2, R8) Trap-FM trap comploto with adjustable coro (LS) |
| 76840 78468 | Trap-FM trap comploto with adjustable coro (L) Trap-l.F. Trap (L6) |
| ${ }_{76542} 7848$ |  |
| 76541 | Trap-1.F. trap (48.75 mc) comploto with coro (L4) |
| 78426 | Washor-"C" washer for clutch mechaniem |
| 75190 | Woahor-Insulating washor (nooprono) for capacit |
| 78424 | Washer-Rotaining washer for knob shaft epring |
| 78425 | Waher-Spring wawher for clutch mechaniem <br> RF UNIT ASSEMBLIES KRK27 |
| 78259 |  |
| 77084 |  |
| 78262 |  |
| 782 | $22 \mathrm{mmi}. \pm 5 \%$, 500 volts DC (C5) |
| 705 | $33 \mathrm{mmf}. \pm 5 \%$, 500 volts DC (C9) |
| 78263 |  |
| 78137 |  |
| 78260 | $0.62 \mathrm{mmf}$. . $10 \%$. 500 volts DC (C4) |
| 71502 | $2.2 \mathrm{mmf}. \pm 10 \%$, 500 volte DC (C14) |
| 78257 | Capacitor-Variable tuning capacitor (C1A, C1B, C1C, CID. |
| ${ }_{78258}^{78258}$ | Coil-L.F. coill comploto with adjustable core (LT) |
| ${ }_{78264}^{789}$ | Coill-Poaking coil (L3, R1) |
| ${ }^{72818}$ | Coil-Poaking coil ${ }^{(20 \mathrm{muh})(\mathrm{L} 4)}$ ) |
| 78267 | Coil-RF choke coill (0.15 muh) (L10, L11) |
| 77279 | Coil-RF chohe coil (0.33 muh) (Le, L9) |
| 78269 | Connector-Single contact male connoctor for 1.F. output cabib |
| 788255 | Connoctor-2 contact fomale connoctor for UHF antenna (1) |
| 78256 | Holdor-Crystal holder |
| 77489 | Roctififor-Cryetal rectilor IN82 (CR1) |
| 503110 |  |
| 503215 | 1500 oh ms. $\pm 10 \%$. $1 / 2$ watt (R3) |
| 503222 | 2200 ohms, $\pm 10 \%$, $1 / 2$ watt (R5) |
| 503268 | 6800 oh ms. $\pm 10 \% .1 / 2$ watt (R4) |
| 78268 | Transformer-Antonna input traneformor (T1) |
|  | chassis assemblies <br> KCS 78F-VHF Chassis KCS $78 \mathrm{H}-\mathrm{UHF} / \mathrm{VHF}$ Chansis |
|  | Board-Antonna torminal board for KCS78H |
| 76490 | Brackot-Mounting brackot complote with insulator for picture control |
| 76461 |  |
| 77293 |  |
| 77672 | $\xrightarrow{\text { C131, C133, C196) }}$ |
| 77252 | $1000 \mathrm{mmf} \pm. \pm 100 \%$. $-0 \%$, 500 volt DC (CC133) |
| 73960 | 10.000 mmf.. $\pm 100 \%$. $-0 \%$. 500 volts DC (C104, C134, C194) |
| 76991 | Dual $10.000 \mathrm{mmf}. \pm 100 \%$. $-0 \%$. 500 volte DC (C101A, C101B) |
| ${ }^{77673}$ |  |
| ${ }^{33098}$ |  |
| 33380 | $12 \mathrm{mmf} .. \pm 10 \%$. 500 volte DC (C175) |
| 39044 | 15 mmi.. $\pm 10 \%$. 500 volte DC (C141) |
| 73664 | $39 \mathrm{mmf}. \pm 10 \%$. 500 voltu DC (C140) |
| 76475 |  |
| 76474 | 82 mmf., 1000 volto DC (C153) |
| 39636 | 220 mmin . 5000 voltu DC (C154) |
| 39638 | ${ }^{270} \mathrm{mmm}$ f., 500 voltu DC (C139) |
| (76579 | 270 mmf., 1000 voltu DC (C149, C191) |
| ${ }_{76476}$ | $330 \mathrm{mmff}$.1000 volts (C182) |


| $\begin{aligned} & \text { stock } \\ & \text { No. } \end{aligned}$ | description |
| :---: | :---: |
| 503239 | \| 3900 ohms, $\pm 10 \% .1 / 2 \mathrm{watt}$ (R202) |
| 502247 | 4700 ohms, $\pm 5 \% .1 / 2$ watt (R188) |
| ${ }^{5132288}$ | ${ }^{6890}$ ohms. $\pm 10 \%$, 1 watt (R150) |
| 523268 | 6800 oh ms. $\pm 10 \% .2$ wath (R211) |
| 503282 | $8200 \mathrm{oh} \mathrm{ms}, \pm 108.1 / 2$ watt (R159. R169. R180, R183) |
| 523282 | 8200 ohmm, $\pm 10 \% .2$ watt (R140) |
| 502310 | $10,000 \mathrm{ohms} . \pm 5 \%$ \% $1 / 2 \mathrm{watt}$ (R107, R108) |
| 5.3310 | 10.000 ohms, $\pm 10 \% .1$ watt (R217) |
| 503312 | 12,000 oh ms. $\pm 10 \%$. $1 / 2$ watt (R111) |
| 503315 | 15,000 oh ms. $\pm 10 \% .1 / 2$ watt (R189) |
|  | 18,000 ohms. $\pm 10 \%$. $1 / 2$ watt (R157, R172, R21) |
| 232. | 22.000 ohms. $\pm 10 \% .1 / 2$ watt (R162. R166, R171, R201) |
| 503339 | 39,000 ohma. $\pm 10 \%$, 1/2 watt (R106) |
| ${ }_{50347}^{7039}$ | 43,000 ohms. 5 5\%, $1 / 1 /$ watt (R147) |
| 503347 | 47,000 ohms. $\pm 10 \%$, $1 / 2$ watt (R136, R149, R165) |
| ${ }_{5} 512347$ | 47.000 oh mas. $\pm 5 \% .1$ watt (R206) |
| 502356 | $56.000 \mathrm{ohms}. \pm 58.1 / 2$ watt (R129, R1 |
| 5033 | 56,000 ohms, $\pm 10 \%$. $1 / 2$ watt (R212) |
| 5123 | 56,000 oh ms $\pm 5 \% .1$ watt (R182) |
| 5033 | 68,000 ohms, $\pm 10 \%$. $1 / 2$ watt (R151, |
| 503382 | ${ }^{82,000 ~ o h m s, ~} \pm 1050.1 / 2$ watt (R198) |
| 513410 | 100,000 oh hs. $\pm$ 109. 1 watt (R179, R219) |
| 503412 | 120,000 ohms, $\pm 10 \%$ \% $1 / 2$ watt (R158) |
| 502415 | 1500000 ohms. $\pm 5 \%, 1 / 1 / 2$ watt (R148) |
| 503415 | 150.000 ohms. $\pm$ 10\% $1 / 1 / 2$ watt (R178, R191. R18) |
| 512415 | 150.000 oh me. $\pm 5 \% .1$ watt (R203) |
| 502418 | 180.000 ohma, $\pm 5 \% .1 / 2$ watt (R125) |
| 503422 | $220.000 \mathrm{ohms}, \pm 10 \%$, $1 / 2$ watt (R190, |
| 502427 | 270.000 ohms. $\pm 5 \%, 1 / 2$ watt (R181) |
| ${ }_{5}^{503427}$ | 270.000 ohms. $\pm$ 10\%. $1 / 2$ watt (R163, R177) |
| ${ }_{5}^{503433}$ | 330,000 ohms. $\pm 10 \% .1 / 2$ watt (R12. R195, R197) |
| ¢03349 |  |
| ${ }_{503688}^{50347}$ | 680,000 ohme. $\pm 10 \%$ \% $1 / 2$ wott (R100, R167) |
| 503482 | 820.000 ohms. $\pm 10 \%$, $1 / 2$ watt (R196, R207) |
| 503510 | $1 \mathrm{magohm} . \pm 10 \%$. $1 / 2 \mathrm{watt}$ (R161) |
| 502511 | 1.1 mesohm, $\pm$ 5\%. $1 / 2$ watt (R185) |
| ${ }_{5}^{503312}$ | 1.2 megohm, $\pm$ 10\% $1 / 1 /$ watt (R184) |
| 503515 | 1.5 mogohm. $+10 \%$, $1 / 2$ watt (R173) |
| 11769 | 1.8 mosoh m, .5 5\%, $1 / 2$ watt (R124. R205) |
| 503522 | 2.2 megohm, $\pm$ 10\%\% $1 / 2$ watt (R164. R170) |
| 5033 | 3.9 megohm, $\pm 10 \%$ \% $1 / 2 \mathrm{watt}$ (R137, R152) |
| 503610 | $10 \mathrm{megohm}, \pm 10 \%, 1 / 2$ watt (R109) |
| 76795 | Transformer-Hi-voltage transformer (T115) |
| 76440 | Traneformer-Horizontal oscillator transformor comploto with |
| 76982 | Traniformer-Output transformor (T103) |
| 777112 |  |
| 76981 |  |
| 77636 | Traneformor-Vertical output tranoformer (T1 |
| 77637 |  |
| 7763 | Tranoformer-2nd pix I.F. transformer completo with adjustable core (T106) |
| ${ }^{76433}$ | Trannformer-3rd or 4th pix 1.F. transformer (T107, T108) |
| 76933 <br> 77585 | Trap-4.5 MC trap (L105, C137) Washor-"C washer for picture control extonsion ehaft (2 raq'd) |
|  |  |
| 77000 | (For Modele 178350, 173350U, 179351, 175331U) <br> Spaaher-5" PM spoakor comploto with cone and voice coil |
|  |  |
|  | (For Models 173360, 1753600 ) |
| 75024 | Cone-Cone and voice coil ( 3.2 ohms) for apoakor stampod 971490.3 W |
| 77129 | Cone Cone and voice coil ( 3.2 ohmm) for eppakor stampod $971490-3 R$ |
| 75022 |  |
|  |  <br>  |

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## DESCRIPTION AND SPECIFICATIONS

The Magnavox Model 700426 UHF tuner is two-tube, continuously tuning unit which incorporates a 24 position detent action
for simplicity of operation. It is for simplicity of operation. It is mounted at the front left of the tivarily of a preselector, oscillator, crystal mixer and cascode I. F. amplifier. It covers all 70 UHF television channels and has a 41 mc. I. F. output which is MHF switch

It has a bandpass of at least three channel widths which allows the UHF range to be covered in steps of three tor detent. Stations in a particular area can be quickly and accurately tuned by this method because the FCC normally allocates UHF stations at least six channels apart and only one station will be present on every other detent posi-
tion. The tuner is inoperative during VHF reception.

Turn the channel selector to channel 77. Set the sweep generator to 851.5 mc and ac. (channel 76 pixenerand 859.75 .25 (channel 78 sound). Adjust C603 and C610 trimmer lead inductances L603 and L606 by bending leads for a curve as shown in Fig. 3


FIG. 3
high frequency rf curve

Because of interaction between high end and low end adjustments, recheck the curve on channel 20 . A $30 \%$ tilt is
To check for tracking, turn channel selector to channel 50. Set sweep generinsert marker signals of 681.25 me (channel 49 pix.) and 697.75 mc . (channel 5l sound). A 5
Set the channel selector on channel 20, and turn the sweep generator center frequency to 509.5 mc . Insert marker frequencies of 501.25 (channel 19 pix.) and and C610 trimmers for response curve as in Fig. 2. $8+14 \mathrm{CV}, 108-300$ SERIES $B+210 \mathrm{~V}, 106-107-400-500$ SERIES


Connect oscilloscope to TP601. Connect 300 ohm output of UHF sweep generator to Loosely couple the signal generator to the preselector to provide markers.


## OSCILLATOR

Turn on the receiver and turn UHF-VHF switch to UHF. Connect oscilloscope t TP601, 300 ohm sweep cable to UHF antenna terminals and loosely couple sigR. F. alignment.

Set the sweep generator center frequency to 553 mc . Turn channel selector to channel 20. Set marker signal to 565 mc , turn fine tuner fully clockwise and ad565 mc . Set marker signal to 541 mc . turn fine tuner fully counter-clockwise and bend the fine tuner stop to place oscillator marker at 541 mc .

FIG.I
TOP \& REAR VIEW OF TUMER

The following alignment makes use of the I. F. amplifiers and video detector of the tuner so it is extremely important that their alignment be correct. If I.F. alignment of the receiver is necessary, see the Service Bulletin on that instru

The R. F. and oscillator alignment necessitates the use of a UHF sweep gener-
ator and a signal generator which will ator and a signal generator which will
deliver frequencies of 500 mc . to 910 mc . If UHF equipment is not available, harmonics of VHF instruments may be used. See Magnavox pamphlet "Servicing The
Magnavox 700426 UHF Tuner Using VHF Test Equipment".

## PRESELECTOR

As no tubes are included in the preselector, alignment should be completed
with the receiver turned off. Refer to Fig. 1 for instrument connections and alignment points. ADJUSTMENT

et the sweep generator to 895 mc ., turn channel selector to channel 77 and fin nal to 907 clockwise. Set marker sig ance lead on oscillator grid by induct lead to center the oscillator marker at 07 mc . Set marker signal to 883 mc . turn fine tuner fully counter-clockwis and carefully adjust L605, inductance glass fine tuner, to cente he marker at

Because of interaction between high end ad low end osfillator adjustments, recheck the low frequency setting.
Set the channel selector to channel 50 and sweep generator frequency to 733 mc . et marker signal to 743 mc . and turn fine tuner fully clockwise. Oscillator marker must be at 743 mc . or above. Set marker signal to 723 mc . then turn fine ator marker must be clockwise. Oscil-

## IF AMPLIFIER

Turn UHF-VHF switch to UHF. Connect I.F. sweep generator to high side of the crystal mixer thru a 1000 ohm resistor ator to provide markers. signal gener cilloscope across the video detector load resistor in the TV chassis and connect bias battery to I. F. and R. F. AGC circuits (see I. F. alignment in


IF CURVE

Remove UHF tuner shield cover and adjus L617 (using insulated screwdriver in slot in bottom of iron core) for maximum curve height with 45.75 mc. marker near
$50 \%$ (seefig. 4). If necessary adjust L607 (using short aligning tool) for proper tilt (not over 10\%) allowing slight reduction in curve height.


OJohn F. Rider


RF Deck Figure 2


IF Deck Figure 3
ALIGNMENT AND SERVICING

Alignment and servicing of the 700359 tuner converter is a simple procharacteristics bandpass is essentially predetersical layout and associated circuitry. Except as stated elsewhere in this bulletin, bandpass is uut sutject to cerioue change during alignment; however, replacement of any component within the RF or IF circuits may disturb the band-pass characteristics of the instrument. Accordingly, whenever parts within these circuits are replaced, electrical and physical specifications of the original components must be duplicated by using original parts. A parts list for the 700359 tuner converter is included in this manual. Wires, parts and other accessories must be replaced in their exact former positions.

| $\begin{gathered} \text { TUBE } \\ \text { NO. } \end{gathered}$ | $\begin{aligned} & \text { TUBE } \\ & \text { TYPE } \end{aligned}$ | FUNCTION | plate |  | CATHODE |  | GRID |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | $\begin{aligned} & \text { PIN } \\ & \text { NO. } \end{aligned}$ | VOLTS | $\begin{aligned} & \text { PIN } \\ & \text { NO. } \end{aligned}$ | VOLTS | $\begin{aligned} & \text { PIN } \\ & \text { NO. } \end{aligned}$ | VOLTS |
| V601 | $$ | OSCILLATOR | 187 | 107 | 5 | 0 | 28.6 | -570-8 |
| V602 | $6 \mathrm{BK7}$ | IF | 6 | 126 | 8 | 1.5 | 7 | 0 |
|  |  |  | 1 | 240 | 3 | 126 | 2 | 125 |

Voltage Chart Figure 4

## Test Equipment Required

It is recommended that the following test instruments be obtained for UHF alignment, in addition to that used on VHF, because it is evident that this new band of frequencies will become more popular as more station licenses are granted, and that the work can be per formed quicker and more efficiently with equipment designed specifically for UFF. It is equally evident that the use of present VHF channels will aiso expand, so any VHF equipment on hand will become even more useful.

In the event that the following recommended UBF gear is not on hand and until it can be obtained, the Magnavox Company has prepared a bulletin on the use of VHF test equipment for UHF alignment. Copies of that outline are being distributed along with this maintenance manual.

1. UHF sweep generator, with a range of 470 to 890 mc ., with a minimum sweep width of 40 mc . at the low end of the band and 60 mc . at the high end. It should have a continuously calibrated attenuator, providing as low as 100 microvolts output.
2. UHF marker generator for locating frequencies of 378 and 828 mc .
3. VHF marker generator for locating frequencies of 77.25 and 87.75 mc .
he following alignment instructions represent minimum requirements for acceptable performance of the converter. Its alignment must be performed with the unit installed in an operating television receiver

## F Alignment on Channel

1. Remove the shield cover from the converter.
2. Open test point 602 and ground TP601 and TP603, see fig. 3.
3. Connect the oscilloscope to the test point on the VHF tuner, see fig. 5. and set the tuner on hannel 5.

VHF Tuner Figure 5

4. Connect the sweep generator to the converter antenna terminals, tune the converter to approximately 500 mc . (channel nals, tune the converter to approximately 500 mc . (channel 19), and adjust the sweep ge
the scope similar to fig. 6.
5. Loosely couple the VHF marker to TP602, and set it to 77.25 mc . and 81.75 mc . If the markers are not positioned as in fig. 6. spread or compress the air coil L613, located below P601

Channel 5 IF Curve - Figure 6
6. Tune the converter and sweep generator to approximately 850 mc. (channel 77) and re-adjust coil 1613 if necessary, for a curve similar to that on 500 mc . Adjust 1612 for maximum height at 850 mc .

T601 may be adjusted for the best compromise.

## IF Alignment on Channel 6

1. Open test points 601 and 603, and ground TP602.
2. Connect the oscilloscope to test point on the VHF tuner, and set the tuner on channel 6 .
3. Tune the converter to approximately 500 mc ., couple the sweep generator to the antenna terminals, and adjust it for a response curve similar to fig. 6.
4. Loosely couple the VHF marker to TP601, and set it on 83.25 mc . and 87.75 mc . If the markers are not positioned as in fig. 7. align T601 (for curve width) and I612 (for maximum height) Keep the marker level down so the "birdies" are about $1 / 8^{\circ}$ high.


Channel 6 IF Curve - Figure 7

## Oscillator Alignment

1. Remove the shield and 6BK7 tube from its socket.
2. Connect the UHF marker generator, through a . 5 mmf. capacitor, to the junction of $\mathrm{x} 601, \mathrm{~L} 605, \mathrm{C} 611$ and C 612.
3. Connect the oscilloscope to test point 602, through a 10,000 ohm isolating resistor.
4. Tune the converter to its lowest frequency (extreme counterclockwise) position.
5. Set the marker generator frequency on 378 mc . and adjust the oscillator trimmer C6l5 for a beat on the scope.
6. Tune the converter to its highest frequency (extreme clockwise) position.
7. Set the marker generator frequency to 828 mc . and adjust the end inductor L610 for a beat on the scope.
8. Recheck both high and low frequency positions so the beats appear without further adjustment

## Preselector Alignment

1. Connect the properly terminated UHF sweep generator to the antenna terminals.
2. Tune the converter to approximately 500 mc . (Channel 19) and adjust the sweep generator for a flat topped response curve on the scope
3. Loosely ccuple the VHF marker generator to the antenna terminals and set it on 77.25 mc . and 87.75 mc . The markers should appear on the edge of the pass-band as shown in fig. 8


RF Curve at 500 mc . Figure 8
4. If they do not, adjust RF trimmers C603 and C608 and the ccupling capacitor $\mathbf{C} 606$ for the proper band pass.
5. Tune the converter to approximately 850 mc . (Channel 77) and adjust the sweep generator for a response curve on the 'scope. The markers should appear as in fig. 9.


RF Curve at 850 mc. Figure 9
6. If they do not, adjust the RF end inductors 1602 and 1603 for the proper band pass.

Recheck both low and high frequency positions for proper loca tion of the markers, and repeat the foregoing adjustments if necessary

The alignment may be checked at any frequency throughout the UHF band. If the VHF markers appear within the pass-band on the 'scope, tracking is satisfactory.


| video fr alignant |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  tap to junction of n222 and C215. |  |  |  |  |  |
| SWEEP GEN: COUPLING | SWEEP GEN. FREQUENCY | SIG. GEN. coupling | $\begin{aligned} & \text { SIG. GEN. } \\ & \text { FREQUENCY } \end{aligned}$ | $\begin{aligned} & \text { CONNECT } \\ & \text { SCOPE } \end{aligned}$ | adjustents |
| 1stif grid | 40nc. Adjust gain so trap visible. | Converter <br> grid. | 47.25me modulated. Adjust gainso pip is just visible | Across vid. <br> dot. load <br> rosistor h212 <br> H212 | Sot contrast to mid. Adjuat top t202 to contor pip in snckout, soo Fig. 1. Max. ationuation is at two core positions. Use one with slug farthest out. |
| " | 40nc. Set gon. output for $2 V \mathrm{P} / \mathrm{P}$ output at scopo | " | Unmodulated 42.75 mc . 45.0 . 45.75 . | $"$ |  <br>  |
| Converter grid | " | Loosely couple | Unmodulared 45.75 mc . 42.0 ma. 42.75 苗 | " | Tune channol seloctor to bigh chennel. Tune conVerter plate coll L3 for max. with ${ }^{45.75}$ markor sox ap on curvo. Tune gain and proper tilt. |
| VHF ant. Leras. Fig. 3 if is not balanced | $\begin{aligned} & \text { Channels } \\ & 2 \text { thru. } 13 \\ & \text { h.F. } \end{aligned}$ | $"$ | Unmodulated 42.75 m . <br> 45.75 mc | " | Check all channels for bandwidth, slope and position of carrier. |
| High side of UHF <br>  <br>  | ${ }_{\text {gain }}^{\text {minc. }}$ samo | $\cdots$ | Unmodulated $\mathbf{4 5 . 7 5} \mathrm{mc}$. | " | Sot Unf-Mif switch to Unf. Romove unf tuner ahiold and adjust if ampl. plato coil loll for nax. with aerker 50 x up on curve. Do not change r201 or L201. |



NO. 700426 UHF TUNER


NO. 700379 VHF TUNER



## SERVICE ADJUSTMENTS



## General Information

POWER SUPPLY-These receivers are designed to operate from a power source of 117 volts at 60 cycles A.C. It will, howver, operate satisfactorily from a line wliuse voltage is no lower than 105 volts, or no greater than 125 volts at 60 cycles A.C. Always measure the voltage of the line with a dependable a-c voltmeter if it is suspected that the line voltage is beyond the above acceptable limits.

fig. I. FRONT PANEL ADJUSTMENTS

Below is given a description of the steps required in adjustment of the Beam Bender and Deflection Yoke and the adjustment of the Focus, Vertical Size and Linearity, and Horizontal Size, Linearity, Drive and A.F.C. controls. However, it should be remem bered that these adjusments are to be made only when picture quality is such that service adjustment is warranted. Use this description as a check-list and if a particular phase of quality is good, leave it alone and go on to the next operation. Refer to figur 1 for location of front panel controls. and to figure on the schematic diagram for location of rear panel controls
IMPORTANT-The adjustment of the Beam Bender (Ion Trap magnet) must be performed immediately after the receiver warms up. If any length of time is permitted to elapse while the receiver is on, and while the Beam Bender is misadjusted, serious damage to the internal structure of the cathode-ray gun may result.
A. PREPARATION FOR SERVICE ADJUSTMENT

1. Remove the wood screws on the back cover and the one hex-head P.K. screw adjacent the line cord bracket, dis engage the interlock, and remove the back and the line cord.
2. Drop hinged door on front panel for access to the auxiliary controls as illustrated in Fig. 1. The lower set of these controls is adjusted by means of a narrow shanked screwdriver.
3. Connect a substitute interlock line cord between receive and suitable power outlet and turn on the receiver allow ing about 30 seconds of warm-up period before proceed ing. Keep the BRIGHTNESS control turned fully coun-ter-clockwise.
B. BEAM BENDER (ION TRAP) ADJUSTMENT
4. Position the beam bender on the glass neck approxi mately $1 / 2 "$ from the plcture lube base.
5. Advance the BRIGHTNESS control almost fully clockwise.
6. Starting from this position, adjust the Beam Bender by moving it forward or backward, and at the same time rotating it slightly around the neck of the tube until the brightest raster appears on the screen. If two maxi mum brightness positions are found, the one nearest the tube base is the correct setting. This adjustment should be done quickly to avoid damaging the gun structure
7. Adjust the BRIGHTNESS control to maximum, fully clockwise.
8. Re-adjust the Beam Bender carefully for maximum
9. The Beam Bender must be adjusted at all times for max imum brightness. A misadjusted Beam Bender can dam age the picture tube in a matter of seconds and it is of utmost importance to make this the first adjustment when the set is turned on and the last adjustment befor
C. DEFLECTION YOKE ADJUSTMENT
10. Loosen the wing thumb screw located at the top of the deflection yoke frame.
11. Check to see that the deflection yoke mounting bracke rubber cushions press firmly against the flare of the tube.
12. Press the yoke firmly against the flare of the tube.
13. Rotate the yoke until the lines of the raster are horizontal and squared with the picture mask, and tighten the wing screw.
D. FOCUSING ADJUSTMENTS
14. Adjust BRIGHTNESS and CONTRAST controls so that the raster brilliance corresponds to that of an averag picture.
15. If a corner of the raster is shadowed, it indicates that the electron beam is striking the neck of the tube. Loosen the Focus Coil Wing Screws and rotate the coil about its horizontal and vertical axis until the entire raster is visible, approximately centered, and with no shadowed corners. The Focus Coil should be kept closet, coil fo necessarily touching, hecuar of range of the focus control. A slight readjust ment of the Beam Bender may now be required.
16. Adjust the focus control (see Fig. 1) so that the lines of the raster are sharp and distinct over the greates screen area.
. SYNC STABILITY ADJUSTMENT
17. Tune in a weak station preferably at a time when the noise level is high.
18. Turn the SYNC STABILITY control clockwise to the position of best picture stability.
19. Tune in a strong station and check the picture for twist If excessive twist is noticed, turn the SYNC STABILIT control counterclockwise until the twist disappears.
20. The point of best SYNC STABILITY and least twist will coincide under most conditions. If two distinct position are found, a compromise will usually be satisfactory. The noise stability will improve with clock good signal are terclockwise position.
F. HORIZONTAL A.F.C. ADJUSTMENT

In order to check this adjustment tune in a station, prefer ably one that is transmitting a test pattern. If difficult is encountered in locking the picture horizontally or if it locks-in only when the Horizontal Hold Control is a either end of its rotation, ådjust the Horizontal A.F.C control as follows:

1. Turn CONTRAST down about half way.
2. Turn HORIZONTAL HOLD CONTROL fully counterclockwise.
3. Check that the SYNC STABILITY control is properly adjusted.
4. If the picture is not locked in, turn the HORIZONTAL A.F.C. control till it does lock-in
5. Momentarily interrupt the signal by switching the chan nel selector off channel and then back. The pictur should just fall out of sync. If it does not, turn the

## SERVICE ADJUSTMENTS (Continued)

of the other. If vertical synchronization "falls-out," re adjust the VERTICAL HOLD control. (Refer to Fig. 1 ) Adjust the HORIZONTAL DRIVE trimmer for the elimination of drive lines in the picture as follows: While serving the raster, turn the trimmer counterclockwise ntil thin vertical white (drive) lines appear at the lef enter of the screen. Then turn the control clockme y further clockwise than necessary to eliminate th drive lines. This adjustment is extremely critical and mproper adjustment may shorten the life of the hor ontal output tube. Turning the trimmer clockwise (clos ing plates) reduces the drive to the horizontal outpu be and insufficient drive excessive proportions.
Readjustment of the HORIZONTAL A.F.C. control may now be necessary.
Adjust the HORIZONTAL SIZE control slotted screw, ocated at the rear of the High Voltage cage at the rear of the chassis, for correction of horizontal width. The arge outer arcs of the test pattern should coincide with the edge of the picture mask. (Refer to schematic diagram.)
-Adjust the HORIZONTAL LINEARITY control slotted screw, located at the rear of the High Voltage cage, for entral alignment of the inner circles of the test pattern. If no test pattern is available, the linearity can be adjusted with fair accuracy by adjusting for minimum ontrol is rotated a dip in cathode current will be ob served

Horizontal A.F.C. adjustment screw sightly clockwis and again momentarily interrupt the signal. Continu his procedure until the picture just falls out of sync only when the signal is interrupted
6. Rotate the Horizontal Hold Control clockwise until the picture falls into sync. The picture should now stay in ync. throughout most of the range of the Horizontal Hold Control.
7. If the picture cannot be made to hold sync., carefully repeat the above procedure. If difficulty is still encoun ered, it may be necessary to make a complete alig scilloscope, as described on page 10 of this folder.
G. PICTURE CENTERING, SIZE AND LINEARITY

1. Horizontal or Vertical Centering is accomplished meWing Nut sufficiently to twist the Focus Coil slightly bout its horizontal or vertical axis. Make sure the orners of the raster are not shadowed. See step D. 2 Note: Some receivers are equipped with a magnetic cenering disc, located between the focus coil and the delection yoke. To center the picture in the mask, rotate and slightly vary the position of the dise in its vertical plane. This adjustment should be made in conju
with positioning of Focus Coil (described above).
2. Adjust the VERTICAL SIZE and VERTICAL LINEARTY controls until the test pattern is vertically linea nd symmetrical from top to bottom, and fills the mask. Adjustment of either control may require readjustment

## Alignment Instructions Video I-F and Sound Alignment Procedure

## TV VIDEO I-F ALIGNMENT

1. Set channel selector to quiet portion of VHF band
. Set contrast control fully counterclockwise.
Apply 3V. negative bias between the A.G.C. bus (at C53)
and ground. (Use $2-11 / 2 \mathrm{~V}$. cells in series.) Connect TV I-F Signal Generator through a 1500 mmf condenser to Test Point (A) of tuner unit: low side to
ground. (See schematic diagram.)
ground. (See schematic diagram.)
Connect negative lead of V.T.V.M. or 20,000 ohm per volt
meter to pin 7 of V7A $6 A L 5$ diode TEST'POINT (B) posimeter to pin 7 of V7A GAL5 diode TEST P
2. During alignment maintain Signal Generator output below
1.5 volts peak on V.T.V.M. (Note: High Signal Generator 1.5 volts peak on V.T.V.M. (Note: High Signal Generator
input may cause overloading, resulting in incorrect alignment.)
3. Feed $43.8 \mathrm{MC}( \pm .05 \mathrm{MC})$ from Signal Generator and adjust
4. Adjust top tuning core of T4 to its maximum counterclockwise position (all out). This is an adjacent sound trap essary to reduce or eliminate adjacent sound interference. Whe
Feed 45.5 mc ( +05 mc ) from Signal Generator and adjust T4 bottom core for maximum output
Feed 41.25 mc ( $\pm .05 \mathrm{mc}$ ) from Signal Generator and adjust T3 top core for minimum output.
. Feed $42.8 \mathrm{mc}( \pm .05 \mathrm{mc})$ from Signal Generator and adjust
tom core for maximum output.
Feed 41.0 mc ( $\pm .05 \mathrm{mc}$ ) from Signal Generator and adjust
T2 for maximum output. T2 for maximum output. Feed 45.2 mc ( $\pm .05 \mathrm{mc}$ ) from Signal Generator and adjust
T1 for maximum output (adjacent to 6 U 8 on top of tuner) Replace the meter with the vertical input of an Oscilloscope to test point (B) through a 10 K isolating resistor, low side of scope to ground
5. Remove Signal Generator. Feed a video I.F. Sweep Genof the 6 U 8 VHF converter tube, making sure the shield is not grounded. (Refer to fig. 4.)
6. Observe response curve on the Oscilloscope (refer to fig. 47.25 mc and 45.75 mc . It is absolutely important to keep,$~$ Sweep Generator output at the lowest usable level to prevent response distortion due to overloading.
7. If response curve does not a pproximate that shown in fig. 4 repeat alignment steps 7 to 1 . Check bias battery potentia tuning cores may be necessary to approximate the recom mended response curve of fig. 4
NOTE: Top and bottom cores accessible from either end of
8. 

tor outputs at: Kinimum to avoid curve distortion. Marker piphould be kept barely visible.

## TV SOUND ALIGNMENT

NOTE: TV-phono switch if used must be in TV position Connect a 4.5 MC Signal Generator ( $\pm .01 \mathrm{MC}$ ) through
1500 MMF condenser to TEST POINT (B). See schematic diagram
2. Obtain two resistors of approximately 100,000 ohms each Whose resistances have been matched accurately with an ohmmeter. Connect them in series across
$(\mathrm{R} 178)$ at the 6 T 8 tube socket (V11A).
. Connect negative lead of V.T.V.M. to junction of matched Connect negative lead of V.T.V.M. to junction
resistors of step 2; positive lead to ground. Feed $4.5 \mathrm{MC}( \pm .01 \mathrm{MC})$ from signal generator, and adjust
L22, sound take-off coil, for maximum deflection on
V.T.V.M. V.T.V.M.
5. Adjust the top and bottom cores of T6 sound I.F. trans
6. Adjust the bottom core of T7 for maximum deflection on
. .i.v.m.
Repeat steps 4 to 6 using minimum signal input necessary roper meter deflection
Connect positive lead of V.T.V.M. to junction of C152 and Connected as in step 3. See schematic diagram. I.V.M.
9. Adjust top slug of T7 for zero output on V.T.V.M. between two opposite polarity peaks. If accurate 4.5 mc . signal generator is not available, the following procedure may be used only when the video IF's and tuner are properly aligned.
Connect antenna to appropriate antenna terminals and
tune in station signal
2. Follow steps 2 to 9 of TV SOUND ALIGNMENT.

ว11S


| channel nUmber | SWEEP GEN. CENTER FREQ. (1OMC.SWEEP) | MARKER GENERATOR FREOUENCES |  |
| :---: | :---: | :---: | :---: |
|  |  | $\begin{gathered} \text { VIDEO } \\ \text { CARRIER } \end{gathered}$ | $\begin{aligned} & \text { SOUND } \\ & \text { CARRIER } \end{aligned}$ |
| 2 | 57 mc . | 55.25 mc | 59.75 mc . |
| 3 | 63 mc | 61.25 uc . | 65.75 mc . |
| 4 | 69 Mc . | 67.25 Mc . | 71.75 mc . |
| 5 | 79 mc . | 77.25 mc. | 81.75 mc . |
| 6 | 05 nc . | 83.25 MC . | 87.75 mc . |
| 7 | 177 mc . | 175.25 mc . | 179.75 Mc . |
| 8 | 183 mc . | 181.25 mc . | 105.75 mc . |
| 9 | 189 mc . | 107.25 mc . | 19.75 mc . |
| 10 | 195 nc . | 193.25 mc. | 197.75 mc . |
|  | 201 mc . | 199.25 mC . | 203.75 mc . |
| 12 | 207 Mc | 20525 mc | 209.75MC. |
|  | 213 mc . | 24,25 nc. | 215.75 mc . |


difur
Fig. 4. If ALIGNMENT BLOCK DIAGRAM

FIG. 2. deflection yoke and focus coil assembly

A. Proper non-metallic tool for alignment of video I.F. tran
B. End "A" can be used for tuning top or bottom core from one side of transformer at a time
$\mathrm{C} \& \mathrm{D}$. By using end "B" of alignment tool, both top and bottom fom tor bottom of chassis. fig. 3. allgnment tool

John F. Rider

CHASSIS 119, 120 Series
4.5 MC TRAP ALIGNMENT

1. Remove V6 (6CB6 3rd I-F amplifer)

Connect diode detector output to Connect a 4.5 MC Signal Generator ( $\pm 0.01 \mathrm{MC}$
A.M. modulation, 'through a 1500 MMF con
grid of V8 (pin 9 6CL6). Low side to ground. Set A.M. modulation for approximately $30 \%$ modulation 4. Set generator output to 0.1 volt.

Short out L22 (sound take-off coil) by connecting a jumpr (
Adjust L15 (4.5 MC trap) for minimu
or minimum pattern on Oscilloscope.
Connect input of diode detector to CRT cathode. (See fig. $11 \quad \begin{gathered}\text { *Note: If accurate } 4.5 \mathrm{MC} \text { generator is not available, use station } \\ \text { signal. Short out L22 as in step } 7 \text { above. Note presence of } 4.5\end{gathered}$


HORIZONTAL OSCILLATOR TRANSFORMER ALIGNMENT
Refer to Se
alignment.

1. Tune in a TV
a test pattern station, preferably one that is transmitting
a test pattern. If after attempting the Horizontal A.F.C. Service Adjustment, described above, the picture cannot be made to sync.
pre-set the Horizontal Stabilizing adjustment (inner slug of T11, beneath chassis) 5 turns in from its maximum out
2. Set the Horizontal Hold control to the center of its range
and adjust the Horizontal A.F.C. adjustment until the

Connect a low capacity probe of an oscilloscope to terminal
"C" of the Horiontal oscillator transformer, T11; low side "C" of the Horiontal oscillator transformer, T11, low side capacity probe is unavailable, connect a 10 K resistor in
series with the vertical scope lead.

## PARTS LIST-SERIES 119-120

## CAPACITORS

| SYMBOL | PART NO. | DESCRIPTION |
| :---: | :---: | :---: |
| C1-C38 | Part of Tuner | Unit E-36.167 |
| C50 | B-4.115-1 | 5000 MMF 500V |
| C51 | D-4.104-70 | $560 \mathrm{MMF} \pm 10 \%$ |
| C52 | D-4.108-12 | 1500 MMF 500 V . |
| C53 | D-4.108-12 | 1500 MMF 500 V . |
| C54 | B-4.242-1 | 680 MMF |
| C56 | D-4.108-12 | 1500 MMF 500 V . |
| C57 | B-4.242-1 | 680 MMF |
| C58 | D-3.100-30 | . 25 MF 200 V |
| C60 | D-4.108-12 | 1500 MMF 500V |
| C61 | B-4.242-1 | 680 MMF |
| C62 | B-4.242-1 | 680 MMF |
| C63 | C-4.109-10 | 100 MMF |
| C64 | C-4.109-16 | 10 MMF |
| ${ }^{\text {C } 654}$ | C-5.435-3 | 4 MFF 450 V . |
| C66 | D-4.104-38 | $100 \mathrm{MMF} \pm 10 \%$ |
| C67 | D-3.105-21 | $.1 \mathrm{MF} \mathrm{400V}$. |
| C68 | D-3.105-23 | . 22 MF 400 V . |
| C69 | D-3.105-23 | .22 MF 400 V . |
| C80 | B-4.138 | 5000 MMF Heavy |
| C81 | B-4.138 | 5000 MMF Heavy Du |
| * C 83 A | C-5.435-3 | 40 MF 450 V |
| C584 | D-4.108-12 | 1500 MMF 500V. |
| C85 | D-4.108-12 | 1500 MMF 500V. |
| C86E | B-4.125-1 | 5000 MMF 450 V . |
| ${ }^{\text {C }} 887 \mathrm{C}$ | C-5.435-3 | 4 MFF 450 V . |
| ${ }^{\text {C }}$ 888 | C-5.435-4 | 40 MF 450 V . |
| *C89B | C-5.435-4 | 40 MF 450 V . |

Cer. Disc.
Mica
Cer.
Cer.
Cer. Disc.
Cer.
Cer. Disc.
Paper Tub.
Cer.
Cer. Disc.
Cer. Disc.
Cer.
Cer.
Elect.
Mica
Molded Tub.
Molded Tub.
Molded Tub.
Cer. Disc.
Cer. Disc.
Elect.
Cer.
Cer.
Dual Cer. Disc.
Elect.
Elect.
Elect.

Adjust the Horizontal Stabilizing brass slotted screw until
the broad and narrow peaks of the pattern on the oscillo-
the broad and narrow peaks of the pattern on the oscillo-
scope are of equal height. (See illustration.) During Hori-
zontal Stab. adjustment, picture must be kept in sync. by
adjusting the Horizontal A.F.C. adjustment, if necessary.
Disconnect oscilloscope and follow Service Adju
*Refer to sche
 C 137
C 138
C 139
C
C 140
D
C 111
yMBOL PART NO.

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## V.H.F. R.F. ALIGNMENT

Connect balanced 300 ohm sweep generator to VHF antenna
terminals. (Top terminals at rear of chassis.) See fig. 8 for terminals. (Top terminal
suitable matching pads.
Connect R.F. Marker Generator loosely to VHF antenna terminals.
Connect vertical amplifier of Oscilloscope through a 10 K
resistor to TEST POINT (A), fig. 4.
Short A.G.C. bus to ground across C53, 5000 mmf discap condenser.
Set TV channel selector to Channel 10.
6. Adjust Sweep Generator for Channel $10,10 \mathrm{mc}$ sweep and Generator.
Observe response curve on Oscilloscope. If necessary, adjust C3 and C12 for overcoupled pattern and C6 for maximum response in center of bandpass. Re
ments for flat response. See fig. 6 .
Chcek markers on response curve of all remaining channels setting Sweep and Marker Generators at corresponding frequencies for each channel. See Table 1 for convnient tabu-
lation of proper frequencies. If the R.F. Markers do not fall lation of proper frequencies. If the R.F. Markers do not fall
in automatically in their proper places on all channels, a
sla in automatically
compromise mu
C 3 , 6 and C 12 .

## V.H.F. OSCILLATOR ALIGNMENT

Connect
minals.
2. Couple R.F. Marker Generator loosely to the VHF antenna terminals.
. Connect vertical input of Oscilloscope through a 10 K de (B). (B).

Couple 45.75 MC video I.F. Marker Generator looseity to
first I.F. grid (Pin 1 of 6 CB6 V4) . Rotate Fine Tuning control to center of range.
6. Set channel selector to Channel 10.
7. Set Sweep Generator to Channel 10, and Marker Generator to 193.25 MC (Video carrier) Observe response curve and adjust 011 ment, see fig 7 for zero-beat with 4575 MC marker Zero beat is indicated by an unmistakable break-up of the response curve.
NOTE: Quality of response curve does not affect accuracy
of oscillator alignment, so long as a zero-beat is obtained. of oscillator alignment, so long as a zero-beat is obtained. Check for zero beat on all channels by adjusting each indi-
vidual oscillator coil slug with the fine tuning control set in the mechanical center of its range and the channel selector, Sweep Generator and Marker Generator at the correspond-
ing frequencies. See Table 1, Fig.5. ing frequencies. See Table 1, Fig. 5.
NOTE: Adjust oscillator slug from front end of tuner with a long non-metalic screwdriver. A clearance hole is pro-
vided through the UHF unit when the UHF drum is turned
to VHF See fig

## V.H.F. R.F. and Oscillator Alignment


G. 7. RF TUNER AdJUSTMENT POINTS (Standard COIL UHF-vhF 82 CHANNEL CASCODE TUNER)

## U.H.F. R.F. ALIGNMENT

The UHF
turned off
2.

Connect unbalanced 300 ohm UHF Sweep Generator to the bottom antenna terminals, at the rear of the chassis. See fig. 8 for suitable matching pads.

Loosely couple
Remove UHF I.F. plug from UHF I.F. input jack and insert 100 ohm $1 / 2 \mathrm{w}$. non-inductive resistor between center conductor and ground shield of plug. Connect vertical input of Oscilloscope across the 100 ohm resistor. Low side of scope to ground. See fig.
5. Set TV channel and band (decade) selector for Channel 69.
6. Feed 803 mc at 40 mc sweep from Sweep Generator.
. Observe response curve on Oscilloscope and if necessary, adjust C33 and C34, see fig. 7 , so that response curve falls. within limits. Vary Marker Generator to check bandwidth. See Table 2 Fig. 10 for corresponding frequencies.
8. Check response curves on at least one channel in each decade setting ( $14-19,20-29$, etc.), and set the Sweep Generator to the corresponding frequencies. See table 2 . If the response adjustment of C33 and C34 should be made.
9. Reinsert UHF I.F. plug. The R.F. alignment is now com-1 plete for all UHF channels.


Turn receiver on and allow a 10 minute warmup period
before proceeding with adjustments before proceeding with adjustments.
2. Connect UHF Sweep Generator to bottom antenna termiing pads for oscillator alignment is not generally required However, to suit various input matching conditions, its use
may be warranted. may be warranted.)
3. Couple UHF Marker Generator loosely to bottom antenna
terminal
Couple 45.75 mc video carrier I.F. Mar
to first I.F. grid (Pin 1 of 6 CB 6 V4). Connect vertical amplifier input of Oscilloscope through a
10 K de-coupling resistor to TEST POINT (B) pin 7 of
$6 \mathrm{AL5}$ VA diode 6AL5 V7A diode.
Rotate fine tuning control to center of its range.
NOTE: There is one oscilla
NOTE: There is one oscillator adjustment for each decade
of UHF channels. If local stations fall into different decades, the oscillator adjustments can be set to make sach station come in at the same point of the fine tuning control If there is more than one local station in any one decade, a compromise adjustment must be made. It will be neces-
sary to readjust the fine tuning control when changing stations.
area. TV channel and decade selector for a station in the 8. Set the

Set the Sweep Generator to the corresponding channel and the UHF Marker to the video carrier frequency of the channel. See table 2.
Adjust the UHF oscillator adjustment for zero-beat be-
tween the UHF Marker and the I.F. Marker. This zero-beat is indicated by an unmistakable breakup of the observed response curve.
NOTE: Quality of response curve does not affect accuracy
of oscillator alignment, so long as a zero-beat is obtained. . Check for zero-beat on all channels expected to be received in the area. See table 2 .


ALIGNMENT OF THE TUNER SHOULD NOT BE ATTEMPTED UNLESS IT HAS BEEN DEFINITELY DETERMINED that it is necessary, and should only be made with adequate and properly

## MATTISON TELEVISION AND RADIO CORDORATION

## Alignment Procedure

## MATTISON SILVER ROCKET CHASSIS

a) Use an RCA V.T.V.M. or equivalent
b) Use RCA sweep generator or equivalent.
c) Use an RCA marker generator or equivalent

PROCEDURE:

1) Adjust fourth I. F. Coil, No. T105 to 23.9 m. c. for maximum (bottom slug).
2) Adjust marker oscillator to 21.75--adjust to minimum (top slug).
3) Adjust marker oscillator to 25.75 m . c. Adjust bottom slug on Ll 83 for maximum reading on V.T.V.M.
4) Adjust top slug at same coul 27.75 minimum on V.T.V.M.
5) Adjust marker to 22.8 m . c. --adjust T104 for maximum (bottom slug).
6) Adjust top slug at same transformer, No. T104 for minimum.
7) Adjust T103 bottom slug for maximum 22.3 m . c. Adjust top slug for minimum.
8) Adjust converter coil on R. F. tuner to 25.7 m . c. maximum.
9) With sweep generator connected to antenna binding post and marker oscillator loosely coupled to the R. F. oscillator at the tuner, check over-all I. F. sweep response with oscilloscope. Make sure that picture carrier does not fall beyond $50 \%$ of the curve Curve should be 4 m .c. wide from 21.75 sound carrier to 25.75 picture carrier.

* THESE TUBES ARE IN HIGH VOLTAGE COMPARTMENT.


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BLECTRIGAL INPUT - - - - - - - - - - - - - 117 Volts A.C., 60 cyclos

##  <br> 64-88MC, 174-216 MC



ANTENNA INPUT- . . . . . . . . . . . . . . . . 300 ohms, Balanced

Re-Adjust the beam bender or ion trap if necessary.
*The chassis contains electrostatically focused picture tubes. These tubes will ordinarily have the focus electrode wired to the 140 volt B+supply. Due to line voltage variations, however, it may become necessary to raise or lower the voltage on this electrode for best focus. Any well filtered voltage fram zero, or ground, to a positive 400 volts is permissable on this electrode. If satisfactory focus is not obtained within this range of voltages, re-chock the width and horlzontal drive adjustments. If these adjustments are found to have been correctly made, check the second anode voltage on the picture tube. For this measurement, a voltmeter which will range to at least fifteen thousand volts is necessary. The picture tube second anode voltage should range between 11.5 and $13.5 \mathrm{~K} . \mathrm{V}$. positive. The picture is centered by means of a centering magnet, located just to the rear of the deflection yoke, in the position formerly occupied by the focus umit. This magnet may be rulalod lu aly direction to correctly center the pattern. When this ring is in a vortical plane, the thumbscrew will adjust vertical centering. When the ring is in a horizontal plane, horizontal centering will be effected by adjustzent of the thumbscrew. (See assembly instruction.)

## Alignment Procedure

Necessery Equipments
Television Sweep Generator
Marker Frequency Generator
Vacuum Tube Voltmeter
4. SMC CrystallGenerator, or equivalent, oscilloscope

## Sound I.F. Alignment

1. Connect 4.5MC generator to the grid of the video amplifier tube. Low signal level is important here. Metering may be accomplished at the sound take-off point of the rationdetector (at the juncture of R-155 and C-160) with the meter ground connected to pin eight of the 6V6.
2. Adjust the slug of $\mathrm{L}-18$ (sound take-off coil) for maximum negative meter indication. Attenuate the output of the generator so that not more than five volts is measured on the meter, as the alignment progresses.
3. Adjust the top slug of T-5 (ratio det. primary) for the maximum negative reading. This adjustment is on the bottom for sets employing TS-10062 for $\mathrm{T}-5$.
4. Move the meter ground to the juncture of two $100 \mathrm{~K} 1 \%$ resistors placed across m-156 in tho sound dotector oircuit, and adjust the bottom (top for TS-10062) slug of I-5 (ratio det.) for zero voltage. The other moter lead remains connected as in step 1. No. 4.5MC trap adjustment is necessary. The trap consists of a coil L-l7 which is self-resonant at 4.5MC.

## Video I. F. Alignment

The I.F. amplifier contains five tuned circuits, no traps being necessary The video carrier is passed through the I.F. at a freq. of 26.1uC, and the sound carrier at 21.6 MC . Extreme care must be taken in alignment, to assure that the sound carrier is attenuated substantially below the level of the video carrier. This is necessary to assure that the slight AM modulation on the sound carrier due to picture modulation will be sufficiently low to be removed by the detector, and not produce spurious phase modulation of the sound I.F. A band width of 3.4 MC (6DB down) with a stage gain of from 12 to 15 times is attained. Earlier sets employed a staggered quintuple, which resulted in a different order of stagger of the I. F. coils. (See peaking frequencies below.) These sets may be identified by the values of the grid load resistors on the last two I.F. amplifier tubes, (R-109 and R-113) 6800 ohms In the later sets, employing a staggered double, the third 1.F. grid rosishor, $R$, ancor in stagger, lies in the wiring of the A.G.c. to the second I.F. amplifier. In the triptis triplatal (C-105) hal ben added as additional A.G.C. docouplia

## Peaking Frequencios

Adjust curve for band width of 3.4 MC .
lst IF tumer slug to high side 2nd IF slug to middle of band 3rd IF slug to low side 4th IF slug to low side 5 th IF slug to high side


Use only sufficient input to give pattern on scope with scope vertical control at maximum gain.

Should A.G.C. be developed with this decreased input apply a D.C. battery of -3 V , to A.G.C. line and alien as above

An I. F. alignment signal is best introduced to the chassis by means of a suitable cup, or tube shield floated over the mixer tube to oapacity couple the signal to the plate circuit. It may be necessary to disabl the local oscillator* to prevent R.F. harmonics from distorting the trace on the scope screen. The oscilloscope is connected to the grid of the video amplifier, through a 100,000 ohm isolating resistor. or the no more than a negative 1 volt reading. The resulting overall response should coincide with the curve shown below.
*A dummy $6 J 6$ may be substituted for the mixer tube with the \#l pin removed, to facilitrte alignment.
The R．F．tuner in the receiver has to be pre－aligned by the manufacturer
and adjustment in the field is not recommonded．It may be necessary on
occasional sets，however，to re－set the local oscillator tuning elug．
This may be accomplished without test equipment，if it is possible to
reoeive a signal of good quality，and if the I．F．and R．F．portions of
the set are functioning corroctly．Simply set the fine tuming in the center
of its range and adjust the oscillator slug for best picture detail．The
oscillator adjustment is recessed in a hole in the tumer front directiy
to the right of the tuner shaft．This adjustment must be checked on
each channel to be received．It is 1mportant that a non－metalic align－
ment screwdriver be used to prevent detuning when the adjustment is com－
pleted and the screwdriver withdrawn．On sets using a wooden front panel，
a small hole is proved under the flanged tuner knob which will accomm－
odate this alignment tool，and make possible re－setting the osc．slug
without removing the set from its cabinet．If a signal of sufficient
strength is not available，oscillator adjustment may be made with the
sweop generator connected as for I．F．alignment，and the video R．F．
carrier frequency applied to the antenna terminals of the receiver from
an accurately calibrated signal generator．With the hook－up outlined
above，a pip，or marker indicating the video carrier for the particular
channel being set will appear on the I．F．response curve．This pip will
ride up and down on the curve，when the fine tuming oontrol is moved，and
the oscillator is correctly set when the pip is passing through the point
on the curve marked 26.1 in Fig．5，with the fine tuning at the center of its
rotation．

NO SIGNAL VOLTAGE MEASUREMENTS

| TUBE | APPLICATION | PIN 1 | PIN 2 | PIN 3 | PIN 4 | PIN 5 | PIN 6 | PIN ？ | PIN 8 PI | PIN 9 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | lst I．F．Amp． | 0－1．5 | 0 | 0 | 6．3AC | 140 | 140 | t．7－1．2 |  |  |
| 6av6 | 2nd I．F．Amp． | 0－1．5 | 0 | 0 | 6．3AC | 140 | 140 | t．7－1．2 |  |  |
| 6 CB6 | 3rd I．F．Amp． | 0 | 1.8 | 0 | 6．3AC | 140 | 140 | 0 |  |  |
| $6 \mathrm{CB6}$ | 4th I．F．Amp． | 0 | 1.9 | 0 | 6．3AC | 140 | 140 | 0 |  |  |
| 12BY7 | Video Amp． | ＋5to3．0 | －1．0to－3．0 | 0 | 6．3AC | 6．3AC | 0 | 220－290 | 140 |  |
| 6ad6 | Sound I．F．Amp． | 140 | 140 | 60 | 60 | 200 | 45 | 140 |  |  |
| 6al5 | Ratio Detector | －11 | －11 | 6．3AC | 0 | 0 | NC | －22 |  |  |
| 12AU7 | Sync．Amp．\＆ Clipper | ＋15 | 0 | f4tof 18 | 6．3AC | 6．3AC | ＋120 | Oto－45 | 0 | 0 |
| 12AX7 | Horiz．Phase Det．\＆lst Aud | io +100 | －． 5 | 0 | 6．3AC | 6．3AC | ＋6．5to8． 2 | －1．0to3．3 | 3 ＋1．0to4．8 | 8 |
| 6sn7 | Horiz．Osc． | －1．0tot3．3 | ＋ 275 | ＋10to－12 | －7to－9 | ＋130 | ＋10to－12 | 0 | 6．3AC |  |
| 6BG6 | Horiz．Output | ＋． 6 | 0 | 0 | ¢ 8 | －19to－36 | NC | 6．3AC | ＋280 |  |
| 6 H 4 | Damper | NC | NC | ＋500 to | NC | ＋360 | NC | \＄200 | $\begin{aligned} & \text { CAP DO NO } \\ & +200 \end{aligned}$ | NOT MEASUE： |
| 6SN7 | Vert．Multi． |  |  | ＋575 |  |  |  |  |  |  |
|  | Vibrator | －17to－30 | ＋70tot 150 | ＋1．0 | 0 | ＋24to－40 | ＋1 | 6．3AC | －17to－30 |  |
| 6SN7 | Vert．Output | ＋． 2 NC | +290 to +450 | 0 to＋24 | t． 2 | $\begin{gathered} +290 \text { to } \\ -450 \end{gathered}$ | 0 tot24 | 6．3AC | 0 |  |
| ＊6V6 | Audio Output | NC | ＋60 | ＋200 | ＋200 | －5to－15 | NC | 760 | 0 |  |
| 504 | L．V．Rectifier | NC | ＋400 | NC | 360AC | NC | 360AC | NC | \＄400 |  |
| 1B3 | H．V．Rectifier |  |  | DO NOT | MEASURE |  |  |  |  |  |
| 6au6 | AGC－Zeyer | ＋220to350 | ＋350 | ＋200 | ＋200 | 0 | ＋450 | ＋350 |  |  |
| 6v3 | 24＂Damper | NC | NC | NC | 200 | 200 | NC | t350 | $\nvdash 650$ |  |
|  |  |  |  |  |  |  |  |  | CAP |  |
| 6AH4 | 24 ＂Vert． Output | 0 | 0 | NC | NC | 300 | NC | 6．3AC | Otof－25 |  |
| 6CD6 | $24^{\text {n }} \text { Horiz. }$ output | ＋8 | 0 | 0 | ＋8 | －15 | NC | 6．3AC | －140 |  |

## IMFORTANT NOTICE

In previous models，the filament winding on the power transformer which supplied heater voltage to the 6 W 4 was connected directly to the positive 140 vit supply．This was done to minimize the potential between heater and cathode of the 6W4 damper．

In these models，this heater winding is maintained at a positive 220 volts by means of a voltage divider connected between Bt and ground． The filament winding is bypassed by a ． 05 mf d 600 volt capacitor to ground．

Below is a circuit diagram which shows the interconnections between the U．H．F．tuner unit and the V．H．F．tuner．The switch mentioned above performs the following functions：

I。 Transfers the $V . H_{\circ} F$ 。tungr input from the VoHoF。antenna to the out put of the U．H．F．undt．
2．Shorts the V．H．F．antenna when 3witched to U．H．F．
3．Applies Bt to U．H．F．unit for its oscillator supply．
4．Supplies filament voltage for U．H．F．dial lights．

＊Readings taken from Pin Socket with +140 as common negative reference．
1．Where readings may vary according to control settings，min．\＆max．readings are given，
2．Measurements are from socket pin to chassis，unless otherwise stated．
2．Measurements are from socket pin to chassis，unless otherwise st
3．All measurements taken with line voltage maintained at $117 \mathrm{~A} . \mathrm{C}$ ．

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ELECTRICAL SPECIFICATIONS

Power Supply
Power Consumption
Power Output
Tuning Range
Antenna Input Imp.
intermediate
Frequencies
ntercarier Soun
System
oud Speake
Voice Coil Imp,
oice Coil Imp.

- 125 Volts AC 60 Cycles Onl 170 Watts
2.7 Watts (Max.

155 Watts ( $10 \%$ Distortion)
2 Channel
00 Ohms balanced
Picture 26.4 MC
Sound 21.9 MC
4.5 MC

Electro-Magnetic 3.2 Ohms 400 Cycles 00 Ohms

## SUPPLEMENTARY MANUAL

Models GSL-3064C and GSL-3083C are identical to the issue "A" and " B " covered in Manual No. 4113A xcept for the following changes

V19 (Metal Picture Tube) 17TP4 has been
hanged to 17HP4 (Glass Picture Tube) Due to the difference in the mounting of the glass picture tube the necessary brackets, straps, insulatin this supplement n this supplement
A schematic diagram together with a complete parts are included in this manual. For test patterns, alignment procedure, wave forms and other service information refer to Manual No. 4113A.


These models use 19 tubes, (including picture tube and rectifier) have a crystal diode video detector employ a intercarrier sound circuit, have safety interlock and a fuse in the low voltage power supply Picture tube has electrostatic focus, which is auto matic and permanent

## UBE COMPLEMENT

| Svmbol | Type | Function |
| :---: | :---: | :---: |
| V1 Tuner | 6 BC 5 | R-F Ampiifier |
| $V^{2}$ Tuner | ${ }_{\substack{6.1 / 6}}^{6}$ |  |
| V4 | $\mathrm{fiCBf}^{\text {c }}$ | 2nd Pix I-F Amplifier |
| $\bigcirc$ |  | 3 rd Pix I-F Amplifier |
| va |  | Video Anp. |
| 8 | ¢A A | Sunc. Senarat |
| V8 | 6 6AL, | ITorizontal Phase Det |
| Y:10 A\&B | ${ }_{6} \mathrm{SN} \times 7 \mathrm{GT}$ | Vert. Osc. \& Phase Splitter |
| V11 | fiSxigT | Horizntal Oscillator |
| V12 A\&B | ${ }^{6} \mathrm{~T} 8$ | Audio Amp. \& Ratio netector |
| V13 | $6 \mathrm{BrO6GT}$ | Horizontal Output |
| , | 6. $\mathrm{W}^{4}$-GT |  |
| V16 | ${ }_{6} \mathrm{Y} 6 \mathrm{G}$ | Audio Output |
| 17 | 183-GT | High Voltage Rectifier |
| V18 |  | 1.nw Voltage Rectifier |
| Y19 | $17 \mathrm{TP4}$ |  |

TUBE COMPLEMENT

| Symbol | Type | Function |
| :---: | :---: | :---: |
| V1 Tuner | $6 \mathrm{BC5}$ | R-F Amplifier |
| V2 Tuner | 6 J 6 | R-F Osc. \& Mixer |
| v3 | $6 \mathrm{CB6}$ | 1st Pix I-F Amplifier |
| V4 | $6 \mathrm{CB6}$ | 2nd Pix I-F Amplifier |
| Vis | $6 \mathrm{CB6}$ | 3rd Pix I-F Amplifier |
| V6 | 6AH6 | Video Amp. |
| V7 | 6AU6 | Sound Driver |
| V8 | 6AU6 | Sync. Separator |
| v9 | 6 AL5 | Horizontal Phase Det. |
| V10 A\&B | 6SN7GT | Vert. Osc. \& Pnase Splitter |
| V11 | 6SN7GT | Horizontal Oscillator |
| V12 A\&B | 6 678 | Audio Amp. \& Ratio Detector |
| V13 | 6 S 4 | Vertical Output |
| V14 | 6BQ6GT | Horizontal Output |
| V15 | 6 W 4 -GT | Damper |
| V16 | ${ }_{6} \mathbf{Y} 6 \mathrm{G}$ | Audio Output |
| V17 | 183-GT | High Voltage Rectifler |
| V18 | ¢L4-G | Low Voltage Rectifier |
| V19 | 17HP4 | Pix Tube $17^{\prime \prime}$ Glass Rectangular |



PICTURE TUBE REPLACEMENT: To replace the picture tube it is necessary to remove the chassi from the cabinet. This may be accomplished in the following manner:

1. Remove the front panel control knobs by pulling them straight from their shafts
2. Remove the cabinet back. İemove antenna term inal board from cabinet back. You will not that the interlocked line cord disconnects the powe when the cabinet back is removed.
3. Disconnect speaker plug from chassis, remove

CAREFULLY out of the cabinet.
4. Remove the picture tube as shown and outlined in the illustration. To install a new picture tube, reverse the procedure making sure that the picture tube fits close against the picture tube cushion. If the picture tube sticks or fails to slip into place smoothly, investigate and remove It is important that all the clips and shims used in mounting the tube be replaced, otherwise difficulty may be encountered when horizontal or vertical centering is required.

TEST EQUIPMENT: To service this receiver propely, it is recommended that the following test equipment be available:

## R-F SWEEP GENERATOR meeting the following

 requirements:(a) Frequency ranges:

$$
18 \text { to } 30 \mathrm{mc}, 10 \mathrm{mc} \text { sweep width }
$$

40 to $90 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
170 to $225 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating source.

Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled. Electronic Voltmeter and a high voltage probe for use with this meter to permit measurements up to 20 kilovolts.


FIG. 7 - OVERALL RESPONSE CURVE

SIGNAL GENERATOR to provide the following frequencies; (Output on these ranges should be adjustable and at least .1 volt maximum.)
(a) Intermediate alignment frequencies

### 26.1 Plate coil tuner

24.4 1st Pix I.F. Coil
24.0 2nd Pix I.F. Coil
4.5 mc video trap and sound I.F.
26.1 3rd Pix I.F. Coil
(b) Radio frequencies.

| Channel <br> No. | Pieture <br> Crarrer <br> Frea. Mc. | Sound <br> Canrier <br> Freq. M. |
| :---: | :---: | :---: |
| 2 | 55.25 | 59.75 |
| 3 | 61.25 | 65.75 |
| 4 | 67.25 | 71.75 |
| 5 | 77.25 | 81.75 |
| 6 | 83.25 | 87.75 |
| 7 | 175.25 | 179.75 |
| 8 | 181.25 | 185.75 |
| 9 | 187.25 | 191.75 |
| 10 | 193.25 | 197.75 |
| 11 | 199.25 | 203.75 |
| 12 | 205.25 | 209.75 |
| 13 | 211.25 | 215.75 |

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## TUNER ALIGNMENT

Frequency
Adjust
26.1 MC Converter plate coil (on top of tuner) for maximum dc at picture detector.
2. 24.4 MC 1st picture I-F coil L-5 (above chassis) for maximum dc at picture detector
3. 24.0 MC 2nd picture $1-\mathrm{F}$ coil L-6 (above chassis) for maximum dc at picture detector
4. 26.1 MC 3rd picture I-F coil L-7 (above chassis) for maximum dc at picture detector
B. I-F Sweep Generator into converter grid by means of tube shield insulated from base. Connect oscilloscope across R-21, 6800 Ohms (in place of VTVM). Apply -4.5 bias (battery) to AGC line
Tuner should be switched to a channel not being used so as not to cause interference.


FIG. 10 OVERALL I.F. RESPONSE CURVE 1035

Observe overall I-F response, which should be as shown above: A slight touch-up may be required. At no time should it be necessary to turn any of the picture I-F coils more than $1 / 2$ turn of the slug. The following comments are suggestions only:

1. The height of the 26.4 MC marker is controlled by the ( 26.1 MC ) converter plate coil on tuner and the ( 26.1 MC ) 3rd P.I.F. coils.
2. The 23.7 MC marker position is controlled by the 2nd picture I-F coil ( 24.0 MC ) and the 1st picture I-F coil ( 24.4 MC )

### 4.5 MC TRAP ALIGNMENT:

1. Tune in a station
2. Adjust fine tuning rotar until sound bars just appear in picture.
3. Turn L-10 slug all the way out (counter clockwise).
4. Turn the slug in (clockwise) until the horizontal scanning lines are smooth and continuous.

SOUND I-F ALIGNMENT: Connect signal gen erator to grid of video amp. (6AH6), adjust contras control to maximum. Set signal generator to 4.5 MC (no modulation) (setting of 4.5 MC must be accu rate). Connect (2) two 50,000 ohm resistors across C-39 (resistors must match within 5\%). 1. VTVM is connected across C-39. See Fig. 12. Adjust L-12 and T-3 (Bottom) for maximum on VTVM. This adjustment should be made with voltage on VTVM under 12 volts. 2. Connect VTVM between junction of R-39, R-40 and junction of the (2) two 50,000 ohm resistors. See Fig. 12. Adjust T-3 (Top) for zero on VTVM. If VTVM reads below zero, revers leads and again adjust T-3 (Top) for zero reading Re-check step one.


FIG. 12
1039
A. Sweep generator with balanced 300 ohm output to antenna terminals. Marker generator output to antenna terminals. Marker generator output Point" on tuner. Ground AGC line at junction of $\mathrm{R}-12$ and $\mathrm{C}-17$.

10.3

1. With channel selector on channel 12, adjust C-1, C-9 and C-3 for response as in Figure 14 Picture and Sound markers at $90 \%$ maximum
response.

2. Check response on all channels. If markers are below $70 \%$ on any channel, readjust $\mathrm{C}-1$, are below $70 \%$ on any channel, read
$\mathrm{C}-9$ and $\mathrm{C}-3$. Re-check all channels.


FIG. 14 - PIX AND AUDIO MARKERS
C. Oscillator adjustment:

1. Remove AGC ground. Apply - 4.5 Volts on
. Connect oscilloscope to output of video detector. Place fine tuning in center of range. Check response on all channels. Picture marker should be at $50 \%$. See Fig. 7 .
If some channels are off, individual oscillator coil slugs will require adjustment. Adjust each channel slug, accessible through hole in front of chassis with a non-metallic screwdriver to bring Picture Marker to correct

## MONTGOMERY WARD TV PAGE 14-3



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## ELECTRICAL SPECIFICATIONS

Power Supply . . . . . . . . . . . . 105-125 Volts AC
Power Consumption .......Television-210 Watts Radio-35 Watts Phonograph-55 Watts
.......... 2.4 Watts (Max.) 1.8 Watts ( $10 \%$ Distortion)

Tuning Ranges ...........VHF-Channels 2 thru 13 UHF-Channels 14 thru 83 AM-540-1600 KC
Intermediate Freq. (Tel.) . . . . Pieture-26.20 MC
I-F (UHF Position Only) . .... .Picture 121.75 MC Sound 126.25 MC
Intermediate Freq. (Radio). . 455 KC
Selectivity (Radio) . . . . . . .
45 KC Broad at 1,000 Times Signal, measured at $1,000 \mathrm{KC}$
Sensitivity (Radio) .........(For . 5 Watt Output)
10 Microvolts Average 300 Ohms Balanced
Intercarrier Sound System 4.5 MC

Loud Speaker ............. . $8^{\prime \prime}$ PM Dynami
Voice Coil Impedance . ..... 3.2 Ohms 400 Cycles
Record Changer ........... See Manual 5096A (VM-950)
Cartridge . . . . . . . . . . . . . . . Shure P77V ( 60 H 17 )
Needles-78 RPM
.Shure 85-16 (61H2)
$-331 / 3$ \& 45 RPM -Shure 85-18 (61H13)

## TUBE COMPLEMENT

## TELEVISION

| TELEVISI |  |
| :---: | :---: |
| symbol | Type |
| VHF Tuner. | . . 616 |
| *VHF Tuner. | . . 6BQ7 |
| UHF Tuner. UHF Tuner. | . 6 AF4 |
|  | . IN72 or |
|  | 1N82 |
| V-1 ..... | . 6 CB6 |
| V-2 | .6CB6 |
| V-3 ...... | . 6 CB6 |
| V-4 A \& B. . . .6AL5 |  |
| V-5 A \& B. . . . 12AT7 |  |
| V-6 ....... . 6 6AH6 |  |
| V-7 .........6BE6 |  |
| V-8 ........6SN7-GTA |  |
| V-9 ........6AU6 |  |
| V-10........6AU6 |  |
| V-11........6AU6 |  |
| V-12........6AL5 |  |
| V-13........6AV6 |  |
| V-14........6AQ5 |  |
| V-15........6AL5 |  |
| V-16........6SN7-GTA |  |
| V-17........6BQ6-GT |  |
| V.18........6AX4-GT |  |
| V-19........ 1 1B3-GT |  |
| V-20 \& V-22. . 5U4-G |  |
| V-21....... | .21MP4 |

R-F Osc. and Mixer
R-F Amplifier
R-F Osc.
Crystal Mixer
1st Pix I-F Amplifier 2nd Pix I-F Amplifier 3rd Pix I-F Amplifier Pix Det. and DC Restorer st Video Amp. and Phase Splitter
Video Output
Sync. Separator Vertical Osc. \& Vertical Output Automatic Gain Control 1st Audio I-F 2nd Audio I-F Ratio Detector 1st Audio Amplifier Audio Output Phase Detector Horizontal Oscillator Horizontal Output Damper
High Voltage Rectifier Low Voltage Rectifier Picture Tube 21" Metal Rectangular (Electrostatic) *For replacement purposes a 6BZ7 tube may be used in place of a 6BQ7 tube.



Fig. 1-Tube Loyout.


Fig. 2-Front Panel Controls


## SERVICE SUGGESTIONS

NO RASTER ON PICTURE TUBE－If raster cannot be obtained
check below for the possible causes．
：lon trap magnet adjustment is incorrect．
No $+B$ voltage．Check 4／10 ampere fuse．Replace if defective．If tuse continually burns out，check （A）Horizontal output tube V－17（6BQ6－GT）
（C）Check horizontal oscillator tube V－16（6SN7－GTA） for proper operation．
（D）With an ohm meter，check for a short between terminal 1 of the horizontal output transformer （T－9）and the chassis．
Check DC resistance
（E）Check DC resistance of T－9
No high voltage．Check V－17，V－18 and V－19 tubes and circuits．If the horizontal deflection circuits are operating as evidenced by the correct voltage（ 600 V ）
measured on terminal No． 1 of T－9，the trouble be isolated to the high voltage rectifier circuit Eath the high voltage winding to the 6BQ6－GT plate an $1 B 3$ plate is open，tube V － 19 is defective，its filamen circuit is open，R－105 and C－75 defective or pix tube elements shorted internally．
circuit open．

HORIZONTAL DEFLECTION ONLY－If only horizontal deflec－ ion is obtained as evidenced by a straight line acros he face of the picture tube，it can be caused by the following：
Vertical oscillator and vertical output tube V－8 inoper ative．Check socket voltages．
2：Vertical oscillator transformer（ $T$－4）defective
4：Yoke vertical coils open or（T－5）open or shorted．
Vertical hold，height or linearity
fective．
POOR VERTICAL LINEARITY－If adjustment of the heigh and linearity controls will not correct this condition，any of the following may be the cause．
1：Check variable resistors $\mathrm{R}-49$ and
2：Vertical output transformer（T－5）and R－54．
3：Capacitors C－47B，C－70 or C－71 defective．
3：Capacitors $\mathrm{C}-47 \mathrm{~B}, \mathrm{C}-70$ or $\mathrm{C}-71$
4： $\mathrm{V}-8$ defective，check volta
：Excess leakage or incorrect value of capacitor C－68，
or open or incorrect value of resistors R－90 \＆R－92．
Low plate voltages．Check rectifier tube and capacitors in + B supnlv circuits．
7：Capacitor C－67 defective
8：Vertical deflection coils（L－12）defective．
POOR HORIZONTAL LINEARITY－If adjustment of the Hori－ zontal drive and linearity controls does not correct this 1：Check or replace horizonta
2：Check or replace damper tube V － 18 （ $6 \mathrm{~A} \times-\mathrm{GT}$ ．
3：Check capacitors C．77，C－78，C－79 and horizontal linearity control（L－16）for defects．
Horizontal deflection coils（L－17）defective．
TRAPEZOIDAL OR NONSYMMETRICAL RASTER
1：Defective yoke．
WRINKLES ON LEFT SIDE OF RASTER－This condition can be caused by：
1：Defective yoke due to C－76 or R－106（internal in yoke
assembly）being wrong value or open．These com－
2． V －18（6AX4－GT）ded in rear of yoke assembly

SMALI RASTER－This condition can be caused by：
1：Low $+B$ or line voltage．Check $\mathrm{V}-20 \& \mathrm{~V}-22$（ 5 U G ）．
2：Insulticient oulput trom horizontal output tube V－17． Replace tube．
3：Insufficient output from vertical oscillator and vertical
4：Incorrect setting of horizontal drive control R－89．
5：V－18（6AX4－GT）defective．
6：Incorrect setting of（L－15）width control．
3：Check and realign，if necessary，the picture I－F and R－F circuits．

## MAN MADE NOISE IN SOUND（Ignition，etc）

RASTER；NO IMAGE，BUT ACCOMPANYING SOUND－This condi－ rion can be caused by：
1：No signal on picture tube grid．Check V－5A（12AT7）2：Check sound I－F alignment
．and V－6（6AH6）tubes and associated circuits．
2：Bad contact to picture tube grid（lead to socket BENDING OR S－ING
broken）．
3：AGC tube（V－9）may be defective．Check tube and 1：Check sync stability control adjustment．
its associated circuit．
2：Check capacitors C－47A and C－49A．
SIGNAL APPEARS ON PICTURE TUBE GRID BUT IMPOSSIBLE TO
SYNGRONIZ THE PICTURE VERTICALLY AND HORIZONTALIY
1．A condition of this nature can be caused by：
2：If tubes are O．K．check voltages，and associa -5 B ．
3：AGC system inoperative．Check V－9（6AU6）AGC tube and associated circuits．

## fective

Check sync separator tube V－7（6BE6）and phase splitter V－5B（12AT7）and V－5A（12AT7）video ampli－

5：Check AGC threshold control．
PICTURE NORMAL－NO SOUND OR WEAK OR DISTORTED SOUND
1：Check sound I－F alignment．
2：Check V－10（6AU6）V－11（6AU6）V－12（6AL5）V－13 （6AV6）V－14（6AQ5）and associated circuits．

## raster on tube but no picture or sound

This condition can be caused by，
1：Defective pix I－F Amplifier tubes V－1，V－2 or V－3
ALIGNM

TEST EQUIPMENT－To service this receiver properly，it is
recommended that the following test equipment be avail－ able：
R－F SWEEP GENERATOR meeting the following requirements： （a）Frequency ranges：

18 to $30 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
40 to $90 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
120 to $130 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
170 to $225 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
470 to $890 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
（b）Output adjustable with at least .1 volt maximum
（c）Output constant on all ranges．
（d）Flat output in all attenuator positions．
CATHODE－RAY OSCILIOSCOPE preferably one with a wide band vertical deflection and an input calibrating source SIGNAL GENERATOR to provide the following frequencies： （Output on these ranges should be adjustable and at least ． 1 volt maximum．）
（a）Intermediate alignment frequencies
23.1 mc first picture I－F coil．
24.1 mc third picture I－F coil．

2：Defective pix detector tube V－4A（6Al5）．Check tube and its associated circuit．
3：Defective R－F Amplifier or oscillator mixer tubes in the tuner．
4：UHF－VHF switch defective．

## POOR FOCUS

1：Improper setting of Ion Trap magnet．
2：Defective picture tube or picture tube socket
PICTURE JITTER：
1：If regular sections at left of the picture are dis－ placed，replace the horizontal oscillator tube V－16．
2：Vertical instability may be due to loose connections or noise received with the signal．
3：Horizontal instability may be due to unstable trans－ mitted sync．
4：Check receiver AGC system for proper operation．
5：Check phase splitter V－5B，（12AT7）and sync separa tor V－ 7 （6BE6）．
6：Check for improper setting of sync stability control．
7：Picture tube grid lead not held in position by support spring，ie：close proximity of grid lead to sync and horizontal tubes will cause picture to jitter at high contrast setting．
8：Check AGC threshold control．
No PICTURE OR SOUND OR WEAK PICTURE OR SOUND IN UHF POSITION
If this condition is encountered
1：Check to see whether or not a UHF station is operating in the vicinity．
2：The 6AF4 oscillator tube or the IN72（or IN82）crystal may be defective．
3：Pre－selector in UHF tuner defective．
4：Low pass filter defective．
5：The UHF antenna and oscillator strips in the VHF funer defective
6：Defective switch on UHF funer．

## URE

25.9 mc second picture I－F coil．
21.7 mc sound trap．
4.5 mc video trap \＆sound I－F．
25.2 mc converter plate coil（Tuner）．

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled．
ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 20 kilovolts． SERVICE PRECAUTICNS－To service the receiver remove the chassis from the cabinet．To do so，remove the knobs，the cabinet back，disconnect the leads from the speaker，the radio chassis，remove the antenna terminal boards at rear of cabinet，and then the 5 chassis mounting bolts．The chassis may be serviced with the picture tube in place transformer on the bottom．The weight of the chassis will be supported against the power transformer and pix tube brackets．
CAUTION：Do not permit the kinescope second－anode lead to become shorted to the chassis．To do so will cause R－105．


Fig. 8-Top Chassis Video
and Audio l-F Adiustments
A. Unmodulated R-F signal into Converter Grid by mean
 of tube shield insulated from base. VTVM with filter in lead of 22 K ohms and 5000 mm connected to pic. det. load Fig. 10-vTVM Connections resistor, ( $\mathrm{R}-37$ ) 4700 ohms, in series with peaking coil (L-6) from Pin 7 of 6AL5. In put signal level should be such that output is less than 2 volts DC. Apply -4.5 V battery bias on AGC line.

| 1. | freguency <br> 2DJUST |  |
| :--- | :--- | :--- |
| 2.2 MC | Converter plate coil on top of <br> tuner for maximum dc at picture <br> detector. |  |
| 3. | 23.1 MC | lst picture I-F coil (T-1) for <br> maximum dc at picture detec- <br> tor. |
| 4. | 25.9 MC | 2nd picture I-F coil (T-2) for <br> maximum dc at picture detec- <br> tor. |
| 5. | 21.7 MC | 3rd picture I-F coil (T-3 below <br> chassis) for maximum dc at pic- <br> ture detector. |
| 3rd picture I-F trap (T-3 in can <br> above chassis) for minimum dc <br> at picture detector. |  |  |

B. I-F Sweep Generator into converter grid by means of tube shield insulated from base.

Connect oscilloscope across R-37 (in place of VTVM). Apply -4.5 V bias (DC) to AGC line (battery).
Tuner should be switched to dead channel so as not to cause interference.

fig. 9-Bottom Chassis Video
and Audio 1-F Adjustments.


Fig. 13-Top Tuner Adiustments
B. RF AND CONVERTER ADJUSTMENT.

1. With channel selector on Channel 12, adjust C-201 slightly favoring the Pix carrier, then adjust C-206 slightly favoring the Pix carrier, then adjust C-206 sound markers at $90 \%$ maximum response.
2. Check response on all channels. If markers are below $70 \%$ on any channels, readju


Fig. 14-Pix \& Audio Markers

The height of the 26.2 MC marker is controlled by the 5.7 MC (Converter Plate Coil on tuner) and the 25.9 MC (2nd P.I.F.) coils.
2. The uniformity of response (flatness across top and position of 23.5 MC ) marker is controlled for th most part by the 24.1 MC third picture I-F coil.
3. The 23.0 MC marker position is controlled by the first picture I-F (23.1 MC coil). However, it is NOT advisable to change the setting of the coil, due be avoided unless believed to be absolutely neces sary.

## VIDEO

With 4.5 MC unmodulated signal from a high impedance source, ( 10,000 ohms in series with the generator) into plate of the picture detector tube (Pin 7-6AL5) and VIVM on picture tube grid, tune 4.5 MC trap (L-7 Top) for
A. Sweep generator with balanced 300 ohm output to antenna terminals. Marker generator output to an-
minimum response. VTVM on $0-10 \mathrm{~V}$ AC scale. This ad justment can also be made while observing a picture from a station. Tune trap for least 4.5 MC beat in picture

## AUDIO I-F

1: With signal generator ser to 4.5 MC and dc VIVM connected to junction of R-13 and C-14, adjust sound ake-off coil (L-13 Top) and sound I-F transforme lugs ( T .6 Top \& Bottom) for maximum.
2: With VTVM connected to pin 7 of V-12 (6AL5) adjust the ratio detector primary ( $T-7$ Bottom) for maximum
3: With VTVM connected to junction of R-17, R-20 and C-18, adjust ratio detector secondary (T-7 Top) fo ross over (zero voltage) on lowest scale.

NOTE - If no signal generator is available, the proedure above may be followed by tuning in a station and using the 4.5 MC beat between picture and sound carrier.

## TUNER ALIGNMENT

OSCILLATOR ADJUSTMENT
. Apply -4.5 volts on I-F AGC line at junction of R-1 and C-30A.
2. Connect oscilloscope to output of video detector. Place fine tuning in center of range. Check response and picture marker at $50 \%$. (See Figure 12).
3. If markers are off, individual oscillator coil slugs will require adjustment. Adjust each channel slug, accessible through hole in front of chassis with a non-metalicic scre
To ad postion.
. To adjust oscillator on UHF position, feed the sweep generator with center frequency of 124 MC and markers at 121.75 and 126.25 into the input of the low pass fiter (ouput of carrier marker is at $50 \%$ and that 126.25 marker marker is in the sound notch. If a sweep generato is not available, a single frequency generator se to 126.25 MC and VTVM may be used. Connec VTVM to the pix detector load resistor R-37. Feed generator into the low pass filter. Adiust oscillato slug in the VHF tuner so that the 126.25 marke is in the sound notch of the I-F curve.
5. If the 6AF4 oscillator tube in the UHF tuner is re placed, it may be necessary to adjust the oscillato the chassis. (See Figure 15). Adjust this trimmer until the tuner will cover a range of below 470 MC to above 890 MC .


## REPLACEMENT PARTS LIST

## RADIO AND RECORD CHANGER

PRICES SUBJECT TO CHANGE WITHOUT NOTICE


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## OSCILLOSCOPE WAVEFORM PATTERNS

The waveforms on this page were taken with the receiver tuned to a normal picture. The numbers on the waveforms correspond to the numbers on the schematic diagram correspond to the numbers on
which identifies each test point.
The voltages shown on each waveform are the approximate peak to peak amplitudes. The frequencies shown in-
dicates the repetition rate of the waveform, not the sweep rate of the oscilloscope. If the waveforms are observed on the oscilloscope with a poor high frequency response, the corners of the pulses will tend to be more rounded than those shown below and the amplitudes of any high frequency pulse will tend to be less.


No. $\begin{aligned} & \text { 1-6AL5 Pix Det. Plate } \\ & \text { 3.5 P.P } 60 \\ & \text { C.P.P.S. }\end{aligned}$
No. 7-12AT7 Phase Splifter Plate



No. 8-6SNT-GTA-Vert. Osc. Plate 125 V P.P 60 C.P.S.

No. $14-65 \mathrm{~N} 7$ - Hor. Osc. Plate
50 V P.P 15,750 C.p.S.


No. 3-Pix Tube Grid
20-100V P-p 80 c.P.S
No. 9-6SN7.GTA Vert. Osc. Gric
No. 15-65N7 Hor. Ose. Grid
48V P.p 15,750 C.P.s.


No. 5-6BEO Sync Sep. Plate
20 V P.P 60 C.P.S.
No. 10-6SN7-GTA Vert. Output Grid



No. 17-6BQ6 Grid
120V P.P 15.750 C.P.S.


No. 18-6AX4-GT Damper Plote
120V P-P 15.750 C.P.S.

No. 11 -Vert. Def. Coii
loov P.P 60 C.P.S.


No. 6-12AT7 Phose Splifter Cathode
18 V P.- 60 C.P.S.


No. 6-12AT7 Phase Splitrer Cathode
6-12AT7 Phase Splitter
18 V
P.P
15,750
C.P. 5

No. 12 -6AUG A.G.C.
450V P.P 15.750 C.P.S

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Fig. 5-Bothom Socket Voltoges

## SERVICE SUGGESTIONS

## NO RASTER ON PICTURE TUBE - If rasier

check below for the possible causes.
1: Ion trap magnet adjustment is incorrect.
2: $N o+B$ voltage. Check $4 / 10$ ampere fuse. Replace defective. If fuse continually burns out, check (A) Horizontal output tube V - 17 (6BQ6-GT) (B) Check damper tube V -18 (6AX4-GT).
(C) Check horizontal oscillator tube V-16 (6SN7-GTA) for proper operation.
With an ohm meter, check for a short between
terminal 1 of the horizontal output transformer (T-9) and the chassis.
(E) Check DC resistance of T-9.

3: No high voltage. Check V-17, V-18 and V-19 tubes and circuits. It the horizontal deflection circuits are measured on terminal No. 1 of T-9, the trouble can be isolated to the high voltage rectifier circuit. Either the high voltage winding to the 6BQ6-GT plate and
183 plate is open tube $\mathrm{V}-19$ is defective, its filament 183 plate is open, tube $\mathrm{V}-19$ is defective, its filament circuit is open, $R$ - ints shorted internally
4: Defective picture tube heater open or cathode return circuit oden.
HORIZONTAL DEFLECTION ONLY - If only horizontal deflec tion is obtained as evidenced by a straight line across the face of the picture tube, it can be caused by the following:
: Check capacitors C-77, C.78, C-79 and horizontal
linearity control (L-16) for defects.
4: Horizontal deflection coils (L-17) defectiv

## trapezoidal or nonsymmetrical raste

 1: Defective yokeWRINKLES ON Left Side of raster - This condition can be aused by:
: Defective yoke.
2: V-18 (6AX4-GT) defective
SMALI RASTER - This condition can be caused by
1: Low +B or line voltage. Check $\mathrm{V}-20$ ( 5 U 4 G ).
Insufficient output from horizontal output tube V-17
Replace tube.
3: Insufficient
output tube V-8. Replace tube.
4: Incorrect setting of horizontal drive control
6: Incorrect setting of (L-15) width control.
RASTER; NO IMAGE, BUT ACCOMPANYING SOUND - This condition can be caused by:
1: No signal on picture tube grid. Check V-5A (12AT7) and V. 6 (12BY7) tubes and associated circuits.
2: Bad contact to picture tube grid (lead to socke
3: AGC tube
AGC tube (V.9) may be defective. Check tube and

SIGNaL appears on picture tube grid but impossible to SYNCHRONIZE THE PICTURE VERTICALIY AND HORIZONTALL - A condition of this nature can be caused by:

1: Defective sync separator $V-7$ or phase spliter V-5B.
2: If tubes are O.K. check voltages, and associated cir-
3: AGC system inoperative. Check V. 9 (6AUC), AGC tub and associated circuits.

SIGNaL ON PICTURE TUBE GRID and horizontal sync only - If this condition is encountered, check

1: Vertical integrating network capacitors C-53A, B \& C
sistors R.68A, \& \& C

## SIGNAL ON PICTURE TUBE GRID and VERTICAL SYNC ONLY

1: V. 15 or V. 16 defective
2: Improper setting of ( $(-14)$ horizontal frequency con
3: Check setting of horizontal drive control and horizon
tal linearity control.
picture stable but with poor resolution - If the pictur resolution is not up to standard, it may be caused by any of the following
2: Defective picture detector $V-4 A$ \& 3 , ( $6 C B 6$ 's), Difier V -5A
3: Defective picture tube.
4: Open video peaking coil. Check all peaking coils and L-11 for continuity. Not 5. that $\mathrm{L}-5, \mathrm{~L}-9$ and $\mathrm{L}-10$ have shunting resistors.

Leakage in V .6 (12BY7) grid capacitor C-36. If the
capacior is not found to be defective, check the fol
lowing: 1 :Check all potentials in video circuits.
2: Check picture tube grid circuit for poor or dirty
contact.
3: Check and realign, if necessary, the picture Iand R-F circuits.

PICTURE SMEAR
1: A smear can be attributed to phase shift at the low or high frequency end of the video characteristic. This capacitors in the improper values of resistors and on video output tube V. 6 (12BY7), open or shorted peaking coils, video amplifier load resistors are
improper value (high
2: This trouble can also originate at the transmitter. Check reception from another station
3: Check and realign, if necessary, the picture I.F and R.F circuits.

MAN MADE NOISE IN SOUND (ignition, etc)
1: Check sound I.F tubes V-10, 11 \& 12 and associated circuits.
2: Check sound I-F alignment.

## 8ENDING OR S-ING

1: Check sync stability control adjustment
2: Check capaciors C-47A and C-49A.
3: V - 17 (6BQ6-GI) defective or V -16 (6SN7-GTA) de rective.
4: Check sync separator tube V .7 ( $6 C S 6$ ) and phase splite V.5B (12AT7) and V.5A (12AT7) video amplifier.

5: Check AGC threshold control.

## ICTURE NORMAL-NO SOUND OR WEAK OR DISTORIED SOUND

 1: Check sound I-F alignment.2: Check V-10 (6AUG) V-11 (6AU6) V-12 (6AL5) V-13 (6AVG) V-14 (6AQ5) and associated circuits.

## raster on tube but no picture or sound

This condition can be caused by
1: Defective pix 1-F Amplifier tubes V-1, V-2 or V-3
2: Defective pix detector tube V-4A (6AL5). Check tub and its associated circuit.
3: Detective R-F Amplifier or oscillator mixer tubes in the tuner

## POOR FOCUS

1: Improper selting or defective focus magnet
2: Defective picture tube

## PICTURE JITTER:

1: If regular sections at left of the picture are dis placed, replace the horizontal oscillator tube V.16.

2: Vertical instability may be due to loose connections or noise received with the signal
3: Horizonial instability may be due to unstable trans mitted sync.
4: Check receiver AGC system for proper operation.
5: Check phase splitter V-5B, (12AT7) and sync separa tor V-7 (6CS6).
6: Check for improper setting of sync stability control
7: Picture tube grid lead not held in position by support spring, ie: close proximity of grid lead to sync and horizontal tubes will cause picture to jitter at high contrast setting.
8: Check AGC threshold control.

## ALIGNMENT PROCEDUR

TEST EQUIPMENT - To service this receiver properly, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR meeting the following requirements: (a) Frequency ranges:

18 to $30 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
40 to $90 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
170 to $225 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating source.

SIGNAL GENERATOR to provide the following trequencies: (Output on these ranges should be adjustable and at east 1 volt maximum.)
(a) Intermediate alignment frequencies
23.1 mc first picture I-F coil.
24.1 mc third picture I.F coill
25.9 mc second picture I-F coil.

> 21.7 mc sound trap. 4.5 mc video trap \& sound I.F. 25.2 mc converter plate coil (Tune

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled.
ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 20 kilovolts. SERVICE PRICAUTIONS - To service the receiver remove the chassis from the cabinet. To do so, remove the knobs, the the antenna terminal board at rear of cabinet, and then the 5 chassis mounting bolts. The chassis may be serviced with the picture tube in place provided the chassis is turned on its side with the power transformer on the bottom. The weight of the chassis will be supported against the powe
transformer and pix tube brackets. CAUTION: Do not permit the kinescope second-onode lead to become shorted to the chassis. To do so will cause a considerable overload on the high voltage filter resisto
$\mathrm{R}-105$.

## ALIGNMENT PROCEDURE

## PIX I-F



10 A0J C-209
C-209


A. Unmodulated R-F signal into Converter Grid by means of tube shield insulated from base. VTVM with filter in lead of 22 K ohms and 5000 mmf connected to pic. det. load Fig. 9-VTVM Connections resistor, (R-37) 4700 ohms, in series with peaking coil (L-6) from Pin 2 of 6AL5. In. put signal level should be such that output is less than 2 volts DC. Apply $\mathbf{~} 4.5 \mathrm{~V}$ battery bias on AGC line. (Junction of $R-35 \& R-36$ ).

| frequency |  |
| :--- | :--- |
| 25.2 MC | Converter plate coil on top of <br> tuner for maximum dc at picture <br> detector. | detector.



3rd picture I-F coil (T-3 below chassis) for maximum dc at picure detector.
3rd picture I-F Irap (T. 3 in can bove chiassis) for minimum de at picture detector.
B. I-F Sweep Generator into converter grid by means of tube shield insulated from base.
Connect oscilloscope across R-37 (in place of VTVM). Apply -4.5 V bias (DC) to AGC line (battery).
Tuner should be switched to dead channel so as not to cause interference.


Fig. 11-Overall Response Curve

Observe overall I.F response, which should be as shown above: A slight touch-up may be required. At no time should the trap coil be re-ediusted, nor should it be neces sary to turn any of the picture I-F coils more than $1 / 2$ turn of the slug. The following comments are suggestion only:

The height of the 26.2 MC marker is controlled by the 25.2 inc (Converter Plate Coil on tuner) and the 25.9 MC (2nd P.I.F.) coils.
2. The uniformity of response (flatness across top and position of 23.5 MC ) marker is controlled for the most part by the 24.1 MC third picture I-F coil.
3. The 23.0 MC marker position is controlled by the first picture I-F ( 23.1 MC coil). However, it is NOT advisable sound rejection. Its adjustment should be avoided unless believed to be absolutely necessary.

With 4.5 MC unmodulated signal from a high impedance source, ( 10,000 ohms in series with the generator) into plate of the picture detector tube (Pin 2-6AL5) and VTVM on picture tube grid, tune 4.5 MC trap ( $\mathrm{L}-7 \mathrm{Top}$ ) for minimum response. VTVM on $0-10 \mathrm{VAC}$ scale. This adjustment can also be made while observing a picture from a station. Tune
trap for least 4.5 MC beat in picture.

## AUDIO I-F

1: With signal generator set to 4.5 MC and dc VTVM connected to iunction of R-13 and C-14, adiust sound take-off coil (L-13 Top) and sound I-F transformer slugs (T.6 Top \& Bottom) for maximum.

2: With VTVM connected to pin 7 of V -12 (6AL5) adjust the ratio detector primary (T-7 Bottom) for moximum.
3: With VTVM connected to junction of R-17, R-20 and $\mathrm{C}-18$, adjust ratio detector secondary ( $\mathrm{T}-7$ Top) for cross over (zero voltage) on lowest scale.
NOTE - If no signal generator is availabie, the proedure above may be followed by funing in a station and using the 4.5 MC beat between picture and sound
carrier.

## TUNER ALIGNMENT

A. Sweep generator with balanced 300 ohm output to antenna terminals. Marker generator output to antenna terminals. Oscilloscope to "test point" Figure 12) on tuner. Connect $11 / 2 \vee$ bias to AGC line at junction of $\mathrm{R}-34$ and $\mathrm{C}-29$ on the receiver.

Fig. 12-Top Tuner Adjustments.
B. RF AND CONVERTER ADJUSTMENT.

1. With channel selector on Channel 12, adjust C-201 slightly favoring the Pix carrier, then adjust C-206 and C -209 for response as in Figure 13. Picture and sound markers at $90 \%$ maximum response.
2. Check response on all channels. If markers are below $70 \%$ on any channels, readjust $\mathrm{C}-201, \mathrm{C}-206$, and C -209. Recheck all channels.


C OSCILIATOR ADJUSTMENT.

1. Apply -4.5 volts on I-F AGC line at iunction of R-1 and C-30.
2. Connect oscilloscope to output of video detector. Place fine tuning in center of range. Check response on all channels. Sound marker should be in notch and picture marker at $50 \%$. (See Figure 11).
3. If markers are off, individual oscillator coil slugs will require adiustment. Adiust each channel slug accessible through hole in front of chassis with a non-metallic screwdriver to bring sound marker to correct position.

## OSCILLOSCOPE WAVEFORM PATTERNS

VHF TUNER ASSEMBLY INFORMATION


Fig．14－＂${ }^{\prime \prime}$＂Tuner Pictoriol．

fig．15－Tuner Schemotic Diogrom

The waveforms on this page were taken with the receiver
funed to a normal picture．The numbers on the waveforms correspond to the numbers on the schematic diagram which dentifies each test point． peak to peak shown on each waveform are the approximate位

| No．${ }^{2-12 A T V}$ Plote |
| :--- |
| 44 V P．P 00 C．P．. |


No．8－6SN7－GTA－Vert．Ose．Plote

the repetition rate of the waveform，not the sweep rate of the oscilloscope．If the waveforms are observed on the oscilloscope with a poor high frequency response，the corners of the pulses will tend to be more rounded than those shown below and the amplitudes of any high fre
quency pulse will tend to be less．


No．3－Pix Tube Grid
23．150V P．P． 60 C．P．S．S．
No．9－6SN7．GTA Vert．Osc．Grid



No． 11 －vert．Def．Coil
GSV P．p 60 C．P．S．
No．17－68Q6 Grid
SoV P．p 15.750 C．P．S．


No．6－12AT7 Phose Spliter Cothode
No．13－6Als Phose De
18y P．P 15.750 C．P．S．


In earlier production R-79 was $5.6 \mathrm{~K}, \mathrm{R}-81$ was $220 \mathrm{~K}, \mathrm{R}-96$ was 1.8 K
R. 99 was $5.6 \mathrm{~K}, \mathrm{R}-103$ was $47 \mathrm{~K} 1 / 2 \mathrm{~W}$ and R-114 was not

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## DIFFERENCES BETWEEN EARLY AND LATE MODELS

The maior differences between the early and late models of the 3309 A UHF Converter are summarized in the table below. In addition, there are numerous differences in detail. A separate schematic diagram and parts list has been included for each version of this Converter.

|  | EARIY MODEL | LATE MODEL |
| :---: | :---: | :---: |
| I-FIF <br> AMPLIFIER | CIRASCODE <br> CIRCUIT TUBE <br> OBQ7 OR 6BK7 | PENTODE <br> CIRCUIT TUBE <br> TYPE 6CB6 |
| RECTIFIER | TUBE TYPE 6X4 | SELENIUM <br> RECTIFIER <br> 35 MA. |

## REPLACEMENT OF CRYSTAL DIODES

In both the early and late models of the 3309A Converter either of two types of crystal diodes may be found. A type iN72 or type TN82 crystal diode unit is mounted on the top of the chassis by teans of a clip-in crystal holder. These crystal types are usualiy means of a clip in thys application unless the circuit is realigned It is therefore recommended that the crystal unit be replaced with It is therefore recommended har the crystil
Polarity should be observed when replacing the crystal. The circuil will operate if the crystal is inserted backwards, but the noise leve will increase. Be sure that the replacement crystal is inserted with the corresponding ends in the same position as the original unit

## ELECTRICAL DESCRIPTION

The signal from the UHF antenna is coupled to. a band pass pre selector network that is tuned by means of two ganged variable inductors. A third section of the variable inductance gang varies the frequency of the local oscillator in the range of 378 mc to 828 mc. The signal voltage from the preselectior network and the output voltage from the local oscillator are coupled to a crystol diode mixer circuit. The useful output from the mixer will then become the intermediate frequency of the Converier. The center i-f frequency will in all cases be 82 mc . The i-f ampliner follows the mixer shage provide effective amplification of the signal. The output from the i-f amplifier is coupled to the VHF antenna rerminals of the television receiver. The VHF tuner will readily accept the 82 mc signal when tuned to either channel 5 ( 76 to 82 mc ) or channel 6 ( 82 to 88 mc ).

## ALIGNMENT

Complicated or specially-designed test equipment is not required for practical alignment of the 3309A. Instruments used in most TV ervice shops for testing VHF sets usually are satisfactory for align ing the Converter. In addition to these tools, the following instruments are needed: a VHF signal generator with AM output and a weep modulation of at least 12 megacycles; an oscilloscope o accuum tube voli-ohmmeter for measurement of the reiative signa nd an operating VHF television set. The latter is suggested as ractical amplifier for raising the output signal
 1 crystal diode and crystal diode
117 volts, 50 to 60 cycles AC

## GENERAL DESCRIPTION

The Airline U.H.F. Converter (Model 3309A) provides complete U.H.F. television coverage of channels 14 through $83(470 \mathrm{mc}$. to 890 mc .). It may be attached to any standard television receiver is complete with own self-contained power supply. The only connection required to the V.H.F. television receiver is made to the antenna terminals.
The power cord from the television receiver may be connected to the power receptacle on the rear of the Converter, and the television receiver power switch will then be left in the "On" position. Power to both the receiver and the Converter may then be controlled by means of the single switch on the Converter. The external V.A.F. antenna, when connected to the Converter, will be connected directly to the television receiver when the Converter selecior
witch is set to the V.H.F. position; and will be disconnected when the Converter selector switch is set to the U.H.F. position. The Converter is turned on when the switch is in the U.H.F. position, and standby when in the V.H.F. position.

SPECIFICATIONS


Fig. 2. Dial Stringing Detail
||

## VOLTAGE MEASUREMENTS

NOTE:Voltage measurements made by means of an electronic voltmeter (VTVM) shouid be taken between tube socket terminals and the thassis. Measurements within 20 percent of the specified value usually will assure satisfaclry performance of the Converter.

EARLY CASCODE I-F AMP. MODEL

| TUBE | USE | PIN NO. 1 | PIN NO. 2 | PIN NO. 3 | PIN N0. 4 | PIN N0. 5 | PIN N0. 6 | PIN N0. 7 | PIN N0. 8 | PIN NO. 9 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $6 \times 4$ | Rect. | 170VAC | NC | 0 | 6.3VAC | NC | 170VAC | 190VDC | - | - |
| $\begin{aligned} & \text { 6BK7 } \\ & \text { or } \\ & \text { 6BQ7 } \end{aligned}$ | I-F AMP | 120VDC | 0 | .85VDC | 6.3VAC | 0 | 125VDC | 0 | IVDC | 0 |
| 6AF4 | OSC. | $85 \mathrm{VDC} *$ | 5.7VDC* | 0 | 6.3VAC | 0 | 5.7VDC* | $85 \mathrm{VDC*}$ | - | - |
| LATE PENTODE I-F AMP. MODELS |  |  |  |  |  |  |  |  |  |  |
|  | I-F AMP |  |  |  |  | 98 VDC | 98VDC | 1.3VDC | - | -_ |
| 6AF4 | OSC. | $85 \mathrm{VDC} *$ | $\begin{aligned} & 5.7 \mathrm{VDC} \\ & \text { (neg. } \\ & \text { 3VDC } \\ & \text { min.) } \end{aligned}$ | $0$ | 6.3 VAC | 0 | 5.7VDC* (neg. 3 VDC min.) | 85VDC* | - | - |
| Selenium Rectifier "K" Terminol 125VDC <br> *Meosurement mode with 15 K isoloting resistor in series with valtmeter probe. |  |  |  |  |  |  |  |  |  |  |

## RESISTANCE MEASUREMENTS

NOTE: Resistance measurements, made by means of an electronic ohmmeler (VTVM), should be taken between tube sockel terminals and taking these measurements, the Converter switch must be furned to the "UHF" position and the line cord performance of the Converter. When
then

EARLY CASCODE I-F AMP. MODEL


## ALIGNMENT

The 3309A UHF Converter to be aligned should be connected to the VHF television antenna terminals. The oscilloscope or VTVM should then be connected to the TV set at a point which permits salisfaciory observarion of the relarive intensity and character of the AM (or sweep-modulated) signal introduced into the Converter
(video delector load resistor). The procedure for alignment consists of the following steps in the suggested sequence shown: (1) alignment of the I-F stage; (2) positioning of the oscillator for proper band coverage; and (3) alignment of R-F circuits for maximum effectiveness.


Fig. 3


Fig. 4.

## I-F ALIGNMENT

## EARLY CASCODE AMP. MODEL

1. Connect the VHF signal generator, through a suitable resistormatching network (Fig. 1) to the crystal mixer of the Converter at the junction of $\mathrm{XI}, \mathrm{C} 9,14$, and Cl 2 (Fig. 9). Apply an AM signal centered at 82 megacycles.
2. Align input and output I-F transformers, T 2 and T 3 , to obtai the maximum signal. Location of $1-F$ alignment points is shown in Figs. 5 and 7.
3. Replace $A M$ signal with a sweep of at least 12 megacycles centered at 82 megacycles. If a sweep generator with 82 megacycle center frequency is not available, switch from channel 5 to 6 to see skirts of curve.
4. Readiust slugs of double-funed I-F output Iransformer, T3, for equal signal response at VHF channels 5 and 6 . The I-F amplifier must be aligned for a minimum 12-megacycle band-width and the maximum gain possible with this band-width.

## LATE PENTODE AMP. MODEL

1. Connect the VHF signal generator, through a suitable resistormatching network (Fig. 3), to the crystal mixer of the Converter at the iunction of $\mathrm{C} 9, \mathrm{C} 10$, , LI and XI (Fig. 10). Apply an AM signal centered at 82 megacycles.
2. Align input and output $\mathrm{l}-\mathrm{F}$ transformers, T 2 and T 3 , 10 obtain the maximum signal. Location of I-F alignment points is shown in Figs. 6 and 8 .
3. Replace $A M$ signal with a sweep of at least 12 megacycles centered at 82 megacycles.
4. Readiust slugs of double-tuned I-F transformer, T3, for equal signal response at VHF channels 5 or 6 . The 1-F amplifier must ealigned for a minimum 12-megacycle band-width, and the maximum gain possible with this band-width.

## OSCILLATOR ADJUSTMENT

## EARLY CASCODE AMP. MODEL

1. Adjust 3309A luning control so that indicating pointer is positioned at extreme left-hand edge of dial.
2. Feed a 465 -megacycle $A M$ signal into Converter antenna erminals through a matching network described in Fig. 4. Adiust oscillator trimmer, ClO , for maximum signal. (Use non-metalic alignment tool.) When using a VHF signal generator, a fundath harm 93 megacycles may be .
3. Adjust 3309A tuning control so that indicator is positioned at xtreme right-hand edge of dial.
4. Set signal generator for 900 -megacycle output (5th harmonic of 180 megacycles). Carefully spread or pinch together the legs of the oscillator end-inductor (Fig. 5) for maximum signal.
5. 'Repeat above steps until no further improvement in signal is apparent. The oscillator alignment figures of 465 and 900 megacycles are approximate only, and may not fall precisely every case, the and minimum dial settings; however, in quencies can be funed by normal manipulation of the dial

## Late pentode amp. model

1. Adjust 3309A tuning control so that indicating point is positioned at extreme left-hand edge of dial.
2. Feed a 465 -megacycle AM signal into the converter antenno terminals through a matching network (described in Fig. 2). A.tiust oscillator trimmer, CII, for maximum signal. When using a VHF signal generator, a fundamental of 93 megacycles may be employed to produce the 5 th harmonic energy of 465 megacycles
3. Adiust 3309A tuning control so that indicator is positioned at extreme right-hand edge of dial.
4. Set signal generator for 900 -megacycle output (5th harmonic of 180 megacycles). Carefully spread or pinch together the legs of he oscillator end-inductor (Fig. 6) for maximum signal.
5. Repeat above steps until no further improvement in signal is apparent. The oscillator alignment figures of 465 and 900 megacycles are approximate only, and may not fall precisely the maximum and minimum dial settings; however, in every case, the oscillator must be aligned so that both frequencies can be funed by normal manipulation of the dial.

## R-F ALIGNMENT

## REPAIR PARTS

## EARLY CASCODE I-F AMP. MODEL

Adiust tuning control so that indicator is positioned at extreme eft-hand edge of dial
Feed a 465 -megacycle signal into the Converter antenna erminals las indicated above for oscillator alignment.
3. Adjust R-F trimmers, C 6 and C 3 , for maximum signal.

Readiust tuning control so that indicator rests at extreme rightand edge of dial.
5. Set signal generator for 900 megacycles output

Adjust R-F end-inductors (Fig. 5) for maximum signal.
7. Repeat above steps until no $f$ rther improvement in signal is pparent.
3. Readjust tuning control so that indicator is positioned at extreme left-hand edge of dial.
9. Adjust coupling trimmer, B1, for maximum signal


Fig. 5. Early Boltom View


## ATE PENTODE I-F AMP. MODEL

1. Adjust tuning control so that indicator is positioned at extrem left-hand edge of dial.
2. Feed a 465 -megacycle signal into the Converter antenna termi nals (as indicated above for oscillator alignment).
Adjust R-F trimmers, C3 and C7, for maximum signal. Physical location of R-F alignment points is shown in Fig. 8.

Readiust tuning control so that indicator rests at extreme righthand edge of dial.
5. Set signal generator for 900 -megacycle output
6. Adiust R -F end-inductors (Fig. 6) for maximum signa

Repeat above steps until no further improvement in signal is pparent


Fig. 6. Lote Bottom View


Fig. 8. Late Top View

EARLY CASCODE MODEL

\begin{tabular}{|c|c|c|c|c|c|c|c|}
\hline \begin{tabular}{l}
REF. \\
No.
\end{tabular} \& \[
\begin{aligned}
\& \text { Part } \\
\& \text { no. }
\end{aligned}
\] \& description \& \[
\begin{aligned}
\& \text { PRICE } \\
\& \text { EACH }
\end{aligned}
\] \& REF.
No. \& PART \& description \& \[
\begin{aligned}
\& \text { PRICE } \\
\& \text { EACH }
\end{aligned}
\] \\
\hline \multicolumn{4}{|c|}{CONDENSERS} \& \multicolumn{2}{|l|}{} \& \multicolumn{2}{|l|}{\multirow[t]{2}{*}{\begin{tabular}{l}
CONDENSERS \\
Condenser, 68 uuf \(\pm 10 \%\).
\end{tabular}}} \\
\hline \multirow[b]{2}{*}{C3, C7} \& \& \multirow[t]{2}{*}{Condenser, .8-6.5 uuf.} \& \multirow{13}{*}{\(\$ .50\)
.08

.36
.90} \& C1, C2, C12 \& \multirow[b]{2}{*}{A-600220-1} \& \& <br>
\hline \& A.600220-1 \& \& \& \multirow[t]{2}{*}{C3, C6
C4, 7 c} \& \& Condenser, , 8-6.5 uuf........... \& \$ . 50 <br>
\hline C4
C5 \& A-600389.2 \& Condenser, ${ }^{\text {condenser, } 0.4 \text { uuf } \pm \text {. } 10 \%}$ \& \& \& \& Condenser, 1.0 uuf. \& \multirow[t]{2}{*}{. 08} <br>
\hline C6 \& \& \& \& \& A.600025-15 \& Condenser, 1.2 uuf.
Condenser, 2.2 uff. \& <br>

\hline C8 \& \& $$
\text { Condenser, } 1.5 \text { uuf } \pm 10 \% \text {. }
$$ \& \& \& \multirow[t]{2}{*}{A.600282-3} \& Condenser, 3-10 uuf \& \multirow[t]{2}{*}{. 36} <br>

\hline C10 \& \& Condenser, 68 uuf $\pm 10 \%$. \& \& Cl1 \& \& 隹 \& <br>
\hline $\mathrm{Cl1}$ \& A.600282-3 \& Condenser, 3-10 uuf. \& \& C13 \& \& Condenser, 68 uuf. \& \multirow[t]{2}{*}{} <br>

\hline $\mathrm{Cl}^{2}$ \& \& | Condenser, 10 uuf. |
| :--- |
| Condenser, Filler $30-30 / 150 \mathrm{~V}$. | \& \& C15 \& \& \& <br>

\hline ${ }_{C 13} \mathrm{Cl} 3$, $\mathrm{Cl13B}$ \& 103035 \& Condenser, Filter 30-30/150V. Condenser, 68 uuf \& \& C14A \& \multirow{5}{*}{FP 318.5} \& \multirow[t]{2}{*}{Condenser, 20-20-20/200-175-150.} \& \multirow[t]{4}{*}{. 90} <br>

\hline $$
\begin{aligned}
& \mathrm{C} 14, \mathrm{C} 16 \\
& \mathrm{C} 15, \mathrm{C} 17
\end{aligned}
$$ \& \&  \& \& ${ }^{\text {C14B }} \mathrm{Cl14C}$ \& \& \& <br>

\hline ${ }^{\text {C18, }} \mathrm{Cl} 9$ \& \& Condenser, 1000 uuf \& \& C16, ${ }^{\text {C17 }}$ C19 \& \& \multirow[t]{2}{*}{Condenser, 1000 uuf} \& <br>
\hline \multicolumn{3}{|l|}{\multirow[t]{2}{*}{C21, C22, C23, C24-Part of T3 Output I-F Transformer}} \& \& \multirow[t]{2}{*}{C20, C21, C22} \& \& \& <br>
\hline \& \& \& \& \& \& \& <br>
\hline \multicolumn{4}{|c|}{RESISTORS} \& \multicolumn{4}{|c|}{RESISTORS} <br>
\hline R1, R2 \& \& Resistors, 1500 ohms- $1 / 2 \mathrm{~W}$ \& \& R2 \& \& Resistor, 3300 ohm-2W. \& <br>
\hline R3 \& \& Resistor, 12 K ohms $-1 / 1 / \mathrm{W}$. \& \& R3, R4 \& \& Resistor, 680 ohm-2W.. \& <br>
\hline R4 \& \& Resistor, $4702 h m-1 / 2 \mathrm{~W}$. \& \& R5, R6 \& \& Resistor, 56 ohm $\pm 10 \%-1 / 2 \mathrm{~W}$ \& <br>
\hline ${ }^{\text {R } 5}$ \& \& Resistor, 1200 ohms-2W \& \& ${ }^{\text {R7, R8 }}$ \& \& Resistor, 470 ohm-1/2W.
(Part of Inductuner). \& <br>
\hline \multicolumn{4}{|l|}{\multirow[t]{2}{*}{R7, R8-Part of Inductuner L7A, B and C .}} \& R9, R10 \& \& (Part of inductuner).. \& <br>
\hline \& \& \& \& \multicolumn{4}{|l|}{} <br>
\hline \multicolumn{4}{|c|}{TRANSFORMERS AND COILS} \& \multicolumn{4}{|l|}{} <br>
\hline II \& B-630124-1 \& | Transformer, Power... \& \& T2 \& B.630070-1 \& Transformer, Input. \& 2.50 <br>
\hline T2 \& B.630130-1 \& Transformer, I-F Input. \& . 50 \& T3 \& B-630121-1 \& Transiormer, Output. \& 4.60 <br>
\hline T3 \& B-630131-1 \& Transformer, 1-F Output \& \& L1, L2 \& \& \& <br>
\hline 11 \& A. 600407 \& Choke. \& \& L7, L8, L9 \& A.600033-2 \& Choke. \& . 08 <br>
\hline L2, L3 \& A.600240-1 \& Choke, 38 uh \& . 50 \& L3, L4 \& 6000285 \& Choke \& <br>
\hline L4, L5 \& A.6003833-1 \& \& . 10 \& 110 \& A-600240 \& Choke \& 50 <br>
\hline 16 \& A-600384-1 \& Choke \& . 10 \& 111 \& A. $600240-2$ \& Choke \& . <br>
\hline ${ }_{\text {L }}^{17 \mathrm{~A}}$ \& A.600286-1 \& Tuner, UHF \& 13.50 \& ${ }_{\text {L12B }}$ \& A.600286-1 \& Tuner, UHF \& 13.50 <br>
\hline \multicolumn{4}{|l|}{\multirow[t]{2}{*}{LIC miscellaneous}} \& \& \& \& <br>
\hline \& \& \& \& \multicolumn{3}{|r|}{miscellaneous} \& <br>
\hline Al \& B-630094-1 \& Antenna. \& \& \multirow[t]{2}{*}{Al
B1} \& \multirow[t]{2}{*}{B-630094-1} \& \multirow[t]{2}{*}{Antenna-...........
Nylon Adjustment Screw.} \& 1.80 <br>
\hline S01 \& A.600214-1 \& Power Outlet, A. C. \& . 28 \& \& \& \& \multirow[t]{2}{*}{. 28} <br>
\hline SRI \& A.600474-1 \& Selenium Rectifier. \& 1.44 \& \& A-600214-1 \& Power Outlet, A. C....... \& <br>

\hline SWIA \& \& \multirow[t]{2}{*}{Switch} \& \multirow[t]{2}{*}{1.66} \& \multirow[t]{2}{*}{| SWIA SWIB |
| :--- |
| SWIC |} \& \multirow[t]{2}{*}{B-630069-1} \& \multirow[t]{2}{*}{Switch} \& \multirow[t]{2}{*}{1.66} <br>

\hline SWIB
SWIC \& B-630069-1 \& \& \& \& \& \& <br>
\hline
\end{tabular}

PARTS - BOTH MODELS

| Part no. | name Of Part | price EACH | $\begin{gathered} \text { Part } \\ \text { no. } \end{gathered}$ | name of part | Price <br> EACH |
| :---: | :---: | :---: | :---: | :---: | :---: |
| B-630065-1 |  | \$ 5.50 | A.600296-1 | Osc. Plate Bracket | \$ 04 |
| ${ }_{\text {A }}^{\text {- } 6000376-1}$ | Cable Clamp. | . 08 | ${ }_{\text {B-630129-1 }}$ | Osc. Shield | . 20 |
| A-660365-1 | Chassis, I-F. | . 28 | A.600298-1 | Osc. Shield Lid | . 08 |
| ${ }_{\text {C }-646056-1}$ | Chassis, R. F. | . 33 | A. $600280-1$ | Osc. Trimmer Bracket. | . 18 |
| A-600387-1 | Chassis, End. | . 10 | A. 6000034.1 | Socket (I. F.). | . 18 |
| B. 630049.3 | Cord, A. C. | . 82 | A. $6000215-1$ | Socket (Osc.) Screw 6-32 (Trimmer). | . 01 |
| A.600433-1 | Crystal...... | 2.90 .20 | A-11511.62 | Screw 6-32 (Trimmer). | . 01 |
| A.600378-1 | Crystal Board | . 80 | A. $600035-1$ | Shield, 7 Pin Tube (0sc.). | . 14 |
| B-630062-1 A-13972-16 | Eyelet. | . 01 | A.600035-3 | Shield, 7 Pin Tube (1-F). | . 08 |
| A.11514-29 | Hex Nut. | . 01 | A. $6002217-1$ | Terminal Board. | . 14 |
| A.600023-7 | Insulator. | . 01 | A. 6002777.1 | Trimount Stud..... | . 10 |
| C-646070-1 | Knob (Function). | 1.00 | A. 600222 -1 | Transmission Line, | 2.50 |
| C-646070-2 | Knob (Tuning) Knob, Spring | .80 .02 | ${ }_{\text {B-63012-1 }}^{\text {B-630070-1 }}$ | Transformer, , Input.... Transformer, Output. | 2.60 4.60 |
| A.600256-1 | Knob, Spring. | . 02 | B.630121-1 |  |  |




## TUBE COMPLEMENT

| 6BQ7 or 6BZ7 | R．F．Amplifier |
| :--- | :--- |
| 6J6 | Oscillator，Modulator |
| 6CB6 | Video I．F．Amplifier |
| 6CL6 | Video Amplifier |
| 6AU6 | Sound I．F．Amplifier |
| 6AL5 | Sound Detector |
| 6SN7GT | A．F．Amplifier，Horizontal |
|  | AFC Control |
| 6W6GT | Audio Amplifier |
| 6SN7GT | SYnc Separator，Phase Splitter |
| 6SN7GT | Horizontal Oscillator |
| 1B3GT | H．V．Rectifier |
| 6BQ6GT | Horizontal Output |
| 6W4GT | Horizontal Damper |
| 12BH7 | Vertical Oscillator，Vertical |
| 5U4G | Amplifier |
| 21YP4A | Power Rectitier |
|  | 21＂Picture Tube |
| Electrostatic Focus |  |
|  | Video Detector |
| 1N60 | Germanium Crystal |

## ELECTRICAL SPECIFICATIONS

Power Supply
Power Consumption
Power Output
Antenna Input Imp．
Tuning Range
Loud Speaker

Voice Coil Impedance
nter－Carrier Sound
I．F．CIRCUIT
R．F．STAGE One
IF．STAGES
Three＂Combined Picture and Sound＂and one＂Sound＂ 41．25 M．C．Sound Carrier
55．75 M．C．Video Carrier
4．5 M．C．Inter－Carrier Sound

## GENERAL INSTALLATION INSTRUCTIONS

While each receiver is correctly aligned at the factory ough handling in transit，ageing，drift，etc．，may throw the receiver off，so we suggest that the proper oscillator trimmers，ratio detector，and rear panel controls（see pages 4 and 5）be checked for correct adjustment with a trans－ mitted television pattern，in the customer＇s home at the time of installation．Be sure to have the receiver operating for one－half hour before making these adjustments．Liste below is the correct procedure to follow in making thes adjustments．
（A）Check all operating chamnels，using FINE TUNING CONTROL for best picture detail．（See paragraph TRIMMERS．）
（B）Check LOCALITY ADJUSTER CONTROL located Check LOCALLTY AD of chasser setting

Note：The signal strength（too strong or too weak） will lie affected by location and distance from th tation，type of aitena acrical disturbances

PEAKING THE INDIVIDUAL OSCILLATOR TRIMMERS
（A）Set chamuel selector knob to the desired channel
（B）Set the FINE TUNING CONTROL to the cente position．
（C）Remove the channel and fine tuning knobs．This will expose the individual channel adjustment screw opening just to right of the channel shaft．See Fig． 1
（D）Use a non－metailic screwdriver such as polysterene or nylon

Adjust the individual oscillator screw for best picture de tail．A slight adjustment in either direction is all that is necessary．CAUTION：DO NOT ADJUST INDISCRIM INATELY，this may cause the adjustment screw to fal from its locking position


## ADJUSTMENT FOR STATION BUZZ

If station buzz is excessive and is NOT bue to＂contrast control＂being advanced too far in a clockwist direction or the locality adjuster control in the incorrect position，ad－ just the ratio detector secondary adjustment screw locater on top of the ratio detector for minimum buzz．MAKE SURE THAT THIS POSITION IS BETWEEN the tw MAXIMUM buzz peaks that will be noticed when adjus ment screw is turned to the right or left of the minimu buzz position．

## HIGH VOLTAGE WARNING

This television receiver contains high voltages which are dangerous to life or may result in serious burns．Never operate or service the receiver outside of the cabinet or with the high voltage shield cover removed until all the safety precautions necessary for working with high voltage equipment have been observed．

## PICTURE TUBE

## handling precaution

Shatterproof gogqles and heavy gloves must be worn by individuals while handling or installing the picture abe int a high vacuum and is subjected to excessive cair pressure．解 HANDLE damage to property or injury to an individual．

## CHASSIS REMOVAL INSTRUCTIONS

## o remove chassis from cabinet correctly：

．Remove back from cabinet．
Disconnect speaker leads from jack mounted on chassis．（Remove speaker from table model cabinet）．
3．Remove the 4 pushon type knobs．
4．Remove the 4 chassis mounting screws．
When reinstalling chassis make sure inside of safety glass is clean and face of picture tube is free of finger marks．lint，etc．Any commercial glass cleaner may be used．

When replacing picture tube always have face of tube tight against rubber stops


## REAR PANEL CONTROL ADJUSTMENTS

don't disturb these panel controls unnecessarily-if the picture is good, leave them alone.

Normally, after the receiver has been properly installed,
only the two dual operating controls on front of cabinet
need he adjusted by the owner need be adjusted by the owne

ONLY when the picture does not stay locked in the center
of the screen, or is egg-shaped or very fuzzy, will it be of the screen, or is egg-shaped or very fuzzy, will
necessary to adjust one of the rear panel controls.
If you experience a poor quality television picture, do not The cause may be due to temporary station transmitter The cause
difficulties.

Before adjusting any of the panel controls, study the picture you are receiving and compare it with one of teristics. ADJUST ONLY THE CONTROL INDICATED AS THE ONE TO BE USED to correct that particula
By having someone hold a mirror in front of screen it is possible to adjust the required control and still look at
the screen while making the adjustnent. Turn the the screen while making the adjustment. Turn the
proper control slowly to the right or left until the picture proper control slowly to the right
stops rolling, becomes clear, etc.


If picture is too strong ond the CON.
TRAST CONTROL is not set too high TRAST CONTROL is not set too high.
adjust to either medium or strong signol.


If the picture is weak and on adjustment
of the FINE TUNING CONTROL does of the FINE TUNING CONTROL does
not bring out good picture detoil, adjust
to either medium or weak signal.

VERTICAL AND HORIZONTAL CENTERING TO BE ADJUSTED BY A QUALIFIED
TLEVISION TECHNICIAN ONLY. Ad.
iust the 2 centering rings mounted on iust the 2 centering rings mounted on for proper centered picture.


BRIGHTNESS CONTROL: This control BR used in adiusting for brilliance or light intensity of the screen. When picture is
too light os shown odiust Brightness Con-

If PATTERN continuously rolls across screen in verticol diritection (up or or downs dit
ADJUST VERTICAL HOLD CONTROL othat pattern stops rolling and remains

OJohn F. Rider

## INTERFERENCE

Electical interference reflections and refractions, all of which will affect the quality of the picture are problems that cannot be eliminated by any of disturbance must be considered when the tele
vision antenna is installed.

This means that both the type of antenna and its installation are of the greatest importance and is one of the reasons why we recommend that only a trained television technician install the antenna.



## ALIGNMENT DATA

## ALIGNMENT PROCEDURE

All circuits are very stable and will seldom require adjustment. Only when major parts of the tuner or the video I-F
trip have been replaced or tampered with will it be necessary to realign the receiver.
Generally under normal conditions only the INDIVIDUAL CHANNEL TRIMMERS in the tuner unit may require adjustment by the service technician

## RATIO DETECTOR AND SOUND I-F ALIGNMENT

In most cases only the secondary of the ratio detector coil will require adjustment. This can be done simply by adusting the top adjustment screw of the ratio detector for minimum buzz with the sound carrier of a TV station. For complete alignment use steps 1,2 , and 3 in the alignment table.

## PICTURE I-F ALIGNMENT

Receiver should be run for at least $1 /$ hour before proceed ing with alignment.


FIG. 2

## EQUIPMENT REQUIRED

VACUUM TUBE VOLTMETER
For video IF alignment maintain readings in middle of low volt scale.

SIGNAL GENERATOR supplying a 4.5 MC . (within $.25 \%$ 40 to 216 MC . (within 1\%) signal. With output adjustable to at least .1 volt maximum.

CATHODE-RAY OSCILLOSCOPE. Must have good fre quency and phase response from 10 cycles to at least 2 MC .

SWEEP (GENERATOR. Capable of covering 40 to 270 MC. with a 10 MC . sweep with output adjustable to at least 1 volt maximum.

3 VOLT "A" BATTERY to provide fixed bias during video I-F and R-F alignment.


FIG. 3

## ALIGNMENT TABLE

## RATIO DETECTOR AND SOUND ALIGNMENT

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | Connect Signal Generator to |
| :---: | :---: |
| 1 | In series with .001 Mfd . C-97 and L-13 terminal 3 of 4th I.F. See fig. 5 |
| 2 | In series with .001 Mfd. Cond. to junction of 3 of 4th I.F. See fig. 5 |
| 3 | In series with . 001 Mid. Cond. to cathode of picture tube yollow lead. See fig. |


| Sig. Gen. Freq. | Connoct Voltmeter to |
| :---: | :---: |
| 4.5 MC . | In sories with 47,000 ohm res. across C-23 a 10 Mfd . cond. See fig. 5 |
| 4.5 MC . | In series with 47,000 ohm res. to junction of R-30 and C.44. Seofig. 5 |
| 4.5 MC . | In series with 47,000 ohm res. across C-23 - 10 Mfd . cond. See fig. 5 |

PICTURE I-F ALIGNMENT

| step. | Connect Signal Generator to | Sig. Gen. Freq. | Connect Voltmeter to | Miscellaneous Instructions | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 4 | Ungrounded converter tube (6.J6) shield. | 44.0 MC . | In series with 47,000 ohm res. to iunction of R-37 and L-7. See fig. 5 | Tuner on channol 3, 3 volts bios across C-51 positive side to ground. Locality switch in strong position. See fig. 5 | T. 5 (top) for maximum reading. See fig. 4 |
| 5 | Ungrounded converter tube (6J6) shield. | 43.0 MC . | In series with 47,000 ohm res. to junction of R-37 and L.7. See fig. 5 | Tuner on channel 3, 3 volts bias across C-5I positive side to ground. Locality switch in strong position. See fig. 5 | T. 4 (top) for maximum reading See fig. 4 |
| 6 | Ungrounded converter tube (6J6) shield. | 41.25 MC . | In series with 47,000 ohm res. to iunction of R-37 and L.7. See fig. 5 | Tuner on chonnel 3,3 volts bias across C-51 positive side to ground. Locality switch in strong position. Soe fig. 5 Repoat Steps 5 \& 6 | T-4 (bottom) for minimum reoding. See fig. 5 |
| 7 | Ungrounded converter tube ( 6 Jb ) shield. | 45.4 MC . | In series with 47,000 ohm res. to junction of R-37 and L-7. See fig. 5 | Tuner on channel 3.3 volts bies across C-51 positive side to ground. Localify switch in strong position. See fig. 5 | T-3 (top) for maximum reading. Seo fig. 4 |
| 8 | Ungrounded converter tube (6J6) shield. | 47.25 MC . | In series with 47,000 ohm res. to junction of R-37 and L-7. Sea fig. 5 | Tuner on channel 3, 3 volts bios across C.51 positive side to ground. Locality switch in strong position. Soe fig. 5 Repeat Stops 7 \& 8 | T-3 (bottom) for minimum reoding. See fig. 5 |
| 9 | Ungrounded converter tube (6J6) shield. | 4.6 MC . | In series with 47,000 ohm res. to iunction of R-37 and L-7. See fig. 5 | Tuner on channel 3. 3 volts bios ocross C. 51 positive side to ground. Locality switch in strong position. Seo fig. 5 NOTE: Detune T-2 by turning slug out as far as possible. | T.l (top) for maximum reoding. Soe fig. 4 |
| 10 | Ungrounded converter tube (6J6) shield. | 45.75MC. | In series with 47,000 ohm res. to junction of R-37 and L-7. See fig. 5 | Tuner on channel 3, 3 volts tias across C. 51 positive side to ground. Localify switch in strong position. See fig. 5 | T-2 (top) for maximum reoding Seo fig. 4 |

NOTE 3: For visual check of if response curve (see fig. 2) connect signal and sweep generotor to ungrounded converter tube shield (6Jb). Connect oscilloscope in series with $\mathbf{4 7 . 0 0 0}$ ohm resistor to junction of R-37 and L.7.

TUNER R.F. ALIGNMENT
Note 4: never adjust C-3, C-7 and C-12 Unless absolutely necessary. they are factory preset by special equipment.

| Step No. | Connect Marker Generator to | $\begin{gathered} \text { Marker } \\ \text { Gen. Freq. } \end{gathered}$ | Connect Sweep Gen. to | Sweep Gen. Chan. | Connect Oscilloscope to | Miscellaneous Connections | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 11 | Loosely couple to sweop gen. leads. | 205.25 MC. <br> 20975 <br> 209.75 MC. | 300 ohm antenna terminals. | 12 | Leod extending from top of tuner. See fig. 4 | Tuner on channel 12 3 volt bias to junction of C-51 locality switch in strong position. | C.3. C-7 and C. 12 for max. response having linear pooss with pic. ture and sound mark- ers at $90 \%$ moximum response. See fig. 3 |
| 12 | observe response curve for all channels using correct frequencies and channels. A SLIGHT COMPROMISE SHOULD BE MADE WITH C-3, C-7 and C-12 IF MARKERS ARE BELOW $70 \%$. |  |  |  |  |  |  |

note 5: FOR RF oscillator abignment. set fine tuning control in Center position. adjust individual channel. trimmers for best picture detail with the patterns of a ty station. note: use a non-metallic screw. Driver

NOTE 6: C-I. (See fig. 4) part of a 40 MC . funed trap need only be adiustod when local interferences from 40 thru 45 MC . affect the picture. Adiust C -18 for minimum 40 MC . beat on picture with a station signo!.

NOTE 1: For minimum buzz olwoys odiust T-8 (top) with the sound carrior of a TV stotion
NOTE 2: Alternate 4.5 MC trap aligent
NOTE 2: Alternate 4.5 MC . trap alignment: Adjust T .6 (top) for minimum 4.5 MC . beot on picture with a strong station signal.

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MAIN CHASSIS


MAIN CHASSIS-(Cont.)

|  | Part No. | Dessription | Price | Part No. | Dessription | Prite |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RESISTORS-(Cont.) |  |  |  | miscellaneous-(Cont.) |  |  |
| $\begin{aligned} & R-89 \\ & R .90 \end{aligned}$ | ${ }_{\text {2 }}^{27 \mathrm{E} 225-2}$ | Carbon, 2.2 Megohm 1/2 ${ }^{\mathbf{W}}$. $\pm 20 \%$ | .06 .06 | $17 E 1.18$ $17 E 1.27$ | Socket, Octal | 14 |
| R-91 | $27 \mathrm{EE84-2}$ | Carbon, $680,000 \mathrm{OHM} 1 / 2 \mathrm{~W} . \pm 20 \%$ | . 08 | $17 \mathrm{EL}-36$ | Socket, Miniature 7 Pin | . 14 |
| R. 93 | 27E102-2 | Carbon, 1,000 OHM 1/2 W. $\pm 10 \%$ <br> CHOKES AND COILS | . 06 | 17E1.39 18E25 20E419-4 | Socket, Miniature 9 Pin (Noval Mica) Torminal, Antenna <br> Connector 2nd Anode Picture Tube | .22 <br> .48 |
| L. 6 | 20E363.25 |  | 70 | ${ }_{2}^{20 E 5617.12}$ | Socket Assombly Picture Tube. | . 02 |
| L-7 | 20E363-19 | Diode Shunt Choke. | . 70 | 15E174.4 | Ion trap .................... | . 84 |
| L. 9 | 20E363.26 | Video Shunt Choke | 70 |  |  | 76 |
| L. 10 | 20E831 | Horizontal Hold | 1.74 | 20 E 91 | Antenna, Built-In | 1.46 |
| L-11 | ${ }^{22 E 97}$ | Filter Choke | $\begin{array}{r}2.72 \\ \hline 36\end{array}$ |  |  |  |

MISCELLANEOUS CABINET PARTS

9E45 Safoty Glass

$$
\begin{array}{ll}
\text { 9E45 } & \text { Safoty Glass . } \\
206774.9 & \text { Cabinot Back Asso } \\
36 E 93.2 & \text { Mask for Picture }
\end{array}
$$

Assembly with
$\begin{array}{ll}\mathrm{L}-13 & 20 \mathrm{~EB} \\ \mathrm{~T}-2 & 20 \mathrm{E} \\ \mathrm{T}-3 & 20 \mathrm{E} \\ \mathrm{T}\end{array}$
$\begin{array}{cc}\mathrm{T} .3 & 20 \\ \mathrm{~T} .4 & 20 \mathrm{E} \\ \mathrm{T}-5 & 20\end{array}$
$\begin{array}{ll}\mathrm{T}-6 & 20 \mathrm{E} 7 \\ \mathrm{~T}-7 & 20 \mathrm{~F} \\ \mathrm{~T}-8 & 20 \mathrm{E} \\ \mathrm{T} & \\ \mathrm{T} & 22\end{array}$

$\begin{array}{ll}\mathrm{T}-12 & 22 \\ \mathrm{~T} \\ \mathrm{~T}-13 & 22 \\ \mathrm{~T} & 22\end{array}$


Rubber Gasket for Mast 5 s ${ }^{\prime \prime}$......
Knob Assembly Channol Solector
$* * 20 E 544-14$
$* 20 E 545-9$$\quad$ Knob Assembly (Channol Solector)
${ }_{*}^{*}$ 2005545-9 Knob Assombly (Of-On-Volumo

Knob Only (Channol Solector)
${ }_{* 37 E 71-7} \quad$ Knob Only (Off.On-Volume).
*37E71-8 Kob, Fine Tuning
**37E71-11 Knob, Fine Tuning

*For mahogany cabinets only.
**For blonde cabinets only.
ere


ELECTRICAL SPECIFICATIONS
Power Supply, .............. 60 Cycles Only 6
Power Consumption ........Television-210 Watts Phonograph-55 Watis
2.4 Wats (Max) 1.8 Watts (10\% Distortion) TV Channels 2 thru 13 AM-540-1600 KC
Intermediate Freq. (Tel.) . . . .Picture- $\mathbf{2 6 . 2 0} \mathrm{MC}$ Sound-21.70 MC

Intermediate Freq. (Radio). . 455 KC
Selectivity (Radio) . . . . . . . . . 45 KC Broad at 1,000 Times Signal, measured at $1,000 \mathrm{KC}$

Sensitivity (Radio) .........(For . 5 Watt Output) 10 Microvolts Average
Tel. Antenna Input Imp. ... 00 Ohms Balanced ntercarrier Sound System
4.5 MC
oud Speaker ..............
PM Dynamic
Vice Coil Impedance . .
Record Changer . . . . . . . . . . See Manual 5096A (VM-950)
Cartridge . . . . . . . . . . . . . . . . Shure P77V (60H17)
Needles-78 RPM .......... Shure 85-16 (61H2)
$-331 / 3$ \& 45 RPM -Shure 85-18 (61H13)

TUBE COMPLEMENT

## TELEVISION

| Symbol Type |  |
| :---: | :---: |
| Tuner.......6J6 | Runction | R-F Amplifier

1st Pix I-F Amplifier 2nd Pix I-F Amplifier 3rd Pix l-F Amplifier Pix Det, and DC Restorer
1st Video Amp. and Phase Splitter
Video Output
Sync. Separator
Vertical Osc. \& Vertical Output
Automatic Gain Control
1st Audio I-F
2nd Audio I-F
Ratio Detector
1st Audio Amplifier
Audio Output
Phase Detector
Horizontal Oscillator Horizontal Output
Damper
High Voltage Rectifier
Low Voltage Rectifier
Picture Tube 21" Metal
Rectangular (Electrostatic)



Fig．3－Removal of Picture Tube

WARNING－Before handling the picture tube，it will be necessary to remove the static charge．In receivers with glass picture tubes，ground the anode lead to chassis， and insert an insulated wire from the well in the tube
to chassis．In receivers with metal picture tubes， to chassis．In receivers with metal picture tubes，remove the static charge by grounding an insulated wire from
the chassis to the metal portion of the tube PICTURE TUBE REPLACEMENT－TO Reple
it is necessary to it is necessary to remove the chassis from the cabin
This may be accomplished in the following manner：
Remove the front panel control knobs by pulling them straight from their shafts．
2．Remove the cabinet back．
Disconnect the leads from the speaker，the radio chassis，remove the antenna terminal board at the rear of the cabinet and then the five chassis mounting
．Remove the picture tube as shown and oulined is
illustration．To install a new picture tube，reverse the procedure making sure that the picture tube fits close against the picture tube cushion．If the picture tube sticks or fails to slip into place smoothly，investigate and remove the source of the trouble．Never force the tube．It is important that all the clips and shims used in mounting the tube be replaced，otherwise difficulty may be encountered when horizontal or vertical centering is required．

tom Socket Vallens


Fig．7－Block Diagram

## RASTER ON TUBE BUT NO PICTURE OR SOUND

This condition can be caused by,
1: Defective pix I-F Amplifier tubes V-1, V-2 or V-3
2: Defective pix detector tube V-4A (6AL5). Check tub and its associated circuit.
3: Defective R-F Amplifier or oscillator mixer tubes the tuner.
POOR fOCUS
1: Improper setting of lon Trap magnet.
2. Defective picture tube or picture tube socket

## PICTURE ITITER:

1: If regular sections at left of the picture are dis placed, replace the horizontal oscillator tube V - 16 .
2: Vertical instability may be due to loose connection or noise received with the signal.
3: Horizontal instability may be due to unstable transmitted sync.
4: Check receiver AGC system for proper operation.
5: Check phase splitter V-5B, (12AT7) and sync separo for V-7 (6BE6).
6: Check for improper setting of sync stability control
7: Picture tube grid lead not held in position by suppor spring, ie: close proximity of grid lead to sync and spring, ie: close proximity of grid ead jitter at high contrast setting.
8: Check AGC threshold control.

POOR VERTICAL LINEARITY - If adjustment of the heigh and linearity controls will not correct this condition, any of the following may be the cause.
2. Vertical output transformer (T-5) defective.

3: Capacitors $\mathrm{C}-47 \mathrm{~B}, \mathrm{C}-70$ or $\mathrm{C}-71$ defective.
4: V-8 defective, check voltages.
5: Excess leakage or incorrect value of capacitor C-68 or open or incorrect value of resistors R-90 \& R-92.
in $+B$ supply circuits.
: Capacitor C-67 defective

POOR HORIZONTAL LINEARITY - if adjustment of the Horiontal drive and linearity controls does not correct this condition, check the following:
1: Check or replace horizontal output tube V-17.
2: Check or replace damper tube V-18 (6AX4-GT).
3: Check capacitors C-77, C-78, C-79 and horizontal linearity control (L-16) for defects.
Horizontal deflection coils (L-17) defective

## trapezoidal or nonsymmetrical raster

1: Defective yoke.
WRINKLES ON LEFT SIDE OF RASTER - This condition can be caused by:
1: Defective yoke due to C-76 or R-106 (internal in yoke

## PICTURE Smear:

1: A smear can be attributed to phase shift at the low or high frequency end of the video characteristic. This can be caus improper values of resistors and capacitors in the video circuits. Check for grid curren
on video output tube V-6 (6AH6), open or shorted peaking coils, video amplifier load resistors are of improper value (high).
2: This trouble can also originate at the transmitter. Check reception from another station.
3: Check and realign, if necessary, the picture I-F and R-F circuits.

## MAN MADE NOISE IN SOUND (Ignition, etc)

1: Check sound I-F tubes V-10, 11 \& 12 and associated circuits.
2: Check sound I-F alignment
BENDING OR S-ING
1: Check sync stability control adjustment.
2: Check capacitors C-47A and C-49A.
V-17 (6BQ6-GT) defective or V-16 (6SN7-GTA) defective.
4: Check sync separator tube V. 7 (6BE6) and phase splitter V-5B (12AT7) and V-5A (12AT7) video ampli fier.
5: Check AGC threshold control.
PICTURE NORMAL-NO SOUND OR WEAK OR DISTORTED SOUND
1: Check sound I-F alignment
Check V-10 (6AU6) V-11 (6AU6) V-12 (6AL5) V-13 (6AV6) V-14 (6AQ5) and associated circuits.

## ALIGNMENT PROCEDURE

TEST EQUIPMENT - To service this receiver properly, it is recond that the following test equipment be avai able:
R-F SWEEP GENERATOR meeting the following requirement
(a) Frequency ranges:

18 to $30 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
40 to $90 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
170 to $225 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
(b) Output adjustable with at least .1 volt maximum
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating source.
SIGNAL GENERATOR to provide the following frequencies: (Output on these ranges should be adjustable and at east .1 volt maximum.)
(a) Intermediate alignment frequencies.
23.1 mc first picture I-F coil.
24.1 mc third picture I-F coil.
25.9 mc second picture I-F coil.
assembly) being wrong value or open. These con 2: V -18 (6AX4-GT) defective.

SMALL RASTER - This condition can be caused by:
1: Low $+B$ or line voltage. Check V al output tube V-17. Replace tube.
Insufficieni output from verrical oscillator and verica outpur fube V-8. Replace tube.
V-18 (6AX4GT) horizo
aster; no image, but accompanying sound - This condiion can be caused by:
and V-6 (6AH6) tubes and associated circuits.
. Bad contact to picture tube grid (lead to sock
3: AGC tube (V-9) may be defective. Check tube and its associated circuit.

1: V-15 or V-16 defective.
2: Impro
3: Check setting of horizontal drive control and horizo
tal linearity control.

PICTURE STABLE BUT WITH POOR RESOLUTION - If the picture
resolution is not up to standard, it may be caused by any of the following:
2: Defective picture detector V-4A, (GAL5) or video amplifier V-5A or video output V-6 (6AH6).
3: Defective picture tube.
4: Open video peaking coil. Check all peaking coils $\mathrm{L}-5, \mathrm{~L}-6, \mathrm{~L}-8, \mathrm{~L}-9, \mathrm{~L}-10$ and $\mathrm{L}-11$ for continuity.
that $\mathrm{L}-5, \mathrm{~L}-9$ and $\mathrm{L}-10$ have shunting resistors.
that L-5, L-9 and L-10 have shunting resistors.
5: Leakage in V.6 (6AH6) grid capacitor C-36. If the

> 1: Check all potentials in video circuits.

2: Check picture tube grid circuit for poor or dirty 3. Contack.
and R-F circuits.
21.7 mc sound trap.
4.5 mc video trap \& sound I-F.
25.2 mc converter plate coil (Tuner)

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled.
ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 20 kilovolts. SERVICE PRECAUTIONS - To service the receiver remove the chassis from the cabine. To do so, remove the knobs, the cabinet back, disconnect the leads from the speaker, the radio chassis, remove the antenna terminal board at rear of cabinet, and then the 5 chassis mounting bolts. The chassis may be serviced with the picture tube in place provided the chassis is the weight of the chassis will taspored against the power transformer and pix tube brackets.
CAUTION: Do not permit the kinescope second-anode lead to become shorted to the chassis. To do so will cause lead to become shorred to the chasis. Toltage filter resistor R-105.


Fig. 8-Top Chossis Video
ond Audio l-F Adiustments
4. Unmodulated R-F signal into Converter Grid by means
 of tube shield insulated from base. VTVM with filter in lead of 22 K ohms and 5000 mmf connected to pic. det. load Fig 10-vivm Connections resistor, (R-37) 4700 ohms, in series with peaking coil (L-6) from Pin 7 of 6AL5. Input signal level should be such that output is less than 2 volts DC. Apply -4.5 V battery bias on AGC line.

| 1. | frequencr <br> 25.2 MC | Converter plate coil on top of <br> funer for maximum dc at picture <br> detector. |
| :--- | :--- | :--- |
| 2. | 23.1 MC | lst picture 1-F coil (T-1) for <br> maximum dc at picture detec- <br> tor. |
| 3. | 25.9 MC | 2nd picture I-F coil (T-2) for <br> maximum dc at picture detec- <br> tor. |
| 4. | 24.1 MC | 3rd picture I-F coil (T-3 below <br> chassis) for maximum dc at pic- <br> ture detector. |
| 5. | 21.7 MC | 3rd picture I-F trap (T-3 in can <br> above chassis) for minimum dc <br> at picture detector. |

B. I-F Sweep Generator into converter grid by means of tube shield insulated from base.
Connect oscilloscope across R-37 (in place of VTVM). Apply -4.5 V bias (DC) to AGC line (battery). Tuner should be switched to dead channel so as not to cause interference.


Fig. 9-Bottom Chassis Video
and Audio I-F Adjustments.


## ALIGNMENT PROCEDURE (Continued)

1. The height of the 26.2 MC marker is controlled by the 25.2 MC (Converter Plate Coil on tuner) and the 25.9 MC (2nd P.I.F.) coils.
2. The uniformity of response (flatness across top and position of 23.5 MC ) marker is controlled for the most part by the 24.1 MC third picture I-F coil.
3. The 23.0 MC marker position is controlled by the first picture I-F ( 23.1 MC coil). However, it is NOT advisable to change the setting of the coil, due to its effect on sound rejection. Its adjustment should be avoided unless believed to be absolutely neces. sary.

## VIDEO

With 4.5 MC unmodulated signal from a high impedance source, ( 10,000 ohms in series with the generator) into plate of the picture detector tube (Pin 7-6AL5) and VTVM on picture tube grid, tune 4.5 MC trap ( $\mathrm{L}-7 \mathrm{Top}$ ) for
minimum response. VIVM on 0.10 V AC scale. This ad. justment can also be made while observing a picture from a station. Tune trap for least 4.5 MC beat in picture.

## AUDIO I-F

1: With signat generator set to 4.5 MC and de VTVM connected to junction of R-13 and C-14, adjust sound take-off coil (L-13 Top) and sound I-F transformer slugs (T-6 Top \& Bottom) for maximum
2: With VTVM connected to pin 7 of V-12 (6AL5) adjust the ratio detector primary ( $\mathrm{T}-7$ Bottom) for maximum.

3: With VTVM connected to junction of R-17, R-20 and C-18, adjust ratio detector secondary (T.7 Top) for cross over (zero voltage) on lowest scale.
NOTE - If no signal generator is available, the procedure above may be followed by tuning in a station and using the 4.5 MC beat between picture and sound carrier.

## TUNER ALIGNMENT


fig. 12-Overall Response Curve
A. Sweep generator with balanced 300 ohm output to antenna terminals. Marker generator output to antenna terminals. Oscilloscope to "test point" (Figure 13) on tuner. Connect $11 / 2 \mathrm{~V}$ bias to AGC line at junction of $\mathrm{R}-34$ and $\mathrm{C}-29$ on the receiver.


Fig. 13-Top Tuner Adjustments
Observe overall I-F response, which should be as shown above: A slight touch-up may be required. At no time should the trap coil be re-adjusted, nor should it be necessary to turn any of the picture I-F coils more than $1 / 2$ turn of the slug. The following comments are suggestions only:


1. With channel selector on Channel 12, adiust C-201 slightly favoring the Pix carrier, then adjust C -206 and C -209 for response as in Figure 14. Picture and sound markers at $90 \%$ maximum response.
2. Check response on all channels. If markers are below $70 \%$ on any channels, readjust $\mathrm{C}-201, \mathrm{C}-206$, and $\mathrm{C}-209$. Recheck all channels.

Fig. 14-Pix \& Audia Markers
C. OSCILLATOR ADJUSTMENT.
3. Apply -4.5 volts on I-F AGC line at junction of $\mathrm{R}-1$ and C-30A.
4. Connect oscilloscope to output of video detector. Place fine tuning in center of range. Check response on all channels. Sound marker should be in notch and picture marker at $50 \%$. (See Figure 12).
5. If markers are off, individual oscillator coil slugs will require adjustment. Adjust each channel slug, accessible through hole in front of chassis with a non-metallic screwdriver to bring sound marker to correct position.




- John F. Rider



## 21" TELEVISION RECEIVER



$$
\begin{aligned}
& \begin{array}{l}
\text { COL RESISTANCE VLLUES LESS } \\
\text { THAN } 10 \text { OHM ARE NOT SHOWN. }
\end{array}
\end{aligned}
$$



PRODUCTION CHANGES
There are two different ratio detector transformers ( $T-7$ ) used in these receivers, Part Numbers 9A2269 and 9A2295. The T-7 circuit shown in this schematic diagram covers
the 9A2269 ratio detector. Receivers using the 9A2295 ratio detector can be identified by the foll row decing

C-18 becomes $47 \times 570 \quad 330 \mathrm{mmf}$ molded mica condenser
15 becomes $884333 \quad 33 \mathrm{~K}$ ohms 0.5 W carbon resistor
$\left.\begin{array}{l}\mathrm{R}-18 \\ \mathrm{R}-19\end{array}\right\}$ become B83103 10 K ohm 0.5 W carbon resistors
In addition, the 9A2295 ratio detector has terminals with numerical identification (1,2,3 etc.) whereas the 9A2269 ratio detector has terminals with alphabetical identi-
fication fication ( $A, B, C$ etc.)



#### Abstract

DEFLECTION YOKE ADJUSTMENT IV the deflection yoke shifts, the picture will be tilted To correct, loosen the thumbscrew on top of the deflection yoke, and rotate yoke until the picture is straight. Before tightening the thumbscrew, make certain that the deflection yoke is as far forward as possible. If the yoke support In the yoke support and the picture tube have shifted in and replaced, it is best to do a complete job of repositioning. See Figure 2. The picture tube should be mounted so that the front of the tube rests against the bracket on the front of the chassis. The clamp around the front of the front of the chassis. The clamp around the front of the tube should then be tightened. The picture tube rear suptube should then be tightened. she pracket mounting screws should be loose enough to permit sliding the bracket forward until it fits snugly agains the flare of the tube. Loosen the yoke adjustment thumb

\section*{SERVICE NOTES}


service test receptacle
A SERVICE TEST RECEPTACLE, accessible from the top of the chassis (see Figure 2), provides the following est points

## Connection To <br> $\underset{\mathrm{B}+}{1 \mathrm{AGC}}$ <br> Video detector output <br> No connection $\mathrm{B}++$

changing of tubes

1. The power should be turned off when changing tubes.
2. Indiscriminate changing or interchanging of tubes should e avoided for the following reasons
a. A change of IF or RF tubes can cause loss of sensi${ }^{\text {tivivity }}$.
b. A change of limiter or ratio detector tubes can cause audio alignment and sensitivity

Changing horizontal oscillator tube can result in to be out of range. This may necessitate readjustment of the horizontal oscillator coil.
removal of cabinet safety glass

1. Remove the screws and molding strip located along top edge of glass.
2. Safety glass will move outward from cabinet allowing its removal by lifting out of lower retaining channel.
3. When replacing, position rubber on glass with low side
of channel facing in
4. Replace molding and s

## \section*{ALIGNMENT} <br> ALIGNMENT

Equipment Required:
Sweep generator: 18 to $220 \mathrm{Mc}, 12 \mathrm{Mc}$ sweep width linear, and capable of 1 volt output
Accurately calibrated, adjustable marker genera tor and/or AM signal generator.
B. Cathode ray oscilloscope: preferably with calibrated attenuator.

NOTES: IMPORTANT
NEVER GROUND THE RECEIVER CHASSIS DURing testing operations or installation ING TESTING OPERATITNS UNLESS AN ISOLATIONTRANSFORMER IS USED.

At all times, keep the marker generator output low
enough to prevent the marker from distorting the enough to preve
response curve.

Some coils resonate at two settings of the core, the correct setting is at the outer end of the winding.
For complete receiver alignment, use the following procedure in sequence. Line voltage must be 117
volts $A C$; if not, adjust with variac.
if and mixer alignment

1. Remove horizontal output tube (V-15) to eliminate RF interference. Complete filament circuit with a 25 BQ6 tube
or other type with similar filament characteristics and base connections, with all pins clipped off except heaters. 2. Remove antenna and make following connections: (See Figure 4).
a. Connect a 3 volt battery to pin 1 (AGC bus) of serv ice test receptacle.
b. Disable tuner oscillator by grounding pin 9 of $\mathrm{V}-2$ (6U8).
c. Connect sweep generator to IF test receptacle, and oscilloscope to video detector load.
2. Center sweep generator frequency at 24.6 Mc with a sweep width of 10 Mc and adjust generator output below point of receiver limiting (approximately 3 volis peak-to-
3. | Adjust | At Marker Freq |  |
| :--- | :--- | :--- |
| L-12 | 21.9 Mc | min output (See IF response <br> curve - Figure 4) |
| T-4 | 26.6 Mc | 26.6 Mc marker (See IF re- <br> spone curve - Figure e) |
| T-6 | at top of curve | flat response (See IF re <br> sponse curve - Figure 4) |

22.9 Mc marker (See IF re-
sponse curve -Figure 4)
ater
sponse curve-Figure 4)
flat response (See IF response -Figure 4)
repeat As some adjustments interact, repeat as necessary to ob tain proper curve. (Move generator to mixer test recep tacle and short across R-11 (4700 ohms).
 interact, adjust simul-
taneously taneously
NOTE: If desired response cannot be obtained, recheck tuning of 21.9 Mc trap (L-12). Accuracy of this adjustmen

Bandwidth may be determined by noting the frequencies at which the markers fall at the $50 \%$ points. Mixer and IF bandwidth over 3.5 Mc may cause loss of picture quality,
and less than 3.2 Mc , a loss of audio.
5. Remove AGC bias battery, BANDWIDTH SHOULD NOT CHANGE OVER. 2 Mc
6. Decrease generator signal until there is a marked de crease in the oscilloscope waveform. Unwanted regenera curve.

## Audio alignment

This alignment may be made by injecting an accurate
Mc signal at the video amplifier grid; however, the 4. 5 Mc signal at the video amplifier grid; however, the be used whenever possible. Station alignment method fol lows:

1. With receiver in good operating condition, tune in sta
2. Connect VTVM from positive terminal of C-54, elec trolytic capacitor to ground.
3. Maintain 5 volts, or less, at VTVM by adjustment or C M by adjustment if necessary) while peaking L-20 and T-7 primary (top) for maximum output.
4. Move VTVM connection to junction of C-2 ( 1000 mmf ) and $\mathrm{R}-45$ ( 33 K ). Set fine tuning for normal picture.
5. Adjust T-7 secondary (bottom) for zero reading on
VTVM
6. Recheck as in steps 2 and 3 and, if necessary, readjus primary of T-7

## . 5 MC TRAP ADJUSTMEN

Tune receiver to a local station and adjust 4.5 Mc trap L-17) for minimum beat interference in picture by locating the two points of adjustment at which the beat is first no Use the minimumamount of inductance (core out of coil) that Use the result in no apparent beat interference

If a station signal is not present, use the following meth od, which requires proper alignment of the audio system.
. Tune the receiver to a low noise, unused channel.
2. Connect AM signal generator to picture tube cathode lead (yellow) thru a 5000 mmf capacitor. Connect ground lead to chassis.
Set generator to 4.5 Mc
. Move VTVM to posi
ground lead to chassis.
5. Adjust $4.5 \mathrm{Mc} \operatorname{trap}(\mathrm{L}-17)$ for minimum VTVM $\dot{G}$ Adjust 4.5 Mc trap (L-17) for minum VTVM reading tuner alignment

GENERAL INFORMATION
It is very unlikely that the Motorola Tuner will need alignment unless it has been damaged, is being replaced, may be changed in most cases without re-alignment, but care must be used in selection or re-alignment may be required.) The tuner operates by shorting out an antenna, RF
and oscillator coil section consecutively for each higher and oscillator coil section consecusvely form each highe any one section will be series connected. Therefore, align ment must start at the highest channel and each adjustment properly completed before the next lower channel adjust
ment is attempted. Low-band channels ( $(6-2)$ may be vidually adjusted by stretching or compressing coil turns, while high band channel inductances ( $7-13$ ) are formed by a stamped metal plate and adjustable as a wit by $\mathrm{C}-11$ (RF) and L-8 (oscillator)
age in coil length (low channels) in frequency

In alignment, the antenna coils must be tuned to videa side of bandpass, and the RF coils to the sound side of

NOTE: Antenna, RF and oscillator coils for any on hannel are in the same relative position (in line) from fron to rear of the tuner

ANTENNA AND RF ALIGNMENT

1. Remove battery used in if alignment and ground pin 1 (AGC bus) of service test receptacle Connect sweep gen erator to antenna input terminal strip and adjust for 10 Mc minimum sweep width. Connect o

OJohn F. Rider
2. Set tuner to channel 7 and sweep generator to 177 Mc
(center frequency). S.et video marker to 175.25 Mc and sound marker to 179.75 Mc . Adjust $\mathrm{C}-11$ for high channel . Set trer to chanel 13 , and
Set video marker to 211.25 Mc and sound marker to 213 Mc . Mc. Adjust L-6 for high channel response curve to 215 . 7 Figure 5 .
. Switch tuner and generator through channels 13 to 7 and check each for correct response curve. (See chart for markers and sweep frequencies.) Coil L-1F will adjus shield). The amot of coil end wire extending through shield varies bandwidth, and position of markers. If this A moved, all previous steps must be repeated. 2) for proper markers as shown on coils (channels 6 thr curve (Figure 5). See alignment chart for marker and

OSCILLATOR ALIGNMENT

Oscillator adjustments are made, using sound frequen cies as reference, to place sound marker slightly highe
than the 21.9 Mc trap dip. Sound markers must move into trap dip (within fine tuner rotation tolerances) when tuner Tuner and sweep generator must be set to channel being aligned.

The marker generator is set to the sound frequency of or more if possible.

Waveform obtained should be similar to mixer wave

## rm.

Consistent tilting of the curve when sound marker Procedure:

Remuve ground added daring previon poces in 9 of $\mathrm{V}-2$ (6U8 oscillator)

| Connect the oscilloscope (through a 47 K ohm resistor) |
| :--- |

across the video load resistor R-27 (5600)
. Set fine tuner for mid-capacity position (capacity in High Band Alignment
4. Adjust oscillator trimmer (C-15) on channel 10, usin hannel 10 sound marker and placing it just above trap null. See Figure 4 and preliminary instructions
5. Check channels 7 through 13 for correct marker posi tions (use fine tuner if necessary). A fine tuner rotation of
over plus or minus 30 degrees from mid-point, to move marker into trap dip, requires
a. Adjustment of coil L-8, on channel 13, for compen ation of channels 10 through 13 .
b. Readjustment of trimmer C-15, on channel 10, for Low Band Alignment
6. Reduce the capacity of fine tuner by rotating 15 degrees clockwise from mid-capacity position
7. Adjust channel 6 oscillator coil, using channel 6 sound marker. Refer to tant to alignment of following coils.
8. Adjust channel 5 through 2 oscillator coils in descendNOTE: WHEN TUNER COVER IS REPLACED, ALL SINE MARER ROTATION LIMITS. LIMITS DIP WITHIN MID-POSITION TO 30 DEGREES CLOCKWISE, ON LOW ChanNels, and plus or minus 30 degrees from Mid-point on high channels.

## TESTS OF RECEIVER SENSITIVIT

. Make sure AGC system is operatine
. Short out resistor R-11 ( 4700 ohms ) in tune
. Calibrate oscilloscope by connecting the input to a 6.3 peak-to-peak.) Connect scope to picture tube cathode (yel low lead).
4. Set contrast control at maximum


5



| cmame | 边 | , semot |  |
| :---: | :---: | :---: | :---: |



## IF Sensitivity Tests

. Stop asoillatot as in ir aligment.
6. Inject 23 Mc AM signal, with $30 \%$ modulation, into LF 500 microvolts should be required to capacitor. Less than o-peak at the picture tube cathode.
7. Inject the generator into mixer test receptacle. peak-to-peak at the picture tube required to produce $18 \frac{\text { Less }}{\text { volts }}$ Overall Sensitivity Tes
8. Remove short on R-11 and oscillator and inject genera tor into antenna input (use resistor matching network, if being checked, and rotate receiver fine tuner for stronges gnal. 18 volts peak-to-peak should be produced at the microvolts on channels 2 through 6 and less than 30 micro volts on channels 7 through 13 .

## Audio Sensitivity Test

9. Connect signal generator (no modulation) to video am plifier grid (pin 2) through a 5000 mmf capacitor and set
10. Connect VTVM (DC scale) to the positive terminal of electrolytic capacitor C-54, and connect ground lead to
11. A 10,000 microvolt signal should produce approxi mately 10 volts.
TV CHASSIS CODING
The following chassis coding system was devised to enable the serviceman to keep abreast of circuit revisions.

The first production chassis number carries the suffix
A-00" (i.e., WTS-518A-00). With the first minor elec-"A-00" (i.e., WTS-518A-00). With the first minot elec subsequent minor change "A-02", "A-03", etc. The firs major revision changes the suffix to "B-00" and, as before,

Mechanical differences between chassis are indicate by the addition of a prefix to the basic chassis (i.e. VTS-518A-00, etc.). These prefixes may be assigned in random sequence but will be confined to the end of the al phabet to avoid
change suffixes.
A) indicates that the chassis contains a factory-installed etc..) indic
UHF tuner.

# PRODUCTION CHANGES 

| Chassis Coding | Changes |
| :---: | :---: |
| A-01 | To improve brightness and to prevent filament breakdown on the picture tube, a new shunting strap is connected between pin 6 (focus grid) and either pin 1 (heater-a potential ground point) or pin 10 (screen grid). 5, 000 mmf 2000 V capacitor added between pin 1 of the picture tube and ground. |
| A-02 | To increase sensitivity and to assure a more secure control knob fitting, VHF tuners change to WTT-24C \& WTT-24CY (longer shafts). R-31 (volume-contrast) changes to Part No. 18B733977 (longer shaft). C-1 ( 220 mmf ) changes to 470 mmf. R-7 $(22,000)$ removed. New low frequency antenna coil (L-1) is used. Part numbers on low frequency antenna coil and VHF tuners do not change. |

ic. 1
To increase the range of the horiz hold contro 47, 000 ohm resistor was added in parallel with the horiz osc coil L-23.
To eliminate picture tube neck shadows on some chassis, the fixed electrical horizontal centering
circuit shown below was used; final centering is still performed with the magnetic centering de-


PARTS LIST
$\begin{array}{ll}\text { Ref. } & \text { Part } \\ \text { No. } & \text { Number }\end{array}$
electrical parts

| C-1 | 21R115905 |  | 220 |  |
| :---: | :---: | :---: | :---: | :---: |
| or | 218121478 | Cer Disc: | 470 mmf 200 | 20 |
| c-2 | 21R115905 | Cer Tub: | 220 mmf 1000v | 25 |
| c-3 | 21R115854 | Cer Tub: | 220 mmf 500 V | 20 |
| C-4 | 21R120100 | Cer Disc: | 1500 mmf 500 V | 20 |
| c-5 | 218400492 | Cer Tub: | 22 mmf 500 V . | 25 |
| c-6 | 21R400943 | Cer Disc: | dual 800 mmf 500 V | 40 |
| c-7 | 218120100 | Cer Disc: | 1500 mmf 500 v . | 20 |
| C-10 | 218120100 | Cer Disc: | 1500 mmf 500 v | 20 |
| c-11 | 21 K 710943 | Trimmer: <br> with screv | cer; .5-3 mmf; and mtg nut. | . 20 |
| -12 | 21R114073 | Cer Tub: | $12 \mathrm{mmf} \mathrm{500v}$. | . 25 |
| c-13 | 21R400943 | Cer Disc: | dual 800 mmf 500 v | . 40 |
| C-14 | 218115640 | Cer Tub: | $18 \mathrm{mmf} \mathrm{500v}$. | . 25 |
| C-15 | 21K710943 | Trimmer: with screw | cer; . $5-3 \mathrm{mmf}$; and mtg nut. | . 20 |
| c-16 | 218114071 | Cer Tub: | 1 mmf 500 v ... | . 30 |
| C-17 |  | Trimmer: of channe | fine tuning; part l selector switch. |  |
| C-18 | $21 \mathrm{R120100}$ | Cer Disc: | 1500 mmf 500v. | . 20 |
| C-1 | 218482726 | Cer Disc: | 10,000 mmf 500v | . 30 |
| c-20 | 21R120100 | Cer Disc: | 1500 mmf 500 v . | . 20 |
| c-21 | 218115312 | Cer Disc: | 5000 mmf 500 V . | . 25 |
| C-22 | 218120100 | Cer Disc: | 1500 mmf 500v | . 20 |
| C-23 | 218115386 | Cer Disc: | 1000 mmp 500 V | . 25 |
| c- | 21R115386 | Cer Disc: | 1000 mmf 500 v . | . 25 |
| C-25 | 21R115386 | Cer Disc: | 1000 mmf 500 v . | . 25 |
| C-26 | 21R115386 | Cer Disc: | 1000 mmf 500 V . | . 25 |
| C-27 | 21R115312 | Cer Disc: | 5000 mmf 500v. | . 25 |
| C-28 | 21R120100 | Cer Disc: | 1500 mmf 500v. | . 25 |
| C-29 | 21R400937 | Cer Disc: | dual 1000 mmf 500 v | 40 |
| c-30 | 21R470329 | Cer Tub: | 30 mmf 500 v ... | . 30 |
| C-32 | 8 R 9810 | Paper Tub: | .25 mf 400 v . | . 35 |
| C-33 | 21R115953 | M1d Phenoli | ic: 3.9 mmf 500 v . | . 10 |
| C-35 | 8 R 9814 | Paper Tub: | . 1 mf loov.. | . 25 |
| C-37 | 21R115386 | Cer Disc: | 1000 mmf 500 v . | . 25 |


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NEVER GROUND THE RECEIVER CHASSIS DURING TESTING OPERATIONS OR INSTALLATION
UNLESS AN ISOLATION TRANSFORMER IS USED.

Keep the marker generator output low enough, a all times, to prevent
the response curve.

Some colls resonate at two settings of the core, th For complete receiver alignment, use the followng procedure in sequence: Line voltage mast polta it in adjut to 117 volte with variac.
. Remove antenna and make following connections: (See igure 8).
a. Connect a 6 volt battery between pin 1 (IF AGC bus) service test recoptacle and ground. Positive side of bat goes to ground.
b. Disable tuner oscillator by grounding pin 9 of $\mathrm{V}-2$ 6U8) and turn channel selector to channel 13 . Connect sweep generator to $1 F$ test receptacle and oscilloscope to detector load resistor (pin 3 of service test
seceptacle). 3. Center sweep frequency at 44 Mc with a sweep width of
10 Mc and adjust generator output below point of receiver oad).

cibe \& tube locations \& if alignient detal

## if and mixer aligneent

1. Remove horizontal output tube ( $\mathrm{V}-16$ ) to eliminate RF in-
terference. Connect a 2500 ohm 10 watt restistor from chas-
is ground to $\mathrm{Bt+}$ (250V bus) to normalize voltages.
as some adjustments interact, repeat as necessary to obain proper curve.
2. Move generator to mixer test receptacle and short
acrossR-10 (4.7K ohms). See Figure 9 for R . 10 10ction

 | $\mathrm{L}-25$ | 45.75 Mc | $\begin{array}{l}\text { If desired over all }\end{array}$ |
| :--- | :--- | :--- | If desired overall response

cannot be obtained, check
dinst cannot be obtained, check
dressing of bypass capaci-
tors, especially the screen ors. especially the screen
bypassing of the 1 st $\& 2 n d$ IF tubes. These lead Length are critical and
should be kept short and should be kept short and
dressed to obtain proper

CHECKs
Bandwidth may be determined by noting the frequencies bandwidth over 3.7 Mc may cause sound bars or burble in the picture; if less than 3 Mc , a loss of resolution or fine
detail in the picture may be noticed.

Decrease generator signal ur.il there is a marked de rease in the oscilloscope waveform. Unwanted regeneraurve. If regeneration is present, check $1 F$ cathode re urve. If regeneration is present. check if cathode re
istors, screen bypass capacitors, and lead dress. Improper alignment may also cause regeneration.

## audio alignment

his alignment may be made by injecting an accurate 4. 5 Mc signal in at the video amplifier grid. However. the
station alignment method which follows is much more ac curate and should be used whenever possible.

1. With receiver in operating condition, tune in station.
?. Connect VTVM from positive terminal of electrolytic сара
2. Maintain 5 volts, or less, at VTVM by adjustment of fine tuning and contrast control (or by removal of antenna, if necessary) while peaking T-8 primary (top) and L-38
L- 39 for maximum output. (See Figure 8 .)
3. Tune for normal picture and carefuly note voltage de
veloped at the positive terminal of $\mathrm{C}-50 \mathrm{~B}$.
4. Move meter to junction of R-54 \& R-56 (dumnny pin o V -9 socket, marked "X" in Figure 8).
5. Adjust $T-8$ secondary (bottom) to give a reading on the VTVM of exactly one-half of reading in step 4.

## . 5 yc trap adjustuent

Tune receiver to a local station and adjust 4.5 Mc trap L- 34 for minimum beat interference in the picture by $10-$ cating the two points of adjustment at which the beat is jus
noticeable. Rotate the core toward the center of these two noticeable. Rotate the core toward the center of these two
points. Use the minimum amount of inductance (core out of points. Use the minimum ampunt of incuctance (core
coil) that will result in no apparent beat interference.

## tuner alignuent

general information
It is very unlikely that the Motorola Tuner will need Iignment unless it has been damaged, is being replaced, has had components replaced in the tuned circuits. Tubes uist be used in most cases without realignment, but care

The tuner operates by shorting out an antenna, RF and oscillator coil section consecutively for each higher chanel. When switched to the lowest channel, all coils of any must start at the highest channel and each adjustment properly completed before the next lower channel adjustment is ttempted. Low-band channels ( $6-2$ ) may be individually ad and channel inductances ( $7-13$ ) are formed by a stamped metal plate and are adjustable as a unit by $\mathrm{L}-13$ and $\mathrm{C}-12$ RF) and L-17 and C-22 (oscillator). The antenna coils are very broad in tuning and generally do not require adjust-
ment.

All alignment procedures in receivers with built-in UHF hers aremade with the UF wner input plug in place durshorting link is installed in the UHF input receptacle. Be ertain this plug is in place during alignment. In receivers ithout the shorting link installed, short UHF input recep. horting wire in place upon completion of alignment unless HF tuner is to be installed

## antenna \& bf alignyent

. Remove battery used in IF alignment and ground RF GC bus (white lead or white lead with color tracer on rear ocket (with leads as short as possible) and adjust for 10 Mc weep width. Connect oscilloscope through a 47 K resistor mixer test receptacle (see Figure 9).
. Set tuner to channel 7 and sweep generator to 177 Mc enter frequency. Set video marker to 175 . 25 and sound


Set tuner to channel 13 and sweep generator to 213 Mc . et video marker to 211.25 Mc and sound marker to 215.75 c. Adjust $\mathrm{L}-13$ and $\mathrm{L}-9 \mathrm{D}$ for maximen amplitude and r
, epear step 2 and 3 as necessary for correth respons.
Check response curve on channels 13 through 7 , setting uner on proper channel and generator at proper frequen

Turn channel selector sweep and marker to channel and turn slug out of UHF input coil $\mathrm{L}-3$ until it affects curve urn slug back into coil until its effect is completely out of this coil and no further tuning should be done.
7. Align low channel RF coils (channels 6 through 2) for (Froper markers as shown on low channel reaponse curv
 on low channels makes a rather large change in frequency. (channels $3 \& 4$ ) and coil L-8A (channel 2) may be adjusted for improved low channel response. While on channel 6 adjust FM trap coil L-1 so that it just starts to affect the curve on the sound side of the response. Be sure that the
UHF coil L- 3 is not affecting the channel 6 response. Whil on channel 2, set sweep and marker to 45 Mc and adjust IF trap coil L-2 for minimum response.
8. With station selector switch on channel 6 and RF swee and marker onchannel 7 , adjust C - 5 for minimum response. 9. With channel selector on UHF position and the swee generator connected to
Mc, adjust $\mathrm{L}-20$ for symmetrical response and maximum amplitude. (Make certain shorting link is in UHF jack.

## oscillator alignient

PRELIminary instructions
The oscillator is adjusted on each channel using the RF sound frequency of this channel for the marker. The marker
must be placed slightly higher, in frequency, on the scope curve than the 41.25 Mc trap dip. This is to compensate
for the chang of oscillator frequency due to the ior the chang= of oscillator frequency due to the tuner cover
being removed. When cover is replaced, sound marker should move into trap dip within fine tuner rotation tolerances. $\xrightarrow{\text { Tune }}$
The marker generator is set to the sound freyuet channel being aligned. Use at least a 10 Mc sweep width, more, if possible.

Waveform to be obtained is similar to that of mixer
Consistent tilting of the curve, when sound marker is in
the trap, indicates misalignment of the IF or mixer section. PROCEDURE

1. Remove the ground added during IF procedure to pin
of 6 O ( 8 (oscillator)
2. Connect the oscilloscope (through a 47 K ohm resistor)

3. Set fine tuner for mid-capacity position (increasing capacity in the counterclockwise direction).

## high-Band alignment

4. Adjust oscillator trimmer C-22 on channel 10 , using channel 10 soundmarker and placing it jus
See Figure 8 and preliminary instructions.
5. Check channels 7 through 13 for correct marker posi 5. Check channels 7 through 13 for correct marker posi-
tions (use proper markers and fine tuner, if necessary). A
fine tuner rotation of fine tuner rotation of over plus or minus 30 degrees from a. Adjustment of coil L-17 on channel 13, for compen sation of channels 10 through 13.
b. Readjustment of trimmer C-22 on channel 10 , for compensation of channels 7 through 10. Recheck marker
positions on channels 7 through 13 . LOW-bAND ALIGNMENT
6. Reduce the capacity of fine tuner by rotating 15 degree
7. Adjust channel 6 oscillator coil, using channel 6 sound
marker. Refer to Figure 8 and preliminary instructions. Accuracy of alignment on this channel is extremely impo
8. Adjust oscillator coils of channels 5 through 2 in de-

|  |  |  |  |
| :---: | :---: | :---: | :---: |
| cuma | \%sif | cos sumi | Patim |
|  | Slla | S935 |  |
| 3 | ${ }_{\text {Elim }}$ | ${ }_{\text {cis }}$ |  |
| ! |  |  |  |
|  | )! | ${ }^{8175}$ | ${ }^{\text {B,235 }}$ |
|  | , inuc | ${ }^{19195}$ |  |
| ! | cosk | ${ }^{19175}$ |  |
| 10 | Bsack | ${ }^{1815}$ | ,19323 |
|  | ${ }_{\text {cole }}$ | ${ }_{2015}^{2035}$ | ${ }^{19323}$ |
| ${ }_{13}^{13}$ |  |  | (2025 |
|  | net |  |  |
|  <br>  |  |  |  |
|  |  |  |  |
|  <br>  |  |  |  |
|  |  |  |  |







NOTE: WHEN TUNER COVER IS REPLACED, ALL SOUND MARKERS MUST MOVE INTO TRAP DII WITHIN
FINE TUNER ROTATION LIMITS. LIMITS ARE $\pm 5^{\circ}$ FROM MID-POSITION ON LOW CHANEELS AND $\pm 30^{\circ}$ FROM MID-
POSITION ON HIGH CHANNELS.

## receiver sensitivity tests

IF Sensitivity Tests

1. Set contrast control at minimum, disable horizontal sweep by removing horizontal output tube and normalize voltages by c
$\mathrm{B}++$ to ground.
2. Stop oscillator by shorting pin a $\mathrm{V}-2$, to ground
3. Short IF AGC bus to ground (pin I of service test recep
tacle).
4. Set ciannel selector to channel 13
5. Connect high side of VTVM to pin 3 of service test re eptacle and other lead to chassis ground.
6. Inject a 45 Mc signai, with no modulation into IF test
receptacle through a 100 mmf microvolts should be required to produce a one $\frac{\text { Less }}{}$ volt $D C$ rise 600 $\frac{\text { above noise at the detector load (pin } 3 \text { of service test re-- }}{\text { ceptacle). }}$ eptacle)
7. Short out R-10 ( 4700 ohm) at V-2 (mixer) grid.
8. Inject the generator into mixer test receptacle. Less DC rise above noise at the detectored toad. produce a one volt

Overall Sensitivity Test
. Remove short on R-10 and oscillator and inject generaor signal into antenna input (use resistor matching network
when necessary). Set generator to the center frequency hen necessary). Set generator to the center frequency of
channel being checked with $30 \%$ modulation. Set fine tuning


## SERVICE NOTES

## icture tube replacement

To replace picture tube:

1. Remove second anode connector and short the picture 2. Carefully remove picture tube socket and ion trap mag net.
2. Remove screws holding picture tube clamping band and
and contrast for maximum output. A peak-to-peak reading with generator outputs of less than 15 microvolts on chan nels 2 through 6 and less than 25 microvolts on channels ?
through 13 . This voltage may be read with a calibned through 13. This voltage may be read with a calibrated os
cilloscope. To calibrate scope, connect the vertical deflec tion plates to a source of 6.3 volts (filament supply). This Sound Sensitivity Tests
3. Connect signal generator through a 5000 mmf into the video detector load (pin 3 of service test receptacle). Inject a 4.5 Mc unmodulated signal at this point. 11. Connect VTVM (DC scale) to the positive terminal of electrol
chas sis.
4. A 5000 microvolt signal should produce appr nimately
5. Carefully remove picture tube using caution not to dantage yoke with neck of tube and not to exert any undue pres.
sure on the tube itself. sure on the tube itsell.
6. Insert new tube carefully into yoke and position tube lightly against the front support bracket lugs. If at this
ime the rear tube support does not bear against the flare of the tube or, if it requires pressure to anainst the flare hind the mounting lugs, loosen rear tube support bracket mounting screws and slide forward or backward to fit against tube without forcing. If the bracket is too tight, it will cause mispositioning of the yoke. Tighten rear sup-
7. Reins
securely.
8. Replace ion trap magnet, picture tube socket, and sec ond anode connector. Loosen yoke adjustment thumbscrew
and yoke saddle screws and push the yoke up against the flare of the tube. Tighten all screws.
9. Readjust yoke, ion trap and centering device
reyoval of cabinet safety glass
10. Remove the screws and molding strip located along top dre
11. Safety glass will move outward from cabinet allowing its
12. When replacing, position rubber on glass with low sid
of channel facing inside of cabine
13. Replace molding and screws.
tone control linkage
To replace or adjust tone control linkage:
14. Set control maximum counterclockwise and install linkage with arms
Tighten screw.
15. With chassis in cabinet, install knob with lettering to
the top

CHANGING OF TUBES (Refer to Figure 10 )
indiscriminate changing or interchanging of TUBES MUST BE AVOLDED.
a. A change of IF or RF tubes may affect alignment
Always check alignment and sensitivity after these changes.
b. A change of audio circuit tubes may cause buzz, loss of sensitivit.
c. Changing horizontal oscillator tube may cauna hor
zontal control to be out of range and This mayrequire readjustment of horizontal oscillator coil. FUSE REPLACEMENT

B+ and tnitial surge: $\quad 7.5$ ohm special rasistor
Filament: fusing wire: 1 " of $\# 26$ copper wire
B+ and initial surge fuse (special 7.5 ohm resistor R -64) B+ and initial surge fuse (special 7.5 ohm resistor R-64)
This fuse is of the plug-in type and is accessible by re moving the cabinet back. See Figure 2 for location.
Filament fuse F-1 (1" \#26 copper wire)
To replace the filament fuse, the chassis must be removed from the cabinet. See Figure 11 for location. Use a piece
of \#26 copper wire 1" long, soldered between the two lugs.

SERVICE TEST RECEPTACLE
A SERVICE TEST RECEPTACLE, accessible from the

\section*{| Pin | Comection To |
| :--- | :--- |
| 1 | IF AGC |
| 2 | B + |
| 3 | Video detector output |
| 4 | Filament |
| 5 | B+ + |}

These tost points are avaliable to the technician merely
yemoval of the recoiver cabtnet back and proulde rapid by removal of the receiver cabinet back and provide rapid SERVICE
The following chart is designed as an aid to the technician as well as a guide to Motorola dealers, salesmen and
non-technical people who may be called upon to correct some of the more simple troubles in television receivers. his chart is planned so that the more readiy corrected
ifficulties are in the first column, the more complicated roblems in the second column, etc.

In general, the information given in the MISCELLANE-

Be certain that all applicable remedies in each section attempted before continuing to the next column.
The television screen supplies an abundance of visible information, therefore, examine the screen very carefully,
determine possible source of trouble and then proceed to
ge. The fiament connection checks the filament fuse as well as the voltage output of the filament transformer. Operation of the recetver from the artenna to the detector may be checked by the use of pin $\# 3$ (detector output). Pin
$\# 1$ allows rapid checking of the $I F$ AGC voltage. It is sug ested that this voltage be checked and recorded at the firat opportunity by the service technician using a receiver in normal operating condition. Such IF AGC voltage informa-
tion may be invaluable when checking sets in which the AGC actionis doubtful. This voltage varies according to the signal strength and may range from a very low value to about
8 volts minus.

## chart

If moving the adjustments or controls does not rectify the oubles, return them to their original position.
Turn the set to the "OFF" position when replacing tubes nd replace only one tube at a time.

Before removing the picture tube, acquaint your self with
the PICTURE TUBE HANDLING PRECAUTIONS
The following should be used in conjunction with the of Chassis) and Figure 10 (Tube Dols), Figure 2 (Rear View

This chart, if used wisely, may be of assistance even in ing multiple troubles. Handling these tre case of a set havproblems regardless of accompanying symptoms may sim. plify the repairs.

| SYMPTOM | CONTROLS | CHECK OR ADJUST | tubes | miscellaneous Checks |
| :---: | :---: | :---: | :---: | :---: |
| SET DEAD (tubes not lighting) | Off-On volume | 1s set plugged in? is back cover on? 1s AC line voltage available at outlet? (Check with lamp) |  | Filament fuse F-1 |
| (tubes are 11t) |  | Power fuse, R-64. Is speaker plugged in? Replace any tubes that do not light. | v-11 |  |
| NORMAL RASTER <br> NO PICTURE <br> NO SOUND | Channel selector (on station?) | Antenna connections. Is station on adr ? | $\begin{aligned} & V-1,2,3,4,5, \\ & 11 \& 12 \end{aligned}$ | B+ voltage. Video detector, <br> CR-1. AGC voltage. RF, <br> IF or mixer stages, |
| WEAK PICTURE <br> (insufficient contrast) | Contrast. Fine tuning. Channel selector on correct channel? | Antenna connections | $\begin{aligned} & \mathrm{v}-1,2,3,4,5, \\ & 6 \& 12 \end{aligned}$ | AGC voltage. Contrast control. RF, IF, mixer \& AGC stages |
| LOW BRIGHTNESS OR NO RASTER | Brightness. | Ion trap magnet | $\begin{aligned} & \mathrm{v}-15,16,17,18, \\ & 19 \& 11 \end{aligned}$ | High voltage at picture tube anode. Drive voltage, pin $5 \mathrm{~V}-16$. Bootstrap voltage. $\mathrm{B}+, \mathrm{B}++$ and CRT voltages. Solder connections, base of CRT. Voltages \& waveforms in $\mathrm{V}-15$ \& V-16 circuits. Horizontal output transformer \& deflection yoke. |
| poor vertical LINEARITY AND/OR SIZE.HORIZ. WHITE LINE. (no vert. sweep) | Vertical size. Vert lin Reduce brightness \& return to normal when trouble is cleared. |  | v-14 | Bootstrap voltage, Voltages in V-14 circuit. Electrolytics, C-99 \& C-74C. Vertical output transformer \& deflection yoke. |
| vertical insta BILITY, PICTURE ROLLS | Vertical hold |  | v-13, 14 | AGC voltage. Voltages in V-13 \& V-14A circuit. Interference. Syic clipping at video amplifier. Refer to tests under WEAK PICTURE. Abnormal power supply ripple. Insufficient bootstrap filtering. Video detector |

John F. Rider



$\dagger$ tro ro cosssis motr an io mata surfi
nores
Voltace measurements

1. Made with a VTVM from point indicated to chases,
2. Line voltage - 117 volts
3. Antenna diaconnected
4. Channel selector switch on channel which
less than 1 volt noise at pin 3 of test recept
5. Contrast control maximum clociwise position
6. All other controls in nor mal operating poltion 7. Voltages associa tod with circuits hav
controls may vary with control settings
waverorms
7. Observed on Dumont Model 241 oscilloscope
8. Contrast control set for signal of 45 P to P a plate of video amp tube
9. All other controls in normal operating poottion 4. Horizontal output tube removed to elimininto HV
pulse inter ference from ecope when obererving all pulse interterence from sope when obererving at
waveforme evcept thoce from phase det through
horiz cricuit
TELEVISION CHASSIS TS-528 \& 603A-00 SERIES

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## GENERAL INFORMATION

This booklet contains service information covering the Motorola TS-902A-03 (horizontal chassis) and the BP-902A-01 (vertical chassis). These individual chassis are interconnected in the 19-inch Motorola color television receiver series which incorporate the 19 VP 22 tri-color picture tube.

## CHASSIS DESCRIPTION

The receiver circuits are built around 29 circuit tubes, a 19 VP 22 19-inch tri-color picture tube (aluminized-glass envelope, electrostatic focusing, 62 degree deflection angle) plus three germanium diodes and three selenium rectifiers. The horizontal chassis contains all signal cir cuits except those devoted strictly to color, the scanning circuits, filament and "B" supply. The vertical chassis contains the color section.
POWER RATING - Source: 117 volts, 60 cycle AC

NUMBER OF TUBES - 29 tubes plus 3 selenium rectifiers, 3 germanium diodes and a tri-colo picture tube

INTERMEDIATE FREQUENCIES - Video: 45.75 Mc Sound: 41.25 Mc and 4.5 Mc

FREQUENCY RANGE - Channels 2 through 13 (VHF tuner - WTT - 67)
Channels 14 through 83 (UHF tuner - TT-37)
ANTENNA INPUT IMPEDANCE - VHF \& UHF: Balanced 300 ohm
FUSES - Filament: 1 inch \#26 copper wire, located beneath chassis near filament transformer Power: Special 7.5 ohm plug-in resistor, located near filament transformer on top

B triple plus 390 volts B plus 125 volts

AUDIO OUTPUT - 1.5 watts undistorted
INSTALLATION \& OPERATION

## Locating the receiver

It is advisable to determine the approximately permanent position of the receiver before any attempt is made to erect an antenna or to install lead-in wires. Once the location of the receiv$e r$ is determined, it is desirable to retain this location, due to the effect of stray external magnetic fields on the purity adjustments of the color fields, etc. Balancing adjustments have bee trols may require re-adjustment for each change in receiver location. Such receiver movements should be avoided.

The selection of the permanent location of the receiver should be based upon the best pictur visibility from the greatest number of room positions; so that all persons can view the picture comfortably. Locating the receiver near windows and corners should be avoided. The location should be chosen so that the cabinet will be subjected to a minimum amount of heat and mois ture; otherwise the cabinet finish may suffer damage. Allow sufficient space behind the cabinet for proper ventilation of the chassis.
Room lighting
It is desirable to have some light in the room when viewing any type of television picture. A completely darkened room tends to create eye-strain. Light from a shaded lamp which does not fall directly on the face of the screen is usually satisfactory.

A condition of room lighting must be taken into consideration with color receivers, however which was not important previously. That is the overall color tint of the lighting used. The room lighting color tint can accentuate or reduce certain color reproductions acutely. While the receiver may be adjusted to compensate for such lighting conditions, it is desirable to use a colorless bulb and lampshade during color program viewing.

It is also important that any receiver set-up adjustments made by the technician are per formed while using the room lighting that will be available during program viewing. If different color lighting is used during set-up, it is quite possible to adjust for white screen conditions only to find that under the viewing lights, the screen may have a predominant blue, green, or red tinge.

Antenna requirements
Indoor antennas of the portable type are often satisfactory for color reception, provided the receiver is located in a strong signal area. However, an outdoor antenna will invariably give a better overall picture on all channels and is recommended whenever possible.
ich must reach the received from the transmitter, contains a number of additional signals many present antenna types and their lead in ires are uneatisfactory. Color reception quires a broad band tre of and move the color and Keep in mind that it is entirely possible for an existing antenna installation to furnish satisfac tory reception on a black/white receiver, but fail completely on color broadcasts. In the case of antennas for UHF reception, the above information more critical UHF antenna set-up.

When deciding on an change channels in the VHF group, and that single-channel, high-band or low-band antennas may have to be replaced to receive the new channels.

After the receiver has been placed in its permanent position as determined by the viewing requirements and lead-in facilities, it is necessary to remove the cabinet back cover and shift the lever connected to the dynamic convergence coils to such position that the coils are moved flush against the neck of the picture tube (the convergence coils are moved away from the picture tube neck during shipment only). This lever is at the extreme top of the rear CRT mounting bracket and may be seen in the top view drawing of the tri-color picture tube(Fig1).

As stated previously, external magnetic fields of varying degrees and directions are encountered for each new receiver location and it is necessary to balance the receiver circuitry for the initial installation location, as well as to correct any misadjustment caused in shipvergence and focus. Since it is almost always necessary to adjust the purity and convergence systems in an initial installation, a complete set-up procedure follows.
NOTE: To facilitate adjustments to the picture tube components and other parts, the cabinet is provided with a removable hinged top section. This top section may be moved only after the cabinet back has been removed.

Depending on the cabinet style, two different top panel locking mechanisms will be encountered. In one type, a small wooden slider, at the center underside of the top panel, will move to the rear; thus unlocking the top panel at the front end of the cabinet. The other type is fas tened to the wooden side channels by thumbscrews.

Uperation of this receiver with the chassis accessible involves shock hazard; therefore no work should be done on this receiver by anyone not familiar with these hazards

Due to the circuit used, there is always a potential difference between the chassis and ground. AN ISOLATION TRANSFORMER SHOULD BE USED WHEN SERVICING THIS RECEIVER.
Do not
operate the receiver with the high voltage compartment shield removed. Make sure he ground springs between the chassis and the picture tube shield and between the yoke assembly and the picture tube shield are making contact.

PICTURE TUBE HANDLING PRECAUTIONS
Extreme care must be used in handling the picture tube as rough handling may cause it to mplode due to atmospheric pressure. DO NOT NICK OR SCRATCH GLASS, OR SUBJECT IT TO ANY UNDUE PRESSURE IN INSTALLATION OR REMOVAL. Do not remove the receiver chassis, install, remove, or handle the picture tube in any manner unless shatterproof goggles and heavy gloves are worn. DISCHARGE 2nd ANODE LEAD BEFORE HANDLING. THE TRI-COLOR PICTURE TUBE SET-UP (TS -902)

One of the first problems in setting up the picture tube is to make the apparent deflection enters of the three beams the same as that dictated by the particular picture tube design. The term "deflection centers" refers to the point inside or near the deflection yoke at which the three beams begin bending for horizontal and vertical sweeping. The forward and rear positioning of the deflection yoke on the neck of the tube locates the correct deflection centers of the beams. When the deflection center of any of the beams is incorrect, the beam will scan phosphor dots of incorrect colors.

The purity magnet mounted on the neck of the tube provides an adjustment whereby the three beams can be made to pass through their centers of deflection when the central area of the screen is being scanned.


FIGURE 1. TOP VIEW OF TRICOLOR PICTURE TUBE

1. Inject a signal from a dot pattern generator or other appropriate source into the receiver.
2. Adjust the three beam positioning magnets and the blue lateral corrector magnet for convergence of the three beams at the center of the screen. (Fig. 1)
3. Remove all signal to the receiver or switch the channel selector to a vacant channel.
4. Cut off the blue and green guns by grounding their grids into the ground holes of the receptacle. (See vertical chassis, front view.) (Fig. 14).
5. Adjust the BRIGHTNESS control for high raster brightness.
6. Loosen four screws (two screws on each side of bracket) to allow backward-forward
movement of yoke. If set has not been previously adjusted for purity, position yoke back as far as the mounting will allow. If set has been adjusted previously for purity, confine yoke ad justment to a minimum. Keep yoke concentric with neck of picture tube.
7. Locate the purity device, consisting of two magnetic rings mounted on the tube neck. The device is between the blue corrector magnet and the dynamic convergence coils. Position the tabs of one ring opposite the tabs of the other ring so that a minimum strength magnetic field is produced. If the correct tabs are opposite each other, rotating both rings of the device together should have no affect on the raster. If the position of the tabs is incorrect, rotate the rings to place the opposite tabs adjacent to each other. VHF OPERATION (channels 2 through 13)


Only for sets equipped for channels (4-83)
VHF CHANNEL SELECTOR \& BANDSWITCH


FRONT PANEL CONTROLS


OJohn F. Rider
8. Check the purity at the center of the screen. If it is not satisfactory:
a. Separate the tabs by a small amount to produce a weak magnetic field.
b. Rotate the purity device to obtain better red purity in the central area of the screen.
c. Continue the process of adjusting the field strength and direction of the magnetic field until the purity in the central area of the screen has been made as large as possible.

NOTE: Use as weak a magnetic field as possible. Avoid shadow due to beam cut-off by the tube neck.
9. Move the yoke forward and backward along the neck of the tube to obtain best edge purity.
10. Re-adjust the purity device for best overall purity.

NOTE: If satisfactory edge purity cannot be obtained, it may indicate either a defective yoke or picture tube.
11. Check the purity of the green and blue fields, one at a time, by keeping the grid of the desired gun inserted into the grid receptacle and grounding the grid plugs of the other two guns. Avoid any shadows due to neck cut-off of the beams.
12. It may be necessary to compromise the setting of the purity device which resulted in best red purity in an effort to obtain best overall purity of all colors. In any compromise setting, however, the red field should always be favored strongly. Re-insert all grid plugs after purity adjustments have been completed.

DYNAMIC CONVERGENCE SYSTEM
Because the phosphor screen is not a true spherical surface, the distance the three beams travel from the center of deflection is greater at the outer areas of the phosphor screen than at the center. At the outer areas, therefore, the beams will cross-over, or convergc, before they reach the shadow mask, thus causing over-convergence in these areas. The dynamic convergence coils apply electromagnetic correction to each of the three beams at a horizontal and vertical sweep rate to correct this condition. This correction causes the point of convergence to change according to the sweep rate and beam position so that it always follows the curvature of the shadow mask.

PROCEDURE

1. Turn all dynamic amplitude controls to minimum (fully counterclockwise). (Fig. 14).
2. Turn vertical tilt controls to minimum (mid-position). (Fig. 14).
3. Position shift lever so that convergence coil pole pleces are seated on the neck of the picture tube. (Fig. 1).
4. Use the signal from a dot pattern generator or other suitable source. Adjust the brightness of each beam so that each color dot can be easily observed. (Use the background and G-2 controls.) CAUTION: Maintain picture tube brightness and modulation level of signa source within limits of good focus.
5. Adjust the three beam positioning magnets and the blue lateral magnet for best convergence at center of screen.
6. Using the red field, adjust yoke and purity device for optimum purity. (Refer to purity ad justment instructions.) NOTE: If purity has been adjusted previously, yoke adjustment is unnecessary.
7. Repeat step 5 for best convergence at center of screen.

## VERTICAL DYNAMIC ADJUSTMENT

1. Choose a vertical column of dots near the center of the screen. Notice that the dots, while converged at the screen center, become progressively over-converged away from the screen center toward the top and bottom of the screen.
2. Observe the position of the blue dot in each dot trio along this vertical column of dots. Ad jusi the red and green vertical tilt controls so that the red and green dots are converged and spaced symmetrically from the blue dot in each group (trio). This symmetrical over-convergence should be made to increase uniformly from screen center to top and screen center to botgence
tom.
3. Adjust the blue vertical tilt control so that all blue dots in each trio along a center vertica line have the same relative position with respect to the red and green dots.
4. Adjust the beam positioning magnets for center convergence, if necessary.
5. Adjust the green vertical amplitude control to position the green dots so that they are equally spaced from the blue dots from top to bottom of the screen.
6. Adjust the green beam positioning magnet to reconverge the green dot with the blue dot at the center of the screen.
7. Repeat step 5 for the red dots.
8. Adjust the red beam positioning magnet to converge the red dot with the blue and green dots at the center of the screen.
9. Adjust the blue vertical amplitude control using the same procedure as used for the blue and green amplitude controls.
10. Adjust the blue beam magnet for convergence of the vertical row of dots HORIZONTAL DYNAMIC ADJUSTMENT
11. a. Peak each of the horizontal dynamic phase coils one at a time for maximum as follows:
b. Turn the blue horizontal dynamic amplitude control to maximum (fully clockwise). Set the red and green horizontal dynamic amplitude controls to minimum (fully counterclockwise).(Fig. 14).
c. Tune the blue horizontal phase coil so that, over the center portion of the screen, the blue dot is displaced a maximum amount from the other two dots. This displacement, which makes the blue dots appear to follow a parabolic path across the screen, should be such that the blue dots are moved toward a horizontal reference line at edges of the screen.
d. Turn the blue horizontal dynamic amplitude control to minimum (fully counterclockwise).
12. Repeat the foregoing procedure for the green gun only.
13. Repeat the foregoing procedure (steps la to $1 d$ ) for the red gun only.
14. Select a horizontal row of dots at the center of the screen.
15. Adjust the blue dynamic amplitude and phase together to obtain the same amount of mis convergence of the blue dot at the screen center and the edges of the screen. This will es tablish a horizontal line across the screen which can be used as reference for positioning the red and green dots.
16. Adjust the blue beam positioning magnet (not the blue lateral corrector magnet) for convergence of the dots at the center of the screen.
17. Adjust the green horizontal dynamic amplitude and phase controls so as to obtain uniform and symmetrical displacement of the green dots away from the blue dots in all horizontal dot trios.
18. Adjust the green beam positioning magnet for center convergence.

Adjust the red horizontal dynamic amplitude and phase controls so as to obtain uniform nd symmetrical displacement of the red dots away from the blue dots in all horizontal do trios.
10. Adjust the red beam positioning magnet for center convergence.
11. Check purity and, if necessary, adjust the three beam positioning magnets and blue lateral magnet for center convergence.
2. Make any required touch-up adjustments necessary to give best possible overall convergence of all the dots. The beam positioning magnets and the dynamic controls are used as indicated by a study of the dot pattern. NOTE: It will not be necessary to reset purity when the touch-up adjus

BALANCING THE BACKGROUND AND G-2 CONTROLS
Compensation for differences in the three phosphor efficiencies, the cut-off voltages and the emission characteristics of the three guns is provided as follows: Three G-2 controls adust the screen voltages for each gun; two BACKGROUND (grid 1) controls adjust the static bias on the blue and green guns. Static bias on the red gun is fixed by circuitry.

Procedure for balancing BACKGROUND and G-2 controls

1. Turn channel selector to a channel transmitting a black and white picture - preferably a test pattern. (Fig. 2)
. Set BRIGHTNESS and CONTRAST controls for normal picture. Disregard color fringing fiects due to misadjustment of the convergence controls.
2. Turn GREEN G-2, BLUE G-2 and RED G-2 controls to maximum clockwise position.
3. Adjust GREEN BACKGROUND, BLUE BACKGROUND and, if necessary, RED G-2 for high ight white on the brightest picture portions.
. Turn BRIGHTNESS control counterclockwise so that screen becomes less bright (grey). If color begins to tint the screen as brightness is reduced: Adjust the G-2 control corresponding to this color untll the bright portions of the screen are white or grey.
4. Adjust the BRIGHTNESS control for normal brightness on the screen. Re-set the BACKGROUND controls so that brightest portions of picture appear white.
. Repeat steps 2, 4, 5 and 6 until no color tinting occurs over the usable range of the BRIGHT NESS control. (Maximum brightness setting is not considered part of the usable range.)

OPERATING CONTROLS

## Front Panel Operating Controls

The large twin front panel knobs control the basic receiver functions for monochrome reception. Only two additional controls are required on the front panel for color reception. These controls are the COLOR INTENSITY and COLOR SHADING controls, located under the front panel cover. (In some models the color intensity control is labeled "chroma" and the color shading control is labeled "fine phase".) (Fig. 2)

## Front Panel Controls Used For Color Reception

## COLOR INTENSITY CONTROL

The COLOR INTENSITY control governs the gain of the color system and thus the intensity f the reproduced colors. Turning the COLOR INTENSITY control counterclockwise will remove all color from the picture

When receiving a black/white picture transmission, always keep the COLOR INTENSITY control turned to the counterclockwise stop. Viewing a black/white transmission with the COLOR INTENSITY control turned up may result in color fringes outlining picture subjects. This gives the appearance of colored "snow" in the picture.

COLOR SHADING CONTROL

The purpose of the COLOR SHADING control is to allow the picture colors to be tinted as desired. The most faithful color reproduction is usually obtained by adjusting the COLOR HADING control for natural flesh tones. Any object having a familiar color (such as sky or water) may be used for this adjustment

## ront Panel Controls Used For Monochrome (black/white) Reception

1. ON-OFF-VOLUME CONTROL

Turn the receiver on by rotating the ON-OFF-VOLUME control to the right until a click is heard. Allow the receiver to warm up for a few minutes. (NOTE: The warm-up period required for a color television receiver to produce a good picture, either in color or in monochrome, is longer than that required for a black/white receiver.) After the receiver is turned n, allow several minutes for the circuitry to stabilize. Then, advance the ON-OFF-VOLUME control temporarily to mid-position and adjust later as required.
2. COLOR INTENSITY CONTROL (Under front panel cover)

Turn off by rotating counterclockwise until stop is reached.
3. CONTRAST CONTROL (Under front panel cover)

Turn CONTRAST control to about the middle of its range
. BRIGHTNESS CONTROL
Turn clockwise until picture screen is lighted. Readjust later in conjunction with CONTRAS as required.
5. VHF CHANNEL SELECTOR

Turn the VHF CHANNEL SELECTOR until the desired channel number appears on top. (VHF channels are numbered 2 through 13).
6. FINE TUNING

Adjust the FINE TUNING control for best picture detail. Readjust CONTRAST and BRIGHT NESS control for most pleasing picture
. ACOUSTINATOR
Adjust the ACOUSTINATOR tone control for the most pleasing tone.

## Tuning UHF Stations

(Only for sets equipped to receive channels 14 to 83. )
Turn VHF CHANNEL SELECTOR control so that window located between numbers 2 and 13 is at top. This switches receiver to UHF and exposes the UHF dial scale.

With the VHF CHANNEL SELECTOR control set to the UHF positicn, UHF stations can be tuned with the FINE TUNING control. Tune first to desired channel, then tune for best picture detail. Readjust CONTRAST and BRIGHTNESS controls for most pleasing picture.

## Receiving Color Programs

1. Adjust receiver for a satisfactory monochrome picture as outlined under "Front Panel Con trols Used For Monochrome (Black/White) Reception".
2. COLOR INTENSITY CONTROL (Under front panel cover)

Advance COLOR INTENSITY control to right (clockwise) until color begins to appear in picture. Adjust COLOR INTENSITY control until desired strength of color is obtained.

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3. COLOR SHADING CONTROL (Under front panel cover) ppearance of some object having familiar coloring.
4. FINE TUNING control is not adjusted correctly, the color may be removed from the picture.

## Supplementary Controls Located Under Front Panel Cover

The small controls located under the front panel cover are provided for customer use, as required. (These controls are practically independent of critical color and monochrome cir cuitry.) The more-frequently used supplementary controls are provided with knobs, while those used infrequently have knurled shaft ends. This provides instantaneous recognition of the primary and secondary supplementary controls. (Fig. 2).

It is advisable to adjust these "under-cover" controls while viewing a black/white transmission, preferably a test pattern. This will reduce the possibility of error when analyzing picture defects. During the adjustment of these controls, color effects can be eliminated by turning the COLOR INTENSITY control fully counterclockwise.

## HORIZONTAL HOLD

This control locks the picture horizontally. If the picture has a tendency to move across the screen horizontally or appears as a series of sloping lines or bars, this control should be the screen horizontally or appears as a series of sloping lines or bars, this control should be the picture remains locked-in, or stationary.

## VERTICAL HOLD

When the picture exhibits intermittent or constant vertical movement; when the plcture appears to be rolling up or down, the VERTICAL HOLD control should be adjusted. The correct adjustment is in the center of the lock-in range.

VERTICAL SIZE AND VERTICAL LINEARITY
When the size of the picture, from top to bottom, is too large or too small, adjust the VERTICAL SIZE control. Stretching or squeezing of the picture at the top or bottom can be eliminated by adjusting the VERTICAL LINEARITY control. It may be necessary to adjust the VERTICAL SIZE and VERTICAL LINEARITY controls simultaneously until a picture which s balanced in shape from top to bottom (linear) fills the screen. If the picture should roll dur ing these adjustments, reset the VERTICAL HOLD control.

## FOCUS

Adjust the FOCUS control for the clearest picture.

## Supplementary Controls Located At Rear of Receiver

The supplementary controls located at the rear of the receiver fall into two classifications: those that can be adjusted easily without affecting the color balancing and picture tube set-up controls and those that require careful adjustment in conjunction with one another. The more critical controls are described in the section "Balancing the Background and G-2 Controls". These controls should be adjusted by a trained technician. (These controls should be adjusted when viewing a black/white test pattern.)

HORIZONTAL CENTERING CONTROL
This control shifts the entire raster and the picture, from left to right, on the screen. Ad just this control to get a picture that is well-centered from left to right

VERTICAL CENTERING CONTROL
This control shifts the entire raster and the picture, from top to bottom, on the screen. Adjust this control to get a picture that is well-centered from top to bottom.

HORIZONTAL DRIVE CONTROL (On models which have a drive control)
This control affects the brightness and width of the picture. Adjust this control untll whit vertical bars appear on the screen; then back off control to the position where bars just dis appear. (NOTE: Adjust HORIZONTAL DRIVE control before making horizontal size adjust ment.)

## HORIZONTAL SIZE CONTROL

This control varies the width of the picture. Move the horizontal size control to the lef until dark edges can be seen on each side of the plcture. Then move control to the right until picture is slightly larger than the picture mask.

## AREA SELECTOR SWITCH

The quality and stability of the picture is controlled by the area selector switch. Set this switch to the position in which the picture is the clearest and most stable.

## SERVICE NOTES

CHANGING OF TUBES
Refer to TS -902 horizontal chassis top view and BP-902 vertical chassis top view for tube ocations.) (See Figs. 11 \& 14).

The receiver should be turned off when changing tubes. Indiscriminate changing or interchanging of tubes should be avoided for the following reasons:

1. A change of IF or RF tube, or crystal detector, can cause loss of sensitivity or poor picture quality. Check alignment and sensitivity after making such changes.
2. A change of ilmiter or ratio detector tubes can cause distorted audio, buzz, or loss of audio sensitivity. Check alignment and sensitivity after changing these tubes.
3. Changing the horizontal oscillator tube can result in poor nolse rejection or cause the horizontal hold control to be out of range. This may necessitate re-adjustment of the horizontal oscillator coll

## FUSE REPLACEMENT

## B plus and initial surge fuse (special 7.5 ohm resistor $\mathrm{R}-73$ )

This fuse is a plug-in type located on the top rear of the horizontal chassis, behind the ertical chassis. It is possible to replace this fuse by removing the back cover. Replace vertical chassis. It is possible to replace this fuse by removing the back cover. Replace the receiver assembly toward the rear of the cabinet

## Filament fuse ( 1 inch of \#26 copper wire)

This fuse is located beneath the chassis in the area below the filament transformer. The hassis must be removed from the cabinet in order to replace the filament fuse. Replace with 21 inch length of \#26 wire soldered between two lugs of the terminal strip; the connection is in series with the heavy green lead from the filament transformer

HORIZONTAL OSCILLATOR ADJUSTMENT
The HORIZONTAL HOLD control should have a syme range of approximately 25 degrees otation. If the control adjustment is overly critical:
. Increase the BRIGHTNESS and reduce the HORIZONTAL SIZE until the edges of the horizontal blanking pulse (grey vertical bars) are visible on either side of the raster
. Shunt the HORIZONTAL OSCILLATOR coll L-43 to ground with a .25 mf 400 V , capacitor and ground the control grid of the horizontal oscillator (pin 4)
3. Adjust the HORIZONTAL HOLD control until the picture is in sync or slowly floating through sync
4. Remove the capacitor shunting L-43 to ground and adjust the HORIZONTAL OSCILLATOR coil until the picture is again in sync or floating through sync.
5. Remove short from control grid (pin 4) of horizontal oscillator.

REMOVAL OF THE CHASSIS
The chassis and the picture tube are mounted independently to a baseboard which is bolted into the cabinet. The chassis may be removed from the cabinet independently of the picture tube by removing four bolts. When removing only the chassis: disconnect the ground lead beween the high voltage cage and the picture tube: disconnect the high voltage lead; disconnect antenna lead-in and unplug speaker plug; unplug the deflection yoke plug from chassis; dis connect yoke leads extending into the high voltage case; on models using a field neutralizing coil, unplug the field neutralizing coil plug.

Both the picture tube and the chassis can be removed by removing the four bolts which hold the baseboard to the cabinet. This operation must include the removal of the antenna from the ide of the cabinet, disconnecting the antenna lead-in, unplugging the speaker plug and remov ing the wire braid from the bezel.

## TONE CONTROL LINKAGE SETTING

In the event it becomes necessary to replace the tone control linkage:

1. Turn the tone control maximum counterclockwise
2. Place the linkage over the TONE and CONTRAST-VOLUME shafts in such a manner that the arms and link are above the shafts.
3. Move the linkage assembly counterclockwise as far as possible

NOTE: After chassis has been replaced in the cabinet, place the TONE control knob over the CONTRAST-VOLUME shaft so that the lettering on the knob is toward the top.

## REMOVAL AND REPLACEMENT OF COLOR PICTURE TUBE

Replacement of the tri-color picture tube necessitates a complete purity and convergence alignment.

To remove the color picture tube:
. Disconnect the picture tube socket. (Refer to Fig. 1).
2. Remove the blue lateral corrector magnet.
3. Remove the PM purity device.
4. Withdraw the dynamic convergence coils from the neck of the tube by shifting the coil lever toward a vertical position.
5. Remove the fibre picture tube mounting strap.
6. Disconnect the plastic high voltage interlock.
7. Loosen connecting rods between front and rear tube supports.
8. Remove front picture tube retaining brackets. Carefully remove the picture tube out the front of the assembly. Use extreme care while pulling the neck of the picture tube through the dynamic convergence coil assembly and the yoke.
9. Remove the magnetic shield from the flare of the picture tube.
10. Remove plastic insulating sleeve from around picture tube; remove second anode con nector.

To install color picture tube:

1. Before installing tube in chassis mounts, clip second anode connector on metal flange of picture tube. Make this connection at a position approximately in line with pin \#12 of the picture tube.
2. Place plastic insulating sleeve around picture tube front. Sleeve fold-over should be positioned in line with pin \#4 of the picture tube.
3. Place magnetic shield on flare of the tube
4. Mount picture tube to chassis with pin \#4 toward top. Replace the front tube-retaining brackets. Position tube so that plastic sleeve over picture tube face edge is flush against retaining brackets
5. Replace fibre picture tube strap; tighten connecting rods between front and rear tube supports; connect high voltage interlock.
6. Replace the PM purity device.
7. Replace the blue lateral corrector magnet so that it is directly below the blue gun and then replace tube socket.
8. Move the dynamic convergence coils in close proximity to the tube neck by shifting the dynamic convergence coil lever toward the tuner side of chassis.
9. Proceed with a complete purity and convergence alignment and background tracking set-up. CIRCUIT DESCRIPTION

## OPERATION OF THE COLOR RECEIVER

The modern color television receiver is more or less based on the original system in which three separate picture tubes were used. In this three -tube system, each picture tube had a transparent color filter of red, green and blue, respectively. Each tube could be driven with a video signal and, in this case, would show the same scene but, with the picture colored entirely red, green or blue, depending upon which tube was lighted. By a system of color sens ine rors and glass screens, it was possible to bring the three pictures together at one focal point in such manner that the viewer would see the three superimposed pictures (one vi picture... but just the picture tube win the rediter were completely in red. The same would hold true for the blue and green tubes

By the foregoing method of using three different picture tubes with color filters, it is possible to produce a color television picture provided that a method is available of breaking the picture down at the transmitter so that the red parts of the scene are sent to just the red pic ture tube, the blue parts of the scene to just the blue picture tube, and the green parts of the picture to just the green picture tube. This can be accomplished by having three cameras at the it can "see" only the blue號

If the signals from the individual cameras reach only the appropriate color picture tube, we have a method of taking the picture apart, color by color, at the transmitter and putting it back have a together correctly at the receiver. For any colors other than those of the color filters, a combination of two or more of the screen colors could be used and mixed to form the desired color.

The system described is possible to construct and was actually used at one time. However, the mechanical, optical and electrical problems involved make it impractical. For example, each picture tube would have to show a picture identical in height, width and linearity in order for them to superimpose perfectly. Experience with obtaining suitable linearity, etc., in just one receiver, gives an insight into the troubles encountered.

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FIGURE 3. BLOCK DIAGRAM


One solution to the problem is the three-electron gun picture tube which attempts to combine the three separate picture tubes used previously into one glass envelope. In this manner, the same deflection yoke and sweep system may be used for all three picture beams, resulting in identical height, width and linearity.

The tri-color picture tube is designed to give the equivalent action of the three separate tubes by dividing its screen into extremely small color dots and by lighting all screen dots of any one basic color by a particular electron gun of three used. In this way, the screen may be made completely red, blue, or green by controlling the beam currents of the individual guns. Likewise, color may be added to a picture by controlling the red gun by the signal from the red camera at the transmitter, the
green gun by the green camera information.

RECEIVING BLACK AND WHITE
All screen dots of any one color are lighted by just one of the three electron guns and thus the light intensity of the three-screen color may be controlled by the beam currents of the individual guns. The beam currents of the three guns may be individually adjusted by grid bias voltages in order to adjust the separate color intensities when there is no signal. If the red dots are made brighter than the blue and green dots, the entire screen will appear with a red tinge, etc. When the light intensity value of all the red, blue and green dots are equal. . . The entire screen will appear white to the viewer. This is due partly to the inabinty of the human eye to distinguish individual colors of equal light intensity values and also to the fact that the crick that the screen of the tri-color picture tube may be made to appear white to the observer and (as determined by the gun grid bias and anode voltages). .... the entire screen can be made arighter or dimmer and still appear as white or shadings of white. A standard black and whit righter or dimmer and and and the screen will appear to follow the shadings of black and white necessary to reproduce the picture. Compatibility is thus maintained between black and white and color receivers.

The circuitry of the color receiver used to carry the black/white (brightness) signal from he second detector to the picture tube, is very similar to the standard video system used in onventional receivers. This system consists of the first and second video amplifiers, through the brightness amplifier and on to the cathodes of the three electron guns, so that the beam currents of all three are increased and decreased by the brightness (Y) signal.

ADDING THE COMPLETE COLOR SIGNAL
In the formation of an actual color telecast, three cameras are used for pick-up at the station. One camera is for the red parts of the picture, a second for the blue parts and the third for the green picture information. The outputs of these three cameras are re-combined in the correct proportions to produce a video signal practically identical to that of a conventional black and white camera. This video signal is transmitted as the "Y" signal and contains all the brightness information necessary to reproduce a picture in black and white. It corres ponds closely to a standard black/white signal in bandwidth, etc., and may be reproduced on a standard black/white receiver. The "Y" signal will also produce a good definition black and white picture through the " $Y$ " channel of a color receiver. In a sense, a color receiver repro duces a good definition black/white picture through the "Y" channel and then correctly colors this picture by information sent over a separate subcarrier and through the "chroma" channel.

The entire signal, brightness " Y " and color "chroma" is passed through the receiver from the antenna to the second video amplifier. The output of the second video amplifier divides into two paths, the brightness channel for the video signal and the chroma channel for the color signal. The brightness signal continues on through the brightness amplifier and to he cathodes of the tri-color picture tube to produce a good detall monochrome picture. The color informanion contues on through the bandpass amplier, bandpass cathede foll $t$ the demodula to the grid of the

The color information from the three cameras at the transmitter is sent over a separat The color information from the three cameras at the transmitter is sent over a separat
subcarrier of 3.58 megacycles, using a two-phase modulation, suppressed-carrier system. subcarrier of 3.58 megacycles, using a two-phase modulation, suppressed-carier system.
(NOTE: In the suppressed carrier system, the actual 3.58 megacycle carrier is not transmitted....... only the upper and lower sidebands, which contain the actual picture color informitted.......only the upper and lower sidebands, which contain the actual picture color info poses, you may assume that a conventional carrier signal and its sidebands is being received The color subcarrier is modulated in amplitude (same as standard black and white video) as well as in phase (phase may be considered as the amount of lead or lag of one signal as com pared to a fixed reference signal standard). The phase of the subcarrier determines the particular color (hue) that is to be reproduced at any particular instant of a horizontal scanning line. The amplitude of the subcarrier determines the strength of this hue in comparison to the black and white signal (brightness) and thus determines its shade or tint (saturation).

THE PHASE ANGLE OF THE SUBCARRIER DETERMINES THE COLOR (HUE)
Two demodulators are used in the receiver to recover the color information brought in y the color subcarrier. Each demodulator can detect a change in the phase of the subcarrier since they are supplied with a signal standard by the local 3.58 megacycle color oscillator (the oscillator signal also effectively re-inserts the 3.58 megacycle subcarrier). A change in phase of the subcarrier can produce a most important action through the demodulators.. it can change the polarity of the output voltage. Depending on the output of either of the deubcarrier, a positive or negative voltage may be developed at the output of either of the de modulators.

Since the polarity of the output voltage of a demodulator is dependent on the phase of the subarrier in comparison to the phase of the local oscillator signal supplied this particular demodulator, it should be apparent that the demodulators can be designed to produce different polarty outputs from the same subcarrier merely by shifting the phase of the oscillator signal fed the of the demodulators. This is accomplished by inserting a phase shifting network between the ocal oscillator and the B-Y demodulator (the network shifts the phase of the to the B-Y demodulator by 90 degrees, in respect to the oscillator slgnal to the $R$ Y drom the wo or). In this manner, it is possible to obtain four different polar demodulators as the same subcarrier signal is shifted through 360 degrees. The demodor one output voltages may be: both positive, bit negative and the other positive.
The output voltages of the two demodulators ( $R-Y \& B-Y$ ) are amplified through their respective amplifiers ( $\mathrm{R}-\mathrm{Y}$ and $\mathrm{B}-\mathrm{Y}$ ) and used to drive the control grids of the red and blue picure tube guns, respectively. If we put a positive voltage on the control grid of the blue gun, the blue phosphor dots over the entire picture screen will be more brightly lighted. If we put a negative vire tire pictur sctic produce a phe arie bright at the blue dots. The second requirement is to get a third negative voltage on the brightess in the green git ing some of the pirive amplifier ( $G-Y$ ). The two voltages subtract from each other across be $G-Y$ met erate the tube. In this particular case, the red positive signal is the larger and the remainde is amplified and inverted through the G-Y amplifier so that a negative voltage is supplied to the control grid of the green electron gun. (NOTE: In the case of a phase angle producing positive or gedative voltage outputs at both demodulators. ... the G-Y amplifier would add voltages.)

The preceding paragraphs explained how positive and negative voltages are produced by two separate demodulators operating on a single subcarrier and how the control grids of the three electron guns receive the correct polarities to increase or decrease the brightness of the colors. We must now take into consideration the fact that a video signal is being fed to the picture tube cathodes simultaneously with the color signals arriving at the control grids It should be obvious that the signals at the control grids can either add to or subtract from the video brightness signals at the cathodes, resulting in an increase of brightness of a par this. the red CRT control grid and the B-Y demodulator and amplifier feeds a negative voltage to the blue CRT control grid. The negative B-Y signal feeds into the control grid of the blue gun and cancels the brightness signal (negative) at the cathode of the blue gun, resulting in no change in the blue beam current. The positive R-Y signal feeds into the grid of the red gun and adds to the negative brightness signal at the cathode of the red gun. Thus, the red electron gun increases its emission and colors the area red.

The green electron gun is fed by the signal from the G-Y amplifier and since the G-Y amplifier is receiving a signal from the output of both the $\mathrm{R}-\mathrm{Y}$ and $\mathrm{B}-\mathrm{Y}$ amplifiers, it will either add or subtract these signals. In this case, there is a positive signal at the output of the R-Y amplifier and a negative signal at the output of the B-Y amplifier, the G-Y amplifier finds the difference, inverts it, and feeds it to the green gun in the correct polarity to cancel the bright ness signal at the cathode of the green gun. Thus, we find that the green gun as well as the blue gun do not change conduction, leaving only the red gun emitting heavily and coloring the area red.

Blue and green signals are formed in the same manner, the only difference being in the phase angle of the 3.58 Mc color subcarrier which, in turn, produces voltages in the demodulators of such polarities that the two unwanted color guns do not change conduction. For example, when transmitting blue, the phase angle of the subcarrier is such that the red electron gun receives a negative signal at the control grid, cancelling the negative brightness signal at the red cathode. The blue electron gun receives a positive signal at the control grid adding to green ( $G-Y$ ) a negative brightness signal of the cathode. Thus, we find that the red and green guns remain at the same brightness level as when no signal was applied and that the blue gun conducts heavily... coloring the particular area being scanned blue.

A similar action occurs for any green areas, with the exception that the polarities are such that the red and blue signals cancel their portion of the brightness signal, while the green signal adds to the brightness signal giving a green area.

It should be apparent that the phase angle of the color subcarrier determines the polarity output of the demodulators and thus, which signals will add and which will cancel creating the particular color required. As the phase angle of the color subcarrier is shifted, from 0 to 360 degrees, the color of the screen will not only change through the three basic of red, blue and green, but also through the entire color spectrum capable of being reproduced by the combinations of these three colors.

Now, let us suppose that the phase of the subcarrier is such that a red area is being produced on the screen and that the voltage of just the color signal alone is reduced. The result is that there is more brightness signal than red color signal and the red takes on a faded tin In other words, when the amplitude of the color subcarrier is changed in respect to the brightness signal, the shade or tint of the particular color reproduced will change. Thilitude of the cor subict in the brightness signal determines the particular shade (saturation) of the basic color and that the phase angle of the subcarrier determines the particular color desired (hue)

In order for the demodulators to be able to detect a change in the phase of the color subcarrier, they must compare the subcarrier against a standard. This standard is the local 3.58 Mc color oscillator in the receiver. However, the local oscillator must have the same phase and frequency as that of the 3.58 Mc oscillator of the transmitter (before the phase of the transmitter subcarrier oscillator is changed by phase shifting). To accomplish this, a color synchronizing signal is sent at the trailing edge of the horizontal synchronizing pulse which is approximately nine cycles of 3.58 megacycles. This signal is called the "burst" signal and its purpose is to pull the receiver's local 3.58 Mc oscillator into the correct phase and frequency. During the horizontal line scanning, the local oscillator maintains its phase and frequency due to the action of the AFC control system. Oscillator stability is with the burst, a change in the phase of the color subcarrier will result in a change in amplitude or polarity of the demodulator output voltage.

THE BANDPASS AMPLIFIER AND COLOR BURST BOOST SYSTEM
The bandpass amplifier is the first tube stage of the color channel. It receives the color signal from the plate of the second video amplifier through a potentiometer mechanically ganged with the contrast control (cathode of the brightness amplifier). In this manner, the amplitude of the color signal through the chroma channel is tracked with the amplitude of the video signal through the brightness channel. An independent gain control potentiometer located in the cathode of the bandpass amplifier, regulates the strength of the color signal only. This control is located on the front panel and is labeled "color intensity"

The synchronizing burst signal also travels through the bandpass amplifier, to reach the automatic frequency control (AFC) system of the local 3.58 megacycle oscillator

To insure constant burst signal to the AFC system, at all settings of the color intensity control; the gain of the bandpass amplifier is automatically increased to maximum during the burs signal by injection of a positive pulse of voltage (burst boost pulse) at its control grid. This positive pulse is generated at the cathode of the damper tube during the retrace time of the hor izontal sweep system and, therefore, arrives at the grid of the bandpass amplifier at approximately the time of the burst signal. (NOTE: The burst pulse is transmitted immediately following the horizontal sync pulse: the sync pulse coincides with the retrace of the horizontal system, therefore, the burst and boost pulses should arrive at the grid of the amplifier almost simul taneously.

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The burst boost pulse, if of constant amplitude, would always increase the gain of the bandpass amplifier during the burst signal. However, the total amplification factor of the stage would still be dependent on the setting of the color intensity control plus the boost voltage and the burst signal would change amplitude as the setting of this control were changed. Since it is desirable to maintain the burst signal at a constant level for best AFC action in the following circuits, a clamping diode ( $N 60$ crystal) is provided from the boost pulse input to the "hot" en of the color intensity control which varies the amplitude of the boost pulse. The clamping ac tion of the diode is regulated by the voltage produced across the intensity control and thus the amplitude of the boost pulse is regulated by the intensity control setting. In this manner, the amplitude of the boost pule is always such that the burst signal is amplified by the same amount (maximum gain). The constant amplitude of the burst signal, provided by this circuit gives superior AFC control action of the 3.58 Mc crystal oscillator

Inspection of the bandpass stage will show that a type 12BY7 sharp cut-off pentode type tube is used. However, a sharp cut-off type tube does not readily lend itself to gain-controlled circuits due to the fact that, as the bias is increased on the control grid, the tube begins acting as a clipper and the gain of the stage is not appreciably changed. A unique action is achieved in the bandpass amplifier, between the high gain of the sharp cut-off pentode and the value of gain characteristic of the remote cut-off pentode, by the use of a larger-than-normal varies with the setting of the cathode bias potentiometer since the total tube current is changed in accordance with the bias. For example, as the bias is increased, the total tube current is decreased and the $I \times R$ drop, occurring across the screen resistor, is decreased resulting in a higher screen potential. As the screen voltage is increased, the tube becomes harder to cut-off due to the fact that the cut-off voltage and gain of the tube are quite dependent on the screen voltage. Thus, we find that the tube begins to act similar to a remote cut-off type of tube; also that the gain is changed, due to the characteristic curve of the tube changing with the screen voltage.

Inspection of the schematic diagram shows that a positive pulse (boost signal) is coupled from the damper tube's cathode through a network ( $\mathrm{R}-150, \mathrm{C}-140, \mathrm{C}-141$ and $\mathrm{C}-142$ ). The sig nal is fed to the junction of the grid resistors $R-101$ and $R-102$ and is developed across re sistor R-102 ( 10 K ohms). The resistor R-101 ( 3300 ohms) and peaking coil L-42 apply the voltage to the control grid. The purpose of the 1 megohm resistor returned to B++ is to counteract any negative voltage developed by the diode's conduction.

The clamping crystal CR-5 connects from the boost signal input point to the "hot" end of the color intensity control. Resistor R-103 is a conventional cathode biasing resistor, as are the cathode bypass capacitors C-105 and C-66C. Capacitor C-66C ( 100 mfd electrolytic) pro-


VOLTAGE AT SCAEEN OF PUAST AMP
4. The 3.58 Mc crystal oscillator
5. The oscillator buffer stage (output).

The burst amplifier receives the entire color signal, at its control grid, from the bandpass amplifier's output link coupling system. Since the screen of the burst amplifier has no B+ volt age other than that fed from a winding on the horizontal output transformer, the tube is without setage except during retrace of the horizontal sweep circuit. In this manner, the band pins amplifer is allowed to operate only during horizontal retrace, which corresponds to the only during the color burst.
vides sufficient bypass action to prevent degeneration, with resultant loss of gain, at low fre quency signals. Due to the inefficient bypass action of an electrolytic capacitor on higher fre quency components, a second paper capacitor (.01 mfd - C-105) parallels the electrolytic.

The crystal CR-5 is connected in the circuit in such manner that a positive pulse voltage at the junction of the grid resistors R-101 and R-102 will cause the crystal to conduct. Considering a case in which the viewer might prefer strong color intensity signals and in which the color intensity control is set to minimum resistance (maximum stage gain), the cathode of CR-5 is at or near chassis ground potential. In this case, the forward resistance of the crystal is effectively shunted across the boost signal input R-102. CR-5 acts as a low resistance path to ground for any positive pulses appearing at this point. Thus, the boost pulse is removed or reduced, since the burst signal is receiving maximum gain and does not require a boost.

Considering the opposite case, in which the viewer might prefer weak color intensity signals, the gain of the bandpass amplifier would be decreased by increasing the resistance of the bandpass amplifier constant for the burst signal, the it is desired to maintain the gain of the the pass a intensity control is adjusted) the tube current flowing through this resistance (asll produce voltage which will be positive at the cathode end negative at the reind and This voltage must be overcome by the boost signal before the crystal diode will conduct; therefore age tive boost pulse will be aiding the signal at the control grid which coll give, therefore, a posi the burst signal. The amplitude of this pulse will nearly equal TC wor gat cathode resistor.

THE 3.58 MC COLOR OSCILLATOR SYSTEM
The path of the synchronizing burst signal, the AFC voltage and local 3.58 Mc oscillator signal is as follows:

From the plate of the second video amplifier to:

1. The burst amplifier
2. The color AFC phase detector
3. The reactance tube


The output of the burst amplifier is transformer coupled to the color AFC phase detector and, due to the keying of this stage as explained, allows only the burst to enter the phase detector. A second input to the phase detector is through transformer coupling from the output of the buffer amplifier, which in turn, is driven by the local 3.58 Mc color oscillator.

The phase detector compares the phase and frequency of the incoming burst signal, from the burst amplifier, with that of the local color oscillator. Any difference in phase or frequency results in a DC output from the center tap of the load resistors and is applied to the control grid of the reactance tube.

The reactance tube's plate current then, is under the direct control of the phase detector. Any change in the current of this stage presents varying amounts of capacitance (produced electronically by the reactance tube) to the crystal controlled oscillator and restores the phase and frequency of the oscillator

THE BURST AMPLIFIER
The burst amplifier performs a similar function in the color system as the sync separato performs in the sync section of the conventional black and white receiver...it separates the color synchronizing burst signal (from the black and white sync as well as from the coloring information). Stated in a different manner, the burst amplifier tube allows only the color sync burst to reach the phase detector for frequency control action.

The burst amplifier is inoperative during the scanning of horizontal picture lines due to the fact that it is not supplied with screen voltage. The tube is made operative during the burst signal by a positive pulse of voltage fed to the screen from an independent gate winding located on the horizontal output transformer. The transformer and gate winding produces sizeable voltages only during the time of horizontal retrace -- during which time the burst amplifier is allowed to conduct.

The burst signal is transmitted during the blanking pedestal immediately following the horizontal sync pulse. In a receiver which is operating properly, retrace of the horizontal sweep system is initiated in close coincidence with the transmitted horizontal sync pulse. Therefore, the time of the horizontal rece, in the receiver, occurs the burst signal. The burst signal only is amplified and passed on to the following stages (see "Gated Burst Amp"drawsignal only is
ing).(Fig. 14

As stated, the burst signal is transmitted after the sync pulse and it is apparent that the As stated, the burst signal is transmitted after the mill slightly lead the burst signal at the grid .... in which case a portion of the last few burst cycles would be lost. To shift the time of the keying pula sor is utilized to shape and delay the keying pulse.

The grid input system of the burst amplifier consists of a parallel resonant tank to grnum
The grid input system of the burst amplifier consists of a parallel resonant rank When tuned to 3.58 Mc , the tank that the tank is adjustable capacitively as well as induct oly and that the capacitor is the color shading control located on the front panel of the recter.

It has been established that the voltage reaching the burst amplifier is that produced cross the resonant tank in the grid circuit, and that this voltage represents the burst signal When the tank is tuned to approximately 3.58 Mc , the signal produced by the tank will have the same phase as that of the incoming burst signal. On the other hand, if the tank circuit is above or below resonance (detuned), as determined by the color shading capacitor...the burst signal developed across the tank will lead or lag the actual burst signal. Since the local color oscillator is synchronized with the burst signal appearing across the burst amplifier grid tank, the local color oscillator will shift its phase to follow that of the tuned tank.

The color oscillator is being used as the standard against which the color subcarrier hase and frequency are being compared. When the phase of the subcarrier changes, the new phase angle represents a specific hue. Therefore, shifting the phase of the local oscillator, by means of the color shading capacitor, is equivalent to shifting all hues by the mount of the oscillator phase shift. This is the method used: to obtain correct, or de sired tints and shades of the picture hues; to compensate for phase shift occurring through the chroma channel.

## THE COLOR AFC TUBE (Phase Detector)

The purpose of the phase detector is to compare the phase and frequency of the local 3.58 Mc color oscillator against the 3.58 Mc color burst sent from the transmitter. Should difference in phase or frequency exist between the burst and color oscillator signals, the phase detector (color AFC) will supply a DC voltage to the reactance tube which will pull the olor oscillator into the desired phase and frequency with the burst signal. The polarity of this corrective voltage is dependent upon whether the color oscillator is running faster or slower (leading or lagging) than the reference burst signal; the amplitude of the DC voltage depends upon the degree of lead or lag. When both the burst signal, from the station, and the local color oscillator signal are matched in phase and frequency, the phase detector has zero output and no correction takes place.

The color AFC diodes (phase detector) may be considered as two conventional second detectors connected in such manner that one of the detectors will put out a positive rectified volt age while the other detector puts out a negative rectified voltage. Diode V-24A produces a positive rectified voltage at its cathode (junction of the .0015 mfd capacitor and 1 meg resistor). Diode V-24B produces a negative rectified voltage at its plate (junction of the .0015 mfd capacitor and 1 megohm resistor). The local color oscillator signal is fed to the phase detector at all times by the tap on coil L-210. The signal is fed equally to both diodes and both diodes will produce the same amount of rectified DC voltage across their load resistors, positive at top end of R-232 and negative at the bottom end of R-234 (see schematic). Maximum positive voltage will be found at the top end of R-232 and maximum negative voltage will be found at the bottom end of $R-234 \ldots$ at some point between these maximum voltage values, a zero point exists. oming to the phase detector, a zero DC voltage will be produced at the output

As stated, the oscillator signal is injected into the phase detector at all times from coil L-210 and by itself produces a zero output voltage. During color reception, the burst signal is also injected into the phase detector; injection is from the tuned transformer T-203. The simultaneous injection of two AC signals into the phase detector create resultant voltages (added vectorially) which affect the two diodes differently. Considering the case when the phase of the burst and oscillator signals are of the required phase, the resultant of the burs and oscillator signal voltages to both diodes V-24A \& B are equal and zero output results. If the phase of the oscillator signal, as compared to the burst signal, is not that required, the resultant voltage to diode V-24A would increase while the resultant voltage to $\mathrm{V}-24 \mathrm{~A}$, would decrease. This would produce increased positive voltage at the cathode of $V=24 \mathrm{~A}$, a output from the detector. This condition results when the phase of the oscillator signal leads the phase of the burst signal. On the other hand, when the phase of the oscillator signal lags the phase of the burst signal, the resultant voltage to diode $\mathrm{V}-24 \mathrm{~B}$ would increase and the resultant voltage to diode V-24A would decrease. This results in increased negative voltage at the plate of $\mathrm{V}-24 \mathrm{~B}$ and decreased positive voltage at the cathode of $\mathrm{V}-24 \mathrm{~A}$. The phase detector would now have a negative DC output voltage.

SUMMARY: When both the phase of the oscillator and burst signals are that required by the circuitry, a zero DC output voltage is produced by the phase detector. When the phase of the oscillator signal leads the burst signal, V-24A conducts more heavily and diode V-24B conducts less heavily, producing a positive output DC voltage. When the phase of the oscillator signal lags the burst signal, diode $V-24 B$ conducts more heavily and diode $V-24 A$ conducts less heavily, producing a negative DC output voltage. This DC output voltage is supplied to the control grid of the reactance tube causing a capacitor tuning action to result which, in turn, pulls the oscillator into correct phase and frequency.

## the reactance tube

The purpose of the reactance tube is to control the phase and frequency of the local 3.58 Mc color oscillator as dictated by the DC voltage produced by the phase detector (a DC volt age is produced in the phase detector when the phase of the local 3.58 Mc oscillator is not correct).

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The reactance tube is connected across the crystal circuit of the oscillator and operates $s$ an electronic capacitos tuning the resonant crystal circuit to the correct frequency. The oscillator signal voltage is fed, in reverse manner, to the plate of the reactance tube through the 100 mmf capacitor ( $\mathrm{C}-236$ ) and arrives at the grid of the reactance tube through the internal plate to grid tube capacity (in some chassis a 2 mmf capacitor is connected externally from plate to grid of the tube). The oscillator signal voltage arriving at the grid of the reactance tube leads the oscillator signal applied at the plate, due to the capacitor action. This leading voltage, at the tube's grid, produces a leading plate current through the reactance tube which makes the entire reactance tube circuit appear as a capacitor to the crystal oscillator. If the reactance tube's plate current and output signal are increased by a positive voltage on the control grid, the tube acts as a larger value capacitor and tunes the crystal to a lower frequency. If the reactance tube's plate current and output signal are decreased by a less positive (negative) voltage at its control grid, the tube acts as a smaller value capacity and tunes the crystal to a higher frequency. It should be clear that the apparent capacity presented to the crystal circuit is the rita that this AC signal can be controlled by the voltage appled the cillator by a DC method is age (as applied to the control grif of erally that of the output voltage when the phase and matic frequency control of the local 3.58 Mc oscillator is available.
matic frequency control of the local 3.58 Mc oscillator is available.
The plate capact is the it it produces no capacity effect. It is easy to plate that if minimum ninim to the tube will lose control of the oscillator. To insure sufficient range of the reactance tube's capacitor action, a tunable inductor ( $\mathrm{L}-215$ ) is incorporated in the plate circuit. This makes it possible to tune the crystal to resonance and still have the reactance tube operate over its most desirable range of voltages and currents.

THE 3.58 MC OSCILLATOR
The 3.58 Mc local color oscillator is basically a tuned plate-tuned grid type of circuit using shunt fed plate tank.

The oscillator is stabilized by a crystal in the grid circuit which replaces the usual L-C tuned tank. The crystal acts as a high " $Q$ " tuned circuit and will operate within a few hundred cycles of the correct frequency, or not at all. The circuit is therefore operating at approximately the correct frequency.

The output of the oscillator increases as the plate L-C tank is tuned toward resonance. However, the circuit will continue to oscillate only when the tank is tuned on the high frequency side of the resonant point (the high frequency side is with the iron core out of the coil and moving into the coil) due to the phase of the feedback voltage required from the plate to grid through the tube's internal capacity. Since the circuit will not operate on the low side of resonance, it can be seen that as the tuning of the plate tank approaches resonance, the oscillator can become unstable, intermittent, or stop oscillating entirely; therefore, the correct point of the oscillator plate tank setting is always below the point of maximum output voltage (resonance) and on the high frequency side of the resonant point.

When operating, the oscillator is controlled by grid leak bias produced by capacitor C-237 ( 57 mmf ) and $\mathrm{R}-246$ ( 150 K ohms) in the grid circuit. This negative voltage may be measured by a VTVM, as in any oscillator, and will give a good indication of the performance of the circuit.

The crystal CR-7, in the grid circuit, replaces the usual L-C tank; however, in action, it is similar to a parallel tuned circuit operating with a very high " $Q$ ", The crystal (in conjunction with the extraneous circuit capacities) will determine the frequency at which the oscillator will operate.

The 100 mmf capacitor ( $\mathrm{C}-236$ ) couples the oscillator voltage to the reactance tube $\mathrm{V}-28 \mathrm{~A}$ which, in turn, acts as a variable electronic capacitor across the crystal, tuning it to the correct phase and frequency as dictated by the DC voltage produced in the color AFC circuit. The the crystal to the reactance tube.

The parallel tuned plate tank, consisting of L-216 and C-242 ( 180 mmf capacitor) is DC isolated from, and "RF" coupled to, the plate of the oscillator by capacitor C-241 (. 01 mfd ).

The plate receives DC voltage through the 150 K ohm resistor R-249. Since the plate current for the oscillator does not flow through the plate L-C tank, it is called a shunt fed oscillator.

A tap on the plate tank coil feeds the oscillator signal to the buffer amplifier which acts as an output amplifier and isolation stage for the oscillator. The tap on the tank matches the impedance of the tank to the grid input impedance of the buffer stage for maximum power transfer.

## THE BUFFER AMPLIFIER

The output of the local oscillator is coupled to the buffer amplifier by means of an impedance matching tap on the tuned plate tank of the oscillator. The buffer amplifier increases the oscillator signal and acts as an isolation stage between the oscinlator and the demodulors, thus keeping changes of voltages from affecting the oscillator stabilty. The ( plifier is from the plate through a system of tuned cons. One tuned coll (L-21 ( 200) feeds the to the R-Y demodulator in phase with the oscikator signal. 1 he opposite coll ( $L-20$ ) feeds the oscillator signal to the B demodulatar fer ampl with is parallel will $L-210$ will result in max pacines, imum voltage A portion of this voltage is tapped off by the divider circuit composed of $\mathrm{C}-212(180 \mathrm{mmf})$ and C-211 (220). The voltage developed across C-2 C is fed the following circuit consisting of -21 (220), $C$, trol. 2 the and 2 th when tuned to resorance. Thus maximum voltage will be developed through in 209 and fed to the $\mathrm{B}-\mathrm{Y}$ demodulator when properly tuned. However since the voltage across the inductive portion of a series resonant circuit will lead the current by 90 degrees, the voltage fed to the $B-Y$ demodulator will be 90 degrees out of phase with that fed to the R-Y demed to the R-Y demodulator. The purpose of these out-of-phase voltages, to the demodulators, is explained in the demodulator section. The oscillator signal into the deme load resistors proportional to peak of the oscillator signal. (This assumes absolutely no other incoming signal.)

On first thought, it would seem that the phasing of this circuit would be quite critical and require complicated and expensive equipment to tune the buffer tank coils for the correct volt age phases. However, an operational characteristic of the circuit makes the job quite easy. This characteristic is that, when the phase shifting coil L-209 is tuned to resonance, it will place maximum load on the parallel tuned tank (L-210). In other words, the voltage developed by coil L-210 will drop below its normal value as the series tank L-209 is tuned to resonance. Thus, we have the effect of the voltage fed to the R-Y demodulators dropping as the voltage to the $\mathrm{B}-\mathrm{Y}$ demodulator is being increased. The voltage being referred to, is the rectified voltage developed at the junction of the 33 mmf capacitor and the 10 K ohm load resistor of the temodulators. This voltage can be measured by use of a VTVM connected from this junction to ground (the hot lead of the meter connects to the junction and the ground lead of the meter connects to chassis).

The method of tuning the phase shifting coils in the output of the buffer amplifier is then to connect the meter to the load side of the R-Y demodulator and tune the first coil ( $\mathrm{L}-210$ ) for max imum voltage reading. Next, tune the phase shifting coil (L-209) for maximum voltage to the $\mathrm{B}-\mathrm{Y}$ demodulator... this will result in reduced voltage to the $\mathrm{R}-\mathrm{Y}$ demodulator. Retune coil $\mathrm{L}-210$ for maximum voltage to the $\mathrm{R}-\mathrm{Y}$ demodulator. Retune coil L-209 for maximum voltage to the $\mathrm{B}-\mathrm{Y}$ demodulator and minimum voltage to the $\mathrm{R}-\mathrm{Y}$ demodulator. It is necessary to work between the two coils until minimum interaction is obtained. The procedure is nothing more than tuning both tank coils to resonance and when this is accomplished, the phase shift will automatically be correct... provided there are no component part failures in the system.

## THE DEMODULATORS

The function of the demodulators in the receiver's color section is similar to that of the second detector in a standard TV or radio receiver; they demodulate the color subcarrier. The demodulators continuously test the phase and amplitude of the incoming color subcarrier during horizontal picture scanning and produce an output voltage when the phase or amplitude changes. horizontal picture scanning and produce an output voltage when the phase or
The reference phase during scanning is that of the local 3.58 Mc oscillator.

Two separate demodulators are required in the receiver to demodulate the color subcarrier ignal completely. Although both demodulators operate on the same subcarrier signal, each is capable of extracting different signal information. This will be explained in the later paragraphs.

One of the demodulators is labeled the $R-Y$ demodulator and consists of the diodes V-25A and $B$ (see the schematic diagram). The other demodulator ( $B-Y$ ) consists of the diodes $V-26 A$ and $B$. Considering the diode sections of tube V-25 only (the R-Y demodulator), we may regard the diode sections A and B as two conventional second detectors connected in such manner that one of the diode detectors (A) will produce a positive rectified output voltage at its cathode while the other detector ( $B$ ) will produce a negative rectified output voltage at its plate'. These voltages will be produced across the load resistors $\mathrm{R}-241$ and $\mathrm{R}-265$ ( 10 K ohms) respectively.

The local color oscillator signal is fed to the demodulators (pins 7 and 5) continuously from the output of the buffer amplifier. Since the oscillator signal voltage is fed to both diodes equally (pins 7 and 5 are tied together), both diodes will produce the same value of rectified DC voltage (opposite polarity) across their load resistors. The load resistor voltage will be maximum positive at the top end of R-241 and maximum negative at the bottom end of R-265. The center tap of R-241 and R-265 will be at a zero voltage point since it is at the mid-point of positive and negative voltages. It should now be clear that when the oscillator signal only is incoming to the demodulator, zero output voltage is produced and no signal reaches the R-Y amplifier. An identical action occurs in the $\mathrm{B}-\mathrm{Y}$ demodulator with the oscillator signal only. As stated, the oscilator signal is injected into the $R-Y$ and $B-Y$ demodulators continuously from the output of the buffer amplifier. During color reception, the color subcarrier is also injected into the demodula fernating current signals into a demodulator either of the injected signals alone. The phase angle between the two in jerent value than ecthed to jected signals detrin and B) a smaller resultant voltage is applied to diode $\mathrm{V}-25 \mathrm{~B}$. Increased conduction current through diode $V$ 25A produces a greater positive voltage at the junction of resistor $R 241$ and $c a p a-$ citor $\mathrm{C}-207$ in rest ducs respect to round. The load voltages are unequal and do not cancel at the center junction. The larger voltage (positive) of the two load voltages will now appear at the output of the R-Y Temodulator. If the phase of the subcarrier signal leads the oscillator signal at the R-Y demodulator, the reverse action would occur and the demodulator would have a negative output voltage. The fundamental action of the $\mathrm{R}-\mathrm{Y}$ demodulator, just explained, is repeated in the $\mathrm{B}-\mathrm{Y}$ demodulator. The major difference between the $\mathrm{R}-\mathrm{Y}$ and $\mathrm{B}-\mathrm{Y}$ demodulator operation is due to a difference in the phase of the local 3.58 Mc oscillator signal fed to each.

In order to understand the action of the two demodulators ( $R-Y$ and $B-Y$ ) when operating on the same subcarrier, it is necessary to first learn some fundamental characteristics of a demodulator. The important rules are that: when the waveform of the incoming subcarria cycle ( 90 degrees), the output of the demodulator is zero. When the incoming subcarrier is in phase with the demodulator: maximum positive voltage appears at the output of the demodulator. When the incoming subcarrier is of opposite polarity ( 180 degrees out of phase) as compared to the local oscillator, the output is maximum negative voltage.
Summary:

1. A demodulator has zero output when the two input signals are a quarter cycle ( 90 degrees) apart.
2. A demodulator has maximum positive output voltage when the two input signals are in phase.
3. A demodulator has maximum negative output voltage when the two input signals are in phase ... but of opposite polarity ( 180 degrees apart).

It should now be a simple matter to understand the action of the two demodulators on the same color subcarrier signal. The B-Y demodulator is fed a local 3.58 Mc oscillator signal which is in phase with the subcarrier reference (zero degrees) and if a subcarrier signal were received at this phase, the demodulator would produce maximum positive output voltage. The R-Y demodulator is fed with a local 3.58 Mc oscillator signal which is a quarter cycle ( 90 degrees) away from the reference phase (zero degrees) and, as explained previously, would have zero output when a signal at zero reference phase is injected into it. In the case just described, the $\mathrm{B}-\mathrm{Y}$ demodulator would have maximum positive output voltage and the $\mathrm{R}-\mathrm{Y}$ demodulator
would have zero output voltage on the same signal. If the phase of the subarmodulator would decrease.... until finally the output of the $B-Y$ demodulator would be zero and the R-Y demodulator would be maximum. This represents a shift of a quarter cycle ( 90 degrees) of the subcarrier.

When one of the three primary phosphor colors (red, green or blue) is transmitted, the phase angle of the subcarrier is such that it falls somewhere between maximum output voltage of one demodulator and zero output voltage of the other demodulator. In this manner, both demodulators will have some output voltage. Also, the polarity of the voltage out of either the demodulators will be determined by the phase angle of the subcarrier in reference to the local oscillator. An example of this is the phase angle of the subcarrier for a red picturearea ( 104 degrees leading). In this case, the subcarrier phase slightly leads the oscillator signal into the R-Y demodulator and consequently the R-Y demodulator will have a positive output voltage. The same subcarrier lags the oscillator signal [-(B-Y) 180 degree phase] into the $\mathrm{B}-\mathrm{Y}$ demodulator and it will have a negative output signal. If the outputs of the demodulators were fed directly into the control grids of the picture tube, the output voltages of the demodulators, as explained, would be correct. However, the signals out of the demodulators must pass through the R-Y and B-Y amplifiers and the polarities of all voltages would be inverted. This presents no problem in the circuit since it is only necessary to interchange the conne tions to the demodulator diodes to produce opposite polarity outputs for the same phase of input signal.

The final result of the demodulator action is to feed a positive voltage to the red electron gun's control grid (during the scanning of red areas) and a negative voltage to the control grids of the blue and green guns. In this manner, the color signal at the electron gun of the red tube adds to that of the brightness signal at the cathode the greater intensity. In the same way, the negative signal blue and green phosphors have no change in brightness. For a review, see "Operation of the Color Receiver".

The term convergence refers to the point at which the three electron beams of the tri-color picture tube are made to cross-over before reaching the dot screen. The correct point for convergence of the three beams is at the hole in the aperture mask, which allows the beams to emerge at the correct angle for each beam to strike dots of just one color (see diagramatic illustration of the mask and screen). Convergence of the three beams is accomplished by a physical inward tilt of the electron guns as well as external, individually adjustable, beam bending magnets. This is called the static convergence system. (Fig. 5).

Exact convergence of the three beams over the entire screen cannot be accomplished by the aforementioned methods since the distance to the aperture mask is greater at the edges of the screen. In other words, the beams have to travel farther to reach the screen edges. This is due to the fact that the aperture mask and phosphor dot screen are not spherical and, therefore, do not follow the curve necessary to keep the beams converged at all points. To correct this condition, it is necessary to change the convergence point of the three beams as they are moved to either side of screen center as well as from top to bottom. Horizontal conver gence is maintained by the horizontal dynamic convergence system and vertical convergence is maintained by the vertical dynamic convergence system. Since the beams are correctly converged at the center of the screen but are misconverged at the outer edges, the voltage waveform that will correct this condition will be minimum when the beams are at the screen center.and maximum at the screen edges. This form of voltage curve is called a parabola.

A study of the location of the electron guns in the neck of the tube and the manner in which the three beams are converged to strike dots of just one color will show that as the point of convergence is moved toward the guns (as it will be when the beams are at the edges of the screen and traveling a longer distance) that the angle of approach of the beams to the screen will be greater and that two of the beams will move below the horizontal scanning line while the third dot (blue) will move above the horizontal scan line.

To correct this condition, we must move the dots that fall below the line upward... and the dot that falls above the line downward. To accomplish this, we add a separate magnetic sweep system to each individual electron gun and feed currents into the coils of this sweep system so that they bend the beams back toward the scan line, as all three of the beams move to the screen edges.

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The dynamic convergence system consists of three separate coils mounted to the neck o the picture tube. Each coil has an effect on just the electron gun and beam that is directly under the coil and moves the beam by magnetic coupling. To insure that each coil has an ef fect on only one beam and to obtain the correct movement of the particular beam, vanes of magnetic material are placed on each side of each electron gun (see layout of dynamic convergence coils). Magnetic coupling from the coils is to the magnetic vanes which, in turn, place magnetic lines across the beam path from vane to vane. Each beam will be moved a equal distances around the neck of the tube ( 120 degrees apart) one beam (blue) will be shifted exactly up and down, while the other two beams will be shifted at an angle...in respect to the horizontal scanning lines. The coils are supplied with parabolic currents at the vertical and horizontal sweep rates, thus keeping the beams converged horizontally as well as vertically. The complete system constitutes the dynamic convergence system. (Fig. 5)



STATIC CONVERGENCE
Direction of beam movement due to adjustment of thre beam positioning magnets and blue lateral corrector magnet. (Beams shown overconverged)

FIGURE 6. STATIC CONVERGENCE

THE BLUE CORRECTOR MAGNET OF THE STATIC CONVERGENCE SYSTEM
As stated previously, the three beams are made to converge at the center of the screen by a physical inward tilt of the electron guns as well as external, individually adjustable, beam positioning magnets. The beam positioning magnets are illustrated in the drawing of the 19 -inch tri-color CRT shown in the "Installation and Operation" section. Notice that the magnets ar spaced equally around the neck of the tube to lie directly above the three electron guns ( 120 egrees apart). The direction of each beam movement is identical to that shown by the arrows in the layout of the dynamic convergence coil drawing. The blue beam is moved in a vertical rection by movement of the blue beam positioning magnet, while the red and green beam are moved at an angle (with reference to a horizontal scanning line) by movement of the red have a converg positioning magnets. It is easy to see that the red and green dots will This s not necessarily true of the blue dot since it can only be moved vertically by the beam posiioning magnet, and should it be out of convergence horizontally with the convergence point of the red and green beams... nothing could be done to correct its position. This condition is solved by an internal arrangement of magnetic material in the blue electron gun to provide feld for horizontal movement of the blue beam, provided by a fourth independent blue lateral corrector magnet (see layout of blue lateral corrector poles).

THE HORIZONTAL DYNAMIC CONVERGENCE SYSTEM
An independent secondary winding of the horizontal output transformer supplies a voltage use to the horizontal dynamic convergence system during each retrace of the horizontal sweep. The pulse occurs at a repetition rate of 15,750 times a second and represents a 5,750 cycle frequency.
he equivalent electrical circuit tal dynamics drawing (Figure 7). It consists of the 500 ohm horizontal dynamic amplitude tentiometer, a. 01 mfd capacitor and the horizontal dynamic resonant circuit) and the horizontal dynamic convergence coir. The of these capacitors is citors may be ignored in the equivalent drawing, since the reactance of the se capacitors negligible.

The amount of retrace pulse fed to the convergence circuit from the horizontal output mormer is determined by the 500 ohm horizontal dynamic amplitude potentiometer. The解 pacitor and the horizontal dynamic phase coil. For the sake of simplicity, it may be considered that the series resonant circuit is excited by the retrace pulse and will then oscillate tits resonant frequency. Since the series circuit must be tuned to 15,750 cycles (the repe(the retrace pulse) it will produce a sine wave of 15,750 cycles (see Fig 7 "Acros Horizontal Drmamic Phase Coill drawing). When the series resonant circuit is tuned to this frequency by adjustment of the phase coil, maximum current will flow through the resonan frequit acts as an sine wave generator driving the horizontal dynamic convergence coil with a 15,750 cycle sine wave. The magnetic field produced by the convergence coil penetrate the glass neck of the picture tube and couples the flux lines through the magnetic vanes on either side of the electron beam (see "Layout of Dynamic Convergence Coils"). (Fig. 5).

The electron beam is thus forced to change its deflection angle in accordance with the 15,750 cycle sine wave and thus its convergence point with the other two beams as they move from left to right-hand sides of the screen for one horizontal scanning line. It is now possible to change the point of convergence of the beam on the left and right-hand sides of the screen as compared to the center of the screen and correct convergence of the beam may be maintained over the entire horizontal scan line.

THE VERTICAL DYNAMIC CONVERGENCE SYSTEM
The same physical coil used for the horizontal dynamic convergence system is also used for vertical dynamic convergence system. The coil on the opposite leg of the core handles tilt voltages only and need not be considered at this time.

The simplified diagram (simplified convergence circuit) shows that the plate current for the vertical output tube flows through all the tilt potentiometers, through the 2 henry choke (in (Fig. 7). parallel with a 70 mfd capacitor) and finally to the B+++ by way of an 820 ohm resistor ( $\mathrm{R}-164$ )

The formation of the dynamic parabolic voltage (vertical) is created across the parallel combination of the 70 mfd capacitor and the 2 henry choke. A combination of the charge and dis charge time of the capacitor through the choke as well as the shape of the current curve throug the capacitor performs the job of changing the sawtooth of current (created during the vertical sweep through the vertical output tube) into the required parabolic voltage. It may be correctly assumed from this point on that the 70 mfd capacitor and the 2 henry choke are acting as the parabolic voltage generator of the system.

Inspection of the simplified convergence circuit shows that the 70 mfd capacitor and 2 henr choke are connected to the dynamic convergence coil through the following series paths: a 100 mfd capacitor, the horizontal dynamic phase coil and a parallel path of a . 05 mfd capacitor and the 2500 ohm vertical dynamic amplitude potentiometer. This diagram may be simplifed since the 100 mfd capacitor acts as a short circuit to 60 cycle current and may be replaced wh a wire. The horizontal dynamic phase coil has such small reactance to 60 cycle current that too may be replaced with a shorting wire. However, in the case of the parallel will not pass of the .05 mfd capacitor and the vertical amplitude potentiometer, the capach 60 cycle current and the 2500 ohm potentiometer is effective in the circuit

The completely simplified circuit is shown in the drawing "Vertical Dynamics" and we find that the parallel circuit of the 70 mfd capacitor and the 2 henry choke are supplying the vertical dynamic coil with the correct parabolic voltages by way of the dynamic amplitude potentiometer and 100 mmf capacitor. (Fig. 8).

The 60 cycle parabolic voltage fed to the convergence coil creates a magnetic flux which is coupled to the beam by the magnetic vanes described previously. Keep in mind that there is a separate coil located on the tube neck for each electron gun.

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THE VERTICAL TILT SYSTEM
The current waveform through the vertical tilt potentiometers is in the form of a sawtooth due to the action of the vertical sweep output tube. A voltage drop can occur across the rotor arm of the potentiometer and the center tap when the arm is not at the electrical center. If the arm of the potentiometer is set at the center tap junction, there would be no voltage drop and no voltage would be fed to the tilt coils. If we assume that the arm of the potentiometer is toward the top of the pot, then a sawtooth will be formed between the rotor arm and the tap. Since the point at which current flows into a resistor is the negative voltage end of the resis tor; the top end of the potentiometer would have a negative polarity sawtooth. This wouldereate a current how herlicular coil associated with this potentiomper. Should the arm of the potentiometer be moved below the center tap, the lower end of the potentiometer would be the negative end and a sawtooth would be formed between the rotor the porm the the amplitude of which would be determined by the amount of resistance botw the arm and the center tap. In this case, the current through the tilt coil would be reversed and a sawtooth flux pattern would be imposed upon the electron beam of an opposite polarity. In other words, a sawtooth of variable amplitude and positive or negative polarity may be added to the electron beam. The effect of this is to add the sawtooth to the vertical dynamic parabola voltages to shape them as required for best convergence in the vertical plane.

HIGH VOLTAGE POWER SUPPLY
The operating voltages which are used to establish beam intensity and shape (focus) in the tricolor picture tube originate in the retrace (kickback) power supply section. Three high voltage rectifiers (two 3A2's and 3A3) are employed in a voltage doublerransformer used in The horizontal transformer is similar to the conventional ype of aut-rans high voltage circuits of black and white receivers. Extra windings are provided, however, to supply pulse voltages to the burst amplifier and the horizontal dynamic convergence sys tem and separate filament voltages to the high voltage rectifiers.


FIGURE 8. VERTICAL DYNAMICS

V-19 (3A2) and V-21 (3A3) conduct during retrace time. V-19 operates from a tap on the primary of T-13 so that the rectified output voltage at the filament of V-19 is approximately 8,000 volts. The focus circuit load drops that 8,000 volts so that approximately 6,000 volts is available at the plate of V-20. R-151 ( 2.5 meg ) is used to adjust the voltage on the focus anode between 6,000 and 8,000 volts. The 6,000 volts at the plate of $V-20$ is coupled over to the plate of V-21 during the interval between pulses when V-20 conducts. This 6,000 volts plus approximately 19,000 volts, developed across the entire auto-transformer primary, appears at the plate of V-21 during retrace time. A voltage at the filament of V- 21 equal to approximately 25,000 volts (developed across $C-148$ ) is available as the high voltage to the picture tube second anode.

Regulation of the 25,000 volt supply is obtained by using a regulator tube across the outpu circuit of the high voltage supply. Part of the output current is shunted through the regulator tube which offers a greater load to the high voltage system during the times when the high voltage tends to increase, with lessened picture tube loading (dark picture portions), and offers less load when the high voltaga tends to decrease, due to increased picture tube loading (bright picture portions).

## THE 19VP22 TRICOLOR PICTURE TUBE

The 19VP22 tricolor picture tube features an aluminized glass envelope, 62 degree deflection, electrostatic focusing; and is constructed for use with an electromagnetic convergence sys tem. (Refer to diagrams of tricolor picture tube and gun assembly.)

Beam sources of the 19VP22 tricolor picture tube are supplied from a matched three-electron gun assembly. The three individual guns that make up the assembly are arranged 120 degrees apart in a triangular pattern. Each gun is tilted (approximately 1 degree) toward the common tube axis. This tilting of the guns is incorporated into the assembly with the intention of obtaining proper convergence of the beams at the center of the screen.

Aside from the yoke, which functions in the conventional manner, four external components are employed in conjunction with the tube's operation. They are: the purity device, the beam positioning magnets and convergence coils (one assembly) and the blue lateral corrector magnet. the purity device (two magnetic rings) is mounted on the neck of the tube between grid two and color purity on the screen. color purity on the screen

Three pairs of pole pieces are attached directly to the anodes of the guns ( 120 degrees apart). These pole pieces, or vanes, are used in conjunction with three permanent magnets (beam positioning magnets) and three electromagnetic coils (convergence coils), which are mounted directly over the pole pieces on the neck of the tube. In this manner, a means is provided for correction of center misconvergence (static adjustment) due to differences in the mechanical positions of the guns; and for correction of misconvergence at edges, top and bottom of the screen (dynamic adjustment), a natural development resulting from the particular shape of the shadow mask and phosphor-dot screen. A separate pair of pole pieces, or vanes, is attached to the focus electrode of the blue gun. This vane is used in conjunction with the blue lateral corrector magnet placed on the tube neck, directly over the vane; the action gives blue beam correction in the horizontal direction.

The tricolor phosphor-dot screen is placed directly on the inside surface of the face plate. (The opposite side of the face plate is the viewing suriace of the tube.) $\bar{q} \overline{0} \overline{0}, \overline{0} \overline{0} \overline{0}$ phos phor dots, arranged in 300,000 groups of dot trios, are located on the phosphor screen. Every dot trio includes a phosphor dot of each of the three primary colors; red, blue and green. A thin, arched shadow mask is positioned approximately 0.4 of an inch behind the phosphor screen. The shadow mask contains approximately 300,000 uniform-sized holes, precisely positioned in respect to the dot trios on the phosphor screen. Unlike the shadow masks in earlier, smaller-sized tricolor tubes, the shadow mask in the 19VP22 is unstressed, permitting expansion and contraction. High voltage requirements of the 19 VP 22 tricolor tube are: 25,000 volts at the anode (regulated); 6,500 to 8,000 volts at the focus electrode (adare: 25,0
justable).


NOTE: Circuit connections which are used during receiver alignment are symbolized $T P$ and MTP throughout the alignment instructions. The location of these important test points can be found readily by referring to BP-902 vertical chassis, bottom view for TP number identification and TS-902 horizontal chassis, bottom view for MTP number identification.

$$
\begin{aligned}
& \text { nasis, } \text {, } A \text { ALIGNMENT } \\
& \text { IFENERAL INFORMATION }
\end{aligned}
$$

The three LF transformers of the TS-902 are aligned consecutively starting with the sweep The three IF transformers of the TS -902 are aligned consecutively starting with the sweep generator at the alignment procedure.

The chassis can be placed on its side, with the SERVICE TEST RECEPTACLE at the top, and positioned so that all connections and adjustments are readily accessible.

The position of the generator and the curve produced for each connection is shown on the IF alignment detail drawing in steps. Follow the steps in sequence. (See Figure 11).

EQUIPMENT REQUIRED
A. Sweep Generator: 38 to $50 \mathrm{Mc}, 12 \mathrm{Mc}$ sweep width, linear, and capable of .1 volt output.
B. Cathode-Ray Oscilloscope: preferably with calibrated attenuator
C. Variac: to adjust the line voltage if not 117 volts

Do not ground the receiver chassis - use an isolation transformer.
Keep generator output as low as possible.
Line voltage must be 117 volts; if not, adjust with variac.
Allow sufficient warm-up time before alignment.
Some coils resonate at two core settings, use the outer end position.
Use a shielded lead for the vertical input of the scope.
Always connect ground end of signal generator, or scope leads, near point of signal input or take-off.
Use the following procedure in sequence for receiver alignment.
STEP \#1 PRELIMINARY PROCEDURE
A. Remove the 6CD6 horizontal amplifier (V-17) from its socket.
B. Connect bias battery to place negative 3 volts on the IF AGC bus (MTP-12) or pin $\# 1$ of the SERVICE TEST RECEPTACLE (see bottom view of TS-902 horizontal chassis).(Fig. 12).
C. Terminate the sweep generator cable with a 56 or 75 ohm resistor, whichever is applicable Also connect a 470 mmf capacitor in series with the hot lead of the generator to provide DC blocking.
D. Short RF secondary coils (in tuner) to ground through the hole in side of tuner shield (MTP-1).

OSCILLOSCOPE: Connects to the video detector output (MTP-6) through a 27 K ohm isolation resistor or directly to pin \#3 of the service test receptacle. Leave In this position for the entire iF procedure.
STEP \#2
SWEEP GENERATOR: Connect to the grid of the 3rdiF. (Use the 3rd IF jack). (Refer to TS-902 horizontal chassis top view and bottom view during IF align ment.) (Fig. 11 \& 12).

## ADJUST

A. Top slug of $3 \mathrm{rd} \operatorname{IF}$ (primary) to 41.25 Mc trap dip (minimum output). . . . ....trap.
B. Bottom slug of 3 rd IF (primary) so the 45.75 Mc marker falls at knee of the response curve.
C. Bottom slug of 3 rd IF (secondary) for 41.85 Mc marker at lower knee of curve.

STEP \#3
SWEEP GENERATOR: Connect to the grid of the lst IF (Use the lst IF test receptacle.)


## AUDIO IF ALIGNMENT

The following alignment may be made by injecting an accurate 4.5 Mc signal in at the video amplifier grid. However, using the station signal method is much more accurate and should be used whenever possible.

A conventional procedure is used in which the IF transformer, and primary of the ratio detector, are tuned for maximum reading on a VTVM connected across the ratio detector load resistor and electrolytic capacitor (MTP-13). The meter is then moved to the top "hot" end of the volume control (MTP-II) and the secondary of the ratio transformer tuned for the zero reading between the two maximum voltage points.

Refer to bottom view of the TS-902 horizontal chassis for location of the following adjust ments: (Fig. 12).

1. With the receiver in good operating condition, tune in a station. Set all controls for normal operation.
2. Connect VTVM to the positive end of the 10 mf electrolytic capacitor located in the 6AL5 ratio detector (pin \#5 of the 6AL5) circuit (MTP-13). The ground end of the meter connects to chassis ground.
3. Maintain 5 volts, or below limiting voltage, at the VTVM. It may be necessary to adjust the fine tuner - or to remove the antenna to attain this reading. NOTE: Adjusting the contrast control will not affect this reading.
4. Adjust the coil located in the plate of the 1st sound audio IF stage ( $1 / 26$ ANB). (See TS-902 horizontal chassis top view for location) and the primary (bottom) of the ratio detector transformer for maximum reading on the meter.
5. Move the DC lead of the VTVM to pin \#8 of the ratio detector (6AL5). This is the "hot" lead of the volume control (MTP-11).
6. Tune the secondary (top) of the ratio detector transformer for the center zero reading on the meter.

TUNER ALIGNMENT
GENERAL INFORMATION
It is very unlikely that the Motorola Tuner will need alignment unless it has been damaged, has been replaced or has had components replaced in the tuner circuits. Tubes may be changed in most cases without realignment.

In the event alignment is necessary, low-band channels ( $6-2$ ) may be adjusted individually by stretching or compressing coil turns, while high-band channel inductances ( $7-13$ ) are formed by a stamped metal plate and are adjusted with L-8, L-13, C-10, C-28 and C-19 in the RF section and L-15 and C-21 in the oscillator section. (Fig. 13).

## EQUIPMENT REQUIRED:

Sweep generator having:
I. Frequency range $40-220 \mathrm{Mc}$
2. 12 Mc sweep width
3. Adjustable linear output
4. Crystal calibrated video and sound carrier markers.

AM signal generator having:

1. Frequency range $\mathbf{4 0 - 2 2 0} \mathrm{Mc}$
2. Accurate frequency and attenuator calibration
3. 400 cycle modulation

Oscilloscope:
Wide-band, high gain type, preferably with a calibrated input attenuator.

PRE-ALIGNMENT PROCEDURE

1. Remove the horizontal output tube, $\mathrm{V}-17$ (6CD6) to eliminate RF interference in the os cilloscope. Connect a 2500 ohm 25 watt resistor from B triple plus to ground to normalize the bus voltage.
2. Detune the oscillator by setting the fine tuner to minimum capacity.
3. Short the RF AGC bus to ground. (This is the third lug from left on rear of tuner - see main schematic.)
4. Remove the tuner cover.
5. Connect a 470 uff capacitor from the converter plate to ground, as close as possible to the tube socket.
6. Keep the generator output as low as possible at all times to prevent overloading the receiver.

CONNECTIONS
Sweep generator - Remove the antenna lead-in from the chassis, and connect the sweep generator to the antenna receptacle. Keep the leads from the generator to the socket as short as possible.

Oscilloscope - Connect the scope lead to the mixer test receptacle. (See top view of the TS-902 horizontal chassis drawing.) (Fig. 11).

## PROCEDURE

Antenna and RF alignment (high channels 7-13) (Refer to tuner alignment detail during following procedures.)

1. Switch the receiver channel selector to channel 8.
2. Center the sweep generator frequency at 185 Mc (center frequency of channel 8).
3. Adjust the trimmers C-10, C-28 and C-19 for the curve labeled HIGH BAND RF CURVE. (NOTE: C-10 positions the curve. $\mathrm{C}-19$ acts as the jack and determines the tilt of the curve. C-28 adjusts bandwidth.) There should be no more than .05 volts peak-to-peak developed at the mixer test receptacle.
4. Center the sweep generator frequency at 213 Mc (center frequency of channel 13).
5. Adjust the channel 13 coils L-8 and L- 13 by spreading or compressing the turns for symmetrical marker positions. (Use the peaks of the curve for reference.) The primary coil L- 8 tends to position the curve, while the secondary coil L-13 affects the tilt of the curve.
6. Re-check channel 8 for proper response. Re-adjust trimmers C-10, C-28 and C-19 for correct curve on channel 8 , if necessary.
7. Check all channels from 13 through 7 for proper curve with tuner shield on. See HIGH CHANNEL RESPONSE CURVE LIMITS. (Fig. 13).

## Antenna and RF alignment (low channels 6-2)

1. Switch the receiver channel selector switch to channel 6 .
2. Center the sweep generator frequency at 85 Mc (center frequency of channel 6).
3. Adjust the secondary coil L-12A to position the frequency of the curve and the primary L-9A for least tilt. Adjust for highest gain with least tilt and symmetrical skirts.
4. Adjust the antenna coll secondary L-4A or primary L-3C to remove tilt. Refer to LOW CHANNEL CURVE shown on TS-902 horizontal chassis top view. NOTE: It may be neces sary to work between coils L-12A, L-9A, L-4A and L-3C to obtain the greatest gain with the least tilt and with symmetrical skirts.

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## FM trap

The FM trap L-1 may tune as low as channel 6, causing severe attenuation in part of the curve. Adjust the trap on channel 6 by spreading coil L-I until no effect of attenuation is seen in the skirts of the response curve.
5. Adjust channel 5, 4, 3, and 2 in sequence by spreading or compressing the coil turns of the respective inductances. MAINTAIN CURVES WITHN THE LOW CHANNEL RESPONSE LIMITS. (Fig. 13).
6. Re-examine curves on all channels for proper tracking with the tuner shield on.

## Oscillator alignment

NOTE: The RF and mixer stages must be aligned before the oscillator is adjusted. Refer to tuner alignment detail during oscillator alignment.

1. Remove tuner shield and 470 uuf capacitor.
2. Set fine tuner to proper center position. (See tuner alignment detail for the fine tuner rotor position.) (Fig. 13).
3. Connect oscilloscope to pin 3 of the service test receptacle (across video load resistor). Connect sweep generator to antenna input socket and adjust for 12 Mc sweep width.
4. Set tuner to channel 8 and sweep generator to 183 Mc center frequency.
5. Adjust C-21 so that 185.75 sound marker falls into the trap dip.
6. Set tuner to channel 13 and sweep generator fo 213 Mc center frequency.
7. Spread or compress L-15 so that 215.75 Mc sound marker falla into the trap dip.
8. Check channel 8 response if it was necessary to adjust channel 13.
9. Examine response on channels 13 through 7. On the high channels, a fine tuner rotation of plus or minus 30 degrees is allowable to obtain the required marker positions.
10. Set tuner to channel 6 and sweep generator to 85 Mc center frequency.
11. Spread or compress $\mathrm{L}-16 \mathrm{~A}$ so that 87.75 Mc sound marker falls into the trap dip.
12. Adjust channel 5, 4, 3, and 2 in the same manner as channel 6. On low channels, fine tuner rotation of plus or minus $10 \%$ is allowable to obtain required marker position.
13. Replace tuner shield and check response on all channels for proper tracking.

## IF trap adjustment

Set tuner to channel 2, with fine tuner adjusted properly, and sweep generator to 44 Mc center frequency (through antenna socket). Adjust L-2 for minimum response at approximately 44 Mc , with equal peaks near the video and sound marker.

## UHF alignment

When the channel selector switch is in the UHF position, the RF and mixer stages of the VHF tuner become two additional stages of 40 Mc IF: the VHF antenna circuit is disconnected and grounded; coil L-5 (tuned to the IF range) is inserted into the grid circuit of the RF amplifier: RF primary coil L-10 and secondary coil L-11 are added to the circuit to bring it into the IF range; the oscillator is disabled and $B$ plus is applied to the UHF tuner.

1. Remove tuner shield and connect sweep generator to UHF input receptacle acrose a total ca pacity of 33 mmf (including cable capacity). Set generator to 44 Mc center frequency with a 12 Mc sweep width.
2. Adjust L-10 and L-11 to place the 41.25 Mc sound marker and the 45.75 Mc video marker on the two peaks of the response curve. Adjust L-5 to eliminate tilt
3. With tuner shield on, the overall curve through the IF stages should be identical to the mixer response curve.

| $15 \times 0$ or 1 Limit eox thit limit | FRENENCY CHART |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | $\begin{aligned} & \text { CHAMNEL } \\ & \text { HUMBER } \end{aligned}$ | $\begin{gathered} \text { SWEEP } \\ \text { GENERTOR } \\ \text { CENTER } \\ \hline \end{gathered}$ | $\begin{gathered} \text { SOUND } \\ \text { MARKER } \\ \text { (RFF COLS } \end{gathered}$ | $\begin{aligned} & \text { PICTURE } \\ & \text { MaRKR } \\ & \text { ANT COILS } \end{aligned}$ |
|  | 2 | 57 Cl | 59.75 | 55.25 |
| - | 3 | 634 C | 65.15 | 61.25 |
|  | 4 | 654 C | 71.75 | 67.25 |
| J 1 ( | 5 | 79MC | 81.75 | 17.25 |
|  | 6 | ${ }^{85 M C}$ | 8175 | 83.25 |
| High Chanvel response Limits | 1 | 177 Mc | 179.75 | 175.25 |
|  | 8 | 183 MC | 185.75 | 181.25 |
| aremis measueso eroom averase or ataks | 9 | 189 MC | 191.75 | 187.25 |
|  | 10 | 195MC | 19775 | 193.25 |
|  | 11 | 201 MC | 203.75 | 199.25 |
| Nota | 12 | 207 MC | 209.75 | 205.25 |
|  | 13 | 213 MC | 215.75 | 21.25 |



Low channel response limits

## ALIGNMENT OF CHROMINANCE BANDPASS SYSTEM

The sections through which the signal will be passed for this alignment are: the first video mplifier, second video amplifier, bandpass amplifier, the bandpass cathode follower and the $\mathrm{R}-\mathrm{Y}$ demodulator. The sweep generator is injected into ist video amplifier by unsoldering the grid series pealding coil leading to the 3rd IF transformer and connecting the generator to the loose end. The sweep generator must be terminated with the network shown in diagram of horizontal chassis, bottom view.

The scope connects to the input side of the R-Y demodulator (junction of 33 mmf and 10 K ohm resistor TP-11). Use a 100 K isolation resistor in vertical input lead. (Fig. 15).

The sections tuned during this procedure are: the lst video amp 4.5 Mc plate trap coil L-39), the coupling transformer at the grid of the bandpasa cathode follower (T-201) for 2. Mc on the bandpass curve and coils in the cathode of the bandpass cathode follower (T-202) or a symmetrical curve (jack action).

## PROCEDURE

1. Remove 3.58 Mc color oscillator tube (V-28B, 12AT7).
2. Connect a bypass capacitor of . 05 mfd 400 V from junction of the 2200 ohm resistor and th delay line to ground (TP-7).
3. Set channel selector switch to channel \#l or unused channel.
4. Set contrast control for maximum (fully clockwise).
5. Set color intensity control to maximum (fully clockwise).


FIGURE 15. BP-902 VERTICAL CHASSIS (BOTTOM VIEW

FIGURE 14. BP-902 VERTICAL CHASSIS (TOP VIEW)
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6. Connect scope to pin \#1 of the R-Y demodulator (V-25, 6AL5) at the junction of the 10 K ohm resistor and 33 mmf capacitor (TP-11) through a 100 K ohm resistor.
7. Disconnect peaking coil from lug \#4 of 3rd IF transformer (MTP-5). Connect sweep generator to loose end of peaking coil. Use decoupling network illustrated in diagram of horizontal chassis, bottom view.
8. Set sweep center frequency to 3 Mc and sweep width for 10 Mc .
9. Set marker generator to 4.5 Mc and adjust 4.5 Mc trap located in the plate circuit (pin \#1) of the first video amplifier for the trap dip. (See TS-902 horizontal chassis top view.) (Fig. 11).
10. Set marker generator to 2.5 Mc .
11. Adjust coil in grid circuit of bandpass cathode follower ( $\mathrm{T}-201$ ) to place 2.5 Mc marker at the knee of the curve. (See BP-902 vertical chassis top view.)(Fig. 14).
12. Adjust the coil in the cathode circuit of the bandpass cathode follower (T-202) for least tilt and symmetrical response curve

Refer to BP-902 vertical chassis top view for curve and slug locations. (Fig. 14)

## ADJUSTMENT OF 3.58 MC TRAP IN BRIGHTNESS AMP PLATE

13. Remove . 05 mfd capacitor at input to delay line. This is used only in bandpass alignment procedure.
14. Leave sweep generator connected to loose end of peaking coil as before. Move scope lead to cathodes of picture tube (pins \#4, 5, and 13). Use crystal detector in scope input lead.
15. Set marker generator to 3.58 Mc and adjust 3.58 Mc trap (plate of the brightness amplifier) for dip.

NOTE: a. Traps must be aligned within + or -50 Kc of specified frequency.
b. The response curve must show no sign of regenerative peaks.
c. If picture tube is not connected, curve may appear slightly different. . . . with small peaks showing.

ALIGNMENT OF THE 3.58 MC TRAPS IN GRIDS OF THE R-Y and B-Y AMPLIFIER
The series tuned shunt traps located in the grid to ground circuits of the R-Y and B-Y amplifiers are tuned for maximum attenuation (minimum signal) using the normal leakage signal from the 3.58 Mc local color oscillator. A wide band scope must be usod as the indicator and may be connected to the control grid of $\mathrm{R}-\mathrm{Y}$ and $\mathrm{B}-\mathrm{Y}$ amplifiers consecutively.

## PROCEDURE

1. Make certain the 3.58 Mc local color oscillator is operating properly and with sufficient output.
2. Turn the color intensity control to minimum or remove the bandpass amplifier (V-8, 12BY7).
3. Connect scope (wide-band only) to grid of R-Y (TP-10) amplifier (V-27A, 12BH7).(Fig. 15)
4. Align the trap ( $L$-207) located in the R-Y amplifier grid circuit for minimum amplitude of the 3.58 Mc signal as seen on the scope.
5. Connect scope (wide-band only) to grid of $\mathrm{B}-\mathrm{Y}(\mathrm{TP}-9) \operatorname{amplifier}(\mathrm{V}-27 \mathrm{~B}, 12 \mathrm{BH} 7$ ).
6. Align the trap (L-208) located in the B-Y amplifier grid circuit for minimum amplitude of the 3.58 Mc signal as seen on the scope.

The 38 MC COLOR OSCILLATOR AND OSCILLATOR BUFFER STAGE ALIGNMENT The 3.58 Mc color oscillator tank coil and the oscillator buffer stage coils are tuned using R-Y demodulator is used as the RF detector external signal generator is not required. The junction of the 10 K ohm resistor and 33 mmf capacitor load circuit. The bottom slug of the quadrature coil is adjusted for maximum reading on the meter and the top slug for minimum 1. Allow set to warm up Turn chan
. Allow set to warm up. Turn channel selector to unused VHF channel or UHF position Turn color intensity and contrast controls to minimum
2. Short AFC bus to ground at TP-4.
3. Connect high side of VTVM to TP-11 junction of 33 uuf capacitor and 10 K resistor in $\mathrm{R}-\mathrm{Y}$ demodulator circuit (a test jack is provided in some chassis).(Fig. 15).

Or, as an alternative, hook up VTVM to TP-6 junction of 1500 uuf and 1 meg resistor in AFC diode circuit. Readings made at this point will be approximately half the readings at the demodulator. Short out grid coil of gated burst amplifier TP-8, otherwise spurious incoming signals may give false injection measurement.
4. In each case when tuning coils, start with slug fully retracted from center of coil.
5. Adjust osc plate $\operatorname{tank}(L-216)$ for maximum response.
6. Adjust osc buffer plate coil, L-210 (bottom slug T-204) for maximum response.
7. Adjust quadrature coil, L-209 (top slug of T-204) for minimum response.
8. It may be necessary to repeat steps 5,6 and 7 for best results.
9. Retune osc plate coil (L-216) turning screw (out) so as to retract slug from coil so that 25 volts of injection is measured at R-Y demodulator (TP-11).
or So that approximately 12 volts of injection is measured at AFC diode (TP-6). ALIGNMENT OF THE COLOR OSCILLATOR AFC SYSTEM

The burst amplifier tube ( $\mathrm{V}-23 \mathrm{~A}, 1 / 26 \mathrm{AN} 8$ ) receives the entire color signal from the output of the bandpass cathode follower. Its screen voltage, however, is keyed from a winding on the horizontal output transformer; the tube operates only during the color burst. The output of the burst amplifier is fed to the color AFC phase detector and the phase and frequency of the burst reference signal is compared with that of the local 3.58 Mc color oscillator. Tuned to the 3.58 Mc burst signal are: a resonant tank in the burst amplifier grid (L-204), the coupling transformer to the AFC phase detector, the plate coil in the reactance tube circuit. An astual transmitted burst sigual is used for the alignment; a VTVM is used for the output indicator. The VTVM is connected to either color AFC diode (V-24, 6AL5) at the junction of the 1 meg resistor and 1500 mmf capacitor. Connected at this point, the meter reads the rectified resultant 3.58 Mc burst voltage and the color oscillator injection voltage.

## PROCEDURE

1. Allow receiver to warm up. Check the 3.58 Mc oscillator alignment and injection to insure normal operation. To check the injection, connect the VTVM to the junction of the 1500 mmf capacitor and 1 meg resistor in the color AFC phase detector circuit (TP-6). Connect the VTVM ground lead to chassis. Short the control grid of the burst amplifier (V-23A) to ground momentarily to eliminate readings from spurious incoming signals. The VTVM should read approximately 12 volts of injection.
2. Tune in a transmission supplying the standard burst of color sync. Set color intensity control for a normal color picture or near maximum CW rotation.
3. Set the fine phase trimmer (color shading control) at mid-range (on half mesh).
4. Connect a VTVM to TP-6 (jct of a 1500 mmf and 1 meg resistor) at AFC diode circuit.
5. Begin with the slugs fully retracted from the coils and tune the burst amplifier grid coil L-204 and plate transformer T-203 for maximum reading on VTVM.
6. Connect VTVM to the AFC bus at TP-4
7. Adjust reactance tube plate coil L-215 (to bring oscillator into sync, if necessary) so that VTVM reads 0 volts on AFC bus.
8. Reduce chrominance signal so that it is just barely visible on the screen, by turning fine tuning control (front panel on RF tuner). This is done so that an extremely weak burst signal is supplied to the AFC diodes. The color oscillator may now possibly be out of sync.
9. Adjust AFC balance pot so that 3.58 Mc osc is in sync.
10. Reset RF fine tuning for normal picture so that adequate burst is supplied to the AFC diodes.
11. Connect an oscilloscope to the plate of the R-Y amplifier and retune L-204 the burst am plifier grid coil so that the burst pulse is zero volts as shown on the scope screen

MEASUREMENTS
IF SENSITIVIT Y
\#1.
2. Short the RF secondary coils of the tuner to ground. These coils may be reached through the hole in the tuner cover.
3. No external bias is applied to the AGC line. The AGC is left wide open with normal or residual bias only.
4. Connect VTVM across the video detector load resistor ( 4700 ohms ).
 (pin \#2 of the 6U8).
6. Less than 300 microvolts should be required for a 1 volt rise above the residual noise voltage at the video detector...as indicated on the meter.

SOUND SENSITIVITY

1. Feed an accurate 4.5 Mc signal across the 10 K ohm sound detector load resistor through a 100 uuf capacitor. (Use a terminated Measurements Corp. Model 80 generator or equivalent.)
2. Connect the VTVM through a decoupling resistor to the positive side of the 10 mfd electrolytic capacitor at the ratio detector output. (The VTVM ground lead connects to chassis.)
3. Less than 3500 microvolts should be required for a 4 volt reading on the VTVM. BANDPASS SENSITIVITY
4. Set the CONTRAST and COLOR INTENSITY controls to maximum
5. Remove the 6 CD6 horizontal amplifier tube ( $\mathrm{V}-17$ ) and the $12 \mathrm{AT} 7,3.58 \mathrm{Mc}$ oscillator tube (V-28B) from their sockets.
6. Connect the high side of the VTVM through an isolation resistor of 100 K ohms to junction of the 33 mmf cap
7. Disconnect the video peaking coil, located between lug on 3rd IF can and pin \#2 of the lst video amplifier, at the can end.
8. Connect generator through coupling network (shown on bottom view of horizontal chassis) into the loose end of the peaking coil (MTP-5) and into the first video amplifier grid. Adjust the generator for 3 Mc output. (Fig. 15)
9. Approximately a 15,000 microvolt signal should produce a rise of 1 volt on the VTVM. VIDEO IF TRAP ATTENUATION MEASUREMENT
10. Set tuner to an unused channel or disable tuner by shorting out the RF secondary coil to
ground at the junction of the RF coil and the 22 mmf capacitor.
11. Connect a terminated CW signal generator (such as Measurements Corp. Model 80) through a 470 mmf blocking capacitor directly to the grid of the mixer tube (MTP-2) pin \#2 of the 6U8. (Fig.
12. Apply minus 3 volts to the IF AGC bus (pin \#1 of service test receptacle).(Fig. 11).
13. Connect VTVM across the video detector load resistor ( 4700 ohms )
14. Record the signal generator output voltage required to produce 1 volt across the video de tector load resistor at the following frequencies: $39.75 \mathrm{Mc}, 41.25 \mathrm{Mc}, 47.25 \mathrm{Mc}$ and 44 Mc
15. Calculate the attenuation for each trap, using the following formula

## Generator output at trap frequency $=$ Attenuation <br> Generator output at 44 Mc

7. Approximate trap attenuation should be

At $39.75 \mathrm{Mc}-80$
At 41.25 Mc - greater than 300
At $47.25 \mathrm{Mc}-65$

MEASUREMENT OF THE SOUND CARRIER TO PICTURE CARRIER RATIO AT THE SOUND DETECTOR

1. Short the RF amplifier secondary coil to ground at the junction of the secondary coil and the 22 mmf capacitor (MTP-1).(Fig. 12)
2. Connect a terminated signal generator (such as Measurements Corp. Model 80) to the grid, pin \#2 of the 6U8 (MTP-2)
3. Connect VTVM across the 10 K ohm sound detector load resistor (MTP-4).
4. Apply minus 3 volts to the IF AGC bus at pin \#1 of the service test receptacle.
5. Record the signal generator output voltage required to produce 1 volt across the sound detector load resistor at 41.25 Mc and 45.75 Mc .
6. Calculate the ratio, using the following formula:
$\frac{\text { Generator output at } 41.25 \mathrm{Mc}}{\text { Generator output at } 45.75 \mathrm{Mc}}=$ Sound to picture carrier ratio
7. The ratio should be no greater than 20 .

REPLACEMENT PARTS LIST


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These models are nineteen tube direct viewing tele vision receivers differing only in type of cabinet, size of speaker and their use in conjunction with a radio receiver and automatic record changer in the combination models. A $17^{\prime \prime}$ electrostatically focused rectangular tube ( $17 \mathrm{HP4}$ ) is used in the $17^{\prime \prime}$ models and a $21{ }^{\prime \prime}$ magnetically focused and rectangular tube $\left\{\begin{array}{c}212 \mathrm{ZP4B} \\ 21 \mathrm{ZP} 4 A\end{array}\right\}$ is used in the $21^{\prime \prime}$ models. Replacement, in all cases, must be of the identical size and type.

Service information for radio chassis in combination models will be found in the Operating and Service Instructions, which are furnished with each set along with operating instructions for the automatic record changer.

## ELECTRICAL AND MECHANICAL SPECIFICATIONS



OPERATING CONTROLS (SEE FIG. I)

Front Panel - Exposed
Chanr,el Selector $\}$ Fine Tuning
Contrast (Picture) Colume

Dual Control
Dual Control


NON OPERATING CONTROLS (SEE FIGS. I AND 6)
Width Control
Horizontal Drive
Horizontal Oscillato
Horizontal Phasing
Height
Centering
Focus


## CIRCUIT DESCRIPTION

## GENERAL

The Olympic receivers covered by this manual use the Intercarrier type of Video and Sound IF System. Both Picture and Seund signals are received by the tuner, converted to an IF frequency and then fed, together through three stages of video IF amplification. At the Video Amplifier stage the two signals are separated then through a Ratio Detector, an Audio amplifier, a Audio Output stage and ultimately to the speaker. The Video signal with its accompanying Sync pulses are fed through a Video Amplifier after which the Sync pulses are diverted into three Sync Separating and Clipping Stages and from there to the Vertical and Horizonta
Sweep Oscillators. The Video information is fed from the Video amplifier to the Cathode of the Cathode Ray (Picture) Tube.

## TUNER U CHASSIS

These receivers include the Olympic "Rocket" Tuner which is of the new cascode type. The principal advantages of the Rocket tuner are; greater sensitivity. improved Signal-to-noise ratio, and low radiation. Most of these properties are accomplished through the use of of the tube are separated by a grounded shield. of the tube are separated by a grounded shield.
The first triode is used as grounded cathode amplifier and the AGC voltage, generated later in the Video Detector and AGC Stage, is applied to the grid. The second Triode section of the tube is a Grounded Grid Amplifier and is directly coupled to the first section. The first section is neutralized by a factory adjusted second section. The overall gain of the two stages is only slightly higher than that of a single pentode but through the use of triodes, which have a smaller amount of tube noise, the signal to noise ratio is greatly improved

## TUNER R-S CHASSIS

These chassis incorporate a Pentode tuner which uses
a $\{6 B C 5\}$ tube as an RF Amplifier.

The Oscillator and Mixer stages are essentially the same as earlier Olympic turret type tuners with the addition of a complete shield covering the entire under coupling, all to minimize radiation.

## PICTURE IF SYSTEM

These receivers have three stages of Video IF Amplification. The first IF coil (L301) is located on the tuner and functions as the output coupling of the tuner. The second IF coil (L-5) is fotlowed by the Adiacent Sound ference in the picture which might be caused by the sound signal of the next lowest channel when the lower channel is used in the same area. The Third Picture IF (L7) is followed by an accompanying Sound Trap (L9) but the Fourth Picture IF transformer (L8) has no trap. All coils and traps are adjusted from the top of the chassis. The If coils are "stagger-tuned" to four fre quencies described la
Note: Adjacent sound trap is used in " $U$ " only.

## VIDEO DETECTOR AND AGC

Both video detection and the development of the AGC voltage are accomplished in the IN64 Germanium diode.
The sound portion of the comp ite signal is picked off the output of the Video Amplifier by the 2nd Sound

## VIDEO AMPLIFIER

The Video information and the Sync and Blanking pulses are amplified at the $12 \mathrm{BY7}(\mathrm{VIO})$ Video Amplifier Tube. The Sync is picked off through an "RC" network consisting of R33 and C33 in the Plate circuit and fed to the Sync Separator (VIIA) and Clipper stages (V I2A). scope (V19 - Pin II) after passing through a 4.5 Mc trap (LI) to eliminate any sound interference in the picture.

## SYNC SEPARATOR AND CLIPPERS

The sync system of these receivers employs three
stages. Two dual triodes, a $12 A \times 7$ \& a 12 AU7 (VII \& stages. Two dual triodes, a $12 A X 7 \&$ a
$V \mid 2)$. The first triode of the first $(V||A|$ is the syn separator stage. This in turn feeds into the second half of the same tube (VIIB), the sync amplifier. The sync amplifier supplies pulses to the Horizontal AFC and oscillator (V14) and simultaneously to the Vertical Block ing oscillator (VI2B) (through the Vertical Intergrating network. The first half of the second tube (Vond is (V12B) is the vertical oscillator.

SWEEP SYSTEM - VERTICAL - 6V6GT
The output of the oscillator stage is amplified in the 6V6GT tube (V13) and then fed through the Vertical Deflection Yoke

## SWEEP SYSTEM - HORIZONTAL

The Horizontal Oscillator is essentially of the blocking oscillator type. The operation of the A.F.C. system depends upon a correcting voltage developed in the control section of the Horizontal Oscillator and AFC tube (V|4), where ing pulses differ in either phase or freauency. The con-
trol tube, (first section V14) is maintained at cut-off until such time as the sync pulse is either ahead or behind the Oscillator sawtooth peak. When either case occurs the control tube develops a voltage which is applied as a bias to the oscillator grid and alters the oscillator frequency to coincide with the frequency of the incoming pulses. The Horizontal Oscillator transadjustment of the oscillator frequency and the front panel Horizontal Hold Control is a fine adjustment in the same sense.

Note: Many of the components in the horizontal cir cuits are of critical value and therefore should only be replaced by the exact replacement part. locating parts when replacing. This can be ac complished by carefully noting positions of parts and leads before removal

## SOUND SYSTEM

The sound carrier is taken off the plate (Pin 7) of the Video Amplifier tube (VIO) and fed into the grid o through the Ratio Detector (V4) the Audio Amplifie through the Ratio Detector (V4) , the Audio Output tube (V) and then to the
(V5), speaker.

## HIGH VOLTAGE POWER SUPPLY

The Energy stored in the horizontal windings of the deflection yoke during the forward sweep produces high "Auto Transformer". (primary) winding of the Horizontal Output Transformer (TR 2771) and is then rectified by IX2B or 1 B3/GT (VI6) to provide approximately 15 Kilovolts for the picture tube anode (V19).
" B " VOLTAGE POWER SUPPLY
The " $B$ " voltage in these chassis is provided by a standard transformer-rectifier circuit. The secondary of the Power Transformer provides, in addition to a center-
tapped "B" voltage winding, a five-volt filament windtapped " $B$ " voltaqe winding, a five-volt filament winding for the 5 U4G Power Rectifier (VI8), and two six-volt windings. One six-volt source is used for the filaments of the Damper Tube (VIT) only, and the other for the
filaments of all other tubes. A " $B$ " voltage of +140 volts is derived from the cathode of the $6 \mathrm{~W} 6 / \mathrm{GT}$ Audio Output Tube (V b). This voltage is utilized primarily in the IF circuits and removal of the 6 W 6 from its socket will therefore make the entire IF strip inoperative

ADJUSTMENTS

## ION TRAP MAGNET ADJUSTMENT

Turn the brightness control fully clockwise and the contrast control fully counterclockwise. Adjust the ion trap magnet by moving it forward or backward and at
the same time rotating it slightly around the neck of the same time rotating it slightly around the neck of
the kinesçope until the raster on the screen is brightest. Of two possible positions, use the one nearest the tube base. Reduce the brightness control setting until the raster is slightly above average brilliance. Adjust focus control until the line structure of the raster is clearly visible (sharp). Readjust the ion trap magnet again for maximum raster brilliance. The final touches on this
adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained. Never correct for a shadowed raster with the ion trap.

## DEFLECTION YOKE ADJUSTMENT

If the lines of the raster are not horizontal or squared with the picture mask. Loosen the deflection yoke adjustcondition is obtained, and retighten the yoke adjust. ment screw. If neck shadow is evident or the corners of the raster are dark, the deflection yoke must be moved forward as far as possible and the wing screw retightened.


## CENTERING MAGNET ADJUSTMENT

(I7"-"R" ONLY)
The 21 "receivers are electromagnetically focused and centering is accomplished by adjusting on arm which extends vertically from the front of the focus coil. This arm may be rotated, for a limited distance, around the neck of the tube and may also be moved up and down. to the neck of the tube will also affect picture position. Before the odiustment arm is used, it should be ascertoined that (I) the focus coil is ot right angles to the

CENTERING ADJUSTMENT (21" - S-U - ONLY The $2 I^{\prime \prime}$ receivers are magnetically focused and centering is accomplished by adjusting an arm which xtends vertically from the front of the focus magnet the neck of the tube and may also be moved around the neck of the tube and may also be moved up and elation to the neck of the tube will also affect picture position. Before the adjustment arm is used, it should be ascertained that (I) the focus magnet is at right angles to the neck of the tube lby setting the two nuts which tighten the tube support rods) and (2) that the neck of the tube is directly centered in the focus magnet of the focus coil and sliding up or down either sid

Note: Remove corrugated shipping clip from around neck of pix tube before attempting any adjustADJUSTMENT OF HORIZONTAL OSCILLATOR
(I) Allow set to warm up to operating temperature. Select station operating normally.
(2) Short out horizontal Phasing Coil (L 17) Terminals Cand D
(3) Set horizontal hold control at maximum clock-wise rotation
(4) Adjust horizontal frequency screw (L 16) until picture falls into sync. Turning the horizontal fre(bars sloping downward to left). Turning the screw counter-clockwise increases frequency (bars slop. ing downward to right.
(5) Connect vertical input lead of oscilloscope with " ' MMF isolating condenser in series to terminal ground oscilloscope to chassis. Set frequency of scope to approximately 5 KC .
(6) Remove short from terminals of the horizontal phasing coil (L 17) and adjust screw (L 17) until wove shape as observed on scope is like that shown in sketch. (See Fig. 3.)
(7) Some further adjustment of horizontal frequency screw (L 16) may be necessary to keep picture
8) Remove scope from terminal " $C$ " and retouch L 16 , as per " $q$ " below.
(9) Turn horizontal hold control through entire range Picture should foll out of sync at either end of
rotation. At full clockwise rotation blanking bar rotation. At full clockwise rotation blanking bar wise position picture should foll counter-clock wise position picture should fall out to $41 / 2$ to 5
bars sloping downward to the left. (If picture stays in sync the tuner switch should be rotated to interrupt signal momentarily)
Caution: It is important that the picture be centered in the mask properly with the horizontal hold user may attempt to center the picture by means of the hold control. Under this condition the control may be on "edge"' and im. pulse noise or change of camera will cause the picture to fall out of synchronization. It should also be noted that some manufacturers
types of $6 S N 7 G T$ may perform better than others in the horizontal oscillator socket and excessive drift of the horizontal oscillator circuit may be caused by a weak or defective SN7GT tube

## ADJUST FOR EQUAL PEAKS



FIG. 3

HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS For best results it is preferable that these adjust ments be made on a transmitted test pattern; althoug satistactory results can an active picture.
Both controls will affect the height AND linearity of the picture and therefore must be adjusted simultane-
ously. It will be found that the Height Control has a tendency to affect the bottom of the picture more than the top and the linearity control just the reverse.

Note: It is advisable that both height and width of the picture be adjusted to a size slightly larger than the mask opening, so that during periods of low line voltage adequate picture size is maintained.

## HORIZONTAL WIDTH \& DRIVE ADJUSTMENT

 tight (clockwise) and then backed off (counter-clockwise) until Horizontal Drive bars appear. Then turn Drive rimmer in again (clockwise) until drive bars, just will appear regardless of Drive Trimmer adial drive bars these sets the trimmer should be set for proper widthImportant: The horizontal oscillator frequency must be checked for proper range of horizontal con(C67). Any adjustment of C67 will usually require resetting of the horizontal frequency adjustment coil (L-16).

## BUILT-IN ANTENNA

All models are equipped with a built-in antenna which provide satistactory reception in many locations. In areas of weak reception an outside antenna will sub stantially improve the pertormance of the receiver. An and are accessible through the opening in the masonite back to permit the connection of on outside aerial. The built-in antenno is normally connected to the antenna posts and must be disconnected when attach ing the outside aerial. To prevent the lead-in wires of he built-in antenna from contacting chassis parts and and held in place by tape or a lead-in wire be folded cases reception can be improved by changing the loca tion of the receiver in the room when set is operating with built-in antenna.

## RF-IF ALIGNMENT PROCEDURE

## EQUIPMENT REQUIRED

(1) RF signal generator to provide the following accurate frequencies:
(a) 4.5 Mc (Video Amplifier Trap. Sound IF and Ratio Detector)
(b) IF Frequencies
21.75 MC Accompanying Sound Trap (L9) $\begin{array}{ll}27.75 \mathrm{MC} & \text { Adjacent Sound Trap (L6) U only } \\ 22.5 \mathrm{MC} & \text { First Pix IF Transformer (L301) }\end{array}$ $\begin{array}{lll}22.5 & \mathrm{MC} & \text { First Pix IF Transformer (L30) } \\ 25.75 \mathrm{MC} & \text { Second Pix IF Transformer (L5) }\end{array}$ $\begin{array}{lll}23.5 & \mathrm{MC} & \text { Second Pix IF Transformer (LL5) } \\ \text { Third Pix IF Transformer (L7) }\end{array}$ 25.25 MC Fourth Pix IF Coil (L8) 21.75 MC Sound Carrier Marker 26.25 MC Picture Carrier Marker
23.0 MC Marker
(c) RF Frequencies

| CHANNEL <br> NUMBER | PICTURE <br> CARRIER <br> FREQ. MC | SOUND <br> CARRIER <br> FREQ. MC |
| :---: | :---: | :---: |
| 2 | 55.25 | 59.75 |
| 3 | 61.25 | 65.75 |
| 4 | 67.25 | 71.75 |
| 5 | 77.25 | 81.75 |
| 6 | 83.25 | 87.75 |
| 7 | 175.25 | 179.75 |
| 8 | 181.25 | 185.75 |
| 9 | 187.25 | 191.75 |
| 10 | 193.25 | 197.75 |
| 11 | 199.25 | 203.75 |
| 12 | 205.25 | 209.75 |
| 13 | 211.25 | 215.75 |

(d) Output on these ranges should be adjustab and capable of providing at least .I volt
If the accuracy of the generator frequencies not known, some type of crystal calibrator should generator for each particular frequency.
2) Electronic Voltmeter
(3) Cathode Ray Oscilloscope, $3^{\prime \prime}$ minimum screen
(4) RF Sweep Generator, meeting the following re quirements:
(a) Frequency Ranges:

$$
\left.\begin{array}{r}
18 \text { to } 30 \mathrm{MC} \\
40 \text { to } 90 \mathrm{MC} \\
170 \text { to } 225 \mathrm{MC}
\end{array}\right\} \quad 10 \mathrm{MC} \text { sweep width }
$$

(b) Output adjustable to .I volt

TO REMOVE CHASSIS FROM CABINET
Remove: (1) Line cord from power outlet
(2) Masonite back
(3) Antenna Lead-in from terminal posts. (4) Speaker plug from rear of chassis.
(5) Knobs from front of cabinet
(6) Four mounting screws and washers from bottom of cabinet

In sliding chassis out of cabinet, be careful that the kinescope tube does not strike against speaker or any other obstruction.
Before proceding it will be necessary to use an extra line (or "cheater") cord to supply AC current to the chassis as the set's line cord is attached to the masonite back of the cabinet.

## ORDER OF ALIGNMENT

When complete receiver alignment is necessary, it should be performed in the following sequence
(1) Accompanying Sound Trap 2) Adjacent Sou
4) 4.5 MC Trap
(5) 4.5 MC Sound IF and Ratio Detector
(6) Tuner

After removing chassis from cabinet re-connect power and speaker plugs.
If a local station is not operating on Channel 9 se the tuner to this channel, turn on power switch and 8 or 10.1

ACCOMPANYING AND ADJACENT SOUND TRAPS Insert a 100,000 ohm $1 / 2$ watt resistor in series with the "Hot Lead" of the electronic voltmeter and connect the Hot Lead of Lhe electronic voltmeer and should be set to the lowest negative scale. Ground lead of meter should be connected to chassis.

Remove the shield of the RF Oscillator and Mixer tube (V2) from ground clips leaving shield resting on tube and connect hot lead of the RF Signal Generato to it. This will couple generator ouiput to mixer plate. Set the generator frequency accurately to 21.75 MC , Layout) for minimum reading on voltmeter.
Set the generator frequency accurately to 27.75 MC and adjust (L6) Adjacent Sound Trap for minimum reading on voltmeter.


FIG. 4
STANDARD RESPONSE CURVE

PIX IF COIL ADJUSTMENT
Adjust the following slugs for maximum output at frequencies and sequence indicated with meter and generator connected as above: (See Sound Traps above)

| L301 | 22.5 MC |
| :--- | :--- |
| L5 | 25.75 MC |
| L7 | 23.5 MC |
| L8 | 25.25 MC |

Note: After setting L5 DO NOT readjust to improve wave shape.
If oscillation occurs during alignment, temporarily raise frequency of L8 by turning screw counter-clockwise until screw projects approximately $3 / 4$. Oscillation is evidenced by high reading on voltmeter $(-5 \mathrm{~V}$ to - 20 V$)$
with signal generator OFF and no signal coming in through the antenna terminals. Atter properly adiust ing L301, L5 and L7 reset L8 to proper frequency, if it had been necessary to detune.
Connect hot lead of sweep generator through a 330 condenser to test point on tuner and connect ground ead to chassis.
Connect vertical input terminal of oscilloscope to junction of peaking coil Li2 and C 25 and connect ground lead of scope to chassis.

Connect 1.5 V flashlight battery with positive terminal to chassis and negative terminal to junction of R13 and C21. This point is AGC bias voltage. Set funer to Channel 9 unless local station is operating on this fre quency, in which case an adjacent channel should be used.

Set Sweep Generator trequency to IF sweep on the 20 to 30 MC range.

Adjust sweep generator output to produce a curve on the scope which is approximately $2 / 3$ of the screen diamete
Loosely couple output of RF signal generator by using shield on $V_{2}$ and set frequency of $R F$ signal gen erator to 26.25 MC (marker).
Curve shown on scope should be similar to the re ponse curve shown in Figure 4. For proper setting of the curve of a point approximutely $50 \%$ should appear of height of the curve.

Reset RF signal generator frequency to 23.0 MC and retouch L301 and L7 for correct positioning of marke on curve.
Recheck setting of 26.25 MC marker to make sure that position has not shifted on curve. Disconnect bias battery.

Note: If the curve cannot be made to appear as above due to a local station or other interference, or if multiple markers appear. remove (VI-6BZ7 or $6 B Q 7$ ) RF tube from tuner

## TRAP ALIGNMENT

Connect voltmeter lead to Diode crystal rectifier as shown in Fig. 5. Connect Diode crystal rectifier between $C . R$. Tube Cathode lead (yellow wire) and chassis ground. Signal generator is connected at junction of LI2 and C33. Set contrast control at maximum and voltmeter to 3 volt scale (negative). Remove 6CB6 (V9) MC Adiust se maximum output of generator at 4. MC. Adjust LI , top of TR-3386 for minimum reading on meter
When it is necessary to retouch this trap in the field proper adjustment can be made by using the local staion signal and turning the Fine Tuning Control to brin fine herringbone sound beat into the picture. The 4.5 MC trap (LI) should then be adjusted to minimize this beat interference.


VOLTMETER AND CRYSTAL DIODE CONNECTIONS

To obtain this setting retouch L8

In view of the fact that the transmitted sound signal from a TV station is probably the most accurate avail able, as far as frequency is concerned, it is recom ment. The set should be connected to an antenna, turned on, allowed to warm up for about 5 to 10 minutes and then tuned for the best picture. A vacuum tube volt meter should be connected to Pin 2-V4 and the mete set to the minus 30 volt scale. The bottom of the 4.5 Ratio Detector ( L 4 - bottom of the chassis) should be tuned for maximum deflection of the meter. The vacuum ube voltmeter should then be connected to the juncfion of R7 and C6 and one side of the volume control and the secondary of the Ratio Detector (L3 - top adjustment) should be adjusted for a zero reading with the meter set to the 3 volt scale. The secondary can also be adjusted by ear tuning L3 for the elimination

TUNER ALIGNMENT FOR MODELS USING TUNER PART CL-2755-2
Note: Before making a complete tuner adjustment i is essential that all the IF, Trap. Sound and Discriminator circuits be aligned to thei proper frequencies as described above WHEN IT IS NECESSARY CONVERTER TUBE IT IS NECESSARY TO REALIGN THE OSCILLATOR ADJUSTMENT ON ALL CHANNELS WITH THE V2 TUBE SHIELD IN LACE
A. RF and Converter Alignment
(I) Set Channel Selector switch to \#12
(2) Connect oscilloscope through 10,000 ohms to test point on tuner (bare tinned copper loop wire located between VI and V2).
(3) Set fine tuning control at approximately midpoint of its tuning range. Temporarily connect umper wire from Test Point "D" to chassis.
4) Feed sweep generator into antenna terminals. sweeping channel 12.
(5) Adjust C301, C302 and C304 for flat top response curve. Check picture and sound carier markers corresponding to frequencies
(6) Remove jumper from Test Point " $D$ " to chassis.
B. Oscillator Alignment

Note: Oscillator adjustments (which are accessible through the hole in the front of the tuner) are provided for each channel. See "Tube and Trimmer Layout". Any oscillator coil slug can be adjusted without interaction on any other channel since individual coils
are used for each of the 12 channels. This adjustment may be made on the station or with sweep generator and signal generator as follows:
(I) Set fine tuning control to midpoint of range. Do not touch during alignment.
(2) Connect sweep generator and marker (signal) generator to antenna terminals.
(3) Connect vertical input lead of scope with 50 K resistor in series to test point $A$.
(4) Refer to following table for frequencies and adjustments.

Couple marker and Sweep Generator as in Section "B", Step ?
Connect Scope Through IOK Isolating Resistor to Test Point "A" and Low Side to Chassis SIGNAL GENERATOR INPUT
Step
Sweep Gen

Procedure
Adiust for placement of 1.25 MC. marker as per response curve Fig. 4. Adjust shape of resnonse curve Fig. 4 for maximum amplitude and bandwidth. Adjust as in Step 1 Adjust as in Step I Adjust as in Step Adjust as in Step 1 Adjust as in Step 1 Adjust as in Step 1 Adjust as in Step 1 Adjust as in Step Adjust as in Step Adjust as in Step Adjust as in Step


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Fig. 4. Model 2044/2144
tector and also eliminates one of the low voltage rectifier fubes. For minor differences, see notes under schematics, Figs 15 and 16. The receiver may be equipped with eithe VHF or VHF/UHF (all-channel) tuning. The following table indicates the different features of the various models.

|  | VHF <br> TUner <br> (10534B) | VHF/UHF <br> Tuner <br> $(10535 \mathrm{C})$ | Chassis <br> Type |
| :---: | :---: | :---: | :---: |
| Model | 1841 | 1941 | 1840 |
| Model | 1842 | 1942 | 1840 |
| Model | 2041 | 2141 | 2040 |
| Model | 2042 | 2142 | 2040 |
| Model | 2043 | 2143 | 2040 |
| Model | 2044 | 2144 | 2040 |

CABINET DIMENSIONS, OVERALL (not including tube shield):


23 in
1842/194
37 in.
24 in.
22 in.

22 in.
Shipping $W_{1}$.

## SPECIFICATIONS:

## CHASSIS DIMENSIONS:

Chassis 1840 and 2040 are the same size and are de signed for horizontal mounting in the cabinet. Dimension
are $173 / 4 \mathrm{in}$. square by 4 in . high.


FIg. 5. Picture Tube Yoke Assembly
TELEVISION TUNING FREQUENCY RANGE: Models using the VHF tuner receive all twelve VHF chan nels, 2 through 13 , and coil strips are available for UHF channels 14 through 83.
All TV channels, 2 through 83 , may be received on models
using the VHF/UHF tuner. This tuner is available throug using the $A$ H/UNF tuner. This tuner is available throug Packard-Bell service de
INTERMEDIATE FREQUENCIES:
Picture Carrier: 45.75 Mc .
Intercarrier Sound: 4.5 Mc .
ELECTRICAL RATINGS:
Line voltage: $110-120$ volts, 60 cycle
ower consumption:
Models 2041/2141, 2042/2142, 2043/2143, and 2044/2144: 210 watts

## SPEAKER DATA:

Type: Permanent magnet dynamic.
Voire coil impedance: 3.2 ohms at 400 cycles.
Cone diameter (all models): 6 inche
FOCUS:

# 2041/2141 

| $221 / 2 \mathrm{in}$. | $3042 / 2142$ |
| :---: | :---: |
|  | 3 in. | 34 in. 24 in. 23 in.

140 lb.
22 in.
105 lb.
SWEEP DEFLECTION:
Electromagnetic, 70 degree

## TUBE COMPLEMENT, 2040 CHASSIS:

 Reference| mbo | Tobe | unction |
| :---: | :---: | :---: |
| V.1 | 6AU6 | Sound I-F |
| V. 2 | 6AL5 | Ratio Detector |
| V.3 | 6AV6 | 1 st Audio \& A.G.C. |
| V. 4 | 6 K 6 | Audio Output |
| V. 5 | 6CB6 | 1 st Pix l-F |
| V. 6 | 6CB6 | 2nd Pix l-F |
| V. 7 | ${ }_{6}$ CB6 | 3 rd Pix 1-F |
| V-8 | $12 \mathrm{AU7}$ | Video Amplifier and Output |
| V-9 | 12AU7 | Sync Separator and Inverter |
| V-10 | 6AL5 | A.F.C. and Discriminator |
| V-11 | 6SN7 | Horizontal Oscillator |
| V. 12 | 6BQ6 | Horizontal Output |
| V-13 | 1 B3 | H. V. Rectifier |
| V-14 | 12 BH 7 | Vertical Oscillator and Vertical Output |
| V-15 | 6AX4 | Damper |
| V-16 | 5 Y3 | L. V. Rectifier |
| V-17 | $5 \mathrm{U4}$ | L. V. Rectifier |
| V-18 | $21 \mathrm{YP4}$ | Picture Tube |
| See section on "Radio Frequency Tuner," |  |  |
|  |  |  |

Picture tube is 17HP4 or 17RP4 on 2044/2144 chassis.
See section on "Radio Frequency Tuner," for See section ond
TUBE COMPLEMENT, 1840 CHASSIS: The tube complement on the 1840 chassis is identical to hat on the 2040 chassis except that $\mathrm{V}-2$ and V - 1 s are

PICTURE TUBE ADJUSTMENTS:
The following picture tube adjustments are to be made receiver is serviced. (See

1. DEFLECTION YOKE. Loosen deflection yoke adjustment screw and rotate yoke so that raster is square with picture tube frame. Make certain yoke is positioned firmly against cone of fube.
2. ION TRAP. Turn contrast control to minimum. Set brightness control at approximately $90 \%$ clockwise. then rotate trap, at the same time turning adjusting screw, to obtain maximum brightness with sharpest focus.
Reset brightness control to just light tube. Turn conrast control clockwise to $90 \%$ of maximum and readjust ion trap for peak brightness and focus.
3. CENTERING. The centering magnet is a dual ring magnet. The centering of the picture is dependent upon the relation of the rings to each other and the elation of both to the tube. To adjust, position the magnet almost against the deflection yoke, then rotate the two sections in relation to each other, and as a ment is quite stable and will need little attention unless its position is disturbed.
NOTE: If centering magnet is adjusted, repeat adjustment

## REMOVING <br> \section*{picture tube}

CAUTION
WEAR GOGGLES OR A MASK AND USE GLOVES WHEN HANDIING TUBE. DO NOT STRIKE OR SCRATCH THE TUBE OR SUBJECT IT TO MORE THAN mODERATE PRESSURE
The uncooted bulb surface of the picture tube should be kept clean and free from dust or fingerprints. This is to preIt is not necessary to remove the picture tube to clean the tube face. Simply remove the three screws in the rail above the tube and remove the safery glass. Clean glass and face of tube with window cleaning fluid on a soff cloth.
remove the picture tube. The procedure is as follows:

1. Disconnect power plug and antenna.
2. Remove back and pull out speaker plug
3. Remove control knobs on front panel.
4. Remove four bolts located under the shelf that the Chassis rests on.
5. Remove picture tube socket.
6. Remove ion trap and centering magnet.
7. Disconnect high voltage lead from picture tube
P. Remove spring harness and unfasten band over top of
picture tube.

## NON-OPERATING CONTROLS:

## GENERAL:

The non-operating controls are located in two places. Five of them are under the nameplate escutcheon on the front of the set. They are:
Focus
Height
Vertical Hold
Vertical Linearity
Brightne
To reach these controls open the spring door on the escutch-
There are two non-operating controls at the rear of the chassis. They are:
Whasis.
Width
Horizon
Also at the rear of the chassis there is a "Local/Dist." switch.
Al controls are marked. Read the following instructions AD

## ADJUSTMEN CONTROLS:

CONTROLS:
The following adjustments should be made while observing a station lest pattern. Allow receiver to warm up for ten minutes.
The BRIGHTNESS control should be adjusted in conjuncfion with the CONTRAST control so that each step (usually five) from black to white in the shading blocks is separate and distinct.
The FOCUS control should be adjusted so that the separate lines in the vertical resolution wedge are distinct as for as possible in to the narrow end of the vertical wedge. Adiust HEIGHT and WIDTH controls in conjunction with
VERTICAL IINEARITY control so that the large circles in the test pattern are as round as possible, and so that the test pattern is slightly larger than the mask opening.
pattern is slighty larger than he mask opening.
The VERTICAL HOLD is adjusted so that the picture does
not move up or down.
The HORIZONTAL HOLD control is set about halfway be. tween the points where the picture tears.

## LOCAL/DISTANCE SWITCH:

For areas in which there is no difficulty in reception operate the receiver with this switch on "LOCAL." For fringe area reception, turn the switch to "DIST." This cuts out the
auxiliary AGC, increases plate limiting in 1 st video, and gives maximum sensitivity

## ALIGNMENT PROCEDURE

## GENERAL:

It is important that the service technician read and adhere to the alignment instructions in this section. This point can not be stressed too strongly, especially in the case of the picture I-F alignmient.
Many service technicians have been accustomed to aligning the picture l-F response curve on the oscilloscope alone. This procedure is not recommended because it is actually quite possible to get what appears to be an acceptable curve and still be lacking in horizontal resolution.

It will be noted that in the following procedure the sweep generator is fed in through the antenna terminals. This being the case, the output impedance of the generator must be matched to the 300 ohm input impedance of the set. A matching network to accomplish this is shown in Fig. 6. The values in the illustration are for a generator of 75 ohms output impedance. If the sweep generator has a 50 ohm impedance use 56 ohms for the shunt resistor and 130 ohms for each of the series resistors.
In step 2 of the procedure below it is directed that the In step 2 of loosely coupled to the converter tube. This is done by disconnecting the tube shield from the ground and connecting the generator between the shield and the ground.

Test point locations are shown on the schematic diagrams, Figs. 13,15 and 16 , and on the chassis illustrations, Figs 8,9 , and 12 .
Allow set to warm up for ten minutes before alignment


## Fig. 6. Matching Network

## picture i-f alignment:

and ground
2. Loosely couple signal generator to mixer tube ( 6 J 6 ) tuner*, keeping leads short. (See general instruc-

| tep | Sig. Gen. Frequency | Adjust | For |
| :---: | :---: | :---: | :---: |
| 3. | 45.50 Mc . | $\begin{gathered} \text { S-15 } \\ \text { (Mixer I-F in tuner) } \end{gathered}$ | MAXIMUM |
| 4. | 45.50 Mc. | 5.6 | maximum |
| 5. | 41.80 Mc . | S.5 | maximum |
| 6. | 43.30 Mc. | S-8 | maximum |
| 7. | 44.50 Mc . | S-10 | maximum |
| 8. | 39.75 Mc . deleted; see | S-4 and S-9 <br> production modific | $\begin{aligned} & \text { Minimum } \\ & \text { ion } 14 \text {. } \end{aligned}$ |
| 9. | 47.25 Mc. | S.3 and S.7 | Minimum |

repeat steps 3 through 9
10. Connect oscilloscope to point "B," using a 22,000 ohm isolating resistor in series with the scope probe. Con nect an electrolytic copacitor, 5 mfd , 50 volis, be tween point " $A$ " and ground, the negative lead going to point "A."
11. Connect sweep generator to antenna terminals Connect sweep generator to antenna terminals
through an impedance matching network. (See general instructions above.)
2. Rotate tuner to channel 3 , and sel sweep generator to center trequency of channel, ( 63 Mc .). With a sweep width of 10 Mc ., adiust generator output to develo approximately 2 volts of AGC.
13. With signal generator loosely coupled to converter tube, adjust output to provide the markers shown o the response curve, Fig. 7. Check the position of the markers one at a time
*In 82 -channel tuner, mixer tube is a 6 U8.
14. Observe the wave form obtained on the oscilloscope and compare it with the waveform shown in Fig. 7. H the spot frequency alignment has been carefully done the comparison will be favorable. However, slight re touching of the I-F adjustments may be required. It should not be necessary to change any adjustment appreciably. The markers should be located as follows:

The 47.25 Mc . and the 39.75 Mc . at minimum sponse. (These markers will be at too low a level to show on scope.)

The 45.75 Mc . marker at $50 \%$ response.
The 43.30 Mc . marker at $95 \%$ response
The 45.00 Mc . marker at $97 \%$ response
The 41.25 Mc . marker at a maximum of $12 \%$ response.

IMPORTANT: The 45.00 Mc . marker must not exceed $97 \%$ response on channel 3 or picture may smear on higher channels.

1. Connect signal generator between point " B " and ground through a 001 mfd isolating capacitor
2. Turn contrast control to maximum.
3. Connect a R-F vacuum tube voltmeter to point "C." If an R-F VTVM is not available, connect a germanium diode crystal in series with the positive probe of
4. Set signal generator to 4.50 Mc ., exactly, with the output at one volt or more.
5. Adjust trap, $\mathrm{S}-11$, for minimum VTVM reading.

NOTE: If signal generator is not capable of one volt output it will be necessary to adjust the trap by visual means. To do this, observe the picture and adjust the trap to eliminate the 4.5 Mc . beat.


Fig. 7. I-F Response Curve

## SOUND I-F AND RATIO DETECTOR ALIGNMENT:

Connect signal generator between point " B " and ground through a .001 mfd isolating capacitor
2. Connect VTVM between point " $D$ " and ground
3. With generator frequency of 4.50 Mc ., adiust $\mathrm{S}-12$
and S-1 for MAXIMUM output.
4. Connect VTVM between points "E" and "F."
5. Adjust Ratio Detector secondary, $\mathrm{S}-2$, for zero be tween positive and negative peaks.

## RADIO FREQUENCY TUNER:

The VHF tuner number 10534B contains two tubes, the R-F amplifier, a 6827 or $68 Q 7 A$, and an oscillator and mixe
tube, a $6 J 6$. The $6 B Z 7$ is interchangeable with the $6 B Q 7$.
Oscillator coil tuning slugs are reached through hole in Oscillator coil tuning slugs are reached through hole in
front of tuner chassis, see Fig. 12. Tuner adjustment other front of tuner chassis, see rig. mended.

## UHF OPERATION:

UHF coil strips for the VHF tuner are available at Packard Bell Factory Service Departments. No tuner adiustment is needed after strip installation except normal slug adiust ment.

OJohn F. Rider

NOTE: TUBE LOCATIONS, TEST POINTS, AND ADJUST MENTS ON THE 2040 AND 1840 CHASSIS ARE IDEN V-2 AND V-16.


## PRODUCTION MODIFICATIONS,

## CHASSIS 2040:

The following modifications were made after production

Ig. 8. Chassis 2040, Top View
3. Capacitor C-51 added to circuit. (To preclude mis lignment of picture I-F due to part variations.)

```
S-3 Trap, 47.25 Mc.
5.5 1st picture l-F, 41.8 Mc.
S-6 2nd picture I-F,45.5 Mc
    Trap, 47.25 Mc.
    3rd picture l-F, 43.3 Mc
    Trap, 39.75 Mc.
    Primary, sound I-F transformer
    -12 Secondary, sound I-F transforme
    S-13 Horizontal hold
    S-14 Width
    S-15 I-F output
    S-16 R-F plate trimmer
S-17 Mixer grid trimmer On R-F funer
S-18 Antenna trimmer
S.19 Trap
```

4. Resistor R-76 added to circuit. This resistor had a value of 1000 ohms originally but now is 10,000 ohms, 2 watts. In the 1840 chassis it has a differen value. (To stabilize variations due to part differ ences.)
5. Resistor R-12 was changed from 1 to 2 watts. (To prevent overheating of resistor.)
6. Capacitor $\mathrm{C}-33$ was changed from 1500 mmf to .01 mfd. (To increase drive on horizintal output tube and increase width.)
7. Resistor R-54 was changed from 18,000 ohms to 15,000 ohms. (To increase drive on horizontal output tube and increase width.)
8. The two triode sections of $\mathrm{V}-14$ were transposed so that terminals 1,2 , and 3 are those of the output triode. Socket was reversed. (To prevent breakdown
of socket.)
9. Capacitor C-38, 001 mfd , was removed from the circuit. This originally was connected to secondary of T -3. (To stabilize vertical oscillator.)
10. Resistor R-9, 2.2 megohms, was removed from the circuit. This was connected to pin 6 of V-3. (To increase AGC voltage.)
11. Capacitor C-47, normally 56 mmf 3500 volts, was changed to $120 \mathrm{mmf}, 2000$ volts IF A THERMADOR POWER TRANSFORMER IS USED. If a TRIAD transformer is used, the value remains at $56 \mathrm{mmf}, 3500$ olts. Compare production modification 15, in 2040 hassis. (To provide sufficient width at low line voltage.)

fig. 9. Chassis 2040, Botfom View

## SOCKET VOLTAGES

11. Resistor R-77 added to circuit. (To help prevent overloading of 12AU7.)
12. Fuse changed from $1 / 4 \mathrm{amp} 250$ volts to $3 / 16 \mathrm{amp}$ 125 volts. (To prevent fuse blowing from possible arc in damper tube.)
13. Resistor R-79 added to circuit. (To prevent high voltResistor R-79 added to circuit. (To prevent high
age breakdown in areas with high altitude.)
14. Capacitor (no reference symbol) removed from trap L-6B. (S-9), and trap slug backed out. (To increase audio gain in fringe areas.)
15. Capacior C-52, $56 \mathrm{mmf}, 3500$ volt (same as C-47) added in parallel with capacitor C-47. Compare vide sufficient width at low line voltage.)

PRODUCTION MODIFICATIONS, CHASSIS 1840:

1. Resistor R-30, 100,000 ohms, was removed from the circuit. This was connected to the grid of the second video (pin 7, V-8). (To prevent overload due to variation in 12AU7 tubes.)

The socket voltages shown were measured on a typica chassis under the following conditions.

1. No signal.
2. Line voltage, 117 volts
3. Volume and contrast controls set at minimum, other controls at normal operating position.
4. DC voltage measured with a vacuum tube voltmeter
5. $A C$ voltages measured with a 1000 ohms-per-vol meter.
NOTE: Some voltages depend upon the setting of related controls. Thus the voltages on the vertical oscillator tube V - 14 depend on the setting of the vertical hold control and the height control.

The figures below indicate the approximate magnitude of the reading to be expected, rather than the exact voltage
Tube location is shown in Fig. 11, which is a BOTTOM VIEW of the chassis.
(VOLTAGES FOR CHASSIS 2040 AND CHASSIS 1840 LISTED IN SEPARATE COLUMNS.)



[^7]Fig. 15. Schematic Diagram, Chassis 2040

C. 1 used only in sets with UHF.VHF funer.


NOTE：TUBE LOCATIONS，TEST POINTS，AND ADJUST－ MENTS ON THE 2040 AND 1840 CHASSIS ARE IDEN－ tical except that the 1840 does not use tubes V－2 AND V－16．



table Of replaceable parts

## CHASSIS 1840 \＆ 2040

To be assured of genuine Packord－Bell replacement part order by part number from your nearest Packard－Bell Ser vice Department．Addresses are listed below．

| City | Address |
| :---: | :---: |
| Los Angeles（home office） | 1101 So．Hope St． |
| Albuquerque，N．M． | 4601 Lomas Blvd．，N．E． |
| Alhambra，Calif． | 2221 W．Valley Blvd． |
| Amarillo，Texas | 703 No．Fillmore St． |
| Boise，Idaho | 3001 Crescent Rim Drive |
| Burbank，Calif． | 3007 Magnolia Blvd． |
| Colton，Calif． | 295 So．8th |
| Compton，Calif． | 14912 So．Atlantic Blvd． |
| Culver City，Calif． | 2405 So．La Cienega Blvd． |
| Denver，Colo． | 1441 Ogden St． |
| El Paso，Texas | 1109 Wyoming St． |
| Fresno，Calif． | 531 ＂p＂St． |
| Hollywood，Calif． | 6620 Melrose Ave． |
| Honolulu，Hawaii | 1923 Kalakava Ave． |
| Lubbock，Texas | 1810 Fourth St． |
| Oakland，Calif． | 1009 Cypress St． |
| Phoenix，Ariz． | 228 E ．Roooseveir St ． |
| Portland，Ore． | 326 N．W． 21 st Ave． |
| Pueblo，Colo． | 119 W .13 th St ． |
| Sacramento，Calif． | 1617 Eighteenth St． |
| Salem，Ore． | 2890 Silverton Road |
| Salt Lake City，Utah | 624 So．State St． |
| Santa Ana，Calif． | 406 N．Sullivan St． |
| San Diego，Calif． | 3536 Adams Ave． |
| San Francisco，Calif． | 1157 Post St |
| San Mateo，Calif． | 1037 N．Bayshore Blvd |
| Seattle，Wash． | 2310 Fourth Ave |
| Spokane，Wash． | West 38 Third Ave |
| Tacoma，Wash． | 2329 So．Tacoma Ave． |
| Tucson，Ariz．． | 745 No．Fourth Ave． |
| Yakima，Wash． | 803 Summirview Ave． |
|  |  |



OJohn F. Rider

## CIRCUIT DESCRIPTION

Philco "B" line, Code 147 Television Receivers use two chassis-r-f chassis R-191, containing the r-f, video, audio and sync circuits, and deflection chassis D-197, containing the power and deflection circuits. Since these chassis are not isolated from the 60 cycle power line, all protruding shafts and mounting feet are insulated from the chassis.

CAUTION: See A-C LINE ISOLATION
A separate subchassis contains the r-f amplifier, the oscillator, and the mixer. The r-f amplifier uses a type 6BZ7 tube, V1. The oscillator and the mixer use a type 6X8 tube, V2, the pentode section of the tulse being used for the mixer, and the triode section for the oscillator. The output of the mixer is fed to a three-stage, stagger-tuned, i-f amplifier system employing thrce type 6CB6 tubes, V3, V4, and V5. A type 1 N 64 crystal diode, CD200, is used for the video detector, the output of which is amplified by a twostage video amplifier utilizing a type 6AU6 tube, V6, and a type 6AQ5 output tube, V7. The connections at the detector are such as to produce a composite video signal with negative-going sync pulses. The signal, which is suljected to a 360 -degree phase shift through the video amplifier, is applied to the grid of the picture tube, V19; therefore the sync pulses at this point are negative-going. A positive-going blanking pulse, taken from the vertical-output stage, is applied to the cathode of the picture tube for suppression of the vertical retrace.
Sound i.f. (intercarrier) is obtained by utilizing the beat frequency produced when the $45.75-\mathrm{mc}$. video carrier and the $41.25-\mathrm{mc}$. sound carrier are mixed in the video detector. The $4.5-\mathrm{mc}$. beat frequency is the difference between 45.75 mc . and 41.25 me., and contains the FM sound signal. This $4.5-\mathrm{mc}$. siznal contains only a negligible amount of video amplitude modulation, provided that the amplitude of the $41.25-\mathrm{mc}$. signal is considerably lower than that of the $45.75-\mathrm{mc}$. signal. The proper relationship between the two carriers is established during the alignment of the receiver. There is sound output only when loth the video and sound carriers are present.
The oscillator is tuned primarily to obtain the best picture, since the $4.5-\mathrm{mc}$. relationship always exists between the two carriers. The $4.5-\mathrm{mc}$. sound i.f. (intercarrier), which is taken from the plate circuit of the video amplifier, is passed through a $4.5-\mathrm{mc}$. sound i-f stage using a 6AU6 tube, V8, and is then applied to the FM detector, which utilizes two diode sections of a 6 T 8 tube, V9A. The triode section of the 6T8, V9B, is used as the first audio amplifier. The power


A portion of the video signal appearing at the output of the first video amplifier is applied to grid 3 (pin 7) of the 6CS6 sync separator, V11. Since gridleak bias is used on grid 3, the tips of the sync pulses are clamped to zero, and the video components swing in a negative direction from zero. Because of the cutoff characteristics of grid 3 , the video components are eliminated, and only negative-going sync pulses appear in the plate circuit of the sync separator. At the same time, however, a signal is taken from the video detector and applied to grid 1 (pin 1) of the 6CS6 tube. This grid is returned to B plus, and the bias is maintained close to zero, because of a small grid-current flow. Since the signal applied to grid 1 is composite video with negative-going sync, any noise modulation present in the signal appears in the form of sharp spikes, driving in a negative direction. The circuit constants are chosen to allow grid 1 to cut off plate current whenever the signal goes more
negative than the sync pulses. A series grid-limiting negative than the sync pulses. A series grid-limiting resistor, R608, is also incorporated to prevent the video components from appearing in the plate circuit of the sync separator. A-G-C voltage is also developed in the sync separator circuit in the following manner: On tips of the sync pulses, grid 3 (pin 7) of the 6CS6 iübe draws cuizent which flows downward through the network R602, R603, R604, R211, and L 214 , causing capacitors $\mathrm{C} 605, \mathrm{C} 602$, and C 603 , to
assume negative charges proportional to the amount assume negative charges proportional to the amount
of peak signal applied to grid 3. The tuner a-g-c voltage is delayed by means of a resistor divider network which applies a small positive voltage to the work which applies a small positive voltage to the
tuner a-g-c circuit. This positive voltage prevents a-g-c action from lowering the tuner gain on weat signals. To prevent the delay voltage from driving the tuner a-g-c voltage positive on weak signals, a diode clamp (part of V9B) is connected across $\mathbf{C} 602$
The negative-going sync pulses appearing in the plate circuit of the sync separator are fed to one half of a 12AU7 tube, V12A, connected as a phase-splitter circuit; positive sync pulses appear in the plate cir-
cuit, and negative sync pulses are taken from the cathode.
Proper triggering of the vertical oscillator require positive synchronizing pulses. The vertical sync signal is separated from the horizontal sync signal by the vertical integrator circuit, and is fed to the grid circuit of the vertical blocking oscillator, one half of a 12AU7 tube (V12B). The output of the vertical oscillator is amplified by a type 12B4 tube, V13, which is employed as the vertical-output amplifier. The output of the amplifier is applied to the vertical-deflection coils through the vertical-output transformer.

The horizontal-sweep circuits require both positive and negative sync pulses. The phase-comparer circuit uses a 6AL5 tube, V14. Positive sync pulses are applied to the plate of V14A, and negative sync pulses are applied to the cathode of V14B. A saw. tooth voltage, taken from the horizontal-output circuit, is fed to the plate of V14B and to the cathode of V14A, for comparison of the sync and horizontal sweep voltages. When the saw-tooth and sync signals are exactly in phase, no voltage is developed across R800, but when the two signals are out of phase, either a positive or a negative voltage is developed, depending upon whether the horizontal-oscillator frequency is lower or higher than the sync-pulse frequency. The grid circuit of the horizontal oscillator, type l2AU7 tube, V15, operating as a cathode coupled multivibrator, is connected to R800 through a filter network. When the voltage at this point goes in a positive direction, the frequency of the horizontal oscillator is increased; when the voltage swings negaive, the frequency of the oscillator is decreased. In this manner the frequency of the horizontal oscillator is controlled over the lock-in range of the circuit. The horizontal hold control, R811, adjusts the horizontal-oscillator frequency so that it :s within the control range of the phase comparer. The output of the horizontal oscillator is fed to the horizonta output amplifier, which makes use of a type 6BQ6GT tube, V16. The screen voltage for the horizontal amplifier is supplied from a voltage-divider network The network includes R818, R816 (the WIDTH control), R817, R315 (the BRIGHTNESS control), and R316. R816 varies the voltage applied to the sc-een thus adjusting for proper picture width. Adjusting R315 for brightness varies the bias on the picture tube. The change in bias causes a change in beam current, and would tend to result in a change in pic ture width and a variation in the second-anode voltage. However, when the control arm of the BRIGHT NESS control, R315, is moved toward ground, smaller part of the control is shunted by the 22,000 ohm resistor, R316, and the total resistance of the voltage divider is increased. This increase in re sistance results in a decrease in the current through the divider, and the screen voltage on the horizontal mplifier is increased proportionally, thus compensating automatically for the increasc in beam current in the picture tube. The horizontal amplifier feeds the deflection coils through the horizontal-output ransformer. A 6AX4GT tube, V17, is used as the horizontal damper.
The second-arode voltage for the picture tube is supplied by one 1B3GT high-voltage rectifier tube,

V18. The B plus voltage for the receiver is supplied by two selenium rectifiers, CR100 and CR101 in a full-wave, voltage-doubler circuit, operating directly from the power line. Bias voltage is obtained from across a filter choke, which is in series with the negative side of the B plus supply. The B plus boost volt age, derived from the horizontal damper circuit, sup plies higher B plus voltage to the vertical oscillator, first audio stage, and the first anode of the picture tube. Filament voltage for all the tubes except the high-voltage rectifier is supplied by a step-down transformer. Filament voltage for the high-voltage rectifier is supplied by a winding of the horizontaloutput transformer.
The circuit description, schematic diagram, base layout, and service information for r-f chassis R-191 is given in PR-2507. Whan deflection chassis D-197, the filter choke is not mounted on the speaker, and a plain p-m speaker is used. The filter choke is mounted on the D-197 chassis.

## IMPORTANT A-C LINE ISOLATION

 CAUTION: One side of the a-c line is con-nected to the chassis through C101 and L100. nected to the chassis through C101 and L100. The other side of the a-c line is connected to the chassis through F100, R100, CR100, and Cl03, in series. Grounding the chassis will result in a shori circuit acioss one or the other of these two branches in the voltagedoubler circuit. During servicing and alignment it is desirable that an a-c line isolation transformer capable of handling at least 225 watts (Philco Part No. 45-9600) be used. Failure to use an isolation transformer will greatly increase the shock hazard, and may result in damage to the test equipment or receiver, or both.

SPECIFICATIONS
VHF TUNING .....Twelve channel, 12 ineremental tuner, covering VHF Television Chan nels 2 through 13; fine tuning of local oscillator

UHF TUNING (if provided)
.Continuous tun ing, covering UHF Television Channels 14 through 83; fine and coarse tuning

## INTERMEDIATE FREQUENCIES

Video Carrier Sound (intercarrier) . .......................... 45.75 mc TRANSMISSION LINE . . . . 300 -ohm, twin-wire lead OPERATING VOLTAGE ........ 110 to 120 volts, 60 cycles, a. c.
POWER CONSUMPTION
Without UHF, 205 watts; with UHF, 210 watts.

| TUBE COMPLEMENT <br> R－F CHASSIS R－191 |  |  |
| :---: | :---: | :---: |
|  | TUBE TYPE | FUNCTION |
| V1 V2 V3，V4， $\mathbf{v 5}$ V6 V7 V8 V9 V10 V11 V19 | 6BZ7 miniature 6X8 miniatare 6CB6 miniature 6AU6 miniature 6AQ5 miniature 6AU6 miniature 6T8 miniature <br> 6V6GT octal 6CS6 miniature 17YP4 or 21ZP4A | R．F Amplifier Oscillator－Mixer Video I－F Amplifiers <br> Video Amplifier <br> Video Output Amplifier <br> Sound I－F Amplifier <br> Ratio Detector，First <br> Audio，and Tuner A．G－C <br> Clamp <br> Audio Output <br> Sync Separator <br> Picture Tube |
| DEFLECTION CHASSIS D－197 |  |  |
| REFERENCE SYMBOL | TUBE TYPE | FUNCTION |
| V12 <br> V13 <br> V14 <br> V15 <br> V16 <br> V17 <br> V18 <br> V19 | 12AU7－miniature <br> 6BQ6GT－octal <br> 6AL5－miniature <br> 12AUT̄－－miniature <br> 6CD6G—octal <br> 6V3A－miniature <br> 1B3GT－octal <br> 24VP4 | Phase splitter，vertical oscillator <br> Vertical output <br> Phase comparer <br> Horizontal oscillator <br> Horizontal output <br> Damper <br> High－voltage rectifier <br> Picture tube |

## B SUPPLY FUSE REPLACEMENT

The $B$ supply protective fuse，F100，is wired into the low－voltage section，and is in series with the selenium rectifiers．For replacement，use a l．6－ ampere delayed－action－type fuse，Philco Part No． AD2248－19．

CAUTION：Discharge the circuit before re－

## placing the fuse．

HORIZONTAL－OSCILLATOR

## ADJUSTMENT

To adjust the horizontal－oscillator circuit，tune in station and proceed as follows：
1．Reduce the width of the picture until approxi－ mately 1 inch of blank screen appears at the right－ hand and left－hand sides of the picture．
2．Increase the BRIGHTNESS control setting un－ til the blanking becomes visible．This will appear as a dark vertical bar on each side of the picture．
3．Connect a $.1 \mu$ f．condenser from the test point， adjacent to TC800；to ground．（The plate side of，the horizontal ringing coil，L800，is connected tarthe teat point．）

4．Set the HORIZONTAL HOLD control to the approximate center of its mechanical rotation．
5．Adjust the HORIZ HOLD CENTERING con－ trol until equal portions of the blanking bar appear on both sides of the picture．
6．Remove the $.1-\mu f$ ．condenser from the test point．
7．Adjust the horizontal ringing coil，L800，until equal portions of the blanking bar again appear on both sides of the picture．
8．Rotate the HORIZONTAL HOLD control through its range．The picture should fall out of sync on both sides of the center of its rotation．If the picture does not fall out of sync on both sides， readjust the HORIZ HOLD CENTERING control．
9．Rotate the HORIZONTAL HOLD control through its range，and observe the number of diag－ onal blanking bars that appear just before the picture pulls into sync．The pull－in should occur with from 1 to 2 diagonal bars when the sync position is ap－ proached from either direction．If proper pull－in is proached from either direction．If proper
not obtained，repeat the above procedure．

## VIDEO PEAKING－COIL ADJUSTMENT

The video peaking coil，L303，is adjusted at the factory for proper transient response of the video circhits．Ordinarily，this coil will require no further adjustment by the serviceman．On any station where excessive overshoot or excessive smear is present，a slight adjustment of L303 may improve the picture quality on that station；however，this adjustment may sacrifice the quality on other channels．If L303 is re－ placed in servicing，adjustment will be required．
Before adjusting L303，check the tuner alignment and i－f alignment．（Never adjust L303 until the align－ ment of the receiver is correct．）Then tune in a sta－ tion and adjust L 303 until there are no trailing whites or smear in the picture．Turning TC301 clockwise reduces trailing whites and overshoot；turning TC301 counterclockwise reduces picture smear and increases trailing whites．The proper position is the point where no smear or trailing whites appear in the picture．
The above procedure for adjustment of TC301 ap－ plies to a particular station exhibiting smear or over－ shoot．After TC301 is adjusted，reception on all the other stations should be checked，to make certain that the adjustment has not impaired the picture TEST EQUIPMENT REQUIRED quality．

## GENERAL

## TELEVISION ALIGNMENT

The alignment procedure follows the general pat．for Television and FM，Model 7008，or equivalent． tern of first checking the tuner response with an FM 2．Vacuum－tube voltmeter，or $\mathbf{2 0 , 0 0 0}$－ohms－per－vol sweep generator and oscilloscope，comparing the re voltmeter．

The following test equipment is recommended for aligning the receiver：
1．Philco Precision Visual Alignment Generator
sponse curve with that given in the manual，and aligning the tuner if necessary．After it is established that the tuner is in correct alignment，the video i－f channel is aligned by tuning each coil to its assigned pole frequency，using an AM signal，and then feeding in a sweep signal at the antenna terminals and re－ touching the i－f adjustments to obtain the desired pass band．Finally，the sound channel is aligned， using an AM signal，by tuning the sound take－off coil and the i－f and ratio－detector transformers．
The over－all response curve（r－f，i－f）of the cir－ cuits from the antenna terminals to the video de－ tector，after the i－f stages have been aligned，should appear essentially the same，regardless of the channel under test．If not，the tuner should be aligned．
The video－carrier intermediate frequency is $\mathbf{4 5 . 7 5}$ me．，and the sound intermediate（intercarrier）fre－ quency is 4.5 mc ．Alignment of these circuits requires careful workmanship and good equipment．The fol－ lowing precautions must be observed：
1．There must be a good bond between the receiver chassis and the test equipment．This is most easily obtained by having the top of the workbench metallic． The receiver chassis should be placed tuner－side down on the bench．If the bench has no metallic top，the test equipment and chassis can be bonded by a strip of copper about 2 inches wide．The section of the chassis nearest the tuner should rest on the strip．
2．Do not disconnect the picture tube，picture－tube yoke，or speaker while the receiver is turned on．
3．Allow the receiver and test equipment to warm up for 15 minutes before starting the alignment．
4．The marker（AM）signal generator should be calibrated accurately to the frequencies used and to the sound and video r－f carriers of each channel used during alignment．If Model 7008 is used，the built－in crystal calibrator provides an excellent means of cali－ bration．An alternate method for calibrating the sig－ nal generator to the sound and video r－f carrier fre－ quencies is to zero－beat the signal generator with the received signals．
For further information regarding calibration，re－ fer to Philco Lesson PR－1745（J）entitled＂Television fer to Philco Lesson P


Figure 1．Antenna－Input Matching Network

3．R－F Probe，Philco Part No．76－3595（for use with Model 7008 generator）．

## IGS AND ADAPTERS REQUIRED

## Mixer Jig

Connections to the grid of the mixer tube may be made through the alignment jack provided for that purpose．To connect the generator to this point，a mixer jig，Philco Part No．45－1739，and a connecting cable，Philco Part No．45－1635，may be used．As an alternate，a Philco alligator－clip adapter，Part No． 45－1636，with as short a ground lead as possible，may be used to connect the alignment jack．The ground lead should be connected as close as possible to the mixer tube．It is essential that the signal－generator output lead be terminated with a 68 －ohm resistor （carbon），so that regeneration，caused by connection of the lead to the mixer，is held to a minimum．

## Antenna－Input Matching Network

Figure 1 shows an impedance－matching network for coupling the signal generator to the antenna－ input terminals of the receiver．This network，which is designed to have an input impedance of $\mathbf{7 5}$ ohms and an output impedance of 300 ohms，is used to match a $75-\mathrm{ohm}$ generator to a $300-\mathrm{ohm}$ antenna－ input circuit．The resistors used in this network should be of carbon－composition construction，and should be chosen from a group to obtain values within $10 \%$ of those indicated．The resistors should be placed in a shield can，to prevent variable effects． An antenna matching jig，Philco Part No．45－1736， which consists of a matching transformer and con－ necting box，may be used in place of the resistor network．
Video I－F Alignment Jig
（Video Test Jack Adapter）
The alignment jig shown in figure 2 should be used during the i－f alignment，to apply the proper bias to the a－g－c bus，and to provide a convenient oscillo－ scope connection．This jig consists of a 5 －prong plug， a 10,000 －ohm potentiometer，two isolating resistors （one 10,000 －ohm and one 15,000 －ohm），two $1500-$


Figure 2. Video I-F Alignment Jig
micromicrofarad capacitors, two $71 / 2$-volt batterics and switch. A suggested method of fabricating the jig is also shown. It is suggested that the bias batteries and potentiometer be mounted in a metal box. of convenient size.
The potentiometer and switch are connected across the two $71 / 2$-volt batteries. The switch is used to disconnect the potentiometer, to prevent the discharge of the battery while not in use.

## Sound I-F Alignment Jig

Figure 3 shows the jig that should be used to connect the voltmeter and oscilloscope to the VOLUME CONTROL socket, J400.

## TELEVISION TUNER ALICNMENT

After the tuner is serviced, or if an i-f alignment is required, the tuner alignment should be checked by observing the tuner response curve, as given under Bandpass Alignment. If the response curve does not fall within the limits shown in figure 5, the tuner should be realigned. If realignment is necessary, use the procedure given below.

Since the frequency of the local oscillator affects the tuner response, the local-oscillator alignment should be made first.

## Oscillator Alignment

General
Tuning cores are provided in the oscillator coils at channels $13,11,9,7,6$, and 4. By adjusting these tuning cores, all channels may be placed on frequency. This procedure should be carried out with the highest-frequency channel first, since the align ment of each channel affects the alignment of all the channels below it in frequency. The channel adjustments are so arranged that, with one exception, each adjustment corrects the tuning of more than one channel. The coverage of the various adjustments is as follows:

| CHANNEL <br> ADJUSTMENT | CHANNES CORRECTED <br> BY ADJUSTMENT |
| :---: | :---: |
| 13 | 13 and 12 |
| 11 | 11 and 10 |
| 9 | 9 and 8 |
| 7 | 7 only |
| 6 | 6 and 5 |
| 4 | 4,3, and 2 |




TP2-2201-1
Figure 4. Television Tuner, Showing Locations of Adjustments
The FINE TUNING cam should be preset for all adjustments by placing the stop on the FINE TUNING cam between the Channel 7 and 8 holes on the front plate of the tuner. Sce figure 4.

## Procedure Using Signal Generator

An r-f siznal (unmodulated), at the oscillator fre quency, is fed into the antenna input from an $A M$ signal generator, and the oscillator tuning cores are adjusted for zero beat. The r-f signal frequency should be accurately determined. It is preferable that the signal be taken from a crystal-controlled source; if this is not available, the signal generator may be calibrated against the television station.

1. Connect the hot lead of the oscilloscope to the mixer plate test point, G2, through a 1000 -ohm resistor, and connect the ground lead of the oscilloscope to the chassis, near the test point. (High oscilloscope yain may be necessary to obtain a visual beat. In this instance, base-line hum may be ignored.)
2. Connect the $A M$ (marker) generator to the 300 -ohnn antenna-input terminals. For this purpose the antenna-input matching network is not required.
3. Disconnect the white lead from the tuner, and connect it to the negative terminal of a $11 / 2$-volt battery. Ground the positive terminal. If regeneration is obscrved, the bias may be increased to 4 or 5 volts, to reduce the regeneration.
4. Mcchanically preset the fine-tuning cam stop as shown in figure 4.
5. Fced in an r-f signal (unmodulated), at the oscillator frequency for Channel 13, with the CHANNEL SELECTOR set for Channel 13.
6. Adjust the tuning core for Channel 13 (see figure 4).
7. Reset the signal-generator frequency and the

CHANNEL SELECTOR, and adjust the tuning cores for Channels 11 and 9 , respectively.
8. Repeat steps 5, 6, and 7 until Channels 13, 11, and 9 are within plus or minus 500 kc . of the correct frequency.
9. Feed in r-f (unmodulated) signals, at the oscillator frequencies for Channels 7, 6, and 4, consecutively (see NOTE below), and adjust the respective tuning cores (see figure 4).

NOTE: The exact position of the FINE TUNING cam should be marked when Channel 4 is correctly aligned. This position is to be used in step 4 of the i-f alignment procedure.

## Procedure Using Station Signa

The following simplified procedure may be used to align the oscillator when the television i-f alignment is satisfactory and a station signal is available:

1. Mechanically preset the FINE TUNING cam to the center of its range (see figure 4).
2. Tune in the highest-frequency channel to be received.
3. Adjust the tuning core for that channel, or the next higher channel, for the best picture; that is, starting with sound in the picture, turn the tuning core until the sound disappears. Repeat for each channel received in the area.

## andpass Alignment

General
The bandpass alignment consists of aligning the tuner at Channels 13 and 6, and then making it track down to Channels 7 and 2, respectively.
During the alignment, a fixed bias of $11 / 2$ volts is applied to the r-f amplifier tube.
An FM (sweep) signal is applied to the antennainput circuit, and an oscilloscope is connected to the mixer plate circuit. The oscilloscope gain should be as high as possible, consistent with hum level and "loounce" conditions. Hum conditions will cause distortion of the time base and response. Bounce conditions, which are caused by poor line regulation, will cause the response and time base to jump up and down. The use of too high an oscilloscope gain aggravates these conditions, whereas the use of too low a gain necessitates increasing the generator output to a point where the tuner may be overloaded. Overload may be checked by changing the generator output while observing the shape of the response curve; any change in the shape of the curve indicates overload, in which case a lower generator output and higher oscilloscope gain must be used. The tuner coupling link should be disconnected from the


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## Figure 5. Television Tuner Response Curve,

i-f section by removing the plug, PL500, and a 40- to $\mathbf{7 0}$-ohm carbon resistor should be connected across the open end of the plug. This is done to eliminate the absorption effect of the tuner link coil, L200, on the response curve.

## Procedure

1. Disconnect the white (a-g-c) lead, from the tuner, and connect it to the negative terminal of a $11 / 2$-volt battery. Ground the positive terminal.
2. Disconnect the tuner plug, PL500, at terminal board B13 (see figure 33), and connect a 40 - to 70 -ohm carbon resistor across the plug.
3. Connect a 1000 -ohm resistor in series with the hot lead of the oscilloscope. Connect the other end of the resistor to the mixer plate test point, $\mathbf{G 2}$, and connect the ground lead of the oscilloscope to the chassis, near the test point.
4. Connect the FM (sweep) generator to the 300 ohm antenna-input terminals through an antennainput matching network. See figure 1 .
5. Set the CHANNEL SELECTOR and FM (sweep) generator to Channel 13 ( 213 mc .). Adjust the generator for sufficient sweep to show the complete response curve.
6. Establish the channel limits (see figure 5) by using the marker (AM r-f) signal generator to produce marker pips on the response curve. (Set the marker generator first to 210 mc ., then to 216 mc .) The curve should be reasonably flat between the limits shown in figure 5 .
7. Adjust TC502 and TC504 (figure 4) for a symmetrical, approximately centered pass band.
8. Set the CHANNEL SELECTOR and FM gencrator to Channel 7 ( 177 mc .).
9. Establish the channel limits by using the marker generator to produce marker pips on the response curve. (Set the gencrator first to 174 mc ., then to 180 mc .) The curve should le reasonally flat between the limits.
10. On Channel 7, note the response curve, with respect to tilt and center frequency. The curve should be centered in the pass band, and should be symmetrical.
11. If the curve is not symmetrical, and appears unbalanced, as shown in figure 6 , leave the generator and tuner set to Channel 7, and adjust C508 and C512 (see fipure 4) to obtain a response curve which is the mirror image (tilt in the opposite direction) of the original. This is a form of overcompensation, to allow for the effect of Channel 13 adjustment on Channel 7. For example, if the Channel 7 response appears as in figure 6A, then the trimmer should be adjusted to obtain the response shown in figure 6B.
12. Reset the CHANNEL SELECTOR and gen erators to Channel 13. Readjust TC502 and TC504 for a symmetrical and centered band pass. Sec step 4.
13. Set the CHANNEL SELECTOR and generators to Channel 7, and check the response for center frequency and symmetry. Repeat steps 8 and 9 as many times as is necessary to obtain the most symmetrical, centered response curves on Channels 13 and 7 Channels 7 through 13 are now correctly aligned.
14. Set the CHANNEL SELECTOR and sweep generator to Channel 6 ( 85 mc .).
15. Establish the channel limits, using the marker generator to produce marker pips on the response curve. (Set the generator first to 82 mc ., then to 88 J 200 . mc .)
16. Adjat TC503 and 4. Connect the oscilloscope to the $15,000-0 \mathrm{hm}$ re sistor from the video i-f alignment jig. Connect the approximately centered pass band. Set the marker ground lead of the oscilloscope to the ground lead generator to 85 mc . Detune TC505 counterclockwise from the adapter. until a single peak appears.

CAUTION: Do not turn the core of TC505
excessively, or it will fall out of the coil.
Adjust TC503 until the peak falls on the $85-\mathrm{mc}$. marker. It may be necessary to increase the output of the generator during this adjustment. Then adjust TC50l for maximum curve height and symmetry of the single peak. The antenna circuit is now tuned for Channels 2 through 6. To prevent overloading, the output of the generator should be reduced after this adjustment is completed.
17. Readjust TC503 and TC505 for a symmetrical response, centered about 85 mc .


Figure 6. Television Tuner Response Curve, Showing Tracking Compensation


Figure 7. R-F Chassis R-191, Top View, Showing Locations of Adjustments
and tune the i-f marker generator (capacitively coupled to the mixer grid) to 45.75 mc . Note two marker generators are used for this procedure. The r-f marker generator is connected to the antenna terminals, while the i-f marker generator is coupled capacitively to the mixer grid teat point, Gl. A jig constructed from a piece of fiber tubing, with $3 / 10$-inch inside diameter, and a brass machine screw which fite tightly into the tubing, is used to couple the generator capacitively to the test point. The screw is adjusted so that its tip clears the test point by approximately $1 / 64$ inch. The output cable of the
marker generator is connected to the head of the brass screw in the jig and to the chassis near the mixer tube. Both marker generators should be adjusted for the minimum output required to make the markers barely visible. Failure to observe this precaution, or the use of excessive output from the sweep gen erator, will cause misleading results. After the equipment is properly connected, adjust the FINE TUNING control for zero beat of the two markers, as observed on the oscilloscope. When zero beat is obtained, remove the i-f marker.
5. If the response curve does not fall within the limits shown in figure 8, the adjustment of the trim mers may be touched up slightly, while observing the response curve. Do not retouch the setting of C202 at this point. To adjust the curve, first adjus C206 and C212, alternately, until maximum improvement has been obtained. C212 affects the tilt of the curve, and C206 affects the dip of the curve. After C212 and C206 have been adjusted, adjust C210 for proper slope at the $42.5-\mathrm{mc}$. side of the curve, then adjust C526 for proper level at the video carrier frequency ( 45.75 mc. ). After these adjustments have been made, if the response curve still does not fall within the limits shown in figure 8, a slight readjust. ment of C202 is permissible.

CAUTION: Do not turn any of the trimmers excessively. To retouch, turn the trimmers only slightly.

## SOUND I-F ALIGNMENT

1. Remove the lat $v-i-f$ tube, and conncet v.t.v.m. or a 20,000 -ohms-per-volt voltmeter to the sound i-f alignment jig (figure 3). Adjust the VOLUME control for moderate speaker output.
2. Feed in an accurately calibrated $4.5-\mathrm{mc}$. AM signal, through the $\mathbf{2 2 0 0}$-ohm resistor in the video ialignment jig, to pin 2 of $\mathbf{J 2 0 0}$.
3. Tune TC400, TC401, and TC402 for maximum indications on the meter. The point of maximum meter indication for TC402 should also be the poin of minimum speaker output.
4. Tune TC402 for minimum speaker output.
5. Connect an r-f probe or crystal detector to the grid (pin 2) of the picture tube. See NOTE below.
6. Tune TC300 for minimum indication on oecilloscope. (If a crystal detector is not available, TC300 may be adjusted for minimum beat pattern, as observed on the picture tube, with a station picture present.)
7. Replace the lst v-i-f tube. Tune in a station,

$\stackrel{\text { TP3-891 }}{\text { Le }}$
Figure 8. Over-All, R-F, I-F Response Curve, Showing Tolerance Limits
using the speaker output as an indication of correct tuning.
8. Turn the FINE TUNING control clockwise to obtain a slightly fuzzy picture.
9. Tune TC402 for minimum AM (noise) output.

NOTE: The R-F Probe, Part No. 76-3595, is used as a detector of the $4.5-\mathrm{mc}$. signal, and the oscilloscope is used as an indicating device. An alternate crystal detector may be made up as shown in figure 9.


Figure 9. Wiring Diagram of Crystal Detector

## OSCILLOSCOPE WAVEFORM PATTERNS

These waveforms were taken with the receiver ad justed for an approximate peak-to-peak output of 2 justed for an approximate peak-to-peak output of 2
volts at the video detector. The voltages given with volts at the video detector. The voltages given with
the waveforms are approximate peak-to-peak values. the waveforms are approximate peak-to-peak values.
The frequencies shown are those of the waveformsThe frequencies shown are those of the waveforms-
not the sweep rate of the oscilloscope. The waveforms
were taken with an oscilloscope having good high frequency response. With oscilloscopes having poor high-frequency response, the sharp peaks of the horizontal waveforms will be more rounded than those shown, and the peak-to-peak voltages will differ from those shown.


Figure 10. Video Detector Output,
2 volts, 60 c.p.s.
TP2-787


Figure 12. Video Amplifior Plato, 50 velts, 60 c.p.s.


Figure 14. Syac Separator Motto, 26 vols, 15,750 c.p.s.


## Figure 11. Video Detector Outpint

 2 volts, 15,750 c.p.s.

Figure 13. Sync Saparator Grid, 40 voles, 60 c.p.s.
 21 volts, 60 c.p.s.


Fizure 16. Phase-Splitter Plate, Pin TP2-640 34 volts, 60 c.p.s.


Figure 18. Vertical-Oscillator Plate, Pin 6 50 volts, 60 c.p.s.


Figure 20. Vertical-Output Plate,
1200 volts, 60 c.p.s.
 11 volts, 15,750 c.p.s.

Figure 17. 85 volts, 60 c.p.s.


Figure 19. Vertical-Output Grid, Pin 5 24 volts, 60 c.p.s.


Figure 21. Phase-Splitter Plate, Junction of R614 R615, and C800
13 volts, 15,750 c.p.s


## VOLTAGE MEASUREMENTS



Figue 24. Morizental Oncillator lametion G800 Tost Point 26 volts, 15,750 c.p.s.


TP2-648
Figure 26. Herizontel-Oncitiator Grid,
45 volts, 15,750 c.p.s.


Figure 25. Herizontal-Oreillater Cothede 16 volts, 15,750 c.p.s.


Figure 27. Herizomel-Output Grie 120 volts, 15,750 c.p.s.


Yete TP2-650 Pin 5 of J 800
4100 volts, 15,750 c.p.s.

- Sen CAUTION.
- CAUTION: Hiph-voltage pulece are present in the horisontalontpot circuit. The wavelorm in figure 28 was taken with the alligator clip of the ascilloscope lead clipped over the insult
tion of the lead connectod to pin 7 of $\mathrm{J800}$. (To prevent pun tion of the lead connected to pin 7 of J800. (To prevent punce
ture of the insulation of the lead, file of the teoth of the alligator clip, and wrap friction tape aroand the elip.) Connection
o other points in the horisontal-oatpat cireat is dangeronch because of the high voltages present. The poukto-penk voluage shown for figure 28 is the actual voluge present; however, the amplitude of the scope presentation depends apon the degree of coupling.

The voltages given here and on the schematics were taken with a 20,000 -ohms.per-volt voltmeter, with a line voltage of 117 volts, and no signal input to the receiver. Since voltage readings taken in the video i-f stages vary widely with different test equipment setups, voltage measurements for these stages are omitted from the diagrams.


* Voltage measured mith at,ooo ohm isolating resistor
in series with meter proaie

Figure 29. R-F Chassis R-191, Bottom View, Showing Voltages at Socket Pins





Figure 34. R-F Chassis R-191, Schematic Diagram



Figure 37. Philco UHF Tuner-Adapter UT22, Part No. 43-6703, Schematic Diagram



TP3-795
Figure 46. Change-Over Switch Mounting Details and Lead-Dress Details
and attach to the rear of the VHF tuner on the r-f chassis. See figure 45.
6. Remove the screw on the side of the VHF tuner, as shown in figure 41. Place the switch assembly on the two mounting studs, and fasten it in place with the flat washere, lock washers, and nuts provided. See figure 46. Fasten the upper switch bracket in place as shown in figure 46.
7. Put the VHF Channel Selector in the Channel 2 position. Rotate the switch actuator clockwise (as vicwed from the rear of the VHF tuner) on the tuner shaft until the actuator touches the fiber cam on the change-over switch. Fasten the switch actuator in this position. Rotate the Channel Selector to the UHF position. Check the switch operation to make sure that the switch is thrown properly. Rotate the Channel Selector to Channel 13 position and check the switch operation to make sure that the switch is not thrown in this position. Fasten the lower switch bracket to the side of the VHF tuner with the screw removed in step 6. Lubricate the switch-actuator stud and switch cam with cup grease.
8. Remove the audio-output tube from its socket, and insert the adapter plug into the socket. Insert the tube into the adapter. See figure 46.
9. Insert the coaxial cable from the VHF tuner into the bottom socket on the change-over switch. Insert the coaxial cable from the r-f chassis into the top socket on the switch. See figure 46.
10. Pull the orangc lead from the VHF tuner up out of the r-f chassis, and cut it off at the point where it comes through the chassis. Skin the orange lead attached to the VHF tuner, and solder it to the lug on the change-over switch, as shown in figure 44.

CAUTION: The orange lead supplies B plus
to the VHF tuner. Tape the loose end to
prevent shorting to the chassis.
11. Remove the pilot lamp from the r-f chassis pilot-light socket. Cut the pilot-light lead from the r-f chassis where it passes through the chassis, and discard the socket and lead. Tape up the lead to prevent the possibility of a short circuit. Mount the new pilot-light socket from the change-over switch with the drive screw provided, as shown in figure 47. Inert the pilot light in the socket, and install the shield provided over it.
12. Remove the antenna lead from the VHF tuner, and solder the short lead from the UHF.VHF changeover switch to the VHF tuner terminals from which the antenna lead was removed. Slide the folded fiber lead holder over the tapered-line coil assembly on the VHF tuner, and dress the twin-wire antenna leads through the holder. See figure 44. The fiber holder will prevent the twin-wire leads from touching the tubes on the r-f chassis.
13. Place the UHF tuner in the cabinet between the r-f and deflection chassis, and fasten the UHF


TP3-755
Figure 47. Pilot Light Mounting Details
tuner to the chassis shelf with the three screws re moved in step 3. It is important that these screws be tightened securely, so as to hold the UHF tuner in place on the chassis shelf. Turn the UHF tuning shaf o its extreme counterclockwise position, and check the pointer position on the scale. The pointer should be positioned just below the Channel 14 mark on the scale. If the pointer is not properly positioned, loosen the three mounting bolts and move the UHF tuner


Figure 48. UHF Tuner, Showing Location of Ground Lead and Coaxial Socket


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## Figure 49. Rear View of VHF Tuner, Showing Lead Dress

assembly to properly position the pointer; then fasten the assembly with the three mounting screws.
14. Fasten the ground lead and the dress lugs to the r-f chassis with drive screws. See figure 46. Install the chassis in the cabinet, and fasten the ground strap under the screw on the UHF tuner as shown in figure 48. Fasten the $r$-f chassis with the original mounting bolts. Place the original knobs on their shafts, and the felt washer and knob supplied on the UHF tuning shaft.
15. Insert the coaxial plug from the change-over switch into the socket on the UHF tuner. See figure 48. Insert the 5 -pin plug from the UHF tuner into the socket on the bracket at the rear of the VHF tuner. Dress the leads under the dress lug as shown in figure 46.
16. Replace the fiber antenna-lead holder with the new holder provided. Fasten the new holder with the nails provided (or screws for metal cabinets), and then pass the twin-wire leads through the holes as shown in figures 49 and 50 . Pull the leads through


Figure 50. Antenna-Lead Holder


TP2-3170-1
Figure 51. Antenna-Lead Connections, Common Built-In Antenna
the holder until they are tight, making certain that the leads do not contact the tubes or the chassis. Wrap tape around the yellow-marked twin-wire leads with the spade-lug ends, to prevent the leads from passing back through the fiber holder.
17. Fasten the antenna terminal board provided as shown in the illustrations above (figures 51 to 55). Replace the cabinet back, and make the connections as illustrated, according to the type of antenna installation, being used.
18. Paste the label provided over the outsideantenna instructions on the cabinet back.


Figure 52. Antenna-Lead Connections, Common External Antenna


TP2-3174-1
Figure 53. Antenna-Lead Connections, Separate
xternal Antennas


Figure 54. Anfenna-Lead Connections, VH Built-In and UHF External Antennas


Figure 55. Antenna-Lead Connections, VHF External and UHF Built-In Antennas

## PARTS LIST

## IMPORTANT

General replacement items commonly stocked by the serviceman are omitted from this parts list. All condensers are molded-bakelite Philco condensers, with a 600 -volt rating, and all resistors are $1 / 2$ watt, unless otherwise indicated. Parts are listed according to chassis type, and should be ordered in this way rather than by model number. A list of miscellaneous parts is given at the end of the parts list for each chassis type. All parts are symbolized in the schematic diagram and base layout, for identification purposes.
NOTE: Part numbers identified by an asterisk (*) are general replacement items. These numbers may not be identical with those on factory parts. Also, the electrical values of some replacement items may differ from the values indicated in the schematic diagram and parts list. The values substituted in any case are so chosen that the operation will be unchanged. When ordering replacements, use only the "Service Part No."
SECTION 1-POWER SUPPLY

## D-197

SECTION 7-VERTICAL SWEEP (Cont)

| Reference Symbol | Doscription | Service Part No. | Reference Symbol | Description | Service Part No. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{array}{\|l\|l} \mathrm{Cl} 100 \text { and } \\ \mathrm{Cl01} \end{array}$ | Condensers, filter, electrolytic, $120 \mu$ f., 150v $\qquad$ | 30-2568-61 | R708 | Potentiometer, VERT. LIN. control, 2.5 megohms | 33.5565 |
| C102 | Condenser, filter, electrolytic, $10 \mu$ f., 25v | 45-3035-6 | R710 | Resistor, screen divider, 22,000 ohms, 2 watts .............. | 66-3225340 |
| C103 | Condenser, filter, electrolytic, $100 \mu \mathrm{f}$, 300v | 30.2584.7 | R711 | Resistor, screen divider, 18,000 ohms, 2 watts $\qquad$ | 66.3185340 |
| $\begin{aligned} & \text { CR100 and } \\ & \text { CR101 } \end{aligned}$ | Rectifiers, selenium, 450 ma . . | 34-8003-8 | R714 | Resistor, vertical damping, 680 ohms, 1 watt ............... | 66-1684340 |
| F100 | Fuse, | AD2248-19 | T700 | Transformer, vertical oscillator | 32-8431-2 |
| F101 | Fuse, filament | Piece of \#26 wire | T701 | Transformer, vertical output.. | 32-8637 |
| J100 | Socket, a-c line | 27-6240-3 | SECTION 8-HORIZONTAL SWEEP |  |  |
| J101 | Socket, chassis, connecting ... | 27-6274-1 |  |  |  |
| L100 | Choke, filter .............. | 32.8600.1 |  |  |  |
| PLIOO | Plug, a-c line | Part of a.c line cord ass'y. (see | $\begin{aligned} & \text { C805 } \\ & \text { C806 } \end{aligned}$ | Condenser, by-pass, $82 \mu \mu \mathrm{f}$. ... <br> Condenser, ringing, . $0022 \mu \mathrm{f}$.. | 60.00825437 |
| PL101 | Plug and cable ass'y., chassis connecting | Misc. "A") ${ }^{\text {S }}$ | C807 | Condenser, d-c blocking. 390 $\mu \mu \mathrm{f}$. | 60.10395437 |
|  | necting | (See Misc. "B" in PR-2507) | C808 | Condenser, charging, $330 \mu \mu \mathrm{f}$. | 60.10335417 |
| R100 | Resistor, current limiting, 5 ohms, 20 watts $\ldots . . . . . .$. | 33-3448-18 | C811 | Condenser, decoupling, $10 \mu \mathrm{f}$., $450 \mathrm{v} \ldots . . . . . . . . . . . . . . . . .$. | Part of C103 |
| S100 | Switch-off-on | Part of VOL. UME control | C813 | Condenser, anti-ringing, $82 \mu \mu$ f., 4000v | 30-12464 |
| T100 | Transformer, filament | 32.8643 | J800 | 300v $\qquad$ <br> Socket, deflection $\qquad$ | $\begin{aligned} & \text { Part of C103 } \\ & 27.6274 .8 \end{aligned}$ |
| SECTION 4-SOUND |  |  |  |  |  |
| R414 | Potentiometer, VOLUME con- |  | J801 | Socket, gate pulse .......... | 27.6273 |
|  | trol, 2 megohms .......... | 33-5564-16 | L800 | Coil, stabilizing, $30-80 \mathrm{mh} . .$. | 324557 |
| SECTION 7-VERTICAL SWEEP |  |  | L801 | Coil, r-f choke, horizontaloutput plate | Part of T800 |
| C707 | Condenser, screen filter, $20 \mu$ f. 200v | Part of Cl03 | $\begin{array}{\|l\|} \hline \text { L802 and } \\ \text { L803 } \end{array}$ | Coils, horizontal deflection ... | Part of deflec tion yoke ass'y ( see Misc. "A") |
| $\mathrm{L} 700 \text { and }$ | Coils, vertical deflection | Part of deflec- | L804 | Coil, r.f choke, damper cathode | Part of 7800 |
|  |  | tion yoke ass'y. ( see Misc. "A") | L805 | Coil, r.f choke, damper plate.. | 324112-24 |
| R701 | Potentiometer, VERT. HOLD control, 250,000 ohms ...... | Part of R810 | L806 | Coil, r-f choke, horiz.output heater | 324112-18 |
| R704 | Potentiometer, HEIGHT control, 2.5 megohms .......... | \|33-5565-32 | PL800 | Plug. deflection ............ | Part of cable ass'y. (see Misc. "A") |



OJohn F. Rider

R-F CHASSIS R-191 (Cont.)

TV TUNER, PART No. 76-8400 (Cont.)

| Reforence Symbol | Description | Service Part No. |
| :---: | :---: | :---: |
| J500 | Socket, tuner link | Part of Connector ass'y, tuner to i.f (see Misc. " ${ }^{\prime \prime}$ ) |
| L500, L501, <br> L502, and <br> L503 | Coils, tapered line .. | 32-4432.3 |
| L504 | Coil, FM trap | 3245503 |
| L505 to L511 incl. | Coils, antenna tuning ........ | Part of WS500A |
| L512 | Coil, r-f coupling | 312-5145 |
| L513 to L519 incl. | Coils, rff plate tuning ....... | Part of WS500B |
| L520 to L526 incl. | Coils, mixer grid tuning .... | Part of WS500C |
| L527 | Coil, i.f trap ............... | 324552-1 |
| L528 | Coil, mixer plate ........... | 312.5151-10 |
| L530 | Coil, filament choke | 324550-1 |
| L531 | Coil, filament choke ........ | 32-4550-11 |
| L532 to L538 incl. | Coils, oscillator tuning ...... | Part of WS500D |
| PL500 | Plug, tuner link ............. | Part of Cable and Plug ase'y. (see Misc. "C") |
| R508 | Resistor, oscillator feed, 33,000 ohms $\ldots \ldots \ldots \ldots \ldots . . . . . . . . . . . . . . . . . . . . . . . ~$ | 66-3334340 |
| R510 | Resistor, mixer plate feed, 10,000 ohms, 1 watt ........... | 66-3104540 |
| $\begin{aligned} & \text { WS500A(F) } \\ & \text { and } \\ & \text { WS500A (R) } \end{aligned}$ | Switch, wafer, antenna ...... | 76-8410 |
| $\begin{aligned} & \text { WS500B (F) } \\ & \text { and } \\ & \text { WS500B(R) } \end{aligned}$ | Switch, wafer, r.f plate ...... | 76-8409 |
| $\begin{aligned} & \text { WSS50C(F) } \\ & \text { and } \\ & \text { WS500C(R) } \end{aligned}$ | Switch, wafer, mixer grid ... | 76.8408 |
| $\begin{aligned} & \text { WS500D(F) } \\ & \text { and } \\ & \text { WS500D(R) } \\ & \text { TEN } \end{aligned}$ | Switch, wafer, oscillator ..... | $76-8407$ $76-8417$ |

MISCELLANEOUS "C"

| Description | Service Part No. |
| :---: | :---: |
| Cam and shaft, fine tuning <br> Cable and plug, tuner to i-f <br> Connector ass'y, tuner to i-f <br> Coupling, fine tuning shaft <br> Detent, ball <br> "E" Washer, detent (in back of fine tuning cam) | 76-6936-3 <br> 41.3754-55 <br> 76-8521 <br> 54-4912-2 <br> 56-8020 <br> 1W60980FA3 |

Miscellaneous "C" (Cont.)

| Description | Service Part No. |
| :---: | :---: |
| Front panel ass'y. | 76-8395 |
| Hairpin, plunger grounding ............. | 56.9858 |
| Hairpin, plunger.pivot lever-pin ......... | 1W42704FA3 |
| Pivot pin, lever | 56.9149 |
| Lever, plunger | 56-9148 |
| Plunger | 56-8034-1 |
| Retaining ring | 1W61043 |
| Shaft | 76-6914-4 |
| Shaft extension | 56-8358 |
| Shield, tube, 9-pin miniature ............ | 56.5629.5 |
| Socket, tube, 9-pin miniature | 27-6203-21 |
| Spring, shaft .. | 56-8023 |
| Spring, plunger ........................ | 56.9628 |
| Spring, detent index | 56.9158 |
| Terminal panel, antenna ................ | 76-5504-2 |
| Washer, detent (in back of fine tuning cam) | 56.9351 |
| Washer, fiber, fine tuning plunger ....... | 27-4109-13 |
| Washer, spring, plunger lever ........... | 56-9157 |

CONNECTING CABLES, PLUCS, AND SOCKETS

| Reference Symbol | Description | Service Part No. |
| :---: | :---: | :---: |
| J100 | Socket, aec line | 27.6240.3 |
| J101 | Socket, chassis connecting .. | 27.6274-1 |
| J200 | Sockeh, video test | 27.6273 |
| J400 | Sockeh, volume control ...... | 27.6273 |
| J401 | Socket, speaker ............ | 27-4785.2 |
| J800 | Sockeh deflection-yoke connector | 27-6274.8 |
| PL100 | Plug and line cord ase'y. .... | 41.3865 |
| PL101 | Plug and cable ass'y, chasais connecting | 41-4146-10 |
| PL400 | Plug and cable ass'y, volume control | 41-4136.3 |
| PL401 | **Plug and cable as'yn. | See cabinet parts list |
| PL800 | Plug and cable ass'y, de- |  |
|  | (17" picture tabe) <br> (21" picture tube) | $\begin{aligned} & 41-4086-18 \\ & 41-4086-25 \end{aligned}$ |
|  | Cable, high voltage ......... | AD-2631 |
|  | Cable and socket ass'y, picture tube | 41-3964-19 |
|  | Cable and socket ass'y, pilot light | 27-6233-103 |

* NOTE: The length of this cable varies with cabinet and speaker
parts list.

UHF TUNER-ADAPTER UT22, PART No. 43-6703

| Reference Symbol | Description | Service Part No. |
| :---: | :---: | :---: |
| C1 and C2 | Condenser, antenna input, 680 $\mu \mu$ f. | Part of panel filter |
| C3 | Condenser, tuning: Shaft and rotor ass'y. | 76.74814 |
| C3A | Stator, r.f, l.h. ..... | 56.9595 |
| C3B | Stator, rif, r.h. | 56.9595.1 |
| C3C | Stator, r-f, l.h. | 56.9595 |
| C3D | Stator, rff, r.h. | 56.9595.1 |
| C3E | Stator ass ${ }^{\text {y }}$., oscillator | 79 |
| C3F | Stator ass $\mathrm{y}_{\text {., oscillator }}$ | 76.7479 |
| C4 | Condenser, padder ass'y, r.f. | 76.7472 |
| C5 | Condenser | Stray capaci. tance |
| C6 | Condenser, padder ass'y, ref. | 76.7472 |
| C7 | Condenser, mixer tank, $30 \mu \mathrm{f}$. | Part of board ass'y., mixer |
| C8 | Condenser, temperature compensating, $4 \mu \mu \mathrm{f}$. | 30-1224-109 |
| C9 | Condenser, oscillator trimmer | 31.6525 |
| C10 | Condenser, oscillator tank, 2.5 $\mu \mu$ f. | Part of tank ass'y, osc. |
| C11 | Condenser, by-pass | Part of tank ass'y., osc. |
| C12 | Condenser, grid by.pass, 500 $\mu \mu \mathrm{f}$. | 30.1245-3 |
| C13 | Condenser, feedback, $1.0 \mu \mu \mathrm{f}$. | 30-1238.2 |
| C14 | Condenser, hcater by-pass, 500 $\mu \mu \mathrm{f}$. | 30.1245-3 |
| C15 | Condenser, plate by-pass, 500 $\mu \mu \mathrm{f}$. | 30.1245-3 |
| C16 | Condenser. input coupling, 8 $\mu \mu \mathrm{f}$. | ${ }^{30-1224-46}$ |
| C17 | Condenser, neutralizing, 680 $\mu \mu$ f. | 62:168001001 |
| C18 | Condenser, decoupling. 680 $\mu \mu \mathrm{f}$. | 62-168001001 |
| C19 | Condenser, cathode by-pass, <br>  | 62.168001001 |
| C20 | Condenser, filament by-pass, $470 \mu \mu \mathrm{f}$. | 62.147001011 |
| C21 | Condenser, cathode tuning, $680 \mu \mu$. | 62-168001001 |
| C22 | Condenser, grid by-pass, 680 $\mu \mu \mathrm{f}$. | 62-168001001 |
| C23 | Condenser, plate taning, 1-5 $\mu \mu \mathrm{f}$. | 31-6520-10 |
| C26 | Condenser, grid by-pass, . 01 $\mu$ f. | 30.1238-2 |
| C27 | Condenser, decoupling, 680 $\mu \mu \mathrm{f}$. | 62-168001001 |
| C28 | Condenser, output coupling. $680 \mu \mu \mathrm{f}$. | 62-168001001 |
| $\begin{aligned} & \mathrm{C} 29 \text { and } \\ & \mathrm{C} 30 \end{aligned}$ | Condenser, antenna input, 100 $\mu \mu \mathrm{f}$. | 30-1225-13 |
| C31 | Condenser, grid tuning, 1-5 $\mu \mu \mathrm{I}$. | 31-6520-10 |
| CD1 | Crystal detector, mixer circuit | 34-8026 |
| 11 and 13 | Lamps, pilot, UHF .......... | 34-2068 |
| 12 | Lamp, pilot, VHF .......... | 34.2068 |
| L1 | Inductor, ref, l.h. ............ | $\begin{aligned} & \text { Part of C3A. } \\ & \text { Stator } \end{aligned}$ |


| Reference Symbol | Description | Service <br> Part No. |
| :---: | :---: | :---: |
| L2 | Inductor, r.f, r.h. | Part of C3B. Stator |
| L3 | Inductor, r-f, l.h. | Part of C3C- <br> Stator |
| L4 | Inductor, r.f, r.h. | Part of C3D. <br> Stator |
| L5 and L6 | Inductors, crystal mixer | Part of board ass'y., mixer |
| L7 and L8 | Inductors, oscillator coupling | Part of board ass'y., mixer |
| L9 and L10 | Inductors, oscillator | Part of board ass'y, osc. |
| $\mathrm{L}_{\mathrm{L} 12}^{\mathrm{L} 1} \text { and }$ | Inductors, oscillator | 76-7627 |
| L13 | Choke. heater decoupling | 324556.3 |
| L14 | Choke, heater-cathoae decoupling | 3245564 |
| L15 | Choke. plate decoupling .... | 324556-2 |
| L16 | Coil, input tuning, primary | 32-4597.7 |
| L17 | Coil, input tuning, secondary. | 324597.9 |
| L18 | Coil. neutralizing .......... | 32-45974 |
| L19 | Choke, cathode tuning . | 324597.5 |
| L22 | Choke, plate decoupling .... | 324556-2 |
| $\begin{aligned} & \mathrm{L} 23 \\ & \mathrm{~L} 24 \end{aligned}$ | Coils, i-f trap | Part of panel filter |
| R2 | Resistor, damping, 220 ohms | 66-1228340 |
| R3 | Resistor, decoupling, $\quad 6800$ olims $\ldots . . . . . . . . . . . . . . . . . . . . .$. | 66-2688340 |
| R4 |  | Part of L13 |
| R5 |  | Part of L15 |
| R6 |  | 66-2104240 |
| R7 |  | 66-0688340 |
| R8 and R9 | Resistor, antenna input, 470,000 ohms | Part of panel filter |
| R10 | Resistor, grid loading, 8200 ohms .......................... | 66-2828340 |
| R11 | Resistor, pilot light, 3.9 ohms | 66.9398340 |
| R12 | $\begin{aligned} & \text { Resistor, B+ } \\ & 000 \text { ohms, } 10 \text { watts } \begin{array}{l} \text { dropping, } 10 . \end{array} . \end{aligned}$ | 33-1336-58 |
| R13 | Resistor, a-g-c decoupling, 10, 000 ohms | 66-3108340 |
| R14 | Resistor, bias divider, 1.5 meg. ohms | 66-5158340 |
| R15 | Resistor, damping, 10 ohms | 66.0108340 |
| R16 | Resistor, damping, 470 ohms. | 66-1478340 |
| R17 | Resistor, plate load, 3300 ohms | 66-2338340 |
| $\begin{aligned} & \text { R18 and } \\ & \text { R19 } \end{aligned}$ | Resistor, tuner disabling, 150, 000 ohms | 664158340 |
| R20 | Resistor, bias divider, 1.5 megohms | 66.5158340 |
| R21 | Resistor, pilot light, 10 ohms. | ${ }^{66-0108340}$ |
|  | Roard ass'y., mixer ......... Board ass'y, oscillator ..... | $\begin{aligned} & 76.7475-4 \\ & 76.7480 \end{aligned}$ |
|  | Panel, filter ............... | 76-8078 |
|  | Tank ass'y, oscillator ...... | 76.7627 |


| Reference Symbol | Description | Service Part No. |
| :---: | :---: | :---: |
| C1 and C2 | Condenser, antenna input, 680 $\mu \mu \mathrm{f}$. | Part of panel filter |
| C3 | Condenser, tuning: Shaft and rotor ass'y. | 76-74814 |
| C3A | Stator, r.f, l.h. | 56-9595 |
| С3в | Stator, r.f, r.h. | 56-9595-1 |
| C3C | Stator, rif, l.h. . ........... | 56-9595 |
| C3D | Stator, r-f, r.h. . ........... | 56-9595-1 |
| C3E | Stator ass'y., oscillator .... | 76.7479 |
| C3F | Stator ass'y, oscillator | 76.7479 |
| C4 | Condenser, padder ass'y, rif. | 76.7472 |
| C5 | Condenser . ${ }^{\text {c............... }}$ | Stray capacitance |
| C6 | Condenser, padder ass'y., r-f. | 76.7472 |
| C7 | Condenser, mixer tank, $30 \mu \mu \mathrm{f}$. | Part of board ass'y., mixer |
| C8 | Condenser, temperature compensating, $.4 \mu \mu$ f. .......... | 30-1224-109 |
| C9 | Condenser, oscillator trimmer | 31-6525 |
| C10 | Condenser, oscillator tank, 2.5 $\mu \mu \mathrm{I}$. | Part of tank ass'y, osc. |
| C11 | Condenser, by-pass ......... | Part of tank ass'y, osc. |
| C12 | Condenser, grid by-pass, 500 $\mu \mu \mathrm{f}$. | 30-1245-3 |
| C13 | Condenser, feedback, $1.0 \mu \mu \mathrm{f}$. | 30.1238-2 |
| C14 | Condenser, heater by-pass, 500 $\mu \mu$. | 30-1245-3 |
| C15 | Condenser, plate by-pass, 500 $\mu \mu$ f. | 30-1245-3 |
| C16 | Condenser, input coupling, 8 $\mu \mu \mathrm{f}$. | 30-1224-46 |
| C17 | Condenser, neutralizing, 680 $\mu \mu \mathrm{f}$. | 62-168001001 |
| C18 | Condenser, decoupling, 680 $\mu \mu \mathrm{f}$. | 62-168001001 |
| C19 | Condenser, cathode by-pass, $680 \mu \mu \mathrm{f}$. $\qquad$ | 62.168001001 |
| C20 | Condenser, filament by-pass, $470 \mu \mu$. | 62.147001011 |
| C21 | Condenser, cathode tuning, $680 \mu \mu \mathrm{f}$. | 62.168001001 |
| C22 | Condenser, grid by-pass, 680 $\mu \mu$. | 62-168001001 |
| C23 | Condenser, plate taning, 1-5 $\mu \mu \mathrm{f}$. | 31-6520-10 |
| C26 | Condenser, grid by-pass, . 01 $\mu$ f.............................$~$ | 30.1238-2 |
| C27 | Condenser, decoupling, 680 $\mu \mu \mathrm{f}$. | 62-168001001 |
| C28 | Condenser, output coupling, $680 \mu \mu \mathrm{f}$. | 62-168001001 |
| $\begin{aligned} & \mathrm{C} 29 \text { and } \\ & \mathrm{C} 30 \end{aligned}$ | Condenser, antenna input, 100 $\mu \mu \mathrm{f}$. | 30-1225-13 |
| C31 | Condenser, grid tuning, 1-5 $\mu \mu \mathrm{f}$. | 31-6520-10 |
| CD1 | Crystal detector, mixer circuit | 34.8026 |
| 11 aud 13 | Lamps, pilot, UHF .......... | 34-2068 |
| 12 | Lamp, piloc, VHF ........... | 34-2068 |
| L1 | Inductor, rif, l.h. ............ | $\begin{array}{\|l} \text { Part of C3A. } \\ \text { Stator } \\ \hline \end{array}$ |


| Reference Symbol | Description | Service Part No. |
| :---: | :---: | :---: |
| L2 | Inductor, r-f, r.h. ..... | Part of C3B. <br> Stator |
| L3 | Inductor, r-f, 1.h. ........... | Part of C3C. |
| L4 | Inductor, r-f, r.h. | Part of C3D. <br> Stator |
| L5 and L6 | Inductors, crystal mixer ..... | Part of board ass'y., mixer |
| L7 and L8 | Inductors, oscillator coupling | Part of board ass'y., mixer |
| L9 and L10 | Inductors, oscillator | Part of board ass'y, osc. |
| $\mathrm{L}_{\mathrm{L} 12} \text { and }$ | Inductors, oscillator | $76.7627$ |
| L13 | Choke. heater decoupling ... | 32-4556.3 |
| L14 | Choke, heater-cathoae decoupling | 32-45564 |
| L15 | Choke. plate decoupling .... | 32-4556-2 |
| L16 | Coil, input tuning, primary .. | 32-4597.7 |
| L17 | Coil, input tuning, secondary. | 32-4597.9 |
| L18 | Coil. neutralizing .......... | 32.45974 |
| L19 | Choke, cathode tuning ... | 324597.5 |
| L22 | Choke, plate decoupling .... | 324556.2 |
| ${ }_{\mathrm{L} 24}^{\mathrm{L} 23} \text { and }$ | Coils, i-f trap | Part of panel filter |
| R2 | Resistor, damping, 220 ohms | 66-1228340 |
| R3 | Resistor, decoupling, $\quad 6800$ ohms ......................... | 66.2688340 |
| R4 | Resistor, decoupling, $\quad 220$ ohms ......................... | Part of Ll3 |
| R5 | Resistor, decoupling, 10,000 ohms | Part of L15 |
| R6 | Resistor, cathode bias, 1000 ohms $\ldots . . . . . . . . . . . . . . . . .$. | 66-2104240 |
| R7 |  | 66.0688340 |
| R8 and R9 | Resistor, antenna input, 470, 000 ohms | Part of panel filter |
| R10 |  | 66-2828340 |
| R11 | Resistor, pilot light, 3.9 ohms | 66-9398340 |
| R12 | $\begin{aligned} & \text { Resistor, B+ } \begin{array}{c} \text { dropping, 10, } \\ 000 \text { ohms, } 10 \text { watts } \end{array} . . . . . . . \end{aligned}$ | 33-1336-58 |
| R13 | Resistor, a-g-c decoupling, 10, 000 ohms | 66-3108340 |
| R14 | Resistor, bias divider, 1.5 meg ohms | 66-5158340 |
| R15 | Resistor, damping, 10 ohms . | 66.0108340 |
| R16 | Resistor, damping, 470 ohms. | 66-1478340 |
| R17 | Resistor, plate load, 3300 ohms | 66-2338340 |
| $\begin{aligned} & \text { R18 and } \\ & \text { R19 } \end{aligned}$ | Resistor, tuner dizabling, 150, 000 ohms ................ | 66.4158340 |
| R20 | Resistor, bias divider, 1.5 megohms | 66-5158340 |
| R21 | Resistor, pilot light, 10 ohms. Board ass'y., mixer $\qquad$ | $\begin{aligned} & \text { 66.0108340 } \\ & 76.7475-4 \end{aligned}$ |
|  | Board ass'y, oscillator ...... | 76-7480 |
|  | Panel, filter ........ | 76.8078 |
|  | Tank ass'y., oscillator | 76.7627 |

## CIRCUIT DESCRIPTION

Philco B Line, Code 158, Television Receivers use two chassis-the r-f chassis, R-207, containing the r-f, video, audio, and sync circuits, and the deflection video, audio, and sync circuits, and the deflection
chassis, D- 207 or D-208, containing the power and deflection circuits.
Since these chassis are not isolated from the 60 cycle power line, all protruding shafts and mounting feet are insulated from the chassis.

CAUTION: See A-C Line Isolation.
The r-f amplifier, oscillator, and mixer section is built on a separate sub-chassis. The r-f amplifier uses a 6BZ7 tube, V1. The oscillator and mixer each use one half of a $12 \mathrm{AZ7}$ tube, V2. The output of the mixer is fed to a four-stage i.f amplifier system employing four 6CB6 tubes, V3, V4, V5, and V6. A 1N64 ploying four 6 CB 6 tulhes, V , 4 , 5 , and V . A 1 N 64
crystal diode is used for the video detector. One half crystal dhote is used for the video detector. One half
of a 6 U 8 tule, V7A, is used as the first video amplifirr, which feeds into a 6 AQ 5 video ontput amplifier, V8.

Sound i-f (intercarrier) is obtained by utilizing the beat frequency produced when the $45.75-\mathrm{mc}$. video carrier and the $41.25-\mathrm{mc}$. sound carrier are nixed in the video detector. The beat frequency, 4.5 mc ., is the difference between 45.75 mic . and 41.25 mc ., and contains the FM sound signal. This $4.5-\mathrm{mc}$. signal contains only a negligille amount of the video amplitude modulation, provided that the amplitude of the $41.25-\mathrm{mc}$. signal is considerably lower than that of the $45.75-\mathrm{mc}$. signal. The proper relative amplitude the $45.75-\mathrm{mc}$. signal. The proper relative amplitude
of the two carriers is established in the alignment of of the two carriers is established in the alignment of
the receiver. There is sound output only when both the receiver. There is sound output only-
the video and sound carriers are present.
The oscillator is tuned primarily to obtain the best picture, since the $4.5-\mathrm{mc}$. relationship always exists picture, since the $4.5-\mathrm{mc}$. relationship always exists
between the two carriers. The 4.5 mc . sound i.f. (intercarrier), which is taken from the video detector, is amplified by a 6BA6 tube, V9, and a 6AU6 tor, is amplified by a 6BA6 tube,
tube, V10, and is fed to the FM detector, which tube, V10, and is fed to the FM detector, which
utilizes two diode sections of a 6 T 8 tube, V11A. The utilizes two diode sections of a 618 tube, VIIA. The
triode section of the $6 T 8$ tuhe, V11B, is used as the triode section of the 6T8 tuhe, V11B, is used as the
first audio amplifier. The power amplifier uses a first audio amplifi
6L6GA tube, V12.
A.G.C voltage for the video i-f system and the A.f amplifier is obtained from a keyed a-g-c system r-f amplifier is obtained from a keyed a-g-c system
which uses a 6AU6 tube, V13, as the a-g-c gate. Comwhich uses a $6 \mathrm{~A} \mathrm{O}_{6}$ tube, V 13 , as the a.g-c gate. Com-
posite video from the video amplifier plate circuit, posite video from the video amplifier plate circuit,
V7A, is fed to the grid of the a-g-c gate tule, while a V7A, is fed to the grid of the a-g-c gate tube, while a
gating or keying pulse, obtained from a winding on gating or keying pulse, obtained from a winding on
the horizontal-output transformer located on the deflection chassis, is applied to the plate. The signal
at the grid of V13 has positive sync polarity; therefore, the a-g-c gate can conduct in proportion to the fore, the a-g-c gate can conduct in proportion to the
amplitude of the sync-pulse tips if the gating or keying pulse occurs at the same time as the sync. Because the gate pulse is of constant amplitude (approximately $5(0$ volts peak), the amplitude of the sync pulse deternines the amount of conduction in the gate tube. The plate current of the keyed a- $\boldsymbol{g}-\mathrm{c}$ gate tube flows through R220, R219, and R218, developing a voltage which is negative with respect to the chassis, and is proportional to the plate current. This negative voltage is used to control the gain of the receiver. Since conduction cannot occur in the a-y-c gate tube unless the sync pulse and gating pulse occur at the same time, noise disturbances that occur during the intervals between sync.pulses cannot during the intervals
affect the a-g-c voltage.

Composite video for the sync circuits is taken from the plate circuit of the video amplifier, V7A. The plate load of the video amplifier consists of two sections, R304 and R305. The full output of the amplifier is fed to the grid of the noise inverter, one half of a 12AU7 tube, V14B, and to the grid of the sync separator, one half of a 6 U 8 tube, V7B. The output developed across R305 only is fed to the grid of the developed across R30.5 only is fed to the grid of the
a-y-c gate, V13. The noise inverter is operated with a low value of plate voltage and with high bias (aplow value of plate voltage and aith to the cathode by a voltage-divider network), plied to the cathode by a voltage-divider network,
which keeps the tube beyond cutof. When the comwhich keeps the tube heyond cutoff. When the com-
posite video signal is applied to the grid of the posite video signal is applied to the grid of the
noise inverter through C601, the sync appears as noise inverter through C601, the sync appears as
positive pulses, and noise which could affect the positive pulses, and noise which could affect the
sweep circuits also appears as positive pulses. Harmful noise pulses usually have amplitudes far greater than that of the sync pulses, and, therefore, drive the grid of the noise inverter positive sufficiently to allow conduction in the noise inverter plate circuit. To prevent the noise inverter from conducting during, the sync-pulse interval, the gated leveler, using one half of a 12AU7 tube, V14A, is used to clamp the sync pulses below the conduction level of the noise inverter. The gated leveler conducts only when the sync pulses and gating pulse occur at the same time, thus leveling the noise-inverter input to the syncpulse level.

The output of the noise inverter consists of nega-tive-going noise pulses. It should be noted that the noise pulses which exceed the sync level have been passed and their polarity reversed by the noise inverter. The output of the noise inverter is now mixed with the composite video and fed to the grid of the sync separator. Since the composite video fed to the sync separator. Since
grid of the sync separator has positive sync polarity, grid of the sync separator has positive sync polarity,
the positive noise pulses carried with the composite
video would be passed by the sync separator; howvideo would be passed hy the syne separator; how-
ever, the output of the noise inverter consists of ever, the output of the noise inverter consists of
these same noise pulses, but of opposite polarity. these same noise pulses, hit of opposite polarity.
Thus, cancellation of the noise pulses is effected. Thus, cancellation of the noise pulses is effected.
The output of the sync separator contains only the The output of the syne separator contains only the
sync pulses, which arc fed to the deflection chassis through the connecting cable.
The phase rplitter, using one half of a 12AU7 The, V15A, inverts the sync polarity for proper trigtube, V15A, inverts the sync polarity for proper trig-
gering of the vertical oscillator. The vertical sync is separated from the horizontal sync ly the integrator separated from the horizontal sync lisy is fed to the grid of the vertical blockcircuits, and is fed to the grid of the vertical block-
ing oscillator, which uses one half of a 12AU7 tube, ing oscilator, which uses one half of a
V15B. The output of the vertical oscillator is anpliV15B. The output of the vertical oscillator is anplified by the vertical-output amplifier, which uses a
6BQ6GT tube, V16. The output of this amplifier is 6BQ6GT tube, V16. The output of this amplifier is
applied to the verticat-deflection coils through the vertical-output transformer.
In addition to the vertical-sync output, two hori-zontal-sync outputs are taken from the phase splitter, one from the cathode, and the other from the plate circuit. These two outputs are of opposite polarity, and are fed to the two diodes of the phase comparer, a 6AL5 tube, V17; the negative pulses are fed to the cathode of V17B, and the positive pulses, to the the plate of V17A. A portion of the horizontal sweep output voltage is taken from the horizontaloutput transformer, and is fed to the plate of V17B and the cathode of V17A, for comparison of the horizontal-sync and horizontal-sweep voltages. When the sweep and sync are in phase, no voltage is developed across R800, but when the two signals are out of phase, a voltage is developed across R800. When this voltage is positive, it increases the frequency of the horizontal oscillator (a 12AU7 tube, V18) ; when the voltage is negative, it reduces the frequency of the oscillator. This action holds the horizontal oscillator in phase with the sync signal. The horizontal hold control, R810, adjusts the horizontal-oscillator frequency so that it may be controlled by the phase comparer. The output of the horizontal oscillator is fed to the horizontal-ontput amplifier, which uses a 6CD6G tube, V19. The horizontal-output tube feeds the deflection coils through the horizontal-output transformer. A 6V3A tube, V20, is used as the hori zontal damper.
The second-anode voltage for the picture tube is supplied by two 1B3GT high-voltage-rectifier tubes, V 21 and V22, connected in a voltage-doubler circuit. The B-plus voltage for the receiver is supplied by two selenium rectifiers, CR100 and CR101, in a full-wave selenium rectifiers, CRIM and CRIO, in a full-wave
voltage-doubler circuit, operating from the power voltage-doubler circuit, operating from he power
line through an autotransformer which provides a step-up of the line voltage. Bias voltage is obtained
from across the filter choke which is in series with the negative side of the B-plus supply. The B-plusloost voltage derived from the horizontal-damper circuit supplies higher B-plus voltage to the first circuit supplies higher B-plus voltage to the first
anode of the picture tube. Filament current for all anode of the picture tube. Filament current for all
the tules pxcept the high-voltage rectifiers is supplied the tilies except the high-voltage rectifiers is suppled ly a 117 -volt, 60 -cycle step-down transformer. Fila-
ment current for the high-voltage rectifiers is supment current for the high-voltage rectifiers is sup-
plied by two windings on the horizontal-output plied ly two windings on the horizontal-output transformer.

NOTE: The D-207 and D-208 chassis incorporate a protective high-voltage shorting porate a protective high-voltage shorting
switeh (located on the rear of the highswiteh (located on the rear of the high-
voltage cage), which shorts the output of voltage cage), which shorts the output of
the 1 B3GT high-voltage doubler-rectifier the 1B3GT high-voltage doubler-rectifier (V22) to ground when the cabinet back is removed. Do not attempt to operate the receiver with the cabinet back removed without first disabling this shorting switch. The switch can be disabled temporarily for service work ly removing the two self tapping screws at the botton edge of the rear cover of the high-voltage cage, and propping up the rear cover.

## IMPORTANT

## a-c line isolation

CAUTION: One side of the a-c line is connected to the chassis through Tl 100 Cl 01 , and $L 100$, in series. The other side of the a-c line is connected to the chassis through R100, F100, CR100, and C103, in series. Grounding the chassis will result in a short circuit across one or the other of these two branches in the voltage-doubler circuit. During servicing and alignment, it is desirable that an a-c line isolation transformer capable of handling at least 250 watts (Philco Part No. $\mathbf{4 5 - 9 6 0 0}$ ) be used. Failure to use an isolation transformer will greatly increase the shock hazard, and may result in damage to the test equipment, or receiver, or both.

## SPECIFICATIONS

VHF TUNING …............elve-channel, 13-position wafer switch; Television Channels 2 through 13 and UHF position
UHF TUNING (if provided)
Continuous tuning; Channels 14 through 83
INTERMEDIATE FREQUENCIES
Video carrier
45.75 mc .
. .4 .5 mc .

TRANSMISSION LINE $\quad 300$-ohm, twin-wire lead OPERATING VOLTAGE ................... 110 to 120 volts POWER CONSUMPTION ...........VHF only models, 250 watts; VHF and UHF models, 255 watts

TUBE COMPLEMENT R-F CHASSIS R-207

| reference symbol | TUBE TYPE | function |
| :---: | :---: | :---: |
| V1 | 6BZ7-miniature | R.F amplifier |
| V2 | 12AZ7-miniature | Oscillator, mixer |
| $\begin{aligned} & \mathbf{V} 3, \mathbf{V} 4, \\ & \mathbf{V F}_{2}, \mathbf{V} 6 \end{aligned}$ | 6CB6-miniature | Video i.f amplifiers |
| v7 | 6U8--miniature | Video amplifier, sync separator |
| v8 | 6AQ5-miniature | Video out put |
| V9 | 6BA6-miniature | First sound i.f amplifier |
| V10 | 6AU6-miniature | Second sound i.f amplifier |
| V11 | 6T8-miniature | FM detector, first audio amplifier |
| V12 | 6L6GA-octal | Audio output |
| V13 | 6AU6-miniature | A.G.C gate |
| V14 | 12AU7-miniature | Gated leveler, noise inverter |
| V23 | 27LP4 or 24VP4 | Picture tube |

DEFLECTION CHASSIS, D-207 OR D-208

| REFERENCE <br> SYMBOL | TUBE TYPE | FUNCTION |
| :---: | :--- | :--- |
| V15 | 12AU7-miniature | Phase splitter, vertical <br> osecillator |
| V16 | 6BQ6GT-octal | Vertical output |
| V17 | 6AL5-miniature | Phase comparer |
| V18 | 12AU7-miniature | Horizontal oscillator |
| V19 | 6CD6G-octal | Horizontal output |
| V20 | 6V3A-miniature | Damper |
| V21, V22 | 1B3GT-octal | High.voltage rectifiers |

## REMOVING, REPLACING 27LP4 PICTURE TUBE

## GENERAL

The Philco 27LP4 picture tube is designed for a maximum of safety. Moreover, when properly mounted in the frame assembly, the picture tube is supported in such a manner as to provide a maximum of protection against breakage. Therefore, it is important that the tube be properly installed in its supporting frame. It is suggested that the service technician protect his eyes and the exposed parts of his body when handling all picture tubes. The
emoval and installation of the 27LP4 picture tube is quite safe if the procedure given below is followed.

CAUTION: Because of the bulkiness and increased weight of the 27LP4 tube, as compared with that of the smaller picture tubes, replacement of the 27 LP 4 requires two men. These tubes are not delicate when handled in the proper manner; however, care must be taken not to mar the glass in any way, as surface scratches and chips weaken a glass structure considerably. Also, because of its srucht, do not attempt io handle this tube by the neck.

## PROCEDURE FOR REMOVING 27LP4 TUBE

1. Remove both the deflection chassis and the r-f chassis from the cabinet.
2. Lay the cabinet face-down on the floor, taking precautions against marring the cabinet.
3. Remove the four nuts and washers that secure the mounting feet of the picture-tube assembly to the front of the cabinet.
4. Remove the two wood screws that secure the rear supporting struts of the tube assembly to the cabinet.
5. Remove the tube assembly (one man on each side of the cabinet)
6. Place the tube assembly face-down on a soft, protective cloth or mat, and slip the beam-hender magnet off the rear end of the tube. Referring to figure 1 , loosen clamp ring (A) by means of clamp screw (B), unhook the four clips securing the web straps to the mounting feet, and lift the deflectionyoke housing and strap assembly (containing the deflection yoke and focus assembly) off the neck of the tube.
7. Mark the positions of the four mounting feet on the front hand with a pencil or scriber (this is necessary because the mounting feet are free to slide, necessary because the mounting
once the front band is loosened)
8. Loosen the two Allen head clamping screws (C) and (D) with a $5 / 16$-inch Allen wrench, and remove the front band assembly.

PROCEDURE FOR INSTALLING 27LP4 TUBE

1. Place the picture tube face-down on a soft protective cloth or mat, and position the front band assembly over the tuhe so that the lateral indentation in the band coincides with the welded seam around the outer edge of the tube's face plate.

Take up slack in the band, tightening both clamp ing screws (C) and (D) by hand.

NOTE: If the front band is positioned correctly, the distance from the bottom edge of each mounting foot to the surface on which the tube is resting will be $17 / 8$ inches, as shown in figure 1 .
2. Position the mounting feet, on the front band to coincide with the marks previously made on the front band.
3. Tighten both clamping screws (C) and (D) alternately, using a $5 / 16$-inch Allen wrench

NOTE: Take up on clamping screw (C) and (D) as tightly as possible. As can be seen from figure 1 , the separation between the ends of the bands must be less than $1 / 8$ inch, when tightened.
4. Slip the deflection-yoke housing and strap as sembly (containing the deflection yoke and focus assembly) over the neck of the tube, and position it so that clamp screw ( $B$ ) on clamp ring ( $A$ ) is on the side of the tube opposite the anode button.
5. Place the clips (on the web straps) over the hooks on the four mounting feet, and tighten clamp ring (A) by means of clamp screw (B).
6. With the cabinet face-down on the floor, place the tube assembly in the cabinet (one man on each side of cabinet), and replace the four nuts and washers that secure the mounting feet to the front of the cabinet.
7. Replace the two wood screws that secure the rear supporting struts of the tube assembly to the cabinet.
8. Stand the cabinet upright, and install the r-f chassis, deflection chassis, and beam-bender magnet.

## ADJUSTING 27 LP4 PICTURE-TUBE ASSEMBLY

1. Mechanically center the focus assembly, over the neck of the tube, by adjusting the centering plate It is important that the focus assembly and yoke be concentric with the tube neck for best focus and shadow clearance


Figure 1. 27LP4 Picture-Tube Asseimbly
2. Set the HORIZ. CENTERING control (R824) to its extreme counterclockwise position, and set the BRIGHTNESS control for maximum brightness of the picture.
3. Adjust the beam bender for maximum bright ness of the picture.
4. If necessary, loosen the wing nuts and rotate the deflection yoke, to correct for picture tilt. Mak certain that the deflection yoke is as far forward as possible, and tighten the wing nuts.
5. Adjust the centering plate so that neck shadow is just eliminated on the right-hand side of the is just eliminated on the right-hand side of the
screen, at the same time keeping the picture centered screen, at the same time keeping the picture centered
vertically. Do not attempt to center the picture horizontally by means of the centering plate.
6. Adjust the FOCUS control (on focus assembly). Set the CONTRAST control for the proper level, and readjust the FOCUS control for the best over-all focus.
7. Repeat steps 3 and 5, if necessary
8. Adjust the HORIZ. CENTERING control (R824) for proper horizontal centering of the picture.
9. Turn the BRIGHTNESS control slowly toward the minimum position, checking that shadow does the minimum position, checking that shadow doen
not appear at any brightness level. If shadow does appear, repeat steps 5 and 8, and recheck.

## B SUPPLY FUSE REPLACEMENT

The B supply protective fuse, F100, is wired into the low-voltage section, and is in series with the selenium rectifiers. For replacement, use a 1.6 -ampere selenium rectifers. For replacement, use a 1.6-ampere
delayed-action-type fuse, Philco Part No. 45-2656-23.

CAUTION: Discharge the circuit before re-
placing the fuse.

## HORIZONTAL-OSCILLATOR

ADJUSTMENT
To adjust the horizontal-oscillator circuit, tune in a station and proceed as follows:

1. Reduce the width of the picture so that approximately one inch of blank screen appears at the righthand and left-hand sides of the picture.
2. Increase the BRIGHTNESS control setting so that the blanking time becomes visible. This appears as a dark vertical bar at the right-hand and left-hand sides of the picture.
3. Connect a $.1-\mu \mathrm{f}$. condenser from Test Point G800 to ground.
4. Set the HORIZ. HOLD control to the center of its mechanical rotation.
5. Adjust the HORIZ. HOLD CENTERING control to bring the picture into the center of the blanking liars. When the picture is centered in the blanking bars, the bars at the left-hand and right-hand sides of the picture will be of equal width.
6. Remove the $.1-\mu \mathrm{f}$. condenser from the Test Point. (See step 3.)
7. Adjust the horizontal ringing coil, L800, until the picture is again centered in the blanking bars.
8. Rotate the HORIZ. HOLD control through its range. The picture should fall out of sync to both sides of the center of rotation. If the picture does not fall out of sync to both sides, readjust the HORIZ. HOLD CENTERING control to obtain fall-out to either side of sync.
9. Rotate the HORIZ. HOLD control through its range, and observe the number of diagonal blanking bars that are visible just before the picture pulls into sync. The pull-in should occur with from 1 to 2 diagonal bars when the sync position is approached from either direction. If proper pull-in is not obtained, repeat the above procedure.

## VIDEO PEAKING-COIL ADJUSTMENT

The video peaking coils, L305 and L307, are adjusted at the factory for proper transient response of the video amplifiers. Ordinarily, these coils will require no further adjustment by the serviceman require in cases where they have been tampered with, or where replacement becomes necessary. Under noror where replacement becomes necessary. Under nor i-f stages is undertaken, the video peaking coils i-fould not require adjustment.

Before adjusting L305 and L307, check both the tuner and i-f alignment. (Never adjust L305 and L307 tuner and i-f alignment. (Never adjust L305 and L30 until the alignment of the receiver is correct.) Then tune in a station and adjust the receiver to give a picture of the best obtainable quality, with medium contrast. Turn the fine tuning control clockwise unti a very slight beat pattern appears in the picture Carefully observe the appearance of the picture re garding smear or overshoot (trailing whites). A small amount of overshoot may be desirable, to produce a sharper picture. Conversely, in weak-signal areas, a small amount of smear may he desirable, to reduce the harsh appearance of "snow". The adjustments of L305 and L307, and their effects on the picture, are as follows:

1. The amount of overshoot may be reduced by turning both TC302 and TC303 counterclockwise.
2. The amount of smear may be reduced by turn ing both TC302 and TC303 clockwise.
Normally, the point of proper adjustment is where minimum smear and trailing whites appear in the picture; however, a compromise adjustment may be made to suit prevailing conditions. As a rule, when properly adjusted, the adjustment screws (TC302 and TC303) should protrude from the chassis by approxinately $1 / 2$ inch to $3 / 4$ inch

## TELEVISION ALIGNMENT

## GENERAL

The alignment consists of tuning each i-f coil to iven frequency, using an AM signal, and then feed ing in a sweep signal at the antenna terminals and ouching up the adjustments to obtain the desired pass band.

The over-all response curve (r-f, i.f) of the circuits rom the antenna terminals to the video detector, after the i-f stages have been aligned, should appear essentially the same, regardless of the channel under test. If not, the tuner should be aligned. Before aligning the tuner, refer to the CAUTION given under Procedure in Tuner Bandpass Alignment Procedure.
The video-carrier intermediate frequency is 45.75 mc., and the sound intermediate (intercarrier) frequency is 4.5 mc . Alignment of these circuits requires areful workmanship and good equipment. The following precautions must be observed:

1. There must be a good bond between the receiver chassis and the test equipment. This is most easily obtained if the top of the workbench is metalic. The receiver chassis should be placed tuner-sidedown on the bench. If the bench has no metallic top, the test equipment and chassis can be bonded by a strip of copper about two inches wide. The section of the chassis nearest the tuner should rest on the strip.
2. Do not disconnect the picture tube, picture-tube yoke, or speaker while the receiver is turned on
3. Allow the receiver and test equipment to warm up for 15 minutes before starting the alignment.
4. The marker (AM) signal generator should be calibrated accurately to the frequencies used and to the sound and video r-f carriers of each channel used during alignment. If Philco Model 7008 is used, the built-in crystal calibrator provides an excellent means of calibration. An alternate method of calibrating the
signal generator to the sound and video r-f carrier frequencies is to zero-beat the signal generator with the received signals.

For further information regarding calibration, refer to Philco Lesson PR-1745 (J) entitled "Television Service in the Home."

## TEST EQUIPMENT REQUIRED

The following test equipment is recommended for aligning the receiver:

1. Philco Precision Visual Alignment Generator for Television and FM, Model 7008, or equivalent.
2. Vacuum-tube voltmeter, or 20,000 -ohms-per-volt voltmeter.
3. R-F Probe, Plitco Part No. 76-3595 (for use with Model 7008 generator).

## JIGS AND ADAPTERS REQUIRED

## Mixer Jig

Connections to the grid of the mixer tube may be made through the alignment jack provided for tha purpose. To connect the generator to this point, a mixer-wrid jig, Philco Part No. 45-1739, and a con mecting cable, Philco Part No. 45-1635, may be used necting chite, Philco alliger ip As an alternate, a Phico alligator-clip adapier, Par No. 45-1636, with as short a ground lead as possible may be used to connect the alignment jack. The ground lead should be connected as close as possible to the mixer tube. It is easnial that the signa generator output lead be terminated with a 68 -ohn resistor (carbon) so that -regeneration, caused by connection of the lead to the mixer, is held to a minimum.

## Antenna-Input Matching Network

An impedance-matching network for coupling the signal generator to the antenna input terminals of the receiver is shown in figure 2 . This network, which is designed to have an input impedance of $\mathbf{7 5}$ ohms

and an output impedance of 300 ohms, is used to match a 75 -ohm generator to a 300 -ohm antennainput circuit. The resistors used in this network should be of carbon-composition construction, and should be chosen from a group to obt in values within ten percent of those indicated. The resistors should be placed in a shield can to prevent variable effects. An antenna-matching jig, Philco Part No. $45-$ 1736, which consists of a matcling transformer and connecting box, may be used in place of the resistor network.

## Video I-F Alignment Jig

(Video Test Jack Adapter No. I)
The alignment jig, used at J200, and shown in figure 3 , should be used during the i.f alignment to apply the proper bias to the a-g-c bus, and to provide a convenient oscilloscope connection. This adapter consists of a five-pin plug, and two 10,000 -ohm resistors and a $1500_{\mu} \mu \mathrm{ff}$. condenser for isolation of the bias supply. To isolate the oscilloscope from the receiver circuits, a 15,000 -ohm resistor, by-passed by a $1500-\mu \mu \mathrm{f}$. condenser is used. A suggested method of fabricating the jig is also shown in figure 2. This jig


Figure 3. Video I-F Alignment Jig
Figure 3. Video I-F Alignment Jig
hould not be used to observe the composite video from the video detector output.

## Sound I-F Alignment Jig

## (Video Test Jack Adapter No. 2)

To observe the composite video at J200, a jig may be made with a five-pin plug and a 2200 -ohm resistor (See figure 4.) The 2200 -ohm resistor should be connected to pin 2 of the plug. A ground lead should be connected to pin 3. To observe the composite video, onnect the oscilloscope to the 2200 -ohm resistor an the ground lead. This jig is also used for injection of the $4.5-\mathrm{mc}$. signal during sound i-f alignment.

## Sound I-F Alignment Jig (FM rest Point and <br> olume Control Socket Adapter)

Figure 5 shows the adapter that should be used to connect the voltmeter to the FM detector through th volume control socket (J400) and FM test point (G400). The adapter should be inserted into the olume control socket, and the clip lead from the adapter connected to the FM test point. The volume control cable and plug (PL400) is inserted into the socket on top of the adapter.

## TELEVISION TUNER ALIGNMENT

After the tuner is serviced, or if an i-f alignment is required, the tuner alignment should be checked If realignment is necessary, use the procedure given below

Figure 4. Sound I-f Input Alignment Jig
Figure 4. Sound input Alignment Jig
(Video Test Jack Adapter No. 2)



Figure 5. Sound I-F Output Alignment Jig (FM Test Point and Volume-Control Socket Adapter)

Since the frequency of the local oscillator affect the tuner response, the local-oscillator alignment should be made first.

## Oscillator Alignmen

## General

It is possible to place each channel exactly on frequency by adjusting the tuning core of each coil The adjustment procedure should be carried out with the highest channel (13) first, since the align ment of each channel will affect the alignment of the channels below it in frequency. The FINE TUN ING control should be preset for all adjustments by placing the stop on the fine-tuning cam at Channel 8 oscillator tuning core. See figure 6 .

## Procedure Using Signal Generators

An r-f signal (unmodulated), at the video carrier frequency of the channel, is fed into the antenna input, and an i.f signal, at the i.f carrier frequency is fed to the first i-f amplifier. Two AM signal gen erators are used to supply the above signals. An oscilloscope is connected to the video detector output. The oscillator core is then adjusted for zero beat on each channel. The two generators should be accu rately calibrated, as described in Philco Leso Series, PR-1745(J).

To align the oscillator, proceed as follows

1. To observe the zero beat, connect the oscilloscope to the video detector output through the video i-f alignment jig. See figure 3. Bias the tuner and i-f a-g-c circuits with $11 / 2$ volts, and remove the gatepulse plug, PL801, from the socket, J801. To apply
the bias to the tuner, connect the battery to the white lead which comes off the feed-through con denser at the top of the tuner. To make certain that good connection is made to the tuner a-g-c circuit, remove the glyptol coating on this condenser terminal.
2. To feed in the i-f comparison signal, remove the shield from the first vi-if tube, and wrap several turns of insulated copper wire around the tube. Con nect the output leads of the v-i.f signal generator to the two ends of the wire loop, and set the generato for unmodulated output at 45.75 mc .
3. To feed in the signal representing the channel frequency, set the r-f signal generator at the video carrier frequency of Channel 13 , and connect the output to the antenna-input terminals of the receiver through the proper matching jig.
4. Mechanically preset the fine-tuning cam, as hown in figure 6, and set the CHANNEL SELEC TOR to Channel 13
5. Adjust the Channel 13 tuning core for zero beat, as indicated by the oscilloscope
6. Retune the r-f signal generator and the CHAN NEL SELECTOR for Channels 12, then 11, etc., each ime adjusting the respective tuning core for zero eat. The tuning cores should be adjusted progressively from the highest-frequency channel to the lowest, hecause the higher channel adjustments will affect the lower channels.

## Procedure Using Station Signal

The following simplified procedure may be used to ign the oscillator when the television i-f alignment is satisfactory and a station signal is available. If this


Figure 6. Television Tuner Showing Locations of Adjustments
procedure is used in the service shop, signals from all stations which the customer can receive must be available in the service shop

1. Mechanically preset the fine-tuning cam as shown in figure 6.
2. Tune in the highest-frequency channel to he received, and adjust the tuning core for that channel for the best picture; that is, starting with sound in the picture, turn the tuning core until the sound in the picture just disappears.
3. Repeat step 2 for each channel received in the area, starting with the highest-frequency channel and finishing with the lowest channel

## Tuner Bandpass Alignment

General
The bandpass alignment consists of aligning the tuner at Channel 13 and 6 and then making it track properly.

During the alignment, a fixed bias of $11 / 2$ volts is applied to the r-f amplifier tube through the whit a-g.c lead.
An FM (sweep) signal is applied to the antenna input circuit through the proper matching jig, and an oscilloscope is connected to the junction of R5l and the tuner red lead. The oscilloscope gain should be as high as possible, consistent with "hum" leve and "hounce" conditions. Hum conditions will cause distortion of the time base and response. Bounce conditions will cause the response and the time base to jump up and down, and are caused by poor line regulation. The use of too high an oscilloscope gain aggravates these conditions, whereas the use of too
low a gain necessitates increasing the generator output to a point where the tuner may be overloaded The scope controls should be adjusted so that the width of the presetaion is the height Over width of he prearn double he height. Over load nut while output while observing the shape of the response curve. When the generator outpue is changed, the vertical gain of the oscilloscope should be readjusted to keep the scope presentation amplitude the same. Do not readjust the horizontal gain control. Any change in the shape of the curve indicates overload in which case a lower generator output and higher oscilloscope gain must be used.
The signal-generator output circuit must be properly matched to the antenna input circuit of the tuner. The antenna-input matching network shown in figure 2, or a Philco antenna matching jig, Part No. 45-1637, may be used for this purpose. If a matching jig is not used, the result obtained will be extremely unreliable.
Regeneration or a mismatch in the test setup will also cause poor and unreliable results. To check for regeneration or mismatch move the hand along the generator cable after all equipment is connected, and observe the response curve on the oscilloscope screen If the response curve on the oscilloscope changes as the hand is moved along the cable, regeneration or mismatch is indicated. Another check may also be made with the VOLUME control advanced until noise can be heard from the speaker. If the level of the noise changes as the hand is moved along the gen erator cable, regeneration or mismatch is indicated. The symptoms which indicate these conditions may also be caused by failure to use the proper matchin jig , as described above.

## Procedure

CAUTION: When comparing the response curves from channel to channel, maintain the 2-to-l width-to-height relationship in the oscilloscope presentation, as described above

1. Conriect the FM (sweep) and AM marker gen erators to the 300 -ohm antenna input terminals through an antenna-input matching jig.
2. Connect the oscilloscope to the junction of R518 ( $15 \mathrm{~K}, \mathrm{lw}$ ) and the tuner red lead.
3. Apply $11 / 2$ volts of bias to the white tuner a-g.c lead
4. Disconnect the tuner coupling link at wiring panel B-14, terminals 1 and 4 , and solder a 68 -ohm, one-half watt carbon resistor to the open link coming from the tuner. See figure 9 . Remove the first i-f tube from its socket.
5. Set the CHANNEL SELECTOR and FM (sweep) generator to Channel 13 ( 213 mc .). Adjust the generator for sufficient swcep width to show the complete response curve
6. Establish the channel limits (see figure 7) by using the marker (AM) r-f signal generator to produce marker pips on the response curve. (Set the marker generator first to 210 mc ., and then to 216 mc .) The response curve should be reasonably flat between the limits.
7. Adjust TC502 and TC504 for a symmetrical response, centered about 213 mc ., and falling within the specifications, as shown in figure 7.
8. Set the CHANNEL SELECTOR and FM (sweep) generator to Channel 7 ( 177 mc .). Establish the channel limits by using the marker signal generator to produce marker pips on the response curve. (Set the marker generator first to 174 mc ., and then to 180 mc .) The curve should be reasonably flat between the limits.
9. On Channel 7, observe the tilt, and center frequency of the response curve. The curve should be centered on the pass band, and should be symmetrical. If it is not symmetrical and appears unbalanced, as in figure 8, adjust C507 and C512 (figure 6) to obtain a response curve which is the mirror image (tilt in the opposite direction) of the original; for example, if Channel 7 response curve appears as in figure 8A, adjust C507 and C512 until the curve appears as in figure 8B. This adjustment overcompensates to make allowance for the effect of Channel 13 adjustments (to be made in step 10) upon Channel 7 response.
10. Reset the CHANNEI. SELECTOR and generators to Channel 13, and repeat steps 8 through 10 as many times as is necessary to obtain the most symmetrical and centered response curves on Channels 13 and 7 . Channels 7 through 13 are now correctly aligned.
11. Set the CHANNEL SELECTOR and sweep enerator to Channel 6 ( 85 mc .)
12. Establish the channel limits, using the marker generator to produce marker pips on the response curve. (Set the marker generator first to 82 mc ., and then to 88 mc .)
13. Adjust TC503 and TC505 for a symmetrical, approximately centered pass band. Set the marker generator to 85 mc . Detune TC505 counterclockwise until a single peak appears. Adjust TC503 until the peak falls on the $85 \cdot \mathrm{mc}$. marker. It may be necessary o increase the output of the generator during this adjustment. Then adjust TC50l for maximum curve height and symmetry of the single peak. The antenna circuit is now tuned for Channels 2 through 6.
14. Readjust TC503 and TC506 for a symmetrical


Figure 7. Television Tuner Response Curve Showing Bandpass Limits
response, centered about 85 mc ., and falling within the specifications, as shown in figure 7. Channels 2 through 6 are now correctly aligned.

## VIDEO I-F ALIGNMENT

## Prellminary

Before proceeding with the i-f alignment or making an alignment chicck, obscrve the following preliminary instructions:

1. Preset the CONTRAST and BRIGHTNESS con trols to the maximum counterclockwise position.
2. Preset the CHANNEL SELECTOR to Chan nel 4.
3. Insert the video i.f alignment jig into J200.
4. Connect the oscilloscope to the 15,000 -ohm re sistor from the video i-f alignment jig. Connect the ground lead of the oscilloscope to the ground lead rom the adapter.
5. With a voltmeter connected across the point shown in figure 3, set the potentiometer to furnish 14 volts of bias.
6. Connect the AM generator to the mixer tes point, G500, through a mixer jig, and adjust the generator for approximately 30 percent modulation at 400 cycles. Adjust the output of the generator during the alignment to keep the output at the second detector below .6 volt, peak to peak

NOTE: If the i-f shield has been removed
for repairs, it must be replaced before pro-
ceeding with the alignment.

## Procedure

1. Tune the AM generator to 47.25 mc ., and adjust C201 for minimum output, as observed on the oscilloscope
2. Tune the AM generator to 41.25 mc ., and


Figure 8. Television Tuner Response Curve, Showing Tracking Compensation
djust C203 for minimum output, as observed on the oscilloscope.

NOTE: In steps 1 and 2 , it is necessary to keep the generator output sufficiently high that a null indication may be observed on the oscilloscope; however, avoid overloading the receiver by excessive signal.
3. Tune the AM generator to the frequencies indicated below, and adjust the trimmers for maxi mum output.
a. 42.7 mc .-adjust C 514
b. 44.75 mc --adjust C204
c. 45.7 mc.-adjust C210
d. 44.4 mc .-adjust C215
e. 43.0 mc -adjut C 218
f. 42.0 mc djuat C 206

Increase the bias (by means of the potentiom ter) until the scope presentation of step $f$, above, is reduced to 50 percent of its previous amplitude, and retouch C206 for maximum indication on th oscilloscope.
5. Connect the sweep generator and r-f marker generator to the antenna terminals through a match ing jig. (If a separate oscilloscope is used, feed th weep output of the generator to the horizontal input terminals of the oscilloscope.) Set the CHANNEL ELECTOR to Channel 4 , and tune the sweep gen erator for output on Channel 4. Tune the r-f marke generator for the video carrier frequency of Channe 4 ( 67.25 mc .), and tune the i-f marker generato (connected through jig to mixer grid) to 45.75 mc

Note that two marker generators are used for this procedure. The r-f marker generator is connected to the antenna terminals, while the i.f marker generator is connected capacitively to the mixer grid test point, G500. A jig constructed from a piece of fiber tubing with $3 / 16$-inch inside diameter, and a brass machine screw which fits tightly into the tubing, is used to connect the generator capacitively to the test point. The screw is adjusted so that it clears the test poin by approximately $1 / 64 \mathrm{inch}$. The output cable of the marker generator is connected to the head of the brass screw in the jig and to the chassis, near the mixer tube. Both marker generators should be adjusted for the minimum output required to make the markers barely visible. Failure to observe this precaution, or the use of excessive output from the sweep generator, will cause misleading results. After the equipment is properly connected, adjust the FINE TUNING control for zero-beat of the two markers, as observed on the oscilloscope. When zero beat is obtained, remove the i-f marker.
6. If the response curve does not fall within the limits, as shown in figure 10, the adjustment of the trimmers may be touched up slightly, while observing the response curve. Do not retouch the setting of $\mathrm{C} 201, \mathrm{C} 203$, or C 206 . To adjust the curve, first adjust C215 and C218, alternately, until maximum improve ment has been obtained. C215 affects the tilt of the curve, and C218 affects the dip of the curve. After C215 and C218 have been adjusted, adjust C514 for proper slope at the $42.25-\mathrm{mc}$. side of the curve, and then adjust C204 and C210 for proper level at the video carrier frequency ( 45.75 mc .).


Figure 9. R-F Chassis, Top View Showing Locations of Adjustments


Figure 10. Over-all R-F, I-F Respanse Curve
CAUTION: Do not turn any of the trimmers excessively. To retouch, only turn the trimmers slightly.

## SOUND I-F ALIGNMENT

The sound i.f system may be aligned by the use of a station signal or an accurately calibrated signal generator, for the signal source. If the station signal is used, tune the FINE TUNING control for the bes picture, regardless of sound. It will be necessary to reduce the signal input to the receiver, so that the d-c output at the sound detector, as measured with the aid of the sound i-f output alignment jig (between point $B$ and ground), is kept below 5 volts maximum, and preferably below 3 volts. To establish this level in strong-signal areas, it may be necessary to short the antenna terminals and to apply bias to the a-g.c circuit. The signal input to the receiver may be adjusted by varying the length of the shorting lead The bias may be applied to the a-g-c circuit by means of the jig shown in figure 4. The sound i-f output alignment jig shown in figure 5 should be used for convenient connection of the meter to the sound detector output.

When a signal generator is used, bias should be applied to the a-g-c circuit, to avoid any possibility of regeneration, using the sound i-f input alignment jig (figure 4).. In addition, the first video i.f tub should be removed, to aid in the reduction of circui noises from the i-f system.
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1. Connect the generator through the 2200 ohm resistor, in the sound i-f input alignment jig, to pin 2 of J 200 . The generator should be adjusted for unmodulated output at 4.5 mc .
2. Insert the sound i-f output alignment jig in the volume-control socket ( $J 400$ ), and insert the volumecontrol plug (PL400) in the top of the jig. Connect the clip lead to the FM teat point (G400): conncet 20,000 -ohms.per-volt voltmeter between point " B " and the ground lug of the jig, with the neqative lead and the ground lug of the jig, wi
3. Adjust TC300, TC400, TC401, and TC402 for maximum output, as indicated on the meter. If the maximum output, as indicated on the meter. If the
output exceeds 5 volts, reduce the signal input to the receiver.
4. Shift the positive lead of the meter to point "C" on the sound i-f output alignment jig, and adjust TC403 for zero crossover. Zero crossover is indicated by a zero indication on the meter, under the following conditions: when TC403 is turned in one direcion from this zero point, the meter will swing posiive; turning TC403 in the opposite direction will canse a negative swing. ( $T o$ aid in reading a positive and negative swing on the meter, set the pointer, by means of its zero-adjustment screw, to a conveuient calibration mark on the scale, hefore connecting the meter to the circuit.)
5. Replace the first video i.f tube, and then tune in a station on the receiver. Turn the FINE TUNING control to obtain a slightly fuzzy picture, and retouch TC403 for minimum AM (noise), using the speaker output as an indication.
ADJUSTMENT OF 4.5=MC. TRAP
To adjust the $4.5-\mathrm{mc}$ trap in the plate circuit of he first video amplifier, proceed as follows:
6. Connect the output of the signal generator to

## OSCILLOSCOPE

The waveforms shown below were taken with the eceiver adjusted for an approximate peak-to-peak output of 2 volts at the video detector The voltages given with the waveforma are approximate peak-topeak values. The frequencics shown are those of the


Figure 12. Video-Detector Output, Pin 2 of J 200 , 1 deo-Detector Output
2 volts, 60 t.p.s.
the lead from pin 2 of the sound i-f alignment jig (see figure 3). Adjust the generator for 4.5 mc ., 400 -cyele modulated output. Set the output attenuator for maximum output from the generator.
2. Connect the input of an r-f probe, shown in figure 11, to the grid of the picture tube, and connect the output leads of the probe to the vertical input terminals of the oscilloscope. Adjust the vertical gain terminals of the oscillosenpe. Ady of the oscilloscope to maximum.
3. Adjust TC301 for minimum indication on the oscilloscope. (The normal setting for TC301 is with the screw approximately $5 / 8$ inch out from the ohassis.) An alternate method for adjustment of TC301 may be used if a $4.5-\mathrm{mc}$. generator is not available. To adjust TC301 without the generator, proceed as follows:

1. Tune in a strong station signal.
2. Turn the FINE TUNING control in a clockwise direction until a fine beat pattern appears in the picture.
3. Adjust TC301 until the heat disappears or is at a minimum. When correctly adjusted, the screw will be out from the chassis approximately $5 / 8$ inch.
4. If more than one station is available, check the setting of TC301 on all stations.


Figure 11. R-F Probe for Sound-Trap Adjustment

## EFORM PATTERNS

The waveforms were taken with an oscilloscope having good high-frequency response. With oscilloscope having poor high-frequency response, the sharp peaks of the horizontal waveforms will be more rounded than those shown, and the peak voltages will differ

Figure 13. Gate-Pulse Plug, Pin 4 700 volts, 15,750 c.p.s.


Figure 14. A-G-C Gate Grid, Pin 1


Figure 16. Gated-Leveler Grid, Pin 2


Figure 18. Noise-Inverter Cathode, Pin 8


Figure 22. Phase-Splitter Plate, Pin 1


Figure 24. Vertical-Oscillator Plate, Pin $6{ }^{\text {1P2.69 }}$ 130 volts, 60 c.p.s.

figure 15. Gate-Pulse Plug, Pin 3


Figure 17. Noise-Inverter Plate, Junction of
R605, C602, and C603, 23 volts, 15,750 c.p.s.


Figure 19. Sync-Separator Plate, Pin 1


Figure 21. Phase-Splitter Grid, Pin 2


Figure 23. Vertical-Oscillator Grid, Pin $7^{\text {TP2 }}$ 170 volts. 60 c.p.s.


Figure 25. Vertical-Output Grid, Pin 5 40 volts, 60 c.p.s.


Figure 26. Vertical-Output Plate, Plate Cap


Figure 28. Phase-Splitter Cathode, Pin $3^{\text {Tp2.642 }}$ 9 volts, 15,750 c.p.s.


Figure 30. Horizontal Oscillator, G800 Test Point


Figure 32. Horizontal-Oscillator Grid, Pin $2^{\text {Tp2.64 }}$


Figure 34. Horizontal-Deflection Yoke, Pin 7 of J 800 H600 volts, 15,750 c.p.s.
-CAUTION: High-voltage pulses are present in the horizontal-output circuit. The waveform in figure 34 was taken with the waveform in figure 34 was taken with of the oscilloscope lead clipped alligator clip of the oscilloscope lead clipped
over the insulation of the lead connected to pin 7 of J 800 . (To prevent puncture of the pin 7 of J 800 . (To prevent puncture of the
insulation of the lead, file off the teeth of the insulation of the lead, file off the teeth of the
alligator clip, and wrap friction tape around


Figure 27. Phase-Splitter Plate, Junction of R614, R615, and C800, 13 volts, 15,750 c.p.s


Figure 29. Phase Comparer, Pins 1 and $2^{\text {TP2.652 }}$


Figure 31. Horizontal-Oscillator Cathode, Pins $8^{\text {P1.647 }}$ and 3,14 volts, 16,750 cat


Figure 33. Horizontal-Output Grid, Pin $5^{\text {Tp2.649 }}$ Figure 33. Horizontal-Output Grid, Pin 5 130 volts, 15,750 c.e.s.
Figure 35. Gate-Pulse Socket, Pin 4 of J801 700 volts, 15,750 c.p.s
the clip.) Connection to other points in the horizontal-output circuit is dangerous, due to the high voltages present. The peak-topeak voltage shown for figure 34 is the actual voltage present; however, the amplitude of the scope presentation depends upon the degree of coupling.

## VOLTAGE MEASUREMENTS

The voltages given here and on the schematic diagrams were taken with a 20,000 -ohms-per-volt voltmeter, at a line voltage of 117 volts, and with no signal input to the receiver. Since voltage readings taken in the video i-f stages vary widely with different test equipment setups, voltage measurements for these stages are omitted from the diagrams.


Figure 36. R-F Chassis R-207, Bottom View, Showing Pigure 36. R-F Chassis R-207, Botrom View, Showing


Figure 37. Deflection Chassis D-208, Bottom View, Showing Voltages at Socket Pins
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Figure 41. Television Tuner, Part No. 76-7600-3, Schematic Diagram


Figure 42. R-F Chassis R-207, Base Layout


Figure 45. Deflection Chassis D-208, Base Layout

Figure 44. Deflection Chassis D-208, Schematic Diagram



The two tanks of the UHF tuner, the antenna tank and the mixer tank, are used to prevent the i-f and oscillator signals from feeding back to the antenna and interfering with other receivers. The two tanks pass incoming signals readily, but do not pass the i-f or oscillator signal.

## CHANGE-OVER SWITCH

The change-over switch supplied with the TunerAdapter is used to switch from VHF to UHF, and vice versa. It is installed on the back of the VHF tuner, and is operated by an actuator mounted on the VHF tuner shaft. When the Channel Selector of the VHF tuner is turned to the UHF position, the changeover switch makes proper connections for UHF operation. In this position, the switch places a 150,000 ohm resistor in series with the VHF mixer plate which drops the voltage on the plate of the tube. (In the UHF position, the VHF Channel Selector places extra inductances in the VHF r-f and mixer circuits, permitting them to operate as i-f amplifiers, and it also shunts the VHF oscillator grid circuit with a 10 -ohm resistor, putting the oscillator out of operation.) The change-over switch also turns off the VHF pilot light, turns on the UHF dial pilot lights, and connects the antenna to the UHF tuner.
When the VHF Channel Selector is turned to any VHF position, the change-over switch places a $150,000-\mathrm{ohm}$ resistor in series with the UHF local oscillator plate circuit, which drops the voltage applied to the plate, and puts the oscillator out of operation. The switch also turns on the VHF pilot light, turns off the UHF dial pilot lights, and connects the antenna to the VHF tuner.

## PLANETARY DRIVE

The UHF tuner is tuned by means of a 3-gang tuning condenser, which is driven through a specially designed planetary drive. See figure 48. The planetary drive is so constructed that fine tuning and coarse tuning can be accomplished with a single control knob. The tuning shaft is coupled to the driving shaft through three balls, which form a planetary drive that produces slow rotation for fine tuning. After rotating 180 degrees with the tuning shaft, a pin engages the driving shaft, and the two shafts are direct-coupled, for coarse tuning. To reengage the planetary drive for fine tuning, it is only necessary to reverse the direction of rotation. The dial pointer is connected to the tuning gang through a cord drive, and indicates the channel number to which the tuner is tuned. See figure 49.

## ALIGNMENT AND REPAIRS

The frequencies at which the Tuner-Adapter operates are extremely high; therefore, it is necessary that the utmost care be taken to safeguard against upsetting the delicate adjustments of the tuner. It is recommended that the serviceman make only minor repairs to the tuner, such as replacement of the tube or crystal and the wiring of external leads. The Tuner-Adapter should be returned to the factory for alignment and major repairs, unless the serviceman
place with the two $10-32$ nuts provided.
3. Remove the tuner assembly from the mounting board with which it was shippen. Keep the three screws for mounting the tuner in the cabinet.
4. Place the spacers on the mounting studs and attach the bracket and socket assembly to the rear of the VHF tuner on the r-f chassis. Sce figure 5t.
5. Place the switch-actuator assembly on the shaft extending from the rear of the VHF tuner so that the switch actuator stud points away from the tuner. See figure 54.


Figure 54. Vhf-UHF Change-Over Switch, Mounting Details
is properly equipped to perform these jobs. In general, a good rule to follow is not to remove the cover of the Tuner-Adapter.

NOTE: Replacing the tube with a new one may detune the tuner. If this occurs, a num ber of atubes should be tried, until the most satisfactory substitute for the original is found.

## INSTALLATION INSTRUCTIONS FOR UHF TUNER-ADAPTER UT2OB

To install the UHF tuner-adapter, proceed as follows:

1. Remove the cabinet back and r-f chassis from the cabinet; then remove the nameplate on the control panel by pushing it out from inside the cabinet.
2. Insert the dial scale and bezel assembly into the hole provided in the cabinet. Fasten the assembly in
3. Place the switch assembly on the two mounting studs, and fasten it in place with the flat washers, lock washers, and nuts provided. See figure 54.
4. Put the VHF Channel Selector in the Channel 2 position. Rotate the switch actuator clockwise on the tuner shaft until the actuator touches the fiber cam on the change-over switch, and fasten the switch actuator in this position. Rotate the VHF Channel Selector to the UHF position. Check the switch operation, to make sure that the switch is thrown properly. Rotate the VHF Channel Selector to Channel 13 position, and check the switch operation, to make sure that the switch is not thrown in this position. Lubricate the switch-actuator stud and switch cam with cup grease.
5. Remove the pilot lamp from the r-f chassis pilot-light socket. Remove and discard the pilot-light socket and cable assembly from the r-f chassis. Insert the pluy from the change-over switch into the socket


Figure 55. Pilot-Light Socket, Mounting Details

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Figure 43. R-F Chassis R-207, Schematic Diagram

## IMPORTANT

General replacenient items commonly stocked by the serviceman are omitted from this parts list. All condensers are molded-bakelite Philco condensers, with
a 600 -volt rating, and all resistors are $1 / 2$ watt, $\pm 10 \%$, unless otherwise indicated. a 600 -volt rating, and all resistors are $1 / 2$ watt, $\pm 10 \%$, unless otherwise indicated.
Parts are listed according to chassis type, and should be ordered in this way rather than by model number. A list of miscellaneous parts is siven at the end of the parts list for each chassis type. All parts are symbolized in the schematic diagram and base layout, for identification purposes.

DEFLECTION CHASSIS D-207
SECTION 1-POWER SUPPLY

| Reference Symbol | Description | Service Part No. |
| :---: | :---: | :---: |
| C100 and Cl01 | Condensers, filter, electrolytic, $120 \mu \mathrm{f}$., 150v. | 30-2568-61 |
| C102 | Condenser, filter, electrolytic, $10 \mu \mathrm{f} ., 25 \mathrm{v}$, | 45-3035-6 |
| C103 | Condenser, filter, electrolytic, $100 \mu \mathrm{f}$, 300 v . | 30.2584.7 |
| $\begin{aligned} & \mathrm{Cl07} \text { and } \\ & \mathrm{Cl08} \end{aligned}$ | Condensers, high-voltage rec tifier, $500 \mu \mu$ f., 20,000 volts | 30.1229.6 |
| CR100 and CR101 | Rectifier, selenium, 450 ma . | 34-8003-8 |
| F100 | Fuse, line, 1.6 amperes | AD2248-19 |
| F101 | Fuse, filament | Piece of \#26 <br> wire |
| J100 | Socket, a.c line | 27.6240-3 |
| J101 | Socket, chassis connecting | 27.6274.1 |
| L100 | Choke, filter | 32-8600.1 |
| PLIOO | Plug, ace line | $\begin{aligned} & \text { Part of a.c line } \\ & \text { cord ass'y. (See } \\ & \text { Misc. "A") } \end{aligned}$ |
| PL101 | Plug and cable ass'y. chassis connecting | (See Misc. "B") |
| R100 | Resistor, current limiting, 5 ohms, 20 watts ................... | 33-3448-18 |
| R101 |  | 66.3474340 |
| R102 | Resistor, filament dropping (piece of \#24 wire) | 41-4149.2 |
| R105, R106, and R107 | Resistor, high-voltage rectifier, 1.5 megohms | 33-1352-2 |
| S100 | Switch, off-on | Part of VOL- <br> UME control <br> 32.8597 |


| SECTION 7-VERTICAL SWEEP |  |  |
| :---: | :---: | :---: |
| $\begin{array}{c\|} \hline \text { Reference } \\ 5 y \mathrm{ymbol} \end{array}$ | Description | Service Port No. |
| C702 | Condenser, filter, $10 \mu \mathrm{f}, 450 \mathrm{v}$. | Part of C103 |
| C707 | Condenser, screen filter, $20 \mu$ f., 200v. | Part of C103 |
| L700 and | Coils, vertical deflection. | Part of deflec. |
| L701 |  | tion yoke ass'y. (See Misc. "A") |
| R701 | Potentiometer, VERT. HOLD control, 250,000 ohms. | Part of R810 |
| R704 | Potentiometer, HEIGHT control, 2.5 megohms | 33.5565.32 |
| R708 | Potentiometer, VERT. LIN. control, 2.5 megohms | 33.5565-32 |
| R710 | Resistor, screen divider, 22,000 ohms, 2 watts | 66-3225340 |
| R711 | Resistor, screen divider, 18,000 ohms, 2 watts | 66-3185340 |
| T700 | Transformer, vertical oscillator | 32.8431.9 |
| T701 | Transformer, vertical output | 32.8637 |

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| $\begin{gathered} \hline \text { Reference } \\ \text { Symbol } \end{gathered}$ | Description | Service Port No. |
| :---: | :---: | :---: |
| C102 | Condenser, filter, electrolytic, 10 $\mu \mathrm{f}$, 25 v . | 45.3035-6 |
| C103 | Condenser, filter, electrolytic, $100 \mu \mathrm{f}$., 301 s v. | 310.2581 .7 |
| $\mathrm{Cl} 04 \text { and }$ C105 | Condensers, high-voltage rectifier, $5000 \mu \mathrm{f}$., 20,1000 volts | 30.122\% 96 |
| Criouand | Rectifier, selenium, 50 ma. | 31.81013-8 |
| CRIOI |  |  |
| F100 | Fuse, line, 1.6 amperes | AD22 ${ }^{\text {P-19 }}$ |
| F101 | Fuse, filament | \#26 wire |
| J100 | Socket, are line | 27.62 210.3 |
| J101 | Socket, chassis connerting | 27.627-1 |
| L100 | Choke, filter | 32-86010-1 |
| PL100 | Plug, are line | Part of are line cord ass'y. ISee Misc. "A") |
| PL101 | Plug and cable ass'y. chassis connerting | (See Misc. "B") |
| R100 | Resistor, rurrent limiting, 5 ohms, 20 watts | 33-348-18 |
| R101 | Resistor, filter, 47,001 ohms, 1 watt | 66.347 3 341 |
| R102, R103, and R104 | Resistors, high-voltage rectifier, 1.5 megohms | 33-1352-2 |
| Sl00 | Switch, offion | Part of VOLUME control |
| T100 | Transformer, filament | 32.8635 |

## SECTION 7—VERTICAL SWEEP

$$
\begin{aligned}
& \begin{array}{|l|l}
\text { C702 } \\
\text { C707 }
\end{array} \quad \begin{array}{l}
\text { Condenscr, filter, } 10 \mu \mathrm{f}, \text {, } 450 \mathrm{v} . \\
\text { Condenser, sereen fin }
\end{array} \\
& \begin{array}{l}
\text { L.700 and } \\
\text { L7711 }
\end{array} \\
& \text { R701 Potentiometer, VERT. HOLI) } \\
& \begin{array}{l}
\text { Potentiometer, VERT. HOL } \\
\text { contril, 250,000 ohms } \\
\text { Potentiometer, HEIGHT con- }
\end{array} \\
& \begin{array}{l}
\text { Potentiometer, HEIGHT con } \\
\text { trol, } 2.5 \text { megohms } \\
\text { Potent. LIN }
\end{array} \\
& \begin{array}{c}
\text { Potentiometer, VERT. LIN. } \\
\text { rontrol, } 2.5 \text { megohms. }
\end{array} \\
& \begin{array}{c}
\text { Resistor, screen divider, } 22,000 \\
\text { olims, } 2 \text { witts }
\end{array} \\
& \text { olms, } 2 \text { watts. } \\
& \begin{array}{c}
\text { Resistor, screen divider, 18,000 } \\
\text { olims, } 2 \text { watts }
\end{array} \\
& \text { Transformer, vertical oscillator }
\end{aligned}
$$

## SECTION 8-HORIZONTAL SWEEP

| SWEEP | R418 | Potentiometer, dual ……....... | 33.5563.56 |
| :---: | :---: | :---: | :---: |
| SWEEP | R418A | Potentiometer, TONE control, 5 megohms | Part of R418 |
| 60.20225434 | R418B | Potentiometer, VOLUME control, 2 megohms | Part of R418 |
| $60-10395+37$ 60.10275117 | R419 | Resistor, $\mathrm{B}+$ dropping, 400 ohms, 2.6 watts | Part of R224 |
|  | T400 | Transformer, audio output | 32.8579 |
| 30-4651-16 | Z400 | Transformer, 1st sound i-f | 32.4497A |
| 30-1246-4 | $\begin{aligned} & \mathrm{Z} 401 \\ & \mathrm{C} 220 \end{aligned}$ | Transformer, FM detector Condenser, by-pass, $680 \mu \mu \mathrm{f}$. | 32-4450.6A <br> 62.1680101001 |
|  | C221 | Condenser, hy-p.ass, 680 m f . | 62-168001601 |
| Part of C103 | C223 | Condenser, a-p.e filter, $2 \mu \mathrm{f}$. | 45-31135 |
|  | C224 | Condenser, electrolytic | 30-258-24 |
| 30-1246-5 | C224A | Condenser, filter, $40 \mu \mathrm{f}$. | Part of C224 |
| 27.6274.7 | C224B | Condenser, filter, $10 \mu \mathrm{f}$. | Part of C224 |
| 27.6273 | C224C | Condenser, filter, $10 \mu \mathrm{f}$. | Part of C224 |
| 32-4557 | C226 | Condenser, cathode by-pass, $18 \mu \mathrm{f}$. | 62.018400021 |
| Part of 7800 | CD200 | Crystal, video detector | 34-8022 |

R-F CHASSIS R-207
SECTION 4

| SECTION 4-AUDIO |  |  |
| :---: | :---: | :---: |
| C405 | Condenser, by-pass, $56 \mu \mathrm{ff}$. ... | 30-1251-2 |
| C409 | Condenser, detector, balancing, $330 \mu \mathrm{f}$. | 62-133001001 |
| Cil2 | Condenser, r-f by-pass, 330 $\mu \mu \mathrm{f}$. | 62-133001001 |
| C413 | Condenser, filter, $2 \mu$ f. | 45-3035 |
| C416 | Condenser, plate by-pass, . 0033 $\mu$ f., 1000v. | 30-4650-89 |
| C418 | Condenser, filter, $60 \mu \mathrm{f}$. | Part of C224 |
| J400 | Socket, VOLUME control | 27.6273* |
| L405 | Coil, filament choke | 32.4112.15 |
| PL401 | Plug, speaker | 27-4785-22 |
| R406 | Resistor, voltage divider, 27,000 ohms, 1 watt | 66.3124346 |
| R412 | Resistor, cathode bias, 180 ohms, 2 watts | 66-1185340 |
| R418 | Potentiometer, dual | 33.5563.56 |
| R418A | Potentiometer, TONE control, 5 megohms | Part of R418 |
| R418B | Potentiometer, VOLUME control, 2 megohms | Part of R418 |
| R419 | Resistor, B + dropping, 400 ohms, 2.6 watts | Part of R224 |
| T400 | Transformer, audio output | 32.8579 |
| Z 400 | Transformer, 1st sound i.f | 32.4497A |
| Z401 | Transformer, FM detector | 32-4450.6A |
| C220 | Condenser, by-pass, $6810 \mu \mathrm{f}$. | 62.1680101001 |
| C221 | Condenser, by-pass, $680 \mu \mu \mathrm{f}$. | 62-168001001 |
| C223 | Condenser, a-per filter, $2 \mu \mathrm{f}$. | 45.3035 |
| C224 | Condenser, electrolytic | 30-2581-24 |
| C224A | Condenser, filter, $40 \mu \mathrm{f}$. | Part of C224 |
| C224B | Condenser, filter, $10 \mu \mathrm{f}$. | Part of C224 |
| C224C | Condenser, filter, $10 \mu$ f. | Part of C224 |
| C226 | Condenser, cathode by-pass, $18 \mu \mu \mathrm{f}$. | ${ }^{62.018400021} 34.8022$ |
| CD200 | Crystal, video deteetor | 34-8022 |

CHASSIS D-207, -208, R-20

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## THE TV-300 AND TV-301 DIFFERENCE

The TV-301 is similar to the TV-300, the difference being in the picture tube used and

The TV-300 chassis uses a 21XP4A picture tube which is an electrostatic focus tube. When this tube is used the 27 ohm resistor in the high voltag
transformer is necessary for proper electrical centering of the picture. The TV. 301 chassis uses a 21 WPP4A picture The TV-301 chassis uses a 21 WP4A picture tube which is an electromag
tic focus picture tube. When this picture tube is used the 27 ohm resistor netuc fortus picture tube. when this picture

This is the only difference between these two chassis.
TUBE COMPLEMENT - TV-300 CHASSIS


SPECIFICATIONS - TV-300 CHASSIS
VHF TUNER
welve channel, 13 position
UHF TUNING
overing VHF television channels 2 through 13; Contiouous tuning, covering UHF channels 14
INTERMEDIATE FREQUENCIE
VIDEO CARRER
$\begin{array}{ll}\text { TRANSMISSION LINE } & 300 \text { ohm, twin wire lead } \\ \text { OPERATING VOLTAGE } & 110 \text { to } 120 \text { volts, } 60 \text { cycles, }\end{array}$
OOWER CONSUMPTION $\quad \begin{aligned} & 110 \text { to } 120 \text { volts, } 60 \text { cycles, } A C \\ & \text { Without UHF } \\ & 170 \text { watts }\end{aligned}$
With UHF - 175 watts

## CIRCUIT DESCRIPTION - TV-300

The TV-300 receiver connains a 13 position incremental type
VHF tuner, covering VHF channels 2 through 13 with a UHF
position. Power and filament voltage for the UHF tunerposition. Power and filament woltage for the UHF tuner-
adapter are supplied through a switch built into the rear of
ank the the VHF tuner. The output of the VHF tuner is a 40 Mc .,
IF signal which is inductively coupled to three stager tuned
IF stages. A iNG4 crystal serves as the diode detector for the IF stages. A 1 ING4 crys
output of the IF stages.

## cutput of the IF stages.

The output of the video detector, a negative phase, composite-
video detected signal, is fed through a single video amplifier video detected signal, is fed through a single video amplifier ployed a positive going signal is being applied to the picture
tube and therefore, is fed to the picture tube cathode.

AGC voltage is developed in the output stages of the video
detector and hhrough the bias on the grid of the synn separator. detector and through the bias on the grid of the sync separator
A delay voltage applied to the tuner AGC is effectively ylamped
by the dide by the diode portion of the 6 Tr first audio amplifier stage, to
prevent the RF grid being driven too far positive under weak signal conditions.
The 4.5 Mc., intercarrier IF sound is taken from the output
circuit of the crystal video detector. The 4.5 Mc., sound signal circuit of the crystal video detector. The $4.5 \mathrm{Mc.}$,sound signal
is the resultiog difference signal from the beat between the is the resulting difference signal from the beat between the
video carrier, 45.75 Mc and he 41.25 Mc., sound carrier when
they are mixed in the video detector. In order for the 4.5 Mc ., they are mixed in the video detectior. In order for the 4.5 Mc .,
resultant signal to contain the FM sound with only a negligible resultant signal to contain the FM sound with only a negligible
amount of video modulation, the sound carrier must be con
siderably lower than the video. The proper ratio of the two signals is established during alignment of the receive The intercarrier sound IF signal is fed through a sound I in the sound IF stage. The ratio detector employs the duo-diode section of a 6 T8 tube and the detected signal is fed to the triod section of the same tube as the first audio amplifier. A 6W6GT tube serves as the audio output stage which drives the speaker. B plus voltage, approximately 260 volts, is fed to the screen grid and plate circuits of the $\sigma W 6 G T$, while a second B plus grid. The cathode of this tube is connected through the cathode resistor and through decoupling circuits to the plates and screen grids of all of the IF stages and to the screen grids of the video output tube and the horizontal output rube. Thus, the 6W6GT tube is effectively in series with the tubes mentioned and the necessary B plus voltage for these tubes develops due to the tube since it is in series with the IF tubes, and screen grids o the video output and horizontal output stages, from B plus to ground, forms a large voltage divider network across the power supply, and acts as a voltage regulator for these stages. The voltage drop across the $6 W 6 \mathrm{GT}$ remains approximately 120 volts.
A portion of the composite video signal is taken from the video output circuits to the grid of the sync separator, one half
of a 12 AZ 7 duo-rriode tube. The bias of this tube is such that negative going composite sync pulses appear at the plate. The vertical integrator circuit feeds the vertical sync pulses to the vertical blocking oscillator, a 12BH7 tube.
The vertical blocking oscillator requires a positive pulse for triggering purposes and the incoming syac pulse is negative tap of the oscillator transformer. The action of the transformer circuit causes a large positive overshoot to occur on the syn pulse at the cathode and grid. The grid pulse being larger than that at the cathode, will cause this positive overshoot to trigge the oscillator

## TELEVISION ALIGNMENT

## General

The alignment procedure follows the general pattern of first checking the tuner response with an FM sweep generator and oscilloscope comparing the response curve with that given in the manual, and aligning the tuner if necessary. After it is es tablished that the tuner is in correct alignment, the video I-F channel is aligned by tuning each coil to its assigned pole frequency, using an AM signal, and then feeding in a sweep signa at the antenna terminals and retouching the I.F adjustments to abigned, using an AM signal, by tuning the sound take-off coil and the I-F and ratio-detector transformers.
The over-all response curve ( $\mathrm{r}-\mathrm{f}$, $\mathrm{i}-\mathrm{f}$ ) of the circuits from the antenna terminals to the video detector, after the I-F stages have been aligned, should appear essentially the same, regardless of the channel under test. If not, the tuner should be aligned. The video-carrier intermediate frequency is 45.75 mc ., and
the sound intermediate (intercarrier) frequency is 4.5 mc Alignment of these circuits requires careful workmanship and good equipment. The following precautions must be observed 1. There must be a good bond between the receiver chassis and the test equipment. This is most easily obtained by having

The second half of the 128 BH 7 duo-triode is used as the verrical output amplifier and the vertical signal is fed to the deflection coils through the vertical output transformer. A reto the grid of the picture tube effectively removes vertical retrace lines.
From the plate of the sync separator the horizontal pulses are fed to the cathode circuit of the phase comparer, one-half of $12 A Z 7$ tube. At the same time, a pulse is taken from a winding on the horizontal output transformer, and fed to the the phase comparer is prounded and the circuits of this stage are such that if the incoming signal and the signal taken from the horizontal output transformer are not in phase a difference voltage results in the plate circuit which is fed to the grid of the horizontal oscillator and controls its frequency.
The horizontal oscillator is a conventional multivibrator type
employing a duo-triode 12 AU7A tube. The horizontal hold mploying a duo-triode 12AU7A tube. The horizontal hold
control is placed in the grid circuit of the second triode section of the multivibrator and provides the means of manually adjusting the frequency of the oscillator so that its frequency is within the control range of the phase comparer.
A 6BQ6GT tube is employed as the horizontal output tube. Horizontal width is adjustable by means of a variable resistor contains a 27 ohm resistor inserted in the center transformer provide electrical centering of the raster. High voltage rectification is performed by a 1 B3GT tube, while a 6AX4G tube serves as a damper tube.
A transformer power supply provides B plus voltage. A SU4G tube is employed in full wave rectification of the B plus
voltage. A. 7 ampere slow-blow fuse is incerted in the voltage. A. 7 ampere slow-blow fuse is inserted in the B minus oltage cage on top of the chassis for easy access. The picture tube employed with the TV. 300 cha
he electrostatic fixed focus type with the focus anode, returned to ground or the electromagnetic type. The electrostatic employs ring type permanent magnets for centering of the raster.
the top of the workbench metallic. The receiver chassis should be placed tuner-side down on the bench. If the bench has no strip top, the test equipment and chassis can be bonded by aearest the tuner should rest on the strip.
2. Do not disconnect the picture tube yoke, or speaker while he receiver is turned on.

An the receiver and test equipment to warm up for 15 4. The ore starting the alignment.
4. The marker (AM) signal generator should be calibrated ccurately to the frequencies used and to the sound and video r-f carriers of each channel used during alignment. If nodeb or is used, the built-in crystal calibrator provides an excellent means of calibration. An alternate method for calibrating the is to zero-beat the signal generator with the received signals. For further information regarding calibration, refer to Philco Lesson PR-1745 (J) entitled "Television Service in the Home."

## HORIZONTAL OSCILLATOR ADJUSTMENT

1. Center horizontal hold control.
2. Adjust T-1 until the picture comes into sync.

## JIGS AND ADAPTERS REQUIRED

Mixer Jig
Connections to the grid of the mixer tube may be made hrough the alignment jack provided for this purpose. To con No. 45-1739, and a connecting cable, Philco Part No. 45-1635, may be used. As an alternate, a Philco alligator-clip adapter, Part No. 45-1636, with as short a ground lead as possible, may be used to connect the alignment jack. The ground lead should be connected as close as possible to the mixer tube. It is essential that the signal-generator output lead be terminated with connection of the lead to the mixer, is held to a minimum

## Antenna-Input Matching Network

An impedance-matching network for coupling the signal An impedance-matching network for coupling the signal
generator to the antenna input terminals of the receiver is shown in figure 1. This network, which is designed to have an inpu impedance of 75 ohms and an output impedance of 300 ohms is used to match a 75 -ohm generator to a $300-\mathrm{obm}$ antenna-input


Fig. 1. Antenna-Input Matcbing Network.
circuit. The resistors used in this network should be of carboncomposition construction, and should be chosen from a group, to obtain values within ten percent of those indicated. The re-
sistors should be placed in a shield can, to prevent variable effects. An antenna-matching jig, Philco Part No. 45-1736, which consists of a matching transformer and connecting box, may be used in place of the resistor network.

## TUNER OSCILLATOR ALIGNMENT

table 1

AM GENERATOR: Connect to the receiver anteana-input
terminals. (No matching network is required.) Use in terminals. (No match
modulated R-F output.

OSCILLOSCOPE: Connect the vertical-input lead, in series with a 1000 -ohm resistor, to the mixer plate test poin

TP-4. Connect the scope ground lead to the chassis, near RECEIVER CIRCUIT ALTERATIONS: Disconnect tuner AGC (white) lead from main chassis, and connect a $1.5 \mathrm{-volt}$
bias battery, with negative terminal to white lead from runer, and positive terminal to chassis.

| STEP | $\begin{gathered} \hline \text { AM GENERATOR } \\ \text { DIAL SETTING } \\ \hline \end{gathered}$ | RECEIVER TUNING | aduust | remarks |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 257 mc. | channel 13 | TC-506 for zero beat on scope. | a. If regeneration occurs, increase bias; bias may be increased up to 4 or 5 volts, if necessary. <br> b. Preset fine tuning control to center of its range. |
| 2 | 251 mc . | channel 12 | TC-507 for zero beat on scope. |  |
| 3 | 245 mc . | channel 11 | TC-508 for zero beat on scope. |  |
| 4 | 239 mc . | channel 10 | TC-509 for zero beat on scope. |  |
| 5 | 233 mc . | channel 9 | TC-510 for zero beat on scope. | a. To adjust channel 8 use channel 9 tuning core, then recheck channel 9 . |
| 6 | 221 mc . | channel 7 | TC-511 for zero beat on scope. | a. Repeat steps 1 thru 6 and readjust if necessary until channels are within 500 kc . of proper frequency. |
| 7 | 129 mc . | channel 6 | TC-512 for zero beat on scope. |  |
| 8 | 113 mc . | channel 4 | TC-513 for zero beat on scope. |  |
| 9 | 101 mc . | channel 2 | TC. 514 for zero beat on scope. |  |

VIDEO I-F ALIGNMENT
TABLE 2
A.M. GENERATOR: Connect to mixer test point, TP-2, $\quad$ OSCILLOSCOPE: Connect vertical-input lead to pin No. 11 mately $30 \%$ Adjust the outpu of the generator during alignment to keep the output at
the CRT cathode below 40 volts peak to peak WEEP (FM) GENe below 40 volts peak to peak.
input circuit through antenna-input matching network (see Ggure?)

PRESET: Contrast control full on. Channel selector to chan nel position No. 1.1 . BIAS: Apply
system).
NOTE: I-F shield must be in place

| STEP | am generator dial setting | SWEEP (fm) Generator |  | aduest | remarks |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | sweep dial SETTING | marker dial SETTING |  |  |
| 1 | 45.5 mc . |  |  | TT for maximum indication on scope. | The scope level must not be permitted to exceed 40 volts peak to peak or overloading will occur. |
| 2 | 43.1 mc . |  |  | VC. 1 for maximum indication on scope. |  |
| 3 | 42.7 mc . |  |  | T-2-IF for maximum indication on scope. |  |
| 4 | 45.0 mc . |  |  | TG-IF for maximum indication on scope. |  |
| 5 | 44.4 mc . |  |  | T3-IF for maximum indication on scope. |  |
| 6 |  | Channel 4 ( 69 mc . with 6 mc . sweep width). | Run marker along curve checking against curve limits given in figure 6. | If necessary retouch <br> TT, VC1, T2-IF, <br> T6-IF, T3-IF. | Adjust carrier level with TT and T6 level curve with T-3. Position 42.5 mc . slope with VC-1 and T-2. CAUTION: Retouch only slightly. |

TUNER BANDPASS ALIGNMENT - See Table 3 on Page five


Fig. 2. Television tuner response curve,


Fig. 3. Television tuner response curve, showing tracking compensation.

## TUNER BANDPASS ALIGNMENT

## table 3

SWEEP (FM) GENERATOR: Connect to receiver antenna- RECEIVER CIRCUIT ALTERATIONS: Bias same as Char input circuit through antenna-input matching network (see
figure 1). $\begin{aligned} & \text { 1. Disconnect the tuner coupling link leads and connect a } \\ & \text { 40- to } 70 \text {-ohm carbon resistor across the open end of the }\end{aligned}$ osCILLOSCOPE: Same as in Chart 1. lead from the tuner.

| STEP | SWEEP (FM) GENERATOR |  |  | adjust | remarks |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\begin{gathered} \text { SWEEP } \\ \text { SETHING } \end{gathered}$ |  |  |  |  |
| 1 | Channel 13 <br> (213 m., with <br> (10-m. sweep <br> width.)swer | Set first to 210 mc . and not position of marker on response curve. Then set to 216 mc . and note position of marker on response curve. | Channel 13 |  | Use oscilloscope gain as high as possible with respect to hum level and "bounce". Pips fx channel limits on curve. Response curve should be flat between limits (see figure 2). If not, proceed with step 2. |
| 2 | Channel 13 | 213 mc . | Channel 13 | T-8 - WS2 counterclockwise until single peak appears. | CAUTICN: Care must be taken not to un screw core far enough to make it drop out of the coil. |
| 3 | Channel 13 | 213 mc . | Channel 13 | T-15-WS3 until peak falls on 213 -mc. marker. | It may be necessary to increase sweepgenerator output. |
| 4 | Channel 7 <br> ( 177 mc. , with 10 -mc. sweep width.) | Set first to 174 mc . and note position of marker on response curve. Set to 180 mc . and note position of marker on response curve. | Channel 7 |  | Note curve with respect to tilt and center frequency. Curve should be centered in pass band and symmetrical. If not, proceed with step 5 . |
| 5 | Channel 7 | 174 mc \& 180 mc . | Channel 7 | VC-3 and VC-2 to obtain correct tilt on top of curve. | VC3 and VC2 compensate for the tuning effect of Channel 13 adjustment upon Channel 7. (See figure 3.) |
| 6 | Channel 13 | 213 mc . | Channel 13 | Retouch T-15 of WS3 and T-8 - WS2 for symmetrical response, centered about $213-\mathrm{mc}$. marker. | To retouch, only turn cores slightly. |
| 7 | Channel 7 | 117 mc . | Channel 7 | Repeat step 5. | Check response curve for correct center frequency and symmetry. |
| 8 |  |  |  | Repeat steps 6 and 7. | Repeat Channel 13 and Channel 7 adjustments, alternately, until favorable curves are obtained on both. |
| 9 | Channel 6 ( 85 mc ., with 10-mc. sweep width.) | Set first to $\mathbf{8 2} \mathbf{~ m c}$. and note position of marker on response curve. Then set to 88 mc . and note position of marker on response curve. | Channel 6 |  | Curve should be symmetrical and centered in pass band. If not, proceed with step 10. |
| 10 | Channel 6 | 85 mc . | Channel 6 | T-14 of WS2 counterclockwise until single peak appears. | CAUTION: Care must be taken not to unscrew core far enough to make it drop out of the coil. |
| 11 | Channel 6 | 85 mc . | Channel 6 | T-21-WS3 until peak falls on 85 -mc. marker. | It may be necessary to increase sweepgenerator output. |
| 12 | Channel 6 | 85 mc . | Channel 6 | T-27 - WSS for maximum curve height and symmetry of single peak. | After adjusting TC501, recheck as in step 9. If necessary, reduce sweep-generator output to avoid overloading. |
| 13 | Channel 6 | 85 mc . | Channel 6 | Retouch T-21 - WS3 and T-14-WS2 for symmetrical response, centered about $85-\mathrm{mc}$. marker. | To retouch, only turn cores slighty. |



Fig. 4. Tuner SIDE VIEW

A.M. GENERATOR: Connect the "hor" lead through a 2200 ohm resistor to the junction of C -24, X 3 and the xtal
det. Adiust ohm resistor to he junt
det. Adust generator for
mately $30 \%$ modulation.








Pig. 12. Sync Separator Plate, Pin 1, 30
volits, 1 , 750
c.p.ps

## OSCILLOSCOPE WAVEFORM PATTERN - TV-300

These waveforms were taken wid the receiver aljusted hr au approxinaice poak to-peak output of 6 volts at the video detector. The voltages given with the waveforms are approxinate peak-10-peak values. The frequencies shown are those of the waveforma - not the sweep tate of the oscilloscope. The waveforms wore takoa with an oscilloscope having good high-frequency response. With oscilloscopes having poor high-frequency response, the sharp peaks of the horizontal waveforms will be more rounded than those shown, and the peak-to-peak voltages will differ from those shown.


Fig. 10. Video Amplifier Plate, 83 volts,




Fig. 11. Sync Separator Grid, Pin 2, 90


Fig. 14. Vertical-Output Grid, Pin 2, 72 Fig. 14.
volts, 60 c.p.s.


Fig. 15. Vertical.Output Plate, Pin 9,


Fig. 18. Horizontal. Ossillator Catbode,
Pins 3 and $\$, 18$ vol:s, $15,75 G$ c.p.s.
ig. 16. Pbase Comparer, Pin 6, 7 voln


Fig. 19. Horizontal-Oscillator Grid, Pin


Fig. 22. Wiring Diagram, Bottomt View - TV-300.



OJohn F. Rider


## General

The alignment procedure follows the general pattern of first checking the tuner response with an FM sweep generator and oscilloscope, comparing the response curve with that given in the manual, and aligning the tuner if necessary. After it is es tablished that the tuner is in correct alignment, the video I.F channel is aligned by tuning each coil to its assigned pole fre quency, using an AM signal, and then feeding in a sweep signal ane antenna terminals and retouching the I-F adjustment o oblain the desired pass band. wning, the sound take-off coil and the I-F and ratio-detector transformers.
The over-all response curve (r-f, i-f) of the circuits from the antenna terminals to the video detector, after the I.F stages have been aligned, should appear essentially the same, regardless of the channel under test. If not, the uner should be aligued.
The vider-carrier intermediate frequency is 45.75 mc ., and the sound intermediate (intercarrier) frequency is 4.5 mc . Alignment of these circuits requires careful workmanship and good equipment. The following precautions must be observed:

1. There must be a good bond between the receiver chassi and the test equipment. This is most easily obtained by having the top of the workbench metallic. The receiver chassis should be placed tuner-side down on the bench. If the bench has no metallic top, the test equipnemt and chassis can be bonded by strip of copper abould rest on the strip
2. Do not disconnect the picture tube yoke, or speaker while the receiver is turned on.
3. Allow the receiver and test equipment to warm up for 15 minutes before starting the alignment
4. The marker (AM) signal generator should be calibrated accurately to the frequencies used and to the sound and video r-f carriers of each channel used during alignment. If Philco Alignment Generator Model 7008 is used, the built-in crystal
calibrer calibrator provides an excellent means of calibration. An alte
nate method for calibrating the signal generator to the sound and video i-f carrier frequencies is to zero-beat the signal geneator with the received signals.
For further information regarding calibration, refer to Philc Lesson PR-1745 (J) entitled "Telcvision Service in the Home

## JGS AND ADAPTERS REQUIRED

Mixer Jig
No. 45-1636, with as short a ground lead as possible, may be ued to connect the alignment jack. The ground lead should be connected as close as possible to the mixer tube. It is essential 68 -ohm resistor (carbon), so that regeneration, caused by connection of the lead to the mixer, is held to a minimum.



## Sound i-f input Alignment Jig

(ideo Test Jack Adapler No. 2)
To observe the composite video, at TS1, a jig may be made with a five.pin plug and a $\mathbf{2 2 0 0}$ ohm resistor. (See figure 3.) The 2200 ohm resistor should be connected to pin 2 of the plug. A ground lead should be connected to pin 3. To observe the resistor and the ground lead. This jig is also used for injection of the 4.5 mc . signal during s-i-f alignment.

## Antenna-Input Matching Network

An impedance-matching network for coupling the signal in figure 1. This network, which is designed to have an in impedance of 75 ohms and an output impedance of 300 ohms is used to match a 75 -ohm gencrator to a 300 -ohm antenna-inpul to obtain values within ten percent of those indicated. The sistors should be placed in a shield can, to prevent variable cffects. An antenna-matching jig, Philco Part No. 45-1736, which consists of a matching transformer and connecting box

## Video I-F Alignment Jig

(Video Test Jack Adapter No. 1)
The alignment jig used at TSI and shown in figure 2 , should be used during the i-f alignment, to apply the proper bias the a-g-c bus, and to provide a convenient oscilloscope connec
tion. This adapter consists of a five-pin resistors adapter consists of a five-pin plug, two 10,000 ohm supply. To isolate the oscilloscope from the receiver ciscuis supply. To isolate the oscilloscope from the receiver circuits,
a 15,000 ohm resistor, by-passed by a 1500 a $15,000-\mathrm{ohm}$ resistor, by-passed by a 1500 mmf . condenser, i
used. A suggested method of fabricating the jig is also shown in figure 2. This jig should not be used to observe the composite video from the video detector output.


$$
\begin{aligned}
& \text { Fig. 4. Television curs tuner response curve, } \\
& \text { showing bandpass limits. }
\end{aligned}
$$

Fig. 5. Television tuner response curve, showing tracking compensation. TUNER OSCILLATOR ALIGNMENT
AM GENERATOR: Connect to receiver antenna-input ter minals. (No matching network is required.) Use unmodulated r-f output.
test point.
RECEIVER CIRCUIT ALTERATIONS: Disconnect tuner a-g-c (white) lead from main chassis, and connect a 1.5 volt
OSCILLOSCOPE: Connect the verical-input lead, in series

| STEP | $\begin{aligned} & \hline \text { AM GEEERATOR } \\ & \hline \text { DAL SETING } \end{aligned}$ | $\begin{aligned} & \hline \text { RECEVER } \\ & \hline \end{aligned}$ | adjust | Remanks |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 257 mc . | channel 13 | VC4 for zero beat on scope. | a. If regeneration occurs, inject bias; bias may be increased up to 3 volts, if necessary at pin 1 video test jack - TSI. <br> b. Preset fine tuning adjustment so that it is in the middle of its range. |
| 2 | 251 mc . | channel 12 | VCs for zero beat on scope. |  |
| 3 | 245 mc . | channel 11 | VC6 for zero beat on scope. |  |
| 4 | 239 mc . | channel 10 | VC7 for zero beat on scope. |  |
| 5 | 233 mc . | channel 9 | VCs for zero beat on scope. |  |
| 6 | 227 mc . | channel 8 | VC9 for zero beat on scope. |  |
| 7 | 221 mc . | channel 7 | VC10 for zero beat on scope. |  |
| 8 | 64.5 mc . | channel 6 | VC11 for zero beat on scope. | 2nd harmonic gives 129 mc . |
| 9 | 113 mc . | channel 4 | VC12 for zero beat on scope. |  |
| 10 | 101 mc . | channel 2 | VC13 for zero beat on scope. |  |

AM GENERATOR: Connect to mixer test point, TPi, through a mixer jig, and adjust the generator for approximately
30 percent modulation at 400 cycles. Adjust the output of he generator during alignment, to keep the output at the second detector below 4 volt, peak to peak.
SW'EEP (FM) GENERATOR: After step 7, connect to antennainput circuit through antenna input matching network. (See Ggure 1.)
OSCILLOSCOPE: COnneot the verrical-input lead to the 15 K
resistor of the video i-f alignment jig. Connect scope
IABLE NO.
ground iead to the ground lead of the jig. Plug jig into TS1.
PRESET: Contrast and Brighmess controls fully counterclockwise, and channel selector to channel 4. Adjust AGC switch to normal position.
i-f alignment jig; ground posive bias to pin 1 of video pin 3 of jig. (See figure 2.)
NOTE: If the i-f shield has been removed for repairs, it must be replaced before proceeding with the alignment


Layout SIDE VIEW

SWEEP (FM) GENERATOR: Connect to antenna-input circui
through antenna-input matching network (See figure 1)
OSCILLOSCOPE: Connect the vertical-input lead, in series with
a 1000 -ohm resistor, to the mixer plate test point, TP4.
Connect scope ground lead to the chassis, near TP4.
Connect scope ground lead to the chassis, near TP4.
ECEIVER CIRCUIT ALTERATIONS: Disconnect tuner a-g. (white) lead from main chassis, and connect a 1.5 volt bias battery, with negative terminal to white lead from
tuner, and positive terminal to chassis. Disconnect tuner link from terminal board, B-9, and connect a 40 to $70-\mathrm{ohm}$ carbon resistor across the link.

| STEP | SWEEP (FM) GENERATOR |  | $\begin{aligned} & \text { REEEVERER } \\ & \text { TUNNNG } \end{aligned}$ | adjust | remarks |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | SWEEP DIAL SETTING | MAREER DIAL <br> SETTING |  |  |  |
| 1 | channel 13 <br> ( 213 mc . with $10-\mathrm{mc}$. sweep width.) | Set first to 210 mc . and note position of marker on response curve. Then set to 216 mc . and note position of marker on response curve. | channel 13 |  | Use oscilloscope gain as high as possible with respect to hum level and "bounce". Pips fix channel limits on curve. Response curve should be flat between limits (see fig. 5). If not, proceed with step 2. |
| 2 | channel 13 | 213 mc . | channel 13 | TC502 counterclockwise until single peak appears. | CAUTION: Care must be taken not to unscrew core far enough to make it drop out of the coil. |
| 3 | channel 13 | 213 mc . | channel 13 | TCsu4 until peak falls on 213 mc . marker. | It may be necessary to increase sweep-generator output. |
| 4 | channel 6 ( 85 mc . with $0 . \mathrm{mc}$. sweep width.) | Set first to 82 ncc . and note position of marker on response curve. Then set to 88 mc . and note position of marker on response curve. | channel 6 |  | Curve should be symmetrical and centered in pass band. If not, proceed with step 5 . |
| 5 | channel 6 | 85 mc . | channel 6 | TC503 counterclockwise until single peak appears. | CAUTION: Care must be taken not to unscrew core far enough to make it drop out of the coil. |
| 6 | channel 6 | 85 mc . | channel 6 | TC505 until peak falls on 85 mc marker. | It may be necessary to increase sweep-generator output. |
| 7 | channel 6 | 85 mc . | channel 6 | TC503 for maximum curve height and symmetry of single peak. | After adjusting TC503, recheck as in step 4. If necessary, reduce sweep-generator output to avoid overloading. |
| 8 | channel 6 | 85 mc . | channel 6 | Retouch TC503 and TC505 for symmetrical response, centered about 85 mc. marker. | To retouch, only turn cores slighty. |
| 9 | $\begin{gathered} \text { channel } \\ \text { (UHF) } \end{gathered}$ | 44 mc . | $\begin{gathered} \text { clannel }{ }^{1} \\ (\text { UHF) } \end{gathered}$ | Retouch TC503 and TC505 for symmetrical response centered about 44 mc . | After this adjustment recheck channel 6 and be sure it is within limits. |

NOTE: On channel 7 , observe the tilt and center frequency of the response curve. The curve should be centered on the pass band and should be symmetrical. If it is not symmetrical, an appears unbalanced, as in figure 6 , adjust C507 and C512 (figur 5) to obtain a response curve which is in the mirror image
(ilt in the opposite direction) of the original: for example, it channel 7 response curve appears as in figure 6A, adjust C507 and CS12 until the curve appears as in figure 7B. This adjustment over-compensates to make allowance for the effect of
channel 13 adjustments upon channel 7 response.


AM GEINERATOR: Connect "hot" lead through a 2200 ohm resistor to pin 2 of TS1, using the vileo i-f alignment jig. Connect ground lead of generator to ground lead of jig.


OLTMETER: Use v.t.v.m. or $\mathbf{2 0 , 0 0 0}$ ohms-per-volt voltmeter Connect to sound test point
OSCILLOSCOPE: COnnect through crystal probe to cathod (pin 11) of picture tube.

| STEP | $\begin{gathered} \text { GENERATOR } \\ \text { AMAL } \\ \text { SETTING } \end{gathered}$ | ndjust | remarks |
| :---: | :---: | :---: | :---: |
| 1 | 4.5 mc . | T7 for maximum indication on volt. meter. | Remove 1 st video i-f volume control for moderate speaker out <br> put. |
| 2 | 4.5 mc . | Ts primary (bottom of T5) for maximum indication on voltmeter. |  |
| 3 | 4.5 mc . | T5 secondary (top of TS) for maximum indication on voltmeter and minimum speaker out- put. put. | The point of maximur meter indication foe CS should also be the point of mini- mum speaker output. |
| 4 | 4.5 mc . | T8 for minimum indication as view on the oscilloscope. |  |
| 5 | $\begin{gathered} \text { ust } \\ \begin{array}{c} \text { ustation } \\ \text { signal } \end{array} \end{gathered}$ | Ts primary (bottom of T5) for minimum AM (noise or buzz), using speak- er output for indication. | Replace 1 st video i-f tube, and tune in a station, setting finc tain a crisp picture, with a small amount of beat. |

## Cow insurying 

## Fig. 8. Video Detector TSi, 3.5 volts, 60 c.p.s.





These waveforms were taken with the receiver adjusted for an approximate peak-to-peak output of 3.5 volts at the video detector. The voltages given with the waveforms are approximate peak-to-peak values. The frequencies shown are those of the waveforms - not the sweep rate of the oscilloscope. The waveforms were taken with an oscilloscope having good high-frequency response. With oscilloscopes having poor high-frequency response, the sharp peaks of the horizontal waveforms will be more rounded than those shown, and the peak-to-peak voltages will differ from those shown.

## 

${ }_{83}$ vig. 10. Vides, 60 s.p. Amplifier Plate, Pin


Fig. 13. Vertical-Oscillator Grid, Pin 2,


Fig. 16. Phase Comparer, Pin 2, 11 volts, Fig. 16. Phas
15,750 c.p.s.


Fig. 11. Sync Separator Grid, Pin 7, 38


Fig. 17. Horizontal Oscillator, 43 volts, Fig, 17. Horizontal




Fig. 19. Horizontal-Oscillator Grid, Pin
Gis
2,


Tis. 20. Horionnat.output Grid, Pin



Fig. 23. WViring diagram, bottom view - TV-350 chassis.
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(20):



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vhf tuning
Twelve channel, 13 position incremental tuner, covering VHF television channels 2 through
13; plus UHF position, and fine tuning of local 13; plus UHF position, and fine
oscillator.
Continuous tuning, covering UHF television
UHF TUNING (if provided) Continuous tuning, cover $\begin{gathered}\text { channels } 14 \text { through } 83 .\end{gathered}$

## NTERMEDIATE

FReQUENCIES
Video Carrier
Video Carrier
Sound (intercarrier)
CIRCUIT DESCR
CIRCUIT DESCRIPTION
single chassis. The VHF tenerer used the new line employing tion tuner mounted on a separate sub-chassis. The thirteenth position is used for the reception of UHF signals in conjunction with a UT-26 UHF tuner. The R.F. amplifier is a 6BZ7 tube, while the local oscillator and mixer stages use a type 6X8 tube. The pentode section of the $6 \times 8$ is used for mixing, while the riode is used as a local oscillator.
The output of the mixer, a $40-\mathrm{MC}$ signal, is link coupled to four stagger tuned video I.F stages employing four 6 CB6 tubes.
This I-F system is an improved I-F, in that it contains addiThis 1 -F system is an improved I-F, in that it contains addi-
ional trapping to improve the adjacent channel interference In the grid circuit of the first I-F, we have the 47.25-MC adjacent channel sound trap and the 41.25 -MC accompanying sound trap. In the grid circuit of the third Video I.F, we have an additional 47.25-MC adjacent sound trap along with a 39.75 -
MC adjacent channel picture trap. MC adjacent channel picture trap. This $39.75-\mathrm{MC}$ adjacent
channel picture trap is something we have not used in quite long period of time, and the adjustment of this trap along with the other traps is of primary importance in achieving the top performance built into our TV. 400 chassis.
A 1 N 64 crystal diode is used as a
A 1 N64 crystal diode is used as a video detector. Following the video detector is a video amplifier consisting of two stages.
The first stage uses the pentode section of the 6AX8 and the output stage uses a $6 A Q 5$ which drives the grid of the picture tube.
Sound I-F (intercarrier) is obtained by utilizing the beat requency produced when the $45.75-\mathrm{MC}$ video carrier and the 41.25-MC sound carrier are mixed in the video detector. The beat frequency 4.5-MC is the difference between 45.75-MC and
41.25-MC and contains the FM sound signal. This 4.5-MC signal contains only a negligible amount of the video AM amplitude modulation, provided that the amplitude of the 41.25 MC signal is considerably lower than that of the 45.75 -MC

Operating voltage 100 to 120 volts, 60 cycle, A.C. POWER CONSUMPTION Without UHF, 240 w
TRANSMISSION LINE $\quad 300$-ohm, twin-wire lead
signal. The proper relative amplitude of the two carriers is estabut only when both the video and sound carriers are present A-G-C voltage for the video I-F system and the R-F amplifier is obtained from a keyed a-g-c system which uses a GAU6 tube, as the a-g-c gate. Composite video from the video-amplifier plate circuit through a cathode follower, is fed to the grid of the a-g-c gate tube, while a gating or keying pulse, obtained
from a winding on the horizontal-output transformer, is applied to the plate. The sync-pulse polarity applied to the grid of S 12 is positive; therefore, the a-g-c gate can conduct in proportion to the amplitude of the sync-pulse tips if the gating or keying pulse occurs at the same time as the sync. Because the keying or gate pulse is a constant amplitude, approximately 500 volts peak, the amplitude of the sync pulse will determine the
amount of conduction in the gate tube. The plate current of the keyed a-g.c gate tube flows through a resistor network, developing a voltage which is negative with respect to the chassis and whose amplitude is proportional to the plate current. This negative voltage is used to control the gain of the receiver. Since conduction cannor occur in the a-g.c gate tube unless the sync pulse and gating pulse occur at the same time,
noise disturbances that occur between sync-pulse intervals cannot affect the a.g-c voltage
Composite video for the sync circuits is taken from the plate of the first video amplifier. The output is fed to a cathode follower which delivers the information into the noise inverter circuit. The noise inverter is operated with a bow value of plate voltage and high bias which keeps the tube beyond cut
off. When the composite video signal is applied to the grid of the noise inverter the sync appears as positive pulses: noise which could affect the sweep circuits also appears as positive pulses. Harmful noise pulses usually have amplitudes far greater than the sync pulses, and therefore, drive the grid of
he noise inverter positive sufficiently to allow conduction in he noise-inverter plate circuit.
The output of the noise in
noise pulses. It should be noted consists of negative-going noise pulses. It should be noted that the noise pulses which
exceed the sync level have been passed and their polarity reversed by the noise inverter. The output of the noise inverter is now mixed with the composite video and fed to the grid of the sync separator, the triode section of the 6AX8 tube. Since the composite video fed to the grid of the sync separator has positive sync polarity, the positive noise pulses carried with the composite video would be passed by the sync separator; noise pulses, but they are of opposite polarity; thus, the nois pulses are cancelled. The output of the sync separator contain only the sync pulses which are fed to the vertical and horizontal ircuits. The vertical pulses are fed from the plate of the syn separator to the vertical oscillator through an integrator circuit The vertical oscillator employs a $12 \mathrm{AU7}$ tube as a cathod
coupled multivibrator. A variable resistor in the grid circuit of the second triode adjusts the oscillator frequency and serve as the hold control. A variable resistor in the plate circuit o the same tube provides vertical height adjustment. The vertical output stage employs a 12 B4 tube. A variable resistor in th cathode circuit provides adjustment of the vertical linearity side of the vertical output transformer to the picture tube cathode. The vertical sync is separated from the horizontal sync by the integrator circuit, and is fed to the grid of the vertical oscillator. The output of the vertical oscillator mplified by the vertical-output amplifier, using a 12B4 tube nd the output of the amplifier is applied to the vertical-deflec coils through the verti. is fut transform
ircuit which controls the frequency of the horizontal oscillato GALS tube is employed as the phase comparer in the hor ontal circuits. The plate of one diode is grounded, the athodes of boch diodes are tied together and, from a windin on the horizontal output transformer, a pulse is fed, through shaping network to the plate to the other diode. The hor des. If the incoming sync pulse is not in phase with the pulse from the horizontal output transformer, a difference oltage occurs in the output of the phase comparer which is fed the horizontal oscillator and is used to control its frequenc A cathode coupled multivibrator using a 12AU7A tube provides Aherid of the second thal. Two variable resistors in series employed as the horizontal hold control and horizontal hold entering control. With these controls, the horizontal oscillator requency is adjusted within the range of the phase compare ontrol voltage.
When the voltage is delivered to the horizontal oscillato grid by the phase comparers circuit is positive, it increases th reduces the frequency of the oscillator. This control voltag holds the horizontal oscillator in phase with the sync signal The HORIZ. HOLD control, adjusts the horizontal oscillato othe proper frequency, so that it may be controlled by the hase comparer. The output of the horizontal oscillator is fe
The second anode voltage for the picture tube is furnished by he sectuge winding of the horizontal-output transformet and is rectified by a 1 B3GT high-voltage rectifier tube.

## VIDEO PEAKING-COIL ADJUSTMENT - TV-400

 The peaking con, T , is adjusted at the factory for prop ransient response of the video circuits. Ordinarily, this coil will require no further adjustment by the serviceman. On any anon where excessive overshoot or excessive smear is presen hat station; however this adjustment may sacrifice the qualit on other channels. If Ts is replaced in servicing, adjustmen will be required.Before adjusting TS, check the tuner alignment and I-F and adjust Ts antil there are no trailing whites or smear in the picture. Turning T5 lockwise reduces trailing whites and overshoot; turning 15 ounterclockwise reduces picture smear and increases trailing whites. The proper position is the point where no smear or railing whites appear in the picture

The above procedure for adjustment of T s applies to a partidiar station exhibiting smear or overshoot. After $T$ S is ad insted, reception on all the other stations should be checked, to make certain that the adjustment has not impaired the pictur quality.

## TELEVISION ALIGNMEN

General
The alignment procedure follows the general pattern of first oscilloscope, comparing the response curve with generator and oscilloscope, comparing the response curve with that given in
the manual, and aligning the tuner if necessary. After it is established that the tuner is in correct alignment, the video I-F hannel is aligned by tuning each coil to its assigned pole fre quency, using an AM signal, and then feeding in a sweep signal $t$ the antenna terminals and retouching the I-F adjustments to obtain the desired pass band. Finally, the sound channel is and the I-F and ratio-detector transformers.
The over-all response curve (r-f, i-f) of the circuits from the antenna terminals to the video detector, after the I-F stages have been aligned, should appear essentially the same, regardless o he channel under test. If not, the tuner should be aligned. The video-carrier intermediate frequency is 45.75 mc ., and
he sound intermediate (intercarrier) frequency is 4.5 mc Alignment of these circuits requires careful workmanship and good equipment. The following precautions must be observed:

1. There must be a good bond between the receiver chassis and the test equipment. This is most easily obtained by havin the top of the workbench metallic. The receiver chassis should be placed tuner-side down on the bench. If the bench has no metallic top, the test equipment and chassis can be bonded by strip of copper abour 2 inches wide. The sest
chassis nearest the tuner should rest on the strip is turned on.
2. Allow the receiver and test equipment to warm up for 15 minutes before starting the alignment.
3. The marker (AM) signal generator should be calibrated accurately to the frequencies used and to the sound and video
$r$-f carriers of each channel used during alignment. If model 7008 is used, the built-in crystal calibrator provides an excellen means of calibration. An alternate method for calibrating the signal generator to the sound and video r-f carrier frequencies is to zero-beat the signal generator with the received signals. For Primer informain $(\mathrm{J})$ "Ting

## HORIZONTAL-OSCILLATOR ADJUSTMENT - TV-400

To adjust he horiza and proceed as follows

1. Decenter the picture until blanking can be observed a the right-hand side blanking becomes visible enTNESS control setting until the bar on each side of the picture
2. Connect a .1 mf condenser from the test point, to ground. (The plate side of the horizontal ringing coil, $T 6$, is connected to the test point.)
3. Set the HORIZONTAL HOLD control to the approx mate enter of its mechanical rotation
4. Adjust the HORIZ until equal por
of the picture.
5. Remove the .1 mf condenser from the test point. 7. Adjust the horizontal ringing coil until equal portions of the blanking bar again appear on both sides of the picture.
6. Rotate the HORIZONTAL HOLD control through range. The picture should fall out of sync on both sides of the center of its rotation. If the picture does not fall out of sync on both sides, readjust the HORIZONTAL HOLD CENTERING control.
7. Rotate the HORIZONTAL HOLD control through its range, and obscrve the number of diagonal blanking bars that appear just before the picture pulks into sync.
should occur with from 1 to 2 diagonal bars when the sync position is approached from either direction. If proper pullin is not obtained, repeat the above procedure.

## JIGS AND ADAPTERS REQUIRED - TV-400


$\xrightarrow{\text { Mixer Jig }}$
Connections to the grid of the mixer tube may be made the generator to this point, a mixer-grid jig, Philco Part No


45.1739, and a connecting cable, Philco Part No. 45-1635, may be used. As an alternate, a Philco alligator-clip adapter, Part No. 45 . 1636 , with as short a ground lead as possible, may be used to connect the alignment jack. The ground lead should be connected as close as possible to the mixer tube. It is essential that the signal-generator output lead be terminated with a 68 -ohm resistor (carbon), so that regeneration, caused by conection of the lead to the mixer, is held to a minimum.
Antenna-input Matching Network
An impedance-matching network for coupling the signal in figure 1. ${ }^{\text {T }}$ This nerwork, which is designed to have an input impedance of 75 ohms and an output impedance of 300 ohms is used to match a 75 -ohm generator to a 300 -ohm antenna-input circuit. The resistors used in this network should be of carboncomposition construction, and should be chosen from a group,
to obtain values within ten percent of those indicated. The to obtain values within ten percent of hose indicated. The
resistors should be placed in a shield can, to prevent variable effects. An antenna-matching iig, Philco Part No. 45-1736, which consists of a matching transformer and connecting box, may be used in place of the resistor network.

## Video I-F Alignment Jig

(Video Test Jack Adapter No. 1)
The alignment jig used at TS1 and shown in figure 2, should be used during the i-f alignment, to apply the proper bias to the a-g-c bus, and to provide a convenient oscilloscope connec-
tion. This adapter consists of a five-pin plug, two 10,000 ohms resistors, and a 1500 mmf condenser for isolation of the bias supply. To isolate the oscilloscope from the receiver circuits, a 15,000 -ohm resistor, by-passed by a 1500 mmf . condenser, is used. A suggested method of fabricating the jig is also shown in figure 2. This jig should not be used to observe the comosite video from the video detector output

## Sound I-F Input Alignment Jideo Test Jack Adapter No. 2)

Video Test Jack Adapter No. 2)
To observe the composite video, at TS1, a jig may be made The 2200 ohm resistor should be connected to pin 2 of the plug. A ground lead should be connected to pin 3. To observe the composite video, connect the oscilloscope to the 2200 ohm resistor and the ground lead. This jig is also used for injection of the 4.5 mc . signal during s.i-f alignment.



TUNER BAND PASS ALIGNMENT
(Soe Table No. 2


Fig. 4. Television tuner response curve,
showing bandpars limits.


Fig. S. Television tuner response curve, showing tracking compensation.

## TUNER OSCILLATOR ALIGNMENT

TABLE NO.
M GENERATOR: Connect to receiver antenna-input terminals. (No matching network is required.) Use unmodulated r.f outpur.
OSCILLOSCOPE: Connect the vertical-input lead, in series
Connect the scope ground lead to the chassis, near the test point.
RECEIVER CIRCUIT ALTERATIONS: Disconnect tuner a-g-c (pink tracer) lead from main chassis, and connect a 1.5 volt bias battery, with negative terminal to white lead from with a $1000-$ ohm resistor, to the mixer grid test point. tuner, and positive terminal to chassis.

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## UUNER BANDPASS ALIGNMENT - TABLE 2

SWEEP (FM) GENERATOR: Connect to receiver antennainput throu
figure OSCILLOSCOPE: Connect the oscilloscope to the iunction of
RS18(1SK,1W) and the tuner red lead. Clip ground lead of scope to chassis.

| STEP | SWEEP (FW) GENERATOR |  | RECEVER | aduest | bemarks |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  | Smeet plas | Marker Dial Settine |  |  |  |
| 1 | Channel 13 ( 213 m., with 10 -mc. sweep width.) | Set first to 210 mc . and note position of marker on response curve. Set to 216 mc . and note position of marker on responise curve. | Channel 13 |  | Oscilloscope gain as high as possible with respect to hum level and "bounce". Pips fix channel limits on curve. Response curve to be flat between limits (see figure 4). If not, proceed with step 2. |
| 2 | Channel 13 | 213 mc . | Channel 13 | T8 counterclockwise until single peak appears. | CAUTION: Care must be taken not to unscrew core far enough to make it drop out of the coil. |
| 3 | Channel 13 | 213 mc . | Channel 13 | T15 until peak falls on 213 mc . marker. | Sweep Generator output may have to be increased. |
| 4 | $\begin{aligned} & \text { Channel 7 } \\ & \text { (177 mc., with } \\ & \text { 10-mm. wweep } \\ & \text { widt } \end{aligned}$ width.) | Set first to 174 mc . and note position of marker on response curve. Set to 180 mc . and note position of marker on response curve. | Channel 7 |  | Note curve with respect to tilt and center frequency. Curve should be centered in pass-band and symmetrical. If not, proceed with step 5 . |
| 5 | Channel 7 | $\begin{aligned} & 174 \mathrm{mc} . \\ & \text { and } \\ & 180 \mathrm{mc} . \end{aligned}$ | Channel 7 | VC3 and VC2 to get correct tilt on top of curve. | VC3 and VC2 compensate for the tuning effect of Channel 13 adjustment upon Channel 7. (See figure 5.) |
| ${ }^{6}$ | Channel 13 | 213 mc . | Channel 13 | Retouch T15 and T8 for symmetrical re213 mc . marker. | To retouch, only turn cores slighty. |
| 7 | Channel 7 | 117 mc . | Channel 7 | Repeat step 5. | Check response curve for correct center frequency and symmetry. |
| 8 |  |  |  | Repeat steps 6 and 7. | Repeat Channel 13 and Channel 7 adjustments, alternately, until favorable curves are obtained on both. |
| 9 | $\begin{aligned} & \text { Channel } 6 \\ & \text { (85 m. with } \\ & \text { 10-mc. sweep } \\ & \text { width.) } \end{aligned}$ | Set first to 82 mc and note position of marker on response curve. Set to 88 mc . and note position of marker on response curve. | Channel 6 |  | Curve should be symmetrical and centered in pass-band. If not, proceed with step 10. |
| 10 | Channel 6 | 85 mc . | Channel 6 | T14 counterclockwise until single peak appears. | CAUTION: Care must be taken not to unscrew core far enough to make it drop out of the coil. |
| 11 | Channel 6 | 85 mc . | Channel 6 | T21 until peak falls on 85 -mc. marker. | Sweep Generator output may have to be increased. |
| 12 | Channel 6 | 85 mc . | Channel 6 | T27 for maximum curve height and symmetry of single peak. | After adjusting T27 recheck as in step 9. If necessary, reduce Sweep Generator output to avoid overloading. |
| 13 | Channel 6 | 85 mc . | Channel 6 | Retouch T21 and T14 for symmetrical re 85 -mc. marker. | To retouch, only turn cores slighty. |
| 14 | $\begin{aligned} & 43.5 \mathrm{mc} \text {. } \\ & \text { (with } 10 \text {-mc. } \\ & \text { sweep width.) } \end{aligned}$ | Set first to 45.75 mc. and note position of marker on response curve. Set to 41.25 mc . and note position of marker on response curve. | $\underset{\substack{\text { UHF } \\ \text { (Channel } \\ \text { position.) }}}{ }$ |  | Disconnect sweep (FM) generator from antenna-input terminals and conach to 40 mc. input jack TP1, using a matching network. Curve should be symmetrical ang fat-opped. Markers should fall along flat-topped portion of curve. If not, proceed with step 15. |
| 15 | $\begin{aligned} & 43.5 \mathrm{mc} \text {. } \\ & \text { (with } 10 \text {-mc. } \\ & \text { sweep width.) } \end{aligned}$ | 43.5 mc . | $\begin{gathered} \text { UHF } \\ \begin{array}{c} \text { (Channel } 1 \\ \text { position.) } \end{array} \end{gathered}$ | T9 for most symresponse curve, centered about 43.5 mc . marker. | Recheck band-pass as in step 14, and repeat adjustment if necessary. |

VIDEO I-F ALIGNMENT
mixaror: Connect to mixer test point, TP-2, through
a mixer iig, and adjust the generator for approximately
of the generator during 400 cycles. Adjust the output the second detector below 4 volts peak to peak.

BIAS: Apply 10 volts of negative bias, through 10,000 -oh resistor, to pin 1 of video I-F alignment jig; ground positive side of bias supply to pin 3 of jig. (See figure 2). en repairs, it mus be replaced before proceeding with the alignment.

PRESET: Contrast and Brightness controls fully counterclock oscilso and channel selecior to channel
OSCILLOSCOPE: Connect the vertical-input lead to the $15,000-\mathrm{hm}$ resistor of the video i-f alignment jig. Con See fcope ground 2). Plug jig in ts TS SWEEP (FM) GENERATOR: antenna-input circuit through antenna-input matching ner. work. (See figure 1).

Fig. 7. Over-all R-F, I.F response curve,
sbowing tolerance limits.

|  |  | SWEEP (FM) GENERTTOR |  | adjust |
| :---: | :---: | :---: | :---: | :---: |
| STEP |  | $\begin{aligned} & \text { Sween Dial } \\ & \text { Settling } \end{aligned}$ | Marker Dial Setting |  |
| 1 | 47.25 mc . | not used | not used | VC3 and VC8 for minimum indication on scope |
| 2 | 41.25 mc . | not used | not used | VC9 for minimum indication on scope. |
| 3 | 39.75 mc . | not used | not used | VC4 for minimum indication on scope. |
| 4 | 42.7 mc . | not used | not used | Ti for maximum indication on scope. |
| 5 | 43.1 mc . | not used | not used | VC1 for maximum indication on scope. |
| 6 | 44.4 mc. | not used | not used | VC2 for maximum indication on scope. |
| 7 | 42.0 mc . | not used | not used | VC6 for maximum indication on scope. |
| 8 | 45.0 mc . | not used | not used | VC5 for maximum indication on scope. |
| 9 | 45.7 mc . | not used | not used | VC7 for maximum indication on scope. |
| 10 | not used | $\begin{aligned} & \text { Channel } 4 \text { (69 } \\ & \text { mc., with 6 } \\ & \text { mc., width.) } \end{aligned}$ | Run marker along curve checking against the curve limits given in figure 8. | If necessary, retouch T1, VC6, VC7, VC5 and VC1 as directed in REMARKS column. CAUTION: <br> Do not touch the setting 1, 2 and 3. |




REMARKS

It is necessary to keep the generator out-
put suffiently high that a null indication may be observed on the oscilloscope; how
ever, avoid overloading of the receive
by excessive signal. by excessive signal.
T1 located on tuner. Adjust the output T1 located on tuner. Adjust the outpu
of the AM generator when necessary, to keep the output at the second detccto
below 4 volt, pak to peak. (For con
venience venience, the oscilloscope may be cal
brated for this purpose beforehand.)
$\qquad$

Ser fine runing cam to middle of range. limits shown in figure 7 , netouch VC 5 and VC1 alternately. T1, VC5 and VCI an
fect dip fect dip of curve and VC2 affects tilt o
curve. AAdjust VCG for proper slope a
42.0 m., side of curve and VC7 42.0 mc., side of curre, and VIop for
proper level of curve, at video carrier fre.
quency. If cury quency. If curve surve, at video carrier fre-
the limits, arstight readil within
it


SOUND TAF ALIGNMENT
AM GENERATOR: Connect "hot" lead through a 2200 Thm (Figure 3.) Connect ground lead of generator to ground $\begin{gathered}\text { Connect to sound test point and ground. } \\ \text { 2) of picture fonect through crystal probe to grid (pin }\end{gathered}$


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PARTS LIST CHASSIS - MECHANICAL






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## TUNER - ELECTRICAL


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Alignment Procedure
NECESSARY EQUIPMENT
Television Sweep Generator
Marker Freq. Generator
Vacuum Tube Voltmeter
4.5 Mc fixed freq. Generator or equivalent

## I.F. ALIGNMENT

1. Connect VTVM and the input terminal of the scopes' vertical amplifier o the juncture of 8200 ohm resistor and 410 uh choke - this is immediately following the video detector, the 8200 ohms being the resistor portion of the detector load. I.F. signal may be introduced by means of a miniature tube shield floated over the 6AG5 mixer tube.
2. With the sweep off and the marker frea. set to 23.3 mc , adjust the lst and 3 rd I.F. coils for maximum response, as indicated by VTVM. Generator should be attenuated so as not to provide more than threshold sensitivity (l volt on VTVM at fixed freq., $1 / 2$ volt on sweep.)
3. Re-set marker frequency to 25.6 mc and adjust 2 nd and 4 th I.F. trans formers for maximum VTVM indication, as above.
4. With sweep turned on observe I.F. curve shape on oscilloscope - the kne of the curve should be at approximately $23.5 \& 25.5 \mathrm{mc}$. If original align ment did not produce satisfactory curve, it may be modified by adjusting be taken that both peaks are whe observing the curve on the scope. Care must be taken that both peaks are approximately the same height and that the midportion of the curve is not down more than about 2 db . The sound rides at 21.6 mc and this point should be checked to make sure that it is at least 26 db below the flat top. The picture frequency rides the curve at 26.1 mc and should be 6 db down on the opposite side of the curve. The curve should be about 3 mc wide at 6 db down ( $1 / 2$ way down).

## SOUND ALIGNMENT

1. Connect 4.5 mc generator to the grid of the video amplifier tube (there again, low signal level is important, so that limiting action does not occur.) Metering may be accomplished at the sound take-off point of the ratio and detector (at the juncture of the 15,000 ohm resistor and the 3900 mmf capacitor)
2. Adjust the top and bottom slugs on the sound trans for maximum response 3. Adjust primary of ratio detector (top slug) to maximum.
3. Connect meter ground to the juncture of the two 6800 ohm resistors off the sound detector, and adjust the bottom slug on ratio detector to Zero voltage.

## R.F. ALIGNMENT

The R.F. Tuner in this receiver has been pre-aligned by the manufacturer, and it is not recommended that adjustment be made in the field, especially since the fine tuning control will move the oscillator at least $3 / 4 \mathrm{mc}$ on the low channels and 2 mc on the high channels.

VOLTAGE MEASUREMENTS

6BG6


Phase Detector
No Signal
Signal

| Pin | +2.5 | +3.4 |
| ---: | ---: | ---: |
| 2 | -1.2 | -1.6 |
| 3 | GND |  |
| 4 | HTR |  |
| 5 | 0 |  |
| 6 |  |  |
| 7 | 0 |  |

Clipper Sync. Separator No Signal

Signal

| Pin 1 | +120 |  |
| ---: | ---: | ---: |
| 2 | 0 |  |
| 3 | +6.5 |  |
| 4 | HTR |  |
| 5 | HTR |  |
| 6 | +6.2 | +3.6 |
| 7 | GND |  |
| 8 | +1.3 | +18 |
| 9 | GND |  |





 are identical except tor cabinets and speakers. Models 21. T- 313 GU and 21 -T-314GU employ a 21 EP4 gla
wise identical. These receivers feature full twelve channel VHF coverage plus any four UHF channels.

## ELECTRICAL AND MECHANICAL SPECIFICATIONS

ICTURE SIZE. 227 sq. ins. on a 21 AP4 or a 21 EP4 Xinescope TELEVISION R-F FREOUENCY RANGE
Models $21-7.303,313,313 \mathrm{G}, 314,314 \mathrm{G}, 315,316,322,323$ \& 324
 Modelss 21.T-303U.
$322 U .323 U \& 324 U$
Any desired combination of 16 VHF and/or UHF channels, 54 me. dosired combination of 174 mc. to 216 mc ., 470 mc mo to 890 mc . ICTURE CARRIER FREQUENCY............ 45.75 mc OUUND CARRIER FREQUENCY........ 41.25 mc UDIO POWER OUTPUT RATING IDEO RESPONSE, FOCUS..
OWER SUPPLY RATING KCS82 and KCS82A chassis $\quad . \quad 115$ volts, 60 crcles, 215 watts
KCS82B chassis.


ADJUSTMENT OF HORIZONTAL OSCILLATOR.-I contro at the extreme counter-clock wise position or tailed to
hold sync over the balance of clockwise rotation of the ontrol old sync over the balance of clock wise rotation of the control
oom the pull-in point, it will be necessary to make the follow. rom the pull-in
ing adjustments.

RECEIVER ANTENNA INPUT IMPEDANCE
CS82 chassis (KRK11B Tuner)
Choice: 300 ohms balanced or 22
CS82A chassis (KRK22A Tuner)
Choice: 300 ohms balanced or 72 ,
KCSB2B chassis (KRK12 Tuner)
HF-Choice: 300 ohms balanced or 72 ohms unbalanced LOUDSPEAKERS Models 21-T. $303,21 . \mathrm{T} .303 \mathrm{U}$,
Models 21 T. 313 , 21 T .313 G, .
 3.2 ohms
 Models 21-T-323, 21-T-323U, 971692 -1) $10^{\prime \prime}$ PM, 3.2 ohms


Figure 3-Rear Chassis Adiustments
Horizontal Frequency Adjustment. - Turn the horizontal hold contron to the extreme clockwise position Tune in a tele.
vision station and adust the Tll 14 horizontal frequency vision station and adjust the T114 horizontal frequency adjust.
ment at the rear of the chassis until the picture is just out of sync and the horizontal blanking appears as a a vertical or
diagonal black bar in the eraster. hen turn the T114 core until
dhe bar moves out of the pactur .

Horizontal Locking Range Adjustment-Set the hor
zontal hold control to the full counter-clockwise position Momentarily remove the signal by switching ofic channel the
back. The picture back. The picture may remain in sync. If so turn the T114 rear
core slightly and momentarily switch off channel. Repeat until
 down to the left Sl Sowly turn the horizonal hold control clock.
wise and onote e the east number of diagonal bars obtained just
betore the picture pull before the picture pulls into sync. In more than 3 bars are present just before the picture pulls
into sync, adjust the horizontal locking range trimmer C C 174 A
sightly clockise slightly clockwise. If less than 2 bars are present, madust C 1744
silighty counter-clockwise. Turn the horizontal hold siightly countrer-clockwise. Turn the horizontal hold control
counter.clockwise, momentarily remove the signal and recneck
the number of bars present at the pull-in point. Repeat this counter.clockwise, , momentanily remove the signal and recneck
the number of bars present at the pull-in point. Repeat thit
procedure until 2 or 3 bars

Repeat the adjustments under "Horizontal Frequency.Adjust
ment" and "Horizontal Locking Range Adjustment" until the zonditions specified under each are fulfilled. When the hor zontal hold operates as outlined under "Check of Horizontial
Oscillator Alignment" the oscillator is properly adjusted
If it is impossible to sync the picture at this point and the adjust the Horizontal Oscillator by the method outlined in th alignment procedure on page 16 . For field purposes paragrap
" $B$ " under Horizontal Oscillator Waveform Adjustment may
be omited be omitted.
Adjustments of the horizontal drive control affect horizontal
oscillator hold and locking range. If the drive control was oscillator hock and locking range.
adjusted, recheck the oscillator alignment.
MENTS.-Adjust the heightal LINEARITY ADJUST panel) until the picture fills the mask verticall linearity (R186 under front control nanel), until the test pa control will require a readjustment of the Adhustment of of either ing to align the picture with the mask.
FOCUS. - Adjust the focus control for maximum definition in the test pattern ve
areas of the pattern.
Recheck the position of the ion trap magnet to make sur
Check to see that the yoke
Check to see that the yoke thumbscraw ahd the tocus magnet
KRKIIB R-F OSCILLATOR ADJUSTMENTS. -Tune in all available stations to see if the receiver r-f oscillator is ad justed to the proper frequency on all channels. If adjustmen!
are required, these should be made by the method outlined in the alignment procedure on page 11 . The adjustments for chan
nels 2 through 12 are available from the fron nels 2 through 12 are by removing the from by removing the station selector escutcheon as shown in
4. Adjustment for channel 13 is on top of the chassis.
KRKZ2A R-F OSCILLATOR ADJUSTMENTS. -Tune in all available stations to see in he receiver r-f oscillator ments are required, these should be made by the method out lined in the alignment procedure on page 13. The adjustment cabinet by removing the station selector escutcheon as show in Figure 5. Adjustment tor channel 13 is C 3 on top of the
in


To Rewove scurchion sup

Figure S KRK22A
KRKI2 R-F OSCILLATOR ADJUTMENT fine tuning control to the center of its range on the channel to fine tuning control to the center of its range on the channel to
be adiusted. Adjust the oscillator core for this channel to obtain maximum audio output without distortion. The adjust
ment location is the same for all channels, see figure 6 . The insert in the operating position can be determined by a stamp inger in the insert drum. This stamping is visisible through either
ing on the
the front or rear apertures as shown in tisur


ar apertures as shown in figure

AGC THRESHOLD CONTROL - The AGC threshold
control R154 is adjusted at the factory and normally should no control R154 is adjusted at the fac
require readjustment in the field.
To check the adjustment of the AGC Threshold Control, tune
in a strong signal and sync the picture. Momentarily remove the signal by switching off channel and then back. If the pic uure reappears immediately, the receiver is not overloading due to improper setting of R154. If the picture requires a
appreciable portion of a second to reappear, or bends exces ively, RI 54 should be readiusted.


Figure 6-KRK12 Oscillator Adjustment
Turn RI54 fully counter-clockwise. The raster may be ben
lightly, This should be disregarded. Turn R154 clockwise until picture. Then turn R154 sht bend or change of bend in the remove this bend or change of bend.
If the signal is weak, the above method may not work as it 154 clockwise until the snow in the pid. In this case, turn pronounced, then counter-clockwise until the best signal to is then cou
The AGC control adjustment should be made on a strong
signal if possible. If the control is set too far clockwise on a signal it possible. If the control is set too far clockwise on a
weak signal, then the receiver may overload when a strong
signal is received.
( MLliame
$0.30 M A$
0
$\qquad$ switch

Figure 9-KRK12 Voltage Control Adapter FM TRAP ADJUSTMENT. - In some instances interfer ence may be encountered from a strong FM station signal. the trap tune in the station on which the interference is ob
served and adiust the $F M$ trap for minimum interference in the



Figure 14-KRK11B Tuner Adjustments
CAUTION- -In some receivers, the FM trap L53 or L58
will tune down into channel 6 or even into chanel 5 Needless o say, such an adjustment will cause greatly reduced sensivity on these channels. If channels 5 or 6 are to be received,
heck L53 or L58 to make sure that it does not affect sensiheck L53 or L58 to make s.
vity on these two channels.
The FM trap on models using the KRK 12 Tuner is fastened or as describer ant abonne. cable and is adjusted in the same manReplace the cabinet back and connect the receiver antenna
leads to the cabinet back. Make sure that the screws holding $t$ are up tight, otherwise it maye sure that the screws holding
the buzz when the re.

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$\varepsilon-\nmid 39 \forall d$ ^1 $\forall J I 8 \exists W \forall ~ J O ~ N O I L \forall 8 O d \searrow O J ~ O I O \forall y ~$

## ALIGNMENT TABLE

| $\begin{gathered} \text { CONNECT } \\ \text { HRTROONE } \\ \text { FREO METE } \\ \text { TO } \end{gathered}$ |  |  | MISCELLANEOUS CONNECTIONS <br>  | adiust |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Loorly coupied | 239 mc . | ${ }_{\text {mplen }}^{\text {mpl Gain to maxi- }}$ | Rec. on channol 10 | L9 arabovo | Fig |
|  | 233 mc . |  | Rec. on channol 9 | L8 arabovo | $r_{\text {ric }}$ |
| " | 227 mc . | " | Roc. on channol 8 | L7 $\mathrm{SH}_{1}$ abovo | Fis |
| " | 221 mc . | " | Roc. on channel 7 | 16 at abore | $\mathrm{r}_{1}$ |
| " | 129 mc |  | Rec. on channol 6 | L5 ar above | $\mathrm{F}_{1}$ |
| " | 123 mc | " | Rec. on channol 5 | L4 as above | Fi) |
| * | 113 mc | " | Rec on channel 4 | L3 ar abovo | Fin |
|  | 107 mc |  | Rec. on channol 3 | L2 ar above | F. |
|  | 101 mc | , | Roc. on channel 2 | Ll as abore |  |

KRKIIB ANTENNA MATCHING UNIT ALIGNMENT

## 



Connection between L58 and S5. Roplace V106
KRK22A TUNER ALIGNMENT


ALIGNMENT TABLE
the detailed alignment phoctdure begining on page b should be bead before alignment by use of the table is attempted
alignment table


ALIGNMENT TABLE




$\longleftarrow$
igure 54-Horizontal (5s Volts PP)
$\#$



$\begin{aligned} & \text { Figure } 61 \text {-Grid of Horizontal Oscil- } \\ & \text { lator Control }\end{aligned}$
$\begin{gathered}\text { lator Control }(\text { Pin } 1 \text { of V114) } \\ (6 S N 7 G T)(22.5 \text { Volts PP) }\end{gathered}$
$\begin{aligned} & \text { Figure 62-Cathode of Horizontal } \\ & \left.\text { Oscillator Control (Pin } 3 \text { of } V_{114}\right)\end{aligned}$
$\begin{aligned} & \text { (6SN7GT) (1.2 Volts PP) }\end{aligned}$

Figure 63-Grid of Horizontal Oscillator (Pin 4 of VI14)
$(6 \mathrm{~N} 7 \mathrm{GT})(345$ Volts PP)

Figure 64-Plate of Horizontal Oscillator (Pin S of VI14)
$(6 S N T G T)(175$ Volts $P$ )


Figure $69-$ Plate of Damper
(Pin 5 of V117) $(6 W Y 4 G T)$
in 5 of V117) $(6 W 4 G$
$(160$ Volts $P P)$ $\stackrel{+160}{ }$
Figure $70-$ Plate of AGC Amplifer
$($ (inn 1 of V111A)

$\xrightarrow{5.30 \text { Volts PP) }}$




Grid of Horizontal Sync Separator
(Pin 7 of V111B) $(12 A U 7)$ (Pin 7 of V111B) (12AU7)
Voltage depends on picture

Figure 41- Vertical (85 Volts PP) $\longleftarrow 4$

Figure 42-Horizontal (85 Volts PP) $\Rightarrow$

## Cathode of Horizontal Sync Sep $($ Pin 8 of V111B) $(12 A U 7)$

Figure 43-Veritical (12 Volis PP) $\longleftarrow$

Figure 44-Horizontal (7.5 Volts PP)


Plate of Horizontal Sync Separator
$($ Pin 6 of $V 111 B)(13 A U 17)$
Figure 45-Vertical (45 Volts PP) $\longleftarrow<$
Figure 46-Horizontal (45 Volts PP) $\Rightarrow$

Grid of Vertical Sync Sep.
(Pin 7 of V109B) $(12 A U 7)$

Figure 47 -Vertical (65 Volts PP) $\longleftarrow \leftarrow$
Figure 48-Horizontal (65 Volts PP) $\Rightarrow$

Plate of Vertical Sync Sep.
(Pin 6 of $V 109 B)(12 A U 7)$
Figure 49-Vertical (70 Volts PP) $\longleftarrow \leftarrow$
Figure 50-Horixontal (70 Volts PP)



CHASSIS KCS82, KCS82A, KCS82B

The following measurements represent two sets of conditions. In the first condition, a 15000 microvolt test pattern signal was fed into the receiver,
the picture synced and the $A$ GC control properly adiusted. The second condition was obtained by removing the antenna leadd and hort cer the pieture synced and the AGC control proporly adjusted. The second condition was obtained by removing the antena leads and short circuiting
the reeceiver antenn terminals. Voltages shown are eread with a atype WV97 senior "Volto hysti' between the indicated terminal and chassis
ground and with the receiver operating on 117 volts, 60 cycles, ac. The symbol < means less than.

| $\begin{aligned} & \text { Tube } \\ & \text { No } \\ & \text { No. } \end{aligned}$ | $\begin{gathered} \text { Tube } \\ \text { Type } \end{gathered}$ | Function | Operating Condition | E. Plote |  | E. Scroon |  | E. Cathod |  | E. Grid |  | Noter on Measuremente |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{gathered} \text { Pin } \\ \text { No. } \end{gathered}$ | Volts | $\begin{aligned} & \mathrm{m}_{\mathrm{n}} \\ & \mathrm{No}_{0} \end{aligned}$ | volu | $\begin{aligned} & \text { Pin } \\ & \mathbf{N O}_{0} \end{aligned}$ | Votu | $\begin{aligned} & \text { pin } \\ & \text { No. } \end{aligned}$ | Volt. |  |
| v1 <br> KRK11 ${ }^{\text {B }}$ kRK22A | 6x8 | Mixer | $\begin{gathered} 15000 \mathrm{Mu}, \mathrm{~V} . \\ \text { Sianal } \end{gathered}$ Signal | 9 | 160 | 8 | 160 | 6 | 0 | 7 |  |  |
|  |  |  | No Signal | 9 | 145 | 8 | 145 | 6 | - | 7 | ${\underset{-3.5}{-2.810} 0}^{2}$ |  |
|  |  | $\begin{aligned} & \text { R.F Fill } \\ & \text { O.ocillor } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 95 | - | - | 6 | - | 2 | $\begin{array}{l\|l\|l\|l\|} \hline-3.8 .5 \\ -5.5 \end{array}$ |  |
|  |  |  | No Signal | 3 | 90 | - | - | 6 | 0 | 2 | ${ }_{-5.1}^{-3.0 \text { to }}$ |  |
| $\begin{aligned} & \text { v2 } \\ & \text { KRK11 } \\ & \text { KRK } 22 \mathrm{~B} \end{aligned}$ | 6807A | $\begin{gathered} \text { RAplitior } \\ \text { Rer } \end{gathered}$ | $15000 \mathrm{Mu} . \mathrm{V} .$ <br> Signa | 6 | 170 | - | - | 8 | 0.1 | 7 |  |  |
|  |  |  | No Signal | 6 | 133 | - | - | 8 | 1.1 | 7 | - |  |
|  |  | $\stackrel{\substack{\text { Amplifior }}}{ }$ | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 1 | 270 | - | - | 3 | 170 | 2 | - |  |
|  |  |  | No Signal | 1 | 260 | - | - | 3 | 133 | 2 | - |  |
| $\begin{array}{\|l\|l\|} \hline \mathrm{v}_{1} \\ \text { KRK12 } \end{array}$ | 6807A | $\underset{\text { Amplitior }}{\substack{\text { R.F }}}$ | $\underset{\substack{15000 \mathrm{Mu} \\ \text { Signal }}}{\text { V. }}$ | 6 | 143 | - | - | 8 | 1.2 | 7 | 0 | Shelf removed from tuner box 654 removed from socket to nal on tuner grounded. |
|  |  |  | No Signal | 6 | 138 | - | - | 8 | 1.0 | 7 | - |  |
|  |  | $\underset{\substack{\text { Rmplifior }}}{ }$ | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 1 | 260 | - | - | 3 | 143 | 2 | 97 |  |
|  |  |  | No Signal | 1 | 250 | - | - | 3 | ${ }^{137}$ | 2 | 97 |  |
| v2 knK12 | 6AF4 | $\begin{gathered} \text { R.F } \\ \text { Oncillator } \end{gathered}$ | $\underset{\substack{15000 \mathrm{Mu} \\ \text { Signal }}}{\text { v. }}$ | 187 | 78 | - | - | 5 | 0 | 206 | -8 |  |
|  |  |  | No Signal | 187 | 75 | - | - | 5 | 0 | 246 | -6 |  |
| v3 <br> kRK12 | 6807A | $\begin{gathered} 1 . \mathrm{Fmpifitior} \end{gathered}$ | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 6 | 270 | - | - | 8 | 148 | 7 | 103 | Shelf removed from tuner box$6 S 4$ removed from socket to mal on tuner groundede term - |
|  |  |  | No Signol | 6 | 260 | - | - | 8 | 142 | 7 | 99 |  |
|  |  | $\begin{aligned} & \text { I-F } \\ & \text { Amplifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | 148 | - | - | ${ }^{3}$ | 1.4 | 2 | - |  |
|  |  |  | No Signal | 1 | 143 | - | - | 3 | 1.2 | 2 | 0 |  |
| $\begin{aligned} & \text { v4 } \\ & \text { KRK12 } \end{aligned}$ | 654 | $\begin{gathered} \text { Voltage } \\ \text { Control } \end{gathered}$ | 15000 Mu . V. Signal | 9 | 270 | - | - | 2 | 94 | 6 | *88 | -Dopenda on odiuatmont of R6. |
|  |  |  | No Signal | 9 | 260 | - | - | 2 | so | 6 | ${ }^{65}$ |  |
| v101 | 6aug | 1.t SoundI.F F .mp. | 15000 Mu. Signal. | 5 | 127 | 6 | 140 | 7 | 1.0 | 1 | - |  |
|  |  |  | No Signal | 5 | 110 | 6 | 135 | 7 | . 9 | 1 | $\bigcirc$ |  |
| v102 | 6aug | 2nd Sound1-F Amp. | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 5 | 125 | 6 | 136 | 7 | 0 | 1 | -13 |  |
|  |  |  | No Signal | 5 | 105 | 6 | 115 | 7 | 0 | 1 | --0.8 | Unreliable meaturing point Voltage depende on noise |
| v103 | ${ }_{6 \times 2}$ | Ratio <br> Detector | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | 7 | 0.3 | - | - | 1 | 7.2 | - | - | 7.5 ke deviation at 1000 cycles |
|  |  |  | No Signal | 7 | 0 | - | - | 1 | ${ }^{2} 8$ | - | - | - Uaralisble mensuring point |
| v104 | 6Av6 | $\begin{aligned} & \text { 2at Audio Aup } \\ & \text { Amplitior } \end{aligned}$ | $\begin{aligned} & 15000 \mathrm{Mu} . \mathrm{V} . \\ & \text { Signal } \end{aligned}$ | 7 | 89 | - | - | 2 | 0 | 1 | -0.8 | $\mathrm{At}_{\text {min. }}$ volume ${ }^{\text {a }}$ |
|  |  |  | No Signol | 7 | 87 | - | - | 2 | 0 | 1 | -0.8 | At min. volume |
| v105 | 6K6GT | $\begin{array}{\|c} \text { Audio } \\ \text { Output } \end{array}$ | 15000 Mu. Signal | 3 | 217 | 4 | 225 | 8 | 15.2 |  |  | At min. volumo |
|  |  |  | No Signol | 3 | 210 | 4 | 219 | 8 | 15.0 | 5 | 0 | ${ }^{\text {At min }}$ volume |
| v106 | $6 \mathrm{Cr6}$ | $\begin{aligned} & \text { lat Pis. } 1 . \mathrm{F} \\ & \text { Amplifier } \end{aligned}$ | 15000 Mu . V. Signal | 5 | 202 | 6 | 225 | 2 | $<0.1$ | 1 | -7.5 |  |
|  |  |  | No Signal | 5 | 100 | 6 | 112 | 2 | 0.9 | 1 | *-0.1 | Unreliable measuring point. Make mosouroment tat T104.B. |
| v107 | ${ }_{6} 6$ cr 6 | 2nd Pix. I-F Amplifier | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | $s$ | 205 | 6 | 225 | 2 | $<0.1$ | 1 | -7.5 |  |
|  |  |  | No Signal | 5 | 100 | 6 | 111 | 2 | 0.5 | 1 | -0.1 |  |

VOLTAGE CHART

| Tubo | $\begin{gathered} \mathrm{T}_{\text {Tube }} \mathrm{tpe} \end{gathered}$ | Function | OperatingCondition | E. Plate |  | E. Scroon |  | E. Cathode |  | E. Grid |  | Noteo on Mosaurements |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{gathered} \text { Pin } \\ \text { No. } \end{gathered}$ | voltr | $\underset{\substack{\text { Pin } \\ \text { No. }}}{ }$ | Votus | $\begin{aligned} & \text { Pin } \\ & \text { No } \\ & \text { No. } \end{aligned}$ | Volte | $\begin{aligned} & \text { Pin } \\ & \text { No } \\ & \mathrm{No}^{\prime} \end{aligned}$ | Volte |  |
| v108 | ${ }_{6} \mathbf{C B 6}$ | 3rd Pix. I-F Amplifier | $15000 \mathrm{Mu} . \mathrm{V}$. | 5 | 140 | 6 | 153 | 2 | 2.1 | 1 | - |  |
|  |  |  | No Signal | 5 | 130 | 6 | 141 | 2 | 1.9 | 1 | - |  |
| v109A | 12AU7 | Picture <br> 2nd Det | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 1 | -21 | - | - | 3 | 0 | 2 | $-3.8$ |  |
|  |  |  | No Signal | 1 | $-10$ | - | - | 3 | 0 | 2 | -0.4 |  |
| v1098 | 12AU7 | Vert. SyncSeparator | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 6 | ${ }^{68}$ | - | - | 8 | - | 7 | 58 |  |
|  |  |  | No Signol | 6 | 62 | - | - | 8 | - | 7 | -5.6 |  |
| v110 | ${ }_{6 C 1} 6$ | Video <br> Amplifier | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 6 | 82 | 3.8 | 180 | 1 | 1.1 | 2.9 | $-3.4$ | AGC control set for normal operation |
|  |  |  | No Signal | 6 | 73 | 3.8 | 99 | 1 | 0.9 | 2.9 | -0.4 | AGC control set for normal operation |
| v1114 | $12 \mathrm{AU7}$ | ${ }_{A \text { mplifier }}^{\mathrm{AGC}}$ | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 1 | 42 | - | - | 3 | 148 | 2 | 115 |  |
|  |  |  | No Signal | 1 | 0 | - | - | 3 | 135 | 2 | 82 |  |
| vini | 12AU7 | Hor. SyncSeparator | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 6 | 267 | - | - | 8 | 171 | 7 | 101 |  |
|  |  |  | No Signal | 6 | 259 | - | - | 8 | 118 | 7 | 85 |  |
| V112A | 6SN7GT | Sync <br> Output | $\begin{gathered} \text { 15000 Muw V. } \\ \text { Signal } \end{gathered}$ | 2 | 60 | - | - | 3 | 0 | 1 | $-2.7$ |  |
|  |  |  | No Signal | 2 | 58 | - | - | 3 | - | 1 | -2.1 |  |
| V112B | 6SN7GT | Vertical <br> Oscillator | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 5 | 76 | - | - | 6 | 0 | 4 | -16 | Depends on selting of Vert hold control $\qquad$ |
|  |  |  | No Signal | 5 | 75 | - | - | 6 | $\bigcirc$ | 4 | -15 | Voltages ahown are aynced pix adjustment |
| v113 | 6K6GT | $\begin{gathered} \text { Verrical } \\ \text { Output } \end{gathered}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 260 | 4 | 270 | 8 | 15.9 | 5 | -11 |  |
|  |  |  | No Signal | 3 | 250 | 4 | 260 | 8 | 15.5 | 5 | $-10$ |  |
| v144 | 6SN7GT | $\begin{aligned} & \text { Horizontal } \\ & \text { Osc. Control } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal }}}{\text { V. }}$ | 2 | 172 | - | - | 3 | -2.2 | 1 | -25 |  |
|  |  |  | No Signal | 2 | 160 | - | - | 3 | 1.5 | 1 | -16 |  |
| V1148 | 6SN7GT | $\begin{aligned} & \text { Horizontal } \\ & \text { Oecillator } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 180 | - | - | 6 | $\bigcirc$ | 4 | -74 |  |
|  |  |  | No Signal | 5 | 178 | - | - | 6 | $\bigcirc$ | 4 | -66 |  |
| v115 | 6806GT | $\begin{aligned} & \text { Horizontal } \\ & \text { Output } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu} \\ \text { Signal }}}{ }$ | Cap | - | 4 | 180 | 8 | 18 | 5 | $-17.5$ | $\begin{aligned} & \text { *High Vollage } \\ & \text { Pulse Present } \end{aligned}$ |
|  |  |  | No Signal | Cap | - | 4 | 175 | 8 | 17.5 | 5 | -17 | *High Volatge <br> Pulae Present |
| v116 | $\underset{\substack{183 G T \\ / 8016}}{ }$ | $\begin{aligned} & \text { H. V. } \\ & \text { Rectifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \\ \text { Signal } \end{gathered}$ | Cap | - | - | - | 2*7 | 14,000 | - | - | *High Voltage <br> Pulse Present |
|  |  |  | No Signal | Cop | * | - | - | 2\&7 | 13,000 | - | - | High Vollage <br> Pulse Present |
| v117 | ${ }^{6 W 46 T}$ | Dampor | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 270 | - | - | 3 | * | - | - | High Voltage Pulse Present |
|  |  |  | No Signal | 5 | 260 | - | - | 3 | * | - | - | *High Vollage <br> Pulse Present |
| $\mathrm{v}_{118}$ | 214 Pa | Kinescope | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | 14,000 | 10 | 430 | 11 | 120 | 2 | 78 | At avorage Bnghtnoes |
|  |  |  | No Signal | Cap | 13,000 | 10 | 415 | 11 | 100 | 2 | 58 | At avorage Enghtnoss |
| $\begin{aligned} & v_{119} \\ & v_{120} \end{aligned}$ | su4g ${ }_{\text {5YзgT }}$ | Recitiers | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | $4 * 6$ | - | - | - | $2 \pm 8$ | 285 | - | - |  |
|  |  |  | No Signal | 4*6 | - | - | - | 248 | 274 | - | - |  |




PRODUCTION CHANGES IN KCS82, KCSB2A AND














[^8]d
Direction of arro
clock wise rotation
controls indicate
All voltages measured with "Voltohmyst"
and with no signal input. Voltages should hold within $\pm 20 \%$ with 117 v . acc supply.


CHASSIS KCS82, KCS82A, KCS82B





Ook, Natural Holinue




icture size. EQUENCY RANGE
television r.f frequency range
Models 21-D-305, $-317,-326,-327,-328,-329,-330$
Any of 12 VHF channels, 54 mc . to 88 mc .174 mc . to 216 mc .
Models $21-\mathrm{D}-305 \mathrm{U},-317 \mathrm{U},-320 \mathrm{U},-327 \mathrm{U},-328 \mathrm{U},-329 \mathrm{U}$, $-330 \mathrm{U}$
Any desired combination of 16 VHF and/or UHF channels,
54 inc. 1088 mc ., 174 mc . to 216 mc ., 470 mc . to $890 \mathrm{mc}$. may e used.
INTERMEDIATE FREQUENCIES
Picture Carrier FTequency....
Picture Carrier Frequency
Sound Carrier Frequency
.45 .75 mc .
.41 .25 mc .
audio power output rating
0.0 watts max.

IDEO RESPONSE.
To 4 mc .
OWER SUPPLY RATING
KCS81 and KCS
KCS 818 chasis $\ldots \ldots . . . . . . . .115$ volts, 115 volts, 00 cycles, 205 wates, 305 watts RECEIVER ANTENNA INPUT IMPEDANCE
KCS81 chassis (KRK11B Tuner)
Choice: 300 ohms balanced or 72 ohms unbalanced.
Choice: 300 ohms balanced or
KS8 18 chassis (KRK 12 Tuner) 72 ohms unbalanced.
UHF -Choice: 300 ohms balanced or 72 ohms unbalanced
$\mathrm{VHF}-300$ ohms balanced. VHF- 300 ohms balanced
opehating controls (front)
Channel Selector $\}$
Pature
icture Horizontal Hold
icture Vertical Hold le Control under Panel Single Control under Panel Single Control under Panel rightess Dual Control Knobs

 Mahogany, oak

 "Morrit!"
Mahooany,
Oak

## GENERAL DESCRIPTION

 21.D. 330 are identical except tor cabinet 12 channel VHF coverage.
 .329U and 21.
 nel VHF coverage plus any 4 UHF chan
nels desired. All models have an auxiliary els desired. All models have an auxiliar
udio input iack to permit the use of a xternal record playing attachment.

## Maple, Hed Cherry

TIONS
Chassis designations
KCS81 Models 21.D.305, .317, .326, 327, .328, .329 and .330 employing a KRK11B Tuner
KCS81A Models 21-D.305, -317, .326, $327,-328, .329$ and 330 employing a KRK22A Tuner

KCS81B Models 21-D. $305 \mathrm{U},-317 \mathrm{U},-326 \mathrm{U},-327 \mathrm{U},-328 \mathrm{U},-329 \mathrm{U}$ and -330 U employing a KRK 12 Tune

## sWEEP DEFLECTION

focus .Magnetic
horizontal sweep frequency
frame frequency (Picture Rep

## LOUDSPEAKERS

Models 21-D.305, 21.D.305U .........(971490.3) $8^{\prime \prime}$ PM, 3.2 ohms All models except 21-D.305 and 21-D-305U

$$
12569-12) 12^{\prime \prime} \text { PM, } 3.2 \text { ohms }
$$

non.operating controls (not including r.f and l.f ad. justments)

Picture Centering
Horizontal Drive
top chassis adjustment
Hontal Drive ........ rear chassis screwdriver adjustment
Horizontal Linearity . ..................ear chassis adjustment
Horizontal Oscillator Frequency ........rear chassis adjustment
Horizontal Oscillator Waveform ..... bottom chassis adjustment
Horizontal Locking Range .............rear chassis adjustment
focus
top chassis adjustment
解 Trap Magne
Deflection Coil
op chassis wing nut adjustment
rear chassis adjustment

CHECZ OF HORIZONTAL OSCLLLATOR ALIGNMENT. wise position. The picture should remain in horizontal sync. back. Normally the the signal by switching off channel then ol clockwally the picture will be out of sync. Turn the con-
rowly. The number of diagonal black bars will be gradually reduced and when only 2 or 3 bars sloping down
ward to the left are obtained, the picture will pull into syn pon slight additional clockwise rotation of the control. Pull-in
hould occur betore should occur before the control has been turned 70 degrees
rom the extreme counter.clockwise position. The picture should emain in sync for approximately 90 degrees of additional lockwise rotation of the control. At the extreme clockwise posipicture on the left side.

If the receiver passes the above checks and the picture
ormal and stable, the horizontal oscillotor is properly aligne skip "Adjustment of horizontal Oscillator"" and proceed with
"Centering Adjustment."


Figure 3-Rear Chassis Adjusiment ADJUSTMENT OF HORIZONTAL OSCILLATOR. - It in the control at the extreme counter.ciockwise position or failed to hold sync over 90 degrees of clockwise rotation of the control
from the pullin point, it will be necessary to make the follow
 Figure 2-Yoke and Focus Magnet Aajustment Horizontal Frequency Adiustment. - Turn the horizontal hold
control to the extreme clockwise position. Tune in a television control to the extreme clockwise position. Tune in a television
station and adjust the T114 horizontal frequency adjustment at the rear of the chassis until the picture is just out of sync
and the horizontal blanking appears as a vertical or diagonal and he horizontal blanking appears as a vertical or diagona is just visible at the extreme left side of the picture. Horizontal Locklng Range Aduastment. - Set the horizontal hold control to the full counter-clockwise position. Mome
tarily remove the signal by switching oft channel The picture may remain in sync. If so turn the T114 rear cor slighty and momentarily switch oft channel. Repeat until th picture talls out of sync with the diagonal lines sloping dow
to the left. Slowly turn the horizontal hold control clockwis and note the least number of diagonal bars obtained just
before the picture puns mio sy.

If more than 2 bars are present just before the picture pull slighty clockwise. If less than 2 bars are present. adjust C186A slightly counter clockwise. Turn the horizontal hold contro counter-clockwise, momentarily remove the signal and recheck
the number of bars present at the pull.in point. Repeat this procedure until 2 or 3 bars are present.
ment" and "Horizontal Locking Ranzental Frequency Adjus conditions specified under each are fulifled. When the hori
zontal oncillator Alignmentes as outlined under "Check of Horizontal

AGC system is in proper adjustment it will be necessary to alignment procedure For field purposes paragraph B" under Horizontal Oscillator Waveform Adjustment may
FOCUS MAGNET ADJUSTMENTS.-The focus magnet should be adjusted so that there is approximately three-eighths inch o pace between the rear cardboard shell of the yoke and the at of the front lace of the focus magnet. This spacing gives The axis of the hole through the magnet should be parallel解 with the kinescope neck CENTERING ADJUSTMENT.-No electrical centering controls are provided. Centering is accomplished by means of a sep.
arate plate on the focus magnet. The centering plate includes locking screw which must be loosened betore centering. p and down adjustment of the plate moves the picture side
side and sidewise adjustment moves the picture up and
If a corner of the raster is shadowed. check the position of the ion trap magnet. Reposition the magnet within the range of maximum raster brightness to eliminate the shadow and re no case should the ion trap magnet be adjusted to cause any loss of brightness since such operation may cause immediate or eventual damage to the tube. In some cases it may be neces liminate a corner shadow WIDTH. DRIVE AND HORIZONTAL LINEARITY ADJUST the high voltage applied to the kinescope. In order to obtain the highest possible voltage hence the brightest and bes maximum drive (minimum capacity) consistent with a linear raster. Compression of the raster due to excessive drive can be picture. Besides compression caused by excessive drive another item to watch for is the change in linearity at the
extreme left with changes of brightness control setting. By proper adjustment of the linearity coil, the changes in linearity
with changes in brightness can be made negligible. In general. to achieve this condition, the linearity coil should be sel the optimum position a shat shighty clockwise $t$ the optimum position.
Preset the following
A. - Place the width plug P103 in the minimum width posi B. - Set the width control coil $\mathrm{r}, 109$ in approximately mid position C.-Set the linearity control coil L111 near minimum induc
ance (counter-clockwis) D. - Set the drive ca
D.- Set the drive capacitor C186B in the maximum drive

If the raster is cramped or shows compression bars on the right half of the picture turn C186B clockwise until this con
dition is just eliminated dition is just eliminated.
Adjuity and maximum deflect coil L111 clockwise until bes linearity and maximum deflection or best compromise are ob
lained then turn one quarter turn clockwise from this position Retouch the drive trimmer C186B it necessary to obtain best
linearity and maximum width. nearity and maximum width.
Check the horizontal linearity at various settings of the he right hall and no appreciable change of linearity espe. cially at the extreme left of the picture. If objectional change
does occur, turn linearity coil L111 slighty clockwise and
Adjust the width control Llog to till the mask.
If the line voltage is low and it becomes impossible to fill
The width coil Llog is inoperative in this position.
HEIGT AND VERTICAL LINEARITY ADUSTMENTS. -
Adjust the height COntrol
AIg Adjust the height control (Rigo behind front control panel) until
the picture fills the mask vertically. Adjust vertical linearity R197 behind front control panel). until the test pattern is ssm.
metrical from top to bootom. Adjustment of either control will , equire a readjustment of the other.
FOCUS.- Adjust the focus magnet
he test pattern vertical "wedge" and best focus in the white areas of the pattern.
Recheck the positio
hat maximum brightness is obtained. .



Connect the oscilloscope to pin 9 of V 110 . Adjust T105 and T106 top cores for maximum gain and curve
shape as shown in Figure 10. For final adjustment set the out. shape as shown in Figure 10 . For final adjustment set the out.
put of the sweep generator to produce 0.5 volt peak-to-peak at put of the sweep generator
the oscilloscope terminals.
To align Tl and $\mathrm{T104}$, , connect the sweep generator to the
mixer grid test point TP2. Use the shorest leads possible, with mixer grid test point TP2. Use the shortest leads possible, with
not more than one inch of unshielded lead at the end of the
sweep cable. sweep cable.
Set the channel selector to channel s .
Connect a 180 ohm composition resistor between terminal
" $\mathrm{B} "$ of T 105 and the junction of R 131 and Cl 33 A . Connect the oscilloscope diode probe to terminal "B" of Tios and ground. Couple the signal generator loosely to the diode
probe in order to obtain markers. probe in order to obtain markers.
The shunt trimmer C121 across terminals $A$ and $B$ of 1104 is
variable and is provided as a bandwidth adjustmen variable and is provided as a bandwidth adjustment. Preset
the shunt trimmer to minimum capacity. Adjust Tl (top) and T104 (botiom) for maximum gain
mc . at $75 \%$ of maximum response.
Adjust C121 untili 41.25 mc . is at $85 \%$ response with respect Ao the low trequency shoulder at approximately 41.9 mc. as
sheme in Disconnect the diode probe, the 180 ohm and three 330 ohm Disconnect the diode probe, the 300 ind
resistors.
Models 21-D. 305 U to 21-D. 330 Incl .
Set the signal generator to each of the following frequencies
and peak the specified adjustment for maximum indication on and peak the speciitied adjustment tor maximum indication on
the "Voltohmyst." During alignment. reduce the input signal
if necessary in order to produce 1.0 volt of d.c at pin 9 of if necessary in order to produce 1.0 volt of doc at pin 9 of
V110 with -1.0 volt of f . bias at the junction of R133 and V 110
C 133 m .

$\qquad$ | . $\mathrm{T109}$ |
| :--- |
| .${ }_{\text {T107 }}$ |
| 108 |

To align Tlus and T106, connect the sweep generator 10
the first picture i : grid, pin 1 of V 06 through a $1,000 \mathrm{mml}$.
 "F" of T109 with S33 ohm composition resisinars. Set the i -
bias to -1.0 volt at the junction of R133 and C133B. bias to -1.0 volt at the junction of R133 and C133B.
Connect the oscilloscope to pin 9 of V110, the 6 CL6 video Connect the oscilloscope to pin 9 of V110, the 6CL6 video
amplifior.
Adjust Adjuat T105 and T106 top cores tor maximum gain and
curve shape as shown in Figure 10. For final adjustment set curve shape as shown in Figure 10. For final adjustment set
the output of the VHF sweep generator to produce 0.5 volt the output of the VHF sweep generator to
peak-to-peak at the oscilloscope terminals.
To align the crystal mixer and T2 and T104, connect the
VHF sweep generator to the front terminal of the 1 N82 crystal VHF sweep generator to the front terminal of the 1 NB 82 crystal
holder in series with a 1.500 mmif . ceramic capacitor. Use the holder in series with a 1.500 mmit. ceramic capacitor. Use the
shortest leads possible, grounding the sweep generator to the shorest
tuner case.

Set the channel selector to channel 5 .
Connect a 180 ohm composition resistor between terminal
" B of T 105 and the junction of R 131 and C 133 A . Connect the oscilloscope diode probe to terminal "B" of Tios and ground. Couple the signa pers. The shunt trimmer C121 across terminals A and B of T104 is variable and is provided as a bandwidth adjustment. Preset
the shunt trimmer to minimum capaciti. Adjust $T$ It lep) and
T104 (bottom) tor maximum gain at 43.5 mc. and with 45.75 the shunt trimmer to minimum capacity. Adjust T2 (top) and
T104 (bottom) tor maximum gain at 43.5 mc . and with 45.75
mc. at $75 \%$ of maximum response. mc. at $75 \%$ of maximum response.

Adjust the shunt trimmer C121 until 41.25 mc . is at $85 \%$
response with respect to the low trequency shoulder at ap. response with respect to the low irequency shoulder at ap-
proximately 41.9 mc. as shown in $F$ Figure 13 . Adjust Tl for
 proper wave shape, see Figure 13.

$$
\begin{aligned}
& \begin{array}{cc}
\begin{array}{c}
\text { Figure 13-T2 and } \\
\text { T104 Response with } \\
\text { KRKI2 }
\end{array} & \begin{array}{c}
\text { Figure 14-Over-all } \\
\text { I-F Response with } \\
\text { KRK12 }
\end{array} \\
\hline
\end{array}
\end{aligned}
$$

Disconnect the diode probe, the 180 ohm and the three 330


Figure 15-KRKllb R.F Tuner Adjustments


Figure 16-Sweep Attenuator Pads


Figure 18-KRKIIB R-F Oscillator Adjustments


Figure 23-KRK22A Antenna Matching Unit Response


Figure 20-KRK22A Tuner Adjustments


Figure 21-KRK22A R.F Response


Figure 22-KRK22A R.F Oscillator Adjustment


Figure 24-KRK12 VHF Insert Responses


Figure $25-$ KRK12 Tuner Adjustments

## © John F. Rider


the detalled alignment procedure beginning on page b should be bead before alignment by use of the table is attempted



## RESPONSE PHOTOGRAPHS

Taken from RCA WO58A Oscilloscop

PICTURE I.F RESPONSE - At times it may be desirable to observe the individual if stage response. This can be achieved observe the individual if
by the following method:
For T107. T108 or T109, shunt all i.f transtormers with a 330 ohm carbon resistor except the one whose response is to be ohm carb.
observed.
Connect a wide band sweep generator to the second pix i-f grid and adjust it to $\mathbf{s w e e p}$ from 38 mc . to 48 mc .

Connect the oscilloscope to pin 9 of V 110 and observe the over.all response. The resp.
that of the unshunted stage.
To see the response of translormers T1 (T2), T104 and T105 T106, follow the instructions given Figures 36 through 41 show the response of the various stages
obtained in the above manner. The curves shown are typical obtained in the above manner. The curves shown are typical
although some variation between receivers can be expected. although some varialion between
Relative stage gain is not shown.

$\underset{\substack{\text { Figure } \\ \text { I.F Response }}}{\text { 36-Over-all Pix }}$



Figure $\underset{\text { Pix l-F Transformers }}{\text { 37-Response of T1 (T2)-T104 }}$


Figure $\begin{gathered}\text { 38-Response of Tl05.T106 } \\ \text { Pix I-F Transformer }\end{gathered}$


Plate of V'ideo Amplifier
(Pin 6 of $V 110)(6 C L 6)$
$V$ oltage depends on picture Figure 45-Vertical ( 155 Volts PP)

Figure 46 Horizontal (155 Volts PP)


Figure 47-Grid of Vertical (Pin 7olV111) (12.AU7) (Pin 7 of Vlli) (12.4U7)
(110Volts PP) $V$ oltage depends on picture

Figure 48-Plate of Vertical Sync

$V$ oltage depends on picture


Cathode of Horizontal Sync Separator Figure $49-\mathrm{Vertical}$ ( 18 Volts PP)

Figure 50 -Horizontal (18 Volts PP)


Grid of Horizontal Sync Separator
(Pin 2 of 1112 (12AU7) Figure 51-Vertical (115 VoltsPP)

Figure 52-Horizontal (115 Volts PP)


Plate of Horizontal Sync Separator
$\left(\right.$ Pin 1 of $\left.V^{1} 112\right)(12 A U T)$

( $P^{\text {in }} 1$ of $V^{\prime} 112$ ) (12AUT)
Figure 53-V ertical ( 75 Volts PP)

Figure 54-Horizontal (75 Volts PP)




Figure 79-KRKIIB Tuner Unit Wiring Diagram


Figure 80-KRK22A Tuner Unit Firing Diagram


Figure 81-KRK12 Tuner Unit W'iring Diagram

## CRITICAL LEAD DRESS

1. Keep all wiring in the pixi.f, sound i.f and video circuits as short as possible.
2. Keep the leads on C108, C109, C111, R107, R109, R110, R111 and R112 as short and direct as possible.
3. Do not change the bus wire connections to pin 2 of viol and V102. Sleeving is used on these wires to insure length and to prevent shorting
4. Do not change position of F 150 and L 104 at pin 9 of V 110 5. Ground R128 to pin 3 of V106 and R134 to pin 7 of V107 6. Do not change the grounding of R137, R138 and R141
5. Keep the bus wire from T109-A to Cl 144 (plug-in capacitor) short and direct.
6. Ground the filaments of sockets of V107, V108 and V109 independenlly of tube shields (pin 8). Use ground lances near each socket
7. Dress Cl46 straight up to act as a shield between T101-A and V110-9.
8. Dress C153 and R159 (kine cathode) up in the air above the terminal board.
9. Keep the leads connected to T114.C and T114.D (synchro quide) down so that they will not short out when the chassis is placed in the cabine
10. Do not reroute any wires between 1104 and the terminal board alongside it. Keep all leads on the foot side of the terminal board.
11. Dress all wires routed past T 104 , under the large lances near T104.
12. Dress black and red leads from S102 through slot in cap of S102.
13. Dress R113 close to the chassis with leads as short as possible.
14. Dress C198, C199 and C200 up in the air and away from all other leads and components.
15. Dress all leads away from bleeder resistor R228.
16. The brown and green leads of the vertical output trans. former should be routed from 1102 under clamp on high voltage shield and away from all tubes.
17. Keep leads on C145 as short and direct as possible
18. Do not dress any leads under C121 ( $5-70$ ) trimmer.
19. Keep the wire from the vertical output transtormer T112 away from the $5 U 4 \mathrm{G}$ rectifier tubes.
20. Dress all 2 walt resistors away from each other and all other wires and components.
21. Dress all wires away from damper tubes V118 and V119.
22. Blue wire from pin 1 V111 to terminal board should be routed between V116 and rear apron.
23. Dress all peaking coils up and away from the base.
24. Dress all shielded wires under lances provided.

VOLTAGE CHART
The following measurements represent two sets of conditions. In the first condition, a 5000 microvolt test pattern signal was fed
into the receiver, the picture synchronized and the AGC control properly adjusted. The second condition was obtained by removing into the receiver, the picture synchronized and the AGC control properly adjusted. The second condition was obtained by removing
the antenna leads ond short circuiting the receiver antenna terminals. Voltages shown are read with a type WVIA senior
"Voltohmyst" between the indicated terminal and chassis ground and with the receiver operating on 111 volts, 60 cycles, a.c.

| $\mathrm{T}_{\text {Tube }}^{\text {No. }}$ | $\underset{\text { Typo }}{\substack{\text { Tube }}}$ | Function | Operating | E. Plate |  | E. Scroon |  | E. Cathode |  | E. Grid |  | $\begin{aligned} & 1 \\ & \text { plate } \\ & \text { (mana } \end{aligned}$ | $\underset{\substack{\text { Scroon } \\(\text { ma. } 0 .)}}{ }$ | $\begin{gathered} \text { Notet on } \\ \text { Meamurements } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Pin | Volte | $\underset{\substack{\text { Pin } \\ \text { No }}}{ }$ | Volts | $\begin{array}{\|l\|l} \hline \text { Pin } \\ \text { No } \end{array}$ | volte | $\begin{array}{\|c} \hline \text { Pin } \\ \text { No. } \end{array}$ | Volts |  |  |  |
| V 1KRK11BKRK22AR | 6x8 | Mixer | $5000 \mathrm{Mu} . \mathrm{V}$. Signal | 9 | 160 | 8 | 160 | 6 | 0 | 7 | ${ }_{-2.4}^{-2.40}$ | - | - |  |
|  |  |  | $\mathrm{Si}_{\mathrm{Non} \text { ol }}^{\mathrm{N}}$ | 9 | 145 | 8 | 145 | 6 | 0 | 7 | ${ }_{-3.80}^{-3.50}$ | - | -- |  |
|  |  | $\begin{array}{\|c} \text { R.E.E.ilator } \\ \text { Ostilo } \end{array}$ | $5000 \mathrm{Mu} . \mathrm{V}$. Signal | 3 | 95 | - | - | 6 | 0 | 2 |  | - | - |  |
|  |  |  | $\mathrm{Si}_{\text {Signal }}^{\mathrm{Noo}}$ | 3 | 90 | -- | - | 6 | 0 | 2 |  | - | - |  |
| $\left\lvert\, \begin{aligned} & \mathrm{v} 2 \\ & \text { KRK11B } \\ & \text { RKK22A } \end{aligned}\right.$ | 6BO7A | $\underset{A_{\text {Amp }}^{\mathrm{R} \cdot \mathrm{~F}} \mathrm{itier}}{ }$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 6 | 170 | -- | - | 8 | 0.1 | 7 | 0 | - | -- |  |
|  |  |  | $\mathrm{S}_{\mathrm{Nignal}}^{\mathrm{No}}$ | 6 | 133 | - | - | 8 | 1.1 | 7 | 0 | - | - |  |
|  |  | $\underset{A m p l a t i e r ~}{\text { R.F }}$ | 5000 Mu V Signal | 1 | 270 | - | - | 3 | 170 | 2 | - | - | - |  |
|  |  |  | $\begin{gathered} \text { No } \\ \text { Signal } \end{gathered}$ | 1 | 260 | - | - | 3 | 133 | 2 | - | - | -- |  |
| $\begin{aligned} & \mathrm{v} 1 \\ & \text { xfR12 } \end{aligned}$ | 6BQ7A | $\begin{aligned} & \text { Rimplifior } \end{aligned}$ | $5000 \mathrm{Mu} . \mathrm{V}$. Signal | 6 | 143 | - | - | 8 | 1.2 | 7 | 0 | - | - |  |
|  |  |  | $\mathrm{Sig}_{\text {Noal }}^{\text {No }}$ | 6 | 138 | - | - | 8 | 1.0 | 7 | 0 | - | -- |  |
|  |  | Amplifier | $\begin{aligned} & 5000 \mathrm{Mu} . \mathrm{V} . \\ & \text { Signal } \end{aligned}$ | 1 | 260 | - | - | 3 | 143 | 2 | 97 | - | - |  |
|  |  |  | $\mathrm{signal}_{\text {No }}^{\text {Noma }}$ | 1 | 250 | - | - | 3 | 137 | 2 | 97 | - | - |  |
| v2 | 6NF4 | ${ }^{\mathrm{R} \cdot \mathrm{F}} \mathrm{F}$.illator | $\underset{\text { Signal }}{5000 \mathrm{Mu}} \mathbf{V}$ | 167 | 78 | - | - | 5 | 0 | 248 | -8 | - | - |  |
|  |  |  | Sigor | 147 | 75 | - | - | 5 | 0 | 246 | -6 | - | - |  |
| KRK 12 | 6BQ7A | $\underset{\text { Amplifier }}{\text { I-F }}$ | 5000 Mu V. Signal | 6 | 270 | - | - | 8 | 148 | 7 | 103 | - | - |  |
|  |  |  |  | 6 | 260 | - | - | 8 | 142 | 7 | 99 | - | - |  |
|  |  | ${ }_{\text {Amplifior }}^{\text {I. }}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | 148 | - | - | 3 | 1.4 | 2 | 0 | - | - |  |
|  |  |  | $\stackrel{\text { Nool }}{\text { Signal }}$ | 1 | 143 | - | - | 3 | 1.2 | 2 | 0 | - | - |  |
| v4 | 654 | $\begin{aligned} & \text { Voltago } \\ & \text { Controi } \end{aligned}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 9 | 270 | - | - | 2 | 94 | 6 | ${ }^{68}$ | - | - | $\begin{aligned} & \text { Depends on } \\ & \text { adjustraent } \\ & \text { of R6. } \end{aligned}$ |
|  |  |  | ${ }_{\text {Sigoal }}^{\text {No }}$ | 9 | 260 | - | - | 2 | 90 | 6 | $\bullet 65$ | - | - |  |
| v101 | 6au6 | 1.t Sound | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 127 | 6 | 124 | 7 | 0.7 | 1 | -0.4 | 6.0 | 3.0 |  |
|  |  |  | $\mathrm{S}_{\text {Signal }}^{\text {Nol }}$ | 5 | 126 | 6 | 123 | 7 | 0.5 | 1 | -1.2 | 5.0 | 3.0 |  |
| v102 | 6AU6 | 2nd Sound <br> ${ }_{\text {2nd }}^{\text {2nd }}$ Amp. | 5000 Mu. Signal | 5 | 132 | 6 | 60 | 7 | 0 | 1 | -10 | 2.8 | 1.2 |  |
|  |  |  | Sigor | 5 | 131 | 6 | 65 | 7 | 0 | 1 | -5 | 2.0 | 1.0 |  |
| v103 | 6als | RatioDetector | $\underset{\substack{5000 \mathrm{Mu} \\ \text { Sigal }}}{5 .}$ | $\frac{2}{7}$ | -9.2 | - | - | 5 | 1.0 9.2 | - | - | - | - |  |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | ${ }_{7}^{2}$ | -8.0 | - | - | $\stackrel{5}{1}$ | 8. | - | - | - | - |  |
| v104 | 6avg | lat AudioAmplifie: | $\underset{\text { Signal }}{5000 \mathrm{Mu} .}$ | 7 | 90 | - | - | 2 | 0 | 1 | -0.7 | 0.63 | - | $\underset{\substack{\text { Atmin. } \\ \text { volume }}}{\text { ate }}$ |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | 7 | 88 | -- | - | 2 | 0 | 1 | -0.7 | 0.65 | - |  |
| v104 | 6av6 | $\begin{gathered} \text { R.F Biat } \\ \text { Clomp } \end{gathered}$ | $\underset{\substack{5000 \mathrm{Mu} \\ \text { Signal } \\ \text { V. }}}{ }$ | 5.6 | -3.0 | - | - | 2 | 0 | - | - | - | - |  |
|  |  |  | Signal | 3.6 | 0.3 | - | - | 2 | 0 | - | - | - | - |  |
| vios | 6 AOS | $\begin{aligned} & \text { Audio } \\ & \text { Output } \end{aligned}$ | $\underset{\text { Signal }}{5000 \mathrm{Mu} .}$ | 5 | 32: | 6 | 342 | 2 | 146 | 7 | 136 | 28 | 2.0 |  |
|  |  |  | $\begin{gathered} \mathrm{Na} \text { Signal } \end{gathered}$ | 5 | 323 | 6 | 338 | 2 | 143 | 7 | 133 | 28 | 2.0 |  |
| v106 | 6Av6 | $\begin{aligned} & \text { 1at Pix. I.F } \\ & \text { Amplifier } \end{aligned}$ | $\underset{\substack{5000 ~ M u \\ \text { Signal }}}{ }$ | 5 | 160 | 6 | 215 | 7 | 0.17 | 1 | -6.6 | 1.4 | 4 |  |
|  |  |  | Signal | 5 | 85 | 6 | 115 | 7 | 0.98 | 1 | 0 | 6.3 | 3.3 |  |

VOLTAGE CHART

| ${ }_{\substack{\text { Tube } \\ \text { No. }}}$ | ${ }_{\text {Tupe }}^{\text {Tube }}$ | Function | $\begin{aligned} & \text { Operating } \\ & \text { Condition } \end{aligned}$ | E. Plate |  | E. Scroon |  | E. Cathod• |  | E. Grid |  | $\underset{\substack{\text { plate } \\ \text { (ma.) }}}{1}$ | $\begin{gathered} \text { Sction } \\ (\mathrm{maO}) \end{gathered}$ | $\begin{gathered} \text { Noten on } \\ \text { Meanurements } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | Volts | $\stackrel{\substack{\text { Pin } \\ \text { No. }}}{ }$ | Voite | (1) | Volt | \|linPin <br> No. | Volts |  |  |  |
| v107 | ${ }_{6}$ Cb6 | $\begin{aligned} & \text { 2nd Pix. 1-F } \\ & \text { Amplitier } \end{aligned}$ | $\underset{\text { Signai }}{5000 \mathrm{Mu}} \mathbf{V}$ | 5 | 227 | 6 | 225 | 2 | 0.1 | 1 | -6.6 | 1.5 | 25 |  |
|  |  |  | ${ }_{\text {Signal }}^{\mathrm{No}}$ | 5 | 209 | 6 | 115 | 2 | 0.8 | 1 | 0 | 10.9 | 3.3 |  |
| v108 | ${ }^{6 C b 6}$ | $\begin{aligned} & \text { 3rd Pix. I-F } \\ & \text { Amplifier } \end{aligned}$ | $\underset{\text { Signai }}{5000 \mathrm{Mu} .}$ | 5 | 138 | 6 | 132 | 2 | 1.02 | 1 | 0 | 11.4 | 3.5 |  |
|  |  |  | $\mathrm{Sigog}^{\mathrm{No}}$ | 5 | 134 | 6 | 126 | 2 | . 98 | 1 | 0 | 10.4 | 3.1 |  |
| v109 | ${ }^{6 C b 6}$ | $\begin{aligned} & \text { 4th Pin I-F } \\ & \text { Amplifier } \end{aligned}$ | 5000 Mu . Signal | 5 | 168 | 6 | 165 | 2 | 2.32 | 1 | 0 | 8.85 | 2.2 |  |
|  |  |  | $\begin{gathered} \text { Nool } \\ \text { Signol } \end{gathered}$ | 5 | 156 | 6 | 161 | 2 | 2.07 | 1 | - | 8.6 | 2.1 |  |
| v110 | ${ }^{6} \mathrm{CL} 6$ | $\begin{aligned} & \text { Video } \\ & \text { Amplifier } \end{aligned}$ | $\begin{aligned} & 5000 \mathrm{Mu} \mathbf{~ V .} \\ & \text { Signai } \end{aligned}$ | 6 | 130 | 3.8 | 159 | 1 | . 84 | 2.9 | - 5.0 | 22.5 | 5.5 | - Depends <br> on picture |
|  |  |  | $\mathrm{S}_{\text {Signal }}^{\text {No }}$ | 6 | 130 | 3.8 | 80 | 1 | 0.7 | 2.9 | - 2.0 | 15.0 | 4.0 | - Doponde on picture |
| v111A | 12AU7 | $\underset{\text { Rectifier }}{\text { AGC }}$ | $\begin{gathered} 5000 \mathrm{Mu} \mathrm{~V} \\ \text { Signal } \end{gathered}$ | 1 | -30 | - | -- | 3 | 142 | - | - | 0 | - | $\begin{gathered} \text { AGC control } \\ \text { not for } \\ \text { oporal } \\ \text { oporation } \end{gathered}$ |
|  |  |  | $\mathrm{Si}_{\mathrm{Nogal}}^{\mathrm{No}}$ | 1 | 0 | - | - | 3 | 137 | - | - | 0 | - |  |
| v1118 | 12AU7 | Vert. Sync <br> Separato | $\underset{\text { Signai }}{5000 \mathrm{Mu}_{1}} \mathbf{V}$ | 6 | 110 | - | - | 8 | 0 | 7 | -42 | 25 | - |  |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | 6 | 45 | - | - | 8 | 0 | 7 | - ${ }^{-5}$ | 25 | - | - Depende |
| V112A | 12AU7 | $\begin{aligned} & \text { Hor. Sync. } \\ & \text { Seporolor } \end{aligned}$ | $\underset{\substack{5000 \mathrm{Mu} \\ \text { Signai }}}{\mathrm{v} .}$ | 1 | 323 | - | - | 3 | 192 | 2 | 116 | . 5 | - |  |
|  |  |  |  | 1 | 320 | - | - | 3 | 132 | 2 | 112 | . 5 | - |  |
| v1128 | 12AU7 | $\begin{aligned} & \text { Sync infifer } \\ & \text { Amphif } \end{aligned}$ | $\underset{\text { Signal }}{5000 \mathrm{Mu} .}$ | 6 | 78 | $\cdots$ | - | 8 | 0 | 7 | -3.5 | 6.2 | - |  |
|  |  |  | Sigo ${ }_{\text {Nol }}$ | 6 | 78 | - | - | 8 | 0 | 7 | -1.6 | 6.2 | - |  |
| v113A | 6SN2GT | $\begin{aligned} & \text { Yert. Sync. } \\ & \text { Amplifier } \end{aligned}$ | $\begin{aligned} & 5000 \mathrm{Mu} \mathbf{v .} \\ & \mathrm{Singnai} \\ & \hline \end{aligned}$ | 2 | 140 | - | - | 3 | 19.2 | 1 | -. 35 | 0.1 | - |  |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | 2 | 135 | - | - | 3 | 17.3 | 1 | 0 | $<0.1$ | - |  |
| v1138 | 6SN7GT | $\begin{aligned} & \text { Vert. Ose. } \\ & \& \text { Discharge } \end{aligned}$ | $\underset{\text { Signai }}{5000 \mathrm{Mu} .}$ | 5 | 203 | - | - | 6 | 0 | 4 | -56 | 2 | - |  |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | 5 | 208 | - | - | 6 | 0 | 4 | -55 | . 2 | - |  |
| v114 | ${ }^{6 A O} 5$ | $\begin{aligned} & \text { Vertical } \\ & \text { Output } \end{aligned}$ | $\underset{\text { Signoi }}{5000 \mathrm{Mu}} \mathbf{v} .$ | 5 | 334 | 6 | 334 | 2 | 30 | 1 | 0 | 17.3 | 1.2 |  |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | 5 | 332 | 6 | 332 | 2 | 29 | 1 | 0 | 17.3 | 1.2 |  |
| v115 | 6SN2GT | $\begin{aligned} & \text { Horizontal } \\ & \text { Osc Control } \end{aligned}$ | $\underset{\substack{5000 \mathrm{Mu}_{\text {Signil }} \\ \text { V. }}}{ }$ | 2 | 188 | - | - | 3 | $-9$ | 1 | -28 | 0.37 | - | $\begin{aligned} & \text { Hor. hold } \\ & \text { at mid-range } \end{aligned}$ |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | 2 | 0 | - | - | 3 | 0 | 1 | 0 | 0 | - |  |
|  |  | HorizontalOzcillator | $\underset{\substack{5000 \mathrm{Mu} \\ \text { Signai }}}{\substack{\mathrm{V}}}$ | 5 | 184. | - | - | 6 | 0 | 4 | -72 | 2.5 | - | Hor holdat mid-range |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | 5 | 182 | - | - | 6 | 0 | 4 | -73 | 2.5 | - |  |
| v116 | ${ }^{6 C D 6 G}$ | $\begin{aligned} & \text { Horizontal } \\ & \text { Ouptut } \end{aligned}$ | $\begin{gathered} \underset{\substack{5000 \\ \text { Signai }}}{ } \mathbf{v .} . \\ \hline \end{gathered}$ | Cap | . | 8 | 165 | 3 | 12.5 | 5 | -30 | 110 | 15.0 | $\begin{gathered} \text {-Higb } \\ \text { Volloge } \\ \text { Putule } \\ \text { Procont } \end{gathered}$ |
|  |  |  | $\mathrm{Sig}_{\text {Signal }}^{\text {Nom }}$ | Cap | - | 8 | 165 | 3 | 12.5 | 5 | -30 | 110 | 15.0 |  |
| v117 | $\begin{array}{r} 1 \mathrm{~B} 3 \mathrm{GT} \\ 8016 \end{array}$ | H. V.Rectifier | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} \\ \text { Signai } \end{gathered}$ | Cap | . | - | - | 287 | 16,000 | - | - | - | - | $\begin{gathered} \text { High } \\ \text { Viltage } \\ \text { Pureseot } \\ \text { Puthe } \end{gathered}$ |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | Cap | - | - | - | 247 | 16,400 | - | - | - | - |  |
| $\begin{array}{\|l\|l\|} \hline \mathrm{V} 118 \\ \mathrm{v} 119 \end{array}$ | 6W4GT | Dompers | $\begin{gathered} 5000 \mathrm{Mu} \mathrm{~V} \\ \text { Signal } \end{gathered}$ | 5 | 352 | - | - | 3 | - | - | - | 57 | - | $\begin{gathered} \text { High } \\ \text { Solloge } \\ \text { Putco. } \\ \text { Prosesent } \end{gathered}$ |
|  |  |  | ${ }_{\text {Signal }}^{\substack{\text { No }}}$ | 5 | 348 | - | - | 3 | - | - | - | 57 | - |  |
| v120 | 21 AP4 | Kinatcope | 5000 Mu . V. Signal | Cono | 16.000 | 10 | 525 | 11 | 140 | 2 | ${ }^{82}$ | 0.2 | - | $\underset{\substack{\text { At anorage } \\ \text { Brightaeit }}}{\text { ate }}$ |
|  |  |  | $\mathrm{Sigomal}_{\text {No }}$ | Cono | 16,400 | 10 | 520 | 11 | 132 | 2 | $\cdot 76$ | 0.2 | - | $\stackrel{\circ}{\circ} \mathrm{O}$ voltage on |
| $\begin{array}{\|c\|c\|} \mathrm{v} 121 \\ \mathrm{v} 122 \end{array}$ | 5 S 4 G | Roctitiors | $\begin{aligned} & 5000 \mathrm{Mu} \mathbf{v} \\ & \text { Signai } \\ & \text { S. } \end{aligned}$ | 4*6 | 364 | - | - | 288 | 364 | - | - | $\cdot 145$ | - | ${ }_{\text {Tubor }}^{\text {Per }}$ |
|  |  |  | $\mathrm{Si}_{\text {Soral }}^{\text {No }}$ | 446 | 360 | - | - | 288 | 360 | - | - | $\cdot 150$ | - |  |





John F. Rider


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| STOCX | deschiption |  | deschiption |  | description | $\underset{\substack{\text { stock } \\ \text { No. }}}{\text { coser }}$ | description |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Reisistor-Fixod. comp | $\begin{aligned} & 71966 \\ & 75217 \end{aligned}$ | Capacitor-Mica trimmer, 5.70 mml (C121) Capacitor-Mica trimmer, dual 10.160 mml . (C186A. C186B) | 76 | Coil-Horizontal linearity coil complete with adjustable core (L111) <br> Coil-Peaking coil ( 72 muh ) (L103. R149) | $\begin{aligned} & 503433 \\ & 503439 \end{aligned}$ $503647$ | 330,000 ohms, $\pm 10 \%, 1 / 2$ wall (R116, R205, R220) <br> 390,000 ohms, $\pm 10 \%$. $1 / 2$ watl (R219) |
| 503112 50314 | 120 ohms $\pm 10 \%, 1 / 2$ walt (R11) 470 ohms, $\pm 10 \%$, $1 / 2$ watt (R14) | 9044 |  | ${ }_{76647}$ | Coil-Peaking coil (180 muh) (1107 |  |  |
| 503210 | 1.000 ohms. $\pm 10 \%$ \% $1 / 2 \mathrm{wall}$ (R8) | 765 | Capacitior-Fixed. Coramic, 33 mml ., 6,000 volts (C198) | 7252 | Coil-Peaking coil (500 muh) (L104. L106) | 503668 | 680.000 ohms. $\pm 10 \%$. $1 / 2$ watt (R169) |
| 503233 | $3.300 \mathrm{ohms}, \pm 10 \%$, $1 / 2$ watt (R5) | 76574 | Capaciior-Fixed, ceramic, $39 \mathrm{mmt}$. 3,500 volts (c180) | 76640 76510 |  |  |  |
| ${ }^{503268}$ | $6.800 \mathrm{ohms} . \pm 10 \% .1 / 2 \mathrm{wath}($ (R12) | 39042 |  | 76884 | Coil-Width coil complete with adjusta | 503512 | 1.2 megohm, $\pm 10 \%$ \% $1 / 2$ watt (R136) |
| 523312 | 12.000 ohms. $\pm 10 \%$, 2 watts (R2) |  | 500 volus DC, Tomp. ceet. $=-750$ (C151) | 77654 | Control-AGC control (R180) | 5035 | 3.3 megohm. $\pm 10 \%$. $1 / 2 \mathrm{watt}$ (R196) |
| 523315 502327 | (15,000 ohms. $\pm 10 \%$. 2 wats (R3) | 71924 |  | 77655 |  | 512536 503539 |  |
| 503410 | 100.000 ohms, $\pm 10 \%$, 1/2 watt (R1. R6, R7, R13) | 764 | ${ }_{\text {Capasaitor-Fixed. }}^{\text {Cliz) }}$ mica, 82 mmm . 1,000 volis DC (C165. | ${ }_{\substack{\text { 77640 } \\ 7663}}^{7}$ | Control-Height control (R190) |  |  |
| 503510 <br> 77858 |  | 39396 | Capacitor-Fixed, eramic. non-insulated. 100 mmi . | ${ }_{76649}^{7639}$ | Control-Horizontal hold control (R20 Control-Piture control (R155) | 503582 503610 |  |
|  |  |  |  | 77199 | Control-Ratio coitector balance control (R1 | $\begin{array}{\|c} \left\lvert\, \begin{array}{c} 503610 \\ \hline \end{array} 77656\right. \end{array}$ | Swith-Phonotone awitch (si01) |
| ${ }_{7}^{77557}$ |  | 71614 | Capacitor-Fix | $\xrightarrow{77652}$ | Control-Verrical hold control (R187) Control-Vertical linoarity control (R1) | 76463 | Torminal-Scrow typo grounding torminal |
| ${ }_{77628}$ | Trap-I. |  |  | 76675 | Rectiiior-Picture dotectior crystal rectitier (a) | 77198 |  |
| 76542 | Trap-1.F. trap (11.25 MC) complote with core (L57) | 76575 |  | ${ }_{7}^{76668} 7$ |  | 7197 |  |
| ${ }_{7}^{76541} 7$ |  | 75248 | Capacior-Fixed, mica, 220 mml ., 1.000 volls (C181) | 77651 | Resistor-Wire wound comprising 1 seetion of 600 ohms; | 66435 | Trantormar-2nd pix lif Prict trantormex comp |
|  |  | 476 |  |  |  | 76433 | Transiormer-3rd or th pix li. translormer (T107, T109) |
| 77699 |  | 39638 | Capacitor-Fixdod, mica, 270 mmL ., 500 volts DC (C161) |  |  | 76436 | Transtormer- 5 Sh p pix 1 .F. transtormer (T109, C142. C143. L102, R146, CR101) |
| 699 | Capacitor-Fixed. headed-lead type, $1 \mathrm{mml} ., \pm 10 \%$, 500 volts DC (C40) | $\begin{aligned} & 76599 \\ & 39640 \end{aligned}$ | Capacitor-Fixed, mica, 270 mm ., 1.000 volts DC (C192) Capacilor-Fixed. mica, 330 mml ., 500 volts $D C$ (C159) | 76642 | R228E. R228F) Resietor-Wire wo | 析 | Translormer-Hi-voltage transtormer (Part of Th15) |
| 1500 | Capacitor-Fixed, headed.lead type. 1.5 mm ., $\pm 10 \%, 500$ volts DC (C39) | 39644 | Capacior-Fixed. mica, 470 mml ., 500 volis DC (C109. | 77668 | ${ }_{\substack{\text { Resistor-Wire } \\ \text { KCSA1) }}}^{\text {mound, } 4.000}$ ohms, 7 watts (R121 | 76440 | Transtormer-Horizontal oscillator transtormer complete with adjustable cores (T114) |
| 804 | Capacitor-Fixed, headod-lead type, $2.0 \mathrm{mml} . . \pm 10 \%, 500$ volis DC (C42) | 76488 |  | 77669 | ${ }^{\text {Resisisor-Wire wound. }} 10.000$ ohms, 5 watts (R231 | 76997 | Transtormer-Output translormer (T103) |
| 77210 |  | ${ }_{7} 7166$ | Capacior-Coramic, stand.ott, 1.500 mmt (C144) |  | Roilitior-Fixad, com |  | Translormer-Power transiormer. 117 volta $(T 113)$ |
| 72667 |  | 7374 |  | 503033 503047 | 33 ohms. $\pm 10 \%$, $1 / 2$ watt (R152) <br> 47 ohms. $\pm 10 \%, 1 / 2$ watt (R107, R218) | 76439 | Transtormer-Ratio detector translormer complete adjustable cores (T102, C106, C107) |
|  | tion of 2 mml ., cand 1 section of 22 mmp ., Temp. coett. $=-750$ (C12, C13) | 73473 | Capacitor-Fixed, ceramic, $4.700 \mathrm{mmi} .+100 \%$, $-0 \%$, 500 volts DC, High "K" disc (C126, C128, C130, C136, C138, | ¢502056 <br> 34763 | 56 ohms. $\pm 5 \%$. $1 / 2$ walt (R134) | 76438 | Transtormer-Sound I.F. transtormer complete with adjustable cores (T101, C102. C103) |
| ${ }_{7}^{77616}$ | Capacior-Kdjustable, mica, 4.40 mml ( (C16) | 76470 | C141) | S02022 |  | 76437 | Transformer--Sound take-off transtormer complete <br> Iransiormer--5ound (T110, C147) |
| 77688 |  |  | $=0 \%$. ${ }^{500}$ volis DC . High "K" dizc (C122A. Cl 22 B . <br>  | ( $\begin{aligned} & 502110 \\ & 50310 \\ & 503118\end{aligned}$ | 100 ohms, $\pm 10 \%$. $1 / 2$ watt (R127 for XCS81) <br> 180 ohms, $\pm 10 \%, 1 / 2$ watt (R142) | 77650 | Transformer-Vertical oscillator transformer (Tll1 <br> Transformer-Vertical output transformer (T112) |
| 74182 |  | 73960 |  | ( $\begin{aligned} & 5031122 \\ & 513133 \\ & 5\end{aligned}$ |  | 76494 76482 77595 | Trap--4.5 MC trap (Llo5, C150) |
| 77621 | Capacitor-Fixed, ceramic. crystal holder. 22 mml ., $\pm 10 \%$. Temp. coett. $=-750$ (C11) | 7587 |  |  | 560 ohms, $\pm 10 \%$. $1 / 2$ watt (R198) 680 ohms, $\pm 10 \%, 1 / 2$ watt (R154) |  | $\underset{\left(2 \mathrm{req}{ }^{\prime} \mathrm{d}\right)}{\text { Washer-"C" washer for picture control extension s }}$ |
| 71924 |  |  | $\begin{aligned} & \text { C105A. C105B) } \\ & \text { Capacitor-Electroly } \end{aligned}$ | 503210 |  |  | OOKE 6 magnet Assembli |
| 77625 | Capacitor - Fixed. .ceramic. $220 \mathrm{~mm} 1 .,+100 \%,-0 \%, 500$ volts DC. High "K" dise (C18) | 28417 | Capacitor-Electrolytic, 5 mdd. 450 volus (C1) | ${ }_{5}^{502218}$ | 1.800 ohms $=5 \%$ \% $1 / 2$ watr ( R 1833$)$ | 76863 | Connector-Anode connector complete with contact |
| 77293 | Capacitor-Fixed. ceramic. $470 \mathrm{mml},+100 \%,-0 \%, 500$ volte DC. High "K" disc (C43) |  |  of 10 mtd .200 volts (C120X, C120B, C120C. C120D) | ${ }^{5032233}$ | 3,300 ohms. $\pm 10 \%$, $1 / 2$ watt (R201) | 75542 | Connector- 6 contact male connector-part of deflection |
| 77624 | Capacitor-Fixed. ceramic. $680 \mathrm{~mm} .,+100 \% .-0 \%$, 500 volue DC. High " "K" disc (C4) | 76486 |  | 502339 503239 |  | 74956 | Cushion-Rubber cushion tor dofiection yoke hood |
| 77084 | Capacitor-Ceramic, leadthru, 1.000 mmt ( (C21. C23, C25) |  | 20 mid., 200 volis and 1 nection of 100 mld .. 50 volis (C118A,' C118B, C118C, C118D) | ${ }_{\substack{503247 \\ 502256}}$ |  | \%8 | Hood-Deflection yoke hood-leas rubber cushions |
| 77615 | Capacitor-Ceramic, stand-oft, 1.000 mml . (C3. C19. | 77657 |  | ${ }_{512256}$ | 5.600 ohms. $\pm 10 \%$, 1 watt (R156) | ${ }_{76141}^{76148}$ | Magnet-Focus magnet Magnet-Ion trap magnet |
| 7752 |  |  |  | (14659 |  | 21456 | Screw-No. $8.32 \times 7 / 16^{\prime \prime}$ w ion yoke |
| 7396 |  |  | Capacitors-Fixed, tubular, oll impregnated: Paper, 001 mid., 1,000 volts (C194) | (13268 |  | 76636 | Stud-Adjusting stud complete with guard tor tocus maqnot |
| 77628 | Coil-IF trap (L7) |  | Moulded papor. .0013 mid... 600 volte (C195) | 533282 503310 |  | 76653 |  |
| 77634 | Coil-IF noutralizing coil | 73595 | Paper. 00022 mad.. 600 volts (C110) | 503310 | ${ }^{10.0002}$ (R29) ${ }^{\text {Rms, }} \pm 10 \%$. $1 / 2$ wall (R139, R164. R200. |  |  |
| 77629 77632 | coil-Oscillator cathode coill (L9) Coil-Oscillator heater coil (LL5) | 73803 |  | Sti3310 | 10.000 ohms. $\pm 10 \% .1$ wat (R15) 15,000 ohms, $\pm 10 \%$, $1 / 2$ watt (R15 |  | Speaker assemblits |
| 77631 | Coil-Osacillatior heater coil (114) | 20 |  | (1) $\begin{aligned} & \text { 523315 } \\ & 50318\end{aligned}$ | (15,000 ohms. $\pm 10 \%$ (10\% watts (R143) |  | $971490.3 \mathrm{~W} \quad 971480.3 \mathrm{R}$ |
| 78224 77627 | Coil-Oscillator plate coil (L) Coil-Poaking coil (L6, Rul) | 73789 | Moulded paper, . 0068 mid., 400 volta (C213) | ${ }_{5}^{5033322}$ |  |  | RMA 274 |
| 77695 | Coil-RF plate coil (L8) | 73808 | Paper. . 0082 mid.. 1.000 volts (C148, C162) ${ }^{\text {a }}$ | 522322 | ${ }^{22,000}$ ohms. $\pm 10 \%$, 2 watas (R223) |  | Or Table Modotic |
| 77614 77617 | Control-Oscillatar vollage control (R6) Control-UHF oscillator iniection adjustment control | 73561 73594 |  | ${ }_{5}^{52332327}$ |  | 75024 | Cone-Cone and voice coil tor speakers |
| 7749 | Rectifior-Germanium rectitior IN82 (CR1) | 73562 | Papar, 022 mld.. 400 volis (C113, C178, C179. C189) | ${ }_{503333}$ | $\underset{\text { R235) }}{33.000}$ ohms, $\pm 10 \%$. $1 / 2$ watt (R106, F129, R132. R135, |  | $\begin{array}{r} 3 W \\ \text { Cone } \end{array}$ |
|  | Rosistors-Fixed. composition: | 73798 7758 | Paper. 022 mid. 600 volls (C182) | 503339 | 39.000 ohms, $\pm 10 \%$, $1 / 2$ watt (R110, R173. R212. R215) |  |  |
| 503110 | 100 omms. $\pm 10 \%$, $1 / 2$ watt (R10. H 17 ) | 7352 7353 |  | ${ }_{\text {S }}^{5033347}$ | 47,000 ohms, $\pm 10 \%, 1 / 2$ wall (R103) (R123 tor KCS 56,000 ohms, $\pm 5 \%$, $1 / 2$ watt (R141) |  | $\begin{aligned} & \text { Speaker-8" P.M } \\ & \text { coil ( } 3.2 \text { ohms) } \end{aligned}$ |
| 50312 | 120 ohms, $\pm 10 \%$, $1 / 2$ watl (R2, R9) 1.000 ohms. $\pm 10 \%$, $1 / 2$ watt (R13, R14) |  |  | 503356 <br> 50358 | 55.000 ohme. $\pm 10 \%$, /1/ wath (R105, R209) |  |  |
| 503310 |  | ${ }_{73815}$ |  | ( 503368 |  |  | ${ }^{92569-12 \mathrm{~W}}$ |
| 50332 | 22.000 ohms, $\pm 10 \%$, $1 / 2$ watt (R1) | 73551 | Paper, 0.1 mid.. 400 volts (C183, C214) | 513368 | 68.000 ohms. $\pm 10 \%$, 1 watt (R216) |  | 11141 |
| 503410 | 100.000 ohms. $\pm 10 \%$, $1 / 2$ wall (R18, R19) | 5794 |  | ${ }^{80648}$ |  |  | RMA 274 |
| 503412 | 120.000 ohms. $\pm 10 \%, 1 / 2$ watt. (RS) 270.000 ohms $\pm 10 \%, 1 / 2$ wati (R4) | 73794 |  | ( $\begin{aligned} & 513382 \\ & 503410\end{aligned}$ |  |  | (For Com |
| ${ }_{50344} 5$ | 470.000 ohms, $\pm 10 \%$, 1/2 watt (Ra) | 74957 | Paper, 0.22 mad.., 600 volis (C176) | 503412 | ${ }^{120.0000}$ ohms. $\pm 10 \% \%$, $1 / 2$ wall (R124) |  | Cone-Cone and voice coil |
| 503582 77609 | ${ }^{8.2}$ megohm, $\pm 10 \%$, $1 / 2$ wath (R3, R7) | 73787 77676 | Paper. 0.47 mld.. 200 volis (C191. C196) | 503415 503118 | 150.000 ohms, $\pm 10 \%$, $1 / 2 /$ watt (R159, R195, R202, R204) 1880000 ohms, $\pm 10 \%$, $1 / 2$ watt (R207) | 76993 | Speaker-12" P.M. speaker complete with cone and voice coil ( 3.2 ohms) |
|  |  | 43 | Clip-Mounting elip tor stand.off capacitor | 502422 | 220.000 ohms. $\pm 5 \%$, $1 / 2$ wall (R179) |  | NOTE: 11 stamping on spoaker in instruments does not |
| 77610 |  | ${ }_{7} 73477$ | Coil-Choke coil (L101) |  | 220.000 ohms, $\pm 10 \% .1 / 2$ watt (R233) ${ }^{20}$, |  | agree with above spakaer number., order replacement |
| 77626 | Trap-1. F . trap (L1. C1. L2. C2) |  | Coil-Filament (Part of T115) |  |  |  | stamped on speaker and full description of part required. |

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GENERAL DESCRIPTION
Models 27-D-331 and 27-D-331U are Deluxe "27 Inch" tele- plus any 4 UHF channels desired. These receivers have an vision receivers. Model 27-D-331 features full 12 channel auxiliary audio input jack to permit the use of an external
VHF


ELECTRICAL AND MECHANICAL SPECIFICATIONS

## PICTURE SIZE . . . 420 square inches on a 27MP4 Kinescope <br> RCA TUBE COMPLEMENT Tube Used

## television r-f frequency hange

Model 27-D-331
All 12 VHF channels .54 mc . to 88 mc ., 174 mc . to 216 mc . Model 27-D-331U
Any of 70 UHF channels.
Any of 12 VHF channels. 54 mc. to $88 \mathrm{mc} ., 174 \mathrm{mc}$. . 17890 mc .10216 mc . Any of 12 VHF channels. 54 mc . to $88 \mathrm{mc}$..174 mc . 10216 mc .
(Any desired combination of 16 UHF and/or VHF chan . (Any desired comb

INTERMEDIATE FREQUENCIES
Picture I-F Carrier Frequency
Sound I-F Carrier Frequency
POWER RATING
45.75 mc .

OUDIO POWER OUTPUT BATING VIDEO RESPONSE
WEEP DEFLECTION
FOCUS
.41 .25 mc .
4 watts max.
to 4 mc .
Magnetic Magnetic
ANTENNA INPUT IMPEDANCE Model 27-D.331
Choice: 300 ohms balanced or 72 ohms unbalanced Mpdel 27-D.331U
UHF-Choice: 300 ohms balarced or 72 ohms unbalanced VHF- 300 ohms balanced.

CHASSIS DESIGNATIONS


KCS77B ............................... in model 27-D-331U OUDSPEAKLIS COIL IMPEDANCE (971490-4W) 8 Inch PM Dynamic

Tube Used
Tuner KRK22A (Model 27-D-331)
Function
(1) RCA 6BQ7A R-F Amplitier
2) RCA 6X8 ................. Oscillator and Mixer


A 1 N82 crystal is used as a mixer.
Models 27-D-331 \& 27-D-33IU
(1) RCA 6AU6............1st Picture I-F Amplifier
(3) RCA 6CB6............3rd Picture I-F Amplifier
(4) RCA 6CB6...................
(5) RCA 6CL6....................ideo Amplifier
(7) RCA 6AL5.
(8) RCA 6AU6.
(9) RCA 6AU6
(10) RCA GAL5.
(11) RCA 6AVG
12) RCA $6 A Q 5$

Agitation Compressor
1st Sound I-F Amplifier
$\ldots$ 2nd Sound I-F Amplifier
13) RCA 12AU7...................... Sync Soutput
(14) RCA 12AU7 Horiz. Sync Separator and Sync Amplifier
(15) RCA 6SN7GT and Vert. Sweep Osc. and Dischg.
(16) RCA 6AQ5.
(17) RCA 6 SN7GT Horizontal Sweep Oscillator and Control (17) RCA 6 6N7GT Horizontal Sweep Oscillator and Control
(18) RCA 6 GQ6GT (2 tubes) ..... Horizontal Sweep Output

(20) RCA $1 B 3 G T / 8016 .$.
(21) RCA $5 U 4 G$ (2 tubes)
(22) RCA 27MP4

ELECTRICAL AND MECHANICAL SPECIFICATIONS
(Continued)

| SCANNING ................ Interlaced, 525 line | NON-OPERATING CONTROLS |
| :---: | :---: |
| SCANNING................... .interlaced, 525 line | Horizontal Centering . . . .top chassis adjustment |
| HORIZONTAL SCANNING | Vertical Centering ....... top chassis adjustment |
| FREQUENCY ...................... 15.750 cps | AGC . . . . . . . . . . . . . .rear rearssis adjustment |
| VERTICAL SCANNING FREQUENCY .... 60 cps | Height .......front panel screwdriver adjustment |
| FRAME FREQUENCY | Vertical Linearity . . .front panel screwdriver adjustment |
| cture Repetition Rate). . . . . . . . . . . . . 30 cp | Horizontal |
| OPERATING CONTROLS (front panel) | Locking . . .rear chassis screwdriver adjustment |
| Channel Selector\} .......... . Dual Conntrol | Drive . . . . .rear chassis screwdriver adjustment |
| Fine Tuning | Horizontal Linearity ......rear chassis adjustment |
| Brightness | Horizontal Oscillator <br> Frequency ............. rear chassis adjustment |
| $\left.\begin{array}{l}\text { Sound Volume and } \\ \text { On-Off Switch }\end{array}\right\} \ldots$...... Dual Control Knobs | Horizontal Oscillator <br> Waveform . .......... . bottom chassis adjustment |
| $\left.\begin{array}{l}\text { Picture Horizontal Hold } \\ \text { Picture Vertical Hold }\end{array}\right\}$ Dual Control (Knurled) | Width .................... . rear chassis adjustment Width Link .........H.V. compartment adjustment |
| Contrast-Peaking . . . . . . . . . Single Control Kno | Focus ................ top chassis adjustment |
| ne Switch ............... Single Control Kno | Ion Trap Magnet . . . . . . . . . .op chassis adjustment |
| Control Kn | Deflection Coil .......... .top chassis adjustm |



Figure 3-Rear Chassis Adjustments


|  |  |  | ALIGMMENT PROCEDURE |  |  |  |  | ALIGNMENT PROCEDURE |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| TEST EQOIPMENT.-To properly service the television chassis of these receivers, it is recommended that the follow ing test equipment be available: |  |  |  |  | Picture | Sound | Receiver |  | To align Tl and T 104 , connect the sweep generator to the |
|  |  |  |  | $\underset{\substack{\text { Channel } \\ \text { Number }}}{ }$ | $\underset{\text { Freq. }}{\substack{\text { Carrie }}}$ |  |  | to ground, keeping the leads as short as possible. | mixer grid test point TP2. Use the shortest leads possible, |
|  |  |  |  |  | 699.25 | 73.75 | 745 | Connect an oscilloscope low capacity crystal p | wh more tha |
| VHFments: |  |  |  | 53 | 705.25 7125 7 | 799.75 71575 715 | $\begin{array}{r}751 \\ 757 \\ \hline 57\end{array}$ |  | Adjust C121 until 41.25 mc . is at $85 \%$ response with respect |
| ( 35109 |  |  |  | 54 | ${ }_{71725}^{7125}$ |  | ${ }_{763}$ | gain to maximum. | to the low frequency shoulder at approximately 41.9 mc . as |
|  |  |  |  | ${ }_{5}^{56}$ | ${ }_{7}^{72325}$ | 727.75 | 769 | Connect the thr sweep generator to hee mauling reac- |  |
| (b) Output adiustable with at least 1 volt maximum. |  |  |  | ${ }_{58}$ | $\begin{array}{r}7235 \\ 73.25 \\ \hline\end{array}$ | 73375 | ${ }_{781}$ |  | Disconnect the diode probe, the 180 ohm and three 330 ohm resistors. |
|  |  |  |  |  | 741.25 | 745.75 | ${ }_{787} 7$ |  |  |
|  |  |  |  | 60 61 | $\begin{array}{r}747.25 \\ 753.25 \\ \hline\end{array}$ | $\begin{array}{r}751.75 \\ 757.75 \\ \hline\end{array}$ | 793 799 |  | 10 |
| with crystal ccuuracy: |  |  |  | 62 | 759.25 | 763.75 | 805 | output or 300 ohm balacred output. Chose the $p$ | e signal generator to each of the following requen- |
|  |  |  |  | 63 64 | 765.25 77125 | 769.75 <br> 775 <br> 75 | 811 817 | $\begin{aligned} & \text { to match } \\ & \text { employed. } \end{aligned}$ | (ion on the "Volto hmyst." During alignment, reduce the input |
|  |  |  |  | ${ }_{6}^{64}$ |  | 78175 | ${ }_{823}^{81}$ | Connect the signal generator loosely to the matching | sional if fecessary in order to produce 1.0 volt of d.c at pin 9 |
| (b) Radio frequencies |  |  |  | 67 | $\begin{array}{r}783.25 \\ 789 \\ \hline 89\end{array}$ | 793.75 | 829 <br> 835 <br> 8 | antenna terminals. | $\stackrel{\circ}{\mathrm{C}} 133 \mathrm{~B}$. |
| Channel | Picture Carrier |  | ${ }_{\text {R-F }}^{\text {Recei }}$ | 68 | 795.25 | 79975 | 841 |  | 43.7 mc................................ T109 |
| Number | Freq. Mc. | Freq. Mc. | ${ }_{\text {Freq. }}$ |  | ${ }_{80725}^{801.25}$ | ${ }_{81175}$ | ${ }_{853}^{88}$ | complished by retuning channel number 1 to cover range With WR59B sweep generators this may be acce | 45.5 mc . |
| 2 | 55.25. | 59.75 | 101 107 | 71 | ${ }_{813.25}^{81}$ | 817.75 | ${ }_{859}$ | range. With whisg sweep generatiors this may be accal | 41.8 mc .............................. $\mathrm{T}^{107}$ |
|  | 67.25 | 71.75 | 113 | 72 | 819.25 825 885 | ${ }^{823.75}$ | ${ }_{881}^{865}$ | In making these adjustments on the generator, be sure | align T |
|  | 77.25 <br> 8325 | 81.75 8775 | 123 <br> 129 | 74. | ${ }^{831} 25$ | 835.75 | 877 | to turn the core too tar clockwise so that it becomes lo yond the core retaining spring. | the first picture $i$ it grid, pin 1 of 106 through a 1,000 mmf. |
|  | 175.25 | 179.75 | ${ }_{221}^{221}$ | 78 | 837.25 84325 | 84725 <br> 8475 | -889 | Adjust LSS and LS6 to oblain the resp | "F" of 7109 with 330 ohm composition rexisiors. Set the i -f |
|  | 181.25 187.25 | 185.75 <br> 191.75 <br> 18 | 227 <br> 233 | 77 | 889.25 | 8375 <br> 885 <br> 8895 | 895 | 16. LS5 is most ettective in locating the position of hit eshout |  |
|  | $\begin{array}{r}193925 \\ 19925 \\ \hline 18\end{array}$ | 19775 20375 | 239 <br> 245 | ${ }_{78}^{78}$ | 855.25 <br> 861.25 <br> 6825 | 899.75 <br> 885 <br> 8775 | ${ }_{907}^{901}$ |  | $\begin{aligned} & \text { Connec } \\ & \text { amplifier. } \end{aligned}$ |
|  | $\begin{array}{r}1995.25 \\ \hline 20.25 \\ \hline\end{array}$ | $\stackrel{209.75}{20.75}$ | 251 257 | ${ }_{81}^{80}$ | 867.25 87325 | 871.75 87725 | 913 919 | speciited shape of the response curve. The eadustme | Adjust T10S and T106 top cores for maximum gain and |
| 13 | 211.25 | 215.75 |  |  |  | 883.75 | 15 | procedure until no further adjustmenis are necessary. |  |
| (c) Output of these ranges should be adjustable and at least <br> VHF Heterodyne Frequency Meter with crystal calibrator <br> if the signal generator is not crystal controlled. <br> o 890 mc . RCA Types 40A or 41 A or their equivalent. <br> UHF Signal Generator to provide the following frequencies <br> with crystal accuracy if RCA Type 41A is used. |  |  |  |  |  | 889.75.. |  | Remove the 300 ohm resistor and crystal probe connections | the output of the VHF sweep generator to produce 0.5 volt |
|  |  |  |  | Cathode Ray Oscilloscope.-An oscilloscope with a sensitivity of 1 millivolt per inch is required. A suitable pre-amplifier may be employed with oscilloscopes of lesser sensitivity <br> Electronic Voltmeter.-A voltmeter with a 1.5 volt DC scale is required. RCA Senior "VoltOhmyst" or equivalent. <br> DC Milliammeter.-A milliammeter with a range of 0.50 milliamperes full scale |  |  |  | PICTURE I-F TRAP ADIUSTMENT.-Connect the i-f signal generator across the link circuit on terminals A and B of T104. Connect the "Voltohmyst" to the junction of R133 and | To align the crystal mixer and $T 2$ and $T 104$, connect the VHF sweep generator to the front terminal of the 1 IN82 crystal holder in series with a $1,500 \mathrm{mmin}$. ceramic capacitor. Use theshortest leads possible, grounding the sweep generator to the |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  | tuner |  |  |
| $\underset{\substack{\text { Channel } \\ \text { Number }}}{\text { chen }}$ | Picture | Sound |  |  |  |  |  | Adapter | ket.-An |  |  | preciable current drain and connect the ends of a 1,000 ohm potentiometer across each. Connect the positive termincl of one battery to chassis and the potentiometer arm to the junc- |  |
|  | $\underset{\text { Fre }}{\text { C }}$ | (rrier | $\begin{gathered} \text { R-F Og } \\ \text { Freq. } \end{gathered}$ | the cathode current of the 6 S4 voltage control tube of the KRK12 Tuner. Wiring of adapter is shown in figure 14. |  |  |  | of T105 and the junction of R131 and C133A. |  |  |
| 14... | 471.25 | 475.75. | ${ }_{5}^{517}$ | KRE22A ANTENNA MATCHING UNIT ALIGNMENT.-The antenna matching unit is accurately aligned at the factory |  |  |  |  | Connect the oscilloscope diode probe to terminal " B " of |  |
| 15 | 477.25 4835 | ${ }_{487}^{481}$ | [ 529 |  |  |  |  | produce approximately -1.0 volt of 33 and C133B | diode probe in order to obtain markers. |  |
| 17 | 489.2 | 493 | $\begin{array}{r}535 \\ 541 \\ \hline\end{array}$ | Adjustment of this unit should not be attempted in the customer's home since even slight misalignment may cause |  |  |  | Connect the "Voltohmyst" to pin 9 of V110, the 6CL6 video | The shunt trimmer C121 across terminals A and B of 7104 is |  |
| 18 | ${ }_{50125}^{495}$ | $\begin{array}{r}\text { 499.75 } \\ \hline 5\end{array}$ | 547 | serious attenuation of the signal especially on channel 2 . The |  |  |  | amplifier. | ariable and is provided as a bandwidth adjustment. Preset |  |
|  | ${ }_{513} 5$ | $\begin{array}{r}511.75 \\ 517.75 \\ \hline\end{array}$ | ( 553 | (tuner unit is digned with a particular antenna matchitg |  |  |  | Set the signal generator to each of the following frequen- | T104 (bottom) for maximum gain at 43.5 mc . and with 45.75 |  |
| 22 | S | 5123 <br> 5 <br> 52975 | (595 | aligned. <br> The F-M Trap which is mounted in the antenna matching |  |  |  |  |  |  |
| ${ }_{24}^{23}$ | 5351.25 <br> 51 | 52975 <br> 53575 | 577 |  |  |  |  |  |  |  |
| 25 | 7.25 | 541 | 583 | unit may be adjusted without adversely affecting the alignment of the unit |  |  |  |  | response whely 41.9 mc. as shown in figure 12. Adjust Tl for proximate |  |
| ${ }_{27}^{26}$ | 543.25 59925 |  | 595 | To align the antenna matching unit disconnect the lead |  |  |  | 47.25 mc . | maximum gain. Readjust T 2 and T 104 if necessary to obtain |  |
| ${ }^{28}$ | $\begin{array}{r}555.25 \\ 56125 \\ \hline 5 .\end{array}$ | 565 | 691 607 | With $C$ short iumper, connect the output of the matching |  |  |  | ure i-p tran | Disconnect the diode probe, the 180 ohm and the three 330 |  |
| ${ }_{30}^{29}$ | $\begin{array}{r}5667.25 \\ 5 \\ \hline 573\end{array}$ | $\begin{array}{r}5671.75 \\ \hline 5775 \\ \hline\end{array}$ | ${ }_{613}$ |  |  |  |  | Model 27-D. | ohm resistors. |  |
| ${ }_{32}^{31}$ | 579. | $\begin{array}{r}577.75 \\ 583.75 \\ \hline\end{array}$ | -619 625 | pix i-f amplitier, pin 1 of $V 107$. |  |  |  | Set the signal generator to each of the following frequencies | alignment of picture i.f. |  |
| 33 |  | 589.75 <br> 595 | -631 | Replace the cover on the matching unit while making all adjustments. |  |  |  | and peak the specified adjustment for maximum indication on | Connect the oscilloscope to pin 9 of V110. |  |
| 34 35 | 591.25 <br>  <br> 597.25 | 595.75 60175 | ${ }_{643}^{63}$ | Remove the first pix i-f amplifier tube V106. <br> Connect the positive terminal of a bias box to the chassis |  |  |  | it necessary in order to produce 1.0 volt of d-c at pin 9 of l V110 | Adjust the bias potentiometer to obtain -6.0 volts of bias |  |
| 36 | 66 | 60775 61375 6 | 649 655 | and the potentiometer arm to the junction of Ras3 and C1331s |  |  |  | with -1.0 volt of i-f bias at the junction | as measured by a "VoltOhmyst" at the junction of R133 and |  |
| 38 |  |  |  |  |  |  |  | 43.7 mc . |  |  |
| 49 | 621 | $\begin{array}{r}625.75 \\ 63175 \\ \hline\end{array}$ |  | loscope gain to maximum |  |  |  | 48.15 mc 41.8 me | point TP2 on KRK22A Tuner or to the front terminal of the |  |
| 40 | 633 |  | ${ }_{6}^{67}$ |  |  |  |  | To align $T 105$ and T106, connect the sweep generator to the | 1N82 crystal holder on KRK12 Tuner. Use the shortest leads |  |
| ${ }_{43}^{42}$ | 639.25 645.25 | 643.75 64975 | -685 | Connect $\alpha$ VHF signal generator to the antenna input terminals. Modulate the signal generator $30 \%$ with an audio |  |  |  | first picture i-f grid, pin 1 of V106 through a 1,000 mmi. ce- | end of the sweep cable. If these precautions are not observed, |  |
|  | $\begin{array}{r}651.25 \\ 657 \\ \hline 675\end{array}$ | 655.75 | 697 703 | Tune the signal generator to $45.75 \mathrm{mc}$. and adjust the gen- |  |  |  |  | the receiver may be unstable and the response curves ob- |  |
| 46 | 657.25 <br> 663.25 | $\begin{array}{r}661.75 \\ 667 \\ \hline 6775\end{array}$ | 703 709 |  |  |  |  | bias to -1.0 volt at the junction of R133 and C133B. |  |  |
| 47 | 669.25 675 685 | $\begin{array}{r}67375 \\ 67975 \\ \hline\end{array}$ | 715 721 | L54 in the antenna matching unit for minimum audio indica- |  |  |  | Connect the oscilloscope to pin 9 of V110. | peak-to-peak on the oscilloscope. |  |
| 49 | ${ }^{681} 25$ | 685 | 727 | Tune the signal generator to 41.25 mc . and adjust L 57 for minimum audio indication on the oscilloscope. <br> Remove the jumper from the output of the matching unit. |  |  |  | Adjust T105 and T106 top cores for maximum gain and hape as shown in figure 20. For final adjustmen sel the output of the sweep generator to produce 0.5 volt peak-to-peak at the oscilloscope terminals. | Couple the signal generato loosely to the grid of the irst |  |
| ${ }_{51}^{50}$ | 687.25 693.25 | . 75 | 773 739 |  |  |  |  | produce small markers on the response curve |  |  |

Retouch T108 and T109 to obtain the response shown in
figure 2 . Do not adjust $T 107$ unless absolutely necessary. If
$T 107$ is adjusted ingure 2. Do not adjust Tin unless absolutely necessary. If
Tin7 is ajusted too low in frequency it will raise the level of
the 41.25 mc. sound i -f carrier and may create interference in the picture. It will also cause poor adjacent channel picin the picture. It will also cause poor adjacent channel pic
ture rejection. If 7107 is tuned too high in frequency, the level of the 41.25 mc. sound i -f carrier will be too low and may
of the produce noisy sound in weak signal areas
Remove the oscilloscope, sweep and signal generator conRemove the bias box employed to provide bias for

RRE22A TUNER ALIGNMENT.
Model 27-D-331
A tuner unit which is operative and requires only touch up
adjustments, requires no presetting of adjustments. For such units, skip the remainder of this paragraph. For units which are completely out of adjustment, preset C 2 all the way out. Set channel 7 to 13 oscillator slugs one turn from tight.
Turn Tl slug all the way out. Do not change any of the ad justments in the antenna matching unit
Disconnect the link from terminals "A" and "B" of T104 and
terminate the link with a 39 ohm composition $\quad$ rsistor Turn the receiver channel selector switch to channel 2
The 42.0 mc . trap is adjusted with zero bias. To insure that the bias will remain constant, take a clip lead and short cir-
cuit the AGC terminal of the tuner, at the terminal board, to ground.
Connect the oscilloscope to the test point TP1 on top of the nit. Set the oscilloscope to maximum gain.
put of the antenna matching unit at the junction of L53 and at the bottom of the FM trap L.53
Tune the signal generator 1042.0 mc . and modulate it $30 \%$ with a 400 cycle
maximum output.
Adjust C19 on top of the tuner, for minimum 400 cycle indi-
cation on the oscilloscope. If necessary this adjustment can cation on the oscilloscope. If necessary, this adjustment can be retouched in the field to provide additional rejection to cases, care should be taken not to tune C19 into channel 2 , thereby reducing sensitivity on channel 2
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery to the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case. Adjust the bias potenti-
ometer to produce -30 meter to produce -3.0 volts of bias, as measured by the
"Voltohmyst" at the AGC terminal on the tuner Set the channel selector switch to the tun Set the channel selector switch to channel 8 . Preset $\mathrm{C5}$ to read, -3.0 volts at the test point TPI, as read
on the "VoltOhmyst". The limits for oscillator injection voltage are 2 volts minimum and not exceeding a maximum of 5.5 volts.

Turn the fine tuning control fully clockwise.
Adjust C3 for proper oscillator frequency, 227 mc . This may
be done in several ways. The easiest way and the way which will be recommended in this procedure will be to use the signal generator as a heterodyne frequency meter and beat the oscillator against the signal generator. To do this, tune
the signal generator to 227 mc. with crystal accuracy. Insert one end of a piece of insulated wire into the tuner unit through the hole provided for the adjustment of ClO. Be care-
ful that the wire does not touch any of the tuned circuits as it ful that the wire does not touch any of the tuned circuits as it
may cause the frequency of the tuner oscillator to shift. Connect the other end of the wire to the "r-f in" terminal of the
signal generator. Adjust C 3 to obtain an audible beat with signal generator. Ad
The signal generator.
Turn clockwise until the beat note just begins to chang
Turn C2 clockwise until the beat note just begins to change,
then turn one full turn in the same clockwise direction.
Return the fine tuning control to the mechanical center of its range.
NOTE.-If on some units, it is not possible to reach the proper channel 8 oscillatior frequency by adjustment of C3, switch to channel 13 and adjust $L 42$ to obtain proper channel
13 oscillator frequency as indicated in the table on page 8 . Then, switch to channel 12 and adjust $L 11$ to obtain proper channel 12 oscillator frequency. Continue down to channel
proper frequency on each channel. Then again on channel Switch back to channel 13 and readjust L42 and back Shath bel 8 and adjust C 3 .
Set the Tl core for maximum inductance (core turned
counterclockwise). Connect the swe
Connect the sweep generator through a suitable attenu-
ator, as shown in figure 15 , to the input terminals of the an ater, as shown in fig
Connect the signal generator loosely to the antenna ter
minals.
Set the sweep generator to cover channel 8 .
Set the oscilloscope to maximum gain and use the mini num input signal which will produce a usable pattern on ection during alignment and produce consequent misalign may look normal.
Insert markers of channel 8 picture carrier and sound car
rier, 181.25 me. and 185.75 mc . rier, 181.25 mc . and 185.75 mc .
Adjust C7, C10, C15 and C20 for approximately correct
curve shape, frequency, and band width as shown in
gure 17. curve shap
ligure 17 .
The correct adjustment of C20 is indicated by maximum unes the r-f amplifier plate circuit and attects the of the pass band most noticeably. C7 tunes the mixer gric circuit and affects the till of the curve moss noticeably (as
suming that C 2 has been properly adjusted). C10 is the suming that C20 has been properly adjusted). C10 is the oupling width
Connect the "VoltOhmyst" to test point TPl. Adjust C5 to
read -3.0 volts dc on the "VoltOhmyst" at TPI. Readjust C2 read -3.0 volts de on the "Voltohmyst" at TPI. Readjust C
$\mathrm{C7}$ C10 and C15 for proper response. Adjust C20 for max mum gain at midpoint of the curve. Repeat if necessary until he proper response is obtained
Set the receiver channel switch to channel 13
Adjust the signal generator to the channel 13 oscillator fre
Turn the fine
Adjust L42 to obtain an audible beat. Slightly overshoo ine adjustment of L42 by turning the slug an additional tur oscillator to proper frequency by adjusting C 2 to again obtai he beat.
Set the sweep generator to channel 13.
From the signal generator, insert channel 13 sound and
picture carrier markers, 211.25 mc. and 215.75 mc . Adiust L43 and las for proper reapase at
Adjust L43 and Las for proper response as shown in tig
Turn off the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TPI
Check the oscillator injection voltage to be within limits a range
If it was necessary to readjust C5, turn the sweep and
signal generators back on and recheck the channel 13 esponse. Readjust L43 and L45 if necessary.
Set the receiver channel selector switch to channel 8 and
readjust C 2 for proper oscillator frequency, 227 mc.
Set the sweep generator and signal generator to channel 8
Readjust C7, C10, C15 and C20 for correct curve shape frequency and band width.
Turn of the sweep and signal generators, switch back to
channel 13 and check the oscillator injection voltage at TPI If in intial satting of the ostlater ind far oft, it may be necessary to adjust the oscillator frequency and response on chamnel 8, adjust the oscillator injection on channel 13 and repeat the tracking procedure several times
Turn of the sweep generator and switch the receiver to
channel 6.
Adjust the signal generator to the channel 6 oscillator fre uency 129 mc .
Set the fine tuning control to the center of its mechanical
range.

Adjust $L 5$ for an audible beat. Adjust $L 44, L 46$ and $L 41$ for
poper curve shape ad shown in figure 17 . Recheck the oscillator injection voltage at TP1, to insure that it is within the limits specitied. Readjust $\mathrm{C5}$ if necessary
If C5 required adjustment, witch the receiver and the sig nal generator to channel 8. Readjust C7 for correct curve
shape and recheck C2 and C3 for proper oscillator frequency. Check the response of channels 2 through 6 by switching he receiver channel switch, sweep generator and marke
generator to each of these channels and observing the re sponse and oscillator injection voltage oblained. See figure 17 for typical response curves. It should be found that all
these channels have the proper response with the marker above $80 \%$ response.
If the markers fail to fall within this requirement readjust
L44, 46 and L41 in order to obtain curves within the proper limits.
Switch the channel selector, signal generator and marke generator through channels 7 to 13 and observe the response
curves, referring to tigure 17 for proper wave shape. Chec the injection voltage at each channel to be within limits. I
neceessary readjust $\mathrm{Cl15}$, C7, or C10 to obtain the proper
response.
With the receiver and signal generator on channel 13 ad
just L42 for an qudible beat with the signal generator. Adjust the oscillator to frequency on all channels b
switching the receiver and the frequency switching the receiver and the frequency standarnd to each
channel and adjusting the appropriate oscillator slu to channel and adjusting the appropriate oscillator slug to ob
tain the audible beat. It should be possible to adjust the tain the audible beat. It should be possible to adjust the
oscillator to obtain the audible beat on each channel. Re
check the oscillator injection voltage on each channel to check the oscillator injection voltage on each cha
verify that the voltage is within the specified limits.

\section*{RRE12 TUNER ALIGNMENT

## Model 27-D-331U

## Model 27-D-331U

TUNER VHF ALIGNMENT.-Remove the 6S4 voltage con
trol tube from its socket and insert the adapter. Insert the 6S in the adapter.
Connect the $0-50$ milliampere meter to the adapter socke and furn the adapter switch on
Remove the tuner cover shield.
Rotate the channel selector to a point midway between
channels, disengaging the insert contacts, and observe the channels, disengaging the insert contacts, and observe the is in a non-oscillatory state, short circuit the spring contact 12 and 13 , the two contacts nearest the tuner front.
(NOTE: The contacts are at zero d-c potential.) Should th plate current rise, keep the contacts shorted while adjusting trol, for a 28 milliampere reading on the meter.

Replace the tuner cover shield.
Connect the VHF sweep generator to the antenna terminals. Connect the VHF signal generator loosely to the antenna

Connect the oscilloscope, through the preamplifier if
needed with oscilloscope used, to test point TPl. Ground the AGC bias at the tuner terminal board using a that the bias will remain constan Turn off the adapter switch, removing plate voltage from
the oscillator. This is required because of $R F-I F$ interaction when a crystal is used as a mixer
Set the channel selector and the sweep generator to chan-
nel 2 .
Insert markers of channel 2 picture carrier and sound car
rier, 55.25 mc and 59.75 mc . Adjust antenna T6, r-f amplifier plate L 29 and mixer L 30
adjustments for a adjustments for a symmetrical curve with maximum gain al valley because of no crystal loading and nonlinear detector characteristics. The limitts for the $100 \%$ response points are
shown in tigure 10 . The proper curve shape is shown in figshown in tigure 10. The proper curve shapponse points are
ure 10 (b). If the bandwidth is out of tolerance it con in be corrected by redressing the coupling capacitor of the
double tuned circuit, C40 on insert A. Maximum bandwidth
occurs when the capacitor is centered in the insert chamber. Repeat the above steps for all VHF chan in adiumer Repeat the above steps for all VHF channels adjusting the
appropriate antenna, r-f amplifier plate and mixer slugs for a symmetrical curve with maximum gain at the center of the pass band
Turn off the sweep generator
Remove the oscilloscope and preamplifier if used, from test Turn the AGC control fully clockwise and remove the clip
lead grounding the AGC bias on the tuner terminal board. Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery positive terminal to the tuner case. Adjust the bias potenpositive terminal to the tuner case. Adjust the bias poten-
tiometer to produce -3.5 volts of bias, as measured by the
"Voltohmyst" at the AGC terminal on the tuner. Connect the potentiometer arm of the second bias supply to
the iunction R133 and C133B, and ground the positive battery the junction R133 and Cl133B, and ground the positive battery
eerminal.: Adjust the bias potentiometer to produce -5 volts terminal. Adjust the bias potentiometer to produce - 5 volts
of if bias as indicated on the "VoltOhmyst" at the junction
point point.
Connect the oscilloscope to pin 9 of V110. Use 3 to 5 volts
peak-to-peak output on the oscillosco Turn the adapter switch on to apply plate voltage to the
Turn the channel selector to channel 13 .
Set the fine tuning control to the center of its range.
Adjust the oscillator slug L22 to proper frequency, 257 mc
This may be done in several ways. The easiest way This may be done in several ways. The easiest way and the
way which will be recommended in this procedure will be to use thice signal genenatorm as a heterodyno frequenency meter
and beat the oscillator against the signal generator. To do and beat the oscillator against the signal generator. To do
this, tune the signal generator to 257 mc. with crystal accuracy. Insert one end of a piece of insulated wire into the
luner through either of the two holes next to the oscillato tuner through either of the two holes next to the oscillator
tube on the right front top corner of the tuner. Be careful may cause the frequency of the oscillator to shift Connect may cause the frequency of the oscillator to shift. Connect
the other end of the wire to the ritin terminal of the signal
generator. Adjust L22 oscillator slug to obtain an audio beat generator. Adjust L22 oscil
with the signal generator.
Turn on the sweep generator and set to channel 13. Adjust Turn on the sweep generator and set to channel 13. Adjust
T1 for maximum gain on the oscilloscope. Adjust mixer tank circuit L21 for maximum gain and flatat-lopped curve. Recheck Tl for maximum gain at center of band with the proper re-
sponse. Maximum gain and flat-topped response should be sponse. Maximum gain
Adjust the oscillator to frequency on all VHF channels by
switching the receiver and signal generator to each VHF switching the receiver and signal generator to each VHF hain a beat with the signal generator. Adjust the appropriate mixer slug where necessary to obtain maximum gain and proper curve shape as explained above
Adjust the tunable I-F Trap C16-L7. To do this connect the
signal generator to the fixed I-F Trap C2-L2 at the end opposite the antenna terminal plug. Set the signal generator to 43.5 me. and adjust the output of the signal generator to obtain sufficient indication on the ooscilloscope. Tune the I-F
Trap Culich fior minimum marker indication on the oscillotrap
Remove the signal generator and the oscilloscope.
TUNER UHF ALIGNMENT.-To align the UHF inserts:
Turn ofif the adapter switch, removing plate voltage from
Ground the AGC bias at the tuner terminal board using a clip lead to insure that the bias will remain constant. Connect the oscilloscope, through the preamplifier if needed
with oscilloscope used, to test point TP1. Connect the UHF sweep generator to the antenna terment.
Connect the UHF signal generator loosely to the antenna erminals.
Set the channel selector to the desired position and the
weep generator to sweep the frequency of the insert being

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Insert markers of the picture carrier and sound carrier for desired channel.
Adjust the UHF antenna, link coupling and mixer adjust about the pass band
The responses are shown in figure 11 . The curve shape higher in frequency, however any of these responses are acceptable
Repeat the above steps for all UHF inserts used adjusting he appropriate antenna, link coupling and mixer slugs for ymmetrical curve, with maximum gand about th pass band.
Remove the oscilloscope and preamplifier if used, from test pint 191 .
Remove the clip lead grounding the AGC bias on the tune
lorminal board. lormina boar
Connect the potentiometer arm of one of the bias supplies positive terminal to the tuner case. Adjust the bias potenti"meter to produce -3.5 volts of bias, as measured by the
Voltohmyst at the AGC terminal.
Connect the potentiometer arm of the second bias supply batery terminal. Adjust the bias potentiometer to produc -5 volts of i -f bias as indicated on the "Voltohmyst" at the junction point.
Connect the oscilloscope to pin 9 of V110. Use 3 to 5 volts
peak-to-peak output on the oscilloscope.
Turn the adapter switch on to apply plate voltage to the oscillator.
Turn the channel selector to the lowest UHF channel to be
used, and set the fine tuning control to the center of its range Adjust the oscillator core to proper frequency. To do this, shortest leads possible. Insert a 45.75 mc . marker from the VHF generator.
Set the UHF sweep generator to sweep the desired channel and observe the output of the oscilloscope. If the sweep generator is not sweeping the correct frequency range, it may be
necessary to readjust the sweep in order to place the 45.75 marker on the response curve as in figure 13 .
Set the UHF marker gen. to the picture carrier of the
channel insert being adjusted and connect to test point TPI. Adjust the oscillator core until the markers for 45.75 mc . and the picture carrier coincide on the sweep pattern on th scilloscope
Adjust the mixer core for maximum gain with proper wav
wape. hape.
Connect the "VoltOhmyst" to test point TPl, using 1.5 volt
scale. C scale.
Set oscillator injection adjustment to read .1 volts on the
"VoltOhmyst." Voltohmyst.
Repeat the above steps for all UHF inserts adjusting the oscillator injection control only if the reading on the "Volt
Ohmyst" exceeds 3 volts. Adjust as necessary to read. oolts or less at TPI.
RATIO DETECTOR ALIGNMENT.-In order to obtain good atio detector alignment an AM modulated signal generato hat is exceptionally free from FM modulation must be em ployed. Set the signal generator at 4.5 mc . and connect it or $30 \% 400$ cycle modulation.
As an alternate source of signal, the RCA WR39B on
WR39C calibrator may be employed. II used, connect it to he grid of the 4th pix i-f amplifier, pin l, V109. Set the fre quency of the calibrator to 45.75 (pix carrier) and modulat
with 4.5 mc. crystal. Also turn on the internal AM audi nodulation. The 4.5 mc. signal will be picked oft at T110A and amplified through the sound i - l amplitier.

Connect the "VoltOhmyst" to the junction of R111 and C111 Connect the oscilloscope across the speaker voice coil and turn the volume control for maximum output.
Tune the ratio detector primary $\mathrm{T102}$ top core for maximum
DC output on the "Voltohmyst." Adjust the signal level from DC outpui on he vor minus 10 volts on the "Voltohmyst when finally peaked. This is approximately the operating level of the ratio detector for average signal
Clonnect the "VoltOhmyst" to the junction of R110 and Adjust the T102 bottom core for zero d-c on the meter. Then, turn the core to the nearest minimum AM output on the Repeat adjustments of T102 top for maximum DC and T102
bottom for minimum output on the oscilloscone making final adjustment with the 4.5 mc. input level adjusted to produce
10 volts doc on the "Voltohmyst" at the junction of Rill and Clll1.
Connect the "VoltOhmyst" to the junction of R110 and C1I and note the amount of $d-c$ present. It this voltage exceed $\pm 1.5$ volis, adjust R108 by furning if in until zero $\mathrm{d}-\mathrm{c}$ is ob tained. Readjust the T102 bottom core for minimum output on
the oscilloscope. Repeat adjustments of R108 and T102 botton core until the voltage at R110 and C110 is less than $\pm 1.5$ volis when T102 bottom core is set for minimum output on th oscilloscope.
Connect the "VoltOhmyst" to the junction of R111 and C11 and repeak $T 102$ top core for maximum d-c on the meter and
again reset the generator so as to have -10 volts on the again
meter. Repeat the adjustments in the above two paragraphs until
the voltage at R110 and C110 is less than $\pm 1.5$ volts when the T102 top core is set for maximum dec at the junction of R11 and C111 and the T102 b
SOUND I-F ALIGNMENT.-Connect the sweep generato to the first sound i-f amplifier grid, pin 1 of V101. Adjust the generalior for a sweep widh of 1 mc . at a center frequency of 4.5 mc

Insert a 4.5 me. marker signal from the signal generator into
the first sound i -f grid. With the WR39B or WR39C calibrators the first sound i-f grid. With the WR39B or WR39C calibrator terminal by turning the variable osc. switch off, the calibrate terminal by turning the variable osc. switch off, the cal
switch to 4.5 mc . and the volume control with mod. off.
Connect the oscilloscope in series with a 10,000 ohm resistor
to terminal $A$ of T101.
Adjust Tl01 top and bottom cores for maximum gain and symmetry about the 4.5 me. marker on the i-f response. Th
pattern obtained should be similar to that shown in tigure 18 .
The output level from the sweep should be set to produce approximately 2.0 volt peak-to-peak at terminal $A$ of Tl 1 when the final touches on the above adjustment are made. I
is necessary that the sweep output voltage should not exceed is necessary that the sweep output voltage should not exceed
the specified values otherwise the response curve will be broadened, permilting slight misadjustment to pass unnotice and possibly causing distortion or weak signals.
Connect the oscilloscope to the junction of R110 and C110 Connect the oscilloscope to the junction of R110 and C110
and chack the linearity of the response. The pattern obtained
should be similar to that shown in figure 19.
SOUND TAKE-OFF ALIGNMENT.-Connect the 4.5 mc generator in series with a 1,000 ohm resistor to terminal "C
of T110. The input signal should be approximately 0.5 volt. Short the fourth pix i-f grid to ground, pin 1, V109, to pre-
As an allernate source of signal the RCA WR39B or WR39C
calibrator may be used. In such a case, disregard the above two paragraphs. Connect calibrator acress ligard the above B and modulate 45.75 with 4.5 mc. crystal
Connect the crystal diode probe of a "VoltOhmyst" to th
plate of the video amplifier, pin 6 of V110. plate of the video amplifier, pin 6 of V110.
Adjust the core of T110 for minimum output on the meter
Remove the short from pin 1, V109 to ground, if used.

HORIZONTAL OSCILLATOR ADJUSTMENT. - Normall he adjustment of the horizontal oscillator is not considered be a part of the alignment procedure, but since the oscillato wavelorm adjustment may require the use of an oscilloscope djustment is made at the lactory and normally should no require readjusiment in the field. However, the wavefor ajustment should be checked whenever the receiver ligned or whenever the horizontal oscillator operation mprope

Horizontal Frequency Adjustment.-Tune in a station and Hnc the picture. Nhe picture cannot be synchronized wis ancy core on the sear apron until the picture will synchro ize. If the picture still will not sync, turn the T114 wavelor ddjustment core (under the chassis) out of the coil several urns from its original position and readjust the Tl 14 fr

Examine the width and linearity of the picture. If pictur rol C186B the width control L109 and the linearity contro 1111 until the picture is correct.
Horizontal Oscillator Waveform Adjustment.-The hori ontal oscillator wavelorm may be adjusted by either of two methods. The method outlined in paragraph A below ma employed in the field when an oscilloscope is not availa be. The service shop method outlined in paragraph B below equires the use of an oscilloscope.
A.-Turn the horizontal hold control completely clockwise Aace adjustment tools on both cores of T114 and be prepare on the screen. First turn the $T 114$ frequency core (on the rea apron) until the picture falls out of sync and one diagona lack bar sloping down to the righ appears on the scree Then, turn the waveform adjustment core (under the chassis) ore so as to maintain one diagonal black bar on the Continue this procedure until the oscillator begins to moto boat, then turn the waveform adjustment core out until the motorboating just stops. As a check, turn the T1 14 frequenc core until the picture is synchronized then reverse the direc ync with the diagonal bar sloping down to the right. Co linue to turn the frequency core in the same direction. Add ional bars should not appear on the screen. Instead, the horizontal oscillator should begin to motorboat. Retouch the adjustment core if necessar intil this condition is obtained.
B.-Connect the low capacity probe of an oscilloscope to quarter turn from the clockwise position sold control on in sync. The pattern on the oscilloscone should be as shown in figure 23. Adjust the wavelorm adjustment core of T11 until the two peaks are at the same height. During this ad ustment, the picture must be kept in sync by readjusting the old control if necessary.
This adjustment is very important for correct operation o lower than the sharp peak the wive on the oscilloscop poorer, the stabilizing effect of the tuned circuit is reduce and drift of the oscillator becomes more serious. On the other hand, if the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inade quate and the broad peak can cause double triggering position.
Remove the oscilloscope upon completion of this adjus ment.
Horizontal Locking Range Adjustment.-Set the horizontal hold conirol to the full counterclockwise position. Momen
arily remove the signal by switching off. channel then back

The picture may remain in sync. If so turn the T114 frequency core slightly and momentarily switch off channel. Repeat until the picture falls out of sync with the diagonal lines sloping down to the left. Slowly turn the horizontal hold contro tained just before the picture pulls into sync.
If more than 3 bars are present just belore the picture pulls into sync, adjust the horizontal locking range trimmer C186A slightly clockwise. In less than 2 bars are present, adjus
C186A slightly counterclockwise. Turn the horizontal hold control counterclockwise, momentarily remove the signal and recheck the number of bars present at the pull-i Repeat this procedure until 2 or 3 bars are present.
Turn the horizontal hold control to the maximum clockwise position. Adjust the T114 frequency core so that the diagonal bar sloping down to the right appears on the screen and the reverse the direcilon of adustment so har bar just moves o the screen leaving the picture in synchronization
SENSITIVITY CHECK.-A comparative sensitivity check can be made by operating the receiver on a weak signa
from a television station and comparing the picture and soun obtained to that obtained on other receivers under the same conditions
This weak signal can be obtained by connecting the shop Thenna to the receiver through a ladder type attenuator pac strength available at the antenna. A sufficient number o stages should be inserted so that a somewhat less than normal contrast picture is oblained when the picture contro is at the maximum clockwise position. Only carbon typ aistors should be used to cose the pad.
RESPONSE CURVES.-The response curves shown on pages 16 and 17 and referred to throughout the alignmen curves are typical, some variations can be expected.
The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to the leff. The manner in which they will be seen in a given tes set-up will depend upon the characteristics of the oscilloscope
and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflec tion polarity of the oscilloscope and the phasing of the swee generator
NOTES ON TUNER ALIGNMENT.-Because of the fre quency spectrum involved and the nature of the device, mamy of the tuner unit leads and components are critical in som couple to the tuned circuits, and if resonant at any of the frequencies involved in the performance of the tuner, ma cause serious departures from the desired characteristics. In the design of the receiver these undesirable resonant loops have been shifted far enough away in frequency to allow reasonable latitude in their components and physical a
rangement without being troublesome. When the tuner uni is aligned in the receiver, no trouble from resonant loop should be experienced. However, if the unit is aligned in a jig separate from the receiver, attention should be paid to insure that unwanted resonances do not exist which migh
Tha woo ot a croatal minon in the vow

The use of a crystal mixer in the KRK 12 Tuner makes it disabled. This is due to undesirable $\mathrm{r}-\mathrm{f} / \mathrm{i}-\mathrm{f}$ interaction if th oscillator was allowed to operate during alignment. There fore, the responses shown in figure 10 are not $\alpha$ strictly true representation of the insert band pass during actual opera-
tion. When an insert is aligned using an oscilloscope serve the response, the curve shown in tigure 10 (b) will be the correct response for reference. In actual operation, the band pass will be such that the sound and picture carriers will be at the tips of the curve. The adjacent channel picture and sound carriers will be in the valleys at each side. Care $10(a)$ and $10(\mathrm{c}$ )

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Figure 24-Top Chassis Adjustments (KRK22A Tuner Shown)


Eigure 25-Bottom Chassis Adjustments (KRK22A Tuner Shown)




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27-D.331. 27.D-331U REPLACEMENT PARTS-Continued

| $\begin{aligned} & \text { sToč } \\ & \text { No. } \end{aligned}$ | PART DESCALPTION | $\begin{gathered} \text { sTock } \\ \text { No. } \end{gathered}$ | $\underset{\text { dEschiption }}{\substack{\text { PaRt }}}$ |
| :---: | :---: | :---: | :---: |
| 761 | Clip-Mounting clip for stand-off capacitor | 513310 | 10,000 ohms, $\pm 10 \%$, 1 watt (R |
| 73477 | Coil-Choke coil (Li01) | 503315 | 15,000 ohms, $\pm 10 \% .1 / 2$ watt (R239) |
| 767 | Coil-Filoment winding only tor hi-voltage transtormer | 513315 | 15.000 ohms, $\pm 10 \% .1$ watt (R250) |
| 78197 | Coil-Horizontal linearity coil complete with adjustable | 523315 503318 | 15.000 ohms, $\pm 10 \% .2$ watts (R143) |
|  | core (L111) | 503318 | 18,000 ohms, $\pm 10 \%$, $1 / 2$ watt ( |
| 77842 7840 | Coil-Peaking coil ( 72 muh) (L122) Coil-Peaking coil (150 muh) (L118, R241) | ${ }_{522322}$ | 22,000 ohms, $\pm 10 \%, 1 / 2$ watt (R175) $22,000 \mathrm{ohms}, \pm 5 \%, 2$ watts (R223) |
| 77841 | Coil-Peaking coil (150 muh) (L119, L120, R240, R244) | 503327 | 27,000 ohms, $\pm 10 \%$, $1 / 2$ watt (R174, R178, R212, R232) |
| 76647 | Coil-Peaking coil ( 180 muh) (L107, R158) | 523327 | 27.000 ohms, $\pm 10 \%, 2$ watts (R222, R254) |
| 75252 | Coil-Peaking coil (500 muh) (L104, L106) | 503333 | 33.000 ohms, $\pm 10 \%$, $1 / 2$ watt |
| 76640 76510 | Coil-RF choke coil ( 1.5 muh) (L110. L112) Coil-RF choke coil (4.7 muh) |  | ${ }_{33,000} \mathrm{R} 235 \mathrm{ohms}$, $\pm 5 \%, 2$ watts (R193) |
| 76510 | Coil-RF choke coil (4.7 muh) (L108) | 28744 | 33.000 ohms, $\pm 5 \%, 2$ watts (R193) |
| 76484 | Coil-Widh coil complete with adjustable core (L109) Connector-Second anode lead connector | 503339 503347 | $39,000 \mathrm{ohms}. \pm 10 \%$, $1 / 2$ watt (R110, R173, R242) $47,00 \mathrm{cohms}, \pm 10 \%, 1 / 2$ watt (R103, R215) |
| 76457 | Connector-Second anode lead connec | 503347 | 47.000 ohms, $\pm 10 \%$, $1 / 2$ watt (R103, R215) |
| 7547 | Connector-Single contact male connector for speaker | 512347 502356 | 47,000 ohms, $\pm 5 \%, 1$ watt (R247) 56,000 ohms, $\pm 5 \%$, $1 / 2$ watt (R141) |
| 74594 | Connector-2 contact male connector for power cord | 503356 | $56,000 \mathrm{ohms}$, $\pm 10 \%$, $1 / 2 \mathrm{watt}$ (R105) |
| 50367 | Connector-6 contact female connector for yoke leads (1102) | 503368 | 68.000 ohms, $\pm 10 \%$. $1 / 2$ watt (R |
| 35787 | Connector-Phono input connector (1101) | 513368 | 68,000 ohms, $\pm 10 \%$, 1 watt (R216) |
| 77654 | Control-AGC control (R180) | 8064 | 82.000 ohms, $\pm 5 \%$, $1 / 2 \mathrm{watt}(\mathrm{R} 167$ ) |
| 77655 | Control-Brightness control, volume control (R114A, R114B, | ${ }_{513382}^{50382}$ | 82.000 ohms, $+10 \%, 1 / 2$ watt (R192) |
| 77640 | Control-Height control (R190) | 503410 | $100,000 \mathrm{ohms}, \pm 10 \%$, $1 / 2$ watt (R166, R203, R238) |
| 77826 | Control-Horizontal and vertical hold control (R187A, | 513410 | 100.000 ohms, $\pm 10 \% .1$ watt (R251) |
|  | R1878) |  | 120.000 ohms . $\pm 5 \%$ \% $1 / 1 /$ watt (R246) |
| 77818 | Control-Contrast and peaking controis (R155A, | 503415 | $150.000 \mathrm{ohms}. \pm 10 \%$ \% $1 / 2 \mathrm{watt}$ (RI59. RI |
|  | Control-Ratio detector baiance control |  | 220.000 ohms , $\pm 5 \%$, $1 / 2$ watt (R179) |
| 77643 | Control-Vertical linearity control (R197) | 503422 | $220,000 \mathrm{ohms}, \pm 10 \%$. $1 / 2 \mathrm{wattr}$ (R207, R233) |
| 77647 | Coupling-Coupling (nyion) for picture control or sharpness switch | 502427 <br> 503427 | $270,000 \mathrm{ohms}, \pm 5 \%$, $1 / 2$ watt (R163, R165) $270,000 \mathrm{ohms}, \pm 10 \%, 1 / 2$ watt (R171, R266) |
| 77136 | Cover-Back cover for hi-voltage compartment | 503433 | 330.000 ohms , $\pm 10 \%$, $1 / 2$ watt (R116, R189, R2 |
|  | Cover-Side cover for hi-voltage | 503447 | 470.000 ohms. $10 \%$, $1 / 2$ watt (R117, R148, R160, |
| 73600 | Fuse- $0.25 \mathrm{amp} ., 250$ voits (F101) |  |  |
|  | Grommet-Rubber grommet for 2 nd anode lead | ${ }^{503468}$ | 680,000 ohms, $\pm 10 \%$, 1/2 watt (R169) |
|  | Lead-Anode load complete with eyele | 503482 | $820.000 \mathrm{ohms}, \pm 10 \%, 1 / 2$ watt (R206) |
| 77829 | Link-Link assembly for definition switch shatts | 503510 | $1 \mathrm{mogohm} . \pm 10 \%$, $1 / 2$ watt (R181, R 188 ) |
|  |  | $\begin{aligned} & 502512 \\ & 503522 \end{aligned}$ | 1.2 megohm $+5 \%, 1 / 2$ watt (R186) 2.2 megohm, $\pm 10 \%$. $1 / 2$ watt (R196) |
| 77832 | Plat-Hi-voltage plate (bakelite) complete less corona | 2632 | 3.3 megohm, $\pm 5 \%$, 1 watt (R162) |
| 76675 | Rectitier-Picture detector crystal rectitior | 503539 | 3.9 megohm, $\pm 10 \%$, $1 / 2$ watt (R168) |
|  | Resistor-Wire wound: | 503547 | 4.7 megohm, $\pm 10 \% .1 / 2$ watt (R170) |
| 76468 | 1.5 ohms, 1/3 watt (R225) | 503610 | (10 megohm, $\pm 10 \%$, $1 / 2$ watt (R113) |
| 77835 | 100 ohms, 4 watts (R221) | ${ }_{77831} 77$ | Shatt-Detinition switch extension shaft |
| ${ }_{788223}$ |  | 77830 | Shatt-Dofinition switch knob shaft |
| 77825 | Comprising: 1 section of 335 ohms, 16 watts, 1 section of 375 ohms, 8 watts, 1 section of 1,400 ohms, 7 | 77661 | shell-Mounting shell for hi-voltage capacitor |
|  | watts, 1 section of 600 ohms, 2 watts, and 1 section R228D, R228E) | 73584 77659 | Shield-Tube shield for V101, V102. V103, V106, V107. V109 <br> Shield-Tube shield for V105 |
| 766 | 6.750 ohms, 10 watts (R153) | 76741 | Shield-Tube shield for V113 |
|  | Hesisior-Fixed, composition: | 75718 | Socket-Channel indicator lamp socke |
| ${ }_{503047}^{503033}$ | 33 ohms, $\pm 10 \% .1 / 2$ watt (R152) | 74834 | Socket-Kinescope socket |
| $\begin{aligned} & 503047 \\ & 502056 \end{aligned}$ |  | $\begin{aligned} & 71508 \\ & 50367 \end{aligned}$ | Socket-Tube socket, 6 pin, moulded for V117 |
| 3476 | 68 ohms, $\pm 5 \%, 1 / 2$ watt (R138) |  | Socket-Tube V118, V119 |
| 502082 503082 |  | 73117 |  |
| 503082 502110 | 82 ohms, $\pm 10 \% .1 / 2$ watt (R249) 100 ohms, $\pm 5 \%$, $1 / 2$ watt (R128) | 77658 |  |
| 503115 | 150 ohms , $\pm 10 \%$. $1 / 2$ watt (R253) |  | mounted for V105 |
| 503118 |  | 71494 | Socket-Tube socket, miniature, 7 pin, moulded, saddlemounted for V114 |
| 503:39 |  | 31251 | Socket-Tube V122, V125) Socket, octal, water for V113, V116, V121, |
| 513139 | $390 \mathrm{ohms}, \pm 10 \%$, 1 watt (R118) |  | Ocket-Tube ocket octal, water |
| 503147 503156 | 470 ohms, $\pm 10 \%$, 1/2 watt ( (199) | 76971 | Socket-Tube zocket, miniature, 9 pin, wafor for vill. |
| 503156 503210 | $560 \mathrm{hms}, \pm 10 \%, 1 / 2$ watt (R198) |  | V111. V112, V123 |
| 503210 | 000 hhms. $\pm 10 \%, 1 / 2$ watt (h102, R104, H126, H131, | $\begin{aligned} & 778828 \end{aligned}$ | Switch-Definition switch (S104) Switch-Phonotone switch (S101) |
| 502215 | 1,500 ohms, $\pm 5 \%$, $1 / 2$ watt (R183) | 76463 | Terminal-Screw type grounding terminal |
| 503215 | 1,500 ohms, $\pm 10 \%$, $1 / 2$ watt ( H 236 , R248) | 77198 |  |
| 503222 50233 | 2, 2 200 ohms $\pm 10 \%$, $1 / 2$ watt (R140) |  | with adjustable cores (T104, C125, R125) |
| 502233 502239 | 3,300 ohms, $\pm 10 \%$. $1 / 2$ watt (R201) 3,900 ohms, $\pm 5 \%$, $1 / 2$ watt (R150) | 7719 |  |
| 503329 50329 | $3,900 \mathrm{ohms}, \pm 10 \%, 1 / 2$ watt (R221) | 76435 |  |
| 5032 | 4,700 ohms, $\pm 10 \%$. $1 / 2$ watt (R230) | 433 | Transtormer-Third or tourth pix I.F. transformer (T107. |
| ${ }_{502256}$ | 5.600 ohms, $\pm 5 \%$, 1/2 watt (R137) |  | T108) |
| ${ }_{5}^{513256}$ | 5,600 ohms, $\pm 10 \% .1$ watt (R156) | 76436 | Transformer-Fith pix CR101 Lio2, R146) |
| 14659 503268 |  | 77833 | Transtormer--Hi-voltage transformer (Part of T115) |
| 513268 | 6 6,800 ohms. $\pm 10 \%$. 1 watt (R147) | 76440 | Transtormer-Horizontal oscillator transtormer complote with adiustable |
|  | 8,200 ohms, $\pm 10 \%$, $1 / 2$ watt (R145, R191, R213) |  | Transformer-Output transtormer (T103) |
| 513282 | 8.200 ohms, $\pm 10 \%$, 1 watt (H182) | 77822 | Transformer-Power transformer, 117 volts, 60 cycle |
| 503310 | 10,000 ohms, $\pm 10 \%$, 11/ watt (R139, R164, R200. R229) |  |  |

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REPLACEMENT PARTS-Continued



Figure 2-Yoke and Focus Magnet Adjustments


Figure 3-Rear Chassis Adjustments
INSTALLATION INSTRUCTIONS

ALIGNMENT OF HORIZONTAL OSCILLATOR. - I in the above check the receiver failed to hold sync with the
hold control at the extreme counter-clockwise position or failed to hold sync over 90 degrees of clockwise rotation of the con trol from the pull-in point, it will be necessary to make the

Horizontal Frequency Adjustment. - Turn the horizontal
hold control to the extreme clockwise position. Tune in a adjustment at the rear out of snync and the horizontal blanking appears as a vertical or diagonal black bar in the rastor. Then turn the T114 co
until the bar moves out of the picture leaving it in sync.

Horizontal Locking Range Adjustment.-Set the hori
zontal hold control to the full counter-clockwise position zontal hold control to the full counter-clockwise position.
Momentarily remove the signal by switching off channel then back. The picture may remain in sync. If so turn the T114 rear core slightly and momentaring switch off channel. Repeat until
the picture falls out of sync with the diagonal lines sloping the picture falls out of sync with the diagonal lines sloping
down to the left. Slowly turn the horizontal hold contro down to the left. Slowly turn the horizontal hold control
clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.

## INSTALLATION INSTRUCTIONS

If more than 3 bars are present just before the picture pull ato sync, adiust the $1 /$ izin slightly clockwise. If less than 2 bars are present, adjus
C174A slightly counter-clockwise. Turn the horizontal hold control counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeal
this procedure until 2 or 3 bars are present. his procedure unit 2 or 3 bars are present.
Repeat the adjustments under "Horizontal Frequency Ad
justment" and "Horizontal Locking Range Adjustment" until
the
 horizontal hold operates as outlined under "Check of Horizon
tal Oscillator Alignment" the oscillator is properly adjusted
If it is impossible to sync the picture at this point and the AGC system is in proper adjustment it will be necessary to
adjust the Horizontal Oscillator by the method outlined in th
 may be omitted.
FOCUS MAGNET ADJUSTMENT.-The focus magnet should be adjusted so that there is approximately three-eighth inch of space between the rear metal plate of the yoke
and the flat of the front face of the focus magnet. This spacing gives best average focus over the face of the tube. The axis of the hole through the magnet should be parallel
with the axis of the kinescope neck with the kinescope neck
through the center through the center of the opening

## PIN-CUSHION CORRECTION

Model 21-T.356U only
Two pin-cushion correction magnets are employed to cor
act a small amount of pin-cushion of the raster due to the rect a small amount of pin-cushion of ere raster due to the lens effect of the face of the kinescope. These magnets are
mounted on small arms, one on each side of the kinescope as
shown in shown in Figure 2 . The arms hinge in one plane on self tap.
she ping screws which act both as a hinge and an adjustmen tube maximum correction is obtained. Minimum correction is obtained when the arms are swung away from the tube. To
adjust the magnets, loosen the two self taping screws and adjust the magnets, loosen the two self tapping screws and
position the magnets until the sides of the raster appear straight. Tighten the screws without shifting the position of the magnets. In some cases it may be necessary to twist or bend
the magnet support arms to obtain the appearance of straight the magnet su.
raster edges.
CENTERING ADJUSTMENT.-No electrical centering controls are provided. Centering is accomplished by means
of a separate plate on the focus magnet. The centering plates of a separate plate on the focus magnet. The centering plates tering. Up and down adjustment of the plate moves the picture up and down side.

If a corner of the raster is shadowed, check the position of of maximum raster brightness to eliminate the shadow and recenter the picture by adjustment of the focus magnet plate. In no case should the magnet be adjusted to cause any loss eventual damage to the tube. In some cases it may be neces. sary to shift the position of the focus magnet in order to

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUSTMENTS. - Adjustment of the horizontal drive conto obtain the highest possible voltage hence the brightest and best focused picture, adjust horizontal drive trimmer C174B counter-clockwise until the picture begins to "wrinkle"
middle then clockwise until the "wrinkle" disappears.
Turn the horizontal linearity control Llll clockwise until loe picture begins to "wrinkle"' on the right and then counteris obtained.
Adjust the width control L109 to obtain correct picture width. A slight readjustment of these three controls may be neces sary to obtain the best linearity.
Adjustments of the horizontal drive control affect horizontal scillator hold and locking range. If the drive control wa

HEIGHT AND VERTICAL LINEARITY ADJUST MENTS.-Adjust the height control (R173 behind front con
trol panel) until the picture fills the mask vertically. Adjus rol panel) until the picture fills the mask vertically. Adjus
ertical linearity (R183 behind front control panal) until the est pattern is symmetrical from top to bottom. Adjustment o either control will require o readjustment of the other. Adjus

FOCUS. - Adjust the focus magnet for maximum definition
in the test pattern vertical "wedge" and best focus in the white areas of the vattern. "wedge" and best focus in the

Reaheck the position of the ion trap magnet to make sur
that maximum brightness is obtained.
Check to see that the knurled yoke nuts and the focus
angnet mounting nuts are tight. gnat mouning nuts are ighat.
KRK29 R-F OSCILLATOR ADJUSTMENTS. - Tune justed to the proper frequency on all channels. If adjustment are required, these should be made by the method outlined in the alignment procedure on page 11 . The adjustments for chan
nels 2 through 12 are available from the front of the cabine by removing the station selector escutcheon as shown in Figure
4. Adjustment for channel 13 is on top of the che


To REMOVE Escutcheon, side


Oscinator AOUUTMENT
Gor CHNEL MUMBRT
tor Adjustments
KRKI2A R-F OSCILLATOR ADJUSTMENTS. KRK12A R-F OSCILLATOR ADJUSTMENTS. - Set the fine tuning control to the center on its range on the channel to
be adjusted. Adjust the oscillator core for this channel to obtain maximum audio output without distortion. The adjust-

insert in the operating position can be determined by a stamp-
ing on the insert drum. This stamping is visible ing on the insert drum. This stamping is visible through either
he front or rear apertures shown in Figure 5 . AGC THRESHOLD CONTROL control R154 is adjusted at the factory and normally should not

To check the adjustment of the AGC Threshold Control ture in a strong signal and sync the picture. Momentarily remove
the signal by switching off channel and then back. If the pic the signal by switching off channel and then back. II the pic-
ture reappears immediately, the receiver is not overlooding
due to improper setting of R154. It the picture tequires appreciable portion of a of Recond to If the picture requires an
sively, R154 should be readiunter bends exces.

Turn R154 fully counter-clockwise. The raster may be ben
lightly. This should be disregarded. Turn R154 clockwise until there is a very, very slight bend or change of bend in th remove this bend or change of bend.
If the signal is weak, the above method may not work as may be impossible to get the picture to bend. In this case, turn pronounced, then counter-clockwise until the best signal to pronounced then co
noise ratio is obtained.
The AGC control adjustment should be made on a strong signal if possible. If the control is set too far clockwise on
weak signal, then the receiver may overload when a stron signal is received.
FM TRAP ADJUSTMENT nce may be encountered from a strong FM station sinterfer trap is provided to eliminate this type of interference. To adjust bserved and adiust the FM trap which the interference is te picture. The trap is LS on KRK29 tuners and is located on the antenna matching transformer.
CAUTION.-In some receivers, the FM trap LS will tune uch an adjunel or even into channel 5. Needless to say, such an adjustment will cause greatly reduced sensitivity check L5 to make sure that it does not affect sensitivity on
The FM trap on models using the KRK12A Tuner is fastened o the receiver antenna cable and is adjusted in the same
manner as described above. nn as descibed above.
Replace the cabinet back and connect the receiver antenna are up tight, otherwise it may that the screws holding eceiver is operated at high volume
REFLECTIONS - Multiple ReFLECTIONS. - Multiple images sometimes known as ochoes or ghosts, are caused by the signal arriving at the
antenna by two or more routes. The second or subsequent mage occurs, when a signal arrives at the antenna after being reflected of a building, a hill or other object. In severe
cases of rellections, even the sound may be distorted. In less evere cases, rellections may occur that are not noticeable as reflections but that will instead cause a loss of definition andiure
CABINET ANTENNA.-A cabinet antenna is provided in ut near the antenna torinal board. The cabinet antenna ay be employed for both UHF and VHF reception in place and no reflections are experienced
INTERFERENCE.-Auto ignition, street cars, electrical achinery and diathermy apparatus may cause interference ocation should be removed as far possible, the antenn ways, hospitals, doctors' offices and similar sources of intererence. In mounting the antenna, care must be taken to
keep the antenna rods at least $1 / 4$ wave length (at least 6 eep the antenna rods at least $1 / 4$ wave length (at least 6
eet) away from other antennas, metal roots, gutters or other netal objects.
Short-wave radio transmitting and receiving equipment may cause interference in the picture in the form of moving the interference by the use of a trap in the antenna transmis. ion line. However, if the interfering signal is on the same requency as the television station, a trap will provide no
peceiver
RECEIVER LOCATION. -The owner should be advised tion in the room.
-Away from bright windows and so that no bright light will fall directly on the screen. (Some illumination in ho pive is accest however.)
To give easy access ior operation and comfortable
-To permit convenient connection to the antenna.

- Convenient to an electrical outlet.
-To allow adequate 'ventilation.

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| ALIGNMENT PROCEDURE |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| TEST EQUIPMENT.-To properly service the television chassis of these receivers, it is recommended that the following |  |  |  | Channel Picture <br> Carrier Sound <br> Carrier <br> R-FOsc.   | Connect a 300 ohm $1 / 2$ watt composition resistor from L5 ground, keeping the leads as short as possible. | Set the VHF generator to each of the following frequencies and with a thin fiber screwdriver tune the specified adjustment for maximum indication on the "VoltOhmyst". In each instance the generator should be checked against a crystal calibrator to insure that the generator is on frequency. |
| VHFSweep Generator meeting the following requirements: |  |  |  |  |  |  |
| (a) Frequency Ranges <br> 35 to 90 mc .1 |  |  |  |  |  |  |
|  |  |  |  |  | to maximum | During alignment, reduce the input signal it necequency. order to produce 3.0 volts of d-c at R135 and L102 with -5.0 volts of i-f bias at the junction of R123 and Cl42. |
| (b) Output adjustable with at least . 12 l volt maximum |  |  |  |  | Connect the VHF sweep generator to the matching unit |  |
|  |  |  |  |  | antenna input terminals. In order to prevent coupling rea |  |
| (c) Output constant on all ranges. |  |  |  |  | ance from the sweep generator into the matching unit, it |  |
| (d) "Flat" output on all attenuator positions. |  |  |  |  | advisable to employ a resistance pad at the matching | 45.5 |
| VHF Signal Generator to provide the following frequen.cies with crystal accuracy: |  |  |  |  | terminals. Figure 10 shows three different resistance pads | 43.0 m |
|  |  |  |  |  |  | Set the signal generator to the following frequency and |
| (a) Intermediate frequencies <br> 4.5 mc., 39.25 mc., 41.25 mc ., $43.5 \mathrm{mc} ., 45.75 \mathrm{mc} .$, |  |  |  |  | match the output impedance of the particular sweep | adjust the picture i-f trap for minimum d-c output at junction of |
|  |  |  |  |  | Connect the signal generator loosely to the matching unit | of of d-c on the meter when adjustment is made. |
| (b) Radio frequ |  |  |  |  | ntenna termi | 47.25 mc |
|  |  |  |  |  | at the sweep ge | SWEEP ALIGNMENT OF PICTURE I-F.- <br> Models 21-T-363 to 21-T-375 incl. |
| Channel Number | Picture | Sound | Recenver |  | lished by retur |  |
|  | Freq. Mc. |  | $\stackrel{\text { R-F }}{\text { Freq. }}$ Mc. | ${ }_{69}^{68} \ldots . . . . . . . .795 .25 . . . . . . .799 .75 \ldots . . . . . . . .841$ | With WR59B | To align T2 and T104, connect the sweep generator to the mixer grid test point TP2, in series with a 1500 mmf . ceramic capacitor. Use the shortest leads possible, with not more than one inch of unshielded lead at the end of the sweep cable. Connect the sweep ground lead to the top of the tuner. |
| $\begin{aligned} & 2 . \\ & 3 . \\ & 4 . \end{aligned}$ | 55.25 | 59.75 | 101 |  | retuning channel number 2 to cover the range. In maki |  |
|  | 67.25 | 65.75 71.75 |  |  |  |  |
|  | 77.25 | 81.75 | 123 | $72 \ldots \ldots \ldots .819 .25 \ldots \ldots . .823 .75 \ldots \ldots \ldots . .1865$ | core retaining spring |  |
|  | $\bigcirc 175.25$ |  | 87.75 |  |  |  | 19. L3 is most effective in locating the position of the shoulder of the curve at 52 mc . and L2 should be adjusted to give maximum amplitude at 53 mc . and above consistent with the specified shape of the response curve. The adjusiments in the matching unit interact to some extent. Repeat the above procedure until no further adjustments are necessary. |
|  |  |  | 179.75 | 221 |  | Connect the sweep ground lead to the top of the tuner. Set the channel selector switch to channel 4. |  |
|  | 187.25 | 185.75 |  |  | Clip 330 ohm resistors across terminals A and B of T107 and T108. |  |  |
|  | 193.25 | 197.75 | 239 |  |  |  |  |
|  | 199.25 | 203.75 |  |  | Preset Adiust the bios minimum capacity |  |  |
|  | 211.25 | 215.75 |  |  | bias as measured by a "Voltohmyst" at the junction of R135 |  |  |
| (c) Output of these ranges should be adjustable and at least .1 volt maximum. |  |  |  | 873.25 . . . . . . 877.75.......... 919 | Restore the connection between L5 and Sl-E. Replace V1 | and C142. Set the AGC control fully clockwise. |  |
|  |  |  |  |  | Reste he comechion beiween LS and S.E. heplace | Connect a 180 ohm composition resistor from pin 5 of V106 to terminal $A$ of T106. Connect the oscilloscope diode probe |  |
| VHF Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled. |  |  |  | Cathode Ray Oscilloscope.-An oscilloscope with a sensitivity of 1 millivolt per inch is required. A suitable pre-amplifier may be employed with oscilloscopes of lesser sensitivity. | Models 21-T-363 to 21.T. 375 incl. | to pin 5 of V106 and to ground. |  |
| UHF Sweep Generator with a frequency range of 470 mc . to 890 mc . RCA Types 40 A or 41 A or their equivalent. |  |  |  |  | onnect the i.f signal generator across the link circuit on | Couple the signal generator loosely to the dio der to obtain markers. |  |
|  |  |  |  | Electronic Voltmeter. - A voltmeter with a 1.5 volt DC cale is required. RCA Senior "VoltOhmyst" or equivalent. DC Milliammeter. - A milliammeter with a range of 0-50 ailliamperes full scale. | Connect the "VoltOhmyst" to the junction of R123 and C142. Turn the AGC control fully clockwise. <br> Obtain two 7.5 volt batteries capable of withstanding appreciable current drain and connect the ends of a 1,000 ohm | Adjust T2 (top) and T104 (top) for maximum gain and with <br> 45.75 mc . at $75 \%$ of maximum response. <br> Set the sweep output to give 0.3 volt peak-to-peak on the oscilloscope when making the linal touch on the above adjustment. |  |
| UHF Signal Generator to provide the following frequencies with crystal accuracy if RCA Type 41A is used. |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| Channel |  |  |  | the cathode current of the 6S4 voltage control tube of the KRKI2A Tuner. Wiring of adapter is shown in Figure 15 | potentiomeler across each. Connect the battery positive |  |  |
| 14. | ${ }_{\text {47i. }}$ | eq. Mc. |  |  | terminal of one to the chassis and the potentiometer | Adjust Cl 22 until 42.5 mc . is at $70 \%$ response with respect to the low frequency shoulder of the curve as shown in Figure 22. Maximum allowable tilt is $20 \%$. |  |
|  |  | 481.75 |  |  |  |  |  |
| 16 | 483.25 | 487.75 | 529 | KRK29 ANTENNA MATCHING UNIT ALIGNMENT. -The antenna matching unit is accurately aligned at the factory. Adjustment of this unit should not be attempted in serious attenuation of the signal especially on channel 2 . The r-f unit is aligned with a particular antenna matching transformer in place. If for any reason, a new antenna matching transformer is installed, the r-f unit should be realigned. <br> The F-M Trap which is mounted in the antenna matching unit may be adjusted without adversely affecting the alignment of the unit. | Set the bias to produce approximately -5.0 volt | Disconnect the diode probe, the 180 ohm and two 330 ohm resistors. |  |
| 17 | 489.25 | 493.75 | 535 |  | the junction of R123 and C142. |  |  |
| 19 | 501.2 | 499.75 505.75 | $\begin{array}{r}541 \\ 547 \\ \hline\end{array}$ |  | Connect the "VoltOhmyst" to junction of R135 and L102 and to ground. | Connect the oscilloscope to the junction of R135 and L102. |  |
|  | 507.25 | 511.75 |  |  | Set the VHF signal generator to each of the following frequencies and peak the specified adjustment for maximum indication on the "VoltOhmyst". During alignment, reduce the input signal if necessary in order to produce 3.0 volts of d-c at R123 and L102 with - 5.0 volts of i-f bias at the junction of R123 and Cl42. | Leave the sweep generator connected to the mixer grid test point TP2 with the shortest leads possible. |  |
|  | 513.25 | 517.75 |  |  |  |  |  |
| 23 | 525.25 | 523.75 529.75 |  |  |  | Adjust the output of the sweep generator to obtain 3.0 volts peak-to-peak on the oscilloscope. |  |
| 24 | 531.25 |  |  |  |  |  |  |
|  | 537.25 | ${ }_{541.75}$ | 583 |  |  | Couple the signal generator loosely to the grid of the first pix i.f amplifier. Adjust the output of the signal generator to produce small markers on the response curve. |  |
| 27 |  |  |  | To align the antenna matching unit disconnect the leadfrom the F-M trap L5 to the channel selector switch Sl-E. | 44.5 mc........................... . . . . . T108 |  |  |
|  | 555.25 | 559.75 | 601 |  |  | Retouch T106, T107 and T108 to obtain the response shown in Figure 23. |  |
|  | ${ }_{561.25}^{56}$ | 565.75 | 607 | With a short jumper, connect the output of the matchingunit through a 1000 mmf . capacitor to the grid of the second | 43.0 mc............................... . 106 |  |  |
| 31 | 573.25 |  | 613 |  | Set the VHF signal generator to the following frequency and adjust the picture i-f trap for minimum d-c output at R135, | Models 21-T-356U to 21-T-375U incl. |  |
| 32 | 579.25 | 583.75 |  | pix i-f amplifier, pin 1 of Vloz. |  |  |  |
| 33 | 585.25 | 589.75 | 631 | Replace the cover on the matching unit while making alladjustments.Remove the first pix | L102. Use sufficient signal input to produce 3.0 volts of $\mathrm{d}-\mathrm{c}$ on the meter when the adjustment is made. | the VHF sweep generator to the front terminal of the |  |
| 34 | 591.25 | 595.75 | 637 |  |  <br> Models 21.T.356U to 21-T.375U incl. | 1N82 crystal holder in series with a 1500 mmf . ceramic capacitor. Use the shortest leads possible, grounding the sweep generator to the tuner case. |  |
| 36 | 603.25 | 607.75 | 43 | Connect the positive terminal of a bias |  |  |  |
| 37 | 609.25 | 613.75 |  | and the potentiometer arm to the junction of 123 and $\mathrm{Cl42}$ | Mode/s 21-T.356U to 21-T.375U incl. Connect the "VoltOhmyst" to the junction of R123 and Cl42 |  |  |
| 38 | 615.2 | 619.75 | 661 | Set the potentiometer to produce approximately - 5.0 volts of | Turn the AGC control fully clockwise. | Clip 330 ohm resistors across terminals A and B of T107 |  |
|  | 621.25 627.25 | 625.75 | 667 | Connect an oscilloscope to the junction of R135 and L102and set the oscilloscope gain to maximum. |  | Set the channel selector to channel 5 . |  |
|  | 633.25 |  |  |  | Obtain a 7.5 volt battery capable of withstanding appreciable current drain and connect the ends of a $1,000 \mathrm{ohm}$ |  |  |
|  | 639.25 | 643.75 | 685 | Connect a VHF signel generatototo the antenna input termi. | potentiometer across it. Connect the battery positive terminal to chassis and the potentiometer arm to the junction R123 and | to terminal $\AA$ of T106. Connect the oscilloscope diode probe to pin 5 of V106 and to ground. |  |
|  | 645.25 651.25 | 649.75 | 691 |  |  |  |  |
|  | 657.25 | 661.75 | 697 | Tune the signal generator to 45.75 mc . and adjust the generator output to give an indication on the oscilloscope. Adjust L4 in the antenna matching unit for minimum audio indication on the ascilloscope. <br> Tune the signal generator to 41.25 mc . and adjust Ll for minimum audio indication on the oscilloscope. | C142. Adjust the potentiometer for -5.0 volts indication on the "VoltOhmyst" | Couple the signal generator loosely to the diode probe in order to obtain markers. |  |
|  | 663.25 | 68.75 | 709 |  | Connect the "VoltOhmyst" to the junction of R135 and L102 |  |  |
|  |  | 673.75 679 |  |  | and to ground. | The shunt trimmer Cl22 across terminals A and B of T104 is variable and is provided as a bandwidth adjustment. Preset the shunt trimmer to minimum capacity. Adjust T2 (top) and T104 (top) for maximum gain at 43.5 mc . and with 45.75 mc . at $75 \%$ of maximum response. |  |
|  | 681 | 685.75 |  |  | Connect the output of the signal generator to the front |  |  |
|  | 8 | 691.75 . |  |  | terminal of the crystal mixer in series with a 1500 mmf . ceramic capacitor |  |  |

## Adjust Tl tor maximum gain. Readiust $T 2$ and $T 104$ if neces. sary to obtain proper wave shape, see Figure 13 . <br> Disconnect the diode probe, the 180 ohm and the two 330 ohm resistors <br> Connect the oscilloscope to the junction of R135 and L102. <br> Adiust the bias potentiometer to obtain -5.0 volts of bias as measurued by a "Volto hmyst" at the junction of R123 and C142. <br> Leave the sweep generator connected to the front terminal of the 1 N82 crystal holder with the shortest leads possible and  of the sweep cable. If these precautions are not observed, the receiver may ke unstable and the ress..nnse curves oblained receiver may ke ul may be unreliable. <br> Adjust the output of the sweep generator to obtain 3.0 to 5.0 volts peak-to-peak on the oscilloscope 5.0 volts peak-to-peak on the oscilloscope <br> Couple the signal generator loosely to the grid of the first pix i-f amplitier. Adjust the output of the signal generator to pix 1 -. amplitier. Adjust the output of the signal generator to produce small markers on the response curve. <br> Retouch T106, T107 and T108 to obtain the response shown in Figure 14 . <br> in Figure 14. <br> Remove the oscilloscope, sweep and signal generator connections. <br> Remove the bias box employed to provide bias for alignment. <br> KRK29 TUNER ALIGNMENT <br> Models 21-T. 363 to 21-T-375 incl. <br> A luner unit $w$ hich is operative and requires only touch up adjustments, requires no presetting of adjustments For such units, skip the remainder of this paragraph. For units which are compleiely out of adjustment, preset C27 all the way out. Set channel 7 to 13 oscillator slugs one turn from tight. Iurn T2 slug all the way out. Do not ch ments in the antenna matching unit. <br> Disconnect the link from terminals " $A$ " and " $B$ " of T104 and terminate the link with a 39 a and terminate the link with a 39 ohm composition resistor. Turn the receiver channel selector switch to channel 2. The 43.5 mc . trap is adjusted with zero bias. To insure that the bias will remain constant, take a clip. lead and short circuit the AGC terminal of the tuner at the terminal board circuit the <br> Connect the oscilloscope to the test point TPI on tuner unit. Set the oscilloscope to maximum gain. <br> Connect the output of the VHF signal generator to the output of the antenna matching unit at the junction of LS and C4 at the bottom of the FM trap L5. <br> Tune the signal generator to 43.5 mc . and modulate if $30 \%$ with a 400 cycle sine wave. Adjust the signal generator for maximum output. <br> Adjust C33 on top of the tuner, for minimum 400 cycle indi- cation on the oscilloscope. If necessary, this adjustment can be retouched in the field to provide additional rejection to one specific frequency in the i-f band pass. However. in such cases, care should be taken not to tune C33 into channel 2 , hereby reducing sensitivity on channel 2 <br> Connect the potentiometer arm of one of the bias supplies to the AGC terminal on the tuner and ground the battery positive terminal to the tuner case. Adjust the bias potentiometer to produce - 3.0 volts of bias, as measured by the "VoltO hmyst' at the AGC terminal on the tuner. "VoltOhmyst" at the AGC terminal on the tune <br> Set the channel selector switch to channel 8 . Preset C22 to read -3.0 volts at the test point TP1, as read Preset C22 to read - 3.0 volts at the test point TPl, as read on the "Voltohmstit. The limitit for oscillator injection voltage are 2 volts minimum and not exceeding a maximum of are 2 volts minimum and not exceeding 5.5 volts. <br> Turn the fine tuning control fully clockwis <br> Adjust C25 for proper oscillator frequency, 227 mc . This may be done in several ways. The easiest way and the way which will be recommended in this procedure will be to use the signal generator as a heterodyne irequency meter and beat the oscillator against the signal generator. To do this, tune the signal generator to 227 mc . with crystal accuracy. insert one end of a piece of insulated wire into the tuner unit through the hole provided for the adjustment of Cl6. Be care- ful that the wire does not touch any of the tuned circuits as ul that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscillator to shift. it may cause the frequency of the tuner oscillator to shift. Connect the other end of the wire to the "r-f in" terminal of

## ALIGNMENT PROCEDURE

the signal generator. Adiust C25 to obtain an audible bea
with the signal generator.
Turn the C27 clockwise until the beat note just begins to
change, then turn one full turn in the same clockwise direction. Return the fine tuning control to the mechanical cente of its range.
Note. - If on some units, it is not possible to reach the proper
hannel 8 oscillator frequency by adiustment of C25, switch
 oscillator frequency as indicated in the table on page 8 Then, switch to channel 12 and adjust $L 60$ to obtain prope adjusting the appropriate oscillator trimmer to obtain the proper frequency on each channel. Then again on channel 8 adjust C25 to obtain proper channel 8 oscillator frequency
Switch back to channel 13 and readiust L49 and back to channel 8 and adjust C25.
Set the T 2 core for maximum inductance (core turned
counter-clockwise).
Connect the sweep generator through a suitable attenua-
ator, as shown in Figure 10, to the input terminals of the ator, as shown in Figu
antenna matching unit.
Connect the signal generator loosely to the a ntenna terminals. Set the sweep generator to cover channel 8 .

Set the oscilloscope to maximum gain and use the minimum oscilloscope. Excessive input can change oscillator injectio during alignment and produce consequent misalignment eve hough the response as seen on the oscilloscope may look normal. Insert markers of channel 8 picture carrier and sound
carrier, 181.25 mc . and 185.75 mc . Adjust $\mathrm{C21,C16,Cl1} \mathrm{Cl}$ and $\mathrm{C7}$ for approximately correct
curve shape, frequency, and band width as shown in Fiqure 18 . The correct adjustment of $C 7$ is indicated by maximum
amplitude of the curve midway between the markers. Cll tunes the r-f amplifier plate circuit and affects the frequenc of the pass band most noticeably. C2l tunes the mixer gria ing that C has been properly adjusted). Cl6 is the coupling Connect the "VoltOhmyst" to test point TPI. Adjust C22 to read -3.0 volis dc on the "VoltOhmyst" at TPI. Readjust C27,
C21, C16 and C11 for proper response. Adjust C7 for maximum gain at midpoint of the curve. Repeat if necessary until th gain at midpoint of the curv
proper response is obtained.
Set the receiver channel switch to channel 13 .
Adjust the signal generator to the channel 13 oscillator
Turn the fine tuning control fully clockwise.
Adjust L49 to obtain an audible beat. Slightly overshoo in the same direction from the original setting then restur oscillator to proper frequency by adjusting C 27 to again
obtain the beat obtain the bea

Set the sweep generator to channel 13.
From the signal generator, insert channel 13 sound and From the signal generator, insert channel 13 s .
picture carrier markers, 211.25 mc . and 215.75 mc .
Adjust L36 and L20 for proper response as shown in
Turn off the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TP1
Check the oscillator injection voltage to be within limits a If it was necessary to readjust C22, turn the sweep an response. Readjust L36 and L20 if necessary.
Set the receiver channel selector switch to channel 8 and
readjust C 27 for proper oscillator frequency, 227 mc .

Set the sweep generator and signal generator to channel 8 Readjust C21, C16, Cll and C7 for correct curve shape
requency and bandwidth.

Turn off the sweep and signal generators, switch back to it C21 was adjusted in the recheck of channel 8 resp and If the initial setting of the oscillator injection trimmer wa and response on channel 8, adjust the oscillator injection on channel 13 and repeat the tracking procedure several time

Turn off the sweep generator and switch the receiver to
Adjust the signal generator to the channel 6 oscillator
frequency 129 mc .
Set the fine tuning control to the center of its mechani
cal range.
Adjust L54 for an audible beat. Adjust L48, and L32 oscillator injection voltage at TP1, to insure that it is withi oscillator injection voitage at 1 IP1, io insure
the limits specitied. Readjust C 22 if necessary
If C22 required adjustment, switch the receiver and the signal generator to channel 8 . Readjust C21 for correct curve
shape and recheck C27 and C25 for proper oscillator frequency
Check the response of channels 2 through 6 by switchin generator to each of these channels and observing the response and oscillator injection voltage obtained. Se Figure 18 for typical response curves. It should be foun
hat all these channels have the proper response with the markers above $80 \%$ response.
If the markers fail to fall within this requirement readjust
L48, and L32 in order to obtain curves within the proper limits. Switch the channel selector, signal generator and marker
generator through channels 7 to 13 and observe the response generator through channels 18 to 13 and observe the response the injection voltage at each channel to be within limits,
If necessary readjust $\mathrm{C} 11, \mathrm{C} 21$, or C 16 to obtain the proper response.
With the receiver and signal generator on channel 13 ad
just L49 for an audible beat with the signal generator Adjust the oscillator to frequency on all channels by switch-
ing the receiver and the frequency standard to each channel ing the receiver and the frequency standard to each channel
and adjusting the appropriate oscillator slug to obtain the and adjusting the appropriate oscillator slug to obtain the
audible beat. It should be possible to adjust the oscillator to obtain the audible beat on each channel. Recheck the oscillator injection voltage on each ch
voltage is within the specified limits.

KRKI2A TUNER ALIGNMENT
Models 21-T-356U to 21-T-375U incl
TUNER VHF ALIGNMENT.-Remove the $6 S 4$ voltage control tube from its
654 in the adapter
Connect the 0.50 milliampere meter to the adapter socket ads and furn the adapter switch on.
Remove the tuner cover shield.
Rotate the channel selector to a point midway between non-oscillating plate current. Some tubes may oscillate eve with the tuned circuits disengaged. To be sure the oscillator is in a non-oscillatory state, short circuit the spring
12 and 13 , the two contacts nearest the tuner front.
(NOTE: The contacts are at zero d-c potential.) Should the
plate current rise, keep the contacts shorted while adjusting plate current rise, keep the contacts shorted while adjusting
the oscillator plate current. Adjust $R 6$, oscillator voltage con
trol for a 28 milliampere reading on the meter. rol, for a 28 milliampere reading on the meter
Replace the tuner cover shield

Connect the VHF sweep generator to the antenna terminals Connect the VHF signal generator loosely to the antenna terminals.
Connect the oscilloscope, through the preamplifier if needed
with oscilloscope used to test point TPI. Ground the AGC bias ct the tuner terminal board using a Ground the AGC bias at the tuner terminal board u
clip lead to insure that the bias will remain constant.
Turn off the adapter switch, removing plate voltage from
the oscillator. This is required because of RFIF interaction the oscillator. This is required because of RFIF interaction
when a crystal is used as a mixer.
Set the channel selector and the sweep generator to
channel 2 .
Insert markers of channel 2 picture carrier and sound
carrier, 55.25 mc . and 59.75 mc . Adjust antenna T6, r-f amplifier plate L29 and mixer L30 adjustments for a symmetrical curve with maximum gain at
the center of the pass band. The curves will have a deep the center of the pass band. The curves will have a deep
valley because of no crystal loading and nonlinear detector valley because of no crystal looding and ninlinear detector
characteristics. The limits for the $100 \%$ response points are shown in Figure 1l. The proper curve shape is shown in Figure ll(b). (See Note on page 13 for detailed explanation of
adjustment.) It the bandwidth is out of tolerance, it can asualmy be corrected by redressing the coupling capacitor
us the double tuned circuit, C40 on insert A. Maximum
of of the double tuned cirruitr, C40 on insett $A$. Maximum
bandwidth occurs when the capacitor is centered in the bandwidth occu
insert chamber.
Repeat the above steps for all VHF channels adjusting the Repeat the above steps for all VHF channels adjusting the
appropriate antenna, $r$-f amplifier plate and mixer slugs for a symmetrical curve with maximum gain at the center o the pass band
Turn off the sweep generator
Remove the oscilloscope and preamplifier if used, from test
point TPI.
Turn the AGC control fully clockwise
Remove the clip lead qrounding the AGC bias on the tuner
terminal board. Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery to the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case. Adjust the bias potentipositive terminal to the tuner case. Adjust the bias poten
ometer to produce - 3.5 volts of bias , as measured by the "VoltO hmyst" at the AGC terminal on the tuner
Connect the potentiometer arm of the second bias supply
to the junction of $\mathrm{R123}$ and $\mathrm{C142}$, and ground the positive to the junction of R123 and C142, and ground the positive -5 volts of i-f
Connect the oscilloscope to the iunction of R135 and L102.
Use 3 to 5 volts peak-to-peak output on the oscilloscope. Turn the adapter switch on to apply plate voltage to the oscillator.
Turn the channel selector to channel 13 .
Set the fine tuning control to the center of its range.
Adjust the oscillator slug $L 22$ to proper frequency, 257 mc . This may be done in several ways. The easiest way and the to use the signal generator as a heterodyne frequency meter
and beat the oscillator against the signal generator. To do and beat the oscillator against the signal generator. To do
this, tune the signal generator to 257 mc . with crystal accu racy. Insert one end of a piece of insulated wire into the
tuner through either of the two holes next to the oscillator tuner through either of the two holes next to the oscillator
tube on the right front top corner of the tuner. Be careful tube on the right front top corner of the tuned circuits as i may cause the frequency of the oscillator to shift. Connect the other end of the wire to the "r-f in" terminal of the signal
generator. Adjust L22 oscillator slug to obtain an audio beat generator. Adjust L22 osc
with the signal generator
Turn on the sweep generator and set to channel 13.
Adjust Tl for maximum gain on the oscilloscope. Adjust mixer tank circuit L21 for maximum gain and flat-topped curve proper response. Maximum gain and flat-topped response proper response. Maximum gain
should be obtained simultaneousl


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Figure 8-KRK12A Oscillator Adjustments

Figure 12-KRK12A UHF Insert Responses
 yr or y.
© MLLIAMMETER $\xrightarrow{\text { o-soma }}$
$\sqrt{\cdots-\operatorname{cosec}}$

Figure 15-KRK12A Voltage Control Adapter


Figure 18-KRK29 R-F Response

$$
\underbrace{\text { corRECT }}_{\text {cree }}
$$

Figure 24-Horizontal Oscillator Wave Forms

| VOLTAGE CHART |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | Notes on Moasuremonts |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| the pictur the receive ground an |  | $\begin{aligned} & \text { a terminals. } \\ & \text { e receiver op } \end{aligned}$ | Itages shown ating on 117 | ts, $\begin{aligned} & \text { read } \\ & \text { ct }\end{aligned}$ | with a | The | 97A se | mea | Olt l less | st" betw | een the in | indicated terminal and chassis | . | ${ }_{\text {Type }}$ | Function | $\xrightarrow[\substack{\text { Operating } \\ \text { Condition }}]{ }$ | ( $\begin{aligned} & \text { Pin } \\ & \text { No. }\end{aligned}$ | volu | Pin No. | Volts | ${ }_{\text {Pr }}^{\text {Pin }}$ No. | Volts | Pin No | Volts |  |
|  |  | Function | Operating Condition | E. Plate |  | E. Scroen |  | E. Cathode |  | E. Grid |  | Notes on Measurements | v108 | 6Cb6 | 3rd Pix. I-F Amplifier <br> Amplifier | $\begin{gathered} 15000 \text { Mu. } \mathbf{v .} . \\ \text { Signal } \end{gathered}$ |  |  | 6 | 150 |  | 2.3 | $10$ |  |  |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No } \\ & \text { No } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts |  |  |  |  |  | 5 |  |  |  |  |  |  |  |  |
| v1 кRK29 | 6B07A | R-F <br> Arrolifier | $15000 \mathrm{Mu} . \mathrm{V} .$ | 6 | 170 | - | - | 8 | 0.1 | 7 |  |  | v199A | ${ }^{12 A U 7}$ | $\begin{array}{\|l\|} \hline \begin{array}{l} \text { Picture } \\ \text { 2nd Det. } \end{array} \\ \hline \end{array}$ | $15000 \mathrm{Mu} . \mathrm{V}$. | 1 | -25.8 | - | - | 3 | 0 | 2 | ${ }^{-1.85}$ |  |
|  |  |  | No Signal | 6 | 133 | - | - | 8 | 1.1 | 7 | 0 |  |  |  |  | No Signol | 1 | -14 | - | - | 3 | 0 | 2 | -. 6 |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Amplifier } \end{aligned}$ | $\underset{\text { Signal }}{\substack{15000 \mathrm{Mu} . \mathrm{v} \\ \text { Sin }}}$ | 1 | 270 | -- | - | 3 | 170 | 2 | - |  | v1098 | ${ }^{12 A U 7}$ | $\begin{array}{\|l} \hline \text { Horiz. Sync } \\ \text { Separator } \end{array}$ | $\underset{\text { Signal }}{15000 \mathrm{Mu} . \mathrm{V} .}$ | 6 | 260 | - | - | 8 | 160 | 7 | 122 |  |
|  |  |  | No Signal | 1 | 260 | - | - | 3 | 133 | 2 | - |  |  |  |  | No Signal | ${ }^{6}$ | 253 | - | - | 8 | 105 | 7 | 94.5 |  |
| v2 KRK29 | 6x8 | Mixer | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 9 | 160 | 8 | 160 | 6 | 0 | 7 | $\begin{gathered} -2.4 \text { to } \\ -3.0 \\ \hline \end{gathered}$ |  | vi10A | 6x8 | VidooAmplifier | $\begin{aligned} & 15000 \mathrm{Mu} . \mathrm{V} . \\ & \text { Sianal } \end{aligned}$ | 9 | 120 | 8 | 147 | 6 | . 9 | 7 | $-1.85$ | $\begin{gathered} \text { AGC control sot } \\ \text { for normal operation } \end{gathered}$ |
|  |  |  | No Signal | 9 | 145 | 8 | 145 | 6 | 0 | 7 | $\begin{array}{\|c\|} \hline-2.810 \\ -3.5 \\ \hline \end{array}$ |  |  |  |  | No Signal | 9 | 95 | 8 | 138 | 6 | 1.35 | 7 | -. 6 | AGC control set for normal operation |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Oscillator } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 95 | - | - | 6 | 0 | 2 | $\begin{array}{\|c\|} \hline-3.8 \text { to } \\ -5.5 \\ \hline \end{array}$ |  | v1108 | 6x8 | Vert. Sync Separator | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal. } \end{gathered}$ | 3 | 79 | - | - | 6 | . 90 | 2 | $-26.8$ |  |
|  |  |  | No Signal | 3 | 90 | - | - | 6 | 0 | 2 | $\left\lvert\, \begin{gathered} -3.0 \div 0 \\ -5.1 \end{gathered}\right.$ |  |  |  |  | No Signal | 3 | 46.5 | - | - | 6 | 1.35 | 2 | -2.1 |  |
| v1 <br> KRK12A | 6807A | $\begin{aligned} & \text { R-F } \\ & \text { Amplifier } \end{aligned}$ | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 6 | 143 | - | - | 8 | 1.2 | 7 | - 0 |  | v111A | ${ }^{12 A U 7}$ | $\begin{aligned} & \text { Vidoo } \\ & \text { Output } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathbf{v .} \\ \text { Signal } \end{gathered}$ | 6 | 231 | - | - | 8 | 13 | 7 | 0 |  |
|  |  |  | No Signal | 6 | 138 | - | - | 8 | 1.0 | 7 | 0 |  |  |  |  | No Sional | 6 | 225 | - | - | 8 | 12.5 | 7 | 0 |  |
|  |  | R-F <br> Amplifier | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 1 | 260 | - | - | 3 | 143 | 2 | 97 |  | v1118 | 12Aut | AGC Amplifier | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | -55 | - | - | 3 | 135 | 2 | 125 |  |
|  |  |  | No Signal | 1 | 250 | - | - | 3 | 137 | 2 | 97 |  |  |  |  | No Signal | 1 | 0.3 | - | - | 3 | 132 | 2 | ${ }^{68}$ |  |
| v2 KRK12A | 6AF4 | R-F <br> Oscillator | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 1\&7 | 78 | - | - | 5 | 0 | 2\&6 | -8 |  | v112A | 6Sn7ct | $\begin{array}{\|l\|l} \text { Sync } \\ \text { Output } \end{array}$ | $\begin{gathered} 15000 \text { Mu. } \mathbf{V} . \\ \text { Signal } \end{gathered}$ | 1 | 83 | - | - | 3 | 0 | 2 | $-3.28$ |  |
|  |  |  | No Signal | $1 \& 7$ | 75 | - | - | 5 | 0 | 286 | -6 |  |  |  |  | No Signal | 1 | 84 | - | - | 3 | 0 | 2 | -1.3 |  |
| v3 <br> KRK12A | 6B07A | $\begin{aligned} & \text { I-F } \\ & \text { Amplifier } \end{aligned}$ | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 6 | 270 | - | - | 8 | 148 | 7 | 103 |  | v1128 | 6sn7ct | $\begin{aligned} & \text { Vertical } \\ & \text { Oscillator } \\ & \text { \& Discharge } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathbf{V} . \\ \text { Signal } \end{gathered}$ | 1 | 80 | - | - | 8 | 0 | 7 | -63.5 | Dopender on retting of Vert. hold control |
|  |  |  | No Signal | 6 | 260 | - | - | 8 | 142 | 7 | 99 |  |  |  |  | No Signal | 6 | 182 | - | - | 8 | 0 | 7 | -60 | Voltages shown are synced pix adjumetment |
|  |  | $\begin{aligned} & \text { I-F } \\ & \text { Amplifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | 148 | - | - | 3 | 1.4 | 2 | 0 |  | v113 | 6K6GT | $\begin{array}{\|l\|} \hline \text { Vortical } \\ \text { Output } \end{array}$ | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 3 | 253 | 4 | 262 | 8 | 0 | 5 | -28.8 |  |
|  |  |  | No Signal | 1 | 143 | - | - | 3 | 1.2 | 2 | 0 |  |  |  |  | No Sianal | 3 | 245 | 4 | 253 | 8 | 0 | 5 | -27.5 |  |
| KRK12A | 654 | $\begin{aligned} & \text { Voltage } \\ & \text { Control } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | 9 | 270 | - | - | 2 | 94 | 6 | *68 | -Deponds on adjustmont of R6 | $v 114$ | 68N7GT | Horizontal <br> Osc. Control | $15000 \mathrm{Mu}, \mathrm{~V}$ Signal | 2 | 175 | - | - | 3 | -3.5 | 1 | $-21$ |  |
|  |  |  | No Signal | 9 | 260 | - | - | 2 | 90 | 6 | ${ }^{65}$ |  |  |  |  | No Signal | 2 | 170 | - | - | 3 | -5.5 | 1 | -17.5 |  |
| v101 | 6Aub | $\begin{aligned} & \text { lst Sound } \\ & \text { I.F Amp. } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 122 | 6 | 138 | 7 | 1.01 | 1 | 0 |  |  | 6sn7ct | Horizontal Oncillator | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 183 | - | - | 6 | 0 | 4 | -67 |  |
|  |  |  | No Signal | 5 | 113 | 6 | 126 | 7 | . 95 | 1 | 0 |  |  |  |  | No Signal | 5 | 179 | - | - | 6 | 0 | 4 | -65 |  |
| v102 | 6AU6 | 2nd Sound I-F Amp. | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 210 | 6 | 130 | 7 | 0 | 1 | -2.05 | *Unreliable measuring point Voltage depends on noise | $v 115$ | ${ }^{\text {6B06GT }}$ |  | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | . | ${ }_{4}$ | 193 | 8 | 22 | 5 | -14 | *High Voltage Pulse Preaent |
|  |  |  | $\xrightarrow{\text { No Signal }}$ | 5 | 205 | 6 | 122 | 7 | 0 | 1 | *-1.12 |  |  |  |  | No Signal | Cap | - | 4 | 185 | 8 | 20.5 | 5 | -13.5 | *High Voltage Pulee Present |
| v103 | 6AL5 | Ratio Detector | $\underset{\substack{15000 \text { Mu. V. } \\ \text { Signal }}}{ }$ | 7 | 1.7 | - | - | 1 | 21 | - | - | 7.5 kc doviation at 1000 cycle: | v116 | $\begin{aligned} & \text { 183GT } \\ & 18016 \end{aligned}$ | $\begin{aligned} & \text { H. V. } \\ & \text { Rectifier } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu}, \mathrm{V} \\ \text { Signal }}}{ }$ | Cap | . | - | - | $2 \& 7$ | 18,700 | _ | - | *High Voltage Pulee Prenent |
|  |  | Ratio Detector | $\frac{\text { No Signal }}{\substack{\text { No0 Mu. } \\ \text { Signal }}}$ | 7 | 4.1 1.7 | - | - | 1 | 11.8 <br> 21 | - | - |  |  |  |  | No Signal | Cap | . | - | - | 2\&7 | 18,350 | - | - | *High Voltage Pulse Present |
|  |  |  | ${ }^{\text {No Signal }}$ | 2 | 4.1 | - | - | 5 | ${ }^{11.8}$ | - | - |  | V 117 | ${ }_{6 A X 4 G T}$ | Dampor | $15000 \mathrm{Mu} . \mathrm{V}$ | 5 | 261 | - | - | 3 | . | - | - | *High Voltage Pulee Preaent |
| v104 | 6Av6 | $\begin{aligned} & \text { lut Audio } \\ & \text { Amplifier } \end{aligned}$ | $\begin{aligned} & 15000 \text { Mu. V. } \\ & \text { Signal } \end{aligned}$ | 7 | 78 | - | - | 2 | 0 | 1 | -. 7 | At min. volume |  |  |  | No Signal | 5 | 253 | - | - | 3 | . | - | - | *High Voltage Pulee Present |
| v10s |  |  | No Signal | 7 | 76 | - | - | 2 | 0 | 1 | $-.65$ | At min. volume | v118 | $\begin{aligned} & 21 R P 4 \\ & \text { or } 21 E P_{4} \end{aligned}$ | Kinotope | $15000 \mathrm{Mu}, \mathrm{V}$. Signal | Cap | 18,700 | 10 | 428 | 11 | 44.5 | 2 | 0 | At avorage Brightnoss |
|  | ${ }_{6 \times 6 \mathrm{GT}}$ | AudioOutput | ${ }_{\text {Signal }}$ | 3 | 205 | 4 | 220 | $\because$ | 15.2 | 5 | $\bigcirc$ | ${ }^{\text {At min. volume }}$ |  |  |  | No Signal | Cap | 18,350 | 10 | 425 | 11 | 39.5 | 2 | 0 | At average Brightnoess |
|  |  |  | ${ }_{\text {No Signal }}^{\text {(5000 Mu. V. }}$ | 3 | 198 | 4 | 207 | 8 | 14.5 | 5 | 0 | *Unreliable measuring point Make measurement at T104-B | ${ }_{\text {v120 }} \mathbf{V 1 1 9}$ | $\begin{gathered} \text { SUY } \mathrm{SUGG} \\ \hline \end{gathered}$ | Rectifiors | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal }^{1} . \end{gathered}$ | 486 | - | - | - | 2\&8 | 271 | - | - |  |
| v106 | 6CF6 | $\begin{aligned} & \text { lat Pix. I-F } \\ & \text { Amplifior } \end{aligned}$Amplifier | $\underset{\substack{15000 \mathrm{Mu} . \\ \text { Signal }}}{\text { V. }}$ | 5 | 218 | 6 | 240 | 2 | 132 | 1 | -8.2 |  |  |  |  |  |  |  |  |  | 2.8 |  | - |  |  |
|  |  |  | No Signal | 5 | 95.5 | 6 | 105 | 2 | 1.18 | 1 | *<0.1 |  |  |  |  | No Signal | 4\% 6 | - | - | - | 248 | 271 | - | - |  |
| v107 | ${ }_{6} 6$ cf 6 | 2nd $P_{\text {ix. I-F }}$ Amplifies | $15000 \mathrm{Mu} . \mathrm{V}$. Signal | 5 | 222 | 6 | 243 | 2 | $<0.1$ | 1 | $-8.45$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | No Signal | ${ }^{5}$ | 95.5 | 6 | 105 | 2 | 0.53 | 1 | <0.1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |



## (John F. Rider

## CIRCUIT SCHEMATIC DIAGRAM, KCS83B (KCS83E with 21EP4A Kinescope)



The schematic is shown in the latest
condition at the time of printing.
All resistance values in ohms. $\mathrm{K}=1000$.

All capacitance values less than 1 in $\operatorname{FM}$ noted.

Direction of arro
elockwise rotation

All voltages measured with "VoltOhmyst" and with no signal input. Voltages should
hold within $\pm 20 \%$ with 117 v. a.c supply.

Figure 28-Circuit Schematic
Diagram. KCS*B, KCS3E

CHASSIS KCS83, KCS83B, KCS83E

(c) John F. Rider


| $\begin{aligned} & \text { STOCK } \\ & \text { No. } \end{aligned}$ | description |
| :---: | :---: |
| 503433 | $330.000 \mathrm{ohms}, \pm 10 \%$, $1 / 2$ watt (R115, R191, R193) |
| 503439 | 390.000 ohms, $\pm 10 \%$, $1 / 2$ watt (R151, R178) |
| 502447 | 4770.000 oh me, $\pm 5 \%$. $1 / 2$ watt (R185) |
| 3447 |  |
| 503468 | 680,000 ohms, $\pm 10 \% .1 / 2$ watt (R156) |
| 502482 | 820,000 ohms, $\pm 5 \%$ |
| ${ }^{503482}$ | 820,000 ohms |
|  | 1 mogohm |
| 503512 | 1.2 megohm. $\pm 10 \%$ |
| S02315 | 1.5 megohm, $\pm 5 \%$, $1 / 2 \mathrm{watt}$ (R119, R124) |
| 51235 | 1.8 megohm, $\pm 5 \%, 1$ watt (R201) |
|  | 2.2 mogohm, $\pm 10 \%$. $1 / 2$ watt (R162, R168) |
|  | 3.9 mogohm . $\pm 10 \%$, $1 / 2$ watt (R132, R153) |
| 10 | 10 megohm, $+10 \%$. $1 / 2$ watt (R111) |
| 78203 | Transformor-1at. 1.F. pix transtormor complate with |
| 76433 | Tranaformer-2nd., 3rd. or 4th. I.F. transformer (T106, |
|  | Transformer-Hi-voltage transformor (T115) |
| 26440 | Tranaf ormer-Horizontal osailla tor transto |
|  | Tranoformer-Output transfor |
| 77112 | Transformer-Powor tranaformer 117 volts, 60 cyclo (T113) |
|  | Transformor-Ratio dotoctor trans formor complote with |
| 76981 |  |
| ${ }_{78204}^{78202}$ | Tranaformor- Vortical output traneformor (T112) |
|  | ap-18st. I.F. grid trap complete with adjustable core |
| $\begin{aligned} & 76983 \\ & 78219 \end{aligned}$ |  |
|  | oke and magnet assem |
| 76863 | Connector-Anode connector complete wits contact and |
| 75542 | Cornatior-6 contact male connector for defleetion yoke |
| 78309 | Cushion-Round rub |
|  | Cushion-Rubber cushion for defiection yoke hood |
|  | Maca-D-Focus |
|  | Magr |
|  | Magnot-Pin |
|  | support arm for glase kid |
|  | Spring-Grounding apring (coil) for dollection yo |
| 3310 | Strap-Ground strap (formed) for dellection yoke for glase kinescope |
| 78600 | Strap-Ground strap (woft copper strip) for metal kine- |
| 638 | Stud-Adjusting stud complote with guard for focus |
| 78616 | ke-Dafloction yoko completo with 6 contact mal |
|  | $\begin{aligned} & \text { noctor } \\ & \text { R213) } \end{aligned}$ |
|  | SPEAKER ASSEMBLIES $971636-1 \mathrm{~W}$ |
|  |  |
|  | (For Modol 21 T3S6U) |
| 00 | Speakor-5" P.M. Epeaker complete with cone and voice coil ( 3.2 ohma) |
|  | SPEAKER ASSEMBLIES |
|  |  |
|  | RMA-274 RMA-285 |
|  | C |
| $\begin{aligned} & 77129 \\ & 75022 \end{aligned}$ | Cone- Cone and voice coil for ppeaker stampod $971490-3 \mathrm{R}$ |
|  | Speaker- $8^{87}$ P.M. speaker complete with cone and voice coil ( 3.2 ohms ) |
|  | SPEAKER ASSEM |
|  | (For Models 21 T364, 271 T364U 21 T365, 21 T365U, |
| 77777 | 10 P.M |
|  |  |
| ${ }_{76093}^{75682}$ | Cone-Cone and voice coil (3.2 ohms) |
|  | Speaker-12" P.M. spoaker complete with cone and voice coil ( 3.2 ohms ) |
|  | NOTE:- If stamping on spaaker in instrumenta does not agreo with above speaker number, order replacemen number stampod on speaker and full dossription of part required. |



Model 17.T-352U Metal-Mabogany Grain

Models 17-T.361, 17.T-361U Mahogany, Oak


## GENERAL DESCRIPTION

Models 17-T-352U, 17-T-361 and 17-T-361U are "17 inch elelevision receivers. Models 17-T-352U and 17-T-361U are identical except for cabinets, and speakers. Model 17-T-361 has full 12 channel VHF coverage. Models 17-T-352U and 17-T-361U feature full 12 channel VHF coverage plus any 4 UHF channels desired.

All models include intercarrier FM system; ratio detector; improved picture brilliance; pulsed picture A-G-C; A-F-C horizontal hold; stabilized vertical hold; improved sync sep-
arator ( 3.5 mc. band width for picture channel); and reduced hazard high voltage supply. An auxiliary audio input jack is provided to permit the use of an external record
playing attachment.
NICAL SPECIFICATIONS
PICTURE SIZE.... 146 square inches on a 17 CP4 Kinescope RCA TUBE COMPLEMENT
TELEVISION R-F FREQUENCY RANGE
Model 17-T-361

All 12 television channels. 54 mc . to $88 \mathrm{mc} ., 174 \mathrm{mc}$. to 216 mc . Models 17-T-352U \& 17-T-361U
Any of 70 UHF channels................ 470 mc . to 890 mc . Any of 12 VHF channels, 54 mc . $1088 \mathrm{mc} ., 174 \mathrm{mc} .10216 \mathrm{mc}$ (Any desired combination of 16 UHF and/or VHF channels may be used.)
 Pound I-F Carrier Frequency. $\ldots . . . . . . . .41 .25 \mathrm{mc}$ POWER RATING ............17-T-352U \& 17-T-361U-230 watts aUdIO POWER OUTPUT RATING VIDEO RESPONSE.

## SWEEP DEFLECTION

FOCUS
4 watts max.

ANTENNA INPUT IMPEDANCE
Model 17-T-361
Choice: 300 ohms balanced or 72 ohms unbalanced. Models 17-T-352U \& 17-T-361U
UHF- 300 ohms balanced.
HF-300 ohms balanced.
$\begin{array}{ll}\text { RCA TUBE COMPLEMENT } \\ \text { Tube Used } & \text { Tuner KRK29 (17-T-361) Function }\end{array}$
(1) RCA 6BQ7A ................
(2) RCA 6x .........

## Chassis designations

KCS78F Model 17-T-361 employing a KRK29 Tuner. KCS78J Models 17-T-352U and 17-T-361U employing a KRK12B Models
Tuner.

WEIGHT \& DIMENSIONS

| Model |  | Shipping Weight | Width Inches | Height Inches | Depth Inches |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 2U | 88 | 105 lbs . | $211 / 2$ | $223 / 4$ | 22 |
| T-3 | 87 lbs . | 112 | 241/4 | $353 /$ | 22 |
| T-361 | 921 | 1171 | 241/ | $353 /$ | 22 |

## OUDSPEARERS

Model 17-T-352U (971636-1) 5" PM Dynamic, 3.2 ohms Model 17-T-361.
(971636-1) 5" PM Dynamic, 3.2 ohms (971490-3) $8^{\prime \prime}$ PM Dynamic, 3.2 ohms

## SCANNING

.Interlaced, 525 line
HORIZONTAL SWEEP FREQUENCY . ............. 15.750 cps
VERTICAL SWEEP FREQUENCY
. 60 cps
FRAME FREQUENCY (Picture Repetition Rate) ..... 30 cps
operating controls (Front)
$\left.\begin{array}{l}\text { Channel Selector } \\ \text { Fine Tuning }\end{array}\right\}$
Picture.................
Picture Horizontal Hold Picture Vertical Hold Sound Volume and On-OtI Switc Brightness

> NON-OPI

NON-O
G CONTROLS (under Height ........ adjustments)

## Picture <br> idth Centering

Horizontal Drive . Horizontal Linearity
orizontal Oscillator Frequency orizotal Jocking Wavet
Focus.
on Trap Magn Deflection Coil AGC Control

Dual Control Knob Dual Control Knob ingle Control under Panel Single Control under Panel Control under Panel Dual Control Knobs ader Front Panel) .screwdriver adjustment screwdriver adjustment
including R.F and I . top chassis adjustment rear chassis adjustment 8 screwdriver adjustment
rear chassis adjustment rear chassis adjustmen ottom chassis adiustment rear chassis adjustment top chassis adjustment top chassis adjustment chassis wing nut adjustment rear chassis adjustment


Figure 2-Yoke and Focus Magnet Adjustments


Figure 3-Rear Chassis Adjustment





Models 27-D. $384,27-$ D. 384 C
"Longchamps"
Mabogany, Maple
CKIPTION
Models 27-D-382, 27-D-382U, 27-D-383, 27-D-383U, 27-D-38 and 27-D.384U are Deluxe " 27 Inch" television receivers Models 27-D.382, 27-D. 383 and 27-D. 384 feature full 12 channel VHF coverage.

Models 27.D-382U, 27.D.383U and 27.D.384U feature full
12 channel VHF coverage plus any 4 UHF channels desired These receivers have an auxiliary audio input jack to permi the use of an externnal record playing attachment. All models
incorporate two $8^{\prime \prime}$ PM speater

## ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE 420 square inches on a 27MP4 Kinescope RCA TUBE COMPLEMENT
TELEVISION R-F FREQUENCY RANGE
All 12 VHF channels. 54 mc . to $88 \mathrm{mc} ., 174 \mathrm{mc}$. to 216 mc Models 27-D.382U, 27-D.383U and 27-D.384U
Any of 70 UHF channels............ 470 mc . to 890 mc Any of 12 VHF channels. 174 mc . to 216 mc may be used.) may be used.)
INTERMEDIATE FREQUENCIES Picture I.F Carrier Frequency.
Sound I-F Carrier Frequency POWER RATING

AUDIO POWER OUTPUT RATING VIDEO RESPONSE

SWEEP DEFLECTION

## FOCUS

45.75 mc 41.25 mc
325 watts 325 watts
watts max
to 4 mc .
Magnetic
ANTENNA INPUT IMPEDANCE
Models 27-D-382, 27-D-383 and 27-D-384
Choice: 300 ohms balanced or 72 ohms unbalanced.
Models 27-D.382U, 27-D.383U and 27-D-384U
UHF-300 ohms
VHF- 300 ohms balod
CHASSIS DESIGNATIONS
KCS77
Models 27.D. 383 and 27.D. 384
KCS77D ............... Models 27-D-383U and 27-D.384U KCS77H ..................................... Model 27.D-382 LOUDSPEAKERS (971490-4W) 8 Inch PM Dynami VOICE COIL IMPEDANCE Tunction Tuner KKK29B (Models 27-D.382, 27-D-383 and 27-D.384)
 (2) RCA $6 \times 8$
-F Oscillator and Mixe Tuner KRK12B (Models 27-D-382U, 27-D.383U and 27-D-384U) (1) RCA 6BQ7A R-F Amplifier (VHF only) (2) RCA 6AF4. - ..... R-F Oscillato
 A iN82 crystal is used as a mixer.

| RCA 6AU6 | Models ${ }_{1 s t}$ Picture I |
| :---: | :---: |
| (2) RCA 6CB6 | 2nd Picture I-F Amplifier |
| (3) RCA 6CB6 | 3rd Picture I-F Amplifier |
| (4) RCA 6CB6 | 4th Picture I-F Amplifier |
| (5) RCA 6CL6 | Video Amplitier |
| (6) RCA GCL6 | Peaking Amplifier |
| (7) RCA 6ALS | Agitation Compressor |
| (8) RCA 6AU6 | 1st Sound I-F Amplitier |
| (9) RCA 6AU6 | 2nd Sound I-F Amplifier |
| (10) RCA GALS | Ratio Detector |
| (11) RCA 6AV6 | 1st Audio Amplitier |
| (12) RCA 6AQ5 | Audio Outp |

(13) RCA 12 AU 7 (14) RCA 12AU7 Horiz. Sync Separator Synd Syna and AGC (15) RCA 6SN7GT (16) RCA 6AQ5 (16) RCA 6AQ5.and Vert. Sweep Osc. and Dischg. (17) RCA
(18) RCA 6BO6GT (2 tubes) (19) RCA 6B66GT (2 tubes) ...... Horizontal Sweep Output (20) RCA $1 \mathrm{~B} 3 \mathrm{GT} / 8016$. (21) RCA 5U4G (2 tubes)
(22) RCA $27 \mathrm{MP4}$

Rectifier


Figure S-KRK29B R-F Oscillator Adjustments

## NON-OPERATING CONTROLS

Horizontal Centering ......top chassis adjustment Vertical Centering.........top chassis adjustment AGC............................ chassis adjustment Height...... . front panel screwdriver adjustment Vertical
Linearity .. .front panel screwdriver adjustment Horizontal
Locking rear chassis screwdriver adjustment Horizonta
rear chassis screwdriver adjustmen
Horizontal Oscillator
Frequency
Horizontal Oscillator
Waveform.
Width
Width Link
Focus.
Ion Trap Magnet
Focus Magnet
.rear chassis adjustment
bottom chassis adjustment ... rear chassis adjustment H.V. compartment adjustment top chassis adjustment top chassis adjustment top chassis adjustment top chassis adjustment


Figure 3-Ion Trap and Centering Magnet Adjustments


Figure 4-Rear Chassis Adjustments


Figure 6-KRKI2B Oscillator Adjustment


Figure 7-Chassis Top View (shown with KRK29B Tuner)


Figure 8-Chassis Bottom View (shown with KRK29B Tuner)

ALIGNMENT PROCEDURE

| Channel Number | Picture Carrier Freq. Mc. | Sound Carrier Freq. Mc. | Receiver <br> R-F Osc <br> Freq. Mc |
| :---: | :---: | :---: | :---: |
| 52 | 699.25 | 703.75 | 745 |
| 53 | 705.25 | 709.75 | 751 |
| 54 | 711.25 | 715.75 | 757 |
| 55 | 717.25 | 721.75 | 763 |
| 56 | 723.25 | 727.75 | 769 |
| 57 | 729.25 | 733.75 | 775 |
| 58 | 735.25 | 739.75 | 781 |
| 59 | 741.25 | 745.75 | 787 |
| 60 | 747.25 | 751.75 | 793 |
| 61 | 753.25 | 757.75 | 799 |
| 62 | 759.25 | 263.75 | 805 |
| 63 | 765.25 | 769.75 | 811 |
| 64 | 771.25 | 775.75 | 817 |
| 65 | 777.25 | 781.75 | 823 |
| 66 | 783.25 | 787.75 | 829 |
| 67 | 789.25 | 793.75 | 835 |
| 68 | 795.25 | 799.75 | 841 |
| 69 | 801.25 | 805.75 | 847 |
| 70 | 807.25 | 811.75 | 853 |
| 71 | 813.25 | 817.75 | 859 |
| 72 | 819.25 | 823.75 | 865 |
| 73 | 825.25 | 829.15 | 871 |
| 74 | 831.25 | 835.75 | 877 |
| 75 | 837.25 | 841.75 | 883 |
| 76 | 843.25 | 847.75 | 889 |
| 77 | 849.25 | 853.75 | 895 |
| 78 | 855.25 | 359.75 | 901 |
| 79 | 861.25 | 865.75 | 907 |
| 80 | 867.25 | 871.75 | 913 |
| 81 | 873.25 | 877.75 | 919 |
| 82 | 879.25 | 883.75 | 925 |
| 83 | 885.25 | 889.75 | 931 |

Cathode Ray Oscilloscope.-An oscilloscope with a sensiCathode Ray oscilloscope.-An oscilloscope with a sensi-
tivity of 1 millivilt per inch is required. A suitable pre-amplifier
may be employed with oscilloscopes of lesser sensitivity. Electronic Voltmetar.-A voltmeler with a 1.5 volt DC valent. DC Milliammeter.-A milliammeter with a range of $0-50$ Adapter Socket-A
Adapter Socket.- An adapter socket is required to meter he cathode current of the 6S4 voltage control tube of the
KRK12B Tuner. Wiring of adapter is shown in Figure 9.


Figure 9-KRK12B Voltage Control Adapter
KRK29B ANTENNA MATCHING UNIT ALIGNMENT. -The antenno matching unit is accurately aligned at the customer's home since even slight misalignment may cause serious attenuation of the signal, especially on channel 2. The ormer in place. If for any reason, a new antenna matching transformer is installed, the $r-1$ unit should be realigned. The F.M trap which is mounted in the antenna matching
unit may be adjustec without adversely affecting the alignment of the unit.
To align the antenna matching unit disconnect the lead
from the F.M trap L5 to the channel selector switch S1-E. With a shap LS the channel selector switch Sl-E unit through a $1,000 \mathrm{~mm}$ mi. capacitor to the grid of the second pix i.f a mplifier, pin 1 of V107.
Replace the
adjustments.
Remove the first pix i-f amplifier tube V106.
Connect the positive terminal of a bias box to the chassis
and the potentiometer arm to the junction of R133 and C133B Set the potentiometer to produce approximately - 5.0 volts of Sei the potentiometer to prouace approx

## ALIGNMENT PROCEDURE

Connect an oscilloscope to pin 9, V11O and set the oscillocope gain to maximu 1 .
Connect a VHF signal generator to the antenna input termials. Modulate the signal generator $30^{\circ} \%$ with an audio signal. Tune the signal generator to 45.75 mc . and adjust the generator output to give an indication on the antenna matching unit for minimadio indication on the oscilloscope.
Tune the signal generator to 41.25 mc . and adjust Ll for minimum audio indication on the oscilloscope.
Remove the jumper from the output of the matching unit. Conne ct a 300 ohm $1 / 2$ watt composition resistor from L5 to ground, keeping the leads as short as possible.
Connect an oscilloscope low capacity crystal probe from
5 to ground. The sensitivity of the oscilloscope should be L.5 to ground. The sensitivity of the oscilloscope should be to maximum. Connect the VHF sweep generator to the matching unit antenna input terminals. In order into the matching unit, it is ance from the sweep generator in on at the matching unit
advisable to employ a resistance pad and terminals. Figure 17 shows three difterent resistance pads
use with sweep generators with 50 ohm co-ax output, 72 ohm co-ax output or 300 ohm balanced output. Choose the pad to
match the output impedance of the particular sweep employed. Connect the signal generator loosely to the matching unit Connect the sign
antenna terminals.
Set the sweep generator to sweep from 45 mc . to 54 mc With RCA Type WR59A sweep generators, this may be accomWith WR59B sweep generators this may be accomplished by retuning channel number 2 to cover the range. In making hese adjustments on the generator, be sure not to turn the core too far clock
retaining spring
Adjust L2 and L3 to obtain the response shown in Figure 10. L3 is most effective in locating the position of the shoulder of the curve at 52 mc . and L2 should be adjusted to give maximum amplitude at 53 mc . and above consistent with the spatching unit interact to some extent. Repeat the above pro edure until no further adjustments are necessary
Remove the 300 ohm resistor and crystal probe connections,
Restore the connection between L5 and SI-E. Replace V106


就 $+15 \%$ aesponse point

Figure 10-KRK29B Antenna Matching Linit Response PICTURE I-F TRAP ADJUSTMENT.-Connect the i.f signal gen
Connect the "VoltOhmyst" to the function of R133 and C133B Obtain two 7.5 volt batteries capable of withstandin appreciable current drain and connect the ensitive terminal of one battery to chassis and the potentiometer arm to the junction of R133 and C133B
Set the bias to produce approximately -1.0 volt of bias at
the junction of R133 and C133B.
Connect the "VoltOhmyst" to pin 9 of VIIO, the 6CL6 video amplifier.
Set the signal generator to each of the following frequencie and adjust the corresponding circuit for minimum d-c outpu at pin 9 of vilo. Use sufficient signal input to produce 1.0 vo
39.25 mc T104 top core
$\begin{array}{lll}39.25 \mathrm{mc} \ldots & \cdots \quad \begin{array}{l}\text { T104 top core } \\ 41.25 \mathrm{mc}\end{array} & \\ \text { T105 bottom core }\end{array}$
41.25 mc
47.25 mc

T105 bottom core
T106 bottom core

PICTURE I-F TRANSFORMER ADJUSTMENTS Models 27-D-382, 27-D-383, 27.D-384
Set the signal generator to each of the following frequencies and peak the specilied adjustment for maximum haication on "VoltOhmyst." During alignment, reduce the input signal with -1.0 volt of $\mathrm{i}-\mathrm{f}$ bias at the junction of R133 and C133B.
43.7 mc
45.5 mc.

T 109
T 108
T 107 To align $T 105$ and T106, connect the sweep generator to the
first picture if grid, pin 1 of V106 through a 1,000 mmf.
ceran seramic capacitor. Shunt R137, R141 and terminals "A" and Fias to -1.0 volt at the junction of R133 and C133B.
Connect the oscilloscope to pin 9 of V110.
Adjust T105 and T106 top cores for maximum gain and curve shape as shown in Figure 11. For final adjustment set he output of the sweep generator to produce 0.5 volt peak. -peak at the oscilloscope terminals.


To align T2 and T104, connect the sweep generator to the mixer grid test poin1 TP2. Use the shortest leads possible, with not more than one inch of unshielded lead at the end of the sweep cable
Connect a 180 ohm composition resistor between terminal
" B " of T 105 and the junction of R 131 and C 133 A . Connect the oscilloscope diode probe to terminal " $B$ " of Tlo5 and ground. Couple the signal generator loosely to the
The shunt trimmer Cl2l across terminals " $A$ " and " $B$ " of
T104 is variable and is provided as a bandwidth adjustment. Preset the shunt trimmer to minimum capacity. Adjust T2 (top) and T104 (bottom) for maximum gain at 43.5 mc . and
with 45.75 mc at $70 \%$ of maximum response.

Adjust the shunt trimmer Cl2l until 41.25 mc . is at $85 \%$ response with respect to the low frequency
approximately 41.9 mc . as shown in Figure 12 .
Disconnect the diode probe, the 180 ohm and the three 330 Disconnect resistors.

Models 27-D.382U, 27-D-383U, 27-D-384U
Set the signal generator to each of the following frequencies and peak the specified odjustment for maximum indication signal if necessary in order to produce 1.0 volt of $d-\mathrm{c}$ at pin 9 of V110 with -1.0 volt of i -f bias at the junction of R133 and Cl33B

$$
\begin{aligned}
& 43.7 \mathrm{mc.} \\
& 45.5 \mathrm{mc} \\
& 41.8 \mathrm{mc}
\end{aligned}
$$

T109
$T 108$
$T 107$
To align T105 and T106, connect the sweep generator to the first picture i. t gid, pin
ceramic capacitor. Shunt R137, R141 and terminals " $A$ " and
" $\mathrm{F}^{\prime}$ " "F" of T109 with. 330 ohm composition resistors. Set the ibias to -1.0 volt at the junction of RI 33 and $\mathrm{Cl33B}$.
Connect the oscilloscope to pin 9 of VIIO, the 6CL6 video amplifier.

## ALIGNMENT PROCEDURE

Adjust T105 and T106 top cores for maximum gain and curve shape as shown in Figure 11. For linal adjustment se
the output of the VHF sweep generator to produce 0.5 vol peak-to-peak at the oscilloscope terminals.
To align the crystal mixer and T 2 and T 104 , connect the
VHF sweep generator to the front terminal of the 1 N 82 crystal older in series with a $1,500 \mathrm{mml}$. ceramic capacitor Use the holder in series with a $1,500 \mathrm{mmf}$. ceramic capacitor. Use the tuner case.
Set the channel selector to channel 5
Connect a 180 ohm composition resistor between
"B" of TIO5 and the junction of R131 and C133A.
Connect the oscilloscope diode probe to terminal " $B$ " of diode probe in order to obtain markers.
The shunt trimmer C121 across terminals " $A$ " and " $B$ " of
104 is variable and is provided as a bandwidth adjustmen reset the shunt trimmer to minimum capacity. Adjust T2 (top) and 1104 (bottom) for maximum gain at
45.75 mc at $70^{\prime \prime}$, of maximum response.
Adjust the shunt trimmer C 121 until 41.25 mc . is at $85^{\circ}$ Adjust the shunt trimmer
response with respect to the low frequency shoulder at approximately 41.9 m. as as shown in Figure 14. Addist $T 1$
for maximum gain. Readust $T 2$ and $T 104$ if necessary to for maximum gain. Headjust T2 and T10
obtain proper wave shape, see Figure 15 .
Disconnect the diode probe, the 180 ohm and the three 330 Disconnect
ohm resistors.


SWEEP ALIGNMENT OF PICTURE I-F
Connect the oscilloscope to pin 9 of Vllo.

Adjust the bias potentiometer to obtain -6.0 volts of bias | as mea |
| :--- |
| Cl 133 B |

Leave the sweep generator connected to the mixer grid tes N82 crystal holder on KRK12B Tuners. Use the shortest lead possible with not more than one inch of unshielded lead a he end of the sweep cable. If these precautions are no observed, the receiver may be un
curves obtained may be unreliable.
Adjust the output of the sweep generator to obtain 3.0 volts peak-lo-peak on the oscilloscope.
Couple the signal generator loosely to the grid of the first
pix if amplifier. Adjust the output of the signal generator to produce small markers on the response curve.
Retouch $T 108$ and $T 109$ to obtain the response shown in 1907 is 15 . Do not adjust $T 107$ unless absolutely necessary. e 4125 mc . sound i -f carrier and may create tinterferenct in the picture. It will also cause poor adjacent channel pic ure rejection. If T107 is tuned too high in frequency, the level produce noisy sound in weak signal areas.

Remove the oscilloscope, sweep and signal generator con
ections.
Remove the bias box employed to provide bias for alignmen

## KRK29B TUNER ALIGNMENT

## Models 27.D-382, 27.D.383, 27.D.384

 A tuner unit which is operative and requires only touch up units, skip the remainder of this paragraph. For units whic are completely out of adjustment, preset C27 all the way out. Set channel 7 to 13 oscillator slugs one furn from tight. TurnT 2 slug all the way out. Do not change any of the adjustments in the antenno matching unit.
Disconnect the link from terminals " A " and " B " of TlO 4 and terminate the link with a 39 ohm composition resistor.
Turn the receiver channel selector switch to channel 2 .
The 43.5 mc. trap is adjusted with zero bias. To insure tha the AGC terminal of the tuner at the terminal board to ground
Connect the oscilloscope to the test point TPl on the side o Connect the oscilloscope to the test point TPl on the
the tuner unit. Set the oscilloscope to maximum gain.
Connect the output of the VHF signal generator to the out
put of the antenna matching unit at the junction of $L 5$ and C at the bottom of the FM trap L5.
Tune the signal generator to 43.5 mc . and modulate it 30
with a 400 cycle sine wave. Adjust the signal generator fo maximum output.
Adjust C33 on top of the tuner, for minimum 400 cycle ind be retouched in the field to provide additional rejection to on specific frequency in the i.f band pass. However, in such coses, care should be taken not to tune C 33 into channel 2
thereby reducing sensitivity on chan
位

$$
\begin{aligned}
& \text { Connect the potentiometer arm of one of the bias supplies } \\
& \text { to the AGC terminal on the tuner and ground the battery posi- }
\end{aligned}
$$ tive terminal to the tuner case. Adjust the bias bottentiomete to produce -3.0 voltsof bias, as me easured by the "Voltohmyst" at the AGC terminal on the tune



Figure 16-KRK29B Tuner Adjustments
Set the channel selector switch to channel 8 .
Preset C22 to read - 3.0 volts at the test point TP1, as read on the "Voltohmyst." The limits for oscillator injection voltag Turn the fine tuning control fully clockwise

Adjust C 25 for proper oscillator frequency, 227 mc . This may be done in several ways. The easiest way and the wa signal generator as a heterodyne frequency meter and bea the oscillator against the signal generator. To do this, tune the signal generator to 227 mc . with crystal accuracy. Inse
one end of a piece of insulated wire into the tuner unit throug one end op a pied for the adjustment of Cl6. Be careful that the the hole provided for the adjustment of Cli. Be careful that the
wire does not touch any of the tuned circuits as it may cause


## ALIGNMENT PROCEDURE

the frequency of the tuner oscillator to shitt. Connect the other end of the wire to the "r.f in" terminal of the signal generator
Adjust C 25 to obtain an audible beat with the signal generator Turn 277 clackwise until the beat note just begins to change Turn C27 clockwise until the beat note just begins to change,
then turn one full turn in the same clockwise direction. Return the fine tuning control to the mechanical center of its range.
NOTE.-It on some units, it is not possible to reach the proper channel 8 oscillator rrequency by adjustment or chne 13 oscillator frequency as indicated in the table on page 8 . Then, switch to channel 12 and adjust L60 to obtain prope
channel 12 oscillator frequency. Continue down to channel 8 adjusting the appropriate oscillator trimmer to obtain proper frequency on each channel. Then again on channel 8 , Switch back to channel 13 and readjust L49 and back to
channel 8 and adjust C 25 .
Set the T 2 core for maximum inductance (core turned

Figure 17-Sweep Attenuator Pads

Connect the sweep generator through a suitable attenuator as shown in Fig
matching unit.
Connect the signal generator loosely to the antenna s.

Set the sweep generator to cover channel
Set the oscilloscope to maximum gain and use the minimum
input signal which will produce a usable pattern on the oscil input signal which will produce a usable pattern on the osci alignment and produce consequent misalignment even thoug the response as seen on the oscilloscope may look normal. Insert markers of channel 8 picture carrier and sound
carrier, 181.25 mc . and 185.75 mc.
Adjust C21, C16, C11 and C7 for approximately correct
curve shape, frequency, and bandwidth as shown in Fiqure 18


The correct adjustment of $\mathbf{C 7}$ is indicated by maximum amthe r-f amplifier plate circuit and affects the freequency of the pass band most noticeably. C2l tunes the mixer grid circuit C7 has been properly adjusted). C16 is the coupling adjust ment and hence primarily affects the response bandwidth.
Connect the "VoltOhmyst" to test point TP1. Adjust C22 to
ead -3.0 volts dc on the "VoltOhmyst" at TP1. Readjust C27, read -3.0 volts dc on the "VoltO hmyst" at P1. Readjust
$\mathrm{C} 21, \mathrm{C} 16$ and $\mathrm{Cl1}$ for proper response. Adjust C 7 for maximum C21, C16 and Cll for proper response. Adjust C7 for maximum gain at midpoint of the cur
Set the receiver channel switch to channel 13 .
Adjust the signal generator to the channel 13 oscillator 257 mc .
Turn the fine tuning control fully clockwise.
Adjust L49 to obtain an audible beat. Slightly overshoot the adjustment of L49 by turning the slug an additional turn in the same direction from the original setting, then reset the oscilator to prop
obtain the beat.
Set the sweep generator to channel 13 . From the signal generator, insert channel 13 sound and
picture carrier markers, 211.25 mc. and 215.75 mc.
Adjust L36 and L20 for proper response as shown in
Turn off the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TP1 Check the oscillator injection voltage to be within limits as adjust C22, turn the sweep an signal generators back on and recheck the channel 13 Set the receiver channel selector switch to channel 8 and frequency, 227 mc
Set the sweep generator and signal generator to channel 8 . Readjust $\mathrm{C} 21, \mathrm{Cl6}, \mathrm{Cll}$ and C 7 for correct curve shape保
Turn off the sweep and signal generators, switch back to if C21 was adjusted in the recheck of channel $\&$ response. If the initial setting of the oscillator injection trimmer wa and response on channel 8, adjust the oscillator injection o channel $h 3$ and repeat he seral tim before the proper setting is obtained.

Turn off the sweep generator and switch the receiver to
channel 6 . Adjust the signal generator to the channel 6 oscillator fr
quency 129 mc.
Set the fine tuning control to the center of its mechanica range.
Adjust L54 for an audible beat. Adjust L48 and L32 for lator injection voltage at TP1, to insure that it is within the limits specified. Readjust C22 if necessary
II C22 required adjustment, switch the receiver and the signal generator o channel 8 . headjust C 21 for correct curv shape and rech trequency
Check the response of channels 2 through 6 by switching generator to each of these channels and observing th response and oscillator injection voltage obtained. See Figure
18 for typical response curves. It should be found that all these channels have the proper response with the markers abov 80"; response.
If the markers fail to fall within this requirement readjust
L 48 and L 32 in order to obtain curves within the proper limits.
© John F. Rider

## ALIGNMENT PROCEDURE

Switch the channel selector，signal generator and marker generator through channels 7 ，to 13 and observe the response curves，referring to Figure 18 for proper wave shape．Check necessary readjust C11，C2l or C16 toobtain the proper response． With the receiver and signal generator on channel 13


Figure 19－KRK29B R－F Oscillator Adjustments
Adjust the oscillator to frequency on all channels by switch－
ing the receiver and the frequency standard to each channel and adjusting the appropriate oscillator slug to obtain the abtain the audible beat on each channel．Recheck the oscilla tor injection voltage on each channel to verify that the voltage
is within the specified limits．

KRK12B TUNER ALIGNMENT
Models 27－D．382U，27．D．383U，27－D．384U TUNER VHF ALIGNMENT．－Remove the 6 S4 voltage $6 S 4$ in the adapter
Connect the 0.50 milliampere meter to the adapter socke turn the adapter switch on
Remove the tuner cover shield．
Rotate the channel selector to a point midway between non－oscillating plate current．Some tubes may oscillate even with the tuned circuits disengaged．To be sure the oscillator is in a non－oscillatory state，short circuit the spring
12 and 13 ，the two contacts nearest the tuner front．
（NOTE：The contacts are at zero d．c potential．）Should the plate current rise，keep the contacts shorted while adjusting he oscillator plate current．Adjust R6，oscillator voltage con．
Replace the tuner cover shield
Connect the VHF sweep generator to the antenna terminals． Connect the VHF signal generator loosely to the antenna

Connect the oscilloscope through the preamplifier，if needed with oscilloscope used，to test point TPI．
Ground the AGC bias at the tuner terminal board using a clip lead to insure that the bias will remain constant．
Turn off the adapter switch，removing plate voltage from
the oscillator．This is required because of RFIF interaction the oscillator．This is required because of RF．IF interaction when a crystal is used as a mixe

Set the channel selector and the sweep generator to Insert markers of channel 2 picture carrier and sound car
rier， 55.25 mc ．and 59.75 mc ． ，
Adjust antenna T6，r－f amplifier plate L29 and mixer L30 adjustments for a symmetrical curve with maximum gain at the center of the pass band．The curves will have a deep
valley because of no crystal loading and nonlinear detector valley because of no crystal loading and nonlinear detector
shown in Figure 20．The proper curve shape is shown in ton of adjustments．）If the bandwidth is out of tolerance，it can sually be corrected by redressing the coupling capacitor of occurs when the capacitor is centered in the insert chamber．


Figure 20－KRK12B VHF Insert Responses
Repeat the above steps for all VHF channels adjusting the appropriate antenna，r－f amplifier plate and mixer slugs for a symmetric
pass band．
Turn off the sweep generator
Remove the oscilloscope and preamplifier if used，from test
Turn the AGC control fully clockwise and remove the clip Connect the potentiometer arm of one of the bics supplies to he AGC terminal on the tuner and ground the battery positive erminal to the tuner case．Adjust the bias potentiometer to
produce－ 3.5 volts of bias，as measured by the＂Voltohmyst＂ $t$ the AGC terminal on the tuner．

Connect the potentiometer arm of the second bias supply to the junction R133 and C133B，and ground the positive bettery erminal．Adjust the bias potentiometer to produce -5 volts of
i－f bias as indicated on the＂VoltOhmyst＂at the junction point．
Connect the oscilloscope to pin 9 of Vllo．Use 3 to 5 volts Connect the oscilloscope to pin 9 of
peak－to－peak output on the oscilloscope．
Turn the adapter switch on to apply plate voltage to the
Turn the channel selector to channel 13
Set the fine tuning control to the center of its range
Adjust the oscillator slug L22 to proper frequency， 251 mc ． This may be done in several ways．The easiest way and the use the signal generator as a heterodyne frequency meter and use the signal generator as a heterodyne frequency meter and
beat the oncillator against the signal generator．To do this， tune the signal generator to 257 mc．with crystal accuracy． Insert one end of a piece of insulated wire into the tuner
through either of the two holes next to the oscillator tube on the hrough either of the two holes nex．to the ossillatar tube on the
right front top corner of the tuner．Be careful that the wire does not touch any of the tuned circuits as it may cause the fre． quency of the oscillator to shift．Connect the other end of the
wire to the＂r－f in＂terminal of the signal generator．Adjust LL2
oscillator slug to obtain an audio beat with the signal generator．

Turn on the sweep generator and set to channel 13．Adjust
Tl for maximum gain on the oscilloscope．Adjust mixer tank Tl for maximum gain on the oscilloscope．Adjust mixer tank circuit L21 for maximum gain and flat－topped curve．Recheck response．Maximum gain and flat－topped response should
be obtained simultaneously．
Adjust the oscillator to frequency on all VHF channels by
witching the receiver and signal generator to each VHF witching the receiver and signal generator to each VHF
channel and adjusting the appropriate oscillator slug to chanel and adausing the appropriate oscillatior slug to mixer slug where necessary to obtain maximum gain and roper curve shape as explained above．
Adjust the tunable I．F Trap C16－L7．To do this connect the ignal generator to the fixed I．F Trap C2．L2 at the end oppo． site the antenna terminal plug．Set the signal generator to 43.5
mc．and adjust the output of the signal generator to obtain

Remove the signal generator and the oscilloscope．


Figure 21－KRK12B Tuner Adjustments

TUNER UHF ALIGNMENT．－To align the UHF inserts：
Turn off the adapter switch，removing plate voltage from te oscillator．
Ground the AGC bias at the tuner terminal board using a
clip lead to insure that the bias will remain constant． Connect the oscilloscope，through the preamplifier if needed Connect the oscilloscope，through the preamplifier if needed
with oscilloscope used，to test point TP1． Connect the UHF sweep generator to the antenna terminal
Use a 10 DB attenuator pad to assure proper alignment． Connect the UHF signal generator loosely to the antenna erminals．
Set the channel selector to the desired position and the sweep
used．

Insert markers of the picture carrier and sound carrier frequenci．
（see Table on page 8）．

Adjust the UHF antenna，link coupling and mixer adjustments for a symmetrical curve，with
The respes are in Figure 22 The responses are shown in Figure 22．The o Figure 22 （c）going higher in frequency；how ，

Repeat the above steps for all UHF inser hsed，adjusting the appropriate antenna，link curve，with maximum gain，centered about the pass band．
Remove the oscilloscope and preamplifier，if Remove the oscilloscope
used，from test point TPI．
Remove the clip lead grounding the AGC bias
on the
Connect the potentiometer arm of one of the
 and ground the battery positive terminal to the
uner case．Adjust the bias potentiometer to pro unce－ 3.5 yolts of bias，as measured by the
VoltOhmyt＂at the AGC terminal．
Connect the potentiometer arm of the second and ground the positive battery terminal．Adjus and brias potentioneter to produce－5 yolts of
the bias as indicated on the＂Voltohmyst＂at the if bias as indic
unction point．
Connect the oscilloscope to pin 9 of vilo
Use to 5 volts peak－to－peak output on the
Calloscope．
Turn the adapter switch on to apply plato
oltage to the oscillator．
Turn the channel selector to the lowest UH trol to the center of its range．
Adjust the oscillator core to proper frequency． o do this，connect the VHF signal generator to lest point TPI with the shortest leads possible，
Insert a 45.75 mc ．marker from the VHF nerator．
Set the UHF sweep generator to sweap the esired channel，and observe the output on the scilloscope．If the sweep generator is not sweep necessary to readjust the sweep in order to place the 45.75
as in Figure is
Set the UHF marker generator to the picture connect to test point TP1．
Adjust the oscillator core until the markers fo 5.75 mc ．and the picture carrier co
che sweep pattern on the oscilloscope．

Adjust the mixer core for maximum gain with proper wave shap Connect the＂VoltOhmyst＂to test point TPI，using 1.5 volt Set oscillator injection adjustment to read ．l volt on the Set oscilla

Repeat the above steps for all UHF inserts adjusting the
oscillator injection control only if the reading on the＂Volt－


Figure 22－KRKi2B UHF Insert Responses

## ALIGNMENT PROCEDURE

Ohmyst" exceeds .3 volt. Adjust as necessary to read .3 volt
or less at TPL. or less at TP1.


Figure 23-KRK12B Oscillator Adjustment
RATIO DETECTOR ALIGNMENT. - In order to obtain good ratio detector alignment an AM modulated signal generator that is exceptionally free rom 4 modulation musi be the second sound if grid pin 1 of V1O2. Set the generator for $30 \% 400$ cycle modulation

As an alternate source of signal, the RCA WR39B or WR39C calibrator may be employed. If used, connect it to the grid of the 4 th pix i-f amplifier, pin 1 , V109. Set the frequency of the calibrator to 45.75 (pix carrier) and modulate with 4.5 me. crystal. Also amplified through the sound i-f amplifier.

Connect the "VoltOhmyst" to the junction of R111 and Clll
Connect the oscilloscope across the speaker voice coil and Connect the oscilloscope across the speake
furn the volume control for maximum output.

Tune the ratio detector primary, T 102 top core for maximum C output on the "VoltOhmyst" Adjust the signal level from the signal generator for -10 volts on the "VoltOhmyst" when tinally peaked. This is approximately the operating level of the ratio detector for average signals.
Connect the "VoltOhmyst" to the junction of R11O and Cl1O.
Adjust the Tl02 bottom core for zero d-c on the meter. Then, urn the core to the nearest minimum AM output on the oscilloscope.

Repeat adjustments of T102 top for maximum DC and T102 bottom for minimum output on the oscilloscope making final ajustment wit "Ve 4.5 me. input level adusted produce 1


Figure 25-Ratio De Response

Connect the "VoltOhmyst" to the junction of R11O and Cl1O $\pm 1.5$ volts adjust Rlos by turning it in until zero d.c obtained. Headjust the T1O2 bottom core for minimum output on the oscilloscope. Repeat adjustments of R108 and T102 bottom core until the voltage of R11O and C11O is less than $\pm 1.5$ volts when T102 bottom core is set for minimum output on the oscilloscope.
Connect the "VoltOhmyst" to the junction of RIll and Cll and repeak 102 top core for maximum d-c on the meter and
Repeat the adjustments in the above two paragraphs until T102 top core is set for maximum d-c at the junction of Rlll and C11l and the T102 bottom core is set for minimum indication on the oscilloscope.

SOUND I-F ALIGNMENT.-Connect the sweep gener tor to the first sound 1. of 4.5 mc .
Insert a 4.5 mc. marker signal from the signal generato nto the first sound i-f grid. With the WR39B or WR39C cal brators the 4.5 mc . crystal signal may be obtained at the Rout terminal by turning the variable osc. switch off, the cal
Connect the oscilloscope in series with a 10,000 ohm resistor to terminal A of T101
Adjust Tlol top and bottom cores for maximum gain and symmetry about the 4.5 mc . marker on the i.f response. Th
pattern obtained should be similar to that shown in Figure 24

The output level from the sweep should be set to produce approximately 2.0 volt peak-to-peak at terminal $A$ of $T 10$ when the final touches on the above adjustment are made. the specified values otherwise the response curve will be broad ened, permitting slight misadjustment to pass unnoticed and possibly causing distortion on weak signals.
Connect the oscilloscope to the junction of R110 and C11O and check the linearity of the response. The
should be similar to that shown in Figure 25 .

SOUND TAKE-OFF ALIGNMENT.-Connect the 4.5 mc. generator in series with a 1,000 ohm resistor to terminal mc. generator in series with a 1,000 ohm resistor to terminal
"C" of TIIO. The input signal should be approximately 0.5 volt.

Short the fourth pix i-f grid to ground, pin 1, V109, to prevent oise from masking the output indication.
As an alternate source of signal the RCA WR39B or WR39C calibrator may be used. In such a case, disregard the above two paragraphs. Connect calibrator across link
$\mathrm{A}, \mathrm{B}$, and modulate 45.75 with 4.5 mc. crystal.
Connect the crystal diode probe of a "VoltOhmyst" to the plate of the video amplifier, pin 6 of V110.
Adjust the core of T110 for minimum output on the meter Remove the short from pin 1 Vlo9 to ground, if used.

HORIZONTAL OSCILLATOR ADJUSTMENT.-No mally the adjustment of the horizontal oscillator is no considered to be a part of the alignment procedure, but since the oscillator waveform adjustment may require the use of an oscilloscope, it can not be done conveniently in the field should not require readjustment in the field. However, the wavelorm adjustment should be checked whenever the aceiver is aligned or whenever the horizontal oscillato operation is imprope

## ALIGNMENT PROCEDURE

Horizontal Frequency Adjustment. - Tune in a station and sync the picture. If the picture cannot be synchronized with the horizontal hold control R210, then adjust the T114 frequency core on the rear apron until the picture will
synchronize. If the picture still will not sync, turn the Tll4 waveform adjustment core (under the chassis) out of the coil several turns from its original position and readjust the T1l frequency core until the picture is synchronized.
Examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive width or linearity is incorrect, adjust the horizontal drive
control C186B, the width control L109 and the linearity control
Lill until the picture is correct.
Horizontal Oscillator Waveform Adjustment.-The horizontal oscillator waveform may be adjusted by either o two methods. The method outlined in paragraph $A$ below may
be employed in the field when an oscilloscope is not available. The service shop method outlined in paragraph B below requires the use of an oscilloscope.
A. - Turn the horizontal hold control completely clockwise Place adjustment tools on both cores of T114 and be prepared to make simultaneous adjustments while watching the picture on the screen. First, turn the T114 frequency core (on the rea apron) until the picture falls out of sync and one diagona Then, turn the wavelorm adjustment core (under the chassis) into the coil while at the same time adjusting the frequenc core so as to maintain one diagonal black bar on the screen Continue this procedure until the oscillator begins to motor boat, then turn the wavetorm adjustment core out until the core until the picture is synchronized then reverse the directio of rotation of the core until the picture begins to fall out o sync with the diagonal bar sloping down to the right. Continue to turn the frequency core in the same direction. Additiona oscillator should begin to motorboat. Retouch the adjustmen of the T114 wavelorm adjustment core if necessary until this condition is obtained.
B. - Connect the low capacity probe of an oscilloscope to terminal $C$ of Tll4. Turn the horizontal hold control one quarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown in the two peaks are at the same height. During this adjustment the picture must be kept in sync by readjusting the hold control if necessary

This adjustment is very important for correct operation of the ircuit. If the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poore the stabilizing effect of the tuned circuit is reduced and drit of the oscillator becomes more serious. On the other hand, if is overstabilized, the pull-in range becomes inadequate an the broad peak can cause double triggering of the oscillator when the hold control approaches the clockwise position.
Remove the oscilloscope upon completion of this adjustment.

Figure 26-Horizontal Oscillator Waveforms



Horizontal Locking Range Adjustment.- Set the horizontal hold control to the full counterclockwise position Momentarily remove the signal by switching off channel then back. The picture may remain in sync. If so turn the T114 trequency core siighty and momentarily switch oll channel lines sloping down to the left. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before the picture pulls into sync.
If more than 3 bars are present just before the picture pulls into sync, adjust the horizontal locking range trimmer C186A counterclockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this procedure until 2 or 3 bars are present.
Turn the horizontal hold control to the maximum clockwise position. Adjust the Tll4 frequency core so that the diagonal reverse the direction of adjustment so that bar just moves of the screen leaving the picture in synchronization

SENSITIVITY CHECK. - A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound obtained t.

RESPONSE CURVES. - The response curves shown and referred to throughout the alignment procedure were laken trom a production set. Although these curves are typical, some variations can be expected.
The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflec tion polarity of the oscilloscope and the phasing of the sweep generator.
NOTE ON KRK12B TUNER ALIGNMENT.-The use of a crystal mixer in the KRK12B Tuner makes it necessary to observe the insert responses whe allowed to operate during alignment. Therefore, the response shown in Figure 20 are not a strictly true representation of the insert band pass during actual operation. When an insert is aligned, using an oscilloscope to observe the response, the curve shown in figure 20(b) will be the correct response for reference. In actual operation, the band pass will be such that the sound and picture carriers will be at the tips of the curve. The adjacent channel picture and sound carriers will exceed the limits shown in Fiqures 20(a) and 20(c).
The valley, in the center of the response curve, may var from 0 to $50 \%$ above the base line lor HF inserts. Adjust the output level ol he sweep generator to preventle be indicated by the valley rising above the $50 \%$ level, particularly on the higher VHF channels.
Oscillator injection voltage is not adjusted on VHF inserts. A check may indicate variations from .08 to .3 volts at TP but such readings should not be interpreted as an indication of trouble. On UHF channels, however, the injection voltage should be adjusted to fall within the specified limits.




VOLTAGE CHART

## ALIGNMENT DATA



Figure 27-Top Chassis Adjustments (KRK29B Tuner Sbown)


Pigure 28-Bottom Cbassis Adjustments (KRK29B Tuner Sbown

The following measurements represent two sets of conditions. In the first condition, a 5000 microvolt test pattern signal was fed into the receiver, the picture synchronized and the AGC control properly adjusted. The second condition was obtained by removing into hereceiver, he picture synchronize the receiver antenna terminals. Voltages shown are read with a type WV97A senior

| Tubb | $\begin{gathered} \text { Tube } \\ \text { Type } \end{gathered}$ | Function | OporatingCondition | E. Plate |  | E. Scraon |  | E. Cathode |  | E. Grid |  | $\left(\begin{array}{c} 1 \\ \text { Plate } \\ \text { (ma.) } \end{array}\right.$ | $\begin{array}{\|c\|c\|} \hline \begin{array}{c} \text { scroon } \\ \text { (ma.) } \end{array} \\ \hline \end{array}$ | Notes or |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volue | $\begin{array}{\|l\|l} \hline \text { Pin } \\ \text { No. } \end{array}$ | Vols | (tin | Volts | $\begin{array}{\|l\|} \hline \text { Pin } \\ \text { No. } \\ \hline \end{array}$ | Volu |  |  |  |
| $\mathbf{v}^{2}$ <br> KRK29B | 6B07A | $\begin{aligned} & \text { R-F } \\ & \text { Amplifior } \end{aligned}$ | $\begin{aligned} & \text { soog Mu V. V. } \\ & \text { Signai } \end{aligned}$ | 6 | 170 | - | - | 8 | 0.1 | 7 |  | - | - |  |
|  |  |  | Signal | 6 | 133 | - | - | 8 | 1.1 | 7 | 0 | - | - |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Amplifior } \end{aligned}$ |  | 1 | 270 | - | - | 3 | 170 | 2 | - | - | - |  |
|  |  |  | $\begin{gathered} \text { Noo } \\ \text { Signal } \end{gathered}$ | 1 | 280 | - | - | 3 | 133 | 2 | - | - | - |  |
| v2 KRK29B | 6x8 | Mixor | $\underset{\substack{\text { Signai }}}{5000 \mathrm{Mu} \text {. }}$ | 9 | 180 | 8 | 180 | 6 | 0 | 7 | $\begin{array}{\|c\|} \hline-2.40^{\circ} \\ \hline-3.0^{\circ} \\ \hline 0 \\ \hline \end{array}$ | - | - |  |
|  |  |  | $\begin{gathered} \text { Signal } \\ \text { Sig } \end{gathered}$ | 9 | 145 | 8 | 145 | 8 | 0 | 7 |  | - | - |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Oscillator } \end{aligned}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 95 | - | - | 6 | 0 | 2 | -3.8 ${ }_{-5.5}$ | - | - |  |
|  |  |  | $\begin{gathered} \text { Signal } \end{gathered}$ | 3 | 90 | - | - | 6 | 0 | 2 | -3.0.0 ${ }_{-10}$ | - | - |  |
| $\begin{array}{\|l\|} \hline \mathrm{VI} \\ \mathrm{KRK12B} \end{array}$ | 6807A | $\begin{aligned} & \text { R-F } \\ & \text { Amplifior } \end{aligned}$ | $\underset{\substack{\text { Signal }}}{5000 \mathrm{Mu} .}$ | 6 | 143 | - | - | 8 | 1.2 | 7 | 0 | - | - |  |
|  |  |  | Signol | 6 | 138 | - | - | 8 | 1.0 | 7 | 0 | - | - |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Amplifior } \end{aligned}$ | $\underset{\text { Signai }}{5000} \mathbf{~ M u . ~}$ | 1 | 280 | - | - | 3 | 143 | 2 | 97 | - | - |  |
|  |  |  | $\begin{gathered} \text { Signol } \\ \text { Sign } \end{gathered}$ | 1 | 250 | - | - | 3 | 137 | 2 | 97 | - | - |  |
| v2 <br> KRK12B | 6AF4 | $\begin{aligned} & \text { R-F } \\ & \text { Oscillator } \end{aligned}$ | $\begin{aligned} & 5000 \text { Mu. V. } \\ & \text { Signal } \end{aligned}$ | 187 | 78 | - | - | 5 | 0 | 286 | -8 | - | - |  |
|  |  |  | $\stackrel{\text { No }}{\text { No }}$ | 187 | 75 | - | - | 5 | 0 | 2\&6 | -8 | - | - |  |
|  | 6BQ7A | $\frac{\mathrm{I} \cdot \mathbf{F}}{\mathrm{Fmplifier}}$ | $\underset{\substack{5000 \mathrm{Mu} \\ \text { Signal } \\ \hline}}{ }$ | 6 | 270 | - | - | 8 | 148 | 7 | 103 | - | - |  |
|  |  |  | $\mathrm{sig}_{\text {ignal }}^{\mathrm{N} o}$ | 6 | 260 | - | - | 8 | 142 | 7 | 99 | - | - |  |
|  |  | $\begin{aligned} & \text { I-F } \\ & \text { Arnplifier } \end{aligned}$ | $\begin{gathered} 5000 \mathrm{Mu.V} \\ \text { Signai } \end{gathered}$ | 1 | 148 | - | - | 3 | 1.4 | 2 | 0 | - | - |  |
|  |  |  | Signal | 1 | 143 | - | - | 3 | 1.2 | 2 | 0 | - | - |  |
| v4 KRK12B | 654 | Control | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | 9 | 270 | - | - | 2 | 94 | 6 | ${ }^{68}$ | - | - | Depends on adjustmen of R6 |
|  |  |  | $\stackrel{\text { No }}{\text { No }}$ | 9 | 260 | - | - | 2 | 90 | 6 | ${ }^{65}$ | - | - |  |
| v101 | 6AU6 | let SoundI-FAmp. | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | 5 | 136 | 6 | 136 | 7 | 0.78 | 1 | -0.4 | 6.2 | 3.1 |  |
|  |  |  | $\begin{gathered} \text { No } \\ \text { Signal } \end{gathered}$ | 5 | 131 | 6 | 131 | 7 | 0.73 | 1 | -1.2 | 6.1 | 3.0 |  |
| v102 | baub | 2nd Sound$1-F$ Amp. | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signai } \end{gathered}$ | 5 | 138 | 6 | 60 | 7 | 0 | 1 | -10 | 2.9 | 1.2 |  |
|  |  |  | $\begin{gathered} \text { No } \\ \text { Signal } \end{gathered}$ | 5 | 134 | 6 | ${ }_{6}$ | 7 | 0 | 1 | -5 | 2.1 | 1.0 |  |
| v103 | 8ALS | Ratio Detector | $\underset{\substack{\text { Signal }}}{5000 \mathrm{Mu} .}$ | 2 | $-\frac{9.2}{-9.2}$ | - | - | 5 <br> 1 | $\begin{aligned} & 1.0 \\ & 9.2 \end{aligned}$ | - | - | - | - |  |
|  |  |  | $\begin{aligned} & \text { Signal } \end{aligned}$ | $\frac{2}{7}$ | ${ }^{-8.0}$ | - | - | 5 <br> 1 | ${ }^{\text {8.0 }}$ | - | - | - | - |  |
| v104 | 6AV8 | Iat AudioAmplifior | $5000 \mathrm{Mu} . \mathrm{V} .$ | 7 | 90 | - | - | 2 | 0 | 1 | -0.7 | 0.65 | - | Atmin. |
|  |  |  | $\begin{array}{\|c\|c\|c\|} \hline \text { Signal } \end{array}$ | 7 | 88 | - | - | 2 | 0 | 1 | -0.7 | 0.65 | - |  |
| v104 | 6AvE | $\begin{aligned} & \text { R-F Bias } \\ & \text { Clamp } \end{aligned}$ | $\begin{gathered} 5000 \mathrm{Mu} \mathbf{~ V} \\ \text { Signal } \end{gathered}$ | 5-6 | -3.0 | - | - | 2 | 0 | - | - | - | - |  |
|  |  |  | Signal | 5.6 | 0.3 | - | - | 2 | 0 | - | - | - | - |  |
| v10s | 8 805 | $\begin{aligned} & \text { Audio } \\ & \text { Output } \end{aligned}$ | $\underset{\text { Signail }^{5000} \mathbf{M u} .}{ }$ | 3 | 311 | 6 | 227 | 2 | 12.6 | 7 | 0 | 30.4 | 2.0 | $\begin{gathered} \text { At min. } \\ \text { Volum. } \end{gathered}$ |
|  |  |  | $\begin{gathered} \text { Signal } \end{gathered}$ | 5 | 308 | 6 | 216 | 2 | 11.7 | 7 | 0 | 28.2 | 1.8 |  |
| v108 | baub | $\begin{aligned} & \text { lst Pix. I-F } \\ & \text { Amplifior } \end{aligned}$ | $\underset{\text { Signal }}{5000 \mathrm{Mu} .}$ | 5 | 160 | 6 | 215 | 7 | 0.17 | 1 | -6.6 | 1.4 | . 4 |  |
|  |  |  | $\begin{gathered} \text { No } \\ \text { signal } \end{gathered}$ | 5 | 85 | 6 | 115 | 7 | 0.98 | 1 | 0 | 6.5 | 3.3 |  |
| v107 | 6Cb6 | 2nd Pix. I-F Amplifior | $\bar{F} \underset{\substack{5000 \text { Mu. } \\ \text { Signal }}}{ }$ | 5 | 227 | 8 | 225 | 2 | 0.1 | 1 | -6.6 | 1.5 | . 25 |  |
|  |  |  | $\mathrm{S}_{\text {Signal }}^{\text {No }}$ | 5 | 200 | 6 | 115 | 2 | 0.8 | 1 | 0 | 10.9 | 3.3 |  |



OJohn F. Rider

## CIRCUIT SCHEMATIC DIAGRAM KCS77D, KCS77H



CHASSIS KCS77C，KCS77D，KCS77F，KCS77H
VOLTAGE CHART
REPLACEMENT PARTS

| VOLTAGE CHART |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ${ }_{\substack{\text { Tubo } \\ \text { No．}}}$ | ${ }_{\text {Tupb }}^{\text {Tube }}$ | Function | Oporaing | E．Plate |  | E．Scroon |  | E．Cathode |  | E．Grid |  | $\begin{gathered} \text { platot } \\ \text { (mana.) } \end{gathered}$ |  | ${ }_{\text {M }}^{\text {Noatuesoments }}$ |
|  |  |  |  | Pin， | Vots | Pin． | Volts | （ Pin． | Volts | Ping | Volts |  |  |  |
| v108 | ${ }_{6}$ св6 |  |  | 5 | 138 | 6 | 132 | 2 | 1.02 | 1 | 0 | 11.4 | 3.5 |  |
|  |  |  | Sisonal | 5 | 134 | 6 | 126 | 2 | ． 98 | 1 | 0 | 10.4 | 3.1 |  |
| v109 | ${ }^{6}$ cb6 | ${ }_{\substack{\text { ath Pix } \\ \text { Amplisior } \\ \text { I－F }}}$ | $\begin{gathered} 5000 \mathrm{Mu.} \mathrm{~V} . \\ \text { Signal } \end{gathered}$ | 5 | 168 | 6 | 165 | 2 | 2.32 | 1 | 。 | 8.85 | 2.2 |  |
|  |  |  | $\mathrm{S}_{\text {Simol }}^{\text {No }}$ | 5 | 156 | 6 | 161 | 2 | 2.07 | 1 | 。 | 8.6 | 2.1 |  |
| v110 | 6cL6 |  |  | 6 | 130 | 3．8 | 159 | 1 | ． 84 | 2.9 | －－5．0 | 22.5 | ${ }_{5} 5$ |  |
|  |  |  | $\mathrm{sigo}_{\text {Soral }}^{\text {Nom }}$ | 6 | 130 | 3－8 | 80 | 1 | 0.7 | 2.9 | －-2.0 | 15.0 | 4.0 |  |
| vil1a | ${ }^{12 A U T}$ | ${ }_{\text {Rectitior }}^{\text {Racc }}$ |  | 1 | －30 | － | － | 3 | 142 | － | － | 0 | － |  |
|  |  |  | $\mathrm{Simog}_{\text {Sol }}^{\text {Nol }}$ | 1 | 0 | － | － | 3 | 137 | － | － | 0 | － |  |
| vill | 12AU7 | Sorts Sync． | $\begin{gathered} 5000 \mathrm{Mu}, \mathrm{~V} \\ \text { Signal } \end{gathered}$ | 6 | 110 | － | － | 8 | 0 | 7 | －42 | ． 25 | － | ＂Dependeon noide |
|  |  |  | $\underset{\text { Sigor }}{\text { Nor }}$ | 6 | 45 | － | － | － | 。 | 7 | －${ }^{-5}$ | ． 35 | － |  |
| v122 | 12AU7 | ${ }_{\text {Horer }}^{\text {Hopranarar }}$ |  | 1 | 323 | － | － | 3 | 192 | 2 | 116 | ． 5 | － |  |
|  |  |  | Sisornal | 1 | 320 | － | － | 3 | 132 | 2 | 12 | ． 5 | － |  |
| v123 | 12AU7 | ${ }_{\substack{\text { Sma }}}^{\text {Smplifitior }}$ |  | 6 | ${ }^{78}$ | － | － | 8 | 0 | 7 | －3．5 | 6.2 | － |  |
|  |  |  | Sigo | 6 | ${ }^{78}$ | － | － | ： | 0 | 7 | －1．6 | 6.2 | － |  |
| vi13A | 6snyct | Vort．Sync． | $\mathrm{sucon}_{\mathrm{Signai}}^{\mathrm{Mu}} \mathrm{~V}$ | 2 | 140 | － | － | 3 | 19.2 | 1 | －． 35 | 0.1 | ＿ |  |
|  |  |  | $\mathrm{S}_{\text {Soral }}^{\text {Nol }}$ | 2 | 135 | － | － | 3 | 17.3 | 1 | 0 | ＜0．1 | － |  |
| v133 | 6snzct |  |  | 5 | 203 | － | － | ${ }_{6}$ | 0 | 4 | －56 | ． 2 | － |  |
|  |  |  | $\mathrm{Si}_{\text {Signal }}^{\text {No }}$ | 5 | 208 | － | － | 6 | 0 | 4 | －55 | ． 2 | － |  |
| v114 | 6 605 | Vortical |  | 5 | 300 | 6 | 314 | 2 | 29.2 | 1 | 0 | 23.5 | 1.5 |  |
|  |  |  | $\mathrm{Si}_{\text {Signal }}^{\text {No }}$ | 5 | 297 | 6 | 31 | 2 | 29 | 1 | 0 | 23.5 | 1.5 |  |
| vils | 6SNTGT | Horizontar | $\begin{gathered} 5000 \mathrm{Mu}, \mathrm{~V} . \\ \text { Signal } \end{gathered}$ | 2 | 188 | － | － | 3 | －9 | 1 | ${ }^{-28}$ | 0.37 | － |  |
|  |  |  | ${ }_{\text {Sigor }}^{\text {Nor }}$ | 2 | 0 | － | － | 3 | 0 | 1 | 0 | 0 | － |  |
|  |  | Horizortal |  | 5 | 184 | － | － | 6 | 0 | 4 | －72 | 2.5 | － |  |
|  |  |  | Sional | 5 | 182 | － | － | 6 | 0 | 4 | $-73$ | 2.5 | － |  |
| $\begin{array}{\|l\|l\|} \substack{\mathrm{v} 126} \end{array}$ | 68066T | HorizontalOutput（2 tubes） | ${ }_{\substack{\text { a }}}^{\substack{\text { soon Mui } \\ \text { Signai }}}$ | Cap | ． | 4 | 176 | 8 | 15 | 5 | －21 | 165 | 12. | $\begin{gathered} \text { Siliag } \\ \text { Sutage } \\ \text { Prosent } \end{gathered}$ |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | $\mathrm{Cap}^{\text {a }}$ | ． | 4 | 176 | 8 | 15 | 5 | －21 | 165 | 12.4 |  |
| v117 | ${ }_{\substack{183 G 7 \\ 18018}}$ | Reotitior |  | Cap | － | － | － | 287 | 17，500 | － | － | － | ＿ | $\begin{gathered} \text { High } \\ \text { Hitas. } \\ \text { Protaco } \\ \hline \end{gathered}$ |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | Cap | ． | － | － | 287 | 17，500 | － | － | － | － |  |
| V118 | ${ }^{6 w 4 G T}$ | Damporr | $\begin{gathered} 5000 \mathrm{Mu}, \mathrm{~V} . \\ \text { Signal } \end{gathered}$ | 5 | 298 | － | － | 3 | ． | － | － | － | － |  |
|  |  |  | ${ }_{\text {Signal }}^{\text {Sol }}$ | 5 | 295 | － | － | 3 | － | － | － | － | － |  |
| v120 | ${ }^{27 M P 4}$ | Kinoscope | $\underbrace{5000 \mathrm{Mu}, \mathrm{V} \text { S．}}$ | Con＊ | 16，000 | 10 | 525 | 11 | 140 | 2 | 82 | － | － |  |
|  |  |  | $\mathrm{sim}_{\text {Sornal }}^{\text {Nol }}$ | Cono | 18，400 | 10 | 520 | 11 | 132 | 2 | 76 | － | － |  |
| ${ }_{\text {vil2 }}^{\text {vi2 }}$ | ${ }^{\text {suag }}$ | Rectifiors |  | 486 | 341 | － | － | 288 | 364 | － | － | ${ }^{175}$ | － | $\stackrel{\text { Por }}{\text { Tub．}}$ |
|  |  |  | $\mathrm{S}_{\text {Signal }}^{\text {No }}$ | 486 | 338 | － | － | 288 | 360 | － | － | ${ }^{1} 150$ | － |  |
| v123 | ${ }_{6} 626$ |  | $\underbrace{500 \mathrm{Mu}, \mathrm{v} \text { V．}}$ | 6 | 190 | 8 | 165 | 2at | 4.4 | － | － | 20.5 | 4.25 |  |
|  |  |  | ${ }_{\text {Signal }}^{\text {Nol }}$ | ${ }_{6}$ | 185 | 8 | 157 | 1 | 4.1 | － | － | 18.4 | 4.2 |  |
| v124 | ${ }^{\text {6als }}$ | ${ }_{\text {Agitation }}^{\text {Amompor }}$ |  | 2 | 142 | － | － | 125 | 142 | － | － | 18.4 | 4.2 |  |
|  |  |  | $\mathrm{singol}_{\text {Signal }}^{\text {Not }}$ | 2 | 137 | － | － | 125 | 137 | － | － | － | － |  |


| STock |
| :--- | :--- |
| STock |
| STo |
| No． |


| stock | PART DESCRIPTION |
| :---: | :---: |
| ${ }^{7212}$ | mmf．．．$+0.25 \mathrm{mmf}$.500 volts $\mathrm{DC}\left(\mathrm{C}_{1} 5\right.$ ） |
| ${ }_{7}^{77488}$ | $5 \mathrm{mmff}. \pm .5 \mathrm{mmf}$ ．， 500 volts DC（C34．C36．C38，C41） |
| 71924 | Capacitor－Hixad cioramic，non－insulatod，Tomp． |
|  |  |
| ${ }_{77769}^{7769}$ |  |
| $\begin{aligned} & 77689 \\ & 71750 \\ & 7150 \end{aligned}$ |  |
| $\begin{gathered} 71500 \\ 787047 \\ \hline \end{gathered}$ |  |
| 77828 <br> 77634 <br> 18 |  |
|  |  |
| ${ }_{78224}^{7732}$ | Coil－Oscililator hoater coil $(\mathrm{LL4})$ |
|  | Coil－Osill ator plate coil（LL1） |
| ${ }_{\substack{77892 \\ 77895}}$ | Coiller． |
| 7799 |  |
| ${ }_{\substack{\text { S03047 }}}$ | S7 |
|  |  |
|  | 隹 |
|  | 220，00 ohms．${ }^{2}$ |
|  |  |
|  |  |
|  |  |
| $77610$ | Trantotimer－rimary li．．．ink transtormer completo |
| ${ }_{77585}^{7768}$ |  Washer－c＇washer for req＇d）or for link spring |
|  |  |
| ${ }^{78238}$ | Cap－Tube connoctor cap |
| $\underset{75488}{7686}$ |  |
|  |  |
|  |  |
| ${ }_{76 \text { 76575 }}$ | mmis， 25000 voitis |
|  |  |
|  |  |
| ${ }_{73473}^{7793}$ |  |
| 76470 |  |
| ${ }_{738977}^{7390}$ |  |
|  |  |
|  |  |
|  | Capacitior－Fixiod，coramic，non－inctulatod，Tomp．coof． |
|  |  <br>  |
|  |  |
|  |  |
| ${ }^{76674}$ |  |
| （ickick |  |
|  |  |
|  | Capacitor－Mica |
| $\xrightarrow{71896}$ |  |
|  |  |

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REPLACEMENT PARTS (Continued)


 chot-Tubo mockot, miniature, 7 pin, mouldod, saddle Socket-Tube socket, miniature, 7 pin, moulded, saddle Socket-Tube zocket, miniature. 7 pin, wafor for V124,
Sockot-Tube socket, octal, wafor for V113. V116, V121, Sockot-Tube sockot, octal, wafor for V115 Uupport-Bakelite support only-part of hi-voltage shield Wiitch-Dofinition switch (S104)
Switch-Phono-tono switch (S101)
Trorminal-Screw. type grounding torminal
Transform or- 1 st piz I . . Grid tranaform
Trorminal-Screw. type grounding torminal
Transform or- 1 st piz I . . Grid tranaform


Transformor- list pix I.F. plate transformer complote
with odjustable cores (Ti05, C131, C132, R130)
Transformor- list pix I.F. plate transformer complote
with odjustable cores (Ti05, C131, C132, R130)




Transformor-Hi-vollage transformor (Part of T115)
Transformor-Horizontal oscillator tranformer
Transformor-Hi-vollage transformor (Part of T115)
Transformor-Horizontal oscillator tranformer














SPEAKER ASSEMBLIES
SPEAKER ASSEMBLIES
$971490-4 \mathrm{~W}$
RL105E1
$971490-4 \mathrm{~W}$
RL105E1
RL105E1
RMA-274
RL105E1
RMA-274
75024
78872
Cone-Cone and voice coil ( 3.2 ohms)
Spoakor-8" P.M.
Cone-Cone and voice coil ( 3.2 ohms)
Spoakor-8" P.M.
Spoakor-
coil ( 3.2 hmms )
Spoakor-
coil ( 3.2 hmms )
NOTE:-If stamping on spoaker in instruments doos
NOTE:-If stamping on spoaker in instruments doos
parts by roforring to Model number of instrumont, num.
parts by roforring to Model number of instrumont, num.
ber ntamp
requirod.
ber ntamp
requirod.
miscellaneous
miscellaneous
78624
78547
76184
7844
77748
78532
7842
784
7
788443
71792
77755
x3349
x3350
$\mathbf{x} 3371$
77870

CHASSIS KCS77C, KCS77D, KCS77F, KCS77H

## GENERAL DESCRIPTION

ELECTRICAL AND MECHANICAL SPECIFICATIONS (Continued)

$$
\begin{aligned}
& \text { Models 21-D-395 and 21-D-395U are deluxe "21 inch" } \\
& \text { television-AM-FM radio phonograph combinations. Model three speed record changer is provided to play } 331 / 3,45 \\
& \text { 21-D-395 features full } 12 \text { channel VHF coverage. Model } 78 \text { RPM records. } \\
& \text { 21-D- } 395 \text { features full } 12 \text { channel VHF coverage plus any } 4 \\
& \text { UHF channels desired. }
\end{aligned}
$$

## Electrical and mechanical specifications

PICTURE SI2E. 227 square inches on a 21AP4 Kinescope TELEVISION R-F FREQUENCY RANGE

## rCA TUBE COMPLEMENT

| D-395 |  |
| :---: | :---: |
| All 12 VHF channels, 54 mc . to $88 \mathrm{mc} ., 174 \mathrm{mc}$. to 216 mc . Model 21-D-395U |  |
| Any of 70 UHF channels | 470 mc. to 890 mc. |
| Any of 12 VHF channels, 54 mc . to $88 \mathrm{mc} ., 174 \mathrm{mc}$. to 216 mc . (Any desired combination of 16 UHF and/or VHF channels |  |
| may be used.) |  |
| INTERMEDIATE FREQUENCIES |  |
| Picture I-F Carrier Frequency | 45.75 m |
| Sound I-F Carrier Frequency | 41.25 |
| POWER RATING | 395 |
| AUDIO POWER OUTPUT RATING | G . . . . 10 watts |
| chassis designations |  |
| Television Chassis | Model 21-D.395-KCS81H |
|  | Model 21-D.395U-KCS81K |
| Radio Chassis | RC1111A |
| Audio Chassis | RSI4IE |
| Record Changer | 930409-5 |
| Refer to Service Data 930409 for record changer information |  |
| RCA TUBE COMPLEMENT |  |
| Tube Used | Function |
| Tuner KRK29-Model 21-D-395 |  |
| (1) RCA 6BQ7A | R-F Amplifier |
| (2) RCA $6 \times 8$ | . R-F Oscillator and Mixer |
| Tuner KRK12B-Model 21-D-395U |  |
| (1) RCA 6BQ7A | R-F Amplifier (VHF only) |
| (2) RCA 6AF4 | R-F Oscillator |
| (3) RCA 6 BQ 7 A | I-F Amplifier |
| (4) RCA 6S4 | Voltage Control |

Tube Used Television Chassis
(1) RCA GAU6
(1) RCA 6AU6 (21) RCA 21 AP4

Function
All Models (2) RCA 6CB6................nd Picture I-F Amplifier I-F Amplifier
(3) RCA 6CB6 (4) RCA 6CB6 (5) RCA бCL6 $\ldots \ldots$, 4th Picture I-F Amplifier (6) RCA 6AU6 (7) RCA 6AU6 (8) RCA 6A45 ...........2nd Sound I-F Amplifier

 (12) RCA 12AU7
(13) RCA 12AU7 Horiz. Sync. Sync. Sep. and Sync. Ampl (13) RCA 12AU7. Horiz. Sync. Sep. and Sync. Ampl.
(14) RCA 6 SN7GT Vert. Sync. Amplifier and Vert. Swe Jp Osc. (14) RCA 6SN7GT Vert. Sync. Amplifier and Vert. Swe Jp Osc.
(15) RCA 6AQS....................ical Sweep Output (16) RCA 6SN7GT . Horizontal Sweep Oscillator and Control (17)-RCA 6CD6G ....................izizontal Sweep Output

(20) RCA SU4G (2 tubes) .............................tifiers

| Radio Chassis RClll1a |  |  |
| :---: | :---: | :---: |
| (1) RCA 6 CB 6 |  | R-F Amplifier |
| (2) RCA 6 J6. | Mixer |  |
| (3) RCA GBA6 |  | I-F Amplifier |
| (4) RCA 6AU6 |  | F-M Driver |
| (5) RCA 6ALS |  | Ratio Detector |
| (6) RCA 6AV6 | AM Detector AVC and | Audio Amplifier |
|  | Audio Chassis RSI41E |  |
| (1) RCA 6C4 |  | Phase Inverter |
| (2) RCA 6V6GT | (2 tubes) | Audio Output |
| (3) RCA 5Y3GT |  | Rectifie |



Models 21-D.395. 21-D.395U
"Bainbridge"
Mabogany


Figure 2-Yoke and Focus Magnet Adjustments
radio tuning range
Broadcast
Frequency Modulation Intermediate Frequency-AM
Intermediate Frequency-FM
antenna input impedance

## Model 21-D-395

Choice: 300 ohms balanced or 72 ohms unbalanced. Model 21-D-395U
UHF-300 ohms balanced.
VHF-300 ohms balanced.
Video response
To 4 mc .
FOCUS
SWEEP DEFLECTION
SCANNING
horizontal scanning frequency
VERTICAL SCANNING FREQUENCY ....... 60 cps
FRAME FREQUENCY (Picture Repetition Rate) ..... 30 cps


Figure 3-Rear Chassis Adjustments


Figure 4-KRK29 R-F Ossillator Adjustments
operating controls (front panel)
. $540-1,600 \mathrm{kc}$. $.88-108 \mathrm{mc}$. .455 kc . 10.7 mc .

Fine Tuning
Brightness
Sound Volume and On-Off Switch

Picture Horizontal Hold.
Picture Vertical Hold
Picture
Tone Switch
Radio Tuning
NON-OPERATING CONTROLS
Horizontal Centering
Vertical Centering
AGC
Height ............
Vertical Linearity Horizontal Drive Horizontal Oscillator Freque Horizontal Oscillator Wavefo Width Link


Ion Trap Magne
Deflection Coil
Focus Magnet


Figure 5-KRK12B Oscillator Adjustment AGC THRESHOLD CONTROL-The AGC Threshold Control R180 is adjusted at the factory and normally should not require readjustment in the field.
To check the adjustment of the AGC Threshold Control, tune
in a strong signal and sync the picture. Momentarily in a strong signal and sync the picture. Momentarily remove
the signal by switching off channel and then back. If the picture reappears immediately, the receiver 18 not over-load ing due to improper setting of R180. If the picture requires an appreciable portion of a second to reappear, or bende Turn R180 fully counter-clockwise. Th
lightly. This should be disregard The raster may be ben until there is a very, very slight bend or Turn R180 clockwise picture. Then turn R180 counter-clockwise just sufficiently to picture. Then turn R R 180 counter-clock
remove this bend or change of bend.
If the signal is weak, the above method may not work as it may be impossible to get the picture to bend. In this case,
turn R180 clockwise until the snow in the picture becomea turn
more pronounced, then counter-clockwise until the best signal more pronounced, then co
to noise ratio is obtained.
The AGC control adjustment should be made on a strong signal if possible. It the control is set too far clockwise on weak signal, then the receiver may overload when $\alpha$ strong
sianal is received.


## TELEVISION ALIGNMENT PROCEDURE

TEST EQUIPMENT.-To properly service the television chassis of these receivers, it is re
VHF Sweep Generator meting the following require ments:
(a) Fr
uency Ranges
35 to $90 \mathrm{mc} .1 \mathrm{mc}$. to 12 mc . sweep width
$17010225 \mathrm{mc}$.12 mc sweep width
(b) Output adiustable with at least 11 volt maximum


VHF Signal Generat
with crystal accuracy:
(a) Intermediate frequencies

Radio frequencies
$\begin{array}{cccc}\text { Channel } & \begin{array}{c}\text { Picture } \\ \text { Carrier }\end{array} & \begin{array}{c}\text { Sound } \\ \text { Crarrier }\end{array} & \begin{array}{c}\text { Receiver } \\ \text { R-F Osc. }\end{array} \\ \text { Freq. Mc. }\end{array} \quad \begin{gathered}\text { Freq. Mc. }\end{gathered}$
(c) Output of these ranges should be adjustable and at least VHF Heterodyne Frequency Meter with crystal calibrator
if the signal generator is not crystal controled. UHF Sweep Generator with a frequency range of 470 m
890 mc RCA Types 40 A or 41 A or their equivalent. UHF Signal Generator to provide the following trequencies UHF Signal Generator to provide the fillowing
with crystal accuracy if RCA Type 41A is used.
Cathode Ray Oscilloscope.-An oscilloscope with a sensiCathode Ray Osciloscope.-An oscilloscope wiln a menillivolt perinch is required. A suitable pre-ampli
fier may be employed with oscilloscopes of lesser sensitivity Electronic Voltmeter--A voltmeter with a 1.5 volt DC scale Electronic Voltmeter.-A voltmeter with a 1.5 volt DC
is required. RCA Senior "Voltohm yst" or equivalent.
DC Milliammeter.--A milliammeter with a range of $0-5$
millicmperes full scale. milliamperes full scale
Adapter Socket.-An adapter socket is required to mete
A ${ }^{\text {An }}$ cathode current of the 6 S 4 voltage control tube of the the cathode current of the 654 voltage control tube of
KRK12B Tuner. Wiring of adapter is shown in Figure 9 .
$=2$
MILLIAMMETTER
(5) ${ }_{-}^{\text {O.50MA }}$ switch

Figure 9-KRK12B Voltage Control Adapter
KRK29 ANTENNA MATCHING UNIT ALIGNMENT.-The KRK2 ANTENNA MATCHING UNIT ALLGNMENT.-The
antenna matching unit is acurately aligned at the factory
Adjustment of this unit should not be attempted in the cusAdjustment of this unit should not be attempted in the cuss
tomer's home since even slight misalignment may cause tomer's home since even slight misclignment may cause
serious attenuation of the signal, especially on channel 2. The r.f unit is aligned with a particular antenna matching trans-
former in place. If for any reason, a new antenna matching former in place. If for any reason, a new antenna match
transiormer is installed, the $\mathrm{r}-\mathrm{f}$ unit should be realigned. transiormer is installed, the r -1 unit should be realigned.
The F-M trap which is mounted in the ontenna matching
unit may be adjusted without adversely aftecting the align unit may be adj
ment of the unit.
mo align the antenna matching unit disconnect the lead
Trom the F M trap LS to the channel selector switch Sl I-E. With a short jumper, connect the output of the matching unit through a $1,000 \mathrm{mmf}$ capacitor to the grid of the second
pix $i$ i- amplifier, pin 1 of $V 107$. Replace the
adjustments.
adjusiments.
Remove the first pix i-f amplifier tube V106.
Connect the positive terminal of $a$ bias
Connect the positive terminal of a bias box to the chassi
and the potentiometer arm to the junction of R133 and CC133B
Sit and the potentiometer arm to the junction of R133 and C133B.
Set the pootentiometer to produce approximately -5.0 volts of
bias at the junction of R133 and C133B.

PICTURE I-F TRANSFORMER ADIUSTMENTS.
Connect an oscilloscope to pin 9, V110 and set the oscillocope gain to maximum. Connect a VHF signal generator to the antenna input termi-
nals. Modulate the signal generator $30 \%$ with an audio signal. Tune the signal generator to 4575 mc and adjust th Tune the signal generator to 45.7 mc . and adjust the gen-
erator output to give an indication on the oscillosscope. Adjust L4 in the antenna matching unit for minimum audio indication
on the oscilloscope. on the oscilloscop
Tune the signal generator to 41.25 mc. and adjust Ll for
minimum audio indication on the oscilloscope. Remove the jumper from the output of the matching unit. Connect a 300 ohm $1 / 2$ walt composition resistor from $L 5$ to
ground, keeping the leads as short as possible. ground, keeping the leads as short as possible.
Connect an oscilloscope low capacity crystal probe from
L5 to ground. The sensitivity of the oscilloscope should be approximately 0.03 volts per inch. Set the oscilloscope gain to maximum.
Connect the VHF sweep generator to the matching unit
antenna input terminals. In order to prevent coupling reacance from the sweep generator into the matching unit, it is
advisable to employ a resistance pad at the matching unit advisable to employ a resistance pad at the matching unit
erminals. Figure 17 shows three difterent resistance pads for use with sweep generators with 50 ohm co-ax output, 72 ohm
co-ax output or 300 ohm balanced output. Choose the pad co-ax output or 300 ohm balanced output. Choose the pad
to match the output impedance of the particular sweep ${ }^{1}$ mploye
Connect the signal generator loosely to the malching unit
antenna terminals. antenna terminal
Set the sweep generator to sweep from $45 \mathrm{mc}$. . 1054 mc .
With RCA Type WR59A sweep generators, this may be accomplished by retuning channel number 1 to cover this
range. With WW59B sweep range. With WR59B sweep generators this may be accom-
plished by retuning channel number 2 to cover the range. In naking these adjustments on the generator, be sure not to turn the core too far clock
the core retaining spring
10. Adjust $L 2$ and $L 3$ is obstain the response shown in Figure 10. L3 is most effective in locating the position of the shoulder
of the curve at 52 mc. and 12 should be ajjusted to give
maximum amplitude al 53 mc and above consistent with the of the curve at 52 mcc . and L2 should be adjusted to give
maximum amplitude ai 53 mc . and above consistent with the
specified shape of the response curve. The adjustments in the speciiied shape of the response curve. The adjustments in the
matching unit interact to some extent. Repeat the above promatching unit interact to some extent. Repeat the abo
cedure until no further adjustments are necessary.
Remove the 300 ohm resistor and crystal probe connections.
Restore the connection between L5 and SI-E. Replace Vl06.


Figure 10-KRK29 Antenna Matching Unit Response
PICTURE I-F TRAP ADJUSTMENT.-Connect the i-f signal
generator across the link circuit on terminals A and B of T104. Connect the "VoltOhmyst" to the junction of R133 and $\underset{C}{\text { Cli33 }}$
Obtain two 7.5 volt batteries capable of withstanding ap-
preciable current drain and connect the ends of a preciable current drain and connect the ends of a 1,000 ohm one battery to chassis and the potentiometer arm to the unction of Ru3 and Clisb.
Set the bias to produce approximately -1.0 volt of bias at
the junction of R133 and C 133 B . Connect the "Voltohmyst" to pin 9 of V110, the 6CL6 video
the amplitier.
Set the signai generator to each of the following frequencies
and adiust and adjust the corresponding circuit for minimum d-c output
at pin 9 of $V 110$. Use sufficient signal input to produce 1.0 volt of d-c on the meter when the final adiustment is made.
$39.25 \mathrm{mc} \ldots$
41.25 mc $\quad \mathrm{T} 104$ top core
41.25 mc.
47.25 mc.

T105 bottom cor

Model 21-D-395
Set the signal generator toe each of the following frequencies and peak the speciiied adjustment tor maximum indication on if necessary in order to produce 1.0 volt of d-c at pin 9 of Vll 10 43.7 mc.
45.5 mc
41.8 mc.

T109
T108
T107
To align T105 and T106, connect the sweep generator to the
first picture i -f f grid, pin 1 of 106 through a 1,000 mmd. .eramic
 T109 with 330 ohm composition resistors. Set the i-f bias to
-1.0 volt at the iunction of R133 and C133B. Connect the oscilloscope to pin 9 of Vllo.
Adjust T105 and T106 top cores for maximum gain and
curve shape as shown in Figure 11. For final adjustment se curve shape as shown in Figure 11. For final adjustment set
the output of the sweep generator to produce 0.5 volt peak-to-peak at the oscilloscope terminais.


Figure 11-
TiOS and T106
Response $\quad \begin{gathered}\text { Figure } 12- \\ \text { T2 and Tl04 } \\ \text { Response }\end{gathered} \quad \begin{gathered}\text { Figure 13- } \\ \text { Over-all } 1 \text { I-F } \\ \text { Response }\end{gathered}$
To align T 2 and T 104 , connect the sweep generator to th mixer grid test point TP2, Use the shortest leads possible, with
not more than one inch of unshielded lead at the end of nweep cable.
"Connect a 180 ohm composition resistor between terminal "E" of Tlos and the junction of R131 and C133A.
Connect the oscilloscope diode probe to terminal "B" of
T100 and ground. Couple the signal generator loosely to the diode probe in order to obtain markers.
The shunt trimmer C121 across terminals A and B of T104
variable and is provided as a bandwidth adjustment the shunt trimmer to minimum capacity. Adjust T2 (top) and
T104 (botom) tor maximum gain at 43.5 mc . and with 45.75 Tl04 (bottom) for maximum gain
mc . at $70 \%$ of maximum response
Adjust C121 until 41.25 mc . is at $85 \%$ response with respect
to the low frequency shoulder at approximately 41.9 mc. as to ho low requenc
shown in Figure 12 .
Disconnect the diode probe, the 180 ohm and three 330 ohm
resistors. resistors.

> Model 21-D-395u Set the signal generator to each of the following frequencies
and peak the specified odjustment tor maximum indication on
the "Volt th hmyst." During alignment, reduce the input signal if necessary in order to produce 1.0 veluce the dinput sin pign 9 of
V110 with -1.0 volt of i-f bias at the junction of R133 and C133B.

$$
\begin{aligned}
& \text { 3B. } \\
& \begin{array}{c}
43.7 \mathrm{mc} \\
455 \mathrm{mc} \\
41.5 \mathrm{mc}
\end{array}
\end{aligned}
$$

To align Tl05 and T106, connect the sweep generator to
the first picture $i-1$ grid, pin 1 if V106 through a 1,000 .mmi ceramic capacitor. Shunt R137, R141 and terminals "A" an
$\cdots \mathrm{F}$ " of T109 with 330 ohm composition resistors. Set the i bias to -1.0 volt at the junction of R133 and Cl133B Connect the oscilloscope to pin 9 of V110, the 6CL6 video
amplifier.
Adjust T105 and T106 top cores for maximum gain and curve shape as shown in Figure 11. For final adjustment se
the output of the VHF sweep generator to produce 0.5 vol the output of the VHF sweep generctor to
peak-to-peak at the oscilloscope terminals.

To align the crystal mixer and T2 and T104, connect the VHF sweep generator to the front terminal of the 1N82 crystal
holder in series with a $1,500 \mathrm{mml}$. ceramic capacitor. Use the hortest leads possible, grounding the sweep generator to the

Set the channel selector to channel 5 .
Connect a 180 ohm composition resistor betw
"B" of T105 and the junction of R131 and C133A
Connect the oscilloscope diode probe to terminal "B" of
T105 and ground. Couple the signal generator loosely to the diode probe in order to obtain markers.
The shunt trimmer Cl21 across terminals $A$ and $B$ of $T 104$
variable and is provided as $\alpha$ bandwidth is variable and is provided as a bandwidth adjustment. Prese the shunt trimmer to minimum capacity. Adjust T2 (top) and
T104 (bottom) lor maximum gain at 43.5 mc . and with 45.75 mc . at $70 \%$ of maximum response.
Adjust the shunt trimmer C121 until 41.25 mc. is a
$85 \%$ response with respect to the low $85 \%$ response with respect to the low frequancy shoulder a
approximately 41.9 mc. as shown in Figure 14 Adjust Tl for approximately 41.9 mc. as shown in Figure 14. Adjust Tl for
maximum gain. Readjust T 2 and T 104 if necessary to obtain proper wave shape, see Figure 15.
Disconnect the diode probe, the 180 ohm and the three 330
ohm resistors.

$$
\begin{aligned}
& \begin{array}{l}
\text { Figure } \\
\text { Tig and } \\
\text { T104 }
\end{array} \\
& \begin{array}{c}
\text { Response uith } \\
\text { KRKI2B }
\end{array} \\
& \begin{array}{c}
\text { Figure } \\
\text { Over-all } \\
\text { On }
\end{array} \\
& \begin{array}{c}
\text { I-F Respollonse } \\
\text { with KRK12B }
\end{array}
\end{aligned}
$$

## SWEEP Alignment of pix I-F.

Connect the oscilloscope to pin 9 of V 110 .
Adjust the bias potentiometer to obtain -6.0 volts of bias as measured by a "VoltOhmyst" at the junction of R133 and

Leave the sweep generalor connected to the mixer grid tes
point TP2 on KRK29 Tuner or to the front terminal of the point TP2 on KRK29 Tuner or to the front terminal of the
1N82 crystal holder on KRK12B Tuner. Use the shortest lead possible with not more than one inch of unshielded lead at the the receiver may be unstable and the response curves obtained may be unreliable.
Adjust the output of the sweep generator to obtain 3.0 volts
Couple the signal generator loosely to the grid of the firs pix i-f a mplifier. Addust the output of the signal generator to
produce small markers on the response curve produce small markers on the rest curv
Retouch T108 and T109 to obtain the response shown in Fig.
ure 13 for KRK29 or Figure 15 for KRK12B. Do not adjust T107 unless absolutely necessary. If T101 is adjusted too low in
frequency it will recise the level of the 41.25 mc. sound $i$ icarrier and may create interference in the picture. It will also cause poor adjacent channel picture rejection. If T107 is tuned
too high in frequency, the level of the 41.25 mc . sound i carrier will be too low and may produce noisy sound in weak signal areas.
Remove the oscilloscope, sweep and signal generator conRemove the bias box employed to provide bias for align $\underset{\text { ment }}{\text { Rent }}$

KRK29 TUNER ALIGNMENT

## TUNER ALIGN Model 21-D-395

A tuner unit which is operative and requires only touch up
adjustments, requires no preseting of adjustments. For such
 are completely 1 out of adiustment, preset C27 all the wry out
Set channel 7 to 13 oscillator sluga one turn from tight. Turn
T2 slug all T2 slug all the way out. Do not change any of the adjustment in the antenna matching unit.
Disconnect the link from terminals "A" and "B" of T104 and
terminate the link with a 39 ohm composition Turn the receiver channel selector switch to channel 2 .
The 43.5 mc. trap is adjusted with zero bias. To insure that
the bias will remain constant, take a clip lead and short circuil the bias will remain constant, take a clip lead and short circuit
the $A G C$ terminal of the tuner at the terminal board to ground


Figure 16-KRK29 Tuner Adjustments
Connect the oscilloscope to the test point TPl on the side of
the tuner unit. Set the oscilloscope to maximum gcin. Coret the Sal VHF
Connect the output of the VHF signal generator to the out-
put of the antenna matching unit at the junction of LS and $\mathrm{C4}$
at the bottom of the FM trap L5. Tune the signal generator to 43.5 mc . and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal geralor with $\alpha 400$ cycle
maximum output.
Adjust C33 on top of the tuner, for minimum 400 cycle indieation on the oscilloscope. In necessary this adjustment can specific frequency in the i-i band pass. However, in such cases, care should be taken not to tune. Chowever, in such
thereby reducing sensitivity on chanel 2 . Ceby reducing sensitivity on channel 2
Connect the potentiometer arm of one of the bias supplies posilive terminal to the tuner case. Adjust the bicrs potentiometer to produce -3.0 volts of bics, as measured by the "Volt-
Ohmyst" at the $A G C$ terminal on the tuner
Set the channel selector switch to channel 8 .
Preset C22 to read -3.0 volts at the test point TP1, as read
on the "Voltohmyst." The limits for oscillator injection voltage are 2 volts minimum and not exceeding $\alpha$ maximum of 5.5
alts.
Turn the fine tuning control fully clockwise.
Adjust C25 for proper oscillator frequency, 227 mc . This may which will be recommended in this procedure will be to use the signal generator as a heterodyne frequency meter and beat eo oscillator against the signal generatior. To do this, tune the
ignal generator to 227 mc . with crystal accuracy. Insert one nd of a piece of insulated wire into the tuner unit through he hole provided for the adjustment of Cl6. Be careful that cause the frequency of the tune oscillator to shift. Connect the other end of the wire to the " r -f in" terminal of the signal
generator. Adiust C25 to obtain an audible beat with the generator. Adjus.
signal generator.

Turn C27 clockwise until the beat note just begins to
change, then turn one full turn in the same clockwise direction. Return the fine tuning control to the mechiral NOTE.-If on some units, it it not possible to reach the
proper channel 8 oscillator trequency
switch ado chustment of Chans. switch to channel 13 and adjust L49 to obtain proper channe
13 oscillator frequency as indicaied in the tabie on page 8 . 13 oscilator frequency as indicaled in the table on page 8 .
Then, switch 10 channel 12 and adjust $L 60$ to obtcain proper channel 12 oscillator frequency. Continue down to channel proper frequency on each channel. Then again on channel 8, adjust C25 to obtain proper channel 8 oscillator frequency.
Switch back to channel 13 and readjust L49 and back 10 Switch back to channel
channel 8 and adjust C25.
Set the T 2 core for maximum inductance (core turned
counter-clockwise)


Figure 17-Sureep Attenuator Pads
Connect the sweep generator through $\alpha$ suitable attenuator as shown in Figure 17 to the input terminals of the antenna Connect the signal generator loosely to the antenna ter-

Set the sweep generator to cover channel
Set the oscilloscope to maximum gain and use the minimum
input signal which will produce $\alpha$ usable pattern on the osciloscope. Excessive input can change oscillator iniection during alignment and produce consequent misalignment even though Insert markers of channel 8 picture carrier and sound
carrier, 181.25 mc and 185.75 mc . antier, 181.25 mc. and 185.75 mc .
Adjust C21, C16, C11 and C7 for approximaiely correct
curve shape, frequency, and bandwidh as shown in Figure 18.


Figure 18-KRK29 R-F Respons

The correct adjustment of C 7 is indicated by maximum am
plitude of the curve midway between the markers. Cll tune the r-f amplifier plate circuit and affects the frequency of the pass band most noticeably. C21 tunes the mixer grid circuit C7d aftects the tilt of the curve most noticeably (assuming tho ment and hence primarily aftects the response bandwidth.
Connect the "VoltOhmyst" to test point TP1. Adjust C22 to
read -3.0 volts dc on the "Voltohmyst" at TPI. Readjust C27. read -3.0 volts dc on the "Voltohmyst" at TP1. Readjust C22 gain al midpoint of the curve. Repeat if necessary until the proper response is obtained
Set the receiver channel switch to channel 13 ,
Adjust the signal generator to the channel 13 oscillator irequency 257 mc .
Turn the fine tuning control fully clockwise
Adjust L49 to obtain an audible beat. Slightly overshoot the adjustment of L49 by turning the slog an additional turn in th lator direction from the original setting, then reset the oscil
lator proper trequency by adjusting C 27 to again obtain he beat.
Set the sweep generator to channel 13 .
From the signal generator, insert channel 13 sound and pic
ture carrier markers, 211.25 mc. and 215.75 mc . ther markers, 21.25 mc . and 215.75 mc .
Adjust L 36 and L 20 for proper response as shown in Fig
are 18 . Turn off the sweep and signal generators
Connect the "VoltOhriyst" to the tuner test point TP
Check the oscillator injection voltage to be within limits as
previously specified. Adjust if necessary to bring within range.
If it was necessary to readjust C22, turn the 8 weep and signal generators back on and recheck
sponse. Readjust L36 and L20 if necessary. Set the receiver channel selector switch to channel 8 and
eadjust C27 for proper oscillator frequency, 227 mc. Set the sweep generalor and signal generator to channel 8. Readjust C21, C16, C11 and C7 for correct curve shape,

Turn off the sweep and signal generators, switch back to
channel 13 and check the oscillacor iniection voltage at TPI C21 was adjusted in the recheck of channel 8 response.
If the initial setting of the oscillator injection trimmer was
ar off it may be necessary to dijust the oscillator frequency and response on channel 8, adjust the oscillator injection on
hannol 13 and repeat the tracking procedure several times channol. 3 and repeat the tracking
Turn off the sweep generator and switch the receiver to
channol 6 . Adjust the signal generator to the channel 6 oscillator frequency, 129 mc.
Set the fine tuning control to the center of its mechanical nge
Adjust L54 for an audible beat. Adjust L48 and L32 for aror injection voltage at TP in Figure 18. Recheck the oscilmits specified. Readjust C 22 if necessary.
If C22 required adjustment, switch the receiver and the
ignal generator to channel 8 . Readiust C 21 for correct signal generator to channel 8. Readjust C21 for correct curve
shape and recheck C 27 and C 25 for proper oscillator frequency.
Check the response of channels 2 through 6 by switching
he receiver channel switch. sweep generator and marker enerator to canch of switch, sweep generator and marker sponse and oscillator injection voltage obtained. See Figure 8 for typical response curves. It should be found that all hese channels have
above $80 \%$ response.

If the markers fail to fall within this requirement readjus Switch the order to oblain curves generator through channels 7 to 13 and observe the respons curves, referring to Figure 18 for proper wave shape. Chec necessary readjust C11, C21 or C16 to oblain the prope response.
With the receiver and signal generator on channel 13 adjus


Figure 19-KRK29 R.F Oscillator Adjustment
Adjust the oscillator to frequency on all channels by switch ing the receiver and the frequency standard to each channe and adjusting the appropriate oscillator slug to obtain the abtain the audible beat on each channel. Recheck the oscillator injection voltage on each channel to verify that the voltage

KRI12B TUNER ALIGNMENT
Model 21-D-395
TUNER VHF ALIGNMENT.-Remove the 6S4 voltage con
trol tube from its socket and insert the adapter. Insert the 6S trol tube from its socket and insert the adapter. Insert the 6S in the adapte
Connect the 0-50 milliampere meter to the adapter socke Remove the tuner cover shield.
Rotate the channel selector to a point midway between
channels, disengaging the insert contacts, and observe the channeis, disengaging the insert conlacts, and observe the
non-osillating plate curent. Some tubes may oscillate even
with the tuned circuitr disengaged. To be sure the oscillaior is in a non-oscillatory state, short circuit the spring contact cuit the spring
(NOTE: The contacts are at zero d-c potential.) Sinould the
plate current rise, keep the contacts shorted while adjusting plate current rise, keep the contacts shorted while adjusting
the oscillator plate current. Adjust R6, oscillator voltage con
trol, for a 28 milliampere reading on the meter. 28 milliampere reading on the mete.

## Replace the tuner cover shield.

Connect the VHF sweep generator to the antenna terminals. Connect the VHF signal generator loosely to the antenna Connect the oscilloscope through the preamplifier, if needed with oscilloscope used, to test point TPI
Ground the AGC bias at the tuner terminal board using a
clip lead to insure that the bias will remain constant.
Turn off the adapter switch, removing plate voltage from
the oscillaror. This is required because of RF-IF interaction
when a crystal is used as a mixer. Set the channel selector and the sweep generator to chan-
nel 2 . le
Insert markers of channel 2 picture carrier and sound car-
ier, 55.25 mc. and 59.75 mc. Adjust antenna T 6 , r-f amplifier plate L 29 and mixer L 30 adjusiments for a symmetrical curve with maximum gain at
the center of the pass band. The curves will have a deap valley because of no crystal loading cund nonlinear a detector
characteristics. characteristics. The limits for the $100 \%$ response point are
shown in Figure 20. The proper curve shape is shown in Fig-
use 20(b). (Refer to note on page 15 for detailed explanation
of adiustments.) If the bandwidth is out of tolerance it can usually be corrected by redressing the coupling capacitor of usually be corrected by redressing the coupling capacitor of width occurs when the capacitor is centered in the insert hambe


Figure $20-$ KRK12B VHF Insert Responses
Repeat the above steps for all VHF channels adjusting the appropriate antenna, r-f amplifier plate and mixer slugs for
a symmetrical curve with maximum gain at the center of the pass band.
Turn off the sweep generator.
Remove the oscilloscope and preamplifier if used, from tes point TPI.
Turn the AGC control fully clockwise and remove the clip
lead grounding the AGC bias on the tuner terminal board Coll Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery positive terminal to the tuner case. Adjust the bias poten posmeter to produce -3.5 volts of bias, as measured by the
"Voltohmyst" at the AGC terminal on the tuner.
Connect the potentiometer arm of the second bias supply to the junction R133 and Cli33B, and ground the positive battery
terminal. Adjust the bias potentiometer to produce -5 volts of i-f bias as indicated on the "VoltOhmyst" at the junction point.
Connect the oscilloscope to pin 9 of V110. Use 3 to 5 volt
peak-to-peak output on the oscilloscope. peak-to-peak output on the oscilloscope
Turn the adapter switch on to apply plate voltage to the oscillator.
Turn the channel selector to channel 13
Set the fine tuning control to the center of its range
Adjust the oscillator slug L 22 to proper frequency, 257 me
This may be done in several ways. The easiest way and the way which will be recommended in this procedure will be to use the signal generator as $\alpha$ heterodyne irequency meter and
beai the oscillator against the signal generator. To do this, beai the oscillator against the signal generator. To do this,
tune the signal generator to 257 mc . With crystal accuracy tune the signal generator to 257 mc . With crystal accuracy
Insert one end of a piece of insulated wire into the tuner throughe either of the two holes next to the oscillator tube on
the right front top corner of the tuner. Be careful that the wire the right front top corner of the tuner. Be careful that the wire
does not touch any of the tuned circuits as it may cause the irequency of the oscillator to shift. Connect the other end o the wire to the "r-fin" terminal of the signal generator. Adjus L22 oscillator
generalor.
Turn on the sweep generator and set to channel 13. Adjusi Tl for maximum gain on the oscilloscope. Adjust mixer tank circuit L 21 for maximum gain and flat-topped curve. Recheck
Tl for maximum gain at center of band with the proper Tl for maximum gain at center of band with the proper
response. Maximum gain and flat-topped response should be response. Maximum gain
obtained simultaneously.
Adjust the oscillator to frequency on all VHF channels by
switching the receiver and signal generator to each VHF channel and adjusting the appropriate oscillator slug to ob tain $\alpha$ beat with the signal generator. Adjust the appropriate tain a beat with the signal generator. Ad ant
mixer slug where necessary to obtain maximum gain and
proper curve shape as explained proper curve shape as explained above.
Adjust the tunable I-F Trap C16-17. To do this connect the
signal generator to the fixed I-F Trap C2-L2 at the end opposignal generator to the
site the antenna terminal plug. Set the signal generator to site the antenna terminal plag. Set ine sinal generator to ob
43.5 mc and adjust the output of the signal gene tain sulficient indication on the oscilloscope. Tune the I-F Trap Cl
loscope.

Remove the signal generator and the oscilloscope.

Insert markers of the picture carrier and sound carrier frequencies for the desired channel (see

Adjust the UHF antenna, link coupling and mixer adjustments for a symmertical curve, with
maximum gain, centered about the pass band.
The responses are shown in Figure 22. The
curve shape will usually vary from Figure 22 (a) curve shape will usually vary from Figure 22 (a)
to Figure 22 (c) going higher in frequency, how to Figure 22 (c) going higher in frequency; how
ever, any of these responses are acceptable.
Repeat the above steps for all UHF inserts
used adjusting the appropriate antenna link used, adjusting the appropriate antenna, link coupling and mixer slugs for a symmetrical curve. with maximum gain, centered about the
pass band.
pass band.
Remove the oscilloscope and preamplifier, if
used, from test point TPI. Remove the clip lead grounding the AGC
bias on the tuner terminal board.
Connect the potentiometer arm of one of the
bias supplies to the AGC terminal on the tuner bas supplies to the AGC terminal on the tuner tuner case. Adjust the bias potentiometer to produce - 3.5 volts of bias as measured by the
"VoltOhyst" at the AGC terminal.
Connect the potentiometer arm of the second bias supply to the junction of R133 and Cli33B,
and ground the positive battery terminal. Adjust the bias potentiometer to produce -5 volts of i bias as indicaled on the "Voltohmyst" at the
junction point.
C

Connect the oscilloscope to pin 9 of V110. Use 3 to 5 volts peak-to-peak output on the oscillo-
scope.

Turn the adapter switch on to apply plate
Turn the Turn the channel selector to the lowest UHF
channel to be used. and set the fine tuning control to the center of its range
Adjust the oscillator core to proper frequency.
To do this, connect the VHF signal generator to To do this, connect the VHF signal generator to
test point TP1 with the shortest leads possible. test point TPl with the shortest leads possible.
Insert a 45.75 mc . marker from the $V H F$ generator. Set the UHF sweep generator to sweep the
desired channel and observe the output on the desired channel, and observe the output on the oscilloscope. II the sweep generator is not sweep.
ing the correct frequency range, it may be neces. ing the correct irequency range, it may be neces
sary to readjust the sweep in order to place the 45.75 marker on the response curve as in Fig.
ure 15 .

Set the UHF marker generator to the picture carrier of the channel insert being adjusted and
connect to test point TPl.
Adjust the oscillator core until the markers for
45.75 mc. and the picture carrier coincide on the sweep pattern on the oscilloscope.
Adjust the mixer core for maximum, gain with proper wave shape.
Connect the "VoltOhmyst" to test point TP1, using 1.5 volt
DC scale. C scale.
Set oscillator injection adjustment to read .1 volt on the
"Voltohmyst." VoltOhmys


Figure 22-KRKI2B UHF Insert Responses

Repeat the above steps for all UHF inserts adjusting the oscillator injection control only if the reading on the "Volthatyst exceeds
olts or less at TP


Figure 23-KRK12B Oscillator Adjustment
RATIO DETECTOR ALIGNMENT.-In order to obtain good ratio detector alignment an AM modulated signal generato that is exceptionally free from FM modulation must be em-
ployed. Set the signal generator at 4.5 mc. and connect it to the second sound i-f grid, pin 1 of V102. Set the generator for $30 \% 400$ cycle modulation.
As an alternate source of signal, the RCA WR39B or WR39C calibrator may be employed. If used, connect it to the grid o the 4th pix i-f amplifier, pin 1, V109. Set the frequency of the calibrator to 45.75 (pix carrier) and modulate with 4.5 mc crystal. Also turn on the internal AM audio modulation. The 4.5 mc . signal will be picked
through the sound $\mathrm{i}-\mathrm{f}$ amplifier.

Connect the "VoltOhmyst" to the junction of R11l and Clll Connect the oscilloscope across the speaker voice cail and urn the volume control for maximum output.
Tune the ratio detector primary, Tl 102 top core for maximum DC output on the "VoltOhmyst."' Adjust the signal level from the signal generator for -10 volts on the "VoltOhmyst" when the ratio detector for average signals.
Connect the "VoltOhmyst" to the junctio R110 and $\mathrm{Cl10}$
Adjust the T102 bottom core for zero d -c on the meter. Then turn the core to the nearest minimum AM output on the turn the co
oscilloscope
Repeat adjustments of T 102 top for maximum DC and T 102 bottom for minimum output on the oscilloscope making final
adjustment with the 4.5 mc . input level adjusted to produce 10 volis $d-c$ on the "VoltOhmyst" at the junction of Rlll and Clll.


Figure
Sound I-F
Sound I-F
Response

## TELEVISION ALIGNMENT PROCEDURE

Connect the "VoltOhmyst" to the junction of R110 and Cllo and note the amount of d-c present. If this voltage exceed $\pm 1.5$ volts, adjust R108 by turning it in until zero $\mathrm{d}-\mathrm{c}$ is ob tained Readjust the T 102 bottom core for minimum output on
the oscilloscope. Repeat adjustments of R108 and T102 bottom core until the voltage at R110 and C110 is less than $\pm 1$. volts when T102 bottom core is set for minimum output on the oscilloscope.
Connect the "VoltOhmyst" to the junction of R111 and Cll and repeak $T 102$ top core for maximum d-c on the meter and again reset the generator so as to have -10 volts on the meter

Repeat the adjustments in the above two paragraphs until the voltage at R110 and C110 is less than $\pm 1.5$ volts when R111 and C111 and the T102 bottom core is set for minimum indication on the oscilloscope.

SOUND I-F ALIGNMENT.-Connect the sweep generato to the first sound i-f amplifier grid, pin 1 of V101. Adjust the generator for a sweep width of 1 mc . at acenter frequenc
of 4.5 mc . Insert a 4.5 mc . marker signal from the signal generat into the first sound i -f grid. With the WR39B or WR39C calibrators the 4.5 mc . crystal signal may be obtained at the R-F
out terminal by turning the variable osc. switch oft the calibrate switch to 4.5 me. and the volume control with

Connect the oscilloscope in series with $\alpha 10,000$ ohm resisto Connect the oscillo
o terminal $A$ of T101.
Adjust T101 top and bottom cores for maximum gain and symmetry about the 4.5 mc . marker on the i-f response. Th
pattern obtained should be similar to that shown in Figure 24 .
The output level from the sweep should be set to produce approximately 2.0 volt peak-to-peak at terminal $\AA$ of TlO It is necessary that the sweep output voltage should not exceed the specified values otherwise the response curve will be broadened, permitting slight misadjustment to pas

Connect the oscilloscope to the junction of R110 and Cll and check the linearity of the response. The pattern obtaine should be similar to that shown in Figure 25.
SOUND TAKE-OFF ALIGNMENT.-Connect the 4.5 mc generator in series with a 1,000 ohm resistor to terminal " C "
of T110. The input signal should be approximately 0.5 volt.

Short the fourth pix i-f grid to ground, pin 1, V109, to prevent noise from masking the output indication.
As an alternate source of signal the RCA WR39B or WR39C two paragraphs. Connect calibrator across link circuit, T10 A, B, and modulate 45.75 with a 4.5 mc . crystal.
Connect the crystal diode probe of a "VoltOhmyst" to the plate of the video amplifier, pin 6 of VIIO

Adjust the core of Tllo for minimum output on the meter
Remove the short from pin 1 V109 to ground, if used.
HORIZONTAL OSCILLATOR ADJUSTMENT.-Normally the adjustment of the horizontal oscillator is not considered to b waveform adjustment may require the use of an oscilloscop wavelorm adjustment may require the use of an oscilloscope,
it cannot be done conveniently in the field. The waveform adjustment is made at the factory and normally should no
adjustment should be checked whenever the receiver is
aligned or whenever the horizontal oscillator operation is improper.
Horizontal Frequency Adjustment.-Tune in a station and sync the picture. If the picture cannot be synchronized with the horizontal hold control R210, then adjust the T114 fre quency core on the rear apron until the picture will syn form adjustment core (under the chassis) out of the coil several turns from its original position and readjust the Tll frequency core until the picture is synchronized.
Examine the width and linearity of the picture. If picture width or linearity is incorrect, adjust the horizontal drive trol Llll until the picture is correct.
Hprizontal Oscillator Waveform Adjustment.-The hori zontal oscillator waveform may be adjusted by either of two be employed in the field when an oscilloscope is not avail able. The service shop method outlined in paragraph $B$ below requires the use of an oscilloscope
A.-Turn the horizontal hold control completely clockwise Place adjustment tools on both cores of T114 and be prepared to make simultaneous adjustments while watching the picture on the screen. First, turn the T114 frequency core (on the rea apron) until the picture falls out of sync and one diagona Then, turn the waveform adjustment core (under the chassis) into the coil while at the same time adjusting the frequenc core so as to maintain one diagonal black bar on the screen Continue this procedure until the oscillator begins to motor boat, then turn the waveform adjustment core out until the core until the picture is synchronized then reverse the directio of rotation of the core until the picture begins to fall out o sync with the diagonal bar sloping down to the right. Continue to turn the frequency core in the same direction. Additiona bars should not appear on the screen. Instead, the horizonta of the T114 waveform adjustment core if necessary until this condition is obtained. B--Connect the low capacity probe of an oscilloscope to
erminal C of T114. Turn the horizontal hold control one-quarte turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown in Figure 26. Adjust the waveform adjustment core of $T 114$ until the two peaks are at the same height. During this adjustment control if necessary.
This adjustment is very important for correct operation o he circuit. If the broad peak of the wave on the oscilloscope poorer, the stabilizing effect of the tuned circuit is reduce and drift of the oscillator becomes more serious. On the othe

incorac


corpect

Figure 26-Horizontal Ossillator Wave Form
hand, if the broad peak is higher than the sharp peak, the oscilator is overstabilized, the puil-in range becomes inade oscillator when the hold control approaches the clockwis position
Remove the oscilloscope upon completion of this adjustment Horizontal Locking Range Adjustment.-Set the horizonta tarily remove the signal by switching off channel then back The picture may remain in sync. If so turn the 1114 frequenc core slightly and momentarily switch off channel. Repea until the picture falls out of sync with the diagonal lines sloping down ond lef. She learn he horizontar hold con obtained just before the picture pulls into sync.
If more than 3 bars are present just before the picture pulls slightly slightly clockwise. If less than 2 bars are present, adjust C186 counter-clockwise, momentarily remove the signal and re check the number of bars present at the pull-in point. Repea this procedure until 2 or 3 bars are present.
Turn the horizontal hold control to the maximum clockwise position. Adjust the T 114 frequency core so that the diagona reverse the direction of adjustment so that bar just moves of the screen leaving the picture in synchronization
SENSITIVITY CHECK.-A comparative sensitivity check can be made by operating the receiver on a weak signal from a television station and comparing the picture and sound ob tained to that obtained on other receivers under the sam onditions.
RESPONSE CURVES. - The response curves shown and re a production shout the alignment procedure were taken from variations can be expected.
The response curves are shown in the classical manner o to the left. The manner in which they will be seen in a given lest set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflection polarity of the oscilloscope and the phasing of th

NOTE ON KRK12B TUNER ALIGNMENT.-The use of crystal mixer in the KRK12B Tuner makes it necessary to ob-
serve the insert responses with the oscillator disabled. This is due to undesirable $\mathrm{r}-\mathrm{f} / \mathrm{i}-\mathrm{f}$ interaction if the oscillator was allowed to operate during alignment. Therefore, the responses shown in figure 20 are not a striclly true representation of he insert band pass during actual operation. When an insert curve shown in Figure $20(\mathrm{~b})$ will be the correct response or reference. In actual operation, the band pass will be such hat the sound and picture carriers will be at the tips of the curve. The adjacent channel picture and sound carriers will exceed the limits a each side. Care should be taken not to n in Figures 20(a) and 20(c)

The valley, in the center of the response curve, may vary
rom 0 to $50 \%$ above the base line for VHF inserts. Adjust the output level of the sweep generator to prevent excessive signal input to the tuner. Excessive signal input will be in. dicated by the valley rising above the $50 \%$ level, particularly on the higher VHF channels.
Oscillator injection voltage is not adjusted on VHF inserts. A check may indicate variations from .08 to .3 volts at TPl but such readings should not be interpreted as an indication f trouble. On UHF channeis, however, the injection voltage



RADIO SCHEMATIC DIAGRAM
Figure 27-Radio Schematic Diagram

All resistance values in ohms, $\mathrm{K}=1000$
All cerpacitance values less than 1 in $M F$ and
above 1 in MMF unless otherwise noted.
Direction of arrows at controls indicates
clockwise rotation.

## CRITICAL LEAD DRESS


11. Dress all leads away from R101 in RS141.

RADIO ALIGNMENT PROCEDURE
Before aligning set, completely mesh the gang and set the dial pointer to the mechanical max. calibration point at extreme left end of dial. When making a complete alignment follow the table below in sequence. Connect the output meter across the
speaker voice coil, and turn the receiver volume control to max. Turn tone controls for maximum highs and maximum lows. "AM" I-F ALIGNMENT
Test-Oscillator. - Connect low side of the test-osc. to the chassis, and keep the output as low as possible to avoid a-v-c action


| Steps | the Test Osc. to- | 10 | Switch | Dial to- | Adjust the following |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Pin No. 1 of (43) in series with .01 mid . | 455 kc . Modulated | AM | Low Freq. end of Dial | $\dagger$ Top and bot. cores of T4 For max. voltage across voice coil. |
| 2 | Stator of Cl-D in series with .01 mfd | 455 kc . Modulated | AM | Low Freq. end of Dial | tTop and bot. cores of T2 <br> For max. voltage across voice coil. |

For proper adjustment of the i-f cores start with the cores all the way put. The first peak obtained will be the correct one
FM ALIGNMENT PROCEDURE

| Steps | Connect the High Side of the Test Osc. to | $\begin{aligned} & \text { Tune Test Osc. } \\ & \text { to - } \end{aligned}$ | Function Switch | Turn Radio Dial to |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 3 | Pin No. 1 of V 4 in series with .01 mfd . | 0.7 | FM |  | Adjust the following <br> Top of Ratio d-c $\dagger$ Trans. T5 for maximum DC on "VoltOhmyst." |
| 4 | Pin No. l of V4 in series with .01 mfd . | Modulated | FM |  | Bottom of Ratio d-c $\dagger$ Trans. T5 for minimum audio output on meter |
| 5 | Repeat steps 3 and 4 as necessary making final |  | adjustment with input set to give approx. -4.0 v . on "Voltohymst." |  |  |
| 6 | Pin No. 1 of V3 in series with .01 mfd | 10.7 mc. | FM | 88 mc . | $\dagger$ Top and bottom cores of T3 for |
| 7 | Stator of Cl-C in series with .01 mfd . | 10.7 mc . | FM | 88 mc . | $\dagger$ Top and bottom cores of Tl for maximum d-c across C39. |
| 8 | Connect sweep generator cable to antenna terminals through 120 ohms in each side of line. | $\begin{aligned} & 90 \mathrm{mc} . \\ & 22.5 \mathrm{kc} . \mathrm{FM} \text { mod. } \end{aligned}$ | FM | 90 mc . | OSC, L8 for max. audio output. |
| 9 |  | 106 mc . <br> 22.5 kc . FM mod. | FM | Tune to signal | $\overline{A N T}, \mathrm{Cl}-\mathrm{FT}$ and $\mathrm{R}-\mathrm{F}$ Cl-CT for max. voltage across C39. |
| 10 |  | 90 mc . <br> 22.5 kc . FM mod. | FM | Tune to signal | ANT, L1 and R-F L2 for max. voltage across C39. |
| 11 | Repeat steps 8,9 and 10 as required. |  |  |  |  |
| 12 | Connect a scope to junct. R33 and C35. Check response and linearity. Peak separation should be at least 180 kc . |  |  |  |  |
| $\dagger$ For proper adjustment of the i-f cores start with the cores all the way out. The first peak obtained will be the correct one. <br> "AM" R-F ALIGNMENT |  |  |  |  |  |
| Steps | Connect the High Side of the Test Osc. to | $\begin{aligned} & \text { Tune Test Osc. } \\ & \text { to- } \end{aligned}$ | Function Switch | Turn Radio Dial to | Adjust the following |
| 13 | External radiating loop and couple loosely to receiver loop. | $1,620 \mathrm{kc}$. | $\overline{\text { ÀM }}$ | Min. capacity | *Osc. Cl-BT for maximum output. |
| 14 |  | $1,400 \mathrm{kc}$. | AM | Tune to signal | ${ }^{*} \mathrm{Cl}$ - DT and Cl-ET for max. output. |
| 15 |  | 600 kc | AM | Tune to signal | $\ddagger$ Osc. L5 for max. output while rocking gang. |
| 16 |  | 600 kc . | $\overline{\text { AM }}$ | Tune to signal | ***R-F L7 for max. output. |
| 17 | atil no additional gain in sensitivity is obtained. ${ }^{\text {d }}$. |  |  |  |  |

$\ddagger$ Clip a 10,000 ohm resistor across Cl-D when making this adjustmen
All R-F shields must be in place


Figure 30-
Dial Cord


## ELLEVISION VOLTAGE CHART

 The following measurements represent two sets of conditions. In the first condition, a 5000 microvolt test pattern signal was fed the antenna laads and short circuiting the receiver con Vole "VoltOhmyst" between the indicated terminal and chassis ground and with the receiver operating on 117 volts, 60 cycles, a-c| Tube |  | Function | Operating | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | $\begin{gathered} \text { Plate } \\ \text { (ma.) } \end{gathered}$ | $\left.\begin{array}{\|c\|c\|} \hline \text { Scraen } \\ (\text { mat }) \end{array} \right\rvert\,$ | Notes on Measurements |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | Pin No. | Volts | $\begin{gathered} \text { Pin } \\ \text { Poin } \end{gathered}$ | Volts |  |  |  |
| $\left\lvert\, \begin{aligned} & \mathrm{v}_{1} \\ & \text { XRK29 } \end{aligned}\right.$ | 6BQ7a |  | $\underset{\text { Signal }}{5000 \mathrm{Mu}}$. | 6 | 170 | - | - | 8 | 0.1 | 7 |  | - | - |  |
|  |  |  | $\begin{gathered} \text { No } \\ \text { Signal } \end{gathered}$ | 6 | 133 | - | - | 8 | 1.1 | 7 | 0 | - | - |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Amplifier } \end{aligned}$ | $5000 \mathrm{Mu} . \mathrm{v}$. Signal | 1 | 270 | - | - | 3 | 170 | 2 | - | - | - |  |
|  |  |  | $\mathrm{Sigo}_{\text {Sol }}^{\text {Nol }}$ | 1 | 260 | - | - | 3 | 133 | 2 | - | - | - |  |
| V2 | 6x8 | Mixer | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 9 | 160 | 8 | 160 | 6 | 0 | 7 | $\begin{aligned} & -2.410 \\ & -3.0 \end{aligned}$ | - | - |  |
|  |  |  | $\mathrm{S}_{\mathrm{N} \text { ignal }}^{\mathrm{No}}$ | 9 | 145 | 8 | 145 | 6 | 0 | 7 | $\begin{aligned} & -2.8 \text { to } \\ & -3.5 \end{aligned}$ | - | - |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Oscillator } \end{aligned}$ | $\underset{\text { Signal }}{5000 \text { Mu. V. }}$ | 3 | 95 | - | - | 6 | 0 | 2 | ${ }_{-3.8}^{-3.8}$ | - | - |  |
|  |  |  | $\stackrel{N}{\mathrm{No}}$ | 3 | 90 | - | - | 6 | 0 | 2 | ${ }_{-3.1}^{-3.0}$ | - | - |  |
| $\begin{aligned} & \mathrm{v}_{1} \\ & \text { KRK } 12 \mathrm{~B} \end{aligned}$ | 6BQ7a | $\begin{aligned} & \text { R-F } \\ & \text { Amplifier } \end{aligned}$ | $\underset{\substack{500 \mathrm{Mu} \\ \text { Signai }}}{\mathrm{V} .}$ | 6 | 143 | - | - | 8 | 1.2 | 7 | 0 | - | - |  |
|  |  |  | $\mathrm{S}_{\mathrm{ignal}}^{\mathrm{No}}$ | 6 | 138 | - | - | 8 | 1.0 | 7 | 0 | - | - |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Amplifier } \end{aligned}$ | $\underset{\substack{\text { Signal }}}{5000 \mathrm{Mu}}$. | 1 | 260 | - | - | 3 | 143 | 2 | 97 | - | - |  |
|  |  |  | $\mathrm{Sigo}_{\mathrm{No}}^{\text {Nol }}$ | 1 | 250 | - | - | 3 | 137 | 2 | 97 | - | - |  |
| $\begin{aligned} & \mathrm{v}_{2} \\ & \mathrm{KRK} 12 \mathrm{~B} \end{aligned}$ | 6AF4 | $\begin{array}{\|c} \mathrm{R} \cdot \mathbf{F} \text { © } \mathrm{Ocillatator} \end{array}$ | $\underset{\text { Signal }}{5000 \mathrm{Mu}} .$ | 187 | 78 | - | - | 5 | 0 | $2 \& 6$ | -8 | - | - |  |
|  |  |  | $\underset{\text { Signal }}{\text { No }}$ | $1 \& 7$ | 75 | - | - | 5 | 0 | 2\&6 | -6 | - | - |  |
| $v_{3}$ <br> KRK 12 B | 6BQ7A | $\begin{aligned} & \text { I. } \mathbf{F} \\ & \text { Amplifier } \end{aligned}$ | $\begin{aligned} & 5000 \mathrm{Mu} . \mathrm{V} . \\ & \text { Signal } \end{aligned}$ | 6 | 270 | - | - | 8 | 148 | 7 | 103 | - | - |  |
|  |  |  | $\stackrel{\text { No }}{\text { Nignal }}$ | 6 | 260 | - | - | 8 | 142 | 7 | 99 | - | - |  |
|  |  | ${ }_{\text {Amplifier }}^{\text {I.F }}$ | $\underset{\substack{5000 \mathrm{Mu} \\ \text { Signal. }}}{ }$ | 1 | 148 | - | - | 3 | 1.4 | 2 | 0 | - | - |  |
|  |  |  | $\xrightarrow[\text { Signal }]{\substack{\text { No }}}$ | 1 | 143 | - | - | 3 | 1.2 | 2 | 0 | - | - |  |
| $\begin{array}{\|l\|} \hline \text { V4 } \\ \text { KRK 12B } \end{array}$ | 654 | $\begin{aligned} & \text { Voltage } \\ & \text { Control } \end{aligned}$ | $\begin{aligned} & 5000 \mathrm{Mu} . \mathrm{v} . \\ & \text { Signal } \end{aligned}$ | 9 | 270 | - | - | 2 | 94 | 6 | *68 | - | - | $\begin{gathered} \text { Doponde on } \\ \text { Dap } \\ \text { ajustmontint } \\ \text { of } \end{gathered}$ |
|  |  |  | $\mathrm{S}_{\text {Signal }}^{\text {No }}$ | 9 | 260 | - | - | 2 | 90 | 6 | *65 | - | - |  |
| v101 | 6AU6 | $\begin{aligned} & \text { 1st Sound } \\ & \text { I-F Amp. } \end{aligned}$ | $\underset{\substack{5 i g n a l}}{5000 \mathrm{Mu} .}$ | 5 | 127 | 6 | 124 | 7 | 0.7 | 1 | -0.4 | 6.0 | 3.0 |  |
|  |  |  | $\mathrm{Signal}_{\text {No }}^{\text {Nom }}$ | 5 | 126 | 6 | 123 | 7 | 0.5 | 1 | -1.2 | 5.0 | 3.0 |  |
| v102 | 6AU6 | $\begin{aligned} & \text { 2nd Sound } \\ & 1-F_{\text {mp }} \end{aligned}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 132 | 6 | 60 | 7 | 0 | 1 | -10 | 2.8. | 1.2 |  |
|  |  |  | $\begin{gathered} \text { No } \\ \text { Signal } \end{gathered}$ | 5 | 131 | 6 | 65 | 7 | 0 | 1 | -5 | 2.0 | 1.0 |  |
| v103 | 6ALS | RatioDetector | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | ${ }_{7}^{2}$ | -9.2 | - | - | 5 1 1 | 1.0 9.2 | - | - | - | - |  |
|  |  |  | $\begin{aligned} & \text { Signal } \\ & \text { Sigo } \end{aligned}$ | ${ }_{7}^{2}$ | -8.0 | - | - | $\stackrel{5}{1}$ | 8. | - | - | - | - |  |
| v104 | 6AV6 | $\begin{aligned} & \text { 1st Audio } \\ & \text { Amplifier } \end{aligned}$ | $\begin{aligned} & 5000 \mathrm{Mu} \mathrm{~V} . \\ & \text { Signal } \end{aligned}$ | 7 | 90 | - | - | 2 | 0 | 1 | -0.7 | 0.65 | - | $\begin{gathered} \text { At min. } \\ \text { volume } \end{gathered}$ |
|  |  |  | $\begin{gathered} \mathrm{Noo} \\ \mathrm{Signal}^{\mathrm{Nigal}} . \end{gathered}$ | 7 | 88 | - | - | 2 | 0 | 1 | -0.7 | 0.65 | - |  |
| v104 | 6Av6 | $\begin{aligned} & \text { R-F Bias } \\ & \text { Clamp } \end{aligned}$ | $5000 \mathrm{Mu} . \mathrm{V}$ Signal | 5.6 | -3.0 | - | - | 2 | 0 | - | - | -- | - |  |
|  |  |  | $\begin{gathered} \text { No } \\ \text { Signal } \end{gathered}$ | 5 -6 | 0.3 | - | - | 2 | 0 | - | - | - | - |  |
| v106 | 6AU6 | $\begin{aligned} & \text { 1st Pix. I-F F } \\ & \text { Amplifier } \end{aligned}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 160 | 6 | 215 | 7 | 0.17 | 1 | -6.6 | 1.4 | 4 |  |
|  |  |  | $\begin{gathered} \text { Noo } \\ \text { Signal } \end{gathered}$ | 5 | 85 | 6 | 115 | 7 | 0.98 | 1 | 0 | 6.5 | 3.3 |  |


| $\underset{\substack{\text { Tube } \\ \text { No. }}}{\text { a }}$ | $\underset{\text { Type }}{\substack{\text { Tube }}}$ | Function | OperatingCondition | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | $\left\|\begin{array}{c} \text { Plate } \\ (\text { masa }) \end{array}\right\|$ | $\left\lvert\, \begin{gathered} 1 \\ \substack{\text { scraen } \\ \text { (ma.) }} \end{gathered}\right.$ | Notes onMeasurement |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | Pin | Volts | Pin | Volts |  | Volus | $\begin{gathered} \text { Pin } \\ \text { No. } \\ \hline \end{gathered}$ | volts |  |  |  |
| v107 | 6Cb6 | 2nd Pix. I-F Amplitier | $\underset{\text { Signal }}{5000 \mathrm{Mu} .}$ | 5 | 227 | 6 | 225 | 2 | 0.1 | 1 | -6.6 | 1.5 | . 25 |  |
|  |  |  | Signal | 5 | 209 | 6 | 115 | 2 | 0.8 | 1 | 0 | 10.9 | 3.3 |  |
| v108 | 6C86 | ${ }^{\text {3rd Pix. I-F }}$ Amplifior | $\underset{\text { Signal }}{5000 \mathrm{Mu} .} \mathbf{V} .$ | 5 | 138 | 6 | 132 | 2 | 1.02 | 1 | 0 | 11.4 | 3.5 |  |
|  |  |  | $\mathrm{S}_{\text {Signal }}^{\text {No }}$ | 5 | 134 | 6 | 126 | 2 | . 98 | 1 | 0 | 10.4 | 3.1 |  |
| v109 | ${ }^{6 C B 6}$ | 4th Pix. I-F Amplitier | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 168 | 6 | 165 | 2 | 2.32 | 1 | 0 | 8.85 | 2.2 |  |
|  |  |  | $\stackrel{\text { No }}{\text { Nogal }}$ | 5 | 156 | 6 | 161 | 2 | 2.07 | 1 | 0 | 8.6 | 2.1 |  |
| v110 | 6CL6 | Video Amplifier | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 6 | 130 | 3.8 | 159 | 1 | . 84 | 2.9 | *-5.0 | 22.5 | 5.5 | *Depends on picture |
|  |  |  | $\mathrm{Si}_{\text {Signal }}^{\text {No }}$ | 6 | 130 | 3-8 | 80 | 1 | 0.7 | 2.9 | *-2.0 | 15.0 | 4.0 | *Depends <br> on pictur |
| V111A | 12AU7 | AGC | $5000 \mathrm{Mu} . \mathrm{V}$. Signal | 1 | -30 | - | - | 3 | 142 | - | - | 0 | - | $\begin{gathered} \text { AGC control } \\ \text { sotormal } \\ \text { operatiol } \\ \text { operation } \end{gathered}$ |
|  |  |  | ${ }_{\text {Signal }}^{\text {No }}$ | 1 | 0 | - | - | 3 | 137 | - | - | 0 | - |  |
| v1118 | 12AU7 | Vert. Sync. Separator | 5000 Mu V. Signal | 6 | 110 | - | - | 8 | - | 7 | -42 | . 25 | - |  |
|  |  |  | $\mathrm{s}_{\text {ignal }}^{\text {Noo }}$ | 6 | 45 | - | - | 8 | 0 | 7 | *-5 | . 25 | - | *Dopends on noise |
| V112A | 12AU7 | Hor. Sync. Separator | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | 323 | - | - | 3 | 192 | 2 | 116 | . 5 | - |  |
|  |  |  | $\mathrm{Sig}_{\text {Signal }}^{\text {No }}$ | 1 | 320 | - | - | 3 | 132 | 2 | 112 | . 5 | - |  |
| V1128 | 12AU7 | Sync. <br> Amplifier | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } . \end{gathered}$ | 6 | 78 | - | - | 8 | 0 | 7 | -3.5 | 6.2 | - |  |
|  |  |  | $\mathrm{S}_{\text {Signal }}^{\text {No }}$ | 6 | 78 | - | - | 8 | 0 | 7 | -1.6 | 6.2 | - |  |
| V113A | 6SN7GT | $\begin{aligned} & \text { Vert. Sync. } \\ & \text { Amplifier } \end{aligned}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 2 | 140 | - | - | 3 | 19.2 | 1 | -. 35 | 0.1 | - |  |
|  |  |  | $\mathrm{Signal}_{\text {No }}^{\text {Nol }}$ | 2 | 135 | - | - | 3 | 17.3 | 1 | 0 | <0.1 | - |  |
| V1138 | 6SN7GT | Vert. Oec. $\&$ Discharge | $\underset{\text { Signal }}{5000 \mathrm{Mu} .}$ | 5 | 203 | - | - | 6 | 0 | 4 | -56 | . 2 | - |  |
|  |  |  |  | 5 | 208 | - | - | 6 | 0 | 4 | -55 | . 2 | - |  |
| V114 | ${ }^{6405}$ | $\begin{aligned} & \text { Vortical } \\ & \text { Output } \end{aligned}$ | $5000 \mathrm{Mu} . \mathrm{V}$ Signal | 5 | 334 | 6 | 334 | 2 | 30 | 1 | 0 | 17.3 | 1.2 |  |
|  |  |  | $\begin{gathered} \text { Nool } \\ \text { Signal } \end{gathered}$ | 5 | 332 | 6 | 332 | 2 | 29 | 1 | 0 | 17.3 | 1.2 |  |
| v115 | 6SN7GT | Horizontal <br> Osc. Control | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 2 | 188 | - | - | 3 | -9 | 1 | -28 | 0.37 | - | $\begin{aligned} & \text { Hor. hold } \\ & \text { at mid-range } \end{aligned}$ |
|  |  |  | $\underset{\text { Signal }}{\text { No }}$ | 2 | 0 | - | - | 3 | 0 | 1 | 0 | 0 | - |  |
|  |  | Horizontal Oscillator | $5000 \mathrm{Mu} . \mathrm{v}$. Signal | 5 | 184 | - | - | 6 | 0 | 4 | $\cdot 72$ | 2.5 | - | $\begin{aligned} & \text { Hor. hold } \\ & \text { at mid-range } \end{aligned}$ |
|  |  |  | $\stackrel{\text { Sol }}{\text { Nomal }}$ | 5 | 182 | - | - | 6 | 0 | 4 | -73 | 2.5 | - |  |
| v116 | 6CD6G | $\begin{array}{\|l\|l\|} \hline \text { Horizontal } \\ \text { Output } \end{array}$ | $\begin{gathered} 5000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | * | 8 | 165 | 3 | 12.5 | 5 | -30 | 110 | 15.0 | $\begin{gathered} \text { High } \\ \begin{array}{c} \text { Hiltage } \\ \text { Pulise } \\ \text { Pruesent } \end{array} \end{gathered}$ |
|  |  |  |  | Cap | * | 8 | 165 | 3 | 12.5 | 5 | -30 | 110 | 15.0 |  |
| v117 | $\begin{aligned} & \text { 1B3GT } \\ & / 8016 \end{aligned}$ | H. V. Rectifier | $\underset{\substack{\text { Signal }}}{5000 \mathrm{Mu.}} \mathbf{V} .$ | Cap | * | - | - | 247 | 17,500 | - | - | - | - | $\begin{gathered} \text { *High } \\ \text { Voltage } \\ \text { Vulse } \\ \text { Presen! } \end{gathered}$ |
|  |  |  | $\begin{gathered} \text { No } \\ \text { Signal } \end{gathered}$ | Cap | * | - | - | 2\&7 | 17,500 | - | - | - | - |  |
| $\begin{array}{\|l\|l\|} \hline V_{11} \\ \text { V118 } \end{array}$ | 6W4GT | Dampers | $\begin{gathered} 5000 \mathrm{Mu} \mathrm{~V} . \\ \text { Signal } \end{gathered}$ | 5 | 352 | - | - | 3 | * | - | - | 57 | - | *High Pulse Present |
|  |  |  | $\begin{gathered} \text { No } \\ \text { Signal } \end{gathered}$ | 5 | 348 | - | - | 3 | * | - | - | 57 | - |  |
| v120 | 21 AP4 | Kinoecope | $\underset{\substack{5 i g n a l}}{5000 \mathrm{Mu} . \mathrm{V} .}$ | Cone | 16,000 | 10 | 525 | 11 | 140 | 2 | *82 | 0.2 | - | At average Brighines |
|  |  |  | $\mathrm{S}_{\mathrm{Signal}}^{\mathrm{Noo}}$ | Cone | 16.400 | 10 | 520 | 11 | 132 | 2 | *76 | 0.2 | - | *O voltage on Phono. position |
| $\begin{array}{\|l\|l\|} \mathrm{v} 121 \\ \mathrm{~V} 122 \end{array}$ | 5U4G | Reccifiers | $5000 \mathrm{Mu}, \mathrm{~V} .$ Signal | 486 | 364 | - | - | 248 | 364 | - | - | *145 | - | $\underset{\substack{\text { Prer } \\ \text { Tube }}}{ }$ |
|  |  |  | $\stackrel{N}{\text { No }}$ | 486 | 360 | - | - | 288 | 360 | - | - | *150 | - |  |




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KCS81K CIRCUIT SCHEMATIC DIAGRAM


The schematic is shown in the latest
condition ot the time of printing.
All resistance values in ohms. $\mathrm{K}=1000$.

All capacitance values less than 1 in
MF and above 1 in MMF unless otherwise MFted.

| $\underset{\substack{\text { stock } \\ \text { No. }}}{ }$ | description |
| :---: | :---: |
|  | RF UNIT ASSEMELIES-KRK29 |
| 76539 | - Antonna matchin |
| 78235 | Board-Terminal board. 5 contact and ground |
| ${ }_{77853} 7838$ | Brackot-Side bracket for mounting coil and stators Capacitorilaramice variable for fine tuning capac- |
|  | ata |
| 77616 | ${ }_{\text {capatitor-Adjutable, mica }}$ |
|  | itor-Adjust |
| 77913 | $0.8=3.0 \mathrm{mmf}$ ( ${ }^{\text {c22) }}$ |
| 76332 | $1-4 \mathrm{mmf}$. ( C 7 ) |
| 77084 | Capacitor-Caramic:- (C5, C15, C17, C18, C19) Capacitor-Fixed, coramic, non-insulatod, Tomp |
| 77865 |  |
|  |  |
| ${ }_{73960}^{7732}$ |  |
|  | pacitor Fixed coramic, insulatod. High "K" |
| ${ }_{78276}^{75437}$ |  |
| 75199 |  |
|  |  |
|  |  |
| ${ }_{76739} 70935$ |  |
|  | Capacitormerixed, ceramic, non-insulated, Temp. |
| 78247 | $10 \mathrm{mmf}$. , $\pm 10 \%$, 500 volts (C24) |
| 78603 | pacitor- Fixed, ceramic, Temp. coef. $=\mathrm{N} 1$ $82 \mathrm{mmf}, \mathrm{H}+10 \%, 500$ volts (C20) |
|  | pacitor-Fixiod. hoeded -1aed - |
| 71502 71503 | 2.2 mmf., $\pm 20 \%$, ${ }^{\text {coo volts (C31) }}$ |
|  | Caparitor-Mica |
| 778594 |  |
|  | Coil-Antonna matching coil (Part of Ti) |
| ${ }_{73469}$ | Coil-Channol 6 mixar coil (L48) |
| ${ }^{73458}$ | Coil-Channel 6 r.f. grid coil (Lit) |
| 28491 | Coill-Channel erantenna coil (L61) |
| 77919 | Coil-Channel 13 mixer coil (L36) |
| ${ }^{77292}$ | Coil-Channol 13 rif. plate coill (L20) |
| ${ }_{76783}^{77206}$ |  |
| 78271 | Coii-1.F.input coil complete with adjustable |
| 78583 | Coil-Mixer I.F. coil (L43) |
| 785684 | Coil-RF amplifior coupling coil (L) |
| 76537 | Coil-Shunt coil complete with adjustable core (L3) |
|  | Coil-Shunt coil complete with adjustable core (L2) |
| 503112 |  |
| 503147 503210 |  |
| 503233 |  |
| ( 5 So3288 | ${ }^{6880} \mathrm{ohms}$, $\pm 10 \%$ \% $/ 2 / 2$ watt (RI) |
| ${ }_{5}^{523312}$ |  |
| 503410 <br> 503510 |  |
| 78396 | Transformer-Anterna matching tran |
|  | Traniformer-Co |
| ${ }_{7}^{775440}$ | Trap-FM trap complete with adjustable core (LS) |
| ${ }_{76542}$ | $\mathrm{Trap}_{\text {Trap }}$ IF ${ }^{\text {erap }}$ trap ( 41.25 MC ) complote with core (LI) |
| ${ }_{7}^{76541}$ |  |
|  | RF UNIT ASSEMBLIES-Krki2b |
|  | Ball-Steel ball ( $125^{\prime \prime}$ dia.) |
| ${ }_{78601}^{7759}$ |  |
|  | Brackot - bracket and sopring contact asembly for |
| 77575 | ${ }^{\text {Bracket-Drive mechanism mounting bracket for unit }}$ |
| 78599 | Bracket-Drive mechanism mounting bracket for |
|  | Brackot-Lamp bracket |
| 77619 | Bracket-VHF input connector and |
| 76845 77591 |  |
| 77616 | Capacitor-Adjustable, mica:- |
|  |  |
| 777884 | eed-thru, 1000 mmf . |
|  | Capacitor, Fixed, ceramic, crystal holder, temp, coof. |
| 77621 | $22^{\text {mmit. }} \pm \pm$ 10\% (C11) |
|  |  |
| $\begin{aligned} & 77293 \\ & 77624 \end{aligned}$ |  |

REPLACEMENT PARTS

$$
\begin{aligned}
& \begin{array}{l}
\text { Board-Antenna matching transformer tor } \\
\text { boadr } 1 \text { loss coile and capacitors } \\
\text { Board- Torminal board, } 5 \text { contact and ground }
\end{array}
\end{aligned}
$$

$$
\begin{aligned}
& \text { oii-RF plate } 1 . F \text {. coil ( } L 27 \text { ) coil (L7) } \\
& \text { oil-Shunt coil complete with adjustable core (L3 }
\end{aligned}
$$

$$
\begin{aligned}
& \begin{array}{l}
\text { Trantormer-Convertor transformer (T2, R8) } \\
\text { Trap } \\
\text { Trap } \\
\text { Trap IF trap complete with adjustable core (LS) }
\end{array}
\end{aligned}
$$

$$
\begin{aligned}
& \text { rF Unit assemblies-Krkize }
\end{aligned}
$$

$$
\begin{aligned}
& \begin{array}{l}
\text { Bracket-Drive mechanism mounting brackot tor } \\
\text { Hentas stanpod Kakizbl-M1 }
\end{array} \\
& \begin{array}{l}
\text { Bracket-Wamp bracket } \\
\text { Bracket-VFP inp technector and bracket } \\
\text { Backet- Vorticil trachet for oscillator tube shield } \\
\text { Camatine tuning cam }
\end{array}
\end{aligned}
$$



OJohn F. Rider


## GENERAL DESCRIPTION

Model 21-T. 393 teatures an AM/FM radio and full 12 channel
VHF coverage.
Madel $21 . T-393 U$
features an $A M / F M$ radio and full 12 channel VHF coverage plus any 4 UHF channels desired. AL models employ a three speed record changer and $a 12$ inch
PM dynamic speaker. inch" 21-T-392, 21.T-392U, 21-T-393 and 21-T-393U are " 21 inch" television, radio, phonograph combinations. Model age. Model 21-T-392U features an AM radio and full 12 channel VHF coverage plus any 4 UHF channels desired.

## ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE...... 227 square inches on a 21AP4 Kinescope TELEVISION R-F FREQUENCY RANGE $\begin{aligned} & \text { Models } 21 \text {-T-392 and } 21 \text {-T-393 }\end{aligned}$
All 12 VHF channels. 54 mc. to 88 mc. 174 mc . to 216 mc .
Any of 70 UHF channels
AUDIO OUTPUT RATING..... KCS83F. KCS83H, 4 watts max RC1117B....... 2.4 watts max., RS141D....... 10 watts max
LOUDSPEAKER.......(92569-12W) 12" PM Dynamic, 3.2 ohms antenna input impedance
Models 21.T-392 and 21-T.393
Choice: 300 ohms balanced or 72 ohms unbalanced
UHF- 300 ohms balanced. (Any desired
may be used.)
INTERMEDIATE FREQUENCIES
Picture I-F Carrier Frequency
Sound 1.F Carrier Frequency.
VIDEO RESPONSE...
SWEEP DEFLECTION.
FOCUS..
POWER SUPPLY RATNG
21-T-392, 21-T-393...
CHASSIS DESIGNATION
Chassis designation
Chassis RC1117B and Re.Television Chassis KCS83F, Radio Chassis RC1117. and Record Changer 930409.5 or -10.
In Model 21-T.393......Television Chassis KCs83F. Radio Chassis RClll1C. Audio Amplifier RS141D and Record Changer
930409.5 (mah.) 330409.5 (mah.).

In Model 21 TT 392 U ......Television Chassis KCS83H. Radio Chassis RC1117B and Record Changer 930409-5 or -10 Chassis RC1111C, Audio Amplifier RSI41D and Record Changer 930409.5 (mah.).

See Service Data 930409 for Record Changer information.


Model, 21-T.s92, 21-T-s92U
 Mahogany, Walnut

VHF- 300 ohms balanced.
 (5) RCA 35C5................................io Output (2 tubes)

Radio Chastis RClllle
......................F Amplifier (3) RCA 6BA $6 \ldots, \ldots, \ldots$, Oscillator and Mixer ....-F Amplifie Ratio Detector (6) RCA 6AV6......AM 2nd Det. and 1st Audio Amp Audio Chassis RS141D
 (2) RCA 6 VGGT $\ldots \ldots \ldots \ldots \ldots$...................... Output (2 tubes) (3) RCA 5 Y3GT. ...........................................ifier


ELECTRICAL AND MECHANICAL SPECIFICATIONS (Continued)


## (1) RCA 6BQ7a. <br> KCS83H-KRK12A T



A in82 crystal is used as a mixer

|  | All Models |
| :---: | :---: |
| RCA | .1st Picture I.F Amplifioz |
| (2) RCA 6CF6 | 2nd Picture I-F Amplifiter |
| (3) RCA 6Cb6 | 3rd Picture I.F Amp |
| (4) RCA 12 AU 7 | Picture 2nd Det. and Horiz. Sync. |
| (5) RCA $6 \times 8$ | Video Amplitier and Vert. Sync. |
| (6) RCA 12 AU 7 | Video Output an |
| (7) RCA 6AU6 | $18 t$ Sound I-F |
| (8) RCA 6AU6 | 2nd Sound I-F A |
| (9) RCA 6AL5 | Rat |
| (10) RCA 6A | dio An |
| (11) RCA | Audio |
| (12) RCA 6SN7GT. | Vert. Osc. \& Dischg. \& Sync. |
| (13) RCA 6K6GT | Vertical Sweep |
| (14) RCA 6SN7GT | Horiz. Sweep Oscillator and |
| (15) RCA 6BQ6GT | Horizontal Sweep OU |
| (16) RCA 6AX4GT | Dan |
| (17) RCA 1B3-GT/8016 | .High Voltage Rec |
| (18) RCA $21 \mathrm{AP4}$. | Kines |
| (19) RCA SU4G |  |
| (20) RCA 5 |  |



Figure 6-Models 21-T.392, 21-T.392U Cable Diagram

## operating conthols (fronil



Dual Control Knobe Sound Volume and On-OHt Switch
Picture Brine
Brighness...............
Picture Horizontal Hold. Picture Vertical Hold Picture Vertical Ho
TV Tone.......... Single Control under Panel Single Control under Pane Single Control under Panel .Single Control under Panel
non-operating controls (under Front Panal)

Height..................................screwdriver adjustment
Vertical Linearity......................erewdriver adjustment

NON-OPERATING CONTROLS (not including R-F and l-F adjustments)
 Width..............................ear chassis adjustmen Horizontal Drive............rear chassis screwdriver adjustmen Horizontal Linearity................... sear chassis adjustmen Horizontal Oscillator Waveform. ....rear chassis adjustme Horizontal Locking Range ..... rear chases adiusmen rear chassis adjustmen
Focu top chassis adjustmen Deflection Coill............................ . . chassis wing nut adjustmen AGC Control............................rear chassis adjustmen
horizontal sweep frequency. rear chassis adjustmen
vertical sweep frequenc
frame frequency (Picture Ropetition Rato).......... 30 cp


Figure 7-Models 21-T.393, 21-T.393U Cable Diagram


TEST EQUIPMENT.-To properly service the television chassi
of these receivers, it is recommended that the following tes equipment be available:
VHF Sweep Genorator meeting the following requirements (a) Frequency Ranges

35 to 90 mc... 1 mc. to 12 mc . sweep width
170 to $225 \mathrm{mc} ., 12 \mathrm{mc}$. sweep width
(b) Output adjustable with at least .1 volt maximum. (c) Output constant on all ranges.
(d) "Flat" output on all attenuator positions.

VHF Signal Generator to provide the following frequencies with crystal accuracy:
(a) Intermediate frequencies
4.5 mc.. $39.25 \mathrm{mc}$.
4.5 mc.. 39.25 mc., 41.25 mc ., 43.5 mc ., 45.75 mc .
47.25 mc . (b) Radio frequenci

Channel
Number


## Plicture Carrier Freq. Mc. .55 .25 61.25. 67.25. 77.25. 83.25. 175.25 181.25 187.25 193.25 199.25 205.25 211.25.

## TELEVISION ALIGNMENT PROCEDURE

Set the potentiometer to produce app
bias at the junction of R123 and C142.
Connect an oscilloscope to the junction of R135 and L102 and set the oscilloscope gain to maximum
Connect a VHF signal generator to the antenna input term
nals. Modulate the signal generator $30 \%$ with an audio Tuno Tune the signal generator to 45.75 mc. and adjust the gen.
erator output to give an indication on the oscilloscope. Adjust L4 in the antenna matching unit for minimum audio indication on the oscilloscope.
Tune the signal generator to 41.25 mc . and adjust Ll for
minimum audio indication on the oscilloscope miningnaudio nication on
Remove the jumper from the output of the matching unit. ground, keeping the leads as short as position resistor from L5 to Connect an oscilloscope low capacity crystal probe from L to ground. The sensitivity of the oscilloscope should be ap proximately 0.03 volts per inch. Set the oscilloscope gain to maximum
Connect the VHF sweep generator to the matching unit
antenna input terminals. In order the prevent coupling reac ance from the sweep generator into prevent coupling react advisable to employ a resistance pad at the matching it unit terminals. Figure 17 shows three different resistance pads for use with sweep generators with 50 ohm co-ax output, 72 ohm co-ax output or 300 ohm balanced output. Choose the pad to
match the output impedance of the particular sweep employ Connect the signal generator loosely to the matching uni antenna terminals.
Set the Set the sweep generator to $s$ weep from 45 mc . to 54 mc .
With RCA Type WR59A sweep generators, this may be accomplished by returning channel number 1 to cover this range With WR59B sweep generatoros this may be accomplished by
retuning channel number 2 to cover the range. In making retuning channel number 2 to cover the range. In making
these adjustments on the generator, be sure not to turn the these adjustments on the generator, be sure not to turn the
core too far clockwise so that it becomes lost beyond the core retaining spring.
L3 is most effective to obtain the response shown in Figure 11 L3 is most effective in locating the position of the shoulder of the curve at 52 mc . and 2 should be adjusted to give maximum shape of the response curve. The adjustments in the matchin unit interact to some extent. Repeat the above procedure until no further adjustments are necessary
Remove the 300 ohm resistor and crystal probe connections.
Restore the connection between L5 and S1-E. Replace V106.
SHOULDER 52 MC.
 PICTURE I.F TRANSFORMER ADJUSTMENTS Models 21-T. 392 and 21-T-393
Connect the i-f signal generator across the link circuit on Connect the "VoliOhmyst" to the junction of R123 and C142. Turn the AGC control fully clockwise.
Obtain two 7.5 volt batteries capable of withstanding appre potentiometer across and connect Connect the battery a 1,000 ohm potientiometer across each. Connect the batiery positive ter
minal of one to the chassis and the potentiometer arm to the junction of R123 and C142. The second battery will be used
later. later.
Set the bias 10 produce approximately -5.0 volt of bias at
the junction of R123 and C1422 Connect the "VoltOhmyst" to junction of R135:and 102 and to ground.
Set the VHF signal generator to each of the following fre quencies and peak the specified adjustment for maximum indi-
cation on the "Voltohmyst." During alignment. reduce input signal if necessary in order to produce 3.0 volts of d.c at input signal if necessary in order to produce 3.0 volts of d.c. at
R135 and Llo2 with -5.0 volts of i.f bias at the junction of $R 123$
and C142
44.5 mc.
45.5 mc.
43.0 mc Set the VHF signal generator to the following frequency and
adjust the picture $\mathrm{i}-\mathrm{t}$ trap for minimum d-c output at Rl 35 , adjust the picture ir trap for minimum d-c output at R135. L102 meter when the adjustment is made.
$47.25 \mathrm{mc} . \ldots$ Models $21-\mathrm{T} .392 \mathrm{C}$ and 21-T.393U
. 1118
Connect the "VoltOhmyst" to the junction of R123 and C142 Turn the AGC control fully clockwise.
Oblain a 7.5 volt battery capable of withstanding appre
ciable current drain and connect the ends of a 1,000 ohm potentiometer across it. Connect the battery positive termind poleniometer across it. Connect the battery positive termina
to chassis and the potentiometer arm to the junction R123 and
Cl42 Adjust C142. Adjust the
the "Voltohmyst." Connect the "VoltOhmyst" to the junction of R135 and L102 and to ground.
Connect the output of the signal generator to the fron
terminal of the crystal mixer inner terminal of the crystal mixer in series with a $1,500 \mathrm{mmf}$
ceramic capacitor Set the VHF
Set the VHF generator to each of the following frequencies
and with a thin fiber screwdriver tune the specified adjustmen and with a thin fiber screwdriver tune the specified adjustmen
for maximum indication on the "Voltohmyst". In each in stance the generator should be checked against a crysta
calibrator to insure that the generator is on frequency
During alignment, reduce the input signal is
During alignment, reduce the input signal if necessary in
order to produce 3.0 volts of d-c at R135 and L102 with -5.0 volts of i-f bias at the junction of R123 and C142.
$44.5 \mathrm{mc}$.
$45.5 \mathrm{mc}$.
$43.0 \mathrm{mc}$.

| T108 |
| :--- |
| T107 |
| 106 |

Set the signal generator to the following frequency and adius
the picture i.f trap for minimum d.c output at junction of R13s and L102. Use sufficient signal input to produce 3.0 volls of
d.c on the meter when adjustment is made. 47.25 mc ...

L118

## SWEEP ALIGNMENT OF PICTURE

Models 21-T-392 and 21 T 393
To align T 2 and T 104 , connect the sweep generalor to the
mixer grid test point TP2, in series with a 1500 mmi ceramia capacitor. Use the shortest leads possible, with not more than one inch of unshielded lead at the end of the sweep cable. Set the channel selector switch to channel 4
Clip 330 ohm resistors across terminals A and B of T107 and ${ }^{108 .}$ Preset C122 to minimum capacity.
Adjust the bias box potentiometer to obtain -5.0 volts of bias as measured by a "Voliohmyst" at the junction of R123 and
C142. Set the AGC control fully clockwise. Conect hac control fully clockwise.
to terminal A of T106. Connect the oscilloscope diode probe to terminal A of T106. Connect
to pin 5 of V106 and to ground.
Couple the signal generator loosely to the diode probe in
order to obtain markers.
orer

Adjust T2 (top) and T104 (top) for maximum gain and with 45.75 mc . at $75 \%$ of maximum response. Set the sweep output to give 0.3 volt peak-to-peak on the
oscilloscope when making the final touch on the above adjust-
ment.
Adjust C122 until 42.5 mc . is at $70 \%$ response with respect 10 the low frequency shoulder of the curve as shown in Figure
2. Maximum allowable till is Disconnect the diode probe, the 180 ohm and two 330 ohm Cosistors.
Connect the oscilloscope to the junction of R135 and L102. Leave the sweep generator connected to the mixer grid test
point TP2 with the shortest leads possible. Adjust the output of the sweep generator to obtain 3.0 volts peak-to-peak on the oscilloscope.
Couple the signal generator loosely to the grid of the first pix if amplifier. Adjust the output of the signal generator to

## Retouch 11 in Figure 13.



Figure $12-T 2$ and $T 104$
Response with KRK29
Figure 13-Over-all I-F
Response with KRK29

## Models 21-T-392U and 21-T.393U

To align the crystal mixer circuit and T2 and T104 connect he VHF sweep generator to the front terminal of the IN82 Use the shortest leads possible, grounding the sweep gen orator to the tuner case.
Clip 330 ohm resistors across terminals A and B of T107 and Set
Set the channel selector to channel 5 .
Connect a 180 ohm composition resistor from pin 5 of V106 pin 5 of V106 and to ground.
Couple the signal generator loosely to the diode probe in
order to obtain markers.
The shunt trimmer C122 across terminals A and B of T104 variable and is provided as a bandwidth adjustment. Preset he shunt trimmer to minimum capacity. Adjust T2 (top) and
T104 (lop) for maximum gain at 43.5 mc. and with 45.75 me. at $75 \%$ of maximum response
Adjust T1 for maximum gain. Readjust T 2 and T 104 if necessary to obtain proper wave shape, see Figure 14.
Disconnect the diode probe, the 180 ohm and the two 330
ohm resistors.
Connect the oscilloscope to the junction of R135 and L102.
Adjust the bias potentiometer to obtain - 5.0 volts of bias as
measured by a "VoltOhmyst" at the junction of R123 and C142. Leave the sweep generator connected to the front terminal with not more than one inch of unshielded lead at the end of the sweep cable. It these precautions are not observed, the ceiver may be . oblained
Adjust the output of the sweep generator to obtain 3.0 to
5.0 volts peak-to-peak on the oscilloscope. 5.0 vills peak-1opeak on the oscilloscope.

Couple the signal generator losely to the grid of the first
pix i-f amplifier. Adjust the output of the signal generator to produce small markers on the response curve. Retouch T106, T107 and T108 to obtain the response shown
in Figure 15. Remove the oscilloscope, sweep and signal generator conctions.
Remove the bias box employed to provide bias for alignment.


Figure 14-T2 and T104
Response with KRK12A $\quad \begin{gathered}\text { Figure 15-Over-all } \\ \text { I-F Response with KRK12A }\end{gathered}$

## TELEVISION ALIGNMENT PROCEDURE

## RRE29 TUNER ALIGNMENT

Models 21-T-392 and 21-T. 393
A tuner unit which is operative and requires only touch up adjustments, requires no preseting aragraph. For units which are completely out of adjustment, preset C27 all the way out. are channeel 7 to 13 oscillator slugs one turn from tight. Turn T2 slug all the way out. Do not change any of the adjustments the antenna matching unit
Disconnect the link from terminals " $A$ " and " B " of T 104 and
erminate the link with a 39 ohm composition resistor. Turn the receiver channel selector switch to channel 2. The 43.5 me. trap is adjusted with zero bias. To insure that he bias wint remain constant, take a hip lead and short circuil


Texkiti
Figure 16-KRK 29 Tuner Adjustments
Connect the oscilloscope to the test point TP1 on top of the tuner unit. Set the oscilloscope to maximum gain.
Connect the output of the VHF signal generator to the outpu of the antenna matching unit
the botiom of the FM trap 15 .
Tune the signal generator to 43.5 mc . and modulate it $30 \%$ with a 400 cycle sine wave. Adjust the signal generator fo maximum output.
Adjust C33 on top of the tuner, for minimum 400 cycle indica
tion on the oscilloscope. If necessary, this adustment can be retouched in the field to provide additional rejection to one specific frequency in the i.f band pass. However, in such cases. care should be taken not to tune
thereby reducing sensitivity on channel
Connect the potentiometer arm of one of the bias supplie to the AGC terminal on the tuner and ground the battery positive terminal to the tuner case. Adjust the bias potenti-
ometer to produce -30 volts of bias, as measured by the ometer to produce -3.0 volus of bias, as meas
"Voltohmyst" at the AGC terminal on the tuner.
Set the channel selector switch to channel 8 .
Preset C22 to read -3.0 volts at the test point TP1, as read on the "VoltOhmyst". The limits for oscillator injection voltag are 2 volts minimum and not exceeding a maximum of 5.5 volts.
Adjus majust C25 for proper oscillator frequency. 227 me. This
may which will be recommended in this procedure will be to use the signal generator as a heterodyne frequency meter and
beat the oscillator against the signal generator. To do this, beat the oscillator against the signal generatior. To do this,
tune the signal generator to $227 \mathrm{mc}$. with crystal accuracy Insert one end of a piece of insulated wire into the tuner unit through the hole provided for the adjustment of Cl6. Be care
ful that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscillator to shif it may cause the frequency of the tuner oscillator to shilt.
Connect the other end of the wire to the "r in" terminal of
the signal generator. Adjust C25 to obtain an audible bect
with the signal generator.
Turn the C27 clockwise until the beat note just begins Return the fine tuning control to the mechanical center of its range.
Note--II on some units, it is not possible to reach the proper
channel 8 oscillator frequency by adiustment of C25. switch channel 8 oscillator frequency by adjustment of C25. switch
to channel 13 and adjust L49 to obtain proper channel 13 oscillator frequency as indicated in the table on page 8 Then, switch to channel 12 and adjust $L 60$ to obtain proper
channel 12 oscillator frequency. Continue down to channel 8 , channel 12 oscillator frequency. Continue down to channel 8 ,
adjusting the appropriate oscillator trimmer to obtain the proper adjusting the appropriate oscillator trimmer to obtain the proper
frequency on each channel. Then again on channel 8, adjust C25 to obtain proper channel 8 oscillator frequency. Switch back to channel
and adjust C25.
Set the T2 core for maximum inductance (core turned counter-
lock wise).


Figure 17-Sweep Attenuator Pads
Connect the sweep generator through a suitable attenuator, as shown in
Connect the signal generator loosely to the antenna terminals. Set the sweep generator to cover channel 8 .
Set the oscilloscope to maximum gain and use the minimum input signal which will produce a usable pattern on the oscilloscope. Excessive input can change oscillator injection during alignment and produce consequent misalignment even
though the response as seen on the oscilloscope may look normal.
Insert markers of channel 8 picture carrier and sound carrier, 181.25 mc . and 185.75 mc .

Adjust C21, C16. C11 and C7 for approximately correct curve
hapes. frequency, and band width as shown in Figure 18 .


Figure 18-KRK29 R-F Response

The correct adjustment of C7 is indicated by maximum amplitude of the curve midway between the markers. Cl1 of the pass band most noticeably. C21 tunes the mixer grid circuit and affects the tilt of the curve most noticeably (assum-
ing that C 7 has been properly adjusted). C16 is the coupling ing that $\mathrm{C7}$ has been properly adjusted). C16 is the coupling width.
Connect the "VoltOhmyst" to test point TP1. Adjust C22 to
read -3.0 volts dc on the "VoltOhmyst" at TP1. Readjust C27 read -3.0 volls dc on the "VoitOhmysi" at TP1. Readjust C27 C21. C16 and C11 for proper response. Adjust C7 for maximum
gain at midpoint of the curve. Repeat it necessary until th proper response is obtained.
Set the receiver channel switch to channel 13 .
Adjust the signal generator to the channel 13 oscillator fre quency 257 mc .
Turn the fine tuning control fully clockwise.
Adjust L49 10 obtain an audible beat. Slightly overshoo the adjustment of L49 by turning the slug an additional turn in the same direction from the original setting, then reset the
oscillator to proper frequency by adjusting C 27 to again obtain the beat.
Set the sweep generator to channel 13 .
From the signal generator, insert channel 13 sound and
Adjust L36 and L20 for proper response as shown in Figure Turn off the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TPI
Check the oscillator injection voltage to be within limits as
previously specified. Adjust if necessary to bring within range
If it was necessary to readjust C22, turn the sweep and sign generators back on and recheck the channel 13 response. Re adjust L36 and L20 if necessary
Set the receiver channel selector switch to channel 8 and Seadjust 27 for proper oscillator frequency. 227 mc .
Set the sweep generator and signal generator to channel 8
Readjust C21. C16, C11 and C7 for correct curve shape, fre quency and bandwidth.
Tum off the sweep and signal generators, switch back to
hannel 13 and check the oscillator injection voltage at $T P$. channel 13 and check the oscillator injection voltage at
if C21 was adjusted in the recheck of channel 8 response.
Il the initial setting of the oscillator injection trimmer was far off. it may be necessary to adjust the oscillator frequency and response on channel th, adusi the oscillatior injection on channel 13 and repeat the tracking
before the proper setting is obtained.
Turn of
Adjust the signal generator to the channel 6 oscillator freAdjust the si
quency 129 mc .
Set the tine tuning control to the center of its mechanical
Adjust L54 for an audible beat. Adjust L48, and L32 for proper curve shape as shown in Figure 18. Recheck the orcilator injection volkage at limits specified. Readjust C22 it necossary
It C22 required adjustment, switch the receiver and the shape and recheck C27 and C25 for proper oscillator frequency. Check the response of channels 2 through 6 by switching the receiver channel switch. sweep generator and marker generator to each of these channels and observing the response typical response curves. It should be found that all these
channels have the proper response with the markers above $80 \%$ response.

If the markers fail to fall within this requirement readju a 10 and mart Switch the channel selector, signal generator and marker
generator through channels 7 to 13 and observe the respons curves, referring to Figure 18 for proper wave shape. Chec ine injection voltage at each channel to be within limite
necessary readjust C 11 . C21, or C16 to obtain the prope esponse.
With the receiver and signal generator on channel 13 adjust 49 for an audible beat with the signal generator.


Figure 19-KRK29 R-F Oscillator Adjustments
Adjust the oscillator to frequency on all channels by switch. ing the receiver and the frequency standard to each channel and adjusting the appropriate oscillator slug to obtain the
udible beat. It should be possible to adjust the oscillator to audain the audible beat on each channel. Recheck the oscillator injection voltage on each channel to verify that the voltage is

## kRK12A tuner alignment

## Models 21-T-392U and 21.T.393U

TUNER VHF ALIGNMENT.-Remove the 654 voltage control sube from its
Connect the 0.50 milliampere meter to the adapter socket and turn the adapter switch on.
Hemove the tuner cover shield.
Rotate the channel selector to a point midway between hannels, disengaging the inseri contacts, as bille the with the tuned circuits disengaged. To be sure the oscillator in a non-oscillatory state. short circuit the spring contactis
2 and 13 , the two contacts nearest the tuner front.
(NOTE: The contacts are at zero d-c potential.) Should the plate current rise, keep the contacts shortid while adjusting the oscillator plate current. Adjust R6, oscillator
trol, for a 28 milliampere reading on the meter.
Replace the tuner cover shield.
Connect the VHF sweep generator to the antenna terminals Connect the VHF signal generator loosely to the antennc erminals.
Connect the oscilloscope, through the preamplifier if needed with oscilloscope used, to test point TP1
Ground the AGC bias at the tuner terminal board using clip lead to insure that the bias will remain constant.
Tum off the adapter switch, removing plate voltage from
the oscillator. This is required because of RF-IF interaction when a crystal is used as a mixer.

Set the channel selector and the sweep generator to channel
2. Set the channel selector and the sweep generator to channel

Insert markers of channel 2 picture carrier and sound carrier, 55.25 mc. and 59.75 mc .

Adjust antenna T6, If. amplifier plate L29 and mixer L30
adjustments for $\alpha$ asmmetrical adjustments for a symmetrical curve with maximum gain at
the center of the pass band. The curves will have a deep the center of the pass band. The curves will have a deep
valley because of no crystal loading and nonlinear detector characteristics. The limits for the $100 \%$ response points are
shown in Ficure 20. The proper curve shape is shown io Figure shown in Figure 20. The proper curve shape is shown in Figure
20(b). (See Note on page 15 for detailed explanation of adjust20(b). (See Note on page 15 for detailed explanation of adjust-
ment.) It the bandwidth is out of tolerance, it can usually be corrected by redressing the coupling capacitor of the double
tuned circuit, C40 on insert A. Maximut band tuned circuit, C40 on insert A. Maximum bandwidth occurs
when the capacitor is centered in the insert chamber.


Figure 20-KRK12A VHF Insert Responses
Repeat the above steps for all VHF channels adjusting the appropriate antenna. r.f amplifier plate and mixer slugs for
a symmetrical curve with maximum gain at the center of the a symmetric
pass band.
Turn off the sweep generator
Remove the oscilloscope and preamplifier if used, from test point 1 PI.
Turn the AGC control fully clockwise
Remove the clip lead grounding the AGC bias on the tuner
reminal board.
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery positive terminal to the tuner case. Adjust the bias potentiometer to produce -3.5 volis of biass, as macasured by the "VoltOhmyst" at the AGC terminal on the tuner.
Connect the potentiometer arm of the second bias supply
to the junction of R123 and C142, and ground the positive to the junction of R123 and Cl42, and ground the positive
battery terminal. Adjust the bias potentiometer to produce battery terminal. Adjust the bias potentiometer to produce
-5 volts of i - bias as indicated on the "Voltohmyst" at the junction point.
Connect the oscilloscope to the junction of R135 and L102. Use 3 to 5 volts peak-to-peak output on the oscilloscope. Turn the adapter switch on to apply plate voltage to the .
Turn the channel selector to channel 13 .
Set the fine tuning control to the center of its range.
Adjust the oscillator slug $\mathbf{L 2 2}$ to proper frequency, 257 mc . This may be done in several ways. The easiest way and the
way which will be recommended in this procedure will be to use the signal generator as a heterodyne frequency meter
and beat the oscillator aginst the signal generator. To do and beat the oscillator against the signal generator. To do
this, tune the signal generator to 257 me. with crystal accuracy. Insert one end of a piece of insulated wire into th tuner through either of the two holes next to the oscillator
tube on the right front top corner of the tunar. Be careful tube on the right front top corner of the tuner. Be careful
that the wire does not touch any of the tuned circuils as it may cause the frequency of the oscillator to shift. Connec may cause the frequency of the oociliator to shitt. Connect
the other end of the wire to the "r r in" terminal of the signal generator. Adjust L22 oscil
Turn on the sweep generator and set to channel 13. Adjus T1 for maximum gain on the oscilloscope. Adjust mixer tank circuit L21 for maximum gain and flat-topped curve. Recheck T1 for maximum gain at center of band with the procer re.
sponse. Maximum gain and flat-lopped response should be sponse. Maximum gain
obtained simultaneously.
Adjust the oscillator to frequency on all VHF channels by
switching the receiver and signal generator to each VHF swiching the receiver and signal generator to each VHF a beat with the signal generator. Adjust the appropriat ontain a beal with the signal generatior. Adjust the appropriate mixer
slug where necessary to obtain maximum gain and proper
curve shape as explained above.

## TELEVISION ALGGMENT PROCEDURE

Adjust the tunable I.F Trap C16-L7. To do this connect the signal generator to the fixed I-F Trap C2-L2 at the ond opposite
the antenna terminal plug. Set the signal generator to 43.5 me. and adjust the output of the signal generator to obtain ufficient indication on the oscilloscope. Tune the I-F Trap C16-
7 for minimu indication on the oscilloscope.
Remove the signal generator and the oscillosco


Connect the UHF sweep generator to the antenna terminale Use a 10 DB attenuator pad to assure proper alignment.
Connect the UHF signal generator loosely to the antenna erminals
Set the channel selector to the desired position and the sweep generator to sweep the frequency of the insert being used.

Insert markers of the picture carrier and sound carrier for desired channel.
Adjust UHF antenna, link coupling and mixer adjustments for a symmetrical curve, with maximum gain, centered about the pass band. The responses are shown in Figure 22. The curve 22 (c) will usually vary from Fig. 22 (a) to Fig. of these rasponses are acceptable.


Figure 22-KRK12 UHF Insert Responses
Repeat the above steps for all UHF inserts used adjusting the appropriate antenna, link coupling and mixer slugs for a symmetrical curve, with maximum gain, centered about the pass band.
Remove the oscilloscope and preamplifier if used, from test point TPl.
Remove the clip lead grounding the AGC bias on the tuner terminal board.

Connect the potentiometer arm of one of the bias supplies to the AGC terminal on the tuner and ground the battery positive terminal to the uner case. Adjust the bias potentiometer to produce -3.5 volts of bias, as measured by the
"VoltOhmyst" at the AGC terminal.
Connect the potentiometer arm of the second bias supply to the junction of R123 and C142, and ground the positive battery terminal. Adjust the bias poleniometer to produce -5 volts of i.h bias oint.

Connect the oscilloscope to junction of R135 and (102. Use 3 to 5 volts peak-to-peak output on he oscilloscop

Turn the adapter switch on to apply plate voltage to the oscillator.
Turn the channel selector to the lowest UHF channel to be used.
Set the tine tuning control to the center of it

Figure 21-KRK12A Tuner Adjustments

## TUNER UHF ALIGNMENT.-To aliyn the UHF inserts

 Turn off the adapter switch, removing plate voltage from theoscillator. Ground the AGC bias at the tuner terminal board using a hat the bias will remain constant.

Connect the oscilloscope, through the preamplifier if needed
with oscilloscope used, to test point $T P$.

## ange

Adjust the oscillator core until the inarkers for 45.75 mc . and the picture carrier coincide on the sweep pattern on the - Adict

Adjust mixer core for maximum gain with proper wave Connect the "VoltOhmyst" to test point TP1, using 1.5 volt
D.C. scale. Set oscillator injection adjustment to read .1 volt on the Voltohmyst."
Repeat the above steps for all UHF inserts adjusting the
oscillator injection oscillator injection control only if the reading on the "Volt.
Ohmyst" exxeeds 3 volt Adjust as nesary to Ohmyst" exceeds .3 volt. Adjust as necessary to read .3 volt
or less at TPI.


Figure 23 Sound
l.F Response
l-F Response


Figure 24 Ratio
Det. Response

As an alternale method, this step may be omitted at this point in the alignment procedure and the adi
"on the air" after the alignment is completed.
If this is done, tune in a station and observe the picture on The kinescope. If no 4.5 mc. beat is present in the picture, when the fine tuning control is set for proper oscillator.frequency,
then L104 requires no adjustment. If a 4.5 mc . beat is present. urn the fine tuning control slightly clockwise so ast to exagger
ate the beat and then adjust L104 for minimum beat.
AGC CONTROL ADJUSTMENT.-Disconnect all test equip. ment except the oscilloscope which should be connected to pin

Connect an antenna to the receiver antenna terminals.
Turn the AGC control fully counter-clockwise.
Tune in a strong signal and adjust the oscilloscope to see
the video waveform. video wavetorm.
Turn the AGC control clockwise until the tips of sync begin 1o be compressed, then counterclockwise until no compression HORIZONTAL OSCILLATOR ADJUSTMENT. - Normally the adjustment of the horizontal oscillator is not considered to be part of the alignment procedure, but since the oscillator wavenot be done conveniently in the field. The waveform adjustment is made at the factory and normally should not require readjustment in the field. However, the wavetorm adjustment ever the horizontal oscillator operation is improper. or when-
.

Horizontal Frequency Adjustment-Tune in a station and sync the picture. If the picture cannot be synchronized with
the horizontal hold control R196, then adjust the T114 frequency core on the rear apron until the picture will symchronize.
II the picture still will not sync. turn the T114 wavetorm adjust. If the picture still will not sync. turn the T114 wavetorm adjust-
ment core (under the chassis) out of the coil several turns from its original position and readjust the T114 frequency core until the picture is synchronized

Examine the width and linearity of the picture. If picture
width or linearity is incorrect, adjust the horizontal drive conwidth or linearity is incorrect, adjust the horizontal drive control C174B, the width control L109 and the linearity control
Lill until the picture is correct.
Horizontal Osclllator Wave
Horizontal Osclllator Wavetorm Adjustment-The horizontal
oscillator wavetorm may be adjusted by either of two methods. The method outlined in paragraph $A$ below may be employed in the field when an oscilloscope is not available. The service shop method outlined in paragraph B below requires the use
of an oscilloscope.

OJohn F. Rider
A.- Turn the horizontal hold control completely clockwise.
lace adjustment tools on both cores of T114 and be prepared to make simultaneous adjustments while watching the picture on make simultaneous adjustments while watching the picture apron) until the picture talls out of sync and three or four iagonal black bars sloping down to the right appear on the
creen. Then, turn the waveform adjustment core (under the chassis) into the coil while at the same time adjusting the frequency core so as to maintain three or four diagonal black
bars on the screen. Continue this procedure until the oscillator begins to molorboat, then turn the wroceuvere until the oscillator
out until the majustment core out until the motorboatitng just stops. As $a$ check. turn the T114
irequency core until the picture is synchronize then reverse frequency core until the picture is synchronized then reverse
the direction of rotation of the core until the picture falls out of sync with the diagonal bars sloping down to the right. Continue to turn the frequency core in the same direction. No
more than three or four bars should appear on the screen. more than three or four bars should appear on the screen.
Instead. the horizontal oscillator should begin the motorboat. Retouch the adjustment of the T114 waveorm adjustment core
if necessary until this condition is oblained. if necessary until this condition is oblained.
B.-Connect the low capacity probe of an oscilloscope to
eerminal C of Til4. Turn the horizontal hold control one quarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown
in Fiqure 25. Adjust the waveform adiustment coas of T114 until the two peaks are at the same height During this adjust ment. the picture must be kept in sync by readjusting the
hold control if necessary. This antrol if necessary.
This adjustment is very important for correct operation of
the circuit II the broad peak of the wave on the oscilloscope
is lower is lower than the sharp peak. the woise immunity becomes
poorer, the stabilizing effect of the tuned circuit is reduced poorer, the stabizzing etrect of the tuned circuit is reduced
and drift of the oscillator becomes more serious. On the other hand, it the broad peak is higher than the sharp peak, the oscillator is overstabilized, the pull-in range becomes inade quate and the broad peak can cause double triggering of the
oscillator when the hold control approaches the clockwise
position osition
Remove the oscilloscope upon completion of this adjustment.



Figure 25-Horizontal Oscillator Wave Forms
Horizontal Locking Range Adjustment--Set the horizonta hold control to the full counter-clockwise position. Momentarily
remove the signal by switching ott channel then back picture may remain in sync. If so turn the T114 frequency core slightly and momentarily switch oft channel. Repeat until the
picture falls out of sync with the diagol lines slapit picture falls out of sync with the diagonal lines sloping down
to the left. Slowly turn the horizontal hold control clockwise and note the least number of diagonal bars obtained just before
the picture pulls into sync.

It more than 3 bars are present just before the picture pulls
into sync. adjust the horizontal locking range trimmer C174A
 slighty counter-clockwise. Tumn the horizontal hold control
counter-clockwise, momentarily remove the signal and recheck the number of bars present at the pull-in point. Repeat this
procedure until 2 or 3 bars are present. procedure until 2 or 3 bars are present.
Turn the horizontal hold control to the maximum clockwise
position. Adjust the T114 frequency core so that the diagoonal bar sloping down to the right appears on the screen and then reverse the direction of adjustment so that bar just moves to
the left side of the screen leaving the picture in synchronization

SENSITIVITY CHECK-A comparative sensitivity check can be made by operating the receiver on a weak signal from a to that obtained on other receivers under the same condaitions. This weak signal can be obtained by the same conditions. The number of stages in the a a ladder type attenuator pad. The number of stages in the pad depends upon the signal
strength available at the antenna. A sufficient number of stages should be inserted so that a somewhat less than normal ontrast picture is obtained when the picture control in at the
naximum clockwise position. Only carbon type resistors should be used to construct the pad.
REFLECTIONS.-Multiple images sometimes known as echoes Inosts, are caused by the signal arriving at the antenna by
wo or more routes. The second or subsequent in when a signal arrives at the antenna after being reflected oft a building, a hill or other object. In severe cases of reflections, even the sound may be distorted. In less severe cases. reflec.
ions may occur that are not noticeable as reflections but that tions may occur that are not noticeable as reflections,
will instead couse a loss of definition in the picture.
Under certain extremely, unusual conditions, it may be pos-
ible to rotate or position the antena sleanest picture over a reflected path. If such is the case, the anienna should be so positioned. However, such ${ }^{\text {sat }}$ position
may give variable results as the nature of retlecung sunaces may vary with weather conditions. Wet surfaces have been known to have different reflecting characteristics than dry arfaces
Depending upon the circumstances. it may be possible 10
iminate the reflections by rotating the antenna or by moving it to a new location. In extreme cases. it may be impossible to liminate the reflection.
INTERFERENCEE-Auto ignition, street cars, electrical maspoils the dicture. Whenever possible, the antenna location should be removed as far as possible from highways, hospitals, doctors' ottices and similar sources of interference. In mount ing the antenna, care must be taken to keep the antenna rods
at least $1 / 4$ wave length (at least 6 feet) away from other antennas, metal roofs. gutters or other metal objects. Short-wave radio transmitting and receiving equipment may In some instances it may be possible to eliminate the riple ference by the use of a trap in the antenna transmission line as the television station, a signal is on the same frequenc as the television station, a trap will provide no improvemen
The response curves are shown in the classical manner of presentation, that is with "response up" and low frequency to
the left. The manner in which the eft. The manner in which they will be seen in a given test
set-up will depend upon the characteristics of the oscilloscope and the sweep generator. The curves may be seen inverted and/or switched from left to right depending on the deflec
tion polarity of the oscilloscone and qenerator.
KRK29.of the tuner leade of the frequency spectrum involvea, many power supply leads form critical in some respects. Even the circuits, and if resonant at any of the frequencies involved ined from the desired of the tuner, may cause serious departures these undesirable characteristics. In the design of the receive away in frequency to allow reasonable latitude far enough arrangement without being troublesome. When the tuner is aligned in the receiver, no trouble from resonant loops should be experienced. However, if the unit is aligned in $\alpha$ jig separate
from the receiver, attention should be paid from the receiver, attention should be paid to insure that
unwanted resonance does not exist which might present a faulty representation of alianment.
KRK12A.The use of a crystal mixer makes it necessary to
 hallowed to operate during alignment. Therefore, the responses hown in Figure 20 are not a strictly true representation of the aligned, using an oscilloscope to observe the response, the curve shown in Figure 20 (b) will be the correct response for reference. In actual operation, the band pass will be such that
he sound and picture carriers will be al the tips of the curve he sound and picture carriers will be at the tips of the curve.
The adjacent channel picture and sound carriers will be in the valleys at each side. Caie should be taken not to exceed the

TELEVISION ALIGNMENT DATA


Figure 26-Top Chassis Adjustments (KRK29 Tuner shown)


Figure 27-Bottom Chassis Adjustments (KRK29 Tuner shown)

The valley, in the center of the response curve, may vary
rom 0 to $50 \%$ above the base line for VHF inserts. Adjust the output level of the sweep generator to prevent excessive signal input to the tuner. Excessive signal input will be indicated by
the valley rising above the $50 \%$ level, particularly on the higher VHF channels.

Oscillator injection voltage is not adjusted on VHF inserts A check may indicate variations from .08 to .3 volts at TPI, bu trouble. On UHF channels. however, the in indication should be adjusted to fall within the specified limits.


## RADIO ALIGNMENT PROCEDUBE

Betore aligning set, completely mesh the gang and set the dial pointer to the mechanical max. calibration point at extreme lef end of dial. When making a complete alignment follow the table below in sequence. Connect the output meter across the speaker
voice coil. and turn the receiver volume control to max. Turn tone controls for maximum highs and maximum lows. AM" I-F ALIGNMENT

| Steps | Connect the High Side of the Test Osc. to- | Tune Test Osc. to | Function | Turn Radio Dial to- | Adjust the following |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Pin No. 1 of (V3) in series with 01 mfd . | 455 kc . Modulated | AM | Low Freq. end of Dial | $\dagger$ Top and bot. cores of T4 For max. voltage across voice coil. |
| 2 | $\begin{gathered} \text { Stator of Cl-D } \\ \text { in series with } .01 \mathrm{mid} . \end{gathered}$ | 455 kc. Modulated | AM | $\begin{gathered} \text { Low Freq. end } \\ \text { of Dial } \end{gathered}$ | tTop and bot. cores of T2 For max. voltage across voice coil. |

+For proper adjustment of the i.f cores start with the cores all the way out. The first peak obtained will be the correct one.

## OCEDURE

| Steps | Connect the High Side of the Test Osc. to- | Tune Test Osc. | Function | Radio Dial Tuned to- | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| ${ }^{3}$ | Pin No. 1 of V4 in series with .01 mid . | 10.7 mc . | FM |  | Top of Ratio Det. Trans. T5 for maximum DC on "VoltOhmyst" |
| 4 | Pin No. 1 of V4 in series with .01 mfd . | $30 \%$ AM Modulated | FM | - | Bottom of Ratio Det. Trans. T5 for minimum audio output on meter. |
| 5 | Repeat steps 3 and 4 as necessary making linal adjustment with input set to give approx. $\mathbf{- 4 . 0} \mathrm{v}$. on "Voltohmyst." |  |  |  |  |
| 6 | Pin No. 1 of V3 in series with 01 mid. | 10.7 mc . | FM | 88 mc . | $\dagger$ Top and bottom cores of T 3 for maximum d.c across C39. |
| 7 | Stator of Cl-C in series with 01 mid. | 10.7 mc . | FM | 88 mc . | $\dagger$ Top and bottom cores of Tl for maximum d-c across C39. |
| 8 | Connect sweep generator cable to antenna terminals through 120 ohms in each side of line. | $\begin{gathered} 90 \mathrm{mc} . \\ 22.5 \mathrm{kc} . \mathrm{FM} \text { mod. } . \\ 10 \mathrm{mc.} . \\ 22.5 \mathrm{kc} . \mathrm{FM} \text { mod. } . \end{gathered}$ | FM | 88 mc . | $\ddagger$ \#SC, Le for max. audio output. |
| ${ }^{9}$ |  |  | FM | Tune to signal | ANT, C1-FT and R-F Cl-CT for max. voltage across C39. |
| 10 |  | $\begin{gathered} 90 \mathrm{mc} . \\ 22.5 \mathrm{kc} . \mathrm{FM} \text { mod. } . \end{gathered}$ | FM | Tune to signal | $\ddagger$ ANT, L1 and P-F L2 for max. voltage across C39. |

11 Hepeat steps 8, 9 and 10 as required
Connect a scope to junction R33 and C35, check response and linearity. Peak separation should be at least 180 $\dagger$ For proper adjusment of the i.f cores start with the cores all the way out. The first peak obtained is the correct one
$\ddagger_{\text {Adjustable by increasing or decreasing spacing berw }}$


RADIO SCHEMATIC DIAGRAM


#  

| The following measurements represent two sets of conditions. In the first condition, a 15000 microvolt test pattern signal was fed into the receiver, <br> TELEVISION VOLTAGE CHART the picture synced and the AGC control properly adjusted. The second condition was obtained by removing the antenna leads and short circuiting the receiver antenna terminals. Voltages shown are read with a type WV97A senior "VoltOhmyst" between the indicated terminal and chassis ground and with the receiver operating on 117 volts, 60 cycles, $a \cdot c$. The symbol < means less than. |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| TubeNo. | $\underset{\substack{\text { Tube } \\ \text { Type }}}{ }$ | Function | Operating <br> Condition | E Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements | $\begin{aligned} & \text { Tube } \\ & \text { No. } \end{aligned}$ | $\begin{gathered} \text { Tube } \\ \text { Type } \end{gathered}$ | Function | OporatingCondition | E. Plate |  | E. Scroon |  | E. Cathod |  | E. Grid |  | Notas on Mosaramente |
|  |  |  |  | $\begin{aligned} & p_{\text {in }} \\ & \text { No. } \end{aligned}$ | Volis | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \begin{array}{l} \text { Pin } \\ \text { No } \end{array} \end{aligned}$ | Volts |  |  |  |  |  | $\begin{aligned} & P_{\text {in }} \\ & \text { No. } \end{aligned}$ | Volts | Pin No. | volte | $\xrightarrow{\text { Pin }}$ No. | volts | ${ }_{\substack{\text { Pin } \\ \text { No. }}}$ | volts |  |
| KRK29 | 6BO7A | ${ }^{\text {R.F }}$ Amplifier | $\underset{\text { Signal }}{\substack{15000 \text { Mu. V. }}}$ | 6 | 170 | $\cdots$ | - | 8 | 0.1 | 7 |  |  | v108 | ${ }_{6} 6 \mathrm{B6}$ | 3rd Pix. I-F <br> Arn plifier | $\underset{\substack{15000 \mathrm{Mu} \\ \text { Signal V. }}}{ }$ | 5 | 138 | 6 | 150 | 2 | 2.3 | 1 | 0 |  |
|  |  |  | No Signal | 6 | 133 | - | -- | 8 | 1.1 | 7 | 0 |  |  |  |  | No Signal | 5 | 130 | 6 | 143 | 2 | 2.2 | 1 | <0.1 |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Amplifiee } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} \\ \text { Signal } \end{gathered}$ | 1 | 270 | $\sim$ | - | 3 | 170 | 2 | - |  | v109A | 12AUT | Picture2nd Det. | 15000 Mu . V. <br> Signal |  |  |  |  |  | 0 | 2 | ${ }^{-1.85}$ |  |
|  |  |  | No Signal | 1 | 260 | - | - | 3 | 133 | 2 | - |  |  |  |  | Signal No Signal |  | -25.8 -14 | - | - | 3 | 0 | 2 | ${ }_{-1.85}^{-6}$ |  |
| $\begin{aligned} & \text { v2 } \\ & \text { KRK29 } \end{aligned}$ | 6x8 | Mixer | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 9 | 160 | 8 | 160 | 6 | 0 | 7 | $\begin{array}{\|c\|} \hline-2.4 \text { to } \\ -3.0 \\ \hline \end{array}$ |  | v109B | $12 \mathrm{AU7}$ | Horiz. Sync Separator | $\begin{gathered} \text { No Signal } \\ \hline 15000 \mathrm{Mu} . \mathrm{v} . \end{gathered}$ |  |  |  | - |  |  | 2 |  |  |
|  |  |  |  | 9 | 145 | 8 | 145 | 6 | 0 | 7 | $\underset{\substack{2.8 .8 \\-3.5}}{\substack{\text { co }}}$ |  |  |  |  | Signal | 6 | 260 | - | - | 8 | 160 | 7 | 122 |  |
|  |  |  | No Signal | 9 | 145 | 8 | 145 | 6 | 0 |  |  |  |  |  |  | No Signal | 6 | 253 | - | - | 8 | 105 | 7 | 94.5 |  |
|  |  | R-F Oscillator | $\underset{\text { Sigu. }}{15000 \text { Mu. }}$ <br> Signal | 3 | 95 | - |  | 6 | 0 | 2 |  |  | viloa | 6x8 | Video <br> Âmplifie | $15000 \mathrm{Mu} . \mathrm{V}$. <br> Signal | 9 | 120 | 8 | 147 | 6 | . 9 | 7 | $-1.85$ | AGC control let for normal operation |
|  |  |  | No Signal | 3 | 90 | - | - | 6 | 0 | 2 | ${ }_{-5.1}^{-3.010}$ |  |  |  |  | No Signal | 9 | 95 | 8 | 138 | 6 | 1:35 | 7 | -. 6 |  |
| KRK12A | 6B07A | $\begin{aligned} & \text { R.F } \\ & \text { Amplifier } \end{aligned}$ | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 6 | 143 | - | -- | 8 | 1.2 | 7 | 0 |  | vilob | 6x8 | $\begin{array}{\|l\|l\|} \hline \begin{array}{l} \text { Vort. Sync } \\ \text { Soparator } \end{array} \end{array}$ | $\begin{aligned} & 15000 \text { Mu. V. } \\ & \text { Signal } \end{aligned}$ | 3 | 79 | - | - | 6 | . 90 | 2 | -26.8 |  |
|  |  |  | No Signal | 6 | 138 | $\cdots$ | - | 8 | 1.0 | 7 | 0 |  |  |  |  | No Signal | 3 | 46.5 | - | - | 6 | 1.35 | 2 | -2.1 |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Armplifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} \mathrm{~V} \\ \text { Signal } \end{gathered}$ | 1 | 260 | - | - | 3 | 143 | 2 | 97 |  | v111A | 12AU7 | $\begin{aligned} & \text { Vidoo } \\ & \text { Output } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 6 | 231 | - | _ | 8 | 13 | 7 | 0 |  |
|  |  |  | No Signal | 1 | 250 | - | - | ${ }^{3}$ | 137 | 2 | 97 |  |  |  |  | No Signal | 6 | 225 | - | - | 8 | 12.5 | 7 | 0 |  |
| KRKI2A | 6 FF 4 | $\begin{aligned} & \text { R-F.F } \\ & \text { Oscillatar } \end{aligned}$ | $\begin{gathered} 15000 \text { Mu. V. } \\ \text { Signal } \end{gathered}$ | 1\&2 | 78 | - | - | 5 | 0 | 2\% 6 | -8 |  | v1118 | 12AU7 | $\left.\right\|_{\substack{\text { AGMplifior }}}$ | $15000 \mathrm{Mu} . \mathrm{V}$ Signal | 1 | -55 | - | - | 3 | 135 | 2 | 125 |  |
|  |  |  | No Signal | 187 | 75 | - | - | 5 | 0 | ${ }^{248} 6$ | ${ }^{-6}$ |  |  |  |  | No Signal | 1 | 0.3 | - | - | 3 | 132 | ${ }^{2}$ | 68 |  |
| v3 | 6B07A | I-F <br> Amplifie | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} \\ \text { Sigral } \end{gathered}$ | 6 | 270 | - | -. | 8 | 148 | 7 | 103 |  | v112A | 6SNTGT | $\begin{array}{\|l\|l} \hline \text { Sync } \\ \text { Output } \end{array}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | 83 | - | - | 3 | 0 | 2 | $-3.28$ |  |
|  |  |  | No Signal | 6 | 260 | - | - | 8 | 142 | 7 | 99 |  |  |  |  | No Signal | 1 | 84 | - | - | 3 | 0 | 2 | -1.3 |  |
| кRK12A |  | I-F <br> Amplifier | $\underset{\text { Signal }}{\substack{15000 \mathrm{Mu} . \mathrm{V} \\ \hline}}$ | 1 | 148 | - | -- | 3 | 1.4 | 2 | 0 |  | v1128 | 6SN7GT | Vortical <br> Oscillator <br> \& Discharge | $15000 \mathrm{Mu} . \mathrm{V}$. <br> Signal | 1 | 80 | - | - | 8 | 0 | 7 | $-63.5$ | $\begin{gathered} \text { Doponds on ootting of Vort! } \\ \text { hold control } \end{gathered}$ |
|  |  |  | $\underbrace{\text { (500 Mu. V }}_{\text {No Signal }}$ | 1 | 143 | - | - | 3 | 1.2 | 2 | 0 |  |  |  |  |  | 6 | 182 |  | - | 8 | 0 | 7 | -60 | Voltages shown are eynced pix adjustment |
| $v_{4}$ кRK12A | 654 | $\begin{aligned} & \text { Voltage } \\ & \text { Control } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . V \\ \text { Sigral } \end{gathered}$ | 9 | 270 | - | - | 2 | 94 90 | 6 | $\stackrel{* 68}{* 65}$ | 'Depends on adjustment of R6. | v113 | 6K6GT | $\begin{array}{\|l\|l\|} \text { Vortical } \\ \text { Output } \end{array}$ |  | ${ }^{6}$ | 182 253 | - | 262 | 8 | 0 | 5 | $-28.8$ |  |
|  |  |  | No Signal | 9 | 260 | - | - | 2 | 90 | 6 | ${ }^{65}$ |  |  |  |  | No Sional | 3 | 245 | 4 | 253 | 8 | 0 | 5 | $-27.5$ |  |
| v101 | 6AU6 | $\begin{aligned} & \text { ist Sound } \\ & \text { I-FAmp. } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu} . \\ \text { Signal }}}{ }$ | 5 | 122 | 6 | 138 | 7 | 1.01 | 1 | 0 |  | v114 | 6SN70t |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  | No Signal | 5 | 113 | 6 | 126 | 7 | 95 | 1 | 0 |  |  |  |  | $\begin{gathered} \text { Signal } \\ \hline \text { No Signal } \end{gathered}$ |  | 175 | - | - | 3 | -3.5 -5.5 | 1 | -21 |  |
| v102 | 6AU6 | $\begin{aligned} & \text { 2nd Sound } \\ & \text { I-F Amp. } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} \cdot \mathrm{~V} . \\ \text { Signal } \end{gathered}$ | 5 | 210 | 6 | 130 | 7 | 0 | 1 | -2.05 | *Unreliable measuring point Voltage depende on noise |  | 6Sn7ct | Horizontal <br> Oecillator | $\frac{\text { No Signal }}{15000 \mathrm{Mu} . \mathrm{V} \text {. }}$ | 2 |  | - |  |  |  | + |  |  |
|  |  |  | No Signal | 5 | 205 | 6 | 122 | 7 | 0 | 1 | *-1.12 |  |  |  |  | Signal | 5 | 183 | - | - | 6 | 0 | 4 | -67 |  |
| v103 | 6AL5 | Ratio Detector | $\begin{aligned} & 15000 \mathrm{Mu} . \mathrm{V} . \\ & \text { Signal } \end{aligned}$ | 7 | 1.7 | - |  | 1 | 21 | - | - | 7.5 kc deviation at 1000 eycles | v115 | ${ }^{68066 T}$ | $\begin{array}{\|l\|} \text { Horizontal } \\ \text { Output } \end{array}$ | No Signal | 5 | 179 | - | - | 6 | 0 | 4 | -65 | * High Voltage |
|  |  |  | No Signal | 7 | 4.1 | - | - | 1 | 11.8 | - | - |  |  |  |  | Signal | Cap | - | 4 | 193 | 8 | 22 | 5 | -14 |  |
|  |  | $\begin{aligned} & \text { Ratio } \\ & \text { Detector } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 2 | 1.7 | - | - | 5 | 21 | - | - |  |  |  |  | No Signal | Cap | - | 4 | 185 | 8 | 20.5 | 5 | $-13.5$ | Puleo Proont |
|  |  |  | No Signal | 2 | 4.1 | - | - | 5 | 11.8 | - | - |  | v116 | $\begin{aligned} & 183 \mathrm{BT} \\ & 180016 \end{aligned}$ | $\begin{array}{\|l\|l} \text { H. V. } \\ \text { Rectitior } \end{array}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | * | - | - | 227 | 18,700 | - | - | PHigh Voltage Puleo Prosent |
| v104 | 6Av6 | $\begin{aligned} & \text { let Audio } \\ & \text { Amplifior } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 7 | 78 | - | - | , | 0 | 1 | - -7 | At min. volume |  |  |  | No Signal | Cap | . | - | - | $2 \% 7$ | 18,350 | - | - | *High Voltoge Pule Present |
|  |  |  | No Signal | 7 | 76 | - | - | , | 0 | 1 | -. 65 | At min. volume |  |  |  | $\begin{aligned} & 15000 \mathrm{Mu} . \mathrm{V} . \\ & \text { Sianal } \end{aligned}$ | ${ }_{5}$ | 261 | - | - | 3 | . | - | - | *High Voltage <br> Pule Present |
| v10s | ${ }^{666 G 7}$ | $\begin{aligned} & \text { Audio } \\ & \text { Output } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu} \\ \text { Signal }}}{ } \mathrm{V}$. | 3 | 205 | 4 | 220 | 8 | 15.2 | 5 | 0 | At min. volume | $v 117$ | 6AX46T | Damper |  |  |  |  |  |  |  |  |  | ${ }^{\text {Hentigh Voltage }}$ |
|  |  |  | No Signal | 3 | 198 | 4 | 207 | 8 | 14.5 | 5 | 0 | ${ }^{\text {At min. }}$ volume |  |  |  | No Signal | 5 | 253 | - | - | 3 | - | - | - | Puice Proent |
| v106 | ${ }^{6 C 56}$ | lat Pix. I.FAmplifier | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | 5 | 218 | 6 | 240 | 2 | 132 | 1 | -8.2 | *Unreliable measuring point. Make measurement at T104-B | v118 | ${ }^{21 A P 4}$ | Kineacop• | $\underset{\substack{15000 \mathrm{Mu} . \\ \text { Signal }}}{ }$ | Cap | 18,700 | 10 | 428 | 11 | 44.5 | 2 | 0 | At avorage Brightrote |
|  |  |  | No Signal | 5 | 95.5 | 6 | 105 | 2 | 1.18 | 1 | * 0.1 |  |  |  |  | No Signal | Cap | 18,350 | 10 | 425 | 11 | 39.5 | 2 | 0 | Atavorage Brightnoes |
| v107 | ${ }^{6 C 56}$ | $\text { 2nd Pix. I- } F$ <br> Amplifier | $\begin{gathered} 15000 \text { Mu. V. } \\ \text { Signal } \end{gathered}$ | 5 | 222 | 6 | 243 | 2 | $<0.1$ | 1 | -8.45 |  | $\begin{aligned} & \mathrm{v} 119 \\ & \mathrm{v} 120 \end{aligned}$ | 5U4G 5Y3GT | Rectifors |  | 486 | - | - | - | 248 | 277 | - | - |  |
|  |  |  | No Signal | 5 | 95.5 | 6 | 105 | 2 | 0.53 | 1 | $<0.1$ |  |  |  |  | No Signal | 4* 6 | - | - | - | $2 \% 8$ | ${ }^{271}$ | - | - |  |

John F. Rider


## TELEVISION CIRCUIT SCHEMATIC DIAGRAM, KCS83H




Direction of arrows at controls indicates clockwise rotation.

All voltages measured with "VoltOhmyst"
and with no signal input. Voltages should
hold within $\pm 20 \%$ with 117 v. a-c supply

Figure 36-Television Circuit



Models 24-T-420, 24-T-420L "Barrett"
Malogany. Oak

Models 24-T-435, 24-T-435 "Seuell"
Mahogany, Oak


## GENERAL DESCRIPTION

 are identical except for cabinets. Models $24-\mathrm{T}$-420U and 24-T-433U are identical except for cabinets. Models 24-T-420 and $24-\mathrm{T}-435$ have full 12 channel VHF coverage. Models
$24-\mathrm{T}-420 \mathrm{O}$ and $24-\mathrm{T}-435 \mathrm{U}$ feature full 12 channel VHF coverage plus any UHF channels desired.

All models include intercarrier FM sound system; ratio A-F-Cor: improved picture brilliance; pulsed picture A-G-C;
A-Fizantal hold; stabilized vertical hold; noise saturation circuits; improved sync sepparatior ( 3.5 mc. . band satura-
for picture channel); and reduced hazard high voltage or picture channel); and reduced hazard high voltage
supply. An auxiliary audio input jack is provided to permit the use of an external record playing attachment

## ELECTRICAL AND MECHANICAL SPECIFICATIONS

PICTURE SIZE . 327 square inches on a 24 CP4A Kinescope
TELEVISION R-F FREQUENCY RANGE
All 12 television channels. 54 me. to 88 me. 174 mc . to 216 mc.
Models $24-T-420 U$ \& $24-T-435 \mathrm{U}$ Any of 70 UHF channels.
Any of 12 VHF channels, $54 \mathrm{mc} .1088 \mathrm{mc} ., 174 \mathrm{mc} .10216 \mathrm{mc}$. intermediate frequencies
Picture I-F Carrier Frequency
Sound I-F Carrier Frequency
POWER RATING
aUdio POWER OUTPUT RATING
VIDEO RESPONSE
aCA TUBE COMPLEMENT
Tube Used
Tuner
KRK29A/27 (24-T-420U. 24-T-43SU)
(1) RCA 6AF4.. (2) RCA 6BO7A (3) RCA $6 \times 8 \ldots \ldots \ldots\left\{\begin{array}{l}\text { VHF R-F Oscillator } \& \text { Mixer }\end{array}\right.$ $\left\{\begin{array}{l}\text { VHF RFF Amplitier } \\ \text { UHF I-F Amplifier }\end{array}\right.$ A IN82 crystal is used as the UHFFmixer
45.75 mc .

$$
\begin{aligned}
& \text { A IN82 crystal is used as the UHF-r } \\
& \begin{array}{l}
\text { All Models }
\end{array}
\end{aligned}
$$

41.25 mc .

245 watts

SWEEP DEFLECTION
To 3.5 mc .

FOCUS
Magnetic
Magnetic

## ANTENNA INPUT IMPEDANCE

Choice: 300 Models 24-T-420, 24-T-435
Models 24-T-420U, 24-T-435U
UHF- 300 ohms balanced.
RCA TUBE COMPLEMENT
(1) RCA 6CF6.
. . 1st Picture I-F Amplifier 2nd Picture I-F Amplifier
 (4) RCA $12 \mathrm{AU7}$ (5) RCA $6 \times 8$
(5) RCA 6X8
(6) RCA 12 AU
7) RCA 6AU6
(8) RCA 6AU6.
(9) RCA 6AL5.
(10) RCA 6 AVG.
(11) RCA 6AQS,
(12) RCA 12 AUT
(12) RCA 12AU7

Vicure 2nd Det. and Horiz. Sync. Sep.
Video Amplifier and Vert. Sync. Sep.
Video Output \& AGC
2nd Sound I-F Amplifier
..... Ratio Detector
(3) RCA 6AQ5 ....Vert. Osc. and Disch \& Sydio Output
(14) RCA 6SN7GT Horizontal Sweep Oscillator and Control
(15) RCA 6CD6G.................izontal Sweep Output
16) RCA 6AU4GT
17) RCA 1B3-GT/8016
18) RCA 24 CP 4 A
(19) RCA SU4G
(20) RCA 5Y3GT

High Voltage Rectifier

1) RCA $\quad$ Tuner KRK22C (24-T-420 \& $24-\mathrm{T}-435$ ) Function
(1) RCA ${ }_{\text {(2) }}^{\text {6BO7A }}$ RCA

Rectifier

CHASSIS DESIGNATIONS
KCS84C Models 24-T-420 and 24-T-435 employing a KRK22C Tuner.
KCS84E Models $24-\mathrm{T}-420 \mathrm{U}$ and $24-\mathrm{T}-435 \mathrm{U}$ employing a KRK29A/27 Tuner.

WEIGHT \& DIMENSIONS

| Model |  | Shipping <br> Weight | Width <br> Inches | Height <br> Inches |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Inches |  |  |  |  |

LOUDSPEAKERS
Model 24-T-420 .....(971692-1) 10" PM Dynamic, 3.2 ohms Model 24-T-420U Model 24-T-435U (971692-1) 10" PM Dynamic. 3.2 ohms
(971692-1) $10^{\prime \prime}$ PM Dynamic, 3.2 ohms (971692 1) 10" PM Dynac. 32 ons

## scanning

Interlaced, 525 line
HORIZONTAL SWEEP FREQUENCY ........... 15.750 cps
VERTICAL SWEEP FREQUENCY ................. 60 cps


Figure 2-Receiver Operating Controls (UHF-VHF Models)


[^9]OPERATING CONTROLS (FIOR

Fine Tuning Models 24-T-420U \& 24-T-435U VHF Channel Selector and
$\left.\begin{array}{l}\text { UHF Changeover Switch } \\ \text { VHF Fine Tuning and }\end{array}\right\}$... Dual Control VHF Fine Tuning and
UHF Tuning
UHF Tuning
All Models Knobs
$\qquad$ Picture Horizontal Hold ....... Single Control under Panel Picture Vertical Hold.......... Single Control under Panel Sound Volume and On-OH Switch Single Control under Panel Picture
TV-PH
-PH tone switch. Single Control under Pan
non-operating controls (under Front Panel)
Heigh eight .............................erewdriver adjustmen NON-OPERATING CONTROLS (not including R-F and I-F adjustments) to 1 IF Picture Centering rear chasssis adjustmen Width ...................................arssis adjustmen Horizontal Linearity ................ear chassis adjustmen Horizontal Oscillator Frequency ..... rear chassis adjustmen Horizontal Oscillator Waveform bottom chassis adjustmen Horizontal Locking Range rear chassis adjustmen Focus top chassis adjustmen
top chassis adjustmen
lon Trap Magnet top chassis adjustmer Deflection Coil
AGC Control rear chassis adjustmen

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT.urn the horizontal hold control to the extreme counterclockwise position. The picture should remain in horizontal
sync. Momentarily remove the signal by switching oft channel ync. Momentarily remove the signal by switching oft channel
then back. Normally the picture will be out of sync. Turn the ontrol clockwise slowly. The number of diagonal black bars will be gradually reduced and when only 2 or 3 bars sloping
downward to the left are obtained, the picture will pull into ync upon slight additional clockwise rotation of the control. Pull-in should occur before the control has been turned 120 degrees from the extreme counter-clockwise position. The
picture should remain in sync for approximately 90 degrees of additional clockwise rotation of the control. At the extreme lockwise position, the picture should remain in sync and hould not show a black bar in the picture.
If the receiver passes the above checks and the picture is armal. and stable, .Alignt of Horizontal Oscillator" and pro caigned. Skip "Alignment of horizontal."

Figure 4-Rear Chassis Adiustments


O John F. Rider

WIDTH, DRIVE AND HORIZONTAL LINEARITY ADJUST MENTS.-Adjustment of the horizontal drive control affects the high voltage applied to the kinescope. In order to obtain the highest possible voltage hence the brightest and berl locused picture, adjust horizontal drive trimmer Cl74B middle then clockwise until the "wrinkle" disappears.
Turn the horizontal linearity control Llll clockwise until the picture begins to "wrinkle" on the right and then counterclockwise until the "wrinkle" disappears and best linearity is obtained.
Adjust the width control Ll09 to obtain correct picture width
A sightreadjuatment of these three controls may be neces ary to obtain the best linearity
scillator hold and locking range control affect horizontal adjusted, recheck the oscillator alignment.
height and vertical linearity adiustments.Adjust the height control (R173 behind front control panel) until the picture fills the mask vertically. Adjust vertical line-
arity (RI83 behind front control panel), until the test pattern arity (RI83 behind front control panel), until the test pattern
is symmetrical from top to bottom. Adjustment of either conis symmetrical from top to bottom. Adjustment of either con-
trol will require a readjustment of the other. Adjust centering to align the picture with the mask.
FOCUS.-Adjust the focus magnet for maximum definition in the test pattern vertical "wedge" and best focus in the white areas of the pattern.
Recheck the position of the ion trap magnet to make sure hat maximum brightness is obtained.
Check to see that the yoke knurled nuts and the focus magnet mounting screws are tight.
KRE22C OR KRE29A VHF R-F OSCILLATOR ADJUST-MENTS.-Tune in all available stations to see if the receiver r-f oscillator is adjusted to the proper frequency on all channels. If adjustments are required, these should be made by
the method outlined in the alignment procedure on page 11. The adjustments for channels 2 through 12 are available from the front of the cabinet by removing the station selector escutcheon as shown in Figure 5 or 6 . Adjustment for channel 13 is on top of the chassis. The oscillator for the KRK27 UHF the method outlined on page 12 under Alignment Procedure.





Figure S-KRK22C R-F Oscillator Adiustments
AGC THRESHOLD CONTHOL-The AGC threshold con. rol R154 is adjusted at the factory and normally should教
To check the adjustment of the AGC. Threshold Control, tune a strong signal and sync the picture. Momentarily remove ture reappears immediately, the receiver is back. If the picfure roappears immediately. the receiver is not overloading appreciable portion of a second to reappear, or beqde excesaively, R154 should be readjusted.
Turn Ris4 fully counter-clockwise. The raster may be bent slightly. This should be disregarded. Turn R154 clockwise



$\underbrace{}_{-1}$

Figure 6-KRK29A/27 VHF R-F Oscillator Adjustment
until there is a very, very slight bend or change of bend in he picture. Then turn R154 counter-clockwise just sufficiently remove this bend or change of bend

If the signal is weak, the above method may not work as it nay be impossible to get the picture to bend. In this case. urn R154 clockwise until the snow in the picture becomes ore pronounced, then counlor

Tha
The AGC control adjustment should be made on a strong weak signal then the receiver may overload when a strong signal is received.

FM TRAP ADJUSTMENT.-In some instances interference may be encountered from a strong $F M$ station signal. $A$ trap is provided to eliminate this type of interference. To adjust he trap tune in the station on which the interference is the picture. The trap is L53 on KRK22C and L5 on KRK29A uners and is located on the antenna matching translormer.

CAUTION.-In some receivers, the FM trap LS or L 53 will une down into channel 6 or even into channel 5 . Needless ivity on these channels. If channels 5 or 6 are to be received check L5 or L53 to make sure that it does not affect sensitivity on these two channels.
Replace the cabinet back and connect the receiver antenna leads to the cabinet back. Make sure that the screws holding are up tight, otherwise it may rattie or buzz when the eceiver is operated at high volume
CABINET ANTENNA.-A cabinet antenna is provided in models using wooden cabinets and the leads are brought may be employed for both UHF and VHF reception in place of the outdoor antenna in areas where the signals are strong and no reflections are experienced.
RECEIVER LOCATION.-The owner should be advised the importance of placing the receiver in the proper loca of the in importance
tion
The location should be chosen-
-Away from bright windows and so that no bright light
will fall directly on the screen. (Some illumination in the room is desirable, however.
-To give easy access for operation and comfortable
Coprmit convenient connection to the antenna.
-To allow to an electrical outlet.
-To allow adequate ventilation.


CHASSIS KCS84C, KCS84E


Figure 8-Chassis Bottom View (shown with KRK22C Tuner)

TEST EQUIPMENT.-To properly service the television hassis of these receivers, in is recommended that the follow. VHF Sweep Generator meeting the following requirements
(a) Frequency Ranges
35. to 90 mc ., 1 mc . to 12 mc . sweep width

Output to 225 mc., 12 mc. sweep width
(b) Output adjustable with at least .1 volt maximum c) Output constant on all ranges.
ator positions.
VHF Signal Generator to provide the following frequencies a) Intermedia
4.5 mc.. 39.25 mc., 41.25 mc., 43.5 mc., 45.75 mc .,
47.25 mc. b) Radio frequencies

$$
\begin{array}{crrr}
\text { Channel } & \begin{array}{c}
\text { Picture } \\
\text { Carrier } \\
\text { Number }
\end{array} & \begin{array}{c}
\text { Sound } \\
\text { Careq. Mc. }
\end{array} & \begin{array}{c}
\text { Receiver } \\
\text { Freq.Mc. }
\end{array} \\
2 & 55.25 & \text { R-F Os. } \\
\text { Freq. Mc. }
\end{array} .
$$

(c) Output of these ranges should be adjustable and at least I volt maximum
VHF Heterodyne Frequency Meter with crystal calibrator
if the signal generator is not crystal controlled. the signal generator is not crystal controlled.
UHF Sweep Generator with a frequency range of 470 mc .
io 890 mc . RCA types 40 A or 41 A or their equivalent
UHF Signal Gerator
UHF Signal Generator to provide the following frequencies
with crystal accuracy if RCA Type $41 A$ is used.

Picture
Cariier
Fraq. Mc

Receiv
H-F $\mathrm{O}_{\mathrm{s}}$
Receiver
R-FOBg.
Freq. Mc.
req. M
517
523

| Channel Number | $\begin{gathered} \text { Picture } \\ \text { Corrier } \\ \text { Freq. Mc. } \end{gathered}$ | $\begin{gathered} \text { Sound } \\ \text { Carrier } \\ \text { Freq. Mc. } \end{gathered}$ | Receiver <br> R.F Osc. <br> Freq. Mc |
| :---: | :---: | :---: | :---: |
| 49 | 681.25. | 685.75 | . 727 |
| 50 | 687.25 | 691.75 | 733 |
| 51 | 693.25 | 697.75 | 739 |
| 52 | 699.25 | 703.75 | 745 |
| 53 | 705.25 | 709.75 | 751 |
| 54 | 711.25 | 715.75: | 757 |
| 55 | 717.25 | 721.75 | 763 |
| 56 | 723.25 | 727.75 | 769 |
| 57 | 729.25 | 733.75 | 775 |
| 58 | 735.25 | 739.75 | 781 |
| 59 | 741.25 | 745.75 | 787 |
| 60 | 747.25 | 751.75 | 793 |
| 61 | 753.25. | 757.75 | 799 |
| 62 | 759.25 | 763.75 | 805 |
| 63 | 765.25. | 769.75 | 811 |
| 64 | 771.25 | 775.75 | 817 |
| 65 | 777.25 | 781.75 | 823 |
| ¢6 | 783.25 | 787.75 | 829 |
| 67 | 789.25 | 793.75 | 835 |
| 68 | 795.25 | 799.75 | 841 |
| 69 | 801.25 | 805.75 | 847 |
| 70 | 807.25 | 811.75 | 853 |
| 71 | 813.25 | 817.75 | 859 |
| 72 | 819.25 | 823.75 | 865 |
| 73 | 825.25 | 829.75 | 871 |
| 74 | 831.25 | 835.75 | 877 |
| 75 | 837.25 | 841.75 | 883 |
| 76 | 843.25 | 847.75 | 889 |
| 77 | 849.25 | 853.75 | 895 |
| 78 | 855.25 | 859.75 | 901 |
| 79 | 861.25 | 865.75 | 907 |
| 80 | 867.25 | 871.75 | 913 |
| 81 | 873.25 | 877.75 | 919 |
| 82 | 879.25 | 883.75 | 925 |
| 83 | 885.25 | 889.75 | 931 |

Cathode Ray Oscilloscope--An oscilloscope with a sen-
sitivity of 5 millivolts per inch is required. A suitable pre sitivity of 5 millivolits per inch is required. A suitable pre-
mplifier may be employed with oscilloscopes of lesser ensitivity
Electronic Voltmeter.-A voltmeter with a 1.5 volt DC scale CA Senior "VoltOhmyst" or equivalent.
MENT.-The antenna matching unit is accurately aligned at he factory. Adjustment of this unit should not be attempted ause serious attenuation of the signal especially on channel 2. The r-f unit is aligned with a particular antenna matching transiormer in place. If for any reason, a new antenna motch-
ing tramsformer is installed, the r-f unit should be realigned. The F-M Trap which is mounted in the antena matching unit may be adjusted without adversely affecting the alignment of the unit.
To align the antenna matching unit disconnect the lead

With a short jumper, connot the output of the matching nit through a 100 mm . capacitor to the grid of the second pix i-1 ampilier, pin 1 or 10 . adjustments.
Remove the first pix i-f amplifier tube V106.
and the potentiometer arm to the a bition box to the chassis Set the poteniometer to produce approximaely -5.0 volts of bias at the junction of R127 and R148.
Connect an oscilloscope to the junction of R135 and L102 Conet VHF signal 10 maximum.
terminals. Modulate the signal generator $30 \%$ with an audio signal.
Tune the signal generator to 45.75 mc . and adjust the genL4 (or L54) in the and indication on the oscilloscope. Adjut indication on the oscilloscope
Tune the signal cinerato. 4125 did ) for minimum audio indication on the oscilloscope Remove the jumper from the output of the matching unit. Connect a 300 ohm $1 / 2$ watt composition resistor from L ,

Connect an oscilloscope low capacity crystal probe fron
L5 (or L53) to ground. The sensitivity of the oscilloscop
should be approximity should be approximately The sensitivity of the oscilloscope
0.03 volts per inch. Set the oscillo scope gain to maximum.
Connect the VHF swe
Connect the VHF sweep generator to the matching unit
antenna input terminals. In order to prevent coupling react antenna input terminals. In order to prevent coupling react
ance from the sweep generator into the matching unit, it is advisable to employ a resistance pad at the matching uni
terminals. Figure 19 shows three different resistance pads fo use with sweep generators with 50 ohm co-ax output, 72 ohm co-ax output or 300 ohm balanced output. Choose the pad to match the output impedance of the particular swee Connec
antenna termina Set the sweep generator to sweep from 45 mc. to 54 mc.
With RCA Type WR59A sweep generators, this may be accomplished by returning channel number 1 to cover this range. With WR59B sweep generators this may be accom
plished by retuning channel number 2 to cover the ange plished by retuning channel number 2 to cover the range. I making these adjustments on the generator, be sure not to
turn the core too far clockwise so that it becomes lost beyond the core retaining spring
Adjust L 2 (or L56)
Adjust $L 2$ (or LL56) and $L 3$ (or L55) to obtain the response
shown in figure 20. L3 (or L55) is most effective in locating the position of the shoulder of the curve at 52 mc . and L2 (o L56) should be adjusted to give maximum amplitude at 53 mc . and above consistent with the speciiied shape of the response
curve. The adjustments in the matching unit interact to some curve. The adjustments in the mactching unit interact to some
extent. Repeat the above procedure until no further adjust menis are necessary.
Remove the 300 ohm
Remove the 300 ohm resistor and crystal probe connections,
Restore the connection between L5 (or L53) and Sl-E (or S4) Restore the con
Replace V106.
PICTURE I-F TRANSFORMER ADJUSTMENTS.-
Models 24-T-420 and 24-T-435
Connect the i-f signal generator across the link circuit on
terminals $A$ and $B$ of Tl04. Connect the "VoltOhmyst" to the junction of R123 and Cl42. Turn the AGC control fully clockwise. appreciable current drain and connect the ends of a 1,000 ohm poiontiometer across each. Connect the battery positive terminal of one to the chassis and the potentiometer arm to
the junction of R123 and C142. The second battery will be used later.
Set the bias to produce approximately -5.0 volt of bias at
the junction Connect the "Voltohmyst" to the junction of R135 and
L102 and to ground L102 and to ground.
Set the VHF signal
Seet the onf signal generator to each of the following fre
quencies and peak the specified adjustment for maximum indication on the "Volto hmyst." During alignment, reduce
the input signal if necessary in order to produce 3.0 volts o the input signal if necessary in order to produce 3.0 volts o
d-c at R135 and L102 with 5.0 volts of i-f bias at the junction of R123 and C142.
45.5 mc.
43.0 mc.

T108
T107
T106
Set the VHF signal generator to the following frequency
and adjust the picture i-f trap for minimum doc output ai
R135 1102 Use sufficient of d-c 102. Use sufficient signal input to produce 3.0 volt

. 1118 Connect the i-f signal generator across the link circuit on
terminals $A$ and C142 Cl 142.
Turn

Turn the AGC control fully clockwise
Obtain a 7.5 volt battery capable of withstanding appre
ciable current drain and connect the ends of a 1,000 oh potentiometer across it. Connect the battery positive termina
to chassis and the potentiometer arm to the junction R123 and to chassis and the potentiometer arm to the junction R123 and
C142. Adjust the potentiometer for - 5.0 volts indication or the "VoltOhmyst."
Connect the "VoltOhmyst" to the junction of R135 and L102 and to ground.
Set the $V H F$. and with a thin fiber screwdriver tune following frequefcies specified adjust
ment for maximum indiction ment for maximum indication on the "Voltohm yst." In each
instance the generator should be checked agginst $\alpha$ crystal instance the generator should be checked against a cry
calibrator to insure that the generator is on frequency.

During alignment, reduce the input signal if necessary in
order to produce 3.0 volts of d-c at R135 and L 102 with - 5.0 volts of i-f bias at the junction of R123 and C142.
$\qquad$
et the signal generator to the following frequency Set the signal generator to the following frequency and
adjust the picture i.f trap for minimum d-c output at junction
of R15 and LI02 Use sufficient signal input to produce 3.0 adjust the picture i.f trap for minimum d-c output at junction
of R135 and Llo2. Use sufficient signal input to produce 3 .


## SWEEP ALIGNMENT OF PICTURE I-F.-

To align T 2 and T 104 , connect the sweep generator to the mixer grid test point TP, in series with a 1500 mmf. ceramic
capacitor. Use the shortest leads possible, with not more than oneacitor. ose the shortest leads possible, with not more Connect the sweep ground lead to the top of the tune Clip 330 ohm resistors across terminals A and B of T107 and 1108.
Preset C122 to minimum capacity.
Adjust the bias box potentiometer to obtain - 5.0 volts of
bias as measured by a "Voltohmyst" at the junction of R123
and C142. Set the AGC control full aloter bias as measured by a "VoltOhmyst" at the ju
and C142. Sel the AGC control fully clockwise Connect a 180 ohm composition resistor from pin 5 of V106 to terminal A of Tl06. Connect t
to pin 5 of V 106 and to ground.
Couple the signal generator loosely to the diode probe in
order to obtain markers. order to obtain markers
Adjust T2 (top) and Tlio4 (top) for maximum gain and with
45.75 mc. at $75 \%$ of maximum respone
Set the sweep output to give 0.3 volt peak-to-peak on the Set the sweep output to give 0.3 volt peak-to-peak on the
oscilloscope when making the final touch on the above
adiustment adjustment.
Adjust Cl 122 until 42.5 mc . is at $70 \%$ response with respect to the low frequency shoulder of the curve as shown in Figure
23. Maximum allowable tilt is $20 \%$ 23. Maximum allowable till is $20 \%$.
Disconnect the diode probe, the 180 ohm and two 330 ohm resistors.
Connect the oscilloscope to the junction of R135 and L102 Leave the sweep generator connected to the mixer grid tes Leare the sweep generator connecled the mixer grid lest
point TP2 with the shortest leads possible.
Adjust the output-of the sweep generator to obtain 3.0 volts Adjust the output-of the sweep generator to obtain 3.0 volts
peak-to-peak on the oscilloscope. peak-10-peak on
Couple the signal generarator loosely to the grid of the firs
pix i-1 amplifier. Adjust the output of the signal generator to pix i- a amplifier. Adjust the output of the signal markers on the response curve.
Retouch T106, T107 and T108 to obtain the response shown
in Figure 24. in Figure 24. Models 24-T-420U and 24-T-435U To align T 2 and $\mathrm{Tl104}$, connect the sweep generator to the
mixer grid test point TP2, in series with a 1500 mmf. ceramic capacitor. Use the shortest leads possible, with not more than one inch of unshielded lead at the end of the sweep cab
Connect the sweep ground lead to the top of the tuner. Set the channel selector switch to channel Clip 330 ohm resistors across terminals A and B of T107
and T108. Preset C122 to minimum capacity
Adjust the bias box potentiometer to obtain - 5.0 volts of bias as measured by a "Voltohmyst" at the un
and C142. Set the AGC control fully clockwise
Connect a 180 ohm composition resistor from pin 5 of V106 Connect a 180 ohm Composition resistor from pin 5 of V106
to terminal A of Tlob. Connect the oscilloscope diode probe
to pin 5 of 106 and to ground.
Couple the signal generator loosely to the diode probe in Adjust T2 (top) and T104 (top) for maximum gain and Set the sweep output to give 0.3 volt peak-to-peak on the justment.
Adjust C122 until 42.5 mc . is at $70 \%$ response with respec Figure 12.
Disconnect the diode probe, the 180 ohm and two 330 ohm
resistors.

Connect the oscilloscope to the junction of R135 and L102. Leave the sweep generator connected to the mixer grid test
point TP2 with the shortest leads possible. Adjust the output of the sweep generator to obtain 3.0 volts peak-to-peak on the oscilloscope.
Couple the signal generator loosely to the grid of the first roduce small markers on the response curve.
Retouch T106, T107 and T108 to oblain the response shown
in Figure 13. Figure
To align the I-F amplifier circuit of the KRK29A/27, connect the VHF sweep generator to the rear terminal of the
iN82 crystal holder in series with a 1000 ohms and 1500 mmI ceramic capacitor. Use the shortest leads possible,
grounding the sweep ground lead to the tuner case.
Set the UHF CHANGEOVER switch to the UHF position, and Connect a 180 ohm composition resistor and a 1500 mmf .
capacitior in series between test point TP3 and ground with
the capacitor connected to TP3 and the resistor to ground. the capacitor connected to TP3 and the resistor to ground.
Connect the oscilloscope diode probe to the iunction between the resistor and capacitor.
Couple the VHF signal generator loosely to the diode probe in order to obtain markers.
Connect the potentiometer arm of the second bias supply
it the AGC terminal on the tuner and ground the battery to the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case. Adjust the bias potentimeter to produce - 3.0 volts of bias, as measured by the VoltOhmyst" at the AGC terminal on the tuner
Set the sweep generator to produce 0.3 or less peak-to-peak
on the oscilloscope
Adjust L307, on the KRK27 soction, and L9, on the KRK29A section, of the tuner for maximum gain with picture and ound carrier markers as shown in figure 14.
Remove the resistor, capacitor and diode probe from
TP3 and connect the oscilloscope to the junction of R135 and L102. Use 3.0v. peak-to-peak on the oscilloscope.
Retouch L 307 and 19 slightly, if necessary, to produce the
curve shown in figure 14. Do not retouch T2, T104, T106, T107 or 7108.
Connect the VHF sweep generator to the antenna ter-
minali. Keep the $A G C$ bias at -3.0 V and the $\mathrm{I}-\mathrm{F}$ bias at minals. Kolts.
.0 . Couple the signal generator loosely to the grid of the first
picture I-F amplifier. picture I-F amplitie
Switch through all VHF channels and check for proper
curve shape as in figure 13 . Retouch T107 and T108 slightly to correct for any overall tilt that is essentially the same on
all channels. all channels.
Disconnect the VHF sweep generator and connect the UHF
sweep generator to the antenna terminals. Check on all UHF hannels for proper wave shape as shown in tigure 13, re ouching T107 and T108 if necessary to correct any overall tith. Remove the sweep and marker generators and the bias
supplies.

## KRK22C TUNER ALIGNMENT

Models 24-T-420 and 24-T-435
A tuner unit which is operative and requires only touch up
adjustments, requires no presetting of adjustments. For such adjustments, requires no presetting of adjustments. For such unis, sip the remainder of this paragraph. For units which
are completely out of adjustment, preset C2 all the way out.
Set channel 7 to 13 oscillator slugs one turn from tight Set channel 7 to 13 oscillator, slugs one turn from tight.
Turn T2 slug all the way out. Do not change any of the adjustTurn T2 slug all the way out. Do not ct
ments in the antenna matching unit.
Disconnect the link from terminals "A" and "B" of T104
and terminate the link with a 39 ohm composition resistor. Turn the receiver channel selector switch to channel 2. The 43.5 me. trap is adjusted with zero bias. To insure that
he bias will remain constant, take a clip lead and short the bias will remain constant, take a clip lead and short
circuit the AGC terminal of the tuner at the terminal board 10 ground. Connect the oscilloscope to the test point TPI on top of the
uner unit. Set the oscilloscope to maximum gain. luner unit. Set the oscilloscope to maximum gain.
Connect the output of the VFF signal put of the antenna matche ${ }^{\text {ang unit at the generator to the out- }}$
C24 at the bottom of the FM trap L53.

Tune the signal generator to 43.5 mc . and modulate it $30 \%$
with a 400 cycle sine wave. Adiust the signal generator for with a 400 cycle
maximum output
Adjust C19 on top of the tuner, for minimum 400 cycle indication on the oscilloscope. If necessary, this adjustment can be retouched in the field to provide additional rejection to
one specific frequency in the $\mathrm{i}-1$ band pass. However, in such one specific frequency in the i-l band pass. However, in such
cases, care should be taken not to tune C19 into channel 2 , cases, care should be taken not to tune 2 .
thereby reducing sensitivity on channel 2.
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery Conh AGC terminal on the tuner and ground the battery
positive terminal to the tuner case. Aduat the bias potentipositive terminal to the tuner case. Adjuat the bias potenti-
meter to produce -3.0 volts of bias, as measured by the "meter to produce - 3.0 volts of bias, as meas
"VoltOhmyst" at the AGC terminal on the tuner
Set the channel selector switch to channel 8.
Preset C5 to read - 3.0 volts at the test point TP1, as read
on the "VoltOhmyst." The limits for oscillator injection voltage mind are 2
volts.
Turn the fine tuning control fully clockwise,
Adjust C3 for proper oscillator frequency, 227 mc . This may be done in several ways. The easiest way and the way which will recommenda heredyne irdure will be to use he signal generator as a heterodyne frequency meter and
beat the oscillator against the signal generator. To do this tune the signal generator to 227 ma. with crystal accuracy nsert one end of a piece of insulated wire into the tuner unil
through the hole provided for the adjustment of C10. Be care through the hole provided for the adjustment on Clire does not touch any of the care cune circuits an may cause the frequency of the tuner oscillator to shift Connect the other end of the wire to the "r-fin" in terminal of
he signal generator. Adjust C 3 to obtain an audible beat with the signal generator.
Turn the C2 clockwise until the beat note just begins to
change, then turn one full turn in the same clockwise direc ion.
Return the fine tuning control to the mechanical center of its range.
Note.-If on some units, it is not possible to reach the proper channel 8 oscillator frequency by adjustment of C3 switch to channel 13 and adjust L42 to obtain proper channe
13 oscillator frequency as indicated in the table on page 8 , Then, switch to channel 12 and adjust Lll to obtain prope hannel 12 oscillator frequency. Continue down to channel 8 adjusting the appropriate oscillator trimmer to obtain the
proper frequency on each channel. Then again on channe proper frequency on each channel. Then again on channe
B, adjust C 3 to obtain proper channel 8 oscillator frequency Switch back to channel 13 and readjust L42 and back to hannel 8 and adjust C3
Set the T 2 core for maximum inductance (core turned
counter-clockwise).
Connect the sweep generator through a suitable attenua lor, as shown in Figure 19, to the input terminals of the antenna matching unit
Connect the signal generator loosely to the antenna ter
Set the sweep generator to cover channel 8
Set the oscilloscope to maximum gain and use the minimum input signal which will produce a usable pattern on th scilloscope. Excessive input can change oscillator injectio
uring alignment and produce consequent misalignment eve hough the response as seen on the oscilloscope may look normal.
Insert markers, of channel 8 picture carrier and sound
carrier, 181.25 mc . and 185.75 mc . arrier, 25 mc . and
Adjust Cp, C10, C15 and C20 for approximately correc curve
ure 18 .
The correct adjustment of C20 is indicated by maximum
amplitude of the curve midway between the markers C15 amplitude of the curve midway between the markers. C1 of the pass band most noticeably. C7 tunes the mixer grid circuit and affects the tilt of the curve most noticeably (assuming that C20 has been properly adjusted). C10 is the coupling width.
Connect the "VoltOhmyst" to test point TPI. Adjust C5 to
ead -3.0 volts dc on the "VoltOhmyst" at TPI. Readiust C 2 read - -3.0 volts de on the "VoltOhmyst" at TPI. Readjust C2,
C7. C10 and C15 for proper response. Adjust C20 for maxi-

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## mum gain at midpoint of the cur the proper response is obtained.

Set the receiver chanriel switch to channel 13
Adjust the signal generator to the channel 13 oscillato
Turn the fine tuning control fully clockwise
Adjust L42 to obtain an audible beat. Slightly overshoot
the adjustment of L42 by turning the slug an additional turn the adjustment of 42 by turning the slug an additional turn
in the same direction from the original setting, then in the same direction from the original setting, then reset the
oscillaior to proper frequency by adjusting C 2 to again obtain the beat.
Set the sweep generator to channel 13.
From the signal generator, insert channel 13 sound and
picture carrier markers, 211.25 mc . and 215.75 mc .
Adjust L43 and L45 for proper response as shown in Turn of
Turn of the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TPI. Check the oscillator injection voltage to be within limits as
previously specified. Adjust if necessary to bring within previou
range.
If it was necessary to readjust C5, turn the sweep and
signal generators back on and recheck the channel 13 signal generators back on and recheck the
response. Readjust $L 43$ and $L 45$ if necessary. Set the receiver channel selector switch to channe
readjust C 2 for proper oscillator frequency, 227 mc .
Set the sweep generator and signal generator to channel 8 Readjust $\mathrm{C}, \mathrm{Cl0,C15}$ and C 20 for correct curve shape, fre-
quency and bandwidth. quency and bandwidth.
Turn off the sweep and signal generators, switch back to
channel 13 and check the oscillacor injection volage at Thannel 13 and check the oscillalor injection voltage a
TPas adjusted in the recheck of channel 8 response. If the initial setting of the oscillator injection trimmer was
far off, it may ka necessary to adjust the oscillator frequency far oft, it may ke necessary to adjust the oscillator frequency
and response on channel 8, adjust the oscillator injection on and response on channel 8, adjust the oscillator injection on
channel 13 and repeat the tracking procedure several times
belore the proper setting is obtained. channel 1 and repeat the tracking
before the proper setting is obtained.
Turn of the sweep generator and switch the receiver to
channel 6 .
Adjust the signal generator to the channel 6 oscillator
frequency 129 mc . Set the fine tunin
Set the
al range.
Adjust $L 5$ for an audible beat. Adjust L44, L46, and $L 58$ for proper curve shape as shown in Figure 18. Recheck the oscil-
lator injection voltage at TPI, to insure that it is within the ator injection voltage at TP1, to insure that it is within the
imits specified. Readjust C5 if necessary.
If C5 required adjustment. switch the receiver and the
signal generator to channel 8. Readjust C7 for correct curve signal generator to channel 8. Readjust C7 for correct curve
shape and recheck C 2 and C 3 for proper oscillator frequency.
Ceck the response of channels 2 through 6 by switching Check the response of channels 2 through 6 by switching
The receiver channel switch sweep generator and marker enerator to each of these channels and observing the response and oscillaror injection voltage obtained. See Fig.
ure 18 for typical response curves. It should be found that all
these channels have the proper response with the markers these channels have then
above $80 \%$ respanse.
If the markers fail to fall within this requirement readjust
and $L 46$ and L58 in order to obtain curves within the proper Limits.
Switch the channel selector, signal generator and marker curves, referring to Figure 18 for proper wave shape. Check he injection voltage at each channel to be within limits. in necessary readjust Cl5, C7, or C10 to obtain the proper With the receiver and signal generator on channel 13 ad-
just $L 42$ for an qudible beat with the signal generator. Adjust the oscillator to frequency on all channels by switch-
ing the receiver and the frequency standard to each chaning the receiver and the frequency standard to each chan-
nel and adjusting the appropriate oscillator slug to nel and adjusting the appropriate oscillalor slug to obtain
the audible beat. It should be possible to adjust the oscillator the audible beat. It should be possible to adjust the oscillator
to obtain the audible beat on each channel. Recheck the oscillator injection volttge on each channel to verify that the
voltage is within the specified limits.

## RE29//27 TUNER ALIGNMENT

HFF ALIGNMENT-A tuner unit which is operative and requires only touch up adjustments, requires no presetting
of adjustments. For such units, skip the remainder of this paragraph. For units which are completely out of adjustment,
preset C27 all the way out. Set channel 7 to 13 oscillato preset C27 all the way out. Set channel 7 to 13 oscillato:
slugs one turn from tight. Turn T2 slug all the way out. Do not slugs one turn from tight. Turn T2 slug all the way out. Do not
change any of the adjustments in the antenna matching unit. Disconnect the link from terminals " $A$ " and " $B$ " of T104 and
terminate the link with a 39 ohm composition resistor. erminate the link with a 39 ohm composition resistor.
Turn the receiver channel selector switch to channel
Turn the receiver channel selector switch to channel 2.
The 43.5 mc. trap is adjusted with zero bias. To insure that The 43.5 mc . trap is adjusted with zero bias. To insure that
the bias will remain constant, take a clip lead and short circuit the AGC terminal of the tuner at the terminal board to
ground.
Connect the oscilloscope to the test point TP2 on top of the
tuner unit. Set the oscilloscope to uner unit. Set the oscilloscope to maximum gain.
Connect the output of the VHF signal generator to the
output of the antenna matching unit at the junction of C4 at the bottom of the FM trap L5.
Tune the signal generator 1043.5 mc . and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator for maximum outpul
Adjust C33 on top of the tuner. for minimum 400 cycle indi-
cation on the oscilloscope. If necessary, this adjustment cation on the oscilloscope. If neecessary, this adjustment can pecific frequency in the ifrovide additional rejection to one cases, care should be taken not to tune C33 into channel
2, thereby reducing sensitivity on channel 2.
Connect the potentiometer Connect the potentiometer arm of one of the bias supplies
o the AGC terminal on the funer and ground the battery
positive terminal to the tuner and positive terminal to the tuner case. Adjust the bias potenti-
ometer to produce -3.0 volts of bias, as measured by the ometer to produce -3.0 volts of bias, as measured by the
"Voltohmyst" at the AGC terminal on the tuner. Set the channel selector switch to channel 8 Preset C22 to read - 3.0 volts at the test point TP1, as
read on the "Voltohmyst." The limits for oscillator iniection read on the "Volithmyst." The limits for oscillator injection
voltage are 2 volts minimum and not exceeding a maximum 5.5 volts.

Turn the fine tuning control fully clockwise Adjust C25 for proper oscillator frequency, 227 me. This
may be done in several ways. The easiest way and the way which will be recommended in this procedure will be to use
he signal generator as a heterodyne frequency meter and the signal generator as a heterodyne frequency meter and
beat the oscillator against the signal generator. To do this, une the signal generator to 227 mc. with crystal accuracy. nsert one end of a piece of insulated wire into the tuner
nit through the hole provided for the adjustment of Cl6. unit through the hole provided ior the adjustment of C16.
Be careful that the wire does not touch any of the tuned ircuits as it may cause the frequency of the tuner oscillato o shift. Connect the other end of the wire to the "rf. in
terminal of the signal generator. Adjust C25 to obtain an terminal of the signal generator. Adju
audible beat with the signal generator.
Turn C27 clockwise until the beat note just begins to
change, then turn one full turn in the same clockwise Return the fine tuning control to the mechanical center of its Renge. NOTE:-If on some units, it is not possible to reach the
proper channel 8 oscillator frequency by adiustment of C25
switch to channel 13 and adjust L49 to obtain proper channel switch to channel 13 and adjusi L49 to obtain proper channe
13 oscillator frequency as indicated in the table on page 8 . Then, switch to channel as indinated in the table on page 8 adjust l 60 to obtain prope
channel channel 12 oscillator frequency. Continue down to channel 8 adjusing the appropriate oscillator trimmer to obtain the adjust C25 to obtain proper channel 8 oscillator frequency.
Sthen Swith back to channel 13 and readjust L49 and back to
channel 8 and adjust C25. Set the T2 core
Set the T 2 core for maximum inductance (core turned
counter-clockwise).
as annect the sweep generator through a suitable attenuator as shown in figure 19 to the input terminals of the antenna
matching unit. Connect
terminals. the signal generator loosely to the antenna
Set the sweep generator to cover channel 8 .

Set the oscilloscope to maximum gain and use the minimum
input signal which will produce a asable pattern on the oscilloscope. Excessive input can change oscillator injection during alignment and produce consequent misalignment even
though the response as seen on the oscilloscope may look hough the respons as Insert markers of channel 8
carrier, 181.25 mc . and 185.75 mc .
Adjust C21, C16, C11 and C7 for appromixately correct curve shape, frequency, and band width as shown in figure
8.
The correct adjustment of C7 is indicated by maximum am-
plitude of the curve midway between the markers. Cll tunes he r-f amplifier plate circuit and affects the frequency of the and affects the tilt of the Curve tunes the mixer grid circuit and affects the tilt of the curve most noticeably (assuming
that C7 has been properly adjusted). Cl6 is the coupling ad.
justment and hence primarily affects the response band justme
width.
Connect the "VoltOhmyst" to test point TP1. Adjust C22 to read - -3.0 volits de on the "VoltOhmyst" at TPl. Readjust C27,
C21, C16 and C11 for proper response. Adjust C7 for maxmum gain at midpoint of the curve. Repeat if necessary
intil the proper response is obtained. the proper response is obtained.
Set the receiver channel switch to channel 13.
Adjust the sig
quency 257 mc.
Turn the fine tuning control fully clockwise
Adjust L49 to obtain an audible beat. Slightly overshoot the
adjustment of L49 by turning the slug an additional turn in the same direction from the original selting, then reset the oscilator to proper frequency by adjusting C 27 to again obtain he beat.
Set the sweep generator to channel 13
From the signal generator, insert channel 13 sound and pic
ture carrier markers, 211.25 mc. and 215.75 mc Adjust L36 and L20
18.

Turn of the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TPI
Check the oscillator injection voltage to be within limits as
previously specified. Adjust if necessary to bring within range. If it was necessary to readjust C22, turn the sweep and
signal generators back on and recheck the channel 13 signal generators back on and recheck the
response. Readjust $L 36$ and $L 20$ if necessary.
response. Readust
Set the receiver channel selector switch to channel 8 and
readjust C27 for proper oscillator frequency, 227 mc. Sajust C27 for proper oscillator frequency, 227 mc .
Set the sweon
channel Readjust $\mathrm{C} 21, \mathrm{C} 16, \mathrm{Cl1}$ and C 7 for correct curve shape

Turn off the sweep and signal generators, switch back to if C21 was adjusted in the recheck of channel 8 response. If the initial setting of the oscillator injection trimmer wa lar oft, it mary be necessary to adjust the oscillator frequency channel 13 and tepat the tracking procedue inveral ime channel the and repeat the tracking procedure several time
before the
Turn off the sweep generator and switch the receiver to Adjust the signal generator to the channel 6 oscillator fre
quency 129 me. quency 129 me.
Set the fine tuning control to the center of its mechanical
Adjust L54 for an audible beat. Adjust L48 and L32 for propernetion voltage at TP1, to insure that it is within the limits specified. Readjust C22 it necessary
If C22 required adjustment, switch the receiver and the signal generator to channel 8. Readjust C21 for correct curve requency.
Check the response of channels 2 through 6 by switching the receiver channel switch, sweep generator and marke
 18 for typical response curves. It should be found that all
these channels have the proper response with the markers
above $80 \%$ response.

48 and L32 in order to obtain curves within the proper imits 232 in order to obtain curves within the proper Switch the channel selector, signal generator and marker
generator through channels 7 to 13 and observe the response curves, referring to figure 18 for proper wave shape. Check he injection voltage at each channel to be within limits. I necessary
Withe the receiver and signal generator on channel 13 ad -
ust $L 49$ for an audible beat with the signal generator Adjust the oscillator to frequency on all chanele by with ing the receiver and the frequency standard to each channel and adiusting the appropriate oscillator slug to obtain the audible beat. It should be possible to adjust the obcillator to lator injection voltage on each channel. Rechect the oscilvoltage is within the specified limits.
UHF RLIGNMENT
UHF RLIGNMENT. -Ground the I-F transformer $L 307$ by inserting a clip lead through the aperrure provided in the
op of the tuner. Ground the other end of the clip lead to the uner case.
Connect the oscilloscope to the test point TP301, employing
the preamplifier if needed with the oscilloscope used. Connect the output of the UHF sweep erith Connect the output of the UHF sweep generator, through
300 ohm attenuator pad, to the antenna terminals and the sweep generator to sweep channel 83, centered on 387.5 mc . Ad

A test dial made to fit over the split gear on the tuner ahat is necessary for caccurate alignment. Scribe marks at $0^{\circ}, 9{ }^{\circ}$
and $168^{\circ}$ should be marked on the test dial for The $168^{\circ}$ should be marked on the test dial for reference. reterence point is located with the capacitor plates
ully meshed. By placing a $1 /$ /os $^{\circ}$ shim between the stop pin on the tuner and the stop plate on the gear assembly the plates will be in the proper fully meshed position.
Connect the VHF signal generator in eriel 83 , position Connect the VHF signal generator in series with a 1000
ohm resistor to the rear terminal of the crystal holder and
insert markers for 41.25 mc., 43.5 mc. and 45.75 mc.
Connect the UHF marker genergtor 1 loosely to the antenna
ierminals and insert a marker at 887.5 mc. Adjust R-F insert a marker at 887.5 mc .
mum amplitude overcoupled response curve centered at imum amplitude overcoupled. resp.
$887.5 \mathrm{mc}$. as shown in tigure $11(\mathrm{~A})$.
Adjust the oscillator trimmer capacitor C307 until the
43.5 mc . marker coincides with the 43.5 mc. marker coincides with the marker at 887.5 mc. The
markers for 41.25 and 45.75 should be symmetrically located on the top of the response curve as in figure 11(A). Set the UHF sweep and maiker generators to 473.5 mc .
Rotate the tuning dial to the $9{ }^{\circ}$, Channel 14, position. Adjust R-F coils LI and L2 9 , Channel 14, position. Adjust R-F coils LI and $\mathrm{L2}$ for a maximum amplitude over-
Coupled curve centered at 47.5 mc. as shown in figure
$11(B)$. Adjust the oscillator trimmer C 308 until the 43.5 me. marker coincides with the 47
and 45.75 markers as shown.
Repeat the above adjustments, as necessary, until the proper responses are obtained. Tune through, the entire
range and check the tracking. When perfectly tace range and check the tracking. When perfectly tracked the
three markers will be on the top of the response curve however, mistracking to the extent that the 41.25 mc . and 45.75 mc . ride down the sides of the curves to a point no the markers fall below this level, it will be necessary kne markers the RF plates to correct the mistracking. The plates
knite the
may be knited throuh the two may be knited through the two holes provided on the lef in frequency to prevent affecting the tracking above the point in requency to prevent aftecting the tracking above the poin
of knifing. Check which section requires kniting by touching
the plates witt the knifing the plates with the knifing tool while observing the response
then proceed with the nnifing of the proper section or of both then proceed with the
sections if required.
Connect the "VoltOhmyst", to test point TP301. Set the
"Voltohmyst" to the 1.5 v . DC scale Tune "VoltOhmyst" to the 1.5 v . DC scale. Tune over the entire
range observing the reading on the meter. A reading be range observing the reading on the meter. A reading be
tween 05 and 4 volts should be obtained. Voltages outside hese limits are an indication of low B voltage, low or high crystal impedence or an oscillator tube outside allowable Connect the "VoltOhmyst" to the "bias" terminal of the
luner (refer to figure 9 ). Areading between 0.5 and 2.5 volta
should be obtained. Readings above or below this range
will cause crystal currents outside allowable limits and in ment of the oscillator tube will require recalibration at the high and low frequency ends of the band as previousl outlined.
RATIO DETECTOR ALIGNMENT.-Set the signal gen-
erator at 4.5 mc. and connect it to the first sound i-f grid erator at
pin 1 of V101.
As an alternate source of signal, the RCA WR39B o WR39C calibrator may be employed. In such a case, con
nect the calibrator to the grid of the third pix i -f amplifier nect the calibr
pin 1 of V108. Set the frequency of the calibrator to 45.75 mc . (pix carrier)
and modulate with 4.5 mc crystal. The 4.5 mc . signa
will be picked off at 1103 and amplified through the sound will be picked off at L103 and amplified through the sound
Connect the "VoltOhmyst" to pin 2 of V103
Tune the ratio detector primary, $T 102$ top core for maximum d-c output on the "Voliohmyst." Adjust the signal level from the signal generator for 6 volls on the "VoliOhmyst" when
finally peaked. This is approximately the operating level of the ratio detector for average signals.
Connect the "VoltOhmyst" to the junction of R108 and C109 Tune the ratio detector secondary T102 bottom core for zero
d-c on the "Voltohmyst." d-c on the "Vollohmyst.
Repeat adjustments of T102 top for maximum d-c at pin
of $V 103$ and $T 102$ bottom for zero d -c at the junction of R108 and C109. Make the final adjustiments with the signal inpul level adjusted to produce 6 volts $d-c$ on the "VoltOhmyst" a pin 2 of Vios
SOUND I-F ALIGNMENT-Connect the signal generator
to the first sound i-f amplifier grid, pin 1 of V101. As an allernate source of signal, the RCA WR39B or WR39C calibrator may be employed as above.
Connect the "VoltOhmyst" to pin 2 of V103.
Tune the T101 top core for maximum d-c on the "Volt Ohmyst.
The output from the signal generator should be set to
produce approximately 6.0 volts on the "VoltOhmyst" when the final touches on the above adjustment are made.
4.5 MC. TRAP ADJUSTMENT.-Connect the signal gen
erator in series with a 100 ohm resistor to pin 2 of V109 erator in series with a 100 hm resistor to pin ${ }^{\text {pin }}$ of
Set the generator to 4.5 mc and modulate it $30 \%$ with 400 cycles. Set the output to approximately 0.5 volt.
Short the third pix i-f grid to ground, pin 1, V108, to preven noise from masking the output indication.
Connect the crystal diode probe of an oscilloscope to the
plate of the video amplifier, pin 9 of V1lo. Adjust the core of L104 for minimum output on the oscillo scope.
Remove the short from pin 1, V108 to ground.
As an alternate method, this step may be omitted at this
point in the alignment procedure and the adjustment made point in the alignment procedure and the adjustment made
"on the air" after the alignment is completed. If this is done tune in a slation and observe the kinescope. If no 4.5 mc. beat is present in the picture when the fine tuning control is set for proper oscillator-fre.-
quency, then L 104 requires no adjustment. If $\alpha 4.5 \mathrm{mc}$. beat is present, turn the fine tuning control slightly clockwise so as to exaggerate the beat and then adjust L104 for minimum beat.
AGC CONTROL ADIUSTMENT.-Disconnect all test equip ment except
pin 9 of Vlil
Connect an antenna to the receiver antenna terminals. Turn the AGC control fully counter-clockwise
Tune in a strong signal and adjust the oscilloscope to see
the video waveform. the video wavelorm.
Turn the AGC control clockwise until the tips of sync begin
to be compressed, then counter-clockwise until no compres sion is obtaned.
HOHIZONTAL OSCILLATOR ADJUSTMENT. - Normally the adjustment of the horizontal oscillator is not considered
to be a part of the alignment procedure but since the oscil to be a part of the alignment procedure, but since the oscil
lator waveform adjustment may require the use of an oscillo scope, it can not be done conveniently in the field. The waveiorm adjustment is made at the lactory and normally
should not require readjustment in the field. However, the
waveform adjustment should be checked whenever the re-
ceiver is aligned or whenever the horizontal oscillator ation is improper
Horizontal Frequency Adjustment.-Tune in a station and sync the picture. If the picture cannot be synchronized with
the horizontal hold control R196, then adjust the TI14 frequency core on the rear apron until the picture will synchronize. If the pecture still will not sync. turn the TII14
wavelorm adjustmen core (under the chassis) out of the coil waverorm adjustment core e under the chassis out of the coil
several turns rom its original position and readiust the T114 several turns from its original position and readju.
frequency core until the picture is synchronized.
Examine the width and linearity of the picture. If picture width or linearity is incorrect. odjust the horizontal drive
control C174B, the width control Llo9 and the linearity control L111 until the picture is correct. Horizontal Oscillator Waveform Adjustment.-The hori-
zontal oscillator waveform may be adjusted by either of zontal oscillator waveform may be adjusted by either of
two methods. The method outlined in paragraph $A$ below may be employed in the field when an oscilloscope is not available. The service shop method outlined in paragraph B below requires the use of an oscilloscope.
A.-Turn the horizontal hold control completely clockwise.
Place adiustment tools on both cores of T114 and be prepared to make simultaneous adjustments while watching the picture on the screen. First, turn the T114 frequency core ( lon the rear
apron) until the picture falls out of sync and three or apron) until the picture falls out of sync and three or four
diagonal black bars sloping down to the right appear on the diagonal black bars sloping down to the right appear on the screen. Then, turn the wavelorm adis) into the coil while at the same time adjusting the
chat frequency core so as to maintain three or four diagonal black
bars on the screen. Continue this procedure until the oscillator begins to motorboat, then turn the wavelorm adjustment core out until the molorboating just stops. As a check, turn
the T114 Irequency core until the picture is synchronized then reverse the direction of rotation of the core until the picture talls out of sync with the diagonal bars sloping down to the
right. Continue to turn the frequency core in the same direcright. Continue to turn the frequency core in the same direc-
tion. No more than three or four bars should appear on the tion. No more than three or four bars should appear on the
screen. Instead, the horizontal oscillator should begin the screen. Inslead. herboat. Retouch the adjustment of the Tlil waveform
motjustment core if necessary until this condition is obtained. adjustment core if necessary until this condition is obtained B.-Connect the low capacity probe of an oscilloscope to
terminal C of T114. Turn the horizontal hold control onequarter turn from the clockwise position so that the picture is in sync. The pattern on the oscilloscope should be as shown
in Figure 24. Adjust the wavelorm adjustment core of T114 in Figure 24. Adjust the wavelorm adjustment core of T114
until the two peaks are at the same height. During this ad justment, the picture must be kept in sync by readjusting the
hold control if neessary hold control if necessary
This adjustment is very important for correct operation o
the circuit. If the broad peak of the wave on the circuit. If the broad peak of the wave on the oscilloscope
is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing effect of the tuned circuit is reduces
and dritt tol the oscillator beeomes more serious On and drift of the oscillator becomes more serious. On the other hand if the broad peak is higher than the sharp peak, the
oscillator is overstabilized, the pullin range becomes inadequate and the broad peak can cause double triggering of the poscillator when the hold control approaches the clockwis
Remove the oscilloscope upon completion of this adjustment.
Horiz
Horizontal Locking Range Adjustment.-Set the horizontal hold control to the full counter-clockwise position. Momen The picture may remain in sync. If so turn the T114 frequency core slightly and momentarily switch off channel.
Repeat until the picture falls out of sync with the diagonal lines sloping down to the left. Slowly turn the horizontal hold control clockwise and note the least number of diagona bars obtained just before the picture pulls into sync. It more than 3 bars are present just before the picture pulls slightly clockwise. If less than 2 bars are present adjus
Cl 74 A slightly counter-clockwise. Turn the horizontal hold C174A slightly counter-clockwise. Turn the horizontal hold recheck the number of bars present at the pull-in point Repeat this procedure until 2 or 3 bars are present
Turn the horizontal hold control to the maximum clockwise
position. Adjust the T1l4 frequency core so that the diagonal bar sloping down to the right appears on the screen and then reverse the direction of adjustment so that bar just moves to
the left side of the screen leaving the left side of the screen leaving the picture in synchroniza-


Figure 11-KRK27 R-F Response


[^10]Figure 25-Horizontal Oscillator Wave Forms


Figure 26-Top Chassis Adjustments (KRK22C Tuner Shown)


Figure 27-Bottom Chassis Adjustments (KRK22C Tuner Shown)

| VOLTAGE CHART |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| The following measurements represent two sets of conditions. In the first condition, a 15000 microvolt test pattern signal was fed into the receiver, the picture synced and the AGC control properly adjusted. The second condition was obtained by removing the antenna leads and short circuiting the receiver antenna terminals. Voltages shown are read with a type WV97A senior "VoltOhmyst" between the indicated terminal and chassis ground and with the receiver operating on 117 volts, 60 cycles. a-c. The symbol < means less than. |  |  |  |  |  |  |  |  |  |  |  |  | $\begin{aligned} & \text { Tube } \\ & \text { No. } \end{aligned}$ | $\begin{gathered} \text { Tube } \\ \text { Type } \end{gathered}$ | Function | Operating | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements |
|  |  |  |  |  |  |  |  |  |  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ |  |  |  | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | Pin No. | Volts |  |
| $\begin{aligned} & \text { Tube } \\ & \text { No. } \end{aligned}$ | $\begin{aligned} & \text { Tube } \\ & \text { Type } \end{aligned}$ | Function | Operating | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements |  | v109B | 12AU7 | Horiz. Sync Separator | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | 6 | 260 | - | - | 8 | 160 | 7 | 122 |  |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volis | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts |  | V110A | 6x8 | Video Amplifier | $\begin{array}{\|c\|} \hline \text { No Signal } \\ \hline \begin{array}{c} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{array} \\ \hline \end{array}$ | 9 | 120 | - | 147 | 6 | . 9 | 7 | -1.85 | AGC control set for normal operation |
| V1KRK22C KRK29A | 6BQ7A | $\begin{aligned} & \text { R-F } \\ & \text { Amplifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 6 | 170 | - | - | 8 | 0.1 | 7 |  |  |  |  |  | No Signal | 9 | 95 | 8 | 138 | 6 | 1.35 | 7 | -. 6 | AGC control set for normal operation |
|  |  |  | No Signal | 6 | 133 | - | - | 8 | 1.1 | 7 | 0 |  | v110B | 6x8 | Vert. Sync Separator | $\underset{\text { Signal }}{15000 \mathrm{Mu} .}$ | 3 | 79 | - | - | 6 | . 90 | 2 | -26.8 |  |
|  |  | $\begin{aligned} & \text { A-Fplifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | 270 | - | - | 3 | 170 | 2 | - |  |  |  |  | No Signal | 3 | 46.5 | - | -- | 6 | 1.35 | 2 | -2.1 |  |
|  |  |  | No Signal | 1 | 260 | - | - | 3 | 133 | 2 | - |  | v111A | 12AU7 | Video Output | $\underset{\text { Signal }}{15000 \mathrm{Ma} \text {. }}$ | 6 | 231 | - | - | 8 | 13 | 7 | 0 |  |
| v2 <br> KRK22C <br> $\stackrel{\text { Kr }}{\text { KRK29A }}$ | 6X8 | Mixer | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 9 | 160 | 8 | 160 | 6 | 0 | 7 | ${ }_{-2.4}^{-2.0}$ |  |  |  |  | No Signal | 6 | 225 | - | - | 8 | 12.5 | 7 | 0 |  |
|  |  |  | No Signal | 9 | 145 | 8 | 145 | 6 | 0 | 7 | $\begin{aligned} & -2.8 \text { to } \\ & -3.5 \end{aligned}$ |  | V111B | 12AU7 | AGC Amplifier | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | -55 | - | -- | 3 | 135 | 2 | 125 |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Oscillator } \end{aligned}$ |  |  |  |  |  |  |  |  |  |  |  |  |  | No Signal | 1 | 0.3 | - | - | 3 | 132 | 2 | 68 |  |
|  |  |  | $\underset{\substack{15000 \mathrm{Mu} . \\ \text { Signal }}}{ }$ | 3 | 95 | - | - | 6 | 0 | 2 | $\begin{gathered} -3.8 \text { to } \\ -5.5 \end{gathered}$ |  | V112A | 12AU7 | Sync Output | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | 83 | - | - | 3 | 0 | 2 | -3.28 |  |
|  |  |  | No Signal | 3 | 90 | - | - | 6 | 0 | 2 | $\begin{gathered} -3.0 \text { to } \\ -5.1 \end{gathered}$ |  |  |  |  | No Signal | 1 | 84 | - | - | 3 | 0 | 2 | -1.3 |  |
| viol | 6AU6 | 1st Sound I.F Amp. | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 122 | 6 | 138 | 7 | 1.01 | 1 | 0 |  | V112B | 12AU7 | Vertical Oscillator \& Discharge | $\underset{\substack{15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal }}}{ }$ | 6 | 80 | - | - | 8 | 0 | 7 | -63.5 | Depends on setting of Vert. hold contro |
|  |  |  | No Signal | 5 | 113 | 6 | 126 | 7 | . 95 | 1 | 0 |  |  |  |  | No Signal | 6 | 182 | - | -- | 8 | 0 | 7 | -60 | Voltages shown are synced pix |
| v102 | 6AU6 | 2nd Sound I-F Amp. | $\underset{\text { Signal }}{\substack{15000 \mathrm{Mu} \\ \text { V. }}}$ | 5 | 210 | 6 | 130 | 7 | 0 | 1 | -2.05 | *Unreliable measuring point. Voltage depends on noise. |  |  |  | No Signal |  |  |  |  |  |  |  |  | adjustment |
|  |  |  |  |  |  |  |  |  |  |  |  |  | V113 | 6AQ5 | Vertical Output | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \\ \hline \end{gathered}$ | 5 | 253 | 6 | 262 | 2 | 0 | 1.7 | -28.8 |  |
|  |  |  | No Signal | 5 | 205 | 6 | 122 | 7 | 0 | 1 | *-1.12 |  |  |  |  | No Signal | 5 | 245 | 6 | 253 | 2 | 0 | 1.7 | -27.5 |  |
| v103 | 6AL5 | Ratio Detector | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \\ \hline \end{gathered}$ | 7 | 1.7 |  | - | 1 | 21 | - | - | 7.5 kc deviation at 1000 cycles | V114 | 6SN7GT | Horizontal Osc. Control | $\underset{\text { Signal }}{15000 \mathrm{Mu} .}$ | 2 | 175 | - | - | 3 | -3.5 | 1 | -21 |  |
|  |  |  | No Signal | 7 | 4.1 | - | - | 1 | 11.8 | - | - |  |  |  |  | No Signal | 2 | 170 | - | - | 3 | -5.5 | 1 | -17.5 |  |
|  |  | Ratio Detector | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 2 | 1.7 | - | - | 5 | 21 | - | - |  |  | 6SN7GT | Horizontal Oscillator | $\underset{\text { Signal }}{15000 \mathrm{Mu} .} .$ | 5 | 183 | - | - | 6 | 0 | 4 | -67 |  |
|  |  |  | No Signal | 2 | 4.1 | - | - | 5 | 11.8 | - | - |  |  |  |  | No Signal | 5 | 179 | - | - | 6 | 0 | 4 | -65 |  |
| v104 | 6Av6 | $\begin{aligned} & \text { lst Audio } \\ & \text { Amplifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} \text { V. } \\ \text { Signal } \\ \hline \end{gathered}$ | 7 | 78 | - | - | 2 | 0 | 1 | -. 7 | At min. volume | V115 | 6CD6G | $\begin{aligned} & \text { Horizontal } \\ & \text { Output } \end{aligned}$ | $\underset{\text { Signal }}{15000 \mathrm{Mu} .}$ | Cap | . | 8 | 193 | 3 | 22 | 5 | -14 | *High Voltage Pulse Present |
|  |  |  | No Signal | 7 | 76 | - | - | 2 | 0 | 1 | -. 65 | At min. volume |  |  |  | No Signal | Cap | * | 8 | 185 | 3 | 20.5 | 5 | -13.5 | *High Voltage Pulse Present |
| v105 | 6AQ5 | Audio Output | ${ }_{\text {So Signal }}^{\text {So Sigal }}$ | 5 | 205 | 6 | 220 | 2 | 15.2 | 1.7 1.7 | 0 | At min. volume | V116 | $\begin{aligned} & \text { 1B3GTT } \\ & \text { /8016 } \end{aligned}$ | $\begin{aligned} & \text { H. V. } \\ & \text { Rectifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | * | 8 | 185 | $2 \& 7$ | 18,700 | - | -13.5 | *High Voltage Pulse Present |
| v106 | 6CF6 | lst Pix. I-FAmplifier | $\underset{\substack{15000 \mathrm{Mu} \text { Sul } \\ \text { Sign. }}}{ }$ | 5 | 218 | 6 | 240 | 2 | 132 | 1 | -8.2 | *Unreliable measuring point. Make measure-ment at T104.B. ment at 104.B. |  |  |  | No Signal | Cap | * | - | - | $2 \& 7$ | 18,350 | - | - | *High Voltage Pulse Present |
|  |  |  | No Signal | 5 | 95.5 | 6 | 105 | 2 | 1.18 | 1 | *<0.1 |  | V117 | 6AU4GT | Damper | $\underset{\substack{15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal }}}{ }$ | 5 | 261 | - | - | 3 | * | - | - | *High Voltage Pulse Present |
| v107 | 6CF6 | 2nd Pix. I-F <br> Amplifier | $\underset{\text { Signal }}{15000 \mathrm{Mu} .}$ | 5 | 222 | 6 | 243 | 2 | <0.1 | 1 | -8.45 |  |  |  |  | No Signal | 5 | 253 | - | - | 3 | * | - | - | *High Voltage Pulse Present |
|  |  |  | No Signal | 5 | 95.5 | 6 | 105 | 2 | 0.53 | 1 | <0.1 |  | V118 | 24CP4A | Kinescope | $\underset{\substack{15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal }}}{ }$ | Cap | 18,700 | 10 | 428 | 11 | 44.5 | 2 | 0 | $\begin{aligned} & \hline \text { At average } \\ & \text { Brightness } \end{aligned}$ |
| v108 | 6CB6 | $\begin{aligned} & \text { 3rd Pix. I-F } \\ & \text { Amplifier } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 138 | 6 | 150 | 2 | 2.3 | 1 | < 0 |  |  |  |  | No Signal | Cap | 18,350 | 10 | 425 | 11 | 39.5 | 2 | 0 | At average Brightness Brightness |
| V109A | 12AU7 | Picture 2nd Det. | $\begin{array}{\|c\|} \hline \text { No Signal } \\ \hline \begin{array}{c} 15000 \text { Mu. V. } \\ \text { Signal } \end{array} \\ \hline \end{array}$ | 5 1 | 130 -25.8 | 6 | 143 | 2 | 2.2 0 | 2 | <0.1 |  | $\begin{aligned} & \text { V119 } \\ & \text { V120 } \end{aligned}$ | $\begin{aligned} & 5 U 4 \mathrm{G} \\ & 5 Y 3 \mathrm{GT} \end{aligned}$ | Rectifiers | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 4\&6 | 18,350 | 10 | 425 | $2 ¢ 8$ | 277 | 2 | 0 |  |
|  |  |  | No Signal | 1 | -14 | - | - | 3 | 0 | 2 | -. 6 |  |  |  |  | No Signal | 4 \& 6 | - | - | - | 2\&8 | 271 | - | - |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |



O John F. Rider


| (tiocr | descmiptiox |  | DEsCAIPTION |  |  | ${ }_{\text {stocr }}^{\text {mo. }}$ | descaptiox |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 77616 | assemblizs | 7827 | Coil-I.F. input coil complete with adjurtable core (La) |  |  | 502118 | 180 ohms, $\pm 5 \% .1 / 2 \mathrm{watt}(\mathrm{R} 131)$ |
|  |  | 78583 | Coil-Mixor IF. coil (L43) Coil-M.F. ampliier coupling coil (L7) |  |  | 503118 503127 |  |
|  |  | ${ }_{76562} 76$ | Coil-R.F. amplifier coupling coil (L7) Coil-R.F. plate i.F. coil (L27) | 79063 7647 | ${ }_{82} \mathbf{~ m m m i t . , ~} \pm 5 \%$ \% , 1,000 volis ( $C 153$ ) | 504147 | 470 ohms, $\pm 20 \%$, $1 / 2$ watt (R133) |
|  |  |  | Coil-R.F. plate i.F. coil (L27) Coil-Shunt coil complete with adjutable core (L3) | 76575 | 180 mmf. 3 . 500 volis (C144) | 513156 | 560 ohms, $\pm 10 \%$, 1 watt (R116) |
| 77151 |  | ${ }_{76538}$ | Coil-Shunt coil complete with adjuatable core (L2) | ${ }^{36636}$ |  | (503210 |  |
| 76532 | 1.4 mmit ( (C15, C20). |  | Resistors-Fixed. composition: | 76579 39640 |  | 501220 513210 | (1,000 ohmms, $\pm 10 \%$, 1 watt (R105) |
|  | Capacitors-Coramic: Variable for fine tuning-plunger type (C2) | 503033 | 33 ohms, $\pm 10 \% .1 / 2$ watt (R19) | 39640 76476 |  | 523218 5 | 1,800 ohms $\pm 10 \% .2$ watts (H117) |
| 77853 77084 | 1,000 mmi. 100d.thru (C11, C21, C22) | 503112 503147 | 120 ohms, $\pm 10 \%$, $1 / 2$ watt (R2) ${ }^{\text {a }}$ | ${ }^{39644}$ | $470 \mathrm{mm} .. \pm \pm 5 \%$, 500 volis (C107, C108) | 502222 50323 | 2,200 ohms. $\pm 5 \%$, $1 / 2$ watt (R165) |
|  | Capaciors-Fixed, coramic, High "X" diec: | 5 | 1,000 ohms, $\pm 10 \%$, $1 / 2$ watt (RG, R20) | 78796 |  | 50323 50239 | 3,300 ohms, $1 . \pm 5 \% 1 / 2 / 2$ watt (R135) |
| 77293 7725 | $\mathrm{Cl}_{31}\left(\mathrm{C}_{2}\right)$ | 503233 | 3.300 ohms, $\pm 10 \%$, $1 / 2$ watt (R9) | 5217 | Capacil, 10-160 mmi. (C174A, C174B) | 503239 | $3,900 \mathrm{ohms}$. $\pm 10 \%$ \% $1 / 2$ watt (R198) |
| 73960 | 10.000 mml. + $+100 \%$, $0 \%$, 500 volts DC (C28) | 5032 | 5.800 ohms, $\pm 10 \% .1 / 2$ watt (R1) |  | Capacior-Trimmer, adjunable: | 503256 <br> 513256 | 5.600 ohms, $\pm 10 \%$, $1 / 2$ watt (R140. R158) $5600 \mathrm{hms}, \pm 10 \%$ watt (R167) |
|  | Capacitor-Fixed, coramic, insulated. High "X" dive: | 523312 523315 | 12.000 ohms, $\pm 10 \%, 2$ watts (R13) 15.000 ohms, $\pm 10 \%, 2$ watts (R7) | 78220 | 5,70 mmi., 200 volts (C122) Capacitors-Electroytic comp | S522275 | 7.500 ohms, $\pm 5 \%$, 2 watts (1142) |
|  | Capacitor-Fixed, cerramic, non-insulated, Temp. coel. -0 | ${ }_{523322}$ | $22,000 \text { ohms, } \pm 10 \%, 2 \text { watts (R52) }$ | 78213 | ${ }_{1}$ soction of 10 midat, 350 volus 11 section of 5 mid, 350 | 502310 | 10.000 ohms, $\pm 5 \%$, $1 / 2$ walt (R109, R |
| 77865 | $10 \mathrm{mmf} . \pm 1.0 \mathrm{mml}$., 500 volus DS (C1) | 523 | 27.000 ohms, $\pm 10 \% .2$ watts (R53) |  |  | 503310 523310 | 10,000 ohms, $\pm 10 \%$, $1 / 2$ watt (R157) |
|  | Capacitor-Fixod, coramic, non-insulatod, | 503410 | 100,000 ohms, $\pm 10 \%$, $1 / 2$ watt (R3, R10, R11, R12) | 77644 | soction of 80 mid., 400 yolss: and 1 zection of 20 m | ${ }_{5} 503312$ | 12.000 ohms, $\pm 10 \%$, 1/2 watt (R113, R137, R179, R216) |
| 33098 | $10 \mathrm{mmi} ., \pm 1.0 \mathrm{mml}$., 500 volis DC (C4) | 503510 | $1 \mathrm{megohm}, \pm 10 \%, 1 / 2$ watt (R4, RS) |  | 400 volst (C1198, Cllise) vols; and 1 zection of 2 | 36714 | 15.000 ohms, $\pm 5 \%$, $1 / 2$ watt (R177) |
| 76527 | Capacitor-Mica trimmer: <br> $55-80 \mathrm{mml}$. (C10) | 78396 | Transformor-Antenna matching transtormer complete | 78212 |  | 503315 | 15,000 ohms, $\pm 10 \%$, $1 / 2$ watt (R122, R189, R200) |
| 77854 | Clip-Mounting clip for fine tuning core | 78399 76540 |  |  | Capacior-Fixad, papar, oil imprognated, $85^{\circ}$ oparating temparature: | 503318 |  |
|  | Coil-Filument choke coil (L52) Coil-Hoater choke coil (L50, L51) | ${ }_{78466}$ | Trap-1.F. trap (L6) | 75249 | . 001 mda . $\pm 10 \%$, 600 volts | 503322 | 22.000 ohms $\pm 10 \%$. $1 / 2 \mathrm{watt}$ (1169, R176) |
| 7506 | Coil-R.F. amplifior coupling coil (L47) | ${ }_{7}^{76542}$ | Trap-1.F. trap ( 41.25 mc ) complete with core (L1) | ${ }_{7}^{7543}$ | . 001 mid. $\pm 20 \%$, 1,000 volus (C140) ) | 71989 53227 |  |
| 78466 | Coil-P.F. choke cpil (LA8) | 76541 |  | 73595 73599 | . 00227 mid.,. $\pm 10 \%$, 600 volta (C115, C139, C157, C161) | 5233 | 33,000 ohms, $\pm 5 \% .1 / 2$ watt (R181) |
|  |  |  | KRK27 | 7902 | . 0027 mdd., $\pm 10 \%$, 1,000 volts (C118) | 503339 | 39,000 ohms, $\pm 10 \%$. $1 / 2$ watt (R108, |
| 504147 |  |  | Capacitor-Adjustable, steatite: | 79018 | . 0039 mmd . $\pm 10 \%$, 400 volus (C193) | 70351 | $43.000 \mathrm{ohms}, \pm 5 \%, 1 / 2 \mathrm{watt}$ ( R 148 ) |
| ${ }^{504268}$ | 6,800 ohmm. $\pm 20 \%$, $1 / 2 \mathrm{watt}(\mathrm{R} 12)$ | 78259 | 0.6-1.4 mmi. complete with adjustable core (C7, C8) | 78221 |  | 503347 | 47,000 ohms $\pm 10 \%$, $1 / 2$ watt (R163) |
| ${ }_{523312}$ | 12.000 ohms, $\pm 10 \%$, 2 watts (R2) |  | Capacitor-Fixed, cercmicic: | 79017 79019 | . 00882 mdd.. $\pm 10 \%$, 400 volus (C156) | 5123 | 47,000 ohms, $\pm 5 \%, 1$ watt (R202) |
| 523315 | 15,000 ohms, $\pm 10 \%$, 2 watts (R3) | 77084 |  | ${ }_{79014}$ | . 01 mid. $\pm 20 \%$ \% 200 volts ( $\mathbf{C l 1 3}$ ) | S023 | ${ }_{56,000}$ |
| 503510 | 1.0 mogohm, $\pm 10 \%$, $1 / 2 \mathrm{watt}$ ( Ag , R10) |  | $\stackrel{\text { capallors--1. }}{=0}$ | 73561 | . 01 mid., $\pm 20 \%$, 400 voliss (C116) | 503356 | $56.000 \mathrm{ohms}, \pm 10 \%$, $1 / 2$ watt (R209) |
| 336 |  | 78262 |  | 73594 | . 01 mid... $\pm 10 \%$, 600 volts ( $(160)$ | ${ }^{503368}$ | 68.000 ohms, $\pm 10 \%$, $1 / 2 /$ wart (R155, R159) |
| 78399 | Transiormer-Convertor transiormer (T1) | $\begin{aligned} & 78261 \\ & 70596 \end{aligned}$ |  | 73794 73562 |  | 503382 503410 | 82,000 ohms $\pm 10 \%, 1 / 2$ watt (RI94) <br> 100,000 ohms, $\pm 10 \%, 1 / 2 /$ watt (R195) |
|  | Ier unit assemblies |  | Capacior- Fixed , coramic, non-insulatod, | 73798 | . $022 \mathrm{mfd}$. . $\pm 20 \%, 600$ volts (C164) | 503410 50410 | 100,000 ohms. $\pm 20 \%$. $1 / 2$ watt (R187, R214) |
|  |  |  |  | 73810 | . 022 mid., $\pm 20 \%$, 1.000 volus (C154) | 502415 | 150,000 ohms. $\pm 5 \%$, $1 / 2$ watt (11499) |
|  | Capacitor-Adjustable, mica: $4.40 \mathrm{~mm}($ C33) | 78263 |  | $\begin{aligned} & 75345 \\ & 79015 \end{aligned}$ |  | 503415 512415 | 150,000 ohms. $\pm 10 \%$. $1 / 2$ watt (R190) |
| 776 |  | 78137 | 0.51 mmi. | 73552 | . $033 \mathrm{mld}$. . $\pm 20 \%$. 400 volts (C151) | ${ }_{\text {cher }}$ | 180,000 ohms. $\pm 5 \%, 1 / 2 \mathrm{watt}$ (R120) |
| 77151 |  | 78260 71502 |  | 73553 <br> 7559 |  | 503422 | 2200,000 ohms $\pm 10 \%$, $1 / 2$ watt (R1186) |
| 7913 | 0.83 .30 mmi ( $\mathrm{C}^{2}$ | 71502 78257 |  | 73592 73597 |  | 503427 <br> 50343 | 270,000 ohms. $\pm 10 \%$, $1 / 2 /$ watt (R161, R208) |
| 76532 | 1.4 mmL ( $C 7)$ |  | Clid, C15, C16, L1, L2) | 79016 | . 0688 mdd .. $\pm 10 \%$, 200 volta (C166) | 503433 50433 | ${ }^{3350,000 ~ o h m m s, ~} \pm 20 \%$, $1 / 2$ watt (R115) |
|  | Capaciora-COramic: Variable, tor fine tuning capacitor-plunger type (C27) | 78258 78264 | Coil-l.F. coil complote with adjustab) Coil-Peaking coil (L3, HI$)$ | ${ }_{7}^{73551}$ | (e.1 mid. $\pm 20 \%$, 400 volts (C150, C158, C169, C177) | 502439 | 390.000 ohms, $\pm 5 \%$. $1 / 2 \mathrm{watt}$ ( $\mathrm{Hi84}$, R186) |
| 77084 | Food-hru, 1,000 mmi. (C5, C15, C17, C18, C19) | 72618 | Coil-Poaking coil (20 muh) (LA) | 73557 73794 |  | 503393 50347 |  |
|  | Capactiora- Fixod coramic. High "r" diec: | 78267 77279 |  | ${ }_{73786}$ | 0.27 mfd.. $\pm$ 10\%, 200 volts (C187) |  | 470,000 ohms, $\pm 20 \%$, $1 / 2$ watt (1114, $1414, \mathrm{R147}$ ) |
| ${ }_{7725}^{7293}$ |  | 77279 78269 | Coil-R.F. choke coil ${ }^{\text {a }}$ (0.33 muh) ( Lb, L9) Connoctor-Single contact male connector for 1.F. output | 73787 | 0.47 mid., $\pm 20 \%$, 200 volts (C110, C142, C180) | 30562 | 680,000 ohms, $\pm 10 \%$, $1 / 2$ watt (15156) |
| $739$ |  |  | connetor-Single contact male connectior tor cable cire |  |  | 503482 503510 | 820,000 ohms, $\pm 10 \%$, $1 / 2 \mathrm{watt}$ (R192, R203) |
|  | Capaction-Fixod, coramic, insulctiod, High "r": | 78255 | Connector-2 contact female connector for UHF antonna | ${ }_{75249}$ | . 0011 mad., $\pm 5 \%$. 600 volts (cliss) | 50310 | $1.2 \mathrm{mogohm}, \pm 10 \%$, $1 / 2$ watt (R165) |
| ${ }_{7}^{75437}$ |  |  | Holdor-Crytal holdor | ${ }_{7}^{78221}$ |  | 31449 | 1.5 mogohm, $\pm 5 \%$, 1/2 watt ( $\mathrm{Rl1199}$ ) |
| 75199 |  | 99 | Rectifios-Crystal rectifior IN82 (CR1) | 73594 77676 | ${ }_{\text {a }}^{\text {a }}$. 01 mid., $\pm 5 \%$, 600 volts (C182) | S03315 <br> 3993 | $1.5 \mathrm{mogohm}$, , $\pm 0 \%$, $1 / 2$ wart (R124) |
|  | Capacitora-Fixod, coramic, non-insulated. Tomp. coot |  | Rexistors-Fixod. composition: |  | Choke-Filtor choke Coil-Choke coil (L101, L112, L119) | 39063 505522 |  |
|  | $=0$ <br> 5 mml ., $\pm 0.5$ momi., 500 volte (C2) | 503110 503215 | 100 ohms, $\pm 10 \% .1 / 2 /$ watt (R2) | 26442 | Coil-Horizontal linearity coll comploto with adjunta | 504522 | 2.2 megohm, $\pm 20 \%$. $1 / 2 \mathrm{watt}$ (R1188) |
| 77963 | 10 mmit . $\pm 1 \mathrm{mmm}$. 500 volita ( (C22, C37) |  | 1,200 ohms, $\pm 10 \%$, $1 / 2 /$ watt (R5) | 78743 | Coill-Printed I.F. circuit assemble (PC10 | 502539 504610 | ${ }^{3.9}$ megohm, $\pm 5 \%$, $1 / 2$ wolt (R132, R153) |
| 54207 | $18 \mathrm{mmit} .10 \%$, 500 volut (C1) | ${ }_{503268}$ | ${ }_{6,800}$ ohms, $\pm 10 \% .1 / 2$ watt (R4) |  | Coils-Poocking coill : | 504610 78203 |  |
| 76739 | $\begin{aligned} & 27 \mathrm{mmf} ., \pm 10 \%, 500 \text { volts (C3) } \\ & 33 \mathrm{mml}, \pm 10 \%, 50 \text { volts ( (C4) } \end{aligned}$ | 78268 | Tranalormor-Antonna input trantormor ( 71 ) | 75253 71529 | ${ }_{\text {a }}^{(120 \mathrm{muh})(1202)}$ |  | frestable core (Ti06) |
|  | Capacitor-Fixed. coramic, non-insulated, Temp. coos. $=-750$ |  |  | ${ }_{98482}^{7529}$ | ${ }^{(250}$ muh) (L103) |  | core (Lil |
| 78247 | mmi. $\pm 10 \%$, 500 volus (C24) |  |  | 77674 | (250 muh) (L105, R138) (250 muh) (L106, 1215 ) | 78010 | Transformar-Horisontal |
|  |  |  | Capacitors-Fixad, craramic: | 75252 | ( 500 muh ( (L107) | 76450 |  |
| ${ }_{71502}^{71504}$ |  | 33098 | (10 mmld., $\pm 10 \%$, 500 volts (C134 | 76640 7644 | Coil-R.F. choke coill (1.5 muh) (1) |  | Transtormor-Ou |
| ${ }_{7}^{7503}$ | 3.3 mmi. $\pm 20 \%$, 500 volis (C33) | 39042 |  | 76411 | Coil-Width coil complote with adiusiable core Resitorm-Wirs wound: | 78805 | Translormor-Powor transiormor, 117 Volua, 60 |
| 77854 7391 | Clip-Fine tuning clip ior fine tuning core Coll-Antona matching coil (Part of Tl ) | 71922 | 180 mmit . $\pm 10 \%$, 500 voltes (C152) | 78795 | 1.2 ohms, $\pm 5 \%$, $1 / 3$ watt (R210) |  | Transiormer-Sound L.F. tranaformor with adjuntable core |
| 78401 | Coil-Channel No. 6 antonac coill (L61) | 47617 | Capacitors-Fixed, coramic, High "x" disc: |  | 47 ohms, $\pm 10 \%$, ${ }^{2}$ watta (R206) |  | Translormor-Vertical output tametormer (T112 |
| 73074 73450 | Coill-Channol No. 6 mixar coil (L43) Coill-Channol No. 6 ri. plate coll (L32) | 78622 | $470 \mathrm{mmf}. \pm 20 \%$, 500 volts (C127. C129) | 77671 | 3.800 ohms $\pm 10 \%$, 7 watts (1121) | $76993$ | Trap 4.5 MC trap (L104, C135) |
| 73453 | Coil-Channol No. 6 r.at grid coill (Li4) | 77293 |  |  |  |  |  |
| 77919 77915 | Coll-Channol No. 13 mixer coil (L36) Colll-Channol No. 13 ocelllator coil (L) | ${ }_{79623}^{7762}$ |  | 503047 | 47 ohms, $\pm 10 \%$ \% $1 / 2$ watt (R107) |  |  |
| 77921 7 | Coll-Channol No. 13 r.L plate coll (120) |  |  | 504047 <br> 34763 | 47 ohms, $\pm 20 \% .1 / 2$ watt (R205) |  |  |
| ${ }_{76783}$ | Coll-Filament choke coil (L33) Coil-Heater choke coil (L34, L35) | 73960 | 10,000 mmit., $+100 \%$, -0\%, 500 volts (C104, C105, C133) | 3463 503092 |  |  |  |
| 76763 | Coil-Hoater choke coill (L34, L35) |  | Capacilors-Fixad, mica: | 503112 | 120 ohms , $\pm 10 \%$, $1 / 2 \mathrm{watt}$ (R136) |  |  |

- John F. Rider


## ELECTRICAL AND MECHANICAL SPECIFICATIONS



Models 2l:S.S.348K, 2l:S.S.348 Ebony, Maroon

ls 21-5. $355 \mathrm{~K}, 21$ - S .35 SKU Broun Maroon


Models 21-S. $367 \mathrm{~K}, 21$-S. 367 KU Fit Knot




## GENERAL DESCRIPTION

All models are " 21 inch lelevision receivers. Models without $\alpha$ " $U$ designation in the model number are receivers with VHF only and feature full 12 channel VHF coverage. Models with the " U " designation in the model number are UHF/VHF receivers and feature full 12 channel VHF coverage plus any UHF channels desired. All models record playing attachment except Models $21-5-348 \mathrm{~K}$ and 21-S-348KU.
PICTURE SIZE

227 square inches on a 21ZP4A or 21ZP4B Kinescope

TELEVISION R-F FREQUENCY RANGE
Models 21-S.348K to 21-S-369K Incl.
All 12 VHF channels. . . . . 54 mc . to $88 \mathrm{mc}$. , 174 mc . to 216 mc
Models $21-\mathrm{S}-348 \mathrm{KU}$ to $21-\mathrm{S}-369 \mathrm{KU}$ Incl
Any of 70 UHF channels
$\qquad$
470 mc to 890 mc
Any of 12 VHF channels. 54 mc . to $88 \mathrm{mc} ., 174 \mathrm{mc}$. to 216 mc .

## QUENCIES

| Picture I-F Carrier Frequency |  |
| :---: | :---: |
| Sound I-F Carrier Frequency | 41.25 m |
| POWER RATING........................... 175 wat |  |
| AUDIO POWER OUTPUT RATING |  |
| RCA TUBE COMPLEMENT |  |
| Tube Used | Function |
| Tuner KRK22D (Models with VHF only) |  |
| (1) RCA 6BQ7A | R-F Ampli |
| (2) RCA $6 \times 8$ | ator and |

(2) RCA $6 \times 8 \ldots \ldots \ldots \ldots$......................illator and Mixer

21-S-348K to $21-\mathrm{S}-369 \mathrm{~K}$ incl.
21-S-348KU to $21-\mathrm{S}-369 \mathrm{KU}$ incl. ELECTRICAL AND MECHANICAL SPECIFICATIONS (cont'd)

| Chassis designations |  |  |  |
| :---: | :---: | :---: | :---: |
| CHASSIS | TUNER | $\begin{aligned} & \text { KINE- } \\ & \text { SCOPE } \end{aligned}$ | MODELS |
| KCS88 | KRK22D | 212P4B | $\begin{aligned} & 21-S-355 K \\ & 21-S-357 \mathrm{~K} \\ & 21-S-362 \mathrm{~K} \\ & 21-S-357 \mathrm{~K} \\ & 21-S-369 \mathrm{~K} \end{aligned}$ |
| KCS88A | KRK22D | 212P4A | 21-S-348K |
| KCS88F | KRK31 | 21ZP4B | $\begin{aligned} & \text { 21-S-355KU } \\ & \text { 21-S-357KU } \\ & \text { 21-S-362KU } \\ & \text { 21-S-367KU } \\ & \text { 21-S-369KU } \end{aligned}$ |
| KCS88H | KRK31 | 212P4A | 21-S-348KU |

OPERATING CONTROLS (Front)
Channel Selector

Fine Tuning | Models with VHF only |
| :--- |
| $\{\ldots \ldots \ldots \ldots \ldots$. Dual Control Knobs |
|  |
|  |
| UHF/VHF Models |

VHF Channel Seletor
HF Changeover Switch
VHF Fine Tuning and

## All Models

Brightness. .
Horizontal (Freq.)
Vertical Hold
Single Control under Panel Single Control under Panel Single Control under Pane

OPERATING CONTROLS (ETOI)
Sound Volume and On-OH Switch
Picture TV.PH tone switch. . . . . . . . . . . . Single Control under Pane -Except Models 21-S.348K and 21-S-348KU
nON-OPERATING CONTROLS (under Front Panel)

Height
Vertical Linearity
Horizontal Drive
Horizontal Linearity
screwdriver adjustme - driver ad screwdriver adjustme screwdriver $a d j u s t m e n$

## nON-OPERATING CONTROLS

(not including R-F and I-F adjustments)
Picture Centering.
Width
Horizontal Oscillator Wavelorm
Focus.
Ion Trap Magnet
Deflection Coil.
AGC Control.

- ....rear chassis adjurmen
. Interlaced, 525 lin
HORIZONTAL SWEEP FREQUENCY............. 15,750 cps
VERTICAL SWEEP FREOUENCY
frame frequency (Picture Repetition Rate).... 30 cp

CENTERING ADJUSTMENT.-No electrical centering conrols are provided. Centering is accmet The centering plat separate pling nut which must be loosened before centering Ip and down adjustment of the plate moves the picture up nd down and sid de to side.
If a corner of the raster is shadowed, check the maximum raster brightness to eliminate the shadow and ecenter the picture by adjustment of the focus magnet plate. n no case should the magnet be adjusted to cause any ventual damage to the tube. In some cases it may be neces-
and eliminate a corner shadow.

WIDTH AND DRIVE ADJUSTMENTS.-Set the horizontal ontrol at the "pull-in" point. Adjustment of the horizontal drive control affects the high voltage appible voltage hence scope. In order to brightest and best focused picture, adjust horizontal drive rimmer counter-clockwise until a bright vertical line appears in the middle of the picture then clockwise
line just disappears. ine just disappears. At maximum bright
correct picture width.
Return the brightness to normal level and readjust the Return the brightness to
drive trimmer C171 as before.
Adjustments of the horizontal drive control affect horizonta oscillator hold and locking range If the
adjusted, recheck the oscillator alignment.
height and vertical linearity adjustments. Adjust the height control (R165 behind front control panel) until the picture fills the mask vertically. Adjust vertical line arity (R114 behind front control panel), until the test pattern is symmetrical lrom top to bottom. Adjustment of cent centering
trol will require a readjustment of the other. Adjust cent to align the picture with the mask.
FOCUS.-Adjust the focus magnet for maximum definition in the test pattern verical wed white areas of the palt

AGC THRESHOLD CONTROL.-The AGC threshold control R149 is adjusted of the factor
To check the adjustment of the AGC Threshold Control, tune in $\propto$ strong signal and sync the picture. Momentarily remove the signal by switching off channel and then back. If the pic ture reappears immediately, the receiver is not overloading aue reciable portion of a second to reappear, or bends exces appreciable portion of a second to
sively, R149 should be readjusted.
Turn R149 fully counter-clockwise. The raster mary be bent lightly. This should be disregarded. Turn R149 clockwis until there is a very, very slight bend or change or bend in
the picture. Then turn R149 counter-clockwise just sutticiently to remove this bend or change of bend.
If the signal is weak, the above method mary not work as it nay be impossible to get the picture to the ind this case, lurn R149 clockwise until the snow in the picture becomes
more pronounced, then counter-clock wise until the best signal nore poise ratio is obtcined.
The AGC control adiustment should be made on a strong ignal it possible. It the control is set too far clock wise on a signal is received.

PINCUSHION CORRECTION
Two pin-cushion correction magnets are employed to cor rect a small amount of pin-cushion of the raster due to the rect a smat of the face of the kinescopid. These magnets are mounted on small arms, one on each side of the kinescole a
shown in Figure 3. The arms hinge in one plane on self tap shown in Figure 3. The arms hinge in one plane on self ap-
ping screws which act both as a hinge and an adjustment ping screws which act borh as a his are swung towards the tube, maximum correction is obtained. Minimum correction is obtained when the arms are swung away ram the tube. T
adjust the magnets, loosen the two self tapping screws an adjust the magnets, position until the sides of the raster appea straight. Tighten the screws withoul shifting the position of th the magnet support arms to obtain the appearance of straigh raster edges

Recheck the position of the ion trap magnet to make sure
that maximum brightness is obtained.
Check to see that the yoke knurled nuts and the focus


Figure S-KRK22D R-F Oscillator Adjustments
KRE22D. OR RRE31 VHF R-F OSCLILATOR ADJUST MENTS. -Tune in all available stations to see if the receive r -f oscillator is adjusted to the proper frequency on all chan
nels. If adjustments are required, these should be made by the method outlined in the alignment procedure on page 11. The adjustments for channels 2 through 12 are cvailable from
the front of the cabinet by removing the station selector the front of the cabinet by removing the station selector
escutcheon as shown in Figure 5 or 6 . Adjusment for chemnel 13 is on top of the chassis. The oscillator for the KRR2 UHF tuner section of the KRK31 tuner should be adjusted by

Figure 6-KRK31 VHF R-F Oscillator Adjustment


FM TRAP ADIUSTMENT.-In some instances interference may be encountered from a strong FM station signal. A trap
is provided to eliminate this type of interference. To adjust he trap tune in the station on which the interference is the picture The trap is $L 58$ on KRK22D or $L 5$ on KRK 31 tuners the picture. The trap is L58 on KRK22D or L5 on KRK31.
and is located on the antenna matching translormer.
CAUTION.-In some receivers, the FM trap 15 or 158 will une down into channel 6 or veren into chamnel 5 . Needless to say, such an adjustment will cause greatly reduced sensitivity
on these channels. If channels 5 or 6 are to be received. heck 15 or 158 to make sure that it does $n$ offet seneitivity on these two chomnels.
Replace the cabinet back and connect the receiver antenna leads to the cabinet back. Make sure that the screws holding it are up tight, otherwise it may receiver is operated at high volume.

## 21-S-348K to 21-S-369K incl

TEST EQUIPMENT.-To properly service the television chassis of these receivers. it is rec
ing test equipment be available
VHF Sweep Generator meeting the following require (a) Fre
quency Ranges
351090 mc ., 1 mc . to 12 mc. sweep width
170 to 225 mc 12 mc sweep width
(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) "Flat" output on all attenuator positions.

VHF Signal Generator to provide the following frequencie with crystal accuracy
(a) Intermediate frequencies
) Radio frequencie

(c) Output of these ranges should be adjustable and at lean

VHF Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled
UHF Sweep Generator with a frequency range of 470 mc
to 890 mc. RCA types 40 A or 41 A or their equivalent. tr
UHF Signal Generator to provide the following frequencie

Cathode Ray Oscilloscope--An oscilloscope with a sensitivity of 5 millivolts per inch is required. A suitable pre amplitier m
sensitivity.
Electronic Electronic Voltmeter.-A voltmeter with a 1.5 volt DC scale is required. RCA Senior "VoltOhmyst" or equivalen
PICTURE I-F TRANSFORMER ADIUSTMENTS.-
Models 21 -S-348K to 21 - -369 K Incl.
Connect the iff signal generator, in series with a 1500 mml ceramic capacitor, to the mixer grid test point TP2. C120 and to ground. Turn the AGC control fully clockwise Obtain two 7.5 volt batteries capable of withstanding appreciable current drain and connect the ends of a 1.000 terminal of one to the chassis and the potentiometer arm to erminal of one to the chassis and the potentiometer arm to
the junction of R118, R146 and C120. The second bottery will the junction of
be used later.
Set the bicia
Set the bias to produce approximately -4.0 volt of bias at the junction of R118, R146 and C120.
Connect the "VoltOhmyst" to the junction of R129 and L103 and to ground.
Set the VHF signal generator to each of the following frequencies and peak the specified adjustment for maximum should be peaked with their cores of the ends of the coils nearest the chassis.) During alignment, reduce the input signal if necessary in order to produce 3.0 volts of d-c at R 129 and L103 with -4.0 volts of $\mathrm{i} f \mathrm{f}$ bias at the junction of R118
44.5 mc
45.5 m
43.0 m

| $T 107$ |
| :--- |
| $T 106$ |
| 105 |

Set the VHF signal generator to the following frequency and adjust the picture it f rap for minimum d-c output ot
R129, 103 . Use sulficient signal input to produce 3.0 volts of d-c on the meter when the adjustment is made.
(Note: Core should be at end of coil nearest chassis when properly adjusted.) $\begin{gathered}\text { Models } \\ 21-\mathrm{S}-348 \mathrm{KU} \text { to } 21-\mathrm{S}-369 \mathrm{KU} \text { Incl }\end{gathered}$ Connect the i-f signal generator in series with $\alpha 1500 \mathrm{mmf}$. ceramic capacitor, to the mixer grid test point TP2. Connect the "VoltOhmyst" to the junction of R118, R146

## © John F. Rider



## Turn the AGC control fully clockwise

Turn the AGC control fully clockwise. withstanding appre-
Obtain a 7.5 volt battery capable of with ciable current drain and connect the ends of o $1,000 \mathrm{oph}$
potentioneter across it. Connect the battery positive terminal potentiometer across it. Connect the battery positive terminal
to chassis and the potentiometer arm to the junction RI18,
R146 and C120. Adjust the potentiometer for - 4.0 volts indito chassis and the potentiometer arm to the junction R118,
R146 and C120. Adiust the potentiometer for 4.0 volts indi-
cation on the "VoltOhmyst." cation on the "Voltohmyst."
and to ground. and to ground
Set the VHF
and with a thin fiber screwdriver tune the specified adjustment for maximum indication on the "Voltohmyst." In each instance the generator should be checked against a crystal
calibrator to insure that the ge nerator is on frequency. During alignment, reduce the input signal if necessary in

44.5 mc
45.5 mc
43.0 mc

Note: P
T106
T105
chassis.)
Set the signal generator to the following frequency and adjust the picture i-f trap for minimum d-c output at junction
of R129 and L103. Use sufficient signal input to produce 3.0 volts of d-c on the meter when adjusiment is made 47.25
(Note: Core should be at end of coil nearest chassis when properly (djusted.)
SWEEP ALIGNMENT OF PICTURE I-F.-
Models 21 -S- 348 K to 21 -S 369 K ncl.
To align the mixer plate circuit, connect the sweep gener-
ator to the mixer grid test point TP2, in series with a 1500 alor to the mixer grid test point Th2, in series with a
mm. . ceramic capacitor. Use the shortest leads possible. with mmi. ceramic capacitor. Use the shortest leads possible. with
not more than one inch of unshielded lead at the end of the
sweep cable. Connect the sweep ground lead to the top of nol more
sweep abl
the tuner.
the tuner.
Selt the channel selector switch to channel 4.
Set the channel selector switch to channel 4 .
Clip $\alpha 330$ ohm resistor between pin 1 of V107 and ground.
Preset C116 to minimum capacity. Preset Cll 16 to minimum capacity.
Adjust the bias
Adjust the bias box potentiometer to obtain -4.0 volts o
bias as messured by a "VoltOhmyst" at the junction of R118,
R146 and Clina Rias as measured
Clind Cl20.
Connect a 180
Connect a 180 ohm composition resistor from pin 5 of V105
to pin 6 of V105. Connect the oscilloscope diode probe to pin to pin 6 of V105. Connect.
5 of V105 and to ground.
Couple the signal generator loosely to the diode probe in
order to order to obtain markers.
Adjust Tl (top) and T 04 (top) for maximum gain and with 45.75 mc. at $75 \%$ of maximum response.

Set the sweep output to give 0.3 to 0.5 volt peak-to-peak on the oscilloscope when making the final touch on the above adjusiment.
Adiust C116 until 42.5 mc . is at $70 \%$ response with respect
to the low frequency shoulder of the curve as.shown in Figure to the low frequency shoulder of the curve as.shown in Figure
9. Mcximum allowable tilt is $20 \%$. 9. Maximum allowable till is $2 \%$. 180 ohm and the 330 ohm
Disconnect the diode probe, the 180 . resistors.
Connect the oscilloscope to the junction of R129 and L103.
Leave the point TP2 with the shortest leads possible. ${ }^{5}$ Adjust the output of the sweep generator to obtain 3.0 to 5.0 volts peak-to-peak on the oscilloscope.
Couple the signal generator loosely to the grid of the firs pix i-f amplifier. Adjust the output of the signal generator to produce small markers on the response curve.


Figure 9-
KRK22D
T1 and T104
Figure 10-
OVerall 1-F
Respons
Overall $1-F$
Response
with KRK22D
$\quad$ Retouch 10.
in Figure 10.
Increase sweep output ten times and check attenuation at 41.25 mc. Adjust Tl05 and T107 to set 41.25 mcc . between Move the sweep generator to the antenna terminals. Co
nect -3.0 volts bias to pin 5 of V103. Adjust T106 and T1 slightly to correct for any overall tilt while switching from chamnel to channel.

Models 21 -S-348KU to 21 -S-369KU Incl
To align the mixer plale circuit, connect the sweep gener-
otor to the mixer grid test point TP2, in series with a 1500 mmf. ceramic capacitor. Use the shortest leads possible, with not more than one inch of unshielded lead at the end of the
 Set the
Clip a channel selector switch to channel 4 . Preset C116 to minimum capacity
Adjust the bias box potentiometer to obtain -4.0 volts of
ias as measured by $a$ "Voltohmyst" at the junction of R118, Adjust the bias box potentiometer to oblain -4.0 volts of
bias as measured by a "Voltohmyst" at the junction of R118,
R146 and Cl20.
Connect a 180 ohm composition resistor from pin 5 of V105
to pin 6 of V105. Connect the oscilloscope diode probe to pin to pin 6 of V105. Connect
5 of V105 and to ground.
Couple the signal generator loose'y to the diode probe in
order to obtain markers.
Adjust T2 (top) and Tl04 (top) for maximum gain and Set the sweep output maximum response.
Set he sweep output to give 0.3 to 0.5 volt peak-to-peak
on the oscilloscope when making the final touch on the above adjustment.
Adjust Cl 116 until 42.5 mc . is at $70 \%$ response with respect
to the low frequency shoulder of the curve as shown in to the low frequency shoulder of the cal
Figure 11. Maximum allowable tilt is $20 \%$.
Disconnect the diode probe, the 180 ohm and the 330 ohm Discon
resistors.


| Figure 11- | Figure 12- | Figure 13- |
| :---: | :---: | :---: |
| KRK31 | Overall | KRK31 |
| T2 and TIO4 | I-F Response | L9 and L307 |
| Response | with KRK31 | I-F Response |

Connect the oscilloscope to the junction of R129 and L103. Leave the sweep generator connected to the mixer grid tes
point TP2 with the shortest leads possible. point TP2 with the shortest leads possible.
Adjust the output of the sweep generator to obtain 3.0 to Coup peak-to-peak on the oscilloscope.
pix i-f a the signal generator loosely to the grid of the firsi pix i-f amplifier. Adjust the output of the signal generator to
proll markers on the response curve. Retouch T105, T106 and T107 to obtain the response shown Increase sweep output ten times and check attenuation at
41.25 mc. Adjusi T105 and T107 to set 41.25 mc. between 25
4nd 35 times down with curve as shown in Fiqure 12 . To align the I-F amplifier circuit of the KRK31, conect the VHF asweep generator to the rear terminal of the 1 N82 crystal holder in series with a 1000 ohm resistor and a 1500 mmf ceramic capacitor. Use the shortest lecds possible, grounding the sweep ground lead to the tuner case.
Set the UHF CHANGEOVER switch to the UHF position, and
the UHF TUNING to channel 47 at 670 mc. Connect a 180 ohm composition resistor and a 1500 mmf . capacitor in series between test point TP3 and ground with
the capacitor connected to TP3 and the resistor to ground.

Connect the oscilloscope diode probe to the junction betwee Couple the VHF signal generator loosely to the diode probe in order to oblain markers.
Connect the potentiometer arm of the second bias supply
oo the AGC terminal on the tuner and ground the battery to the AGC terminal on the tuner and ground the batter
positive terminal to the tuner case. Adjust the bias potentiometer to produce -3.0 volts of bias, as measured by the ometer to produce - -O
volis of biaz, as meas
VoltOhmyst" ot the AGC terminal on the tuner
Set the sweep generator to produce 0.5 volt or less peak-10
peak on the oscilloscope.
Adjust L307, on the KRK27 section, and L9, on the KRK29D Adjuatt Le the on the KRK27 section, and L9, on the KRK29D
section, of
42.5 me , marker maximum gain with 45.75 mc . and 42.5 mc . markers as shown in figure 13 .

If necessary adjust 127 to place the 45.75 me. marker at
the peak of the curve. Adjust L43 for minimum tilt of the curve as shown in figure 13 . Remove the resistor, capacitor and diode probe from TP3
and connect the oscilloscope to the junction of R129 and L103.
Use 3.0v peak-to-peak on the oscilloscope. Connect the VHF sweep generator to the antenna ter
minals. Keep the AGC bias at -3.0 V and the I . F bias al $\xrightarrow{\text { Luinals. Ke }}$
Couple the signal generator loosely to the grid of the firs
picture I-F amplifier. icture I-F am
Switch through all VHF channels and check for proper
curve shape as in figure 12 . Retouch T106 and T107 slightly curve shape as in figure 12 . Retouch T106 and T107 slightly
to correct for any overall tilt that is essentially the same on
all chennele all channels.
Disconnect the VHF sweep generator and connect the UHF
sweep generator to the antenna terminals. Check on all UHF sweep generator to the antenna termingls. Check on
channels for proper wave shape as shown in figure 12, r touching L307 and L9 if necessary to correct any overall til Do not retouch T2, T104, T105, T106 or T107
Remove the sweep and marker generators and the bias
supplies. supplies.

## kRE22D TUNER ALIGNMENT.-

Models 21-S.348K to 21-S.369K lncl
A tuner unit which is operative and requires only touch up
adjustments, requires no presetting of adjustments. For such anits, skip the remainder of this paragraph. For units which are completely out of adjustment, preset C2 all the way out. Set channel 7 to 13 oscillator slugs one turn from tight. Turn
Tl slug all the way out. Do not change any of the adjustT1 slug all the way out. Do not cha
ments in the antenna matching unit.
Disconnect the link from terminals "A" and "B" or T104
and terminate the link with a 39 ohm composition resisto Disconnect the link from terminals " $A$ " and "B" or Tlion
and terminate the link with a 39 ohm composition resistor Turn the receiver channel selector switch to channel 2 . The 43.5 mc . trap is adjusted with zero bias. To insure that
he bias will remain constant, take a clip lead and short he bias will remain constant, take a clip lead and short
circuit the AGC terminal of the tuner at the terminal board to ground.
Connect the oscilloscope to the test point TPl on top of the
tuner unit. Set the oscilloscope to maximum gain.
Connect the output of the VHF signal generator to the out
put of the antenna matching unit of the junction of L53 and p24 at the bettom of the FM trap L53.
Tune the signal generator to 43.5 mc. and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator fo m output.
Adjust C19 on top of the tuner, for minimum 400 cycle indi cation on the oscilloscope. If necessary, this adjustment can specific frequency in the i-f band pass. Ho reection to on specitic frequency in the it band pass. However, in such
cases, care should be taken not to tune C19 into channel 2 thereby reducing sensitivity on channel 2 .
Connect the potentiometer arm of one of the bias supplies positive terminal to the tuner case. Adjust the bias potenti ometer to produce - -3.0 volts of bias. as measured by the SoltOhmyst" at the AGC terminal on the tune
Set the channel selector switch to channel 8.
Preset C5 to read, -3.0 volts at the test point TPl, as read
on the "Voltohmyst". The limits for oscillator injection voltag on the
are 2 volts minimum and not exceeding a maximum of 5.5
volts
Turn the fine tuning control fully clockwise

Adjust C3 for proper oscillator frequency, 227 mc . This may be done in several ways. The easiest way and the way
which will be recommended in this procedure will be to which will be recommended in this procedure will be to use beat the oscillator against the signal generator. To do this, beat the oscillator against the signal generator. To do this
tune the signal generator to 227 mc . with crystal accuracy Insert one end of a piece of insulated wire into the tuner unit through the hole provided for the adjustment of ClO . Be care-
ful that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscillotor to shift. Connect the other end of the wire to the . T -f in in terminal o the signal generator. Adjuat C3 to obtain an audible be Turn C2 clockwise until the then turn one full turn in the same note iust begins to chan


Figure 14-KRK22D Tuner Adjustment
Return the fine tuning control to the mechanical center of its range.
Note.- If on some units, it is not possible to reach the proper channel 8 oscillator frequency by adiustment uf C3, switth
to chennel 13 and adiust L 42 to obtain proper chanel oscillator frequency as indicated in the table on page 8 Then, switch to channel 12 and adjust L11 to obtcin proper channel 12 oscillator frequency. Continue down to channel 8 , proper frequency on each channel. Then again on channel 8 , adjust C3 to obtain proper channel 8 oscillator frequenc Switch back to channel 13 and readjust L42 and back to channel 8 and adjust C 3
Set the Tl core
counter-clockwise)
Connect the sweep generator through a suitable attenu ator, as shown in figure 15, to the input terminals of th ator, as shown in higur.
antenna matching unit.

|  |  |
| :---: | :---: |
| -mb | 5m |
|  | $\left\{\begin{array}{l}1002 \\ 1000\end{array}\right.$ |
|  |  |



Figure 15--Sweep Attensator Pads
Connect the signal generator loosely to the antenna terminals.
Set the sweep generator to cover channel 8
Set the oscilloscope to maximum gain and use the minimum input signal which will produce a usable pattern on th oscilloscope. Excessive input can change oscillotor injection
during alignment and produce consequent misalignment even though the response as seen on the oscilloscope may look

OJohn F. Rider

Insert markers of channel 8 picture carrier and sound
carrier， 181.25 mc and 185.75 mc ． carrier， 181.25 mc ．
Adjust $\mathrm{C} 7, \mathrm{Cl0}$ ． Cl 15 and C 20 for approximately correct
curve shape，frequency，and band width as shown in figure curv
16.
The correct adjustment of C20 is indicated by maximum
amplitude of the curve midway between the markers．C15 amplitude of the curve midway between the markers．C15
tunes the r－f amplifier plate circuit ond affects the frequency of the pass band most noticeably．C7 tunes the mixer grid circuit and affects the till of the curve most noticeably（assum－ adjustment and hence primarily affects the response band width．
Connect the＂VoltOhmyst＂to test point TPl．Adjust C5 to
read－-3.0 volts dc on the＂VoltOhmyst＂at TPI．Readjust C2， $\mathrm{C7}$ ． C 10 and C15 for proper response．Adjust C20 for maxi－ num gain at midpoint of the curve．Repeat if necessary until he proper


Figure 16－KRK22D R－F Response
Set the receiver channel switch to channel 13.
Adjust the signal generator to the channel 13 oscillator requency 257 mc ．
Turn the fine tuning control fully clockwise
Adjust L42 to obtain on audible beat．Slightly overshoot in the same direction from the original setting，then reset the oscillator to proper frequency by adjusting C2 to again obtain the beat．
Set the sweep generator to channel 13 ．
From the signal generator，insert channel 13 sound and
picture carrier markers， 211.25 mc．and 215.75 mc ． picture carrier markers， 21.25 mc ．and 215.15 mc ．
Adjust L43 and L45 for proper response as shown in Turn
Turn oft the sweep and signal generators．
Connect the＂VoltOhmyst＂to the tuner test point TPI．
Check the oscillator injection voltage to be within limits as
previously speciied．Adjust if necessary to bring within range
If it was necessary to readjust C5，turn the sweep and sig－ nal generators back on and recheck the channel 13 response． nal generators back on and recheck
Readjust L 43
and L45 if necessary．
Set the receiver channel selector switch to channel 8 and
readjust C2 for proper oscillator frequency， 227 mc．
Set the sweep generator and signal generator to channel 8 Readjust $\mathrm{C7}, \mathrm{ClO}, \mathrm{Cl} 15$ and C 20 for correct curve shape
frequency and band width． frequency and band width
Turn of the sweep and signal generators，switch back to
channel 13 and check the oscillator injection voltage at TP1 channel 13 and check the oscillator injection voltage at TP1
in was adjusted in the recheck of channel 8 response．

If the initial setting of the oscillator injection trimmer was
lar oft，it mary be necessary to adjust the oscillator frequency lar off，it mary be necessary to adjust the oscillator frequency
and response on channel 8 ，adjust the oscillator injection on channel 13 and repeat the tracking procedure several times betore the proper selting is obtained．
Turn of the sweep generator and switch the receiver to
Adjust the signal generator to the channel 6 oscillator
frequency 129 mc ．
Set the fine tuning control to the center of its mechanical range
Adjust LS for an audible beat．Adjust L44，L46 and L58
for proper curve shape as shown in figure 16．Recheck the for proper curve shape as shown in figure 16．Recheck the oscillator injection voltage at TP1，to insure
the limits specified．Readjust C5 if necessary．
If C5 required adjustment，switch the receiver and the If CS required adjustment，switch the receiver and the
signal generator to channel 8 ．Readjust $C 7$ for correct curve shape and recheck C2 and C3 for proper oscillator frequency． Check the response of channels 2 through 6 by switching
the receiver channel switch，sweep generator and marker he receiver channel switch，sweep generator and marker spensator to each of these channels and observing the re－ 16 for typical response curves．It should be found that all hese channels have the proper response with the markers If the markers fail to fall within this requirement readjust
L44，L46 and L58 in order to obtain curves within the proper limits．
Switch the charnnel selector，signal generator and marker generator through channels 7 to 13 and observe the response
curves，referring to figure 16 for proper wave shape．Check curves，reterring to ligure each channel to be within limits． if necessary readjust C 15 ， C 7 ，or C 10 to obtain the proper response．
With the receiver and signal generator on channel 13
just L42 for an audible beat with the signal generator． ust L 42 for an cudible beat with the signal generator
Adjust the oscillator to frequency on all channels by switch－
ing the receiver and the frequency standard to each channel and adjusting the appropriate oscillator slug to obtain the audible beat．It should be possible to adjust the oscillator to
obtain the audible beat on each channel．Recheck the oscil－ obtain the audible beat on each chamnel．Recheck the oscil－
lator injection voltage on each channel to verify that the lator injection voltage on each
voltage is within the specified limits．


Figure 17－KRK22D Oscillator Adjustment
KRE22D ANTENNA MATCHING UNIT ALIGNMENT －The antenna matching unit is accurately aligned at the customer＇s home since even slight misalignment may cause serious attenuation of the signal especially on channel 2．Th r－f unit is aligned with a particular anterna mariching tran any reantenna matching former in place．If for any reason，a new antenna match
transformer is installed，the $r-f$ unit should be realigned． The F－M Trap which is mounted in the antenna matching unit may be unit
ment of the unit
To align the antenna matching unit disconnect the lea
from the F－M trap L53 to the channel selector switch S 4 ．

With a short jumper，connect the output of the matching unit through a 1000 mmif．capac
pix i 解 amplifer，pin 1 of V107．
Replace the cover on the matching unit while making all
adjustments． adjustments．
Remove the first pix i－f amplifier tube Vlo6．
Connect the positive terminal of a bias box to the chassis
and the potentiometer arm to the junction of R118，R146 and and the potentiometer arm to the junction of Rxis，R146 and volts of bias at the junction of R118，R146 and C120． Connect an oscilloscope to the junction of R129 and L103 and set the oscilloscope gain to maximum．
Connect a VHF signal generator to the antenna input termi－
nals．Modulate the signal generator $30 \%$ with an audio signal．
Tune the signal generator to 45.75 mc．and adjust the Aenerator output to give an indication on the osciloscope．
Adjust $L 54$ in the antenna matching unit for minimum audio indication on the oscilloscope．
Tune the signal generator to 41.25 mc ．and adjust L 57 for minimum audio indication on the oscilloscope．
Remove the jumper from the output of the matching unit． Connect a 300 ohm $1 / 2$ watt composition resistor from L53 to
ground，keeping the leads as short as possible．
Connect an oscilloscope low capacity crystal probe from L53 to ground．The sensitivity of the oscilloscope should be
approximately 0.03 volts per inch．Set the oscilloscope gain o maximum． Connect the VHF sweep generator to the matching unit
antenna input terminals．In order to prevent coupling reac－ antenna input terminals． advee from the sweep generator employ a rasistance at the matching unit
advisable to
lerminals．Figure 15 shows three diflerent resistance pads for use with sweep generators with 50 ohm co－ax output， 72 ohm
uso
co－ax output or 300 ohm balanced output．Choose the pad co－ax output or 300 ohm balanced output．Choose the pad
to match the output impedance of the particular sweep employed．
Connect the signal generator loosely to the matching unit
antenna terminals．
Set the sweep generator to sweep from 45 mc ． 1054 mc ．
With RCA Type WR59A sweep generators，this may be ac With RCA Type WR59A sweep generators，this may be ac
complished by retuning channel number 1 to cover this range With WR59B sweep generators this may be accomplished by retuning channel number 2 to cover the rache．In making these adjustments on the generator，be sure not to turn the
core too far clockwise so that it becomes lost beyond the core retaining spring．
Adjust L55 and L56 to obtain the response shown in figure
18．L55 is most effective in locating the position of the shoulde 18．L55 is most effective in locating the position of the shoulder
of the curve aft 52 me．and L56 should be adiusted to give of the curve at 52 mc ．and L 56 should be adjusted to give
maximum amplitude at 53 mc ．and above consistent with the specified shape of the response curve．The adjustments in the matching unit interact to some extent．Repeat the abov procedure until no further adjustments are necessary
Remove the 300 ohm resistor and crystal probe connections．
Restore the connection between L53 and S4．Replace V106．


## KRE31 TUNER ALIGNMENT

## Models 21 －S－348K to 21－S－369KU Inc

VHF ALIGNMENT．－A tuner unit which is operative and quires only touch up adjustments，requires no presetting adaustmen．For units which are completely out of adjustment preset C27 all the way out．Set channel 7 to 13 oscillator lugs one turn from tight．Turn $T 2$ slug all the way out．Do nol
 Disconnect the link from terminals＂$A$＂and＂$B$＂of T104 and
erminate the link with a 39 ohm composition resistor．
Turn the receiver channel selector switch to channel 2.
The $43.5 \mathrm{me} . \operatorname{trap}$ is adjusted with zero bias．To insure that he bias will remain constant，take a clip lead and short cir－ uit the AGC terminal of the tuner of the terminal board to ground．
Connect the oscilloscope to the test point TP2 on top of the
Connect the output of the VHF signal generator to the cutput of the antennat matching unit at the junction of L5 and
C4 at the bettom of the FM trap L5．
Tune the signal generator to 43.5 mc ．and modulate it $30 \%$ with a 400 cycle sine wave．Adjust the signal generator for

Adjust C33 on top of the tuner，for minimum 400 cycle indi－ cation on the oscilloscope．In necessary，this adjustment can e retouched one specific frequency in the i－f band pass．However，in such
cases，care should be taken not to tune C33 into channel cases，care should be taken not to tune 2.
2, thereby reducing sensitivity on channel 2.
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery O the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case．Adjust the bias potenti－ positive terminal to the tuner case．Adjust the biass potenti－
＂meter to produce -3.0 volts of bias，as measured by the ＂VoltOhmyst＂at the AGC terminal on the tuner
Set the channel selector switch to channel 8.
Preset C22 to read－ 3.0 volts at the test point TP1，as
ead on the＂VoltOhmys．＂The limits for oscillator injection poltage are 2 volts minimum and not exceeding a maximum voltage are
of 5.5 volts．
Turn the fine tuning control fully clockwise．
Adjust C25 for proper oscillator frequency， 227 mc ．This may be done in several ways．The easiest way and the way he signal generator as a heterodyne frequency meter and the signal generaior as a heerodyne requency meter and lune the signal generator to 227 mc ．with crystal accuracy
Insert one end of a piece of insulated wire into the tuner Insert one end of a piece of insulated wire into the tuner
unit through the hole provided for the adjustment of Cl6． Be careful that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscilloto to shift．Connect the other end of the wire to the＂r－f＂in
terminal of the signal generator．Adjust C25 to obtain an terminal of the signal generator．Adju，
Turn C27 clockwise until the beat note just begins to
change，then turn one full turn in the same clockwise di－
Return the fine tuning control to the mechanical center of it range．
NOTE：－lf on some units，it is not possible to reach the proper channel 8 oscillator frequency by adjustment of C25
switch to channel 13 and adjust L49 to obtain proper channe 13 oscillator frequency as indicated in the table on page 8 Then，switch to channel 12 and adjust L 60 to obtain proper channel 12 oscillator frequency．Continue down to channel 8 ， adjusting the appropriate oscilator trimmer to oblain the
proper frequency of each channel．Then again on channel 8 ， proper frequency orin proper channel 8 oscillator frequency．
adjust C25 to obthat back to channel 13 and readjust L49 and back to Switch back to channel
channel 8 and adjust C 25 ．
Set the T2 core for maximum inductance（core turned
counter－clockwise）
Connect the sweep generator through a suitable attenu－ ator，as shown in figure
antenna matching unit．
Connect the signal generator loosely to the antenna
terminals．

## Figure 22-KRK31 UHF R-F Response

Adjust the oscillator trimmer capacitor C307 until the 43.5 mc. marker coincides with the macrker ot 887.5 mc . The on the top of the response curve as in figure 22 ( A ). Set the UHF sweep and marker generators to 473.5 mc .
 Adjust the oscillator trimmer C308 until the 43.5 mc . marker coincides with the 473.5 mc. marker, with the 41.25 and 45.75 markers as shown. The inductance loop L312 across the oscil oscillator trimmer within range. Refer to figure 20 for locotion oscillator trimmer within range. Reier to igur
of the aperture for making this adjustment.
Repeat the above adjustments, as necessary, until the
proper responses are obtained. Tune through the pronge and check the tracking. When perfectly tracked the three markers will be on the top of the response curves, however, mistracking to the extent that the 41.25 mc . and
45.75 mc. ride down the sides of the curves to $a$ point 45.75 mc . ride down the sides of the curves to a point not
less tham $70 \%$ will not seriously affect the alignment. Should the markers fall below this level, it will be necessary to knife the RF plates to correct the mistracking. The plates
mary be knifed through the two front holes provided on the left side of the tuner. Always knife the plates while tuning lower in frequency to prevent affecting the tracking above the point the plates with the knifing tool while observing the response the plates with the kiing tool while observing the response,
then proceed with the knifing of the proper section or of both sections if required. Note: The two holes ot the rear on the
left side of the tuner are for factory use only. Connect the "VoltOhmyst" to test point TP301. Set the
"Voltohmyst" "t the 1.5 v . DC scale. Tune over the entire ramge observing the reading on the meter. A reading between 05 and 4 volts should be obtained. Voltages outside
these limits are an indication of low B voltage low or high these limits are an indication of low B voltage, low or high
crystal impedance or an oscillator tube outside allowable limits.
Connect the "VoltOhmyst" to the "bias" terminal of the
tuner (refer to figure 25 ) A Aeading betwoen 0.5 and 25 vol tuner (refer to figure 25 ). A reading between 0.5 and 2.5 volts
should be obtained. Readings above or below this range

## ALIGNMENT PROCEDURE

will cause cryatal currents outside allowable limits and in
such cases the oscillator tube should be replaced. Replacesuch of the oscillator tube will require recalibration at the high and
outlined.
OUALIned. DETECTOR ALIGNMENT.-Set the signal generator at 4.5 mc. and connect it to the irst
grid, pin 7 of V108A, in series with a 01 mfd capacitor.
 WR39C calibrator may be employed. In such a case, con-
nect the calibrator to the grid of the third pix $i-1$ cmplifier, nect te calling
pin 1 of $V 107$.
Set the frequency of the calibrator to 45.75 mc . (pix carrier)
and modulate with 4.5 mc . crystal. The 4.5 mc. signal and modulate with 4.5 me. crratal. The m.5 me. signal
will be picked oft at pin 9 of V108A and amplitied through Whe sound i-1. amplifier.
Connect the "VoltOhmyst" to pin 7 of V102.
Tune the ratio detector primary., T102 top core for maximum
d-c output on the "Voltohmyat.: (Peak with core at end of d-c output on the "VoltOhmyst." (Peak with core at end of
coil awry from chassia.). Adjust the signal level from the singaf generctor for 5 volts on the "VoltOhmyst". when
singlly peaked. This is approximately the operating level of
find the ratio peaked. This is approximateltor for average signals.
Connect the "VoltOhmyst" to the junction of R104 and C107. Tune the ratio detector secondary T102 bottom core for zero
d-c on the "VoltOhmyst." (Adjuat with core at chassis end d-c on the the
of coil.)
Repeat adjustments of Tl 102 top for maximum d-c at pin 7 of V102 and T102 bottom for zero d-c at the junction of R104
and C107 Mate and Cl07. Make the tinal adjustments with the signal input
level adjusted to produce 5 volts $\mathrm{d}-\mathrm{c}$ on the "VoltOhmyst" at level adjusted
pin 7 of V102.
SOUND TAEE-OFF XLIGNMENT.-Connect the signal generator to the first video amplifier grid, pin 7 of V108A.
$A_{s}$ an alternate source of signal the RCA WR39B or As an alternate source of signal the above.
WR39C calibrot may be employed as above.
Connect the "Voltohmyst" to pin 7 of V102.
Connect the "Voltohmyst" to pin 7 of V102.
Tune the TiOl top core for maximum d-c on the "Volt-
The output from the signal generator should be set to Produce approximately 5 volts on the "Voltohmystit when
the final touches on the above adjustment ahe mad. al touches on the above adjustment are made. (Alternate Method for Ratio Detector and
Sound I-F Alignment)
Set the signal generator at 4.5 mc. and connect it to the
irst video amplifier grid, pin 7 of V108A in series with $a .01$ hrat video ampl.
mid. capacitor.
Connect the "VoltOhmyst" to pin 7 of V102
Tune the ratio detector secondary T102 bottom core for maximum d-c Tune the ratio detector primary.: T102 top core for maximum
d-c output on the "Voltohmyat." coil away from chansis.) Adjuat the signal level from the signal generator for 5 volts on the "Voltohmyst" when finally
peacked, when mating the above adjustmente" pecked, when making the above adjustmenta.
Tune the T101 (top) core for maximum d-c on the "Volt-
Ohmyat." (Peak with core at chansis end of coil) The output from the signal generator should be set to produce approximately 5 volts on the "Volto hmynt" when Connect the "Voltohmyst" to the junction of R104 and C107. Tune T102 bottom for zero d-c at the junction of R104 and C107. (Make adjustment with core at chansis end of coil.) 4.5 MC. TRAP ADIUSTMENT.-Connect the zignal gen-
orator in serios with a 1500 mmi . capacitor to pin 7 of V108A. orator in series with a 1500 mmin capacitor to pin 7 of VI 08 A . Sycles. Set the output to approximately 0.5 volt.
cy
Short the third pix i-f grid to ground, pin 1, V107, to prevent noise from macsking the output indication.
Connect the crystal diode probe of an oscilloser
Adjuat the video output, pin 6 of V109A.
scope. (Make adjuatment with core of chassis end of coil.) Remove the short from pin 1. V107 to ground.
As an alternate method, this step may be omitted at this "on the cir" afler the alignment is completed.
If this is done, tune in a station and observe the picture on
the kinescope. If no 4.5 mc . beat is present in the picture,
quency, then L 109 requires no adjustment. If a 4.5 mc . beat is
 10 exaggerate the beat and then adjust L109 for minimum the picture synced and the AGC control properly adjusted. The second condition was obtained by removing the antenna leads and short circuit AGC CONTROL ADIUSTMENT.-Disconnect all test equip- ing the receiver antenna terminale. Voltages shown are read with a type WV97A senior "VoltOhmyst" between the indicated terminal and chat ment except the oscilloscope which should be connected tosis ground and with the receiver operating on 117 volts, 60 cycles, a-c. The symbol < means less than.
Connect an antenna to the receiver antenna terminals. Turn the AGC control fully counter-clockwise.
Tune in a strong signal and adjust the oscilloscope to see the video waveform.
Turn the AGC control clockwise until the tips of sync begin to be compressed, then counter-clockwise until no compres sion is obtained.
HORIZONTAL OSCILLATOR AND OUTPUT ALIGNMENT -Normally the alignment of the horizontal oscillator is not considered to be a part of the alignment procedure, but since oscilloscope, it can not be done conveniently in the field
The waveform adjustment is made at the factory and nor mally should not require readjustment in the field. However he wrveform adjustment should be checked whenever the receiver is allgned.
Turn the horizontal drive trimmer Cl71 fully clockwise
then counter-clockwise one full turn. Set the stud of the then counter-clockwise one full turn. Set the stud of the
width coil Llll luwh with the inside rear edge of the chassis. Place a jumper across the terminals of the sine wave coil
L121 and adjust the horizontal (frequency) control until the picture pulls into sync. Remove the short across the sine picture pull
wave coil.
Connect the low capacity probe of an oscilloscope to
the junction of L120, L121 and R189. Turn the horizontal
(frequency) control clockwise until the picture falls out of sync, then counter-clockwise until the picture just pulls into sync. Then counter-ch on the oscilloscope should be as shown
inc. The pation
in Figure 23. Adjust the sine wave adjustment core L121 in Figure 23. Adjust the sine wave adjustment core L121
until the two peaks are at the same height. During this adjustment, the picture must be kept in sync by readjusting the
horizontal (ifequency) control if necessary. horizontal (ifequency) control if necessary.


Figure 23-Horizontal Oscillator Waveforms
This adjuatment is very important for correct operc

This adjustment is very important for correct operation of the circuitit If the broad peak of the warve on the oscilloscope
is lower than the sharp peak, the noise immunity becomes is lower than the sharp peak, the noise immunity becomes
poorer, the stabilizing effect of the tuned circuit is reduced
and drift of the oscille moter poorer, the stabilizing effect of the tuned circuit is reduced
and drift of the oscillator may occur. On the other hand, if
the broad peak is higher than the shar peak the oscill the broad peot is higher than the sharp peak, the oscillator
is overstabilized, the pull-in range becomes inadequate and is overstabilized, the pull-in range becomes inadequacte and
the broad paek can cause double triggering of the oscillotor he broad peak can cause double triggering of the oscillator Remove the oscilloscope upon completion of this adjust-
ment.
Turn the horizontal (frequency) control until the picture falls Tut of sync with the diagonal lines sloping down to the right.
out
Slowly tirn Slowly turn the horizontal control counter-clockwise and note
he number of diagonal bars obtained just before the picture pulls into sync.
Pull-in should occur with one and one-half to three bars prosent. he horizontal drive trimmer Clill counter-clockwise for a bright vertical line in the center of the picfura. Turn the
trimmer clockwise until the line just disappears Set the brightness control to maximum and adjust the width control so the picture tills the mask. Return the brightness control to no
trimmer as above.
immer as above. to three bare present. remain in sync for approximately two toulh turns counter-clockwise from pull-in, apd fall out of sync
with between 2 and 5 bars present before interrupted oscil-

| $\begin{aligned} & \text { Tube } \\ & \text { No. } \end{aligned}$ | $\begin{aligned} & \text { Tube } \\ & \text { Type } \end{aligned}$ | Function | Operating Condition | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts |  |
| $\begin{aligned} & \text { V1 (V2) } \\ & \text { KRK22D } \\ & \text { Or } \\ & \text { KRK29D } \end{aligned}$ | 6BQ7A | R-F <br> Amplifier | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$ Signal | 6 | 170 | - | - | 8 | 0.1 | 7 |  |  |
|  |  |  | No Signal | 6 | 133 | - | - | 8 | 1.1 | 7 | 0 |  |
|  |  | R-F <br> Amplitier | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$ | 1 | 270 | - | - | 3 | 170 | 2 | - |  |
|  |  |  | No Signal | 1 | 260 | - | - | 3 | 133 | 2 | - |  |
| $\begin{aligned} & \text { V2 (V1) } \\ & \text { KRKK22D } \\ & \text { Or } \\ & \text { KRK29D } \end{aligned}$ | 6X8 | Mirer | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$ | 9 | 160 | 8 | 160 | 6 | 0 | 7 | $\begin{array}{r} -2.4 \text { to } \\ -3.0 \end{array}$ |  |
|  |  |  | No Signal | 9 | 145 | 8 | 145 | 6 | 0 | 7 | $\begin{gathered} -2.8 \text { to } \\ -3.5 \end{gathered}$ |  |
|  |  | R-F Oscillator | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 95 | - | - | 6 | 0 | 2 | $\begin{gathered} -3.8 \text { to } \\ -5.5 \end{gathered}$ |  |
|  |  |  | No Signal | 3 | 90 | - | - | 6 | 0 | 2 | $\begin{gathered} -3.0 \text { to } \\ -5.1 \end{gathered}$ |  |
| V101 | 6AU6 | Sound <br> I-F Amp. | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } . \end{gathered}$ | 5 | 126 | 6 | 136 | 7 | 1.2 | 1 | 0.2 |  |
|  |  |  | No Signal | 5 | 120 | 6 | 130 | 7 | 1.1 | 1 | 0 |  |
| V102 | 6AL5 | Ratio Detector | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$ | 7 | -8.0 | - | - | 1 | -0.3 | - | - | 7.5 kc deviation at 1000 cycles |
|  |  |  | No Signal | 7 | -2.9 | - | - | 1 | -0.1 | - | - |  |
|  |  | Ratio <br> Detector | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 2 | -0.4 | - | - | 5 | 7.2 | - | - |  |
|  |  |  | No Signal | 2 | -0 | - | - | 5 | 3.2 | - | - |  |
| V103 | 6AV6 | 18t Audio Amplifier | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 7 | 98 | - | - | 2 | 0 | 1 | -0.8 | At min. volume |
|  |  |  | No Signal | 7 | 96 | - | - | 2 | 0 | 1 | -0.8 | At min. volume |
| V104 | 6AS5 | Audio Output | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$ | 7 | 250 | 6 | 262 | 1 | 149 | 2\& 5 | 141 | At min. volume |
|  |  |  | No Signal | 7 | 240 | 6 | 252 | 1 | 142 | 2\& 5 | 135 | At min. volume |
| V105 | 6CB6 | lat Pix. I-F Amplifier | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } . \end{gathered}$ | 5 | 132 | 6 | 144 | 2 | 0 | 1 | -4.7 | *Unreliable measuring point |
|  |  |  | No Signal | 5 | 112 | 6 | 123 | 2 | 1.2 | 1 | *0.1 |  |
| V106 | 6CB6 | 2nd Pix. I-F <br> Amplifier | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 250 | 6 | 278 | 2 | 145 | 1 | 129 |  |
|  |  |  | No Signal | 5 | 230 | 6 | 255 | 2 | 136 | 1 | 124 |  |
| V107 | 6CB6 | 3rd Pix. I-F <br> Amplitier | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 130 | 6 | 142 | 2 | 2.3 | 1 | 0 |  |
|  |  |  | No Signal | 5 | 121 | 6 | 136 | 2 | 2.2 | 1 | 0 |  |




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REPLACEMENT PARTS

| $\begin{aligned} & \text { symbol } \\ & \text { NO. } \end{aligned}$ | sTOCI | description | $\begin{aligned} & \text { syMBor } \\ & \hline \text { NO. } \end{aligned}$ | sToc: | description |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | TUNER UNTT ASBEMBLIES KRK22D | $\begin{aligned} & \mathrm{T1} \\ & \mathrm{~T} 2 \end{aligned}$ | $\begin{aligned} & 78399 \\ & 78396 \end{aligned}$ | Trandormer-Convertor transformer <br> Transtormor-Antonna matchno trandormor <br> momplet (C24, C25, C26, C27, 11, L53, L54, |
| C1 | 778 |  |  | 77850 | L5S, L56, L57) <br> Bracket-Side bracket for mounting coil and |
| C2 | 77 | Capacitor-Coramic, variable, tor Hine tuningplunger type |  | 77854 | etatora <br> Clip-Mounting clip for fine tuning core |
| c3 | 27151 | Capectior-Adjutable, deatite, 0.8 .3 .0 mmi . |  | 77880 | Connector-Grounding strap connector |
| C4 | 33098 |  |  | 76460 | Contect-Tot podnt contect |
| cs |  | Part of S 1 A . |  | 77882 79198 | Coro-Adyurtable core tor tro |
| C8 |  | Part of 818 |  | ${ }_{7781} 7781$ |  |
| C7 |  | Samo as C2 |  | 78270 | Lover-Fine tuning lover |
| ${ }^{\text {cs }}$ | 77252 |  |  | 14343 | Retainor-Tine tuning ahaft retainor ring |
| C9 |  | Part of S1B |  | 73849 | Rotainor-Retainor for fine tuning apring |
| c10 | 76527 | Capactior-Mica trimmor, $55-80 \mathrm{mmm}$. |  | ${ }_{7}^{79236}$ | Shat-Pine tuniog abaft and cam |
| ${ }^{\mathrm{Cl}}$ | 77004 | Copaedtor-Coramic, leod-hra, 1000 m |  | 76334 | Shiold-Tubo thield |
| C12 |  | Not ueod Pat of SIB |  | 77831 | Shiold-"U" ehaped ahlold tor andoridde of unit |
| ${ }^{\text {c14 }}$ |  | Part of SIC |  | 26336 | Socket-Tube socket, 9 pin miniature, raddle mounted |
| ${ }^{\text {c13 }}$ | 78532 | Capacitor-Adjuateble, toatite, $1-4 \mathrm{~mm}$ |  | 77856 | Spring- Pino tuning core spring |
| $\begin{aligned} & \mathrm{C}_{18}, \mathrm{Cl}^{27} \end{aligned}$ | 23198 | Same as C8 |  | 78241 | Spring-Formed, for tabilising ting tuning love |
| C19 | 77616 | Copacitor-Adjustable, mica, 4.40 mmi . |  |  | NIER UNIT RBsembli |
| C20 |  | Same as $\mathrm{Cl}^{\text {che }}$ |  |  | LRE31 (ERE20D/27) |
|  |  | Not ued | cl | 34202 |  |
|  |  | Part of T2 | C2 | 3056 |  |
| C28 | 73860 |  | C3 | 70935 | coof. $=0,5 \mathrm{mmmin}$. $\pm 0.5 \mathrm{mmi}$., 500 volts |
| c29 | 77293 |  |  |  |  |
|  |  | 70 mm | $\mathrm{C}_{4}$ | 76739 | Capacitor-Tired, coramio, non-ingulatod, Tomp. coof. $=0,33$ mimi., $\pm 10 \%$. 500 volts |
| C31, C32 |  | Seme an Ca | ${ }^{\text {cs }}$ | 77094 | Coppecitor-Coramic, foed.thra, $1,000 \mathrm{~m}$ |
|  |  | Pert of 72 | C6 |  |  |
|  |  | Part of Sin | ${ }^{\text {c7 }}$ | 332 | Capacitor-Adjuateble, ztosito, 1.4 m |
| $\left.\begin{array}{l}\text { L12 } \\ 121 \\ 121 \\ \text { lincl }\end{array}\right\}$ |  | Part of S1B |  | 22 |  |
| $\underset{131}{122}$ tol |  | Part of S1C | C10 C11 | 27151 | Same as C6 (Part of S1D) <br> Capacitor-Adjurtable, steatite, 0.8- |
|  |  | Part of SID | C12 | 78276 | Capacitor--Mired, coramic, ingolatad, High "K" |
|  |  | Part of S1A | c13 |  |  |
| L43, L44 |  | Peat of SIB | Cl 4 |  | Same as cs |
| L5S. 146 |  | Part of S1C | C15 |  | Same an CS |
| 147 | 76562 | Coil-RF amplitior coupling coll |  |  | Not uned |
| 148 | 78468 | Coil-RI chake ooll |  |  | Same as CS |
| ${ }^{L 9}$ | 77859 | Connactor-RI grid awitch return connector |  |  | Semo at cs |
| ${ }_{\text {L52 }}^{\text {L50, }}$ LS1 | 79097 77208 | Coll-Hostor choke ooll Coll-Flumont choke coll | ${ }^{2} 21$ |  | Semo an C11 |
|  |  | Part of T 2 | ${ }_{\text {C22 }}$ | 77913 71504 | Capactior-Aduutable. .toatito, 0.8 .3 .0 mmi . |
| R1 | 504410 | Rosidtor-Fixad, comporition, 100,000 ohmas. |  |  | $\pm 200$ \%, 5000 Jola |
| A2 | 5233 |  | C24 | 47 | Cappecitor-hirod, coramic, non.ingulatod romp. |
| R3 | 523315 | antor-Fired, compoation, 15,000 | $\begin{aligned} & \mathrm{C} 25 \\ & \mathrm{C25} \end{aligned}$ |  | Same at Cll |
|  |  | ${ }_{\text {Part }}{ }^{ \pm 10 \%} \mathrm{Tl}$ ( 2 wathe | C27 |  |  |
| R5, R6, |  | Pert of S1B |  |  | plungors tipe |
|  |  | Parat of SIC | C2 | 73960 |  |
| R9, R10 | 50351 | $\begin{aligned} & \text { Reseastor-Fired, composition, } 1.0 \\ & \pm 10 \text { क, } 13 / 3 \text { waft } \end{aligned}$ | C29 | 77293 |  |
| R11 | 3112 |  | c30 |  | Not uaed |
| R12 | 504268 | Rositor-Fixed, compoation, 6000 ohms, $\pm$ $20 \%$, $1 / 2$ watt | C31 | 71502 | Capacilor-Fixed, hoaded-losd type, 2.2 mmf., $\pm 20 \%, 500$ volts |
| ${ }^{1213}$ |  | Some as R1 |  | 77616 | Capin-Adjutable, mice, 4.40 mmi |
| R14 | 503182 | Reastor-Fised, composilion, 820 ohme, $\pm 10 \%$, | ${ }_{\text {c }}^{34} 40$ |  | $\begin{aligned} & \text { Capactor-A } \\ & \text { Same as C29 } \end{aligned}$ |
| SIA | 77911 | Stator-Ocillator stator complote with rotore, <br>  |  | ${ }^{75437}$ | Capacitor- Fired, coramic, insulated, High "K" disc, 100 mmin., $\pm 20 \%, 500$ volts <br> Same as C26 (Part of S1A) |
| S18 | 3800 | Stator-Mirer stator complete with rodor, colle. <br>  |  | 21503 | Capacitor-Fired, headed-lead type, 3.3 mmf ., $\pm 20 \%$, 500 volt <br> Same an C3l (Part of SIC) |
| sı |  |  |  |  | Not noed |
|  |  |  L46, R8) | CS1 <br> C301.A |  | Seme at C29 <br> Capacilor-Varieble tuning capactor |
| S1D | 78802 | Stator-RT erid stator complete with rotor and coila, (1422) | $\begin{aligned} & \text { B, C, D } \\ & \text { C302 } \end{aligned}$ | 77084 | Capacitor-Fixed, coramic, $1,000 \mathrm{mmf}$., foed- |

REPLACEMENT PARTS (Continuod)

| $\begin{aligned} & \text { sYMBOL } \\ & \text { NO. } \end{aligned}$ | stock | DESCRIPTION | (symbol | $\begin{aligned} & \hline \text { sigci } \\ & \text { NO. } \end{aligned}$ | DEsCription |
| :---: | :---: | :---: | :---: | :---: | :---: |
| C303 | 78137 | Fired, hooded-loed trpe, 0.51 mml ., | ${ }^{\text {R12 }}$ |  | Samo at |
| C304 | 28260 | actior-Fired, hooded-lead tope, 0.62 mm |  | 523312 | $\pm 10 \% .2 \text { watte }$ |
|  |  | $\pm$ +10\%, 500 volta DC | R14 | 5031 |  |
| c303 | 78261 |  |  |  |  |
| C30 | 28262 | Capacitor-Pizod, coramic, non-innulated, Tomp coef. - 0,7 mmi., $\pm 0.3$ mmi., 500 valte DC | R19 | 503033 |  |
| C307, 6308 |  | tootite, $0.6-1.4 \mathrm{mmf}$. |  |  |  |
| C309 |  | cor |  |  |  |
|  |  | $0,33 \mathrm{~mm}$., $\pm 5 \%, 500$ volt | RSI Incl. |  | Reattor-Fired compostion, 22,000 oh |
| ${ }_{C 312}^{\text {C310, }} 3111$ |  | 2 |  |  | $\begin{aligned} & \text { Recietor-Fixed } \\ & \pm 10 \%, 2 \text { waite } \end{aligned}$ |
| C313 | 782 |  volts DC | 53 | 523327 |  S娄 R14 |
| C314 | 71502 |  | ${ }_{\text {R301 }}$ |  | Peat of L303 |
| C315, C 316 |  | 10\% | н302 | 303110 | Readitor-Fized, composition, 100 ob |
| ${ }_{11}{ }^{\text {C301 }}$ | $\begin{aligned} & 7748 \\ & 3885 \end{aligned}$ | Roctitior-crystal reectitior 1 1N82 Connector-4 contact fomale | R30 | 503215 | Readeror- Pired, $\pm 10$, $1 / 2$ watt compoaition, 1500 ohms, |
|  |  | antenaa matching traneformer | R304 | 503268 |  |
| 12 | 78237 | Connector-Single contact female connector UHF connection | R30 | 50322 |  |
| 1301 | 28255 | Connector-2 contact fomale connector for UHF antonna |  |  | $\pm 10 \% \text {. 1/2 watt }$ <br> Stator-Oscillator coil and atator complete with |
| ${ }_{21}$ | 265 | Trap-IF trap ( 41.25 mc ) complote with core Coil-Shunt coil completo with adjustable core |  |  | rotor, coile and trimmer (C22, C37, L49, LSO, LS1, L52, L53, L54, L53, L56, LS7, L58, L59, |
| ${ }^{2}$ | ${ }_{76838}^{7638}$ | Coil-Shunt coll comploto with adjutable core |  | 79372 |  |
| 24 | 76541 | Trap-Tr trap (45.73 mic) complote with core | S18 | 78272 | C36, 136, L37, $138,1239,140,141, L 42, L 43$, |
|  |  | Trap-IM trap comploto wih adjumble |  |  |  |
| ${ }_{\text {L }}^{26}$ | 784 | ${ }_{\text {Trap-II }}$ Coillap | sic | 78274 | tator-RY plato stator comploto mith rotor, |
| L8 | 77899 | Connector-RT grid owitch return connector |  |  |  |
| ${ }^{19}$ | 78271 | Coll- IF input coil complote with adjustable core | SID | 78277 | Stator- Input endector suritching stator complote |
| ${ }_{\text {L12, }}^{\text {L12, L11, }}$ L13, |  | Part of SIE | SIE | 78398 |  |
| L14, <br> L15, $116, ~$ | 73458 | Coll-Channol 6 RF grid coil (Part of SIE) Part of SIE |  |  | cill (C36, L10, L11, L12, L13, L14, L13, L16, L17, L18) |
| L17, L18 ${ }^{\text {L }}$, |  |  | S51 | 78429 | Switch-Antoona alido switoh |
|  | 77921 | Not usod ${ }_{\text {Coll }}$ Channol 13 RF plato coil (Part of SIC) | T1 | 78396 | Transformer-Antonna matching tran |
|  |  | Part of Sic |  | 78399 | Tranatormor-Convortor trandorm |
| ${ }_{127}^{128}$ incl. | 7858 |  | T301 | 88 | Trandormor-UHF antonna inp |
|  |  | Part of SIC |  |  | Board-Antenna matohing tranto board loen coile and capactort |
|  | 73460 | Coll-Channol 6 Rr plate coil (Part of SIC) |  | $\begin{aligned} & 78467 \\ & 78233 \end{aligned}$ |  |
| ${ }^{2} 33$ | 77206 | Coll-Pilament choke coil |  |  | Hators |
| L34, L33 | 26763 | Coil-Hoater choke coill |  | 78430 | Cam-Actuating cam for antenna dide owitch |
| 136 | 77919 | Coil-Channol 13 mixiror coil (Part of S1B) |  | 78417 | Cam-Pine tuning oaxn for VHF |
|  |  | Part of S1B |  | 77854 73591 | Clip-Fine taning ellip for tine tuning core Coll-Antenna matching coll (Part of T1) |
| 243 | 28583 | Coil-Mixor IV coil (Part of S1B) |  | 880 | Connoctor-Grounding drap connector |
|  |  | of S |  | 78269 | Connector-Single contact mele connector for IF output cable |
| L48 | 73874 | Coill-Channol 6 mizar ooll (Part of S1B) |  |  | Contact-Tent point contect |
| 149 | 77915 | Coil-Channol 13 orcillator coill (Part of S1A) |  | 77882 | Core-Adjuatable core tor the tuning capacita |
|  |  | Part |  | 76543 | Core-Adjunting core for IM |
| 161 | 001 | Coll-Channol 6 antenna coil |  | 77918 |  |
| L301, L302 |  | Part of C301 amombly |  | 77914 | Core- 8 -32 $\times 27 / 64^{4}$ adjuta |
| L304 | ${ }_{78268} 72818$ | Strip-Inductances trit |  | 79328 | Dotont-Detent mechanimm and aheft |
| 1308 | 78268 | Strip-Inductance atrip and plate |  | 77917 | Form-Channol 6 codl form complete with coro |
| 1307 | ${ }^{782388}$ | Coll-II coill complote with adjutable core |  | 77912 | Form-Channol 13 coll form complete with coro |
| L2308, 1309 | 772 | Coil-RF choke coil 0.33 muh. Coll-RI choke coill 0.15 muh. |  | 78881 | Form-II with core |
|  | ${ }_{39153}^{2827}$ | Con-ritor choke conlect mele mun. |  | 7840 | Gear-Tunor drivo goar-20 tooth-for XCS88 |
| R1 | 503268 | Rosietor-Fired, comportion, 6800 $10 \%$, $1 / 2 \mathrm{watt}$ |  |  | Gulde-Bakolite guide for tine tuning lover |
| R2 | 50 | dintor-Fised, compoaition, 120 ohmo, $\pm 10$ |  | 78256 |  |
| R3 |  |  |  |  | Inaulator-Insulator for antenna side switch |
|  |  | $\pm 10 \%$, $3 / 1$ walt |  | 76728 | Nut-Speodnut lor capacitora C7, C11, C21, C25 |
|  |  | $1 / 2 \text { wait }$ |  | $\begin{aligned} & 78421 \\ & 79327 \end{aligned}$ | Pin-Clutch mechanimm operating pin Plat--Mounting plato for ahafta (Izont) |
| R6 |  | aistor-Firod, $\pm 10 \%$, $1 / 2$ walt composition, 1,000 ohma, |  | 78404 | Pulloy-Tuser drivon pulley complote with |
| ${ }^{\text {R7 }}$ | 523315 | Revintor-Tired, composition, 15,000 ohms, $\pm 10 \%, 2$ watts |  | 28405 | Puuley-UHF channol markor encutchoon drive Pulley-UHF channol mark |
| ${ }^{\mathrm{RB}}$ |  | Part of T2 3300 |  |  | Pullog-UHF channol markor arcutcheon pullor |
| н9 | 3 |  |  | 79236 | Pullay-UHF channol markor pulloy anomby |
| HIO, R11 |  | Same as R3 (Part of S1B) |  | 78420 | Pulloy-UHF tuner drive pulloy |

replacement parts (Continued)
REPLACEMENT PARTS (Continued)

| sYMBOL | stock | deschiption | $\begin{aligned} & \text { symbol } \\ & \text { NO. } \end{aligned}$ | $\begin{aligned} & \text { STOCR } \\ & \text { NO. } \end{aligned}$ | description |
| :---: | :---: | :---: | :---: | :---: | :---: |
| C1 | 14343 | Rotainer-Fine tuning thatt retainor ring | C120 | 737 |  |
|  | 77849 78419 | Retainer-Retainer for fine tuning apring Ring-Retaining ring tor UHF channel marker | C121 | 77293 | Capacitor-Fixad, coramic, 470 mmf . |
|  | 76547 | oscutcheon pulley <br> Screw-No. $4.40 \times 1 /{ }^{\prime \prime}$ adjusting acrew for L55, | C12 | 77293 | Capacltor-Fixed, ceramic، 470 |
|  | 76549 | L56, L57, L58, L.59, L60 Screw-No. $4-40 \times 3 / 8^{\prime \prime}$ adjusting scrow for L.50, | C123 | 7725 | Capacitor-Fixed, coramic, $001 \mathrm{mld} .4+100 \%$. 0\%, 500 volt |
|  | 75176 |  | C 124 | 29319 | Same ar Cl 21 |
|  | 79325 | Shaft-UHF channel eelector knob shaft and clutch diec |  | 78623 | .001 mí., 500 volts |
|  | $\begin{aligned} & 78407 \\ & 78236 \end{aligned}$ | Shaft-Tuner connecting shaft for KCSB8 chasais Shield-Front shield for KRK29D nection |  |  | 500 volta |
|  | 78252 | Shiold-Oveillator shield for KRK27 soction | C 127 | 7916 | ${ }_{\text {Capaitor }}^{\text {coits }}$ Sixod, coramic, 9 |
|  | 78253 78254 | Shield-RF miold for KRK27 section Shiold-Shiold for cryotal rectior | C12 | 33098 |  |
|  | 76534 | Shield-Tube shiold for KRK29D nection | C129 | 79018 |  |
|  | 76967 77851 |  | C130 | 9042 |  |
|  | 76336 | Socket-Tube ock | 13 | 79149 | Capacitor -Fired, 600 volto a |
|  | 7727 | moun-Tube socket, miniature, 7 pin ceramic, saddle-mounted (KRK27) | C132A, B | 7914 | Capacitor-Electrolytic comprising: <br> 1 eection of 80 mfd., 400 volte and 1 section of 80 mid., 200 volte |
|  | 7842 | Spring-Clutch mechanism operating pin coil | C133 |  | Same an $\mathrm{Cl}^{122}$ |
|  | 77856 | Sppring-Finotur | C134A, B | 79146 | apacitor-Ele |
|  | 78241 | Spring-Formed epring for fine tuning levor |  |  | 1 soction of $30 \mathrm{mfd}$. . 50 volts |
|  | 78422 | Spring-Formed spring lor actuating clutch dirc | C135 | 73557 | Capacitior -Fizod, papor, $0.1 \mathrm{mm}$. , $\pm 20 \%$, 600 volts |
|  |  | Sp | C136 | 76994 | Capacitor-Fizod, papor, $0.33 \mathrm{mt}$. ( $\pm 20 \%$, |
|  | 78428 | Spring-UKF channel marker oscutchoon pulley | 137 | 59667 |  |
|  | 284 | Stop-Motal motop for connecting thaft | С138 |  | Same as C135 |
|  |  | amis | C139 | 7359 | Capaciilor-Fired, paper, 0.047 |
|  |  | ${ }_{\text {Stud- }}$ | C14 | 39640 | Capacitor-Fized, mica, 330 mml ., $\pm 10 \%$, |
|  | 78426 75190 | Washor-Insulating waikher (nooprene) for | C141 | 73551 | Capacitor-Fizod, papor, 0.1 mf.. $\pm 20 \%$. |
|  | 78424 | 隹-Ro | C142 | 73552 | Capacilor-Fixed, papor, $0.033 \mathrm{mf} . \pm 20 \%$, |
|  | 78425 | Washor-Spring washor tor clutch mechanimm | C143 | 76474 | Capacitor- $\mathrm{F}_{1}$ |
|  |  |  | C14 | 396 |  |
|  |  | KCs88, KCS88A, (ERR22D) | ${ }^{\text {c145 }}$ |  | Same ar C107 |
|  |  |  | C146 | 79019 | Capacitor-Fixed, papar, 0.0082 mi., $\pm 10 \%$, 400 volts |
|  | 76507 |  | ${ }^{\text {c147 }}$ |  | Same as Clil |
|  | 79323 | Capacitor--Firod, ceramic, 39 mmf ., $\pm 10 \%$. |  | 782 |  |
|  | 79234 | pacitor-Fized, coramic, 56 mmf ., $\pm 10 \%$. | C1 | 73594 |  |
|  | 7396 | , | C150 | 73595 | ${ }_{\text {Capacitor-Fixod, papo }}^{600}$ |
|  |  | $-0 \%, 500$ volte | C151 | 79317 | Capacitor-Fixad, papar, $0.056 \mathrm{mt} ., \pm 10 \%$, |
|  | 39652 |  | C152 | 73797 | Capacitor-Fixed, papar, 0.01 |
|  | 79315 |  | C15 | 73798 | Capacitor-Fixod, papar, $0.022 \mathrm{mf}. \pm \mathbf{2 0 \%}$, |
|  | 79148 | Capacitor-Fizod, papor, $0.47 \mathrm{mf}$. . $\pm 10 \%$. | 2154 | 73792 | Capacitor-Fizod, papor, $0.068 \mathrm{mt}$. . $\pm 10 \%$. |
|  | 7901 |  | C1 | 73798 | Capasitor-Fixad, papar, $0.022 \mathrm{mt}. \pm 10 \%$, |
|  |  | ${ }^{\text {onily }}$ | 156 | 998 | Capascitor-Fired, papor, 0.001 mf ., $\pm 20$ |
|  | 79014 |  |  |  | 1600 volta |
|  | 79316 | 200 volts <br> Capacitor--Fisod, papor, $01 \mathrm{mf}. \pm 20 \%$. | ${ }_{\text {clise }}$ |  | Same an C141 |
|  | 79014 |  | C159 | 77364 |  |
|  | 4761 | 200 volts <br> Capacitor-Fixed, coramic, $270 \mathrm{mmf} ., \pm 10 \%$, <br> 500 yolte for XCS88, KCSS88F only | C160 | 39396 |  |
|  | 756 |  | 162 | 764 | apactor-Fired, mica, 68 mml ., $\pm 5$ |
|  |  |  |  |  | Same an C141 |
|  | 735 |  | C164 | 73562 | Capacitor 400 volts izeod, |
|  | 79314 | Capacitor-Fixod, papor, 0.0027 ml. . $\pm 10 \%$, <br> Capacitor-Electrolytic, 100 mf ., $+100 \%$, <br> $-10 \%$. 250 volu | C166 |  | Same as Cl120 |
|  | 738 | apacitor Fired, papar, 0.0047 ml ., $\pm 10 \%$ | C167 | 76476 | Capacitor -Fizod, mica, $330 \mathrm{mmt}$. , $\pm 5 \%$, |
|  | 78220 | Capacitor - Adjurtable, 5.70 mmt mica | C168 | 7359 | Capacitor Fixed, paper, $0.01 \mathrm{mp} .4 \pm 5 \%$, |
|  | 39044 | Same at Cl13 Capacitor -Fixed, coramic, ${ }^{\text {a }}$, 15 mml ., $\pm 5$ | C169 | 7647 | Capacitor Fixed, paper, $680 \mathrm{mmi} ., \pm 10 \%$, |
|  | 77293 | - |  |  | Same as C135 |
|  |  |  | C171 | 71807 | Capacitor Mica trimmer, 10.160 mm . |


| SYMBOL | stock | description | ( Symbol | stock | DESCRIPTION |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{Cl}_{172}$ | 76995 |  | $\begin{aligned} & \mathrm{R} 125 \\ & \mathrm{R} 126 \end{aligned}$ |  | Same as R120 <br> Same as R121 |
| ${ }^{C 173}$ |  |  | R127 | 5021 | Resistor-Fixed, composition, 180 ohma, $\pm 5 \%$, |
| C 174 | 73786 |  | 128 | 504147 | 1/2 watt <br> Resistor-Fired, composition, 470 ohms, $\pm 20 \%$, |
| C175 | 73597 |  | H129 | 502239 | Rositarter Fixsod, componition, 39 |
| C176 | 79022 | Capacitor-Fixed, mics, 270 mmf , $\pm 20 \%$. 1000 volts | н130 | 503112 | Helis watt |
| C 177 | 77836 |  | R13 | 503112 |  |
| C179 | 79318 | Capacitor-Fizod, papor, 0.39 mt ., $\pm 10 \%$. |  |  |  |
| C180 |  | $\xrightarrow{200 \text { volts }}$ | R132 | 503 | Renistor-Fixed, composition, $\quad 12,000$ <br> $\pm 10 \%$ |
| C181, 1818 |  | Same as C123 | ${ }^{\text {R133 }}$ |  | Part of L105 |
| $\mathrm{Cl}_{184}$ | 78622 | Capacitor -Fix soo volts | R134 | 524 | Rexistor-Fixed, $\pm 20 \%, 2$ walts |
| CR10 | 766 | Crytal-Crystal operating | 35 |  | Part of L106 |
| F101 | 78214 | Fure 0.3 amp ., | R136 | 513247 | Reesidor-Fix $\pm 10 \%$, 1 wadt att |
| 1101 | 35787 | ${ }_{\text {Connector - }}^{\text {KCSBer }}$ - ${ }^{\text {chono }}$ | R137 | 504447 | Reositor-Fixad. |
| 1102 | 68590 | ${ }_{\substack{\text { Conneetor } \\ \text { leads }}}$ | R139 | 503382 | Resistor- Fircod, componition, 82,000 ohms, |
| 1102 | 78204 | Trap | R140 | 503182 | 0\%, 1/2 watt |
| ${ }^{1} 103$ | 76 | Coil-Poaking ( 36 mh ) |  |  | Reaistor-Fixe |
| L104 | 98 | Coil Poaking ( 250 mh ) | R141 |  | Rosistor--Firat |
| ${ }^{1} 105$ | 77674 | Coil-Poaking ( 250 mh ) | ${ }^{1} 142$ |  | Part of L108 |
| 4106 | 79321 | Coil-Poaking ( 2500 mh ) | $\mathrm{R}_{143}$ |  | Same as R137 |
| ${ }_{\text {L108 }}$ | 75252 71528 | Coil-Peaking ( 500 mh ) Coil-Peaking ( 180 mh ) | R144 | 502 | Resistor--Fixed, composition, 1.6 mogoh |
| L109 | 7915 | Coil-4.5 M.C. video trap with adjustable core (includes C159) | R145 | 51434 | Resistor-Fixod, composition, 47,000 ohms, $\pm 20 \%$, 1 watt |
| L111 | 7914 | Coil-Width coil comploto with adjuatable core | R146 |  | Same as R122 |
| 1112 | 76640 | Coil-R.F. insul. choke, 1.5 mh | R147 | 503347 | Hosithor-Fixed, composition, 47,000 |
| $\underline{L 113}$ | 77676 | Choke-Filltor |  |  | Same af hioz |
| L114, L115! |  |  | ${ }_{\text {R149 }}$ | 788 | Control-AGC |
| L118, L119 | 73 | Coil-2nd. and 3rd. 1.F. pix choke coils | R150 |  | Same as R107 |
| L120 | 79160 | Coil-Horizontal oscillator coil complote with adjustable core | R151 | 503418 |  |
| 12 | 79161 | Coil-Horizontal sine wave coil with adjuztable core | R152 | 503522 | Revistor-Fixad, $\pm 10 \%$, $1 / 2$ watt |
| PC10 | 79142 | Circuit-Printod I.F. sound assembly (includes C102, C103, C104, C106, C107, C108, R101, R102, R103, R104, R105, R106, T101, T102) | R153 | 503339 | Resistor-Fized, composition, 39,000 ohms, $\pm 10 \%, 1 / 2$ watt |
| H101 | 503347 | Resistor-Fixed, composition, 47,000 ohms, $+10 \%$, $1 / 6 \mathrm{watt}$ | R154 R15s | 503512 | Resistor-Fixed, composition, 1.2 megohm, |
| H102 | 503112 |  | R156 | 5034 | Resistor-Fixed, composition, 390,000 ohm <br> $\pm 10 \%$, $1 / 2$ watt |
| H103 | 504210 | Resistor-Fizod, composition, 1000 ohm $\pm 20 \% \%$ $1 / 2$ watt | ${ }^{\text {R157 }}$ |  | Same as R107 |
| H104 | 503339 | Hesistor-Fixed, composition, 39,000 ohme, $\pm 10 \%$, $1 / 2$ watt | H158 |  | $\begin{aligned} & \text { lesistor-Fixed, } \\ & \pm 10 \%, ~ \\ & 2 / 2 \end{aligned}$ |
| R105, R106 | 502310 |  | R160 |  |  |
| R107 | 503333 |  | ${ }^{161}$ |  | Hesiotor-Fixed, $\pm 5 \%, 1 / 2$ watt |
| R108A, B | 78208 | Control-Volume and contrast control | R162 | 503322 | fesiator-Fizod, composition, 22,000 ohms, $\pm 10 \%, 1 / 2$ watt |
| R109 | 5046 | Resistor-Fixed, composition, 10 mego $\pm 20 \%, 1 / 2$ watt | ${ }^{\text {R163 }}$ |  | Same as H 131 |
| R110 | 50 | Resitor- Fixed, componition, 330,000 | R164 R165 | $\begin{aligned} & 78210 \\ & 78806 \end{aligned}$ | Control-Vertical hold contr Control-Height control |
| R11 | 503482 | 捡 | R166 | 3447 |  |
|  |  |  | R167 | 3322 | Hesimor-Firod, composition, 22,000 ohms, |
|  |  |  | R168 |  | Reaintor- Fixed, composition, 18,000 |
|  |  |  | R169 | 3439 |  |
| R114 |  | Hesistor-Fixod, $\pm 20 \%$ $1 / 2$ watt | R170 | 502333 | $\pm 10 \%, 1 / 2$ watt Remistor-Fired, composition, 33,000 ohms, |
| R11 | 018 | Henistor - Fixod componition, 120,000 ohm $\pm 5 \%, 1 / 2$ walt | A17 | 503282 | Revistor-Fized, composition, $\mathbf{8 2}$ |
| R116 | 503315 | Hesistor-Fixed, composition, 15,000 ohme, $\pm 10 \%, 1 / 2$ watt | H172 | 50223 |  |
| R117 |  | Same an R114 | R173 |  | Same as R166 |
| R118 | 502333 | enistor-Fixed, composition, 33,000 ohms, $\pm 5 \%$, $1 / 2$ watt | ${ }_{\text {R174 }}$ | 78807 | Control-Vertical linearity control |
| R1 |  | Reoistor-Fixod, composition, 68 ohms, $\pm 5 \%$, | R176 |  | Some as R111 Rositror-Fixod, composition, 680,000 ohma, |
| 8120 | 502356 | tor-Fired, composition, 56,000 ohms, |  |  |  |
| R121 |  | iator-Fixad, composition, 680 ohms, $\pm 20 \%$, | к17 |  |  |
|  |  | w watt | R178 |  | Control-Brightnoss control |
| R122. R | 23 502415 | osistor-Fixed, composition, 150,000 ohma, $\pm 5 \%, 1 / 2$ watt | 8179 | 504415 |  |
| $\mathrm{R}_{124}$ | 568 |  | R180 | 503418 | Rosimeor-Fixed, composition, 180,000 ohmo, $\pm 10 \%, 1 / 2$ watt |


| REPLACEMENT PARTS (Continued) |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\underset{\text { NOMBOL }}{\text { sYMBol }}$ | $\begin{gathered} \text { STOCEX } \\ \text { NO. } \end{gathered}$ | description | $\underset{\text { SYM }}{\text { SOL }}$ | $\begin{array}{\|c} \text { sTock } \\ \text { No. } \end{array}$ | description |
| R181 <br> R182 <br> R183 <br> H184 <br> R185 <br> R186 <br> R189 <br> R190 <br> R191 <br> R192 <br> R193 <br> R194 <br> R195 <br> R196 <br> R197 <br> R198 <br> R201, 2202, R203 <br> R204 <br> 5102 <br> $T 101$ <br> T102 <br> T103 <br> T104 <br> ${ }_{\text {T107 }}{ }^{7105}$ T106 <br> T108 <br> T110 <br> T111 <br> 2102 |  |  <br> Resistor-Fixed, composition, 100,000 ohms, $\pm 20 \%$, $1 / 2$ watt Switch T.V. phonotone awitch for KCS8B, KCSBer <br> Coil-Sound take-off coil, 4.5 M.C. <br> Transformer-1.F. ratio detector complete with adiustable cores adjustable cores <br> Transformer-Audio output tranalormer <br> Tranaformer-1at. pix 1.F. grid complete with adjuatable core <br> Tranaformer-1at., $2 n d ., ~ a n d ~ 3 r d . ~ p i x ~ 1 . F . ~$ tranaformer tranaformer <br> Transformer-Vertical output transformer <br> Tranoformer-High voltage tranaformer <br> Tranaformer-Power transformer, 117 volts, 60 cycle 60 cycle <br> Plate-1.F. picture plato complote <br>  <br> L118, L111, R119, R12O, R121, R122, R124, R125, <br> Connector- <br> power cord <br> Cover-Back cover for high voltage compartment <br> Grommat-Hubber grommot for 2nd. anode lead <br> Holder-Fuse holder <br> Holder-Tube holder for V117 <br> Insulator-Polystyrene ineulator for high voltage nocket <br> Rnob-Horizontal frequency tuning knob (brown maroon) <br> Lead-Anode lead ansembly complete <br> Plate-1.f. pix mounting plate <br> Shield-Side ahield for high voltage compart- mont <br> Shield-Tube shield for V108A, B <br> Shiold-Tube ahield for V101, V102 \& V107 <br> Socket-Tube socket, 7 pin, miniature for V102 <br> Socket-Tube mocket, 7 pin, miniature, wafer for V103, V104, V105, V106, V107 <br> Socket-Tube oocket, 7 pin, ministure with iumper bar for Vlol <br> Socket-Tube cocket, octal, for V111, V115 Socket-Tube mocket, octal, waler for V112 <br>  <br> Socket-Tube, kine tube nockot assombly Socket-Tube zocket, 9 pin, miniature water for V108A B, V109A; B, V110A, B Strap-Polynyrene <br> Strap-Polyatyrone atrap for 2nd. anode lead |  |  | Washer-Spring washer for horizontal frequency <br> Washer-i8 vellutex washer for high voltage <br> SPEAKER ASSEMBLIES 971636-1W RL1O1C5 RMA-274 <br> (FOR MODELS 21S348K,KU: 21S335K,KU; 21S357K,KU) <br> Speaker- $\mathbf{S}^{\prime \prime}$ P.M. . ppeaker complete with cone and voice coil ( 3.2 ohms) <br> SPEAKER ASSEMBLIES 971490.3W RLIOS-E11 <br> (FOR MODELS 21S362K,K 21S369K,KU) <br> 21S362K.KU; 21S367K.KU; <br> Cone-Cone and voice coil ( 3.2 ohms) <br> Speaker - $\mathbf{8}^{\prime \prime}$ P.M. speaker complete with cone and voice coil ( 3.2 ohms ) <br> NOTE: If atamping on epeaker in instruments does not agree with above speaker number, order replacement parts by referring to Model number of instrument, number stamped on speaker and full description of part required. speaker and full dencription of part required. <br> Miscellaneous <br> Back-Cabinet back complete with power cord for Models $21 \mathrm{~S} 348 \mathrm{~K}, 21 \mathrm{~S} 355 \mathrm{~K},{ }_{215} \mathrm{~S} 357 \mathrm{X}$ Back Cabinet back complete with power cord for Models $21 S 348 \mathrm{KU}, 21 \mathrm{~S} 355 \mathrm{KU}, 21 \mathrm{~S} 357 \mathrm{KU}$ <br> Back-Cabinet back complete with power cord for Modela 21 S 362 K , 21 S 367 K , 21 S 369 K <br> Back-Cabinet back complete with power cord for Modele $21 \mathrm{~S} 362 \mathrm{KU}, 21 \mathrm{~S} 367 \mathrm{KU}, 21 \mathrm{~S} 369 \mathrm{KU}$ <br>  <br> Brackel-Channel marker escutcheon lomp bracket for Models $21 \mathrm{~S} 362 \mathrm{~K}, \mathrm{KU} ; 21 \mathrm{~S} 367 \mathrm{~K}$ <br> KIJ; 21 S 369 K , KU <br> Cloth-Grille cloth for mahogany grain instru: ments for Models $21 \mathrm{~S} 362 \mathrm{~K}, \mathrm{KU} ; 21 \mathrm{~S} 367 \mathrm{~K}$, KU <br> Cloth-Grille eloth for oak instruments for Models 21 S 369 K , XU <br> Cover-Cover and case assembly--ebony-for hidden controls for $21 \mathrm{~S} 348 \mathrm{~K}, \mathrm{KU}$ <br> Cover-Cover and case asembly-maroon- for hidden controls for $21 \mathrm{~S} 348 \mathrm{~K}, \mathrm{KU}$ <br> Cover-Cover and case assembly-maroon- for hidden control for $2 \mathrm{IS} 355 \mathrm{~K}, \mathrm{KU} ; 21 \mathrm{~S} 362 \mathrm{~K}$ <br> Kor hidden controle <br> Cover-Cover and case asembly oak-for hidden controls for $215357 \mathrm{~K}, \mathrm{KU} ; 21 \mathrm{~S} 369 \mathrm{~K}$, <br> Cushion-For deflection yoke hood assembly Cushion-Rubber cushion for dust sealing the kinescope for maroon and obony instruments Cushion-Rubber cushion for safety glass for Modele $21 \mathrm{SJ} 362 \mathrm{~K}, \mathrm{KU} ; \quad 21 \mathrm{~S} 367 \mathrm{~K}, \mathrm{KU}$; $21 \mathrm{~S} 369 \mathrm{~K}, \mathrm{KU}$ <br> Cushion-Rubber cushion for safety glate for Modele $215362 \mathrm{~K}, \mathrm{KU} ; \quad 21 \mathrm{~S} 367 \mathrm{~K}, \mathrm{KU} ;$ $215369 \mathrm{~K}, \mathrm{KU}$ <br> Cushion-Safety glase retainer cuahion <br> Docal-Brightnoes, volume, fine tuning controls <br>  21S362K, KU; 21S367K, KU <br> Decal-Brightnoss, volume, fine tuning controls and channel selector awitch function decal for oak indtuments for Models 215369 K , KU <br> Eacutcheon-Channel marker eacutcheon for -cutch 2 , <br>  Modele $21 \mathrm{~S} 348 \mathrm{KU}, 21 \mathrm{~S} 355 \mathrm{KU}, 21 \mathrm{~S} 357 \mathrm{KU}$, $21 \mathrm{~S} 362 \mathrm{KU}, 21 \mathrm{~S} 367 \mathrm{KU}, 21 \mathrm{~S} 369 \mathrm{KU}$ <br>  21S367X, 21S369K <br> Eecutchoon-UHF channel marker oucutcheon for inatrumenta using KRK31 tuner unit |

21-S-348K to 21-S-369K inc
21-S-348KU to $21-\mathrm{S}-369 \mathrm{KU}$ incl. REPLACEMENT PARTS (Continued)



## GENERAL DESCRIPTION

All models are " 21 inch" television receivers. Models without a "U" designation in the model number are receivers with
VHF only ond feature fill 12 channel VHF coverage. Models with the "U" designation in the model number are UHF $/ \mathrm{VHF}$
 518(U). Models $21-\mathrm{S}-523(\mathrm{U})$ and $21-\mathrm{S}-537(\mathrm{U})$ feature dual loudspeakers and Models $21-\mathrm{S}-526(\mathrm{U})$ incorporate three loud-

$$
\begin{aligned}
& \text { ELECTRICAL AND MECHANICAL } \\
& \text { SPECIFICATIONS }
\end{aligned}
$$

PICTURE SIZE $\ldots \ldots \ldots 227$ square inches on $\begin{gathered}\text { an } \\ 21 Z P 4 B \\ \text { Kinescope }\end{gathered}$
television r-f frequency range
Models 21 -S- 501 to 21-S-537 Incl.
88 mc .174 mc. to 216 mc
Any of 70 UHF channels.
Any of 12 VHF channels .54 mc . to 88 mc .174 mc . to 216 mc intermediate frequencies Picture I-F Carrier Frequency.
Sound IIF Carrier Frequency
POWER power rating
aUdIo POWER OUTPUT RATING video response

OUT RATING ........ 1.5 watts max
HORIZONTAL SWEEP FREOUENCY Interlaced, 525 line
VERTICAL SWEEP FREQUENCY .......... $15,750 \mathrm{cp}$
FRAME FREQUENCY (Picture Repetition Rate) .... 30 cps .

## RCA TUBE COMPLEMENT Tube Used

Tuner KRK22D (Models with VHF only)
(1) RCA 6BQ7A
(2) RCA $6 \times 8$ R.and R-F Amplifier Tuner KRK30 (UHF/VHF Models)
(1) RCA 6AF4 $\ldots$.................UHF Oseillator (2) RCA 6BQ7A $\ldots \ldots \ldots\left\{\begin{array}{l}\text { UHF R-F Amplifier } \\ \text { UHF I-F Amplifier }\end{array}\right.$
(3) RCA 6X8

VHF R-F Oscillator \& Mixer
UHF I-F Amplifier
A K3D or IN82 crystal is used as the UHF mixer

|  | All Models |
| :---: | :---: |
| 1) RCA 6CB6 | 1st Picture I-F Amplifier |
| (2) RCA 6CB6 | 2nd Picture I-F Amplifier |
| (3) RCA 6Cb6 | 3rd Picture I-F Amplifier |
| (4) RCA $6 \times 8$ | 1st Video Amplifier and 1st Sync. |
| (5) RCA 12AU7 | Video Output \& AGC |
| (6) RCA 6AU6. | Sound I-F Amplifier |
| (7) RCA 6als | Ratio Detector |
| (8) RCA 6AV6 | 1st Audio Am |
| (9) RCA 6AS5 | Audio Ou |

 (11) RCA 6K6GT.........Vertical Sweep Output (13) RCA 6BQ6GT ......... Horizontal Sweep Output (13) RCA ${ }^{\text {6BQ6GT }}$.............Horizontal Sweep Output
(14X4GT (15) RCA 1B3-GT/8016 ............. High Voltage Rectifier (16) RCA ${ }_{\text {RCA }}^{21212 P 4 B}$ 218P4 (Models 21 -S-501(U) \& 21-S-502(U) only) (17) RCA 5U4G .................................ectifier (7) RCA 504 G

$$
\begin{aligned}
& \text { diode is used for the Picture } \\
& \text { CHASSIS DESIGNATIONS }
\end{aligned}
$$

| CHASSIS | TUNER | KINE- SCOPE | MODELS | $\begin{aligned} & \text { LOUD- } \\ & \text { SPEAKERS } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: |
| KCS88B | KRK22D | 217P4B | $\begin{aligned} & \text { 21-S-503 } \\ & 21-5.504 \\ & 21-505 \\ & 21-5.505 \\ & 21-506 \\ & 21-5.517 \end{aligned}$ | 1.5 inch |
|  |  |  | (1-519 | 1 1-8 inch |
|  |  |  | $\begin{aligned} & \text { 21-S-525 } \\ & \text { 21-S.5251 } \\ & 21-\mathrm{S}-5252 \end{aligned}$ | 15 inch |
| $\begin{array}{\|l\|} \hline \text { KCS88C } \\ \text { (No Phono } \\ \text { Jack) } \end{array}$ | KRK22D | $\begin{aligned} & \text { 212P4A } \\ & \text { 21ZP4A } \\ & \text { 21ZP4B } \end{aligned}$ | $\begin{aligned} & \text { 21-S-501 } \\ & 21-\mathrm{S}-502 \\ & 21-\mathrm{S}-518 \end{aligned}$ | $\begin{aligned} & 1-5 \text { inch } \\ & 1-5 \text { inch } \\ & 1-8 \text { inch } \end{aligned}$ |
| KC588D | KRK22D | 21ZP4B | 21-S.537 | 28 inch |
| KCS88E | KRK22D | 212P4B | 21-S-526 | $\begin{aligned} & 1-8 \text { inch } \\ & 25 \text { inch } \end{aligned}$ |
| KCS88 | KRK30 | 217P4B |  | $1-5 \mathrm{inch}$ |
|  |  |  | $\begin{aligned} & \hline 21-\mathrm{S}-519 \mathrm{U} \\ & \hline 21-5.521 \mathrm{U} \\ & 21-\mathrm{S}-522 \mathrm{U} \end{aligned}$ | $1-8 \mathrm{inch}$ |
|  |  |  | $\begin{aligned} & \text { 21-S-525U } \\ & 21-S-5251 U \\ & 21-S-5252 U \end{aligned}$ | $1-5 \mathrm{inch}$ |
| KCS88K <br> K (No Phono <br> Jack) | KRK30 | $\begin{aligned} & \text { 21ZP4A } \\ & 21 Z P A A \\ & 21 Z P 4 B \end{aligned}$ | $\begin{aligned} & \text { 21-S.501U } \\ & 21-5020 \mathrm{U} \\ & 21-\mathrm{S}-518 \mathrm{U} \end{aligned}$ | $\begin{aligned} & 1-5 \text { inch } \\ & 1-5 \text { inch } \\ & 1-8 \text { inch } \end{aligned}$ |
| KCS88L | KRK30 | 212P4B | 21-S-537U | 28 inch |
| KCS88M | кRк30 | 212P4B | 21-S.526U | $\begin{aligned} & 1-8 \text { inch } \\ & 2-5 \text { inch } \end{aligned}$ |
| KCS88V Mounting) | KRK22D | 212 P 4 B | 21-S.523 | 28 inch |
| KCS88VA (Vertical Mounting) | KRK30 | 21ZP4B | 21-S.-523U | 2-8 inch |

NOTE: Any chassis designation with an "X" stamped
after the fincl letter indicates plate assembly Z102 is
 UNPACRING-Thes
UNPACKING.-These receivers are shipped complete in
cardbbard cartons. The kinescope is shipped in place in the receiver.
Take the
material
Take the receiver out of the carton and remove all packing
Make sure that all tubes are in place and are firmly seated
in their sockets.
Check to see that the kinescope high voltage lead clip is in
place. a power cord into the 115 volt ac power source and
Plug the receiver interlock receptacle. antenna input

501 to 21-S-537 Incl.
The KRK22D tuner unit is designed for VHF reception only
A 300 ohm antenna input is provided, however, by removing the jumper between pins 1 and 5 of the matching unit inpu
jack, a 72 ohm coaxial line may be used. Jumpers must b iack, a 2 ohm coaxial line may be used. Jumpers must
added betwen pins 1 and 4 and also between pins 2 and
5 as shown in ligure 26 . The coaxial line is then tastened di 5 as shown in figure 26 . The coaxial line is then fastened di-
reccly to pins 1 and 5 , with the shield connected to pin 1 and
the center conductor to

Models $21-\mathrm{S}-501 \mathrm{U}$ to 21 -S-537U Incl
The KRK
The KRK3 3 tuner unit is designed for UHF-VHF reception with
using a OHF inputs provided tor UHF and VHF use. When
O he single transmission line to the proper receiver antenna
祭minals. Do not connect the terminal board jumper W105. (Refer to figure 27.)
When a combination UHF-VHF antenna is used, connect
the transmission line to the VHF terminals on the terminal the transmission line to the VHF terminals on the terminal
board. Connect the jumper W105 to the UHF terminals as
shown in Signals from separate UHF and VHF antennas may be fed Signals irom separate UHF and VHF antennas may be fed
to the tuner. To do this connect the individual transmission ines to their respective terminacls on the terminol board. Do
Do
not connect the jumper W105. Where $a$ "crossover network not connect the jumper Wli05. Where a "crossover network"
$i s$ employed to match the two separate antennas to a com-
 boct the jumper $W$ to the terminals on the terminal
bor
CHECR FOR PROPER OPERATION.-Turn the power
witch to the "on" position and check the operation of the receiver.
Each unit has been completely and accurately adjusted at ever, a check should operate normaly ar his point. HowAdjustment should be made as outlined below, only where indication of improper operation is evident.
ION TRAP MAGNET ADJUSTMENT.-Set the ion trap Starting from this position immediately adjust the magnet by moving
slightly frorward or backward at the same time rotating it raster on the screen. Reduce the brightness control setting until the raster is slightly above average brilliance. Turn the
focus control (shown in Figure 3) until the line structure of
 maximum raster brillimece. The final touches of this adjust-
ment should be made with the brightness control at the maxi-
mum clockwise position with whit ges mum clockwise position with which good line focus cam be maintained.
DEFLECTION YORE ADJUSTMENT.-If the lines of the raster are not horizontal or squared with the picture mask,
rotate the defletion yooe until this condition is obtained.
Tighten the enurlied yoke adjustment nuts.
PICTURE ADJUSTMENTS.-It will now be necessary to
btain $a$ test pattern or picture in order to make further adjustments.
ating properly, it should be possible to sync the picture aper point. However, if the AGC control is misadiusted, and the picture It the
If the receiver is overloading, turn R149 on the rear apron
(see Figure 4) counter-clockwise untl the set operates norally and the picture can be synced
CHECE OF HORIZONTAL OSCILLATOR ADJUSTMENT.Turn the horizontal hold control to the extreme clockwise
position. The picture should be out of sync, with approximately twelve bars sloming downward to the right. Turn the
control counter-clockwise slowly. The number of diagonal control counter-clockwise slowly. The number of diagonal
black bars will be gradually reduced and when only $11 / 2$ to 3 bars sloping do onward to the right are obtained the pic ture will pull int sync upon thigh additional counier-clock
wise rotation of the control. The picture should remain in synn or approximately two full turns of additional counter-clock tise rotalion op the control. Continue counter-clockwise rota
tion until the picture falls out of sync. Rotation beyond fall out position should produce between 2 and 5 bars befor interrupted oscillation (motorboat occurs). Interrupted oscil-
lation (motorbot) should be reached before full counterclockwise rotation.
When the receiver passes the above checks and the picture
is normal and stable, the horizontal oscillator is properly aligned. Skip "Adujustment of Horizontal Oscillatilator" is properly
and pro ADJUSTMENT OF HORIZONTAL OSCILLATOR-H in the above check the receiver failed to hold sync over two full urns of counter-clicckwise rotation of the control from the pull-in poin
Turn the horizontal drive trimmer C171 fully clockwise, then the stud flush with the inside edge of the chassis. Set the sine have coil L121 fully counter-clockwise
Adjustment of the horizontal frequency control in the coun
ter-clockwise direction will show a multiple number of bar belore "motorboat" occurs. Adjust the sine wave coil L12 ntil 3 or 4 bars are presen before "motorboat" occurs When the horizontal frequency control is rotated counter
clockwise from the fall out point.


[^11]
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Adjust C116 until 42.5 mc . in at at $70 \%$ response with rospect
the low frequency shoulder of the curve as shown in

Disconnect the diode probe, the 180 ohm and the 330 ohm

 Connect the oscilloscope to the junction of R129 and L103. Connect the oscilloscope to the junction of R129 and L103.
Leave the sweep generator connected to the mixer grid teast
point TP2 with the shortest leads possible. Adjust the output of the sweep generator to obtcin 3.0 to
0. 5 volts peak-to-peak on the oscilloscope. loscope
Couple the signal generator loosely to the grid of the lirst
pix i-1 cemplifier. Adiust the output of the signal generator to
produce small markers on the response curve. roduce small markers on the response curve. Retouch 11
in $F$ Figure
12.
Increase Rweep output ten times and check arienuation ot
41.25 me. Adjust T105 and T107 to set 41.25 me. between 30 To align the I-F amplifier circuit of the XRK VHF swoep generator to the front terminal of the in82 crystal holder in series with a 1000 ohm resistor and a 1500 mml .
eramic capacior. Use the shortest leacds possible, grounding the sweep ground lead to the tuner case.
To do this, remove the crystal cover
To do this, remove the crystal cover and connect the re-
sistor, criter insulating the lead with tubing, to the crystal
iront terminal sistor, alter ins
ront terminal.
Set the UHF CHANGEOVER witch to the UHF position, and
the UHF TUING between channels 68 and 69 at 800 men. Connect a 180 ohm composition resistor and a 1500 mmf .
capacitor in series between test point TP3 and ground with he capacitor connected to TP3 and the resiator 10 ground. Connect the oscilloscope diode probe to the junction between
the resistor and capacitor. (See Figure 20.) Couple the VHF signal generator loosely to the diode probe
in order to obtain markers. in order to obtain markers.
Connect the potentiometor arm of the second bias supply
to the AGC terminal on the tuner and ground the battery
positive terminal to th the
 ometer to produce - -3.0 volts of biass, che meass.
"Voltolhy
Set the sweep generatior to produce 0.5 volt or less peak-to-
peak on the oscilloscope. peak on the oscilloscope.
Adjust C308, on the UHF section, and L9, on the VHF secAdjust C308, on the UHF section, and L9, on the VHF sec-
tion, of the tuner for maximum goin with 45.75 mc and 42.5
mc. markers as shown in tigure 13 . If necessary adjust 127 to place the 45.75 me. marker at
the peak of the curve. Adjust L43 lor minimum till of the curve as shown in tigure 13 .
Remove the resistor, capacitor and diode probe from TP3
and connect the oscilloscope to the iunction of R129 and L103.
Use 3 . and connect the oscilloscope to the iunction
Use 3.0 p peak-to-peck on the oscilloscope.
Connect the VHF sweep generator the antenna ter-
minnals. Keep the $A G C$ bicas at -3.0 V and the $\mathrm{I}-\mathrm{F}$ bicas at
-4.0 volts. Couple the signal generator loosely to the grid of the first
picture IFF amplifiter. Switch through all VHF channelis and check for proper
curve shap as in ingure 12 . Retoouch T106 and 1 Tor pioply
to correct for any overall tilt that is essentially the same on curve shape as in tigure 12 Retouch T100 and T107 slightly
to correct for any overall tith that is essentially the some on
all channels. Dill channele
Disconnect the VHF sweep generator and connect the UHF
sweep generato to the antenna terminals. Check on all UHF sweep generater
channels tor proper wave shape as shown in tigure el 12 , re-
touching C308 and L9 if necessary to correct any overail tilt Do not retouch T2, T104, T105. T106 or T107.
Remove the sweep and marker generators and the bias
supplies. RRE22D TUNER ALIGNMENT.

Models 21-S. 501 to 21 - S - 537 Incl.
A tuner unit which is operative and requires only touch up
adjustments, requires no presetting of
adjustments For such adjustments, requires no presetting of adjustmenta. For such
units, skip the remainder ot his paragraph For units which
are completely out of adjustment, preset C all the way out.

Set channel 7 to 13 oscillator slugs one turn from tight. Turn
T1 slug all the way out. Do not change any of the adjust10nts an the ontenna matching unit. Disconnet the link from terminals "A" and "B" or T104
and terminate the link with a 39 ohm composition resintor. Turn the receiver channel selector switch to channel 2. The 43.5 mcc . trap is adjusted with zero biass. To insure that he bias will remain constant, take a clip lead and short
circuit the AGC terminal of the tuner at the terminal board to ground.
to ground.
Connect the oscilloscope to the lest point TP1 on top of the
tuner unit. Set the oscilloscope to maximum gain.
Connect the output of the VHF signal generctior to the out-
put of the ampenna malching unit art the junction of L53 and
C24 ot the bottom of the FM trap 153 .
Tune the signal generator to $43,5 \mathrm{mc}$. and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator for with a 400 cycle
maximum output.
Adiust C19 on top of the tuner, for minimum 400 cycle indi-
cation on the oscilloscope. If necessary this adiustment
 specitic frequency in the i-f band pass. However. in such
cates. care should be taiken noo to tune Cl9 into channel 2 , cases, care should be liaken not to tune 2 .
thereby reducing sensitivity on channel 2 .
Connect the potentiometer arm of one of the bias supplies
to the $A G C$ terminal on the tuner and ground the battery o the AGC terminal on the e tuner and ground the batery
positive terminal to to te tuner case. Adjuat the bias poientipomitive torminal to the tuner case. Adiuast the bias potenti-
"Woler provec -3.0 volts of bias. as measured by the
"Voltohmyst" at the AGC terminal on the luner. "Voltohmyst" at the AGC terminal on the tuner.
Set the channel selector switch to channel 8 .
 on the "VoltOhmyst". The limits for oscillator injection voltage
are 2 volts minimum and not exceeding a maximum of 5.5
Turn the fine tuning control fully clockwise.
Adjust C3 for proper oscillator frequency, 227 mc. This
may be done in several wary. The eaciest way and the way may be done in several waya. The eaxiest way and the way
which will be recommended in this procedure will be to use the nignal generator as a heterodyne frequency meter urd beart the oscillator agcinst the signal generator. To do this,
lune the signal generator to 227 mc. with crystal accuracy. Uune the eignal generator to 227 mc. with crystal accuracy.
Insert one end ol a piece of insulated wire into the tuner unit hhrough the hole provided for the adjustment of CiO. Be care-
ful that the wire does not touch any of the tuned circuits as it may couse the trequency of the tuner oucillator to shits. Connect the other end of the wire to the "r-f. in in erminal of
the signal generator. Adjuzt C 3 to oblain an audible beat the signal generator. Adj.
with the signal generatior.
Turn C2 clockwise until the beat note just begins to change.
then turn one full turn in the same clockwise direction.


Antooch Mill
Figure 14- KRK22D Tuner Adjustments
Return the line tuning control to the mechanical center of its range.
Note.- -If on some units it is not possible to reach the proper
channel 8 oscillator irequency by daiusiment of C 3 , swich channel 8 oscillator irequency by ajuantiment of C3, witich
to channel 13 and adjust 42 to obtain proper channel 13 oscillator frequency as indicated in the table on page 8 . Then, switch to channel
channel 12 oscillator frequency. Continue down to channel 8 , adjusting the appropriate oscillator trimmer to obtain the
proper frequency on each channel. Then again on channel 8 , proper frequency on each channel. Then again on channel 8 ,
adjust $C 3$ to obtain proper channel 8 oscillator frequency. adjust C3 to obtain proper channel 8 oscillator frequency.
Switch back to channel 13 and readjust L42 and back to hannel 8 and adjuat C3.
Set the TI core for maximum inductance (core turned
counter-clockwise).

Connect the swoep generator through a suitable attenu-
ator, as shown in tigure 15, to the input terminals of the antenna matching unit


## Figure 15-Sweep Attenuator Pads

Connect the signal generator loosely to the antenna te Set the aweep generator to cover channel 8 . Set the oscilloscope to maximum gain and use the minimum
input signal which will produce a usable pattern on the oscilloscope. Excessive input can achange oscilltortior injection oscilloscope. Excessive input can change oscililator injection
during allignment and produce consequent misalignment even
though the response as seen on the oscilloscope may look though the response as seen on the oscilloscope may look
normal. Insert markers of channel 8
carrier, 181.25 mc and 185.75 mc .
Adjust C7. C10, C15 and C20 for approximolely correct
curve shape, trequency, and band width as shown in tigure curv
16.
The correct adjustment of C20 is indicated by maximum
amplitude of the curve midway between the markers. C15
 circuit and ctifects the tilt of the curve most noticeably y casum
ing that 20 has been properly adjuated). Clo is the cuplin ing that C20 has been properly adjuated). C10 is the coupling
adiustment and hence primarily aflects the response band
width width.
Connect the "VoltOhmyt"" Io tost point TPI. Adjust C5 to
ead -3.0 volts dc on the "VoltOhm yst" at TPI. Readiuat C 2
 mum gain at midpoint of the curve. Repect if necessary un


Figure 16-KRK22D Tuner R-F Responses
Set the receiver channel switch to channel is. 13 oscillator recuency $257 \mathrm{mc}$. .
Turn the fine tuning control fully clockwise.
Turn the fine tuning control
Adjust L42 to obtain an cudible bert. Slightly overshoal tional tur in the same direction from the original setting, then reset the
oacillator to proper frequency by adjusting C2 to again
oblain the beat. blain the beat.
Set the sweep generator to channel 13 .
From the signal generator, insert channel 13 sound and
icture carrier markers 211.25 me. and 215.75 mc pieture carrier markers, 21.23 me. and 21.15 me.
Adjust $L 43$ and $L 45$ for proper response as shown in
igure 16 .
Turn of the sweep and signal generator

Connect the "VoltOhmyst" to the tuner test point TP Check the oscillator injection voltage to be within limita ass
proviously specitied. Adjust if necessary to bring within range. If it was necessary to readjust C5, turn the sweep and sigossary.

Set the receiver channel selector switch 10 chand 0 an Set C 2 for proper oscillator frequency, 227 mc.
Set the sweop generator and signal generator to channel Readjust C7, C10. C15 and C20 for correct curve shape Turn oft the sweep and signal generators, switch back 10
channel 13 and check the oscillator injection voltage ac TP? if $\mathrm{C7}$ wass odjusted in the recheck of channel 8 response far oft, it may be necessary to adjust the oscillotor trequency Yar
and response on chassary 8 , adjuuat the oscillator injection on chanel lis and repeat the tracking procedure several times
Turn of the aweep generator and switch the receiver to
channel 6 .
Adjust the signal generator to the channel 6 oscillator
frequency 129 mc.
Set the fine tuning control to the center of its mechanical
range.
range.
for proper Lor an audible beat. Adjust L44, L46 and L58 Mor proper curve shape as shown in higure 16 . Recheck the
oscillotor injection voltage ot Trl, to insure that it is within
the limits apecitied. Readjust T5 ii the limis specitied. headjust CS if necessary.
II CS required adjustment, switch the receiver and the hape and recher Check the response of channels 2 through 6 by switching
the receiver channel switch, sweep generator and marker generator to each of these chamnels and observing the re 16 for typical response curvez. It should be found that all these channels have the proper response with the markeri
above $80 \%$ response above $80 \%$ respons .
If the markers faril to fall within this requirement readjust
L44, L46 and L58 in order to obtcin curves within the proper
limite
Switch the channel selector, signal generator and marker
generator through channels 7 to 13 and observe the reaponse curves, referring to ligure 16 for proper wave shape Che the injection voltage at each channel to be within limits.
If necessary readjust C 15 , C 7 , or C 10 to obtain the proper
nnel 13 ad
With the receiver and aignal generalor on channel 1 .
junt $L 42$ for an urdible beat with the signal generator.
Adjust the oscillator to frequency on all channels by switch-
ing the receiver and the frequency samdard to each channel
and adiusting the
 cudible beat. It should be possible to adiust the oscillator to
obtain the cudible beat on each channel. Recheck the orcil obtain the audible beat on each channel. Recheck the orcil-
lator injection voltage on each channel to verity that the voltage is within the specified limits.


Figure 17-KRK22D Tuner Oscillator Adjustment KRE22D or RRE30 ANTENNA MATCHING UNIT ALIGN the factory. Adjusiment of this unit should not be attempted in the customer's home since even slight misalignment may cause senimus antenuation of the signal especially on chach-
nel 2 The r-f unit is aligned with a particular antenna matching transiormer in place. It for any reason, a new antenna
malching transformer is installed. the $\mathrm{r}-\mathrm{i}$ unit should be
re-aligned.

I91-セ| ヨ9Vd ^1 $\forall D I 8 J W \forall ~ j O ~ N O I I \forall 8 O d y O S ~ O I O \forall d ~$
CHASSIS KCS88B, C, D, E, J, K, L, M, V, VA

The F-M Trap which is mounted in the antenna matching
unit may be adjusted without adversely affecting the alignment of the unit.
To alige
To align the antenna matching unit disconnect the lead
from the FFM trap L53 (L5) to the channel selecior pwitch
S4 (SIE). from the
S 4 ( SlE ).
With a short jumper, connect the output of the matching
unit through a 1000 mmm . capacitor to the grid of the second unit through a 1000 mmif capacil
pix i - amplifier, pin 1 of V107.
Replace the cover on the matching unit while making all
adjustments. djustments
Remove the first pix i-f cmplifier tube. Vio6. Connect the positive terminal of a bias box to the chassis
and the potentiometer arm to the iunction of R118, R446 and
C120. Set the potentiometer th and
Cl2.. Sel the potentioneter to produce approximately -5.0
volls of bias al the junction of R118, R146 and C120. Connect an oscilloscope to the junction of R129 and L103
and set the oscilloscope gain to maximum. Connect a VHF signal generator to the antenna input termi-
nals. Modulate the signal generator $30 \%$ with an audio signat. Tune the signal generator to 45.75 mc . and adjust the
generator output to give an indication on the oscilloscope. generator output to give an indication on the oscilloscope.
Adiust 54 (LIt in the antennd matching unit for minimum
audio indication on the oscilloscope. audio indication on the oscilloscope.
Tune the signal generator to $41.25 \mathrm{mc}$. . and adiust L 57 (L1)
for minimum audio indication on the oscilloscope.
Remove the iumper irrom the output of the matching unit.
Connect a 300 ohm $1 / 2$ watt composition resistor from L.53 Connect a 300 ohm $1 / 2$ watt composition resistor from
(LS) to ground, keeping the leads as short as possible. Connect an oscilloscope low capacity crystal probe from be approximately
Connect the VHF sweep generator to the matching unit
antenna input terminals. In order to prevent coupling reacantenna input terminals. In order to prevent coupling reac-
tance from the sweep generator into the matching unit, it is tance from the sweep generator into the malching unit, it is
advisale employ a resistance pad or the matching unit
terminals. Figure 15 shows three difierent resistance pads ior terminals. Figure 15 shows three difterent resistance pads for
use with sweep generators with 50 ohm co-ax output, 72 ohm use with sweep generators with 50 ohm co-ax output, 72 ohm
co-ax output or 300 ohm balanced output. Choose he pad
to math to match the output impedance of the particular sweep
employed. Connect the signal
antenna terminals.
Set the sweep generator to sweep from 45 mc . to 54 mc
With RCA Type WRS9A sweep generators, this may be ac. complished by retuning channel number 1 to cover this range Complished by retuning channel number 1o cover his range
With WRS9B sweep generators this may be accomplished by
retuning channel number 2 to cover the ronge In makin retuning channel number 2 to cover the range. In making
these adjustments on the generator, be sure not to turn the these adiustments on the generctior, be sure not to turn the
core too tar clockwise so that it becomes lost beyond the
core retaining spring.
 in figure
of the shoulder of the curve at 52 me. and 56 (L2) should be
adiusited to o ive maximum amplitude at 53 adjusted to give maximum amplitude at 53 me. and above
consistent with the specified shape of the response curve. The consistent wih the speciined shape of the response curve. The
adjustments in the matching unit interct osome extent. Re
peat the above procedure until no further adiustments are peat the above procedure until no further adjusiments at
necessary. Restore the connection between L53 (LS) and S4 (SIE). Re
place V106.


Figure $18-$ KRK22D or KRK30 Antenna Matching KRK30 TUNER ALIGNMENT Models 21 -S. 501 U to 21-S.537U Incl.
VHF ALIGNMENT.-A tuner unit which is operative and
of adustments. For such units, skip the remainder of this presel C27 arl the way out Set channel 7 to 13 oscillator
slugs one turn from tight. Turn T2 slug all the way out. Do not slugs one turn from tight. Turn 2 s.ug all te way out. Do not Disconnect the link from terminals "A" and "B" of T104 and
terminate the link with a 39 ohm composition resistor.
Turn the receiver channel selector switch to channel 2 . The 43.5 mc . trap is adjusted with zero bias. To insure that the bias will remain constant, take a clip lead and short cir-
cuit the $A G C$ terminal of the tuner at the terminal board to Connect the oscilloscope to the test point TP2 on top of the Connect the oscilloscope to the test point TP2
luner unit. Set the oscilloscope to maximum gai
Connect the output of the VHF signal generator to the
cutput of the antenna match ing unit at the junction of $L 5$ and C4 at the bottom of the FM trap L5.
Tune the signal generator to 43.5 mc . and modulate it $30 \%$
with a 400 cqcle sine wave. Adjust the signal generator for
maximum output.
Adjust C33 on top of the tuner, for minimum 400 cycle indication on the oscillosocope. II necessary, this adjustment can
be retouched in the field to provide additional rejection to be retouched in the field to provide additional rejection to
one specilic frequency in the i i-f band pass. However, in such cone seci.ic irequency in the care should be taken tot tune Cowe into channel
2, thereby reducing sensitivity on channel 2 . Connect the potentiometer arm of one of the bias supplies
to the $\mathcal{A G C}$ torminal on the tuner and ground the battery 1o the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case.. Adjust the bias potenti"Voter to produce - 3.0 volts of biass, as meas
"Vohmyst" at the $A G C$ terminal on the tuner.
Preset C22 to read -3.0 volts at the test point TPI, as
read on the "Voltohmyst." The limits for oscillator injection valtage are 2 volts minimum and not exceeding a maximum voltage are
of 5.5 volts.
Turn the fine tuning control fully clockwise.
Adiust C25 for proper oscillator frequency, 227 me. This
may be done in several ways. The easiest way and the way
which will be recommended in this procedure will be to use which will be recommended in this procedure will be to use
the signal generalor as a helerodyne frequency meter and the signal generator as a heterodyne frequency meter and
beat the oscillaror against the signal generator. To do this.
tune the signal generator to 227 mac. with crysial accuracy. tune the signal generator to 227 mc. with crryial accuracy unit through the hole provided for the adjustment of Cli6.
Be careful that the wire does not touch any of the tuned circuirs as it may cure the frequency of the tuner oscillator
to shift. Connect the other end of the wire to the "r-f" in to shitt. Connect the other end of the wire to the "r-." in
terminal of the signal generator. Adjust C25 to obtain an
audible beat with the signal generator. audible beat with the signal generator.
Turn C27 clockwise until the beat note just begins to
change, then turn one full turn in the same clockwise di-
rection. Return the fine tuning control to the mechanical center of its range. NOTE:-II on some units, it is not possible to reach the
proper channel 88 oscillator frequency by adjustment of C25
 13 oscillator frequency ass indicaled in the table on page 8 .
Then, switch to channel 12 and adiust $L 60$ to obtain prope channel 12 oscillator frequency. Continue down to channel 8 . adjusting the appropriate oscillator trimmer to obtain the
proper frequency of each channel. Then again on channel 8 , adiust C25 to obtcin proper channel 8 oscillator frequency
Switch back to channel 13 and readjust L49 and back to Switch back to channel 1 .
channel 8 and adjust $C 25$.
Set the $T 2$ core for maximum inductance (core turned
counterclockwise). counter-clockwise
Connect the sweep generator through a suitable attenu
ator, as shown in figure 15 to the input terminals of the
antenna alor, as shown in fitg
antenna matching unit.
Connect the signal generator loosely to the antenna
terminals. lerminals.
Set the oswellop generator to cover channel 8 . input signal which will produce a usable pattern on the oscil
loscope. Excessive input can change oscillator injection durloscope. Exceassive input can change oscillatior injection dur
ing alignment and produce consequent misalignment even ing alignment and produce consequent misalignment even
though the response as seen on the oscilloscope may look normal
Insert markers of channel 8 picture carrier and sound
carrier, 181.25 mc . and 185.75 mc . Adjust C21, C16. C11 and C7. for approximately correct
curve shope, frequency, and band width as shown in figure curve shape, frequency, and band width as shown in ligur
The correct adjustment of $C 7$ is indicated by maximum am-
plitude of the curve midway between the matrers. Cll tunes
the $r$-f amplifier plate circuit and atfects the frequency uf the
pass band most noticeably. C21 tunes the mixer grid circuit
 justment and hence primarily aftects the response band Connect the "Volto hmyst" to test point TP1. Adjust C22 to
read - -3.0 volts dc on the "Voltohmyst" ot TP1. Readiust C27. C21, C16 and C11 for proper response. Adiuat C7 for maxi-

Serthe receiver channel switch to channel 13
Adjuast the signal generator to the channel 13 oacillator fre-
quency 257 mc. Turn the fine tuning control fully clock wise. Adjust L49 to obtain an audible bect. Slighthy overshoot the
adjustment of L49 by turning the slug additional turn in adjustment of LI49 by turning the slug an additional turn in
the some diriection from the original setting, then resel the
oscillator to proper trequen by oscillator to proper frequency by adjusting C27 to rgacin ob- oscan
loin the bect. Set the swe
From the signal generatotor, insert channel 13 sound and pic-
ture carrier markers, 21.25 mc. and 215.75 mc. Are carrier markers. 211.25 mc. and 215.75 mc .
Adjust $L 36$ and $L 20$ for proper response as shown in figAdjust L36 and L20 for proper response
ure 14.
Tys
Turn off the sweep and signal generators.
Connect the "Voltohmyst" to the tuner Connect the "Voltohmyst" to the tuner lest point TPI Check the oscillator injection voltage to be within limits as
previously specified. Adjust if necessary to bring within range.
If it was necessary to readjust C22, turn the sweep and
signal generators back on and recheck the channel 13 resignal generators back on and recheck the ch
sponse. Readjust L 36 and L 20 if necessary.
Set the roceiver channel selecitor switch to channel 8 and
readiust C27 for proper oscillator frequency 227 mc Set the sweep generator and signal generator to mc. 227 . 8 . Set the sweep generator and signal ge nerator to channel 8 .
Readjust $\mathrm{C} 21, \mathrm{C} 16, \mathrm{C} 11$ and C 7 for correct curve shape, Readjust $\mathrm{C21}, \mathrm{C16}, \mathrm{C11}$
frequency and band width.



If the initial setting of the oscillator injection trimmer was
ara of it inay be necessary to adiust the oscillator frequency lar of it inay be necessary to adjust the oscillator frequency
and response on channel 8 , adiust the oscillator iniection on and response on channel 8, adjust the oscilatior injection on
channel 13 and repeat the tracking procedure several times
before the proper setting is obtained.
Turn of the sweep generator and switch the receiver to channel
Adjust
. the signal generator to the channel 6 oscillator fre Set the fine tuning control to the center of its mechanical $\underset{\text { Adjust }}{\text { range. }} \mathrm{L} 4$ for an audible bect. Adjust $L 14, \mathrm{~L} 48$ and L 32 for proper curve shape as shown in figure 19. Recheck the oscil-
ator injection voltage at TP1, to insure that it is within the limits specified. Readjust C22 if necessary. II C22 required adiustment, switch the receiver and the
signal generator to channel 8 . Readiust C21 for correct curve signal generator to channel 8 . Readjust C21 for correct curve
shape and recheck C27 and C2S lor proper oscillator fre
quency.

Check the response of channels 2 through 6 by switching
he receiver chomnel switch, sweep gengerator and marker generator to to ach of these channep gend observing the re-
sponse and oscillator injection voltage obtcined. See figure sponse and oscillator injection voltage obobrined. See figure
19 for typical response curves. It should be found that all these channels have the proper response with the markers
above $80 \%$ response.


Figure 20~KRK30 Tuner Adiustments
If the markers fail to fall within this requirement readius
L 48 and L 22 in order Switch the channell selector, , ingal generator ond marke
generator through channels 7 to 13 and observe the resions generator through channels
curves. refroring to figure 1 gor proper werve shape. Check
the injection voltage at each channel to be within limits. I the injection voltage ar each channel to be within limits. If
necessary readiust C11, C21 or C16 to obtain the proper response.
With the With the receiver and signal generator on channel 13 ad
juat L49 for an audible beat with the signal generator. UHF SECTION


Figure 21-KRK30 Tuner Oscillator Adjustments Adiust the oscillator to frequency on all channels by switch-
ing the receiver and the frequency standard to each channel and adjusting the appropriate oscillator slug to obtain the
audible beat. It should be possible to adjust the oscillator to audable beat. It should be possible to adjust the oscillator io
obtain the eudible beat on each channel. Recheck the oscillator injection voltage on each channel. channel to vectity that the
voltage is within the specitiod limits.

## John F. Rider

UHF ALIGNMENT R-F--Alignment of the UHF section of
 moval ot the tuner shield which may only be done with the
UHF tuner separate trom its mounting.


Connect a 100 ohm composition resistor between the center
conductor of he 1 I- cable $W 301$ and the tuner casee Conduntor ot the i-f coble W301 and hat tuen rase
Connect the oscilloscope to the center conductor
 with the ossilloscopese used. Ground the oscilloscope to the
tuner cesse. Connect Conect the output of the UHF sweep generatort hrough


 $0^{\circ}$ reterence point is located with the capacitior plates fully
meshed. With the stop pin on the tuner against the stop plaid on the gear assembly the plates will be in the proper fully
mesed Rotate the tunin

 covered with insulated dubing, through the apertren porvided
Ior crystal removal (See igure 20.1 Insert morkers tor 41.25



 | maximum amplitudo overoupled |
| :--- |
| 887.5 mc as shown in tigure $22(\mathrm{~A})$ |



Figure 22-KRK30 Tuner UHF R-F Responses
Adiust the osillator trimmer capacitior C306 until the 43.5
me. marker coincides with the marker at 887.5 me. The markers tor 4 l.2. 2 and 45.75 sheuld be bymmentically located


 markers as shown. The inductance loop tispel caross the socil

 | higure |
| :---: |
| mene |
| Repe |

ment Repeat the above adjustments, as necessary, until the Proper responses are obtained. Tune through the enite range
and check the tracking. When pertectly tracked the three








 scale. Tune over the entire range observing the reading on
te meer. A reading between 03 and 35 volts should be
he blained. Voltages oulside these limits are an indication of low B vilage, Iow or high crystal impedance or an oscillator
lube oulside allowable 1 limis This vollage is an indiction

Connect the "Volto hmyst" to the "bias" terminal of the
should be obtained. Readings above or below this rang cals cause crystal currents outside allowable limits and in suc
cases the oscillator tube should be replaced. Replacement the oscillator tube will require recalibration at the high and
low frequency ends of the band as previously outlined. RATIO DETECTOR ALIGNMENT.-Set the signal gen-
erator at 4.5 mc. and connect it to the lirst video amplitier erator at 4.5 mc. and connect it to the lirss video ampliter
grid, pin 7 of Vio8A, in series with a 01 mld capacitor
it As an allernate source of signal. the RCA WR39B or
WR39C calibrator may be employed. In such a case con WR39C calibralor may be employed. In such a case, con
nect the calibrator to the grid of the third pix i-f amplifier nect te vi07.
pet the frequency of the calibrator to 45.75 mc . (pix carrier
Sel Set the frequency of the calibrator to $45.7 \mathrm{mc}$. . (pix carrie)
and modulate with 4.5 mc crystal. The $4.5 \mathrm{mc}$. signal
will be picked offt at pin 9 of V108A and amplitied through will be picked off at pin 9 of V108A and an
the sound i - amplitier.
Tune the ratio detelecor primary. Tlion top core for maximum
d-c output on the "Voltohmyst." d-c outpur on the "orithmyst. (Peak with core at end coinal aray irom chassis.) Adiust the signal level irom the
signal generator for $S$ volis on the Volthmyst finally peaked. This is approximately the operating level
the ratio detector tor average signals. Connect the "Voltohmyst" to the $i$
Tune the ratio detector secondary $T 102$ bottom ane to zer -c on the "Voltohms." (Adiust with core at chassis end Repeat adjustments of $\mathrm{TlO2}$ top for maximum d-c at pin 7
of V 102 and T 102 bottom for zero d-c at the junction of R104 of V102 and T102 botiom for rero d-c a taximum dunction of R10
and C 107 . Make the final adjustments with the signal inpu and Clo. Make the final adjustments with the signal input
level adiusted to produce 5 volis $d$ de on the "VoliO hmyst at
pin 7 of V10? pin 7 of V10?
SOUND
SOUND TAKE-OFF ALIGNMENT.-Connect the signal
generator ot the first video amplifier grid. pin 7 of ViO8A. generator to the irst video amplitien grid. pin 7 of V108A.
As an alternate source of signal the RCA WR39B or
WR3C calibitor WR39C calibrator may be employed as above.
Connect the "Voltohmyst" to pin 7 of V102.
Tunect the TiO1 top core for maximum do on the "Volt.
Ohmyst." (Peak with core at chassis end of coil.) Ohmyst. (Peak with core at chassis end of coil.
The output trom the signal generator should be to
produce approximately 5 volis on the "Volthmyst" when produce approximatiely ${ }^{5}$ volis son the "Voltohmyst." wher
the final touches on the above adjustment are made.

$$
\begin{aligned}
& \text { (Allernate Method for Ratio Dete } \\
& \text { Sound } 1 \text { AlF Alignment) }
\end{aligned}
$$

Set the signal generator at 4.5 mc and connect it to the
first video amplitier grid, pin 7 of V 108 A in series with $a .01$ midd capacitor.
Connect the "Voltohmyst" to pin 7 of V102.
Tune the ratio detector secondary T102 bottom core for
maximum d-c on the "Voliohmyt." (Peak with core at chassis end of coiil.)
Tune the ratio detector primary. T102 top core for maximum
d-c output on the "Voltohmyst:" d-c output on the "Voliohmys.. (Peak with core at end of
coil away from chassis.) Adiust "he signal level from the
sigal signal generator for s solits on the "Voltignmyst" when finally
peaked, when making the chove adjustments.

Tune the T101 (top) core for maximum d-c on the "Volt
Ohmyst." (Peak with core at chassis end of coil.) The outpuat from the signal generator should be set to
produce approximately 5 volts on the "Voltohmyst" when he final touches on the Tloll adjustment are made. Tune T102 bottom for zero d-c at the junction of R104
and C107. (Make adjustment with core ot chassis end of coil.) 4.5 MC. TRAP ADJUSTMENT.-Connect the signal ge rator in series with a 1.500 mmf . capacitior to pin 7 of Vi 108 A
Set the generator to 4.5 mc . and modulare it $30 \%$ with 400 cycles. Set the output to approximately 0.5 volt Short the third pixi i-1 grid to ground, pin 1 , V107, to preven
noise from masking the output indication. Connect the crystal diode probe of an oscilloscope to the
plate of the video output pin 6 of V109A. Adjust the core of L109, for minimum output on the oscilloscope. (Make adjustment with core of chassis end of coil.) Remove the short from pin 1, V107 to ground.
As an alternate method, this step may be omitted at this
point in the alignment procedure and the adjustment made on the ait" after the alignument is completed.
It this is done. tune in a station and observe the picture on
the kinescope. If no 4.5 mc. beat is present in the picture the kinescope. If no 4.5 mc . beat is prezent in the picture,
when the fine tuning control is set for proper oscillator-fre quency, then L 109 requires no adjustment. If $a 4.5 \mathrm{mc}$. beat present. turn the fine tuning control slightly clockwise so as
o exaggerate the beat and then adiust Llog for minimum beat. AGC CONTROL ADJUSTMENT.-Disconnect all test equip. pin 6 of Vlo9A.
Connect an antenna to the receiver antenna terminals.
Tune in a strong signal and adjust the oscilloscope to see
Turn the AGC contro! clockwise until the tips of sync begin
to be compressed, then counter-clockwise until no compres
Turn the AGC contro! clockwise until the tips of sync begi
to be compressed, then counter-clockwise until no compres
sion is obtained. horizontal oscillator and output alignment Normally the alignment of the horizontal osciliator is no
considered to be a part of the alignment procedure, but sinc the oscillator wavelorm adjustment may require the use of an
oscilloscope, it can not be done conveniently in the field oscilloscope, it can not be done conveniently in the field.
The wavelorm adiustment is made at the factory and nor
mally should not require readiust bet an mally should not require readiustment in the field. However
the wavelorm adjustment should be checked whenever the receiver is aligned.
Turn the horizontal drive trimmer C171 fully clockwise
then counter-clockwise orie full turn. Set the stud of the then counter-clockwise orie full turn. Sel the stud of the
width coil Llll flush with the inside rear edse of the chassis

Place a jumper across the terminals of the sine wave coil
121 and adjust the horizontal (frequency) control until the picture pulls into sync. Remove the short across the sine
wave coil. Connect the low capacity probe of an oscilloscope to
the junction of L120. L121 and R189. Turn the horizontal the unction of L120. L121 and Recki The the harizo the
(trequency) control clockwise until the picture talls out of sync, then counter-clockwise until the picture iust pulls into
sync. The pattern on the oscilloscope should be as shown
in Figure 23 Adis in Figure 23. Adjust the sine wave adjustment core $L 112$
until the two peaks are at the same height. During this adjust until the two peaks are at the same height. During this adjust
ment, the ipicture must be kept in synn by readjusting the
hcrizontal (trequency) contro if necessat hcrizontal (trequency) control if neecessary


Figure 23-Horizontal Oscillator W'sureforms
This adjustment is very important for correct operation of
he circuit It the broad peack of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing eflect of the tuned circuit is reduced he broad peak is higher than the sharp peak, the oscillator is overstabilized. the pull-in range becomes inadequate and
the broad peak can cause double triggering of the oscillator when the hold contral approaches the clockwise position ment.
Horizontal Drive Adjustment (for correct locking range)
Turn the horizontal (ireauency) control until the picture falls Turn the horizontal (1requency) control until the picture falls
out of sync with the diagonal lines sloping down to the right Slowily yurn the horizantal control counter-cicchak wis and note
the number of dicgonal bars obtained iust betore the picture the number of
pulls into sync.
pent
With the horizontal control set at the pull-in point, adjus he horizontal drive trimmer Cly counter-clockwise for a bright vertical line in the center of the picture. Turn the
rrimmer clockwise until the line just disappears. Set the brightness control to maximum and adjust the
width control so the picture fills the mask. Return the brightness control to normal and readjust the horizontal drive rimmar as above
The picture should pull into sync with one and one-hai
to three bars present. remain in sync for approximately two oo hree bars present remain in sync tor approximately two
oul turns rounter-clockwise from pull-in, and tall out of sync
with between 2 and 5 bars with between 2 and 5 bars present beiore interrupted oscil.
ation (motorboating) occurs

## VOLTAGE CHART

The following measurements represent two sets of conditions. In the first condition, a 30000 microvolt test pattern signal was fed into the receiver ing the receiver antenna terminals. Voltages shown are read with a type WV97A senior "VoltOhmyst" between the indicated terminal and chas. sis ground and with the receiver operating on 117 volts, 60 cycles, a.c. The symbol < means less than

| $\begin{aligned} & \text { Tube } \\ & \text { No. } \end{aligned}$ | $\begin{aligned} & \text { Tube } \\ & \text { Type } \end{aligned}$ | Function | Operating Condition | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No } \end{aligned}$ | Volts | $\begin{gathered} \text { Pin } \\ \text { No } \end{gathered}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No } \end{aligned}$ | Volts |  |
| $\begin{aligned} & \text { V1 (V2) } \\ & \text { KRK22D } \\ & \text { Kr } \end{aligned}$ | 6BQ7A | $\stackrel{\text { R-F }}{\text { Amplifier }}$ | $\underset{\text { Signai }}{30000 \mathrm{M}} \cdot \mathrm{~V}$ | 6 | 170 | - | - | 8 | 0.1 | 7 |  |  |
|  |  |  | No Signal | 6 | 133 | - | - | 8 | 1.1 | 7 | 0 |  |
|  |  | $\stackrel{\text { R-F }}{\text { Amplifier }}$ | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | 270 | -- | - | 3 | 170 | 2 | - |  |
|  |  |  | No Signal | 1 | 260 | - | - | 3 | 133 | 2 | - |  |
| $\begin{aligned} & \text { V2 (V1) } \\ & \text { KRK22D } \\ & \text { or } \\ & \text { KRK30 } \end{aligned}$ | 6x8 | Mixer | $\underset{\text { Signal }}{3000 \mathrm{Mu} . \mathrm{V} .}$ | 9 | 160 | 8 | 160 | 6 | 0 | 7 | $\begin{array}{r} -2.410 \\ -3.0 \end{array}$ |  |
|  |  |  | No Signal | 9 | 145 | 8 | 145 | 6 | 0 | 7 | $\begin{aligned} & -2.810 \\ & -3.5 \end{aligned}$ |  |
|  |  | $\stackrel{\text { R-F }}{\text { Oscillator }}$ | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$ | 3 | 95 | - | - | 6 | 0 | 2 | $\begin{array}{r} -3.8 \text { to } \\ -5.5 \end{array}$ |  |
|  |  |  | No Signal | 3 | 90 | -- | - | 6 | 0 | 2 | $\begin{aligned} & -3.0 \text { to } \\ & -5.1 \end{aligned}$ |  |
| V101 | 6AU6 | Sound <br> I-F Amp. | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 126 | 6 | 136 | 7 | 1.2 | 1 | 0.2 |  |
|  |  |  | No Signal | 5 | 120 | 6 | 130 | 7 | 1.1 | 1 | 0 |  |
| V102 | 6ALS | Ratio Detector | $\underset{\substack{30000 \mathrm{Mu} \\ \text { Signal } \\ \text { V. }}}{ }$ | 7 | -8.0 | - | -- | 1 | -0.3 | - | - | 7.5 kc deviation at 1000 cycles |
|  |  |  | No Signal | 7 | -2.9 | - | - | 1 | -0.1 | - | - |  |
|  |  | Ratio Detector | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$ | 2 | -0.4 | - | - | 5 | 7.2 | - | - |  |
|  |  |  | No Signal | 2 | -0 | - | - | 5 | 3.2 | - | - |  |
| v103 | 6AV6 | $\begin{aligned} & \text { 1st Audio } \\ & \text { Amplitier } \end{aligned}$ | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$ | 7 | 98 | - | - | 2 | 0 | 1 | -0.8 | At min. vol.ame |
|  |  |  | No Signal | 7 | 96 | - | - | 2 | 0 | 1 | -0.8 | At min. volume |
| v104 | 6AS5 | $\begin{aligned} & \text { Audio } \\ & \text { Output } \end{aligned}$ | $\begin{aligned} & 30000 \mathrm{Mu} . \mathrm{V} . \\ & \text { Signal } \end{aligned}$ | 7 | 250 | 6 | 262 | 1 | 149 | 2\&5 | 141 | At min. volume |
|  |  |  | No Signal | 7 | 240 | 6 | 252 | 1 | 142 | 2\& 5 | 135 | At min. volume |
| v105 | 6CB6 | $\begin{aligned} & \text { lat Pix. I-F } \\ & \text { Amplifier } \end{aligned}$ | $\underset{\text { Signal }}{30000 \mathrm{Mu} . \mathrm{V} .}$ | 5 | 132 | 6 | 144 | 2 | 0 | 1 | -4.7 | -Unreliable |
|  |  |  | No Signal | 5 | 112 | 6 | 123 | 2 | 1.2 | 1 | $\bullet 0.1$ |  |
| V106 | 6Cb6 | 2nd Pix. I-F <br> Amplitier | $\underset{\text { Signal }}{3000 \mathrm{Mu} . \mathrm{V} .}$ | 5 | 250 | 6 | 278 | 2 | 145 | 1 | 129 |  |
|  |  |  | No Signal | 5 | 230 | 6 | 255 | 2 | 136 | 1 | 124 |  |
| v107 | 6Cb6 | 3rd Pix. I-F Amplitier | $\underset{\text { Signal }}{3000 \mathrm{Mu} .}$ | 5 | 130 | 6 | 142 | 2 | 2.3 | 1 | 0 |  |
|  |  |  | No Signal | 5 | 121 | 6 | 136 | 2 | 2.2 | 1 | 0 |  |


| $\begin{gathered} \text { Tube } \\ \text { Tube } \\ \text { No. } \end{gathered}$ | $\begin{aligned} & \text { Tube } \\ & \text { Type } \end{aligned}$ | Function | Operating | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{aligned} & \text { Piut } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volls | $\begin{aligned} & \text { Pin } \begin{array}{l} \text { Pa } \\ \text { No. } \end{array} \text { m } \end{aligned}$ | Volts |  |
| V108A | 6x8 | lat Video Amplifier | $\underset{\text { Signal }}{3000 \mathrm{Mu} . \mathrm{V} .}$ | 9 | 70 | 8 | 118 | 6 | 0.8 | 7 | -1.5 | AGC control set for normal operation |
|  |  |  | No Signal | 9 | 38 | 8 | 102 | 6 | 1.0 | 7 | -0.3 | AGC control set for normal operation |
| v108B | 6x8 | 1st Sync | $\begin{aligned} & 30000 \mathrm{Mu} . \mathrm{V} . \\ & \text { Signal } \end{aligned}$ | 3 | 50 | - | - | 6 | 0.8 | 2 | -34 |  |
|  |  |  | No Signal | 3 | 46 | - | - | 6 | 1.0 | 2 | -4 |  |
| V109A | 12AU7 | $\begin{aligned} & \text { Video } \\ & \text { Output } \end{aligned}$ | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 6 | 235 | - | - | 8 | 4.0 | 7 | -8.5 | Contrast control at maximum |
|  |  |  | No Signal | 6 | 200 | - | - | 8 | 6.8 | 7 | -0.4 |  |
| V109B | 12AU7 | $\begin{array}{\|l\|} \hline \text { AGC } \\ \text { Amplifier } \end{array}$ | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal. } \end{gathered}$ | 1 | -43 | - | - | 3 | 148 | 2 | 112 |  |
|  |  |  | No Signal | 1 | 0.5 | - | - | 3 | 142 | 2 | 98 |  |
| V110A | 12AU7 | Sync Output | $\begin{gathered} 30000 \text { Mu. V. } \\ \text { Signal } \end{gathered}$ | 1 | 65 | - | - | 3 | 8.0 | 2 | 7.4 |  |
|  |  |  | No Signal | 1 | 62 | - | - | 3 | 7.9 | 2 | 7.9 |  |
| V110B | 12AU7 | Vertical Oscillator \& Discharge | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 6 | 180 | - | - | 8 | 0 | 7 | -63 | Depends on setting of Vert. hold contro |
|  |  |  | No Signal | 6 | 175 | -- | - | 8 | 0 | 7 | -61 | Voltages shown are synced piz adjustment |
| v111 | 6K6GT | Vertical Output | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 262 | 4 | 280 | 8 | 0 | 5 | -29 |  |
|  |  |  | No Signal | 3 | 255 | 4 | 273 | 8 | 0 | 5 | -28 |  |
| V112 | 6SN7GT | Horizontal <br> Osc. Control | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 2 | 280 | - | - | 3 | -2.5 | 1 | -23.5 |  |
|  |  |  | No Signal | 2 | 273 | - | - | 3 | -2.3 | 1 | -21 |  |
|  | 6SN7GT | Horizontal Oscillator | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \\ \hline \end{gathered}$ | 5 | 200 | - | - | 6 | 0 | 4 | -75 |  |
|  |  |  | No Signal | 5 | 193 | - | - | 6 | 0 | 4 | -74 |  |
| V113 | 6BQ6GT | Horizontal Output | $\underset{\text { Signal }}{30000 \mathrm{Ma} .}$ | Cap | - | 4 | 164 | 8 | 11.0 | 5 | -21 | *High Voltage Pulse Present |
|  |  |  | No Signal | Cap | - | 4 | 158 | 8 | 10.5 | 5 | -20 | -High Voltage Pulse Present |
| V114 | $\begin{aligned} & \text { 1B3GT } \\ & / 8016 \end{aligned}$ | H. V. <br> Rectifier | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal } \end{gathered}$ | Cap | - | - | - | 2\&7 | 16,000 | - | - | -High Voltage Pulse Present |
|  |  |  | No Signal | Cap | * | - | - | 2\& 7 | 15,400 | - | - | *High Voltage Pulse Present |
| V115 | 6AX4GT | Damper | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal. } \end{gathered}$ | 5 | 280 | - | - | 3 | - | - | - | *High Voltage Pulse Present |
|  |  |  | No Signal | 5 | 273 | - | - | 3 | - | - | - | -High Voltage Pulse Present |
| V116 |  | Kinescope | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | 16,000 | 10 | 465 | 11 | 65 | 2 | 0 | At average Brightness |
|  |  |  | No Signal | Cap | 15,400 | 10 | 450 | 11 | 63 | 2 | 0 | At average Brightness |
| V117 | 5U4G | Rectifier | $\underset{\substack{3000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal }}}{ }$ | 4\&6 | - | - | - | 2\&8 | 290 | - | - |  |
|  |  |  | No Signal | 4\&6 | - | - | - | 2\&8 | 280 | - | - |  |

[^12]


OJohn F. Rider

| $\underset{\text { SYMBOL }}{\text { Not }}$ | (STOCI | deschiption |  | STock | description | $\underset{\substack{\text { SYMBOL } \\ \text { NO. }}}{ }$ | sTock <br> No. | description | $\begin{aligned} & \text { Symbol } \\ & \text { NOB. } \end{aligned}$ | $\begin{aligned} & \text { stocr } \\ & \text { No. } \end{aligned}$ | descripfion |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| R19 R20 | 502033 | Resistor - Fixed, composition, 33 ohms, =10\%, wis Part or Same a: R6 | $\underbrace{\substack{\text { c133 }}}_{\text {C134A, }}$ | 146 | Part of Zl02 or PCl02 <br> Capacitor-Fixed, electrolytic <br> $100 \mathrm{mid} .,-10 \%,+50 \%$, 400 จ. DC | L111 | $\begin{aligned} & 79144 \\ & 76640 \\ & 76676 \end{aligned}$ | $\begin{aligned} & \text { Coil-Width coil } \\ & \text { Rocator-RF., insulated choke, } 1.5 \mathrm{MH} \\ & \text { Choke-Fillor choke } \end{aligned}$ | R166 R167 | $\begin{aligned} & 503447 \\ & 503322 \end{aligned}$ | Resistor-Flxed, composition, 470,000 ohms, $\pm 10 \%$. $1 / 2 \mathrm{w}$ <br> Resistor-Fixed, composition, 22,000 ohms $\pm 10 \%$, $1 / 2 \mathrm{w}$. |
| (820 |  |  |  | 73557 |  | ${ }^{\text {L114 }} 1$ |  | Part of Yo |  | 3219 |  |
| s1 | 79068 | Stator-Ozaillator coil and stator completo wih roior, coils and trimmer (C22, L36 |  | ${ }_{76994}^{7357}$ |  |  | 79534 | 102 or 2102 | R169 | 9 |  |
| s2 | 78272 |  | ${ }^{\text {c137 }}$ | 76476 |  |  | 79960 |  | ${ }^{1} 170$ | 502333 |  |
|  |  | R19), |  | 73995 |  |  | 79160 |  | R1? | 82 |  |
| S3 | 79274 | Stator-RF plate stator comploto with rotor: coils, restions and capacitors (C12, C31) <br> C39, L10 to L32, R6) | C138 c139 | 73595 7392 | Capacilor-Fixed, paper, $0.0022 \mathrm{ml} ., \pm 10 \%$, Con voltz Capacitor-Fixed papar, $0.047 \mathrm{~mL} .410 \%$. | ${ }_{\substack{4121 \\ \text { PCiol } \\ \text { PCion }}}$ | 79161 79142 79929 | Coil-Horizontal sine wave coil Circuil-Printed I.F. sound circuit assembly | $\mathrm{R}_{1} 72$ | 502322 |  |
| S4 | 78277 |  | Cl39 cl40 | ${ }_{3} 73949$ | Capacitor-Fixed, mica, 330 mmf . $\pm 10 \%$, |  | 79479 | Cirruit-Printed I.F. picture circuit astembly Part of PClot |  | 78807 | Same as R166 <br> Control-Vertic |
| ss | 78398 |  | C141 | 73351 | $\begin{gathered}5000 \text { volts } \\ \text { Capacitor-Fixed, paper, } \\ \text {. }\end{gathered} .1 \mathrm{ml}, \pm 20 \%$, | ${ }_{\text {R107 }}$ | 503333 | Reoistor-Fix,od, composition, 33,000 ohms |  | 30562 | Some as R Rlll Resistor-Fixed, |
| ${ }^{1}$ | 78396 | $\underset{\substack{\text { Transtormer-Antenna matching transtormer } \\ \text { complete }}}{\substack{\text { and }}}$ | $\mathrm{Cl}_{142}$ | 73352 | ${ }_{\text {Capacitor-Fixed, paper, }}^{4000} \mathbf{0 . 0 3 3} \mathrm{ml} ., \pm 20 \%$. | R108A, B | 78208 | Control-"On-Off" voiume and piture con |  | 30562 503422 | Resistor-Fixed, composition, 220,000 ohms, |
|  | 79399 79553 | Transtormer-Converter transiormer (R8) Capacitor-Vatiable tuning capacior | C143 | 76474 |  | R109 | 10 |  |  | 503422 |  |
|  | 795s4 | Spator-Osclustor tator assemby | C144 | 58271 | Capacitor-Fixed, mica, 220 mml , $\pm 10 \%$, | R110 | 133 | Rositior-Fixixd, compostion, 3300000 ohms. |  | 504415 | Resisisor-Fifed, composition, 150,000 ohms. |
| $\underset{\substack{\text { C3306 } \\ \text { C30 }}}{\text { cen }}$ | 79595 <br> 79556 | Capacitor-Oscillator trimmer capacitor Capacilor - Adjustable, ceramic, $\quad 0.8-3.5$ | C145 | 79315 | 500 volts <br> Capacitor-Fixed, paper, $0.0033 \mathrm{ml} ., \pm 10 \%$, | R1II | 502482 |  | R180 | 503418 |  |
|  |  |  | C146 | 79019 | Capaciltor-Fixad. papar, 0.0082 ml , | R11 | 502510 | $\xrightarrow{\text { Reaisicor-Fixicod, }} \pm \underline{\text { a }}$ | ${ }^{\text {R181 }}$ | ${ }_{503433}$ | Resesisor--Fixed, compostion, 3300000 ohms. |
|  | 7959 | Capacitor-Feed thru, 1000 mm . | ${ }^{\text {c } 147}$ |  | Same as clid | $R 11$ | 524147 | Resistior - - Fixed, composition, 470 ohm | R182 | 503982 | Resitior-Fixixed, composition, 820,000 ohms. |
| ${ }_{\text {C312, }}^{\text {c313 }}$ | 79560 |  | C148 | ${ }^{7921}$ | Capacitor-Fixed, paper, 0.003 | R114 | 504210 | Reititor-Fixed, comporition, 1000 ohm | R193 | 502415 | Reisisor-Fixed, composition, 150,000 ohms. |
| CR301 | 77999 |  | C149 | 73594 |  | R115 | 30180 | Resistor-Fixixd, composition, 120,000 ohn | ${ }^{\text {R184 }}$ | 502382 | Resistor-F\|xed, composition, 82,000 ohms, |
| ${ }_{\text {L L301. } 2302}^{\text {L302 }}$ |  |  |  | 79317 |  | ${ }^{8116}$ | 3315 | Resistor-Fixed, composition, 15,000 ohms. | ${ }^{\text {R1 }}$ | ${ }^{503239}$ | Resisisor-Fixed, composition, 3900 ohms, |
| 1304 | 79564 |  | C152 | 737 |  | R117 R118 | 333 |  | ${ }^{\text {R196 }}$ | 512410 |  |
|  | 7965 | Choko-RF choke | $\mathrm{Cl}_{15}$ | 73798 |  |  |  |  | R189 | 503347 | Resisior-Fixixed, composition, 47,000 ohms, |
| L308, 2309 |  | Coil-Mixer coupling coil for oacillator and output section | $\mathrm{Cl}_{54}$ | 79016 | Capacitor-Fixed, paper, 0.068 mf ., $\pm 10 \%$, |  | 522415 | Part of 2102 or PC102 | R190 | 503568 | Resisior-Fixed composition, 6.8 mezohm. |
| 12310 1311 | ${ }_{7}^{795656}$ | $\underset{\substack{\text { Coil-I.F. output coil } 0.15 \\ \text { Coil-oacillator loop microhentior }}}{ }$ | C15s | ${ }^{737}$ | ${ }^{\text {Capaccitor-Fixed, paper, } 0.022 ~ m i t . ~} \pm 10 \%$, |  |  | ${ }^{-5 \%}$ | R191 | 513339 | Resisisor-Fixixed. composition, 39,000 ohms. |
| R301 | ${ }_{502222}$ |  | C156 | 79990 |  | ${ }_{\text {R129 }}^{\substack{\text { R12 I } \\ \text { R129 }}}$ | 50239 |  | ${ }^{\text {R192 }}$ | 503482 | Resisitor-Fixed, composition, 820.000 ohms. |
| R302 | 512268 | Rosistar | cis7 |  | Same as ciss | R130 | 503112 | Rosistor-Flixed, composition, 120 ohms |  | 503510 |  |
| R303 | 502268 |  | $\underset{\substack{\text { c158 } \\ \text { C159 }}}{ }$ | 77364 |  | R131 | 18 |  | R19 | 504047 |  |
| cl01 | 76507 |  | ${ }^{\text {c } 160}$ | 39996 |  | R132 | 513312 | Resistor-Fixed, composition, 12,000 ohms |  | 74015 | Resisor-Fixed, wite wound, 100 ohms, |
|  |  | Part of PC101 | C162 | 76475 | Capacior ${ }^{\text {a }}$ | ${ }^{\text {R133 }}$ |  | Part of Lios |  | 523312 |  |
| c109 | 79014 |  |  |  | Same as Clat | ${ }^{\text {R134 }}$ | 524315 |  | R197 | 5034 | Resisisor-Fixed, composition, 270.000 ohms. |
| c109 | 79017 |  | ${ }^{\text {c } 164}$ | 73562 |  | ${ }_{\substack{\text { R135 } \\ \text { R136 }}}^{\text {R }}$ | 503247 | Part of LLI 106 Resistor-fixed. composition, 4700 | R198 | 70351 |  |
| c109 | 73599 | Capacitor-Fixed 600 volts DC (For 600 volt | ${ }_{\substack{c 166 \\ C 167}}$ | 76476 | Same as Cl20 <br> Capacitor-Fixed, mica, $330 \mathrm{mmi}, \pm 5$ | R137 | 47 | $\pm 10 \%$. $1 / 2 \mathrm{w}$. <br> Resistor-Fixed, composition, 470,000 ohms, | ${ }_{\text {R }}^{\text {R201 }}$ R20 to |  | Part of Yoke |
| cı10 | 79316 |  | c168 | 73594 |  | R139 | 503382 | Resistor-Fixed, composition, 82,000 ohms, |  | 504410 | Resistor-Fixed, composition, 100,000 ohms, |
| cıo | 79530 |  | c169 | 59667 |  | ${ }^{2140}$ | 3182 | $\pm 10 \%$, $1 / 2$ w. <br> Resistor-Fixed, composition, 820 ohms, $\pm 10 \%$. $1 / 2 \mathrm{w}$. | si01 <br> T101, | 78211 | Switch-T.V.-Phono-tone switch (For all Part of PCl01 |
| clil | 79014 |  |  |  | Same as cliss |  | 96441 | Resistor - Tixed, composition, 7500 ohms, |  | 7 | Translormer-Audio transformer (For KCs88B, C, I, K only) |
| cıl2 | 47617 |  | ${ }_{\substack{\mathrm{Cl} 171 \\ \mathrm{C} 172}}$ | ${ }_{7}^{76995}$ | $\begin{aligned} & \text { Capacitor-Fixed, paper, } 0.0012 \mathrm{ml} ., \pm 5 \% \text {, } \\ & 600 \text { volta } \end{aligned}$ | (1) $\begin{aligned} & \text { R142 } \\ & \text { R143 } \\ & \mathrm{R144}\end{aligned}$ |  |  |  | 79476 | Translormer-Audio transformor (For KCS- <br> Traniformer-lyit. I.F. grid transtormer |
| cıl | 75643 |  | ${ }_{\text {c173 }}^{\text {c174 }}$ | 73796 | Same as Cliss Capacitor-Fixed, paper, 0.27 mf , $=10 \%$, | R144 | 1347 | Resistor-Fixed composition, 47000 ohms. |  |  | Part of PC102 or 2102 |
| $\mathrm{ClI}_{3}$ | 73599 |  | C17 | 73597 | 200 volts Capacitor-Fixed, paper, $0.047 \mathrm{ml} ., \pm 10 \%$. |  |  |  | cill | 79143 79 79 79 | Transformer-Vertical ou!put transforme Transformer-High voltage transformer Transformer-Power transformer |
| ${ }^{1} 113$ | 79531 |  | C176 | 79022 | 1000 volis Capacitor - Fixed. mica, $270 \mathrm{mml} ., ~$ $20 \%$ |  | 503347 |  |  | 79156 | Circuii-Picture I.F. circuit plate assembly SPEAKER ASSEMBLIES |
| C114 | 79314 | Capacitor-Fixed, ${ }^{\text {ele ctroilytic, }} 100 \mathrm{ml}$. $-10 \%,+100 \% \%$ v. 250 v. DC | c17 | 79532 | 1000 volts <br> Capacitor - Fixed, coramic, 120 mmf ., | (R148 | 78808 | Same ar R107 Control-AGC control Same |  |  | 971636-1W RLIO1CS |
| clis | 79979 |  | c179 | 99318 | $\pm 10 \%$. 3500 v. DC <br> Capacitor-Fixed, paper, $0.39 \mathrm{ml}, \pm 10 \%$. | ${ }_{\substack{\text { R150 } \\ \text { R151 }}}$ | 418 | Same as R107 <br> Resistor-Fixed, composition, 180,000 ohms, |  |  | RMA-274 |
| ${ }_{C}^{C 116}$ | ${ }_{\substack{78220 \\ 7399}}$ | Capacitor-Variable mica, 5-70 trimmer <br> Capacitor-Fixed, paper, $0027 \mathrm{ml} . \pm 10 \%$. |  |  | 200 volts <br> Part of Yoke | R152 | 22 | $\pm 10 \%$, $1 / 2 \mathrm{w}$. |  |  |  |
| сия | 33094 | Capacitor-Fixed, ceramic, 15 mmf ., $\pm 5 \%$. |  |  | 2102 or | ${ }^{\text {R153 }}$ | ${ }^{50333}$ | Reolifor-Fixiod, composition, 39,000 ohms, |  |  | ${ }_{215521}^{215}$ |
| Cl19 | 7293 | 500 v. DC <br> Capacitor $=$ Fixed, ceramic, 470 mml ., $+100 \%$, | C184 <br> C185 | 78622 | Capacitor-Fixed, coramic, 500 $\mathbf{4 7 0} \mathrm{mml}$, $\pm 20 \%$, <br> 500 volts <br> Part of PCl02 | $\begin{aligned} & \text { R154 } \\ & \text { R155 } \end{aligned}$ | 503512 | Same an R147 <br> Resistor - Fixed, composition, 1.2 <br> $\pm 10 \%$. $1 / 2 \mathrm{w}$. |  | 77000 | Speaker-5" P.M. speaker complete with cone and voice coll (3.2 ohms) |
| C120 | 73787 | Capacitior-Fixed, paper, $0.47 \mathrm{mf}, \pm 20 \%$. 200 v. | $\underset{\substack{\text { cR100 } \\ \text { Fliol }}}{\text { ces }}$ | 76675 78214 | Crystal-2nd. detector <br> Fuse- 3 amps., 250 volts | R156 | 503339 | Resistor-Fixed, composition, 390,000 ohms. |  |  |  |
| $\left.\begin{array}{c}\substack{\mathrm{Cl21} \text { to } \\ \mathrm{C} 127 \text { Inc. }}\end{array}\right\}$ |  | Part of 7102 or PC102 Capacitor-Fixed, cer | ${ }_{101}$ | ${ }_{35797}$ | Connector-Phono input connector (For all chassis except KCS - 8 CBC and K ) | $\begin{aligned} & \mathrm{R} 157 \\ & \mathrm{R} 158 \end{aligned}$ | 12 | Same as R107 <br> Resistor - Fixed composition, 1200 |  |  |  |
| $\mathrm{C}_{129}$ | 790 |  | 1102 1102 | 68990 | Plug-Fomale plug lor defliction yoke Trap-lst | R160 | 310 | Restistor-fixed, composition, 10,000 ohn |  |  |  |
| c130 | 390 |  | L103 L104 | 76011 98982 | Coil-Peaking ${ }^{\text {a }}$ 36 UH Coll-Peaking 250 UH | ${ }^{\text {R16 }}$ | 50239 | Retitior - Fixed, composition, 3900 ohms, |  | 74664 | Speaker-8" PM. speaker complete with |
| ${ }^{\text {c }} 131$ |  |  | ${ }^{2} 1105$ | 77674 | Coil-Peaking 250 UH (includes R133) | 162 | 50322 | Resistor-Fixod, composition, 22,000 ohms, |  |  | Note: If stamping on speaker in insitrument |
|  |  |  | 1106 L1107 | ${ }_{7}^{79321}$ |  | ${ }^{\text {R163 }}$ |  | Same as R131 |  |  | does not agiei with above spoaker nump |
|  |  |  | (1108 | $\xrightarrow{71528}$ |  | ${ }_{\substack{\text { R164 } \\ \text { R165 }}}$ | 78210 78906 | Control-Vertical hold contr Control-Height adjustment |  |  | of instrument, number |

PICTURE SIZE 327 square inches on a $24 \mathrm{CP4A}$ Kinescop TELEVISION R-F FREQUENCY RANGE
 Models 24-S.529U, 24-S-531U \& 24-S. 532 U
Any of 70 UHF channels.
Any of 12 VHF channels, 54 mc to 88 mc .174 mc me. to 216 mc me. INTERMEDIATE FREQUENCIES
INTERMEDIATE FREQUENC,
Picture I-F Carrier Frequency.
Sound I-F Cartier Frequency
POWER RATING
aUdio power output rating
VIDEO RESPONSE .
SWEEP DEFLECTION
focus
ANTENNA INPUT IMPEDANCE
Models 24-S. 529 , 24-S.531 \& 24-S.532
Models 24-5.529U 24.S-531U \& 24.S 532 U
UHF- 300 ohms balimeced
VHF- 300 ohms balanced
rCA TUBE COMPLEMENT
Tuner KRK22D (24-S-529, 24-S-531 \& 24-S-532) Function (I) RCA 6BQ7A.......................-F Amplifie RCA TUBE COMPLEMENT
 Tune: KRK30D (or E) RCA $6 \AA$ F4 $\ldots$. (2) RCA 6BQ7A $\ldots \ldots \ldots \ldots,\left\{\begin{array}{l}\text { VHF R-F Amplitier } \\ \text { UHF I-F Amplifier }\end{array}\right.$ (3) RCA $6 \times 8 \ldots \ldots \ldots \ldots\left\{\begin{array}{l}\text { VHF R-F Oscillator \& Mixe } \\ \text { UHF I-F Amplifier }\end{array}\right.$

A K3D or 1 N82 crystal is used as the UHF mixer.
All Models

| All Models |  |
| :---: | :---: |
| (1) RCA 6CF6 ..............1s | 1st Picture I-F Amplitier |
| (2) RCA 6CF6 $\ldots \ldots \ldots \ldots \ldots$ 2nd | 2nd Picture I-F Amplifier |
| (3) RCA 6CB6 $\ldots \ldots \ldots \ldots .3$ | 3rd Picture I-F Amplifier |
| (4) RCA 12AU7.... Picture 2nd Det. | Det. and Horiz. Sync. Sep. |
| (5) RCA 6X8 ......Video Amplitie | plitier and Vert. Sync. Sep. |
| (6) RCA $12 \mathrm{AU7}$ | Video Output \& AGC |
| (7) RCA 6AU6 | st Sound I-F Amplifier |
| (8) RCA 6AU6............. 2 nd | 2nd Sound I-F Amplitier |
| (9) RCA 6AL5 | Ratio Detector |
| (10) RCA GAV6 | 1st Audio Amplitier |
| (11) RCA 6AO5 | Audio Output |
| (12) RCA 12AU7 .... Vert. Osc. and | and Disch. \& Sync. Output |
| (13) RCA 6AQ5 $\ldots \ldots \ldots .$. | Verrical Sweep Output |
| (14) RCA GSNJGT Horizontal Sweep | ep Oscillator and Control |
| (15) RCA $6 C D 66$ | izontal Sweep Output |
| (16) RCA 6AU4GT | Damper |
| (17) RCA 1B3-GT | High Voltage Rectitier |
| (18) RCA $24 \mathrm{CP4A}$ | Kinescope |
| (19) RCA SU4G | Rectitier |
| (20) RCA SY3GT | Rectitier |
| SCANNING | Interlaced, 525 line |
| HORIZONTAL SWEEP FREQUENCY | NCY .........15,750 cps |
| VERTICAL SWEEP FREQUENCY. | ...... 60 cps |

FRAME FREQUENCY (Picture Repetition Rate) ..... 30 cps


ALIGNMENT PROCEDURE
TEST EQUIPMENT.-To properly service the television
chassis of these receivers. it is recommended that the follow.
ing test equipment be available: VHF Sweep Generator meeting the following require ments:
equency Ranges
35 to 90 mc .1 mc . 10.12 mc . sweep width
$17010225 \mathrm{mc}, 12 \mathrm{mc}$. sweep width (b) Ouiput adjustable with at least .1 volt maximum (c) Output constant on all ranges VHF Signal Generator to provide the following trequencies with crystal accuracy:

Intermediate frequencies
4.5 mc., 39.25 mc..
$47.5 \mathrm{mc}.$.
47.
.
.
Output.of these ram 1 volt maximum
VHF Heterodyne Frequency Meter with crystal calibrator
if the signal generator is not crystal controlled. UHF Sweep Generator with a Irequency range of 470 mc
to 890 mc . RCA types 40 A or 41 A or their equivalent. UHF Signal Generator to provide the following frequencies
with crystal accuracy if RCA Type 41 A is used. with crystal accuracy il RCA Ype 41 A is use Cathode Ray Oscilloscope-An oscilloscope with a sen-
sitivity of 5 millivolts per inch is required $A$ suitable presitivily or smillivolits per inch is required. A suitable pre-
ampliier may be employed with oscilloscopes of lesser
sensitivity Electronic Voltmeter--A voltmeter with a 1.5 volt $D C$ scale
is required. RCA Senior "Vottohmyst" or equivalent. is required. RCA Senion "Volthmyst" or equivalent
KRK22D OR KRK30D (OR E) ANTENNA MATCHING KRK22D OR KRK30D (OR E) ANTENNA MATCHING
UNIT ALIGNMENT.-The antenna matching unit is ac curately aligned or the fantery. Adjustrent of this ac
should not be attempted in the customer's home since even should not be altempted in the customer's home since even
slight misalignment may cause serious attenuation of the slight misalignment may cause serious attenuation of the
signal especially on channel 2. The r-f unit is aligned with
a particular antenna matching transtormer in place. .f for a particular antenna matching transformer in place. II for
any reason, $a$ new antenna matching transformer is in-
 The F.M Trap which is mounted in the antenna matching
unit may be adjusted without adversely aftecting the alignunit may be adit.
To align the antenna matching unit disconnect the lead
from the F-M trap L5 (or L53) to the channel selecto from the FM trap L5 (or L53) to the channel selector switch
S1-E (or S4). With a shorl jumper, connect the output of the matching
unit through a 1000 mmf . capacitor to the grid of the second pix i-i amplifier, pin 11 of V107. Replace the cover on the adjustments.
Kemove the first pix i-f amplitier tube V106.
Conne Connect the positive terminal of a bias box to the chassis
Set the potentiometer arm to the junction of R127 and R148, Set the poteniometer to produce approximaely -5.0 volts of
bias at the junction of R127 and R148. Connect an oscilloscope to the junction of R135 and L102
and set the oscilloscope gain to maximum and set th Connect a VHF signal generalor to the antenna input
terminals. Modulate the signal generator $30 \%$ with an audio
sigma signal.
Tune Tune the signal generator to 45.75 mc . and adjust the gen I4 (or L.54) in the antenna matching unit for minimum audio
indication on the oscilloscope. Tune the signal genercator to 41.25 mc . and adjust LI (or
L 57 ) tor minimum audio indication on the oscilloscol L57) lor minimum cuatio indiction on one the oncilloscope.
Remove the jumper from the output of the matching unit. Remove the jumper from the output of the matching uni
Connect a 300 ohm $1 / 2$ watt composition resistor from

Connect an oscilloscope low capacity crystal probe fro
Ls (or L53) to ground. The sensitivity of the oscilloscop should be approximately 0.03 volts per inch. Set the oscillo Connect the VHF sweep generator to the matching uni antenna input terminals. In order to prevent coupling reac
ance from the sweep generator into the matching unit it it ance from the sweep generator into the matching unit, it
advisable employ a resistance pad of the matching unit
terminals. Figure 19 shows three difierent resistane terminals. Figure 19 shows three different resistance pads fo
use with sweep generators with 50 ohm co-ax output, 72 ohm co-ax output or 300 ohm balanced output. Choose the pad to
match the output impedance match the
employed Comnect the signal
Cntenna terminalis.
Set the sweep Set the sweep generator to sweep from 45 mc . to 54 mc
With RCA Type WR5A sweep generators, this may be accomplished by returning channel number 1 to cover this
range. With WR59B sweop generators this may be acchat range. With WR59B sweep generators this may be accom
plished by retuning channel number 2 to cover the range. in making these adjustments on the generator, be sure not to
turn the core too far clockwise so that it becomes lost beyond the core retaining spring.
Adiust L2 (or LIS6) and L3 (or L55) to obtain the response
shown in figure 20. $L 3$ (or L55) is most effective in the position of the shoulder of the curve of 52 mc . and L 22 (or
L56) L561) should be adjusted to give maximum amplitude al 153 mc and above consisient with the specified shape of the response
curve. The adiustments in the macthing unit interact to some extent. Repeat the above procedure until no further adjust-
ments are necessary. Remove the 300 ohm resistor and crystal probe connections.
Restore the connection between L5 (or L53) and S1-E (or S4). Restore the con
Replace V106.
PICTURE I-F TRANSFORMER ADJUSTMENTS.-
Connect the i-f signal generator across the link circuit on
terminals $A$ and $B$ of $T 104$.
Corminals A and Bollohyst" to the junction of R123 and Connect the Volto rmst to the junctio
Turn the AGC control fuly clock 7.5 se
Obtain two 7.5 volt batteries capable Obtain two 7.5 volt batteries capable of withstandin appreciacntiometer across each. Connect the battery positiv terminal of one to the chassis and the potentiometer arm to
the junction of R123 and C142. The second battery will be used loter.
Set the bias to produce approximately -5.0 volt of bias at Che junction of R122 and Cl42. ${ }^{\text {Connect the "Volith hmyst }}$ to the junction of R135 and L 102 and to ground.
Set the VHF signal
quencies and peak the specifited adjustment for maximum indication on the "Voliohmyst." During alignment., reduce
the input signal if necessary in order to produce 30 volts
 of R 123 and Cl 142 .
44.5 mc
44.5 mc
45.5 mc
43.0
Set the VC

T106 and adjust the picture i-f trap for minimum d-c output at
R135. L102. Use suficient signal input oproduce 3.0 volts
of $d$ c. of d-c on the meter when the adjustment is made. 1418
47.25 mc.
Models $24-$ S.
Models 24-S-529U, 24-S-531U and 24-S-532U

Models 24 -S. $529 \mathrm{U}, 24$.S-531U and 24-S.532U
Connect the i-f signal generator across the link circuit o Connect the i.f signal generator across the link circuit on
terminals $A$ and $B$ of $T 104$. Connect the "VoltOhmyst" to the junction of R123 and Turn
 ciable current drain and connect the ends of at 1,000 ohm
potentiometer across it. Connect the battery positive termina po chassis ond the potentioneter arm ort the punction R123 and
C142. Adjust the potentiometer for - 50 volts indication on C142. Adiust the potentiometer for -5.0 volts indication on
the "Volto hmys.." the "Connect the .VoltOhmyst" to the junction of R135 and L102
and to and to ground.
Set the $V H F$
Snd with a thin fiberatsor screwdriver the tollowing the the specified dadies
ment fior maximum indication on the ment for maximum indicretion on the "Voltohmystied In each
nstance the generator should be checked agacint a crystal instance the generator should be checked agcinst a cr
calibrator to insure that the generator is on frequency.


$$
\begin{aligned}
& 44.5 \mathrm{mc} \\
& 45.5 \mathrm{mc} \\
& 43.0 \mathrm{mc}
\end{aligned}
$$

T 108
T 107
T 106
Set the signal generator to the following frequency and
adjust the picture i -f trap for minimum d-c output at iunction
© John F. Rider


 SWEEP ALIGNMENT OF PICTURE I-FModels 21-S.529, 21-S-531 and 21.S.532


 Connect the swoip ground lita to the thep


 Connect a 180 ohm composition reaisitor from pin 5 of V10 10 terninan at of tranc. Connect the oscilloscope diode probe Couple the signal generator liosesely to the diode probe in
ordor to obtrin marrere Adius T1 (top) and 10 (top) for maxim
with 45.75 me. at $75 \%$ of maximum response Set the sweep output to give 0.3 volt pack-to-pack on the
Oscilloscope when making the Ginal touch on the above Adiust C 122 until 42.5 mc. is ot $70 \%$ response with respe
 Disconnect the diode probe, the 180 ohm and two 330 ohm resisiors Connect the oscilloscope to the junction of R135 and L102 Leave the sweep generator connected to the mixer grid tes
point $T$ TP with the shortast leads posibible.

 Retouch T106, T107 add T109 to ablin the eapne show



 Set the channel selector switch to channel 4
 Preset C122 to minimum capacity.
Bdiust the bias box potentiometer to oblain - 5.0 volts of



Couple the signal gene
order to obtan markess.

Set the sweep output to give 0.3 volt peak-t-peak on the
oscilloscope when making the tinal touch on the above ad. usiment.
 Figure 12 .
Disconnect the diode probe, the 180 ohm and two 330 ohm esistors
Connect the oscilloscope to the junction of R135 and L102.
Leave the sweep generator connecied to the mixer grid
 Aliust the output of the sweep generator to obtain 3.0
volts peak-t-0-peak on the oscilloscope.

 Retouch Ti106. T107 and T108 to obtain the response

 mounding the sweop ground lead to the tuneor case


Sot the UHF CHANGEOEER switch to the UHF position
and the UHF UNNNG betwen channols 68 and 69 on
 capacitior in series between test point TP3 and ground with
the
hapacito comnected to
TP3 and the resisitor to ground Co anect the osillocreope diode probe to the junction be tween the rosisisor and adepacitior.
probe in order to obtain markers. Connect the potentioneter rarm of the second bias supply
to the $A G C$ terminal on the tuner and ground the battery positive torminal to the tuner casese Adijust the bias botent omoter to produce - -3.0 volts of bias, as measured by th Set the sweep, generatior to produce 0.3 or less poak-to







 Couple the signal generator loosely to the grid of the firsi

 to correct tor any overal tilt that is essentialy the same on
all
chameld Discomnect the VHF sweep generator and connect the
UHF sweop generator to the antenna terminals. Check on
 overall tith thy hor and Hib ii necessary to correct am Remove
supplies.

## KRE22D TUNER RLIGMMENT








 short circuit the A.
board to ground.
 the tuner unit set the oscillosacope to moximum gexin.
Connect the output of the vif signal generator to the outrut of the mitenna matching unit of the junction of $L 53$
and 24 at the botiom of the $F M$ trap $L 53$. $30 \%$ with $a 400$ cyle sine wine wave. Adjust the signal gener $30 \%$ with a 400 cy cyle s
otor for maximum output
Adiust Cl 19 on top of the tuner, for minimum 400 cycle indication on the oscililscopop. Hi necessary. this adiusumen
can be retouched in the field to to provide additional reiection to one speciic frequency in the it bamd pass. Howeverer, in such cases, care should be taten not to tune $C$
nel 2, thereby reducing sensitivity on co annel 2 Connect the petentiometer orm of on of the bias supplies
to the $A G C$ terminal on the tuner and $q$ ground the batery positer to produce -3.0 volts of bias, as measured by by the
ome "Volto hmyst" of the AGC terminal on the tuane



 macy be done in several ways. The easiest way und the way
which will be tecommended in this procedure will be to use





Turr the $C_{2}$ clickwise until he beat note just bogins 10
change. then turn one full turn in the same clockwise change,
direricon.
Return
Return the fine tuning control to the mechnical center
 wel 13 oscillator treauency as iust indicated in the table on

 oblin the proper treauency on each channel. Then agai
 542 and back to channel 8 and adjust C 3 .

 Connect the signal generator loosely to the antenna terminals.
Sot the
the
.
Sot the sweep generator to cover chamnel 8
Set the oscilloscope to maximum gain and use the mini-
mum input signal which will produce a usabole pattern on
 ection during aignment and produce eonsequent misolign
mant even thougt he response cas seen on the oscilisoscope may look normal

Adiust C7, C10. CIIS and C20 for approximately correce
curve shape, frequency, amd bend width as shown in FigThe correct adiustment of C 20 is indicated by maximum



 3 ponse band width.

 maximum gain ot midpoint of the curve.
sary until the proper tesponse is obtained.
Adjuet the signal generator to the chamnel 13 oscillator
Irequency 257 mc.
Turn the Eine tuning control tully clockwise.
 in the same direction from the original setting, then reset the oscillalor to proper frequency by adiusting C2 to aggi Sin the bec
From the signal generator, insert channel 13 sound and
 Adiure 18 .
Fin
Turn of the sweep emd signal generators
Connect the "Volto hmyst" to the tuner test point TPI. Check the oscillator iniection vollage to be within limits as
previously specilied. Adius it necessary to bring within ange
If it was necessary to readiust C5, turn the oweep and signal generatorors back on and recheck
ienponse. Readiust L43 and L45 in necessary.
Set the receiver chamnel selectors switech to channel 8 and
eadiust C2 for proper oscillator trequency 227 mc Set the sweep generatior and signnal generator to channel 8 . Readiust C 7 . $\mathrm{Cl}, \mathrm{C} 15$ and C 20 tor correct curve shape, frequency and bandwidt


If the initial setting of the oscllalor injection trimmer was
aro ff , it may be necessary to adiust the oscillaior frequency and response on chamnel 8 , adjust the oscilla:or injection on hannel 13 and repeallin racking Turn off the sweep generator and switch the receiver to
 Set the fine tuning control to the center of its mechani
cal range. Adjust LS lor an audible beat. Adjust L44. L46, and L58 fo ator injection voltage at TP1, to insure that it is within the nits specified. Reaa, If CS required adjustment, switch the receiver and the
ignal generator to channel 8 . Readjust $C 7$ for correct curve signal generator to channel 8. Readjust C7 for correct curve
shape and recheck C2 and C3 for proper oscillator fre
quency

Check the response of channels 2 through 6 by switching
the receiver channel switch, sweep generator and marker generator to eache of these channels and observing the ure 18 for typical response curves. It should be found that a these chamnels have the proper response with the markers
above $80 \%$ response If the markers tail to tall within this requirement readjust
L44. L46 and L58 in order to obtain curves within the proper ${ }^{\text {limits. }}$. Switch the channel selector, signal generator and marke
generalor through channels 7 to 13 and observe the curves. relerring to Figure 18 for proper wave shape. Chect the injection voltage at each channel to be within limits
If necessary readiust C 15 , C 7 , or ClO to obtain the prope response.
With the receiver and signal generator on channel 13 ad
just $\mathrm{L42}$ for an audible bear with the signal generalor. Adjust the oscillator to frequency on all channels by switc
ing the receiver and the frequency standard to each chat ing the receiver and he irequency standard to each chan-
nel and adiusting the appropriate oscillator slug to obtaia the cudible beat. It should be possible to adjust the oscillato to oblain the audible beat on each channel. Recheck the
oscillator injection voltage on each chamnel to verify that the voltage is within the specified limita

ERR30D (OR E) TUNER ALIGNMENT
VHF AlIGNMENT-A tuner unit which is operative and of adiustments. For such units, skip the remainder of this paragraph. For units which are completely out of adjustment slugs one turn from tight. Turn T2 slug all the way out. Do no Disconnect the link from terminals "A" and "B" of T104 and
Turn the receiver channel selector switch to channel 2 The 43.5 me. trap is adjusted with zero bias. To insure thal the bias will remain constant, take a clip lead and short cir-
cuit the AGC terminal of the tuner at the terminal board to Connect the oscilloscope to the test point TP2 on top of the
tuner unit. Set the oscilloscope to maximum gain. Connect the output of the VHF signal generator to the
output of the antenna matching unit
C4 at the bottom of the FM trap 15 incion of $L 5$ and Tune the signal generator to 43.5 mc . and modulate it $30 \%$ mith a 400 cycle sine wave. Adjust the signal generator for Adjust C33 on top of the tuner, for minimum 400 cycle ind
ation on the oscilloscope If necessary, this adiustment be retouched in the field to provide additional rejection to on speciic Irequency in the $i$ if band pass. However, in suc
cases, care should be cases, care should be taken not to tune C3
2. thereby reducing sensitivity on channel 2 .
Connect the potentiometer arm of one of the bias supplies
to the $A G C$ terminal on the tuner and ground the ballery positiver to produce -3.0 volts of bias. as measured by the
omet "VoltOhmyst" at the AGC terminal on the tune Preset C22. to read -3.0 volts at the lest point TPI, as
read on the . Votiohmyst." The limits lor oscillator injection voltage are 2 volts minimum and not exceeding a maximum
of 5.5 volts. of 5.5 volts

Adjust C25 for proper oscillator frequency, 227 mc . This
may be done in several ways. The easiest way and the way

Which will be recommended in this procedure will be to use
the signal generator as a heierod yne frequency meler and



 Iorminal onnect she signal henend end or Adius
audibe beat with the signal generator.
Thun bat with the sisnail generator.
Thil the beat out just begins to
change, then tuwn one full turn in the same clockwise change,
direction
Relurn the fine tuning control to the mechanical center of its
range.
 13 oscillator frequency as indicated in the table on page 8 . Then, swith to channol 12 and adiust 160 to obtain poroper
channel 12 oscillator trequency. Continue down to chanel 8 .

 Shitch back to channel
Set the $\mathrm{T2}$ corer for for maximum inductance (core turned
counterclockw ise) Connect the sweep generato through a auilable atienuator,
as shown in fiyure 19 to the input terminals of the anienna
matching Connect the signal generator loosely to the antenna terminals.
Set the sweep generator to cover channel 8 .
Set the orsilloseope to maximum gain and uss the mini--
mum input signal which will produce a usabbe pattern on
 jection during alignemitand produce eonsequent misiolign-
ment even though the response aus seen on the oscilloscope may look normal.
Insert

 curve sh
ure
The
he ure The correct adjustment of CT is indicaled by maximum
Tmplitude of the curve midway between the markers. Cil

 suming that 7 has heen properly adiustod) Clit is the
coupling adiustment and hence primarily aftects the re-

 iust C27. C21, C16 and Clli for proper response. Adiust
C7 for maximum gain at midpoint ot the curve. Repeal it



Adiust L49 to obtrin an ondible beark, Slighty overshoot
the adiustment of L49 by lurring the slug an additional
 resel the oscillator to prop
to gatin obtuin the beat
Set the sween generior
Set the sweep generaior to chamnel 13
From the signal generatior, insert chamnel 13 sound and
picture carrier markers, 211.25 me. and 215.75 mc .
 $\underset{\substack{\text { figure } \\ \text { Turn oft } \\ \text { The }}}{ }$
 Check he oscillator iniection voltage to be within limits
as previously specitid. Ad ust it necessary to bring within

 Set the receiver channel selector swith to channel 8 and
read
 nel 8.
Readi
R
Trequency and band with and Cl tor correct curve shape
Turn oft the sweep and signal genertors, switch back
 response.
II the initial setting of the oscillator injection trimmer was

 several limes betore the proper seting is oblained.
Turn off the sweep generator and swith the tecciver to churn olf the sweep generaor amd aw Adius in teciver to Adiust the signal generator to the channel 6 oscillator
frequency 129 me. froguency get the tine turing control to the center of its mechamical









 above $80 \%$ response
IIt the materit
If the marteringil it fall within this requirement readiust
$L 48$ and $L 32$ in order to obtain curves within the proper limist





 shannel and dadusting the appororiate scillator slug to
obtain the dudible beat. $1 t$ should be possible to adiust the
 check the oscilialoro injection votage on each
verity that the vollage is within the specitiod ilimits.
 the tuner may orly be pertormed with the UHF section re-
moved from the tuner ossemmly. BF adiusments require moved from the tuner assembly. RF adiustments require
temoval of the tuner shield which may only be done with
 out removing the tuner.
Comnect $a l$
Cot
ohm
Connect a 100 ohm composition resistor between the
conter conductor of the $1-\mathrm{F}$ cable W 301 and the tuner cuse. center conductor of the 1-F cable w301 and the tuner case.
 noede ther case
to the tunet
cose
Conect the ouiput of the UHF sweep generator, hrough
a 300 ohm attenuator pad, to the antenna terminals and
 887.5 m . Ad Aust the output of the sweep generator to full
sweep
Aid eiditil made to fot over the split gear on the tuner

 phates stuly meshed With the stop pin on the tuner against
the stop plate on the gear assembly the plates will be in the stop plate on the gear ossen











 and 45. Th makers as shown The inductance mop te tee positioned, if neessary, io bring the oscillator trimmer
within range. Reier to tigure
9 tor location of the aperture Tor making this adiustment
Repeat the above
Repeat the above adiustments, as necessary. until the
proper responses are oblained. Tune through the entite
ramge and chack the tracking. When pertectly tracked the
three markers will be on the top of the response curve



 the nniting tool while observing the reasponse, then proceed
with the kniting of the proper section or of both sections it Connect the "Voliohmysa" betwoen the center conductor of W301 mo ground Sel the "Vollohyysi" to the 1.50 on the meter. A reading between 03 and .35 volis should
 Ontor tube outsid oullowable limits,
Connect the "Voliohmyl" to the "bias" torminal of the
 range will cause crystal currents outside allowable himis
and in such cases the oscillotor tube should be ree and in such casess the oscillator tube should be replaced at ine mimh ond low frequency ends of the band as pre
viously outlined RATIO DETECTOR ALGNMENT- Set the signal gener-
OTor al 4.5 me. and connect it to the first sound i-f grid, pin 1 of V 10
As an allernate source of signal. the RCA WR39B or WR39C
 Set the frequency of the calibrator to 45.75 me . ( pix carrier)
 picked off of 1103 and amplitied through the sound i-f

 the signal ogenertor tor 6 volis on on the volithm yste" when

 d-c on the "Volt ohmysti" Repeat adiustments of T102 top for maximum d-c ot pin 2 of
 Cling. Make the inal adiusiments with the signd input level
adiusted to produce 6 volts $d-c$ on the
Voltohmyst


 calibrator maty be employed as above or Connect to to
Tunecthe Till top core for maximum d-c on the "VoltOhmys."'
The out
 4.5 MC. TRAP ADVSTMENT.-Connect the signal gener-
ator in in eeries with a 100 ohm resistor to pin 2 of VIV9. Set the generator 104.5 mc . and modulate it $30 \%$ with 40 cycles. Set the output to approximately. .0. volt. Short the third pixixit grid to ground. pin 1 . v108, to prevent
 Connect the crystal diodo probe of am oscilloscope to the plate of the video amplifere, pin 9 of V110.
Adiust the core of $L 104$ ior minimum output on the oscilloScope.
Remove the short from pin 1. . V108
As on alte gronound.
 Pon the oir
oit ater the alignment is completed. It this is done, tune in a station and observe the picture on he tinescope. II no 4.5 me. beat is present in the piciure, when
 turn the fine tuning control slighty lockwise so as to ex
geatate the beet and then adiust tilo tor minimum beat. AGC CONTROL ADPUSTMENT.-Disconnect all test equipment excepp
pin 9 or Vllo.
and Connect an antenna to the receiver antenna terminals.
Turn the $A G C$ control fully counter-clockwise. Turn the AGC control fully counter-clock wise
Tune in a a strong signal mod adiust the oscilloscope to see
The video wavelormitrol clockwise until the tips of sync begin
Turn the $A$ CC contrel

horizontal oscilator adustment. - Normally

 form adiustment is made ot the factory and normally should noi require readiustment in the tield Howevert.the waveitorai
 mproper
Horizonal Frequoncy $A$ diustment- Tune in a station and
sync the picture. Hit he picture cannol be synchronized with

 wavetorm djuatment core (under the chastis) out oi the eol zeveral turns from itio original position and readius
Examine the width and linearity of the picicure. II picture
width or linearity is incorrect.
dijus the the horizontal drive
 control unil the ticture is cortect.
Lill
Horizantal Oscillator Wovetorm Adiustment-The hori
zontal oscillaror wavelorm may be adiusted by bither oo
 may bo employed ine ie when of scilloscope is no

Ploce -Tarn the hotizontal hold control completely clock wise To make simullaneous adiustments while walching the picture
on the scre
 diagonal tlack bars sloping down to the right appear on the chassis) into the coil while oft the samme tore dunder the
 lator becins to motorboinuen turn the wavetorm adiusmest
 reverse the direction of totaion of the core unili he picturt
 right. Conitinue to turn the trequency core in the same direc

 B-Connect the low capacity probe of an ascillosope to
terminal $C$ of
Til4. Turn the horizontal
hold cold control one quarter turn from the clockwise poition so that the pieture
 Until the two peaks are at the same height. During this ad-
iubsmet. the picture must be kept in $y$ ync by teadiusting the
ible iustment the piticue mus
hold control if necessary:
This adiustment is very important for correct operation of
the circuit Il the broad peak of the wave on the oscilloscope the circuit it ithe broad peak of the wave on the oscilloscope poorar. the stabilizing effect of the tuned cirituitit is reduce
and drit of the ossill and dintot the oscilioior beomes. more serious. On the othe
 quate and the broad paak can cause double triggering of the
oscillator when the hold control approaches the elockwise position
Remo
Remove the oscilloscope upon completion of this adjust
Horizontal Locking Range Adiustment-Set the horizantal
hold control to the full counte.alockwise hhold ontriol too the full counter.click kwise position. Momen
tarily remove the signal by swilching off channel then back
 quency cort slighly and momeniarily swith oft channel
 hold control clockwise and note the least number of
baars obtained just beiore the picture pulls into syn
${ }^{11}$ more than 3 bars are present iust betore the picture pulls into sync, adiust the horizontal locking ranget timmer Cili4A
slighty clockwise. 1 il less than 2 bars are preasent adius slighly clockwise. In erss than Curr ore prosent adius control counter-clockwise, momentarily remove the signal and
recheck the number of bats
present at at the pullin point recheck the number of bars present at the pull-in po Turr the horizontal hold control to the maximum clock wise
position Adius the 114 frequency core so that the diagonal




John F. Rider

## VOLTAGE CHART

The following measurements represent two sets of conditions. In the first condition, a 15000 microvolt lest pattern signal was led into the receiver the picture synced and the AGC control properly adjusted. The second condition was obtained by removing the antenna leads and short circuit ing the receiver antenna terminals. Voltages shown are read with a type WV97A senior "VoltOhmyst" between the indicated terminal and chas sis ground and with the receiver operating on 117 volts, 60 cycles, di-c. The symbol < means less than.

| $\begin{aligned} & \text { Tube } \\ & \text { No. } \end{aligned}$ | $\begin{aligned} & \text { Tube } \\ & \text { Type } \end{aligned}$ | Function | OperatingCondition | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Volts |  |
| V1 (V2) <br> KRK22D <br> or <br> KRK30D <br> (or E ) | 6BQ7A | $\stackrel{\text { R-F }}{\text { Amplifier }}$ | $\underset{\substack{15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal }}}{ }$ | 6 | 170 | - |  | 8 | 0.1 | 7 |  |  |
|  |  |  | No Signal | 6 | 133 | - | - | 8 | 1.1 | 7 | 0 |  |
|  |  | $\begin{aligned} & \hline \text { R-F } \\ & \text { Amplifier } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal }}}{ }$ | 1 | 270 | - | - | 3 | 170 | 2 | $\sim$ |  |
|  |  |  | No Signal | 1 | 260 | - | - | 3 | 133 | 2 |  |  |
| V2 (v1) <br> KRK22D <br> or <br> KRK30D <br> (or E) | 6X8 | Mixer | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 9 | 160 | 8 | 160 | 6 | 0 | 7 | $\begin{gathered} -2.4 \text { to } \\ -3.0 \end{gathered}$ |  |
|  |  |  | No Signal | 9 | 145 | 8 | 145 | 6 | 0 | 7 | $\begin{gathered} -2.8 \mathrm{to} 0 \\ -3.5 \end{gathered}$ |  |
|  |  | $\begin{aligned} & \text { R-F } \\ & \text { Oscillator } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal }}}{ }$ | 3 | 95 | - | - | 6 | 0 | 2 | $\begin{gathered} \hline-3.8 \text { to } \\ -5.5 \\ \hline \end{gathered}$ |  |
|  |  |  | No Signal | 3 | 90 | - | - | 6 | 0 | 2 | $\begin{aligned} & -3.010 \\ & -5.10 \end{aligned}$ |  |
| V101 | 6AU6 | ${ }^{1 \text { st Sound }}$ I-F Amp. | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 122 | 6 | 138 | 7 | 1.01 | 1 | 0 |  |
|  |  |  | No Signal | 5 | 113 | 6 | 126 | 7 | . 95 | 1 | 0 |  |
| v102 | 6AU6 | 2nd Sound I-F Amp. | $\underset{\substack{15000 \mathrm{Mu} \\ \text { Signal }}}{\mathrm{V}}$ | 5 | 210 | 6 | 130 | 7 | 0 | 1 | -2.05 | *Unreliable measuring point Voltage depends |
|  |  |  | No Signal | 5 | 205 | 6 | 122 | 7 | . 0 | 1 | *-1.12 |  |
| v103 | 6AL5 | Ratio Detector | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 7 | 1.7 | - | $\cdots$ | 1 | 21 | -- | - | 7.5 kc deviation at 1000 cycles |
|  |  |  | No Signal | 7 | 4.1 | - | - | 1 | 11.8 | -- | - |  |
|  |  | Ratio Detector | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 2 | 1.7 | - | - | 5 | 21 | - | - |  |
|  |  |  | No Signal | 2 | 4.1 | - | - | 5 | 11.8 | - | - |  |
| V104 | 6AV6 | 1st Audio Amplifier | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 7 | 78 | - | -- | 2 | 0 | 1 | -. 7 | At min. volume |
|  |  |  | No Signal | 7 | 26 | - | - | 2 | 0 | 1 | -. 65 | At min. volume |
| v105 | 6AQ5 | Audio Output | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 205 | 6 | 220 | 2 | 15.2 | 1.7 | 0 | At min. volume |
|  |  |  | No Signal | 5 | 198 | 6 | 207 | 2 | 14.5 | 1.7 | 0 | At min. volume |
| V106 | 6CF6 | lst Pix. I-F Amplifier | $\underset{\substack{15000 \text { Mu. V. } \\ \text { Signal }}}{ }$ | 5 | 218 | 6 | 240 | 2 | 132 | 1 | -8.2 | *Unreliable measuring point. |
|  |  |  | No Signal | 5 | 95.5 | 6 | 105 | 2 | 1.18 | 1 | * <0.1 | - B. |
| v107 | 6CF6 | 2nd Pix. I-F Amplifie | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 222 | 6 | 243 | 2 | $<0.1$ | 1 | -8.45 |  |
|  |  |  | No Signal | 5 | 95.5 | 6 | 105 | 2 | 0.53 | 1 | <0.1 |  |
| V108 | 6CB6 | 3rd Pix. I-F Amplifier | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 5 | 138 | 6 | 150 | 2 | 2.3 | 1 | 0 |  |
|  |  |  | No Signal | 5 | 130 | 6 | 143 | 2 | 2.2 | 1 | <0.1 |  |
| v109A | 12AU7 | Picture <br> 2nd Det. | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 1 | -25.8 | - | -- | 3 | 0 | 2 | -1.85 |  |
|  |  |  | No Signal | 1 | -14 | - | -- | 3 | 0 | 2 | -. 6 |  |


| $\begin{aligned} & \text { Tube } \\ & \text { No. } \end{aligned}$ | $\begin{aligned} & \text { Tube } \\ & \text { Type } \end{aligned}$ | Function | Operating Condition | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{aligned} & \text { Pin } \\ & \text { No. } \end{aligned}$ | Voits | $\underset{\text { Pin }}{\text { Pin }}$ | Volts | $\begin{aligned} & P_{1 n}, \\ & \text { No } \end{aligned}$ | Volts | $\begin{aligned} & \text { Pinn } \\ & \text { No. } \end{aligned}$ | Voits |  |
| V109B | 12AU7 | Horiz. Sync Separator | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 6 | 260 | - | = | 8 | 160 | 7 | 122 |  |
|  |  |  | No Signal | 6 | 253 | - | $\cdots$ | 8 | 105 | 7 | 94.5 |  |
| viloA | 6X8 | Video Amplifier |  | 9 | 120 | 8 | 147 | 6 | . 9 | 7 | -1.85 | AGC control set for normal operation |
|  |  |  | No Signal | 9 | 95 | 8 | 138 | 6 | 1.35 | 7 | -. 6 | AGC control set for normal operation |
| v110B | 6x8 | Vert. SyncSeparator | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 3 | 79 | - | - | 6 | . 90 | 2 | -26.8 |  |
|  |  |  | No Signal | 3 | 46.5 | - | - | 6 | 1.35 | 2 | -2.1 |  |
| villa | 12AU7 | $\begin{array}{\|l\|} \hline \text { Video } \\ \text { Output } \end{array}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 6 | 231 | - | - | 8 | 13 | 7 | 0 |  |
|  |  |  | No Signal | 6 | 225 | -- | - | 8 | 12.5 | 7 | 0 |  |
| v111B | 12AU7 | $\begin{array}{\|l\|} \hline \text { AGC } \\ \text { Amplifier } \end{array}$ | $\underset{\substack{15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal }}}{\text {. }}$ | 1 | -55 | - | = | 3 | 135 | 2 | 125 |  |
|  |  |  | No Signal | 1 | 0.3 | - | - | 3 | 132 | 2 | 68 |  |
| V112A | 12AU7 | $\begin{aligned} & \text { Sync } \\ & \text { Output } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu} . \mathrm{V} \\ \text { Signal }}}{ }$ | 1 | 83 | - | -- | 3 | 0 | 2 | -3.28 |  |
|  |  |  | No Signal | 1 | 84 | -- | - | 3 | 0 | 2 | -1.3 |  |
| V112B | 12AU7 | Vertical Oscillator \& Discharge | $\begin{gathered} 15000 \text { Mu. V. } \\ \text { Signal } \end{gathered}$ | 6 | 80 | - |  | 8 | 0 | 7 | -63.5 | Depends on setting of Vert. hold control |
|  |  |  | No Signal | 6 | 182 | - |  | 8 | 0 | 7 | -60 | Voltages shown are synced pix adjustment |
| V113 | 6AO5 | Vertical Output | $\begin{gathered} 15000 \mathrm{Mu} \mathrm{~V} \text { V. } \mathrm{Signal} \end{gathered}$ | 5 | 253 | 6 | 262 | 2 | 0 | 1.7 | -28.8 |  |
|  |  |  | No Signal | 5 | 245 | 6 | 253 | 2 | 0 | 1.7 | -27.5 |  |
| V114 | 6SN7GT | Horizontal Osc. Control | $\underset{\text { Signal }}{15000 \mathrm{Mu} . \mathrm{V} .}$ | 2 | 175 | - | - | 3 | -3.5 | 1 | -21 |  |
|  |  |  | No Signal | 2 | 170 |  | - | 3 | -5.5 | 1 | -17.5 |  |
|  | 6SN7GT | $\begin{aligned} & \text { Horizontal } \\ & \text { Oscillator } \end{aligned}$ | $\underset{\substack{15000 \mathrm{Mu} \text { Signal }}}{\mathrm{V} .}$ | 5 | 183 | - | -- | 6 | 0 | 4 | -67 |  |
|  |  |  | No Signal | 5 | 179 | - | - | 6 | 0 | 4 | -65 |  |
| V115 | 6CD6G | $\begin{aligned} & \text { Horizontal } \\ & \text { Output } \end{aligned}$ | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | . | 8 | 193 | 3 | 22 | 5 | -14 | - High Voltage Pulse Present |
|  |  |  | No Signal | Cap | * | 8 | 185 | 3 | 20.5 | 5 | -13.5 | *High Voltage Pulse Present |
| V116 | $\begin{aligned} & \text { 1B3GT } \\ & 8016 \end{aligned}$ |  | $\begin{gathered} 15000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | * | - | - | $2 \& 7$ | 18,700 | - | - | *High Voltage Pulse Present |
|  |  |  | No Signal | Cap | * | - | -- | $2 \& 7$ | 18,350 | - | - | *High Voltage |
| V117 | 6AU4GT | Damper | $\begin{gathered} 15000 \text { Mu. V. } \\ \text { Signal } \end{gathered}$ | 5 | 261 | - | - | 3 | * | $\cdots$ | - | *High Voltage Pulse Present |
|  |  |  | No Signal | 5 | 253 | = | $\cdots$ | 3 | * | - | -- | *High Voltage Pulse Present |
| V118 | 24CP4A | Kinescope | $\underset{\substack{1500 \mathrm{Mu} . \mathrm{V} \\ \text { Signal }}}{ }$ | Cap | 18,700 | 10 | 428 | 11 | 44.5 | 2 | 0 | At average Brightness |
|  |  |  | No Signal | Cap | 18,350 | 10 | 425 | 11 | 39.5 | 2 | 0 | $\begin{gathered} \text { At average } \\ \text { Brightness } \end{gathered}$ |
| $\begin{aligned} & \text { V119 } \\ & \text { v120 } \end{aligned}$ | $\begin{aligned} & 5 U 4 \mathrm{G} \\ & 5 \mathrm{SY} 3 \mathrm{GT} \end{aligned}$ | Rectifiers | $\begin{gathered} 15000 \mathrm{Mu} \text { V. } \\ \text { Signal } \end{gathered}$ | $4 \& 6$ | - | - | - | 2\&8 | 277 | - | - |  |
|  |  |  | No Signal | 4\&6 | - | - | - | 2 \& 8 | 271 | - | - |  |



OJohn F. Rider


CHASSIS KCS84F, $84 \mathrm{H}, 84 \mathrm{~J}, 84 \mathrm{~K}$

| $\underset{\text { SYM }}{\text { St }}$ | STOCX | deschiption | symbol <br> No. | Stioct | description |  | cick | description |  | $\underset{\substack{\text { stock } \\ \text { No. }}}{ }$ | description |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | 220 |  | Same as R6 | R114 |  |  | $\mathrm{R}_{2175}$ |  | Same as R152 |
| C157 $\substack{\text { ciss } \\ \mathrm{Clss}}$ |  | Same as cis | ${ }_{\text {R1 }}^{\text {R21 }}$ | 78396 | Same as R2 <br> Tranaformer-Antenna matching transformer | R114 | $\begin{aligned} & 502477 \\ & 502433 \end{aligned}$ | Resistor-Fixed, composition, 470,000 ohms, $\pm 20 \%, 1 / 2 \mathrm{w}$ <br> Resistor-Fixed composition 330,000 ohms, | R176 |  | Resistor-Fixed, composition, 22,000 ohms, $\pm 10 \%$, $1 / 2 \mathrm{w}$ |
| C159 |  | Catacilior-Fixed, paper, $0.0039 \mathrm{ml} ., \pm 5 \%$, |  | 78399 | Tranatiotmer-Converior transiormer (R8) |  |  | $\pm 20 \%$, $1 / 2$ w. |  | 502315 | Resistor-Fixed, composition, 15,000 ohms, $\pm 5 \%, 1 / 2 w$ |
| 016 | 735 | Cagacitior-Fixed, paper, $0.01 \mathrm{mf}. \pm 10 \%$, |  | 79 9ss | Capacitor-Variable tuning capacitor | R115 | 512156 |  | R178 | 502439 | Resisitor-Fiixed, composition, 390,000 ohms, $\pm 10 \%$, $1 / 2 \mathrm{w}$, |
| ${ }_{\text {Clib2 }}^{\text {C162 }}$ | 73592 |  | C304, C305 C306 | $\xrightarrow{79554} 7$ | Stator-Os-illator stator asembly Capacitor-O scillator trimmer capacior | R118 | 502210 |  | R179 | 502312 | Resisisor-Fiixed, composition, 12,000 ohms, $\pm 10 \%$, $1 / 2 \mathrm{w}$, |
| C163 | 73797 | Capacitor-Fixed, paper, 0.015 min , $\pm 10 \%$, | C307 | 79556 | Capacitor mmf. | R119 | 502515 |  | R180 | 232 | $\xrightarrow{\text { Resisitor-Fixed, }} \pm 55 \%$ composition, 22,000 ohms |
| $\mathrm{Cl}_{164}$ | 73798 | Capacitor-Fixed, paper, $0.022 \mathrm{ml}, \pm 20 \%$, | ${ }_{C}^{C 308} \mathrm{C} 39 \mathrm{~g}$ to | ${ }_{79555} 7$ | Capacitor-Trimmer, 10.50 mm | R120 | 502418 | $\pm 5 \%$, $1 / 2 \mathrm{w}$. <br> Resistor-Fixed, composition, 180,000 oh | ${ }^{\text {R181 }}$ | ${ }^{502333}$ |  |
| ${ }^{1} 166$ | 29016 | ${ }_{\text {a }}^{\text {a }}$ |  | ${ }_{7}^{7956}$ |  | R121 | ${ }_{77671}$ | ( 5 | 1182 | 50247 | Resfistor- Fixixed, composition, 470,000 ohms, $\pm 10 \%$. $1 / 2$ |
| ${ }^{C 167}$ | 75345 |  | CR301 | 7789 |  | ${ }_{\text {R122 }}$ | 502315 |  | ${ }_{\substack{\text { R183, } \\ \text { R183, R185 }}}$ | 78807 <br> 50239 | Control-Vertical Linearliy Control <br> Resistor-Fixed, composition, 390,000 ohms, |
| ${ }^{168}$ | 73592 | Capacitor-Fixed, paper, 0.047 mi mi, $\pm 20 \%$. | $\mathrm{L} 301, \mathrm{~L} 302$ | 79557 | Coil-RF tank plate | ${ }_{\substack{\text { R123 } \\ \text { R124 }}}$ |  |  | ${ }^{\text {R186 }}$ | 502622 |  |
| ${ }_{\substack{C 169 \\ \mathrm{C} 170}}$ |  | Same as as clis Same as clit |  | 79564 |  |  | 502515 | Resisor-Fixixd, composition. | ${ }^{\text {R187 }}$ | 50410 |  |
| ${ }_{C} 173$ |  | Same as Cl146 |  | 79565 |  | 8126 |  | Resistor - Fixed composition, 68 ohm | R188 | 502233 | Roaisitor-Efixad, composition, 3300 |
| ${ }_{\text {C17\% }}^{\text {cine }}$ | ${ }_{79063}^{7527}$ |  |  |  | Coil-Mixer coupling coil for oscillator and | ${ }^{\text {R126 }}$ | 502356 |  | R189 | 50231 | Resistor-Fixed, composition, 15,000 otme |
| ${ }^{\text {c } 177}$ |  |  | ${ }^{2} 310$ | ${ }_{7}^{79567}$ | Coill-. F. output coil 0.15 microhenries | ${ }_{\text {R128 }}$ | 502033 |  | R190 | 504115 | $\xrightarrow[\substack{\text { a }}]{\text { Resisior-Fixad }}$ |
| ${ }^{\text {c178 }}$ | ${ }^{73553}$ |  | ${ }_{\text {R3301 }}^{\text {L331 }}$ | ${ }^{795666}$ 502222 | Coil-Oscillator loop cail <br> Resistor-Fixed, composition, 2200 ohms, | 8129 |  | Same as R103 | ${ }^{\text {R191 }}$ | 2433 |  |
| C179 | 73562 |  | ${ }^{\text {R3C }}$ | 512 | Reistor Fixed, composition. 6800 ohms. | ${ }_{\text {R131 }}^{\text {R130 }}$ | 502118 |  | R192 | 502882 | Reeisior -1 Fixad, compostion, 820,000 ohms, |
| ${ }_{\substack{\text { c180 }}}^{\text {C181 }}$ | 76476 | Capacitor-Fixed, mica, 330 mml . $\pm 5 \%$, | ${ }^{\text {R303 }}$ | 502268 |  | R132 | 502539 |  | ${ }^{\text {R193 }}$ | ${ }^{502433}$ |  |
| $\mathrm{Cl}_{182}$ | 73594 |  | ${ }^{1} 186$ | 73557 |  | R133 | 50214 |  | R194 | 52382 | Resitior -Fixed, composition, 82,000 ohm |
| ${ }^{18183}$ |  | Same as Clis8. | $\mathrm{C}_{187}$ | 73786 |  | R134 | 502347 |  | R195 | 502410 |  |
|  | ${ }^{649}$ |  | $\mathrm{Cl}^{188, \mathrm{C} 189}$ | 73997 |  | R135 | 502339 |  | R196 R198 | 77639 <br> 50239 | Control-Horizontal Mold Control <br> Resistor-Fixed, composition, 39un ohms |
| C185 | 75249 | Capacilot-Fixeod. paper, $0.001 \mathrm{ml}. \pm 5 \%$. | C190 | 79022 | Capacitor-Fixed, mica, $270 \mathrm{mmf} ., \pm 20 \%$. 1000 $\mathrm{v} . \mathrm{DC}$ | R136 | 502112 |  | R199 | 415 | $\pm 10 \%$, $1 / 2 \mathrm{w}$. <br> Reslstor-Fixed, comporition, 150,0C0 ohms, |
|  | ${ }^{78466}$ | Part of Antenna matching transformer Coil-RF choke | $\begin{aligned} c_{19} \\ 19 \end{aligned}$ | 9018 | Part of Yoke <br> Capacitor-Fixed, mica. $0.0039 \mathrm{mf} ., \pm 10 \%$ | $\begin{gathered} \mathrm{R} 137 \\ \mathrm{R} 13 \end{gathered}$ |  |  | ${ }^{\text {2200 }}$ | 502315 |  |
| L7 | $\xrightarrow{78562}$ 77899 |  |  |  |  | R139 | 522318 |  | R201 | 512518 |  |
|  | 79942 | Coil-I.F. input coil complete with adjustable core | $\underset{\text { cise }}{\substack{\text { C197 } \\ \text { cincl. }}}$ | 75643 | Capacitor-Fixed, paper, 0.001 mf ., $\pm 10 \%$, | R140 | 50256 | Rexistor-Fixed, composition, 5600 ohms $\pm 10 \%$, $/ 2 \mathrm{w}$ |  | 512347 | Resistor-Fixed, composition. 47.000 ohma $\pm 5 \%$, 1 w . |
|  | 73458 | (Part of S3, and SS) <br> Coil-Channel No. 6 RF grid coil (Part of | C199 | 73960 | Capacitor-Fixed, ceramic, 1000 mmi ., 500 v. DC | ${ }_{\text {R142 }}^{\text {R142 }}$ | 52275 |  | R203 R204 | 2510 | Same as R192 <br> Resistor-Fixed, composition, 1 megohm |
|  |  |  | ${ }_{101}^{101}$ | ${ }_{\text {7 }}^{78989}$ | Fuse- 0.45 cmp Connector-Phono input connector | R144 | 502118 |  | R205 | 50247 |  |
|  | 77921 | (Part of S3 and S5) <br> Coil-Channel No. 13 RF plate coil (Part of S 3 and S 5 ) |  | 68590 73477 | connector-Deflection Yoke connector, contact. Lemale chate coil | R145 R146 | $\begin{aligned} & 78209 \\ & 582127 \end{aligned}$ | Control-Brightness control <br> Resistor - Fixed, composition, 270 ohms. |  | 27 | $\pm 20 \%, 1 / 2 \mathrm{w}$ <br> Resistor-Fixed, wire wound, 47 ohma, <br> $\pm 10 \%$, 2 w |
|  |  | (Part of 53 and S5) | ${ }^{12102}$ | $\underset{\substack{75253 \\ 98482}}{ }$ | Coill Patkining cili, 120 UH Coil-Packing coil, 250 UH | ${ }_{\text {R14 }}^{\text {R14 }}$ |  |  |  | 52327 | Reoiitor - Fixed, composillon, 27.000 ohms, $\pm 100 \%$ $\pm 10 \%$, 2 w . |
|  | 28584 | Coil-RF plate 1.F. coil (Part of S3) (Part of ${ }^{\text {S and }}$ Ss) | L103 L104 L105 | ¢ |  | R148 R149 | 502333 502415 | Resistor-Fixed, $\pm 5 \%, 1 / 2 \mathrm{w}$. <br> Resistor-Fixed, composition, 150,000 ohms | R208 R209 | 502356 | Same aa Rl61 <br> Resistor-Fixed, composition, 56.000 ohms, |
| ${ }_{\text {L32 }}$ | ${ }^{2366}$ | ${ }_{\text {Coil }}$ | L105 L106 Lio | $\underset{\substack{78222 \\ 7252}}{ }$ | Coill-Pataking coill, 250 UH Coil-Paking coil 500 UH | R150 | 2347 | ${ }_{\text {coser }}^{ \pm 5 \% \%}$ | ${ }^{2} 210$ | 78795 | (eatisor-Fixwd, wire wound. 1.2 ohms, |
| ${ }^{133}$ | 77206 | Coill Filament choke coil | L108 | 71529 | Coil-Peaking coil, 120 UH | R151 | 502439 | Resisior-fixed, composit | ${ }_{\text {R }}^{\text {R211 }}$ R20 |  | (Part of Yoke) |
|  | ${ }_{7}^{77919}$ | Coil-Heater choke coil Coil-Chaneil No. 13 mixer coil | 1109 1110 | $\underset{\substack{7645 \\ 7640}}{7}$ | Coil-widh coil Choke - RF choke, ches | R152 | 50247 | Reasisor-Eixed. composition, 470,000 ohm | R214 | 502410 |  |
|  |  | (Part of S 1 and S 2 ) | 1211 1112 | ${ }_{73477}^{7642}$ | Coil-Horizontal linearity coil Choke-Filament choke |  |  |  | R215 R216 |  | (Part of Li11, |
|  | 77883 | Coill-Mixer I.F. coil (Part of S1 and s 2 ) |  |  |  | R154 R155 | 78908 |  | ${ }_{\text {R217 }}$ |  | Same as |
| $\underbrace{\substack{\text { L4, } \\ \text { Lincl. } \\ \text { Lid }}}_{\text {L48 }}\}$ | 73874 | (Part of S1 and S2) <br> Coi'-Channel No. 6 mixer coil (Part | lill | ${ }_{\substack{77776 \\ 7824}}^{7}$ | Choke-Filiter choke Coill-lst $1 . \mathrm{F}$ grid trap | R115 R156 | 50246 | Resistor-Fixed, $\pm 10 \%, 1 / 2 \mathrm{w}$. <br> Resistor-Fixed, composition, 680,000 ohm | S101 T101 T102 | 78211 <br> 77981 <br> 7711 <br> 10 | Swith-TV, Phono and Tone Swith |
| 149 | 77915 | S1 and 52) <br> Coil-Channel No. 13 oscillator coil (Pa | 1119 |  | Same as LiL | R157 | 502310 | $\xrightarrow{ \pm 10 \% \%, 1 / 2, ~}$ | T102 T103 | ${ }_{7}^{77112} 7$ | Trannormor-Ratio Det. 1 trantiormer Transiormer-Audio output transiormer |
|  |  | (Par | PC101 | ${ }^{7643}$ | C yoke | R158 |  | Same as R140 |  | 7883 | Transiormer-lat l.F. Grid tranalormer |
| ${ }_{\text {Licl }}^{\text {Leo }}$ |  | Coil-Channel No. 6 antenna | PCIO |  |  | ${ }_{\text {R160 }}^{\text {R159 }}$ |  | Same ar Riss | T108 Incl. $\}$ | 78809 | ${ }_{\text {(Part of PC101) }}^{\text {Transiormer-Vertical output trans }}$ |
| ${ }^{\text {R1 }}$ | ${ }^{502268}$ |  | R101 | 502882 |  |  |  |  | T113 T114 | 78805 <br> 7640 | Trantiormer-Power transiomer |
| R2 | 502112 |  | R102 R103 |  | (Part of Tl 101 ) | ${ }_{1} 162$ |  |  | T115 | cincio |  |
| ${ }_{\text {R3 }}^{\text {R4, RS }}$ | 502410 | Resistor-Fixed, (omposition, 1000000 ohms, | R103 | 5022 |  | R163 |  | Nestion, |  |  |  |
| ${ }_{\text {R4, RS }}{ }_{\text {R6 }}$ | 502510 502210 |  | R10s | 5122 | Resisitor $\pm 20 \%$, 2 |  |  | (ex |  |  |  |
| ${ }^{\text {R6 }}$ | 502210 |  | R10 |  | , | ${ }^{165}$ | 12 | Reitisor-Fixed. composition, 1.2 megohms |  |  | comnector tor Models 245531 and |
| ${ }^{\text {R8 }}$ | 2315 | Resistor-Fixed, composition. 15,000 ohms, $\pm 10 \%, 2$ w. |  | 502 | Resistor - Fixed, composition, 47 ohms, | ${ }^{\text {R166 }}$ | 502222 |  |  |  | exater assemblies |
| ${ }_{\text {R9 }}^{\text {R8 }}$ | 50223 |  | ${ }^{\text {R1 }}$ | 50239 | $\pm 10 \%$, $1 / 2 \mathrm{w}$. <br> Resistor-Fixed, composition, 39,000 ohms, | R167 |  |  |  |  | ${ }_{\text {RMA }} 974$ |
|  |  | ( Same as R3 (Part of S2) | R109, R110 | 502 | Rointor - Fix wd. composition, $10,000 \mathrm{ohms}$, |  | 502522 502322 | Resistor-Fixied. composition. 2.2 megohms, |  | 7777 |  |
| R13 R14 | 522 | (eamisor-Fixed, composition, 12,000 ohms, | 811 | 502 | Resisisor-Fixed, composition, 10 megohms , | R17\%0, |  |  |  |  | Notms) Hfug-in typo lorminal hard |
| R19 | 502182 |  | R112A, B | 7828 | Contol-Power, volume and picture con- | R172 R173 R17 | ${ }_{78810}^{7880}$ | Control-Vertical hold contol Contol-Height control |  |  | ment dors not arioerlicement paris by |
| R19 | 502033 |  | ${ }_{1213}$ | 502312 | Resistor-Fixed, composition, 12,000 ohms. $\pm 10 \%$, $1 / 2$ w. | R173 R174 | 78806 | Control-Height control (Part of Ll08) |  |  | reterring so Noal num ipoaker and fuli number stampd on description of part required. |

OJohn F. Rider


Models 21-D.527, 21-D. $527 U$
Mahogany, Blonde Tropical Hardwood PICTURE SIZE. . 227 square inches on a 21ZP4B Kinescope television r-f freouency range

Model 21-D. 527
All 12 VHF channels, 54 mc . to $88 \mathrm{mc} ., 174 \mathrm{mc}$. to 216 mc Model 21-D-527U
.470 mc , to 890 mc .
Any of 70 UHF channeli .470 mc . to 890 mc Any of 12 VHF channels, 54 mc . to 88 mc ., 174 mc . 10216 mc . INTERMEDIATE FREQUENCIES Picture I-F Carrier Frequency
video pesponse
3
SEE POWER RATING $\quad 250$ watts max
aUdIO POWER OUTPUT RATING $\quad 4.5$ watts max
Chassis designations ...... Model 21-D-527-KCS9 Model 21-D-527U-KCS90A
FOCUS Magnetic
SWEEP DEFLECTION Magnetic
SCANMING ........................... Interlaced, 525 lin
horizontal scanning frequency ...... 15,750 cpa
VERTICAL SCANMNG FREQUENCY................. 60 cpa
FRAME FREQUENCY (Picture Repetition Rate) . . . . 30 cpa
rCA TUBE COMPLEMENT
Tube Used Tuner ERE22D—Model 21-D.527 Function
(1) RCA 6BQ7A ..........................F-F Amplitie

Tuner KRE30C-Model 21-D-527U
(2) RCA 6BQ7A $\ldots \ldots \ldots \ldots\left\{\begin{array}{l}\text { VHF R-F Amplitio } \\ \text { UHF I-F Amplifie }\end{array}\right.$ (3) RCA 6X8 ................ $\left\{\begin{array}{l}\text { VHF R-F Oscillator } \& \text { Mixe }\end{array}\right.$

A K3D or a 1 N82 crystal is used as the UHF mirer

| All Models |  |
| :---: | :---: |
| Ca 6aug | .1st Picture I-F Amplitior |
| 2) RCA $6 \mathrm{CB6}$ | 2nd Picture 1-F Amplitier |
| (3) $\mathrm{RCA} 6 \mathrm{CB6}$ | 3rd Picture I-F Amplitier |
| (4) RCA 6CB6 | 4th Picture I-F Amplitier |
| (5) RCA 6 CL6 | Video Amplifie |
| (6) RCA 6AU6 | 1st Sound I-F Am |
|  | 2nd Sound I-F Amplifio |



Figure 3-Yoke and Forus Magnet Adiustments


Figure 4-Rear Chassis Adjustments


To mewnow ar


Figure 5-KRK22D R-F Oscillator Adjustments


Figure 6-KRK30C VHF R-F Oscillator Adjustment

CHASSIS REMOVAL-To remove the chastis from the
cabinet for repair or installation of a new kinescope the control knobs the cabinet bacch, unplug the, epemove
cable, the kinescope socket, the antenn cable, the yoke and cable, the kinescope socket, the antenna cable, the youe and
high voltage cable. Tacke out the chassis bolts under the cab
inet. Withdraw the chassis trom the back of the cabinet inet. Withdraw the chasesis from the back of the
ALIGNMENT PROCEDURE
TEST EQUIPMENT-To properly service the televisio chassis of these receivers, it is recommended that the follow
ing test equipment be acrilable: ing test equipment be available: (a) Frequency Ranges

5 to $90 \mathrm{mc}$..11 mcc . $\mathrm{t} 12 \mathrm{mc} . \mathrm{sweep}$ width
70 to 225 mc

(c) "Flat" constant on all ranges.

VHF Signal Generators (two) to provide the following
frequencies with crystal accuracy (See Sound Take-O Irequencies with crysid
Alignment on page 15):
 $\xrightarrow{47.25 \mathrm{mc} .}$ Radio
Output of these ranges should be adjustable and at leas
1 volt maximum .1 v
VHF
VHF Heterodyne Frequency Meter with crystal calibrator
if the signal generator is not crystal controlled. UFF Swoep Generator with a frequency range of 470 mc
to 890 mc. RCA types 40 A or 41 A or their equivalent. UHF Signal Generator to provide the following frequen cies with crystal accuracy io provide tye fillowing irequen Cathode Ray Oscilloscope.-An oscilloscope with a sen
sitivity of 5 millivolts per inch is required. A suitable pre sitivity of 5 millivolits per inch is required. A suitable pre-
amplitior may be employed with oscilloscopes of lesser sensitivity.
Senectronic Voltmeter.-A voltmeter with a 1.5 volt DC
scale is required. RCA Senior Voltohmyst or equivalent. PICTURE I-F TRANSFORMER ADTUSTMENTS.Models 21 -D. 527 and 21-D.527U Note: All alignment adiustments should be made with
cores at chassis end of coils except T108 (top) which should cores at chassis end of coils exceppit Tos (top which shoul.
be peaked with core at end of coil away from chassis. Connect the i-f signal generator, in series with a 1500 mm I
ceramic capacitor, to the mixer grid test point $T$ P2. ceramic capacitor to the mixer grid test point TP2.
Connect the "Voltohm yst" to the junction of h152, R153 Connect the Voltonmy to the junction of his2, R153
and C122 and to ground. Turn the AGC control to minimum
Otain two 7.5 volt batteries capable of withstanding Obtain two 7.5 volt batteries capable of withstanding
appreciable current drain and connect the ends of a 1,000 appreciable current
ohm poteniometer cross eech. Connect the battery positive
terminal of one to the chassis and the potentiometer orm to terminal of one to the chasasis and the potentiometer arm to
the junction of R152, R153 and C122. The second battery will be used later
Set the biias to produce approximately -5.0 volts of biacs
at the junction of R152, R153 and C122.
 Set the VHF signal generator to each of the following fre
quencies and peak the specified adjustment for maximum quencies and patk the specified adiustment for maximum
indication on the "Voltohmyst. During olignment, reduce
the input signal if necessary in order to produce 3.0 volis
 junction of R152, R153 and C122.
.T107
TT106
T105
Set the signal generato to each of the foliowing frequen
cies and adiut the corgsonding circuit for minimum doutput at pin 9 of V110. Use sufficient signal input to pro duce 3.0 volts of $\mathrm{d}-\mathrm{c}$ on the meter when the final adjustme
is made.
39.25 mc.
39.25 mc
41.25 mc
47.25 mc

SWEEP ALIGNMENT OF PICTURE I-F.
Wo Ali GNMENT Model 21-D-52
To align $T 2$ and $T 1104$, connect the sweep generator to the
mixer grid test point $T P 2$, in series with a 1500 mmf. ceramic mixer grid test point TP2, in series with a 1500 mmfl . ceramic
capacitor. Use the shortest teads possible, with not more capaciior. sine of unshielded lead at the end of the sweep
than one inch or
cable Conet the sweep ground lead to the top of the cable. Con
Set the channel selector to channel 4.
Connect a 180 ohm
Connect a a 180 ohm composition resistor between terminal
B" of T105 and the innction of B" of T105 and the junction of R12 and R122.
Short the grids of the third and fourth picture 1-F ampliSerort the grids of the third and fourd. Connect the oscilloscope diode probe to terminal "B" of
T105 and ground Set the sweep output for 0.5 volts peak-
to-peak on the T105 and ground. Set the sweep output for 0.5 volis peak
to-pak on the oscilloscope. Couple the iignal generato
loosely to the diode probe in order to obtain markers.

The shunt trimmer Cl19 across terminals "A" and "F" o
T104 is variable and is provided as a bandwidth adjustment reset the shunt trimmer to minimum capacity. Adjust T 5.75 mc . at $75 \%$ of maximum responss maximum gain with
 response with respect to the low frequency shoulder as
shown in Figure 9 . Readjust $T 1$ and T104 ii necessary to btain proper wave shape, see Figure 9. Maximum allowable To alig
The sweep generator to the fourth picture i-f grid, pin 1 ol
 to 5 volts poakk-tilopack
Adjust TIOB top and botto
Arvitiog top and bottom cores for maximum gain and
 me. marker at $90 \%$.
shown in figure 12 .
NOTE: C193 is incorporated as part of T108, fourth picture F trenslormer. Adiuatment is made by varying the penee
ration of the insulated lead, from terminal . E . int the ration of the insulated lead, from ferminal "E". into the
coramic sleove at the bottom of $T 108$ as seen in tigure 26 on page 16. Care should be taken when adjusting to preven amage to the lead or its insulation.
hemove the 180 ohm resistor and the shorts on pin 1 of
108 and V109. V108 and V109.
Adiust the bias box potentiometer to obtain -5.0 volts
of bias mam macsured by a "Voltohmyst" at the junction of
R152, R153 and C122.
y a "VoltOhmyst" at the junction of TP2 with the shortest leand poras to the mixer grid test point
Adice. Adiust the output of the sweop generctor to obtain 3.0 to
.0 volts peak-to-peak on the oscilloscoper Couple the signal generator loosely to the grid of the first
pix i-1 cmplitier. Adjust the output of the signal generator to pix i-1 amplifier. Adjust the out put of the signal generator to
produce small markers on the response curve.


Figure $9-$
KRK22D
Tl and Tli4
Response


Fipure
Oivell
Oespouse

Retouch T105, T106 and T107 to obtain the response shown
Figure 10 . Increacese sweop output ton times and check attenuation at
$1.25 \mathrm{ms}$. Adjust T105 and T107 to set 41.25 mc . between 30 41.25 mc. Adjust T105 and T107 to set 41.25 mc. between
and 40 times down with curve as shown in Figure 10 .
 slightly to correct l
chamnel to channel.

Model 21-D-527U
ar align the mixer plate circuit, connect the sweep gener-
ato to the mixer grid test point $\mathrm{TP2}$, in series with a 1500 nmi. ceramic capacitor. Use the shoriest leads possible, with moer than one inch of unshielded lead at the end of the swee tuner.
Set the channel selector switch to channel 4 .
Connect a 180 ohm composition resistor betw
Connect a 180 ohm componition resistor between terminal
B" of 105 and the iunction of R121 and R125. Short the grids of the third and fourth picture I.F amplifiers to ground, pin 1 of V108 and V109.
Connect the oscilloscope diode probe to terminal "B" of Tlos amd groun. Set the sweep output for 0.5 volts peak-to to the diode probe in order to obtcin markers. The shunt primmer Clise acrosis terminaralers. $A$ ", and " $F$ " o
T104 is variable and is provided as a bandwidth adjustment T104 is variable and is provided as a a bandwidth adiustment
Preseet the shunt trimmer to minimum capacity. Adiust T
(top) and T104 (top and botiom) Ior maximum grin with Preset the shunt trimmer to minimum capacily. Adiust
(top) and Tlit (top and bottom) 1or maximum gain with

45.5 mc . $75 \%$ ot maximum response. | $45.75 \mathrm{mc}$. at $75 \%$ of maximum response |
| :--- |
| Aduas the shunt trimmer C119 until $42.25 \mathrm{mc}$. is at $75 \%$ | response with respect to the low frequency shoulder as

shown in Figure 1 . Readjust T2 and T104 iin necesary y shown in Figure 11. Readjust $T 2$ and T104 if necessary to
obtain proper wave shape, see Figure 11 . Moximum allow. able tilt is $2 \%$.
To align the fo
ho align the fourth picture I.F transtormer T108, connec the sweep generator to the fourth picture i-f grid, pin 1 o
V109. Couple the signal generator loosely to obtain marker Connect the oscilloscope to pin 9 of V110 and set to read


Adjust T 108 top and botiom cores for maximum gain and
curve shape ans show in Figure 12 .

NOTE: C193 is incorporated as part of T108, fourth picture
I-F transformer. Adiustment is made by varying the pene. I. F transformer. Adiustment is made by varying the pene
tration of the insulated lead, from terminal
E., into ceramic sleeve at the bottom of $T 108$ as seen in figure 26
on page 16. Care should be taken when adjusting to preven on page 16. Care should be taken wh
damage to the lead or its insulction
Remove the 180 ohm resistor and the shorts on pin 1 of
V108 and Vlog. V 108 and
Adjust the bias box potentiometer to obtain -5.0 volts

Connect the sweep generator to the mixer grid test point
TP2 with the shortest leads possible. Adiust the shortest leads possible.
0.5 volts 0.5 volts peak-10-peak on the oscilloscope.
Couple the signal generator loosely to the grid of the firs pixi i-f amplitier. Adiust the output of the signal generato
to produce smail markers on the response curve.


Retouch T 105 , T106 and T107 to obtain the response shown
in Figure 10 . Increesse sweep output ten times and check attenuation a
41.25 mc. Adjust T 105 and T 107 to set 41.25 mc. between 30
 To align the I-F amplitifer circuit of thi KRK 3 RC, connect the
VHF sweep generator to the rear terminal of the LN82 crystol VHF sweep generator to the rear terminal of the LN8 crystal
holder in series with a 1000 ohm resistor and a 1500 mmf hetamin capacitor. Use the shortest leads possible, ground
ceramin
ing the sweep ground lead to the tuner case. To do this, ing the sweep ground lead to the tuner case. To do this
remove the crystal cover a t the right side of the UHF tune remove the crystal cover at the right side of the UHF tuner
section Reler to Figure 20 . Cover .one lead of the 1000
ohm resistor with a short piece of insulated tubing and ohm resistor with a short piece of insulated tubing and
fashion a hook at the end of this lead. Connet to the front
terminal of the crystal holder through the aperture under lashion a hook at the end oi this lead. Connect to the front
terminal of the crystal holder through the aperture under
the crystal cover. Connect the capacitor and generator as the crystal cover. Connect the capacitor and generator as
stated above. Set the UHF CHANGEOVER switch to the UHF position
and the UHF TUNING between channels 88 and 69 at 800 and the
 capacitor in series between test poent TP3 and ground with
the capacitor connected to TP3 and the resistor to ground. Connect the oscilloscope diode probe to the junction between the resistor and capacito
Couple the VHF signal generctor loosely to the diode Connect the potentiometer crm of the second bias supply
to the AGC terminal on the tuner and cround the battery
positive terminal to the tuner case. Adjust the bias potentipositive terminal to the tuner case. Adjust the bias potenti-
ometer to produce - 3.0 volts of bias, as measured by the
"Voltohmyst" at the AGC terminal on the tuner.
Set the sweep generator to produce 0.5 volt or less peak
to-peak on the oscilloscope. Adjust C308, on the UHF section, and L9, on the VHF
section of the tuner for maximum gain with 45.75 mc. and
4225 , wn in figure 13 . If necessary adjust L 27 to place the 45.75 me. marker of
$90 \%$ on the curye. Adjust L43 for minimum tilt of the curv as shown in figure 13
Remove the resistor, capacitor and diode probe from TP3
and connect the oscilloscope to pin
volts of V 110 . Use 3.0 to 5.0 Connect the VHF he oscilloscope.
Connect the VHF sweep generator to the VHF antenna ter
minals Keep the AGC bias at -3.0 V and the $\mathrm{I}-\mathrm{F}$ bias a
-5.0 volts. Couple the signnal generator loosely to the grid of the firs
picture I-F amplifier. Switch through all VHF channels and check for proper
curve shape as in figure 10 . Retouch T106 and T107 slightly to correct for any overall tilt that is essentially the same on
all channels. Disconnect the VHF sweep generator and connect the UHF
sweep generator to the UHF antenna terminals. Check on all

UHF channels for proper wave shape as shown in figure 10
retouching C 308 and $L 9$ if necessary to correct any overal
Do not retouch L27, L43, T2, T104, T105, T106 or T107, Remove the sweep and marker generators and the bias
supplies.

## RRE22D TUNER ALIGNMENT.-

A tuner unit which is operative and requires only touch up
djustments, requires no presetting of $a d$ iustments adjustments, requires no presetting of adjustments. For such
units, skip the remainder of this paragraph. For units which are completely out or dijustment, preset turn from tight. Tur 1 slug all the way out. Do not change any of the adjust.


Disconnect the link from terminals "A" and "B" or T104
and terminate the link with a 39 ohm composition resistor. Turn the receiver channel selector switch to channel 2 The 43.5 mc . trap is adjusted with zero bias. To insure that
the bias will remain constant, take a clip lead and short the bias will remcin constant, take a clip lead and short
circuit the AGC terminal of the tuner at the terminal board
to ground. o ground
Connect the oscilloscope to the fest point TPl on
tuner unit. Set the oscilloscope to maximum gain
Connect the output of the VHF signal generator to the out put of the antenna matching unit at the junction of L.53 and
C24 at the bottom of the FM trap L53. Tune the signal generator to 43.5 mc . and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator for maximum outpu
Adjust C19 on top of the tuner, for minimum 400 cycle indi-
cation on the oscilloscope. If necessary, this adjustment can
be on be retouched in the field to provide additional reiection to one speciitic frequency in the i-f band passs. However, in
such casts., care should be taken not to tune Ci9 into channel
2. thereby reducing sensitit vity on chanel thereby reducing sensitivity on channel 2 .
Connect the potentiometer arm of one of the bias supplies
othe $A G C$ terminal on the tuner and ground the battery ositive terminal to the tuner case. Adjust the bias potent ometer to produce - 3.0 volts of bias, as measured by the
Voltohmyst" at the $A G C$ terminal on the
Set the channel selector switch to channel
Preset C5 to read . 3.0 volts at the test point TPI, as read
on the "Voltohmyst." The limits for oscillator injection voltage are 2 volts minimum and not exceeding a maximum of 5.5 volt

Turn the fine tuning control fully clockwise.
Adjust C 3 for proper oscillator frequency, 227 mc . This may be done in several waycy. The easiest way and the wa the signal generammended in this procedure will be to use the signe generator as aterod
beat the oscilator gainst the signal generentor To do this,
tune the signal gengerator to 227 me. with crystal accuracy tune the signal generctor to 227 mc . with crystal accuracy
Insert one end of a piece of insulated wire into the tuner unit Insert one end of a piece of ios the adiustment of Clo Be care
through the hole provided for
ful that the wire does not touch any of the tuned circuits ful that the wire doess not touch any of the tuned circuits as
It may cause the frequency of the tuner oscillator to shift
 with the signal generator
Turn C2 clockwise until the beat note just begins to change,
then turn one full turn in the same clockwise direction.


Figure 14-KRK22D Tuner Adjustments
Return
ts range.

Note, -ll on some units, it it not possible to reach the
proper channel 8 oscillator frequency by adiustment of C 3 switch to channel 13 and adjust $L 42$ to obtain proper channe
13 oscillator frequency as indicated in the table on page $\ell$. Then, switch to channel 12 and adjust $L 111$ to obtain prope
channel 12 oscillator frequency. Continue down to channel 8 , channel 12 oscillator frequency. Continue down to channel 8 ,
adjusting the appropriate oscillotor trimmer to obtain the proper frequency on each channcl. Then again on channol 8 , adjust C3 to obtain proper channel 8 oscillator frequency
Switch back to channel 13 and readjust L42 and back to chacnel 8 and adjust C3
Set the Tl core for maximum inductance (core turne
counter-clockwise).
Connect the swee
ator, as shown in figure 15 , to the input terminals of the
antenna matching unit


Figure 15-Sueep Attenuator Pads
minals.
et the sweep generator to cover channel Set the oscilloscope to maximum gain and use the mini
mum input signal which will produce $a$ usable pattern on the oscilloscope. Excessive input can change oscillator iniection
during alignment during alignment and produce consequent misalignmen
even though the response as seen on the oscilloscope may even though
look normal.
Insert markers of channel 8 picture carrier and sound
carrier, 181.25 mc and 185.75 mc . Adiust C7. C10, C15 and C20 for approximately correct
curve shape, frequency, and band width as shown in figure curve
16.
The correct adjustment of $\dot{C} 20$ is indicated by maximum
amplitude of the curve midway between the markers. C15 tunes the $r$-f amplifier plate circuit and affects matreers. frequenc of the pass band most noticably. C7 tunes the mixer grid
circuit and affects the tilt of the curve most noticeably 1 tas
suming that C20 has been properly adjusted). C10 is the suming that C20 has been properly adjusted) CLiO is the
coupling ajjustment and hence primarily affects the response
band width coupling adjustment and hence primarily aftects the respons
band width
Connett the "Voltohmyst" to test point TPl. Adjust C5
 $\mathrm{C7}$. Cl 10 and $\mathrm{Cl5}$ for proper response. Adjust C 20 for maxi
mum gain at midpoint of the curve. Repeat if necessary until
the proper response is obtained.


Figure 16-KRK22D R-F Response
Set the receiver channel switch to channel 13 .
Adjust the signal generator to the channel 13 oscillator
equency 257 mc.

Adiust 42 to obtcin am audible beat. Slightly overahoot
Ae adjutment of L 42 by turning the slug om additional turn in the same direction from the original setting, then reset the oscillctor to proper frequency by adjusting C2 to again ob crin the beat. From the signal generator, insert channel 13 sound and
picture carrier markers, 211.25 mc. and 215.75 mc . Adjust L4 143 and L45 for proper response as shown in
figure 16. Turn oft the sweep and signal generators.
Connect the "Voltohmyst" to the tuner test point TPl.
Check the oscillator injection voltage to be within limits as
previously specilied. Adjust if necessary to bring within range.
If it was necessary to readjust CS, turn the sweep and sig-
nal generetors back on and recheck the channel 13 response.
Readiust L43 and L45 if necescrict L43 and L45 if necessar
Set the receiver channel selector switch to chamnel 8 and
readjust C2 for proper oscillator frequency, 227 mc . Set the sweep generator and signal generator to channel 8 . Readjust $\mathrm{C7}, \mathrm{Cl0}, \mathrm{Cl5}$ and C 20 for correct curve shape,
irequency and band width: Turn oft the sweep and signal generators, switch back to
hannel 13 and check the oscillator injection voltage at TP1 $\mathrm{C7}$ was adausted in the recheck of channel 8 response.
I the initial setting of the ocsillato ar off, it may be necessary to cdjust the oscillator frequency ar of, it may be necessary to cajust the oscillator frequency
and response on channel 8, adjust the oscilltorin injection on
hanel 13 and repeat the tracking procedure several times channel 13 and repeat the tracking procedure several times
before the proper setting is obtained.
Turn of the sweep generator and switch the receiver to
channel 6 . Adjust the signal generator to the channel 6 oscillator
frequency 129 mc. Set the fine tuning control to the center of its mechanical Adjust L5 for an cadible beat. Adjust L44, L46 and L58
ior for poper curve shape as shown in ifusure 16 . Rerheck the
oscillator iniection voltage at TP1. to insure that it is within oscillator injection voltage at TPL , to insure that it is within
the limits specified. Readjust C 5 it necessary. II C5 required adjustment, switch the receiver and the signal generator to channel I. Readjust C7 lio correct curve
shape and recheck C2 and C3 for proper oscillator frequency. Check the response of channels 2 through 6 by switching
he receiver channel switch, sweep generator and marker The receiver channel switch, sweep generator and marker
generator to each of these channels and observing the re-
ponse and oscillatori injection voltage obtioined ponse and oscillator injection voltage obtcined. See figure
6 for typical response curves. It should be found that all hese chananels have the proper response with the markers
above $80 \%$ response. It the markers fail to fall within this requirement readiust
4.44. L.46 and L.58 in order to obtain curves within the proper Switch
Switch the channel selector, signal generator and marker
generator through channels 7 to 13 and observe the response generator through chamnels 7 to 13 and observe the response
unves. referring tofigure 16 tor proper wave shape. Check The injection voltage at each channel to be within limits.
in necessary readiust $\mathrm{Cl5}$, C 7 , or C 10 to obtain the proper Wine.
With the receiver and signal generator on channel 13 ad-
ust L42 for an audible beat with the signal generator. Adjust the oscillator to frequency on all channels by switch. ing the receiver and he requency standard io each channel
and adjusting the appropriate oscillator slug to obtain the audible beat. It should be possibible to adiust the oscillator to obtain the audible beat on each chamnel. Recheck the oscill-
ator injection voltage on each channel to verify that the voltage is within the specified limits.


Figure IT-KRK22D Oscillator Adustment
KRK22D OR KRE
ALIGNMENT.-The antenna matching unit is accurately

## RADIO

aligned at the factory. Adjustment of this unit should not
be attempted in the customet alignment may cause setioners hatemuation of the signal mes-
pecially on channel 2. The r-f unit is aligned with a par-
 reason, a new antenna matchin
the ret unit should be realigned.
The F.M Trap which is mounted in the antenna matching
unit may be adjusted without adversely affecting the alignTo align the antenna matching unit disconnect the lead Irom the $F$ F-M trap L53 (L5) to the channel selector switch
S4 (SIE). With a short jumper, connect the output of the matching
unit through a 1000 mm . capacitor to the grid of the second pix i-f amplifier, pin 1 of V107.
Replace the cover on the matching unit while making all
adjustments. Remove the first pix i-f amplitier tube VIOC
Connect the positive terminal of a bias bor to the chassis
and the potentiometer arm to the unction of R118, R146 and C120. Sel the potentiometer to produce approximately -5.
volts of bias at the junction of R118, R146 and C120. Connect an oscilloscope to the junction of R129 and L103
and set the oscilloscope gain to maximum.
Connect aUF VH signal generator to the antenna input termi-
nals. Modulate the signal generator $30 \%$ with on audio nals.
signal.
Tune
Tune the signal generator 1045.75 mc. and adiust the
generator output to give an indication on the oscillosco generator output to give an indication on the oscilloscope
Adiust $\mathrm{IS4}$ (Lit) in the antennc mathing unit for minimum
audio indiction on the oscilloscope.
Tune the signal generator to 41.25 mc . and adjust L57 (LI)
for minimum cudio indictation on the oscilloscope. Remove the jumper from the output of the matching unit. Connect a 300 ohm $1 / 2$ watt composition resistor from L53
(L5) to ground, keeping the leads as short as possible. Coonnect an oscilloscope low capacity crystal probe from be approximotely. 0.03 volts per inch. Set the oscilloscope
gain to maximum. gain to maximum.
Connect the VHF sweep generator to the matching unit
antenna input terminals. In order to prevent coupling reacantenn input terminals. In order to prevent coupling reac-
tance from the sweep generator into the matching unit. it is
advisable to employ advisable to employ a resistance pad at the matching unit
terminals. Figure 15 shows three diflerent resistance pads for erminals Figure 15 shows three diflerent resistance pads ior
use with sweep generotors with 50 ohm co coutput. 72 ohm
soon co-ax output or 300 ohm balanced output. Choses the pad
10 match the output impedance of the particular sweep employe
Connect the signal generator loosely to the matching unit
an'enna terminals. Set the sweep generator to sweep from 45 mc . to 54 mc .
With RCA Type WR59A sweep generators, this may be acomplished by rewning channel number to cover this range.
With WRS9B sweep generators this may be accomplished by With wrSg swcep generators shis may be caccomplished by
retuning channel number 2 to cover the range. In making hese adjustments on the generator, be sure not to turn the
core too far clockwise so that it becomes lost beyond the core retaining spring.
Adjust L55 (L3) and L56 (L2) to obtain the response shown
in figure 18 . L55 (L3) is most effective in locating the position of the shoulder of the curve at 52 mc . and $\mathrm{L} 56(\mathrm{~L} 2)$ should be
of adjusted to give maximum amplitude at 53 mm . and aldove
onistent with the specitied shape of the response curve . The onsistent with the specitied shape of the response curve. The
adiustments in the matching unit interact to some extent
Repoat the above procedure until no further adiustments are Repect the
necessary
Remove the 300 ohm resistor and crystal probe connections,
Restore the connection between L53 (L5) and S4 (S1E).
Replace Vlo6.
$C_{53 \mathrm{Mc}} 100 \%$ RESDONSE
 kRE30C TUNER ALIGNMENT

VhF ALIGNMENT.-A tuner unit which is operative and
requires only touch up adjustments, requires no presetting
of adjustments. For such units, skip the remainder of this of adjustmenis. For such units, skip the remainder of this
paragraph. For units which are completely out of odjustment.
preset C27 all the way out. Set chaney 7 to 13 uscillator slugs one turn trom tight. TTurn TT2 slug all the way out. DD not
change any of the adiustments in the antenna matching unit. Disconnect the link from terminals " $A$ " and " $B$ " of T104 and eerminate the link with a 39 ohm composition resistor. Turn the receiver channel selector switch to channel The 43.5 mc. trap is adiusted with zero bias. To insure that
the bias will remain constant, take a clip lead and short circuit the AGC terminal of the tuner at the terminal board to round
Connect the oscilloscope to the test point TP2 on top of
the tuner unit. Set the oscilloscope to maximum gain Connect the output of the VHF signal generator to the
output of the antenna matching unit at the junction of $L 5$ ond
C4 Tune the signal generator 1043.5 mc . and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator for maximum output.
Adjust C33 on top of the tuner, for ninimum 400 cycle indi-
cation on the oscillioscope. If necessary, this $a d i u s t m e n t ~ c a r$ cation on the oscillosiope. If necessary, this adijustment can
be reouched in the field to provide additional rejection to one specific frequency in the i-f band pass. However, in such
cases, care should be taken not to tune Co3 into channel ases, care should be taken not to tune
2. thereby reducing sensitivity on channel 2 .
Connect the potentiometer arm of one of the bias supplies
ot the $A G C$ terminal on the funer and ground the battery the AGC ierminal on the tuner and ground the battery
positive terminal to the tuner case. Adjust the bias potentimeter to produce -3.0 volts of obas. as measured by the
Volthmysti" ot the AGC terminal on the tuner Set the chamnel selector switch to channel 8 .
Prese C22 to read - - 3.0 volis at the test point TP1, as read Prese "Voliohmyst." The limits for oscillator injection voltage are 2 volts minimum and not exceeding a maximum of
Turn.
Adjust C25 for proper oscillator frequency, 227 mc . This nay be done in several warys. The easiest way and the way
which will be recommended in this procedure will be to use he signal generator as a heterodyne frequency meter and
beat the oscillator against the signal generator. To do this,
pine the signal generato to nsert one end of a piece of insulated wire into the tuner nit through the hole provided for the adjustment of C16.
Be careful that the wire does not touch any of the tuned ircuits as it may cause the frequency of the tuner oscillator o shift. Connect the other end of the wire to the "r-f" in
erminal of the signal generator. Adjust C25 to obtain an arminal of the signal generator. Adj
Turn C27 clockwise until the beat note just begins to
change, thon turn one full turn in the same clockwise di-
Return the fine tuning control to the mechanical center of is range.
NOTE:-If on some units, it is not possible to reach the
proper channel 8 oscillator frequency by adjustment of $C 25$ witch to channel 13 and adjust L49 to obtain proper channel 3 oscillaior frequency as indicated in the table on page 8 .
Then, switch to channel 12 and adjust L60 to obtain proper channel 12 oscillator frequency. Continue down to channel 8 , adjusting the appropriate oscillator trimmer to obtain the
proper irequency of each channel. Then again on channel 8 , dijust C25 to obtain proper channel 8 oscillator frequency. Switch back 10 channel
channel 8 and adjust C25.
Set the T 2 core for maximum inductance (core turned Connect the sweep generator through a suitable attenu-
ar as shown in figure 15 to the input terminals of the ator, as shown in figure 15 to the input terminals of the
antenna matching unit. Connect the signal generator loosely to the antenna Cerminals.
Set the sweep generator to cover channel 8
Set the oscilloscope to maximum gain and use the minimum
nput signal which will produce $a$ usable pattern on the oscilloscope. Excessive input can change oscillator injection during alignment and produce consequent misalignment even
hough the response as seen on the oscilloscope may look hormal.
Insert markers of channel 8 picture carrier and sound
carrier, 181.25 mc . and 185.75 mc .
Adjust $\mathrm{C} 21, \mathrm{Cl6,C11}$ and $\mathrm{C7}$ for approximately correct
curve shape, frequency, and band width as shown in figure
19.
amplitude of the eurve midwary between the markers C11
tunes the r-f ampplifier plate circciut and affects the frequency
of the pass band most

 coupling ad
Connect the "Voltohmyst" to test point TP1. Adjust C22 to
read 3.0 volts dc on the "Voltohmyst" at TPl. Readjust C27.
 mum gain at midpoint of the curve. Repeatif if necessary until
Set the receiver channel switch
Adjust the signal generator to the channel 13 oscillator frequency 257 mc .
Turn the fine tuning control fully clockwise
Adjust L49 to obtain an audible beat. Slightly overshoot the
adjustment of L49 by turning the slug an additional turn in


Figure 19-KRK30C VHF R-F Respons
the same direction from the original setting, then reset th
oscillotor to to proper frequency by adjusting C 27 to again of tain the beat.
From the signal generator, insert channel 13 sound and pic Hre carrier markers, 211.25 mc. and 215.75 m Adjust L36 and L20 for proper response as shown in tig ure
Turn off the sweep and signal generators
the tuner test point TPI Check the oscillator injection voltage to be within limits as
previously specified. Adjust if necessary to bring within range.
If it was necessary to readjust C22, turn the sweep and
ignal generators back on and recheck the channel 13 resonse. Readjust $L 36$ and L 20 if necessary. Seet the reeeiver channel selector switch to channel 8 and
readjust C27 for proper oscillotor frequency, 227 mc.
Set the sweep generator and signal generator to channel 8
Readjust C21, $\mathrm{Cl6}, \mathrm{Cl1}$ and C 7 for correct curve shape
Turn of the sweep and signal generators, switch back to
channel 13 and check the oscillator injection voltage at TP1 C21 was adjusted in the recheck of channel 8 response.
It the initial setting of the oscillator injection trimmer was ar off it may be necessary to adjust the oscillator frequency channel 13 and repeat the tracking procedure several times hanne the proper setting is obtained.
Turn off the sweep generator and switch the receiver to
Adjust the signal generator to the channel 6 oscillator fre-
quency 129 mc .
Set the tine tuning control to the center of its mechanical
ange
Adjust L54 for an audible beat. Adjust L14, L48 and L32
Lick
or proper curve shape as shown in tigure 19. Recheck the
oscillotror iniection voltage $\begin{aligned} & \text { TPI , io insure that it is within } \\ & \text { he limits specified. Readiust } C 22 \text { if necessury }\end{aligned}$

ignal genorroct ro heannel 8. Readisus C21 lor correct curve
quency Check the response of channels 2 through 6 by switching the receiver channel swith, sweep generator and marker
generator to each of these chamnels and observing the reponse ond ocsillator injection voltage obtained. See figure for typical response curves. It should be found that all
these channels have the proper response with the markers放 If the markers fail to fall within this requirement readjust
L48 and $L 32$ in order to obtain curves within the proper Switch the channel selector signal generato and marker Switch the channel selector, signal generator and marker
generator through hannels 7 to 13 and onserve the response curves. referring to tigure 19 for proper wave shape. Check
he injection voltage at each channel to be within limits. If the injection voltage af each channel to be within limits. If
necessary readjust C11, C21 or C16 to obtain the proper response
With the receiver and signal generator on channel 13
just L49 for an audible beat with the signal generator.


## \%

## 

 Eipure 20-KRK30C Tuner AdjustmentsAdjust the oscillotor to frequency on all channels by swithnd adjusting the appropriate oscillator slug to obtcin the udible bear.. It shauld be possible to adjust the oscillator to
bicrin the audible beat on each channel. Recheck the oscildor injection voltage on each channel. Recheck the oscholtoge in within the speceified dilimits.
UHF ALIGNMENT.-R-F alignm alignment of the UHF section of aved from the tuner assembly. $\mathbb{R}$-F adiustments require renoval of the tuner shield which may only be done with the HF tuner separate from its mounting.
$I-\mathrm{F}$ and oscillotor adjustments may be
I-F and oscillator adjustments may be accomplished with
ut removing the tuner. Connect a 100 ohm composition resistor between the center
onductor of the I-F cable W301 and the tuner case. Connect the oscilloscope to the center conductor of W30 at the 100 ohm resistor, employing the preamplifier if needed luner case. Connect the output of the UHF sweep generator, through
300 ohm attenuator pad, to the antenna terminals and a
set the sweep generator to sweep channel 83 , entered on
887.5 mc. Adjust the outpout of the sweep generator to full weep width
A test dial
 and $164^{\circ}$ should be marked on the test dial for reference.
The $0^{\circ}$ reterence point is located with the capacitor plates The reshed. With the stop pin on the theer agacinst the stop
fully mested
plate on the ear assembly the plates will be in the proper plate on the gear asse
fully meshed position.
Rotate the tuning dial to the $164^{\circ}$. Channel 83, position.
Conect Connect the UF signal generator in series. With a
ohm resistor to the junction of W 301 and $\mathrm{LBl0}$. This may be done by inserting the load from the resistor, which should be covered with insulated tubing, through the aperture pro
vided for crystal removal. (See figure 20.) Insert markers for
41 41.25 mc. 435 mc. and 45.75 mc.
Connet
erminals ond insert a marker gen at 8875 loors losely to the antenna terminals and insert a marker at 887.5 mc.
Adjust $R$ R- trimmer capacior tabs C C 304 and C305 for
andimum maximum amplitude overcoupled res
ai 887.5 mc as shown in figure $22(\mathrm{~A})$.

[^13]Figure 25-Top Chassis Adjustments

Tune the ratio detector primary. T102 top core for maxi
mum d-c output on the "Voltohmyst." (Pak with core a
end the signal generator for 5 volits on the "Voliohmyst" when the signal generator for 5 volis on the
finally peaked, when making the above adjustments. Tune the T101 (top) core for maximum d-c on the "Volt-
Ohmyst." (Peak with core at chassis end of coil.) The output from the signal generator should be set to
produce approximately 5 volts on the "VoltOhmyst" when produce approximately 5 volts on the "Volithmyst" whe
the final touches on the Tlol adjustment are made. Connect the "VoltOhmyst" to the junction of R107 and
Cl09. Tune T102 bollom for zero d-c at the junction of R107 and
C109 (Make adiustment with core ot chassis end of coil) SOUND tare-off alignment.-Connect two (2) sig nal generators to the grid of the fourth piclure i-f amplifier.
pin ! of Vlog. Set one generator to 45.75 mc ., unmodulated, and adjust
output for . 5 volts. Set the second generator to 41.25 mc., and modulate $30 \%$,
al 400 cycles, with am output of 2 volts. Connect the oscilloscope, in series with diode probe, to
the plote of the video amplitier, pin 6 of V 110 . Set the oscilloscope to mair arin
Adjust T109 for minimum output indication on the oscil As an alternote method, this may be accomplished by
using a received signal as the source for adjustment. It this is done, tune in a station and observe the picture on
the kinescope. If no 4.5 mic. bect is present in the picture when the fine tuning control is set for proper oscillator-tre
quency, short the terminals of the fixed 4.5 mc. trap L105 Wuenc. a 4.5 m. bert present, turn the fine tuning controi
sightly clockwise so as to exaggerate the beat and then
slo slighty clockwise so as to e
adjust $T 109$ for minimum beat.
AGC CONTROL ADIUSTMENT.-Disconnect all test equip.
ment except the oscilloscope which should be connected to
Connect an antenna to the receiver antenna terminals.
Turn the AGC control fully counter-clockwise
Tune in a strong signal and adjust the oscilloscope to see
the video waveform.
Turn the AGC control clockwise until the tips of sync begin
to be compressed, then counter-clockwise until no compres

HORIZONTAL OSCILLATOR ALIGNMENT. - Normally the part of the alignment procedure but since the oscillator usually can not be moy require the use of an oscilloscope, avetorm adjustment is made at the factory and normally hould not require readjustment in the field. However, the eiver is aligned or whenever the horizontal oscillator oper

Tune in a station and sync the picture. If the picture hen adjust the wavetorm adiustment core (top .) conitro out of the coil several turns from its original position and
readjust the frequency control until the picture is synchro-

Examine the width and linearity of the picture. If pictur width or linearity is incorrect, adjust the horizontal drive
trimmer Cligg the width contol Lill and the linearity con-
trol L1133, until the picture is correci Connect the low capacity probe of an oscilloscope the the
center terminal of T112, at the junction of R195. Dress the oscilloscope probe at least one inch away from the sine wave
cil L110. Turn the horizontal frequency picture is in sync. The patitern on the oscilloscope should b as shown in Figure 24. Adjust the waveform adjustment coil 10 until the two peaks are at the same height. During this the frequency control if necessary.

Remove the oscilloscope upon completion of this adjust Turn the horizontal frequency control to the extreme clock num of twelve bars slanting downward to the left. Turn the lack bars will be gradually reduced number of diagonal bars sloping downward to the left are obtained, the picare will pull into sync upon slight additional counter-clock-
wise rotation of the control. The pict ure should remain in sync or approximately two full turns of additional counter-clockion until the picture falls out of sync. Rotation beyond the all-out position should produce between 2 and 5 bars before cillation (motorboat) should be reached before full counter-

When the receiver passes the above checks and the picture
is normal and stable, the horizontal oscillator is properly
aligned. aligned.

(3)
Figure 23-KRK30C Dial Cord



[^14]
©John F. Rider


CHASSIS KCS89, 89A, 89B, 89C, Early




CA TUBE COMPLEMENT
Tube Used Tuner KRK30B (UHF/VHF Models) Function 2) RCA 6BQ7A 3) RCA 6X8 $\left\{\begin{array}{l}\text { VHF R-F Oscillotor } \& \text { Mixer }\end{array}\right.$

A K3D or a 1 N82 crystal is used as the UHF mixer.


 (7) RCA GAU6................2nt Sound I-F Amplifier R) Ratio Detector
8) RCA 6 AV6 11) RCA 12AU7 Vertical Syne Audio Output 12) RCA 12AU7 Horiz. Sync Separator and Sync Amplifiet 14) RCA 6AQ5 16) RCA 6CD6G Horizontal Sweep Oscillator and Control 17) RCA $\operatorname{CAU4GT}$
(18) RCA 1 B3GT
19) RCA SU4G (2 tubes) 20) RCA 24CP4A

Figure 3-Yoke and Focus Maknet Adiustments

Figure 4-Rear Chassis Adiustments


Ton inion who wo wrim
Figure (6-KRK30B VHF R-F Oscillator Adiustmen

CHECK OF HORIZONTAL OSCILLATOR ADJUSTMEN position. The picture should be out of sync, withe a minimum
itwelve bars slanting downward to the lett. Turn the nitrol counter-clockwise slowly. The number of diagonal
lack bars will be gradually reduced and when only $11 / 2$ to 3 bars sloping downward to the left are obtained, the pic-
ure will pull into sync upon slight additional counter-clockwise rotation of the controi. The picture should remain in sync
for approximately two tull turns of additional counter-clockor approximately two tull turns of additional counter-clock-
wise rotation of the control. Continue counter-clock wise rotaion until the picture falls out of synn. Rotation beyond the
fall-out position should produce between 2 and 5 bars belore aterrupted oscillation (motorboac occurs). Interrupted oscil-
ation (motorboat) should be reached before full counter



5-KRK22D R-F Oscillator Adju
ALIGNMENT PROCEDURE TEST EQUIPMENT.-To properly service the television
chassis of these receivers, it is recommended that the followhassis of these receivers, it is re
VHF Sweep Generator meeting the following require ments:
(a) Fr
(b) Output adiustable with at least. 1 volt maximu (c) Output constant on all ramges.
(d) "Flat" output on all altenuctor

VHF Signal Generatora (two) to provide the following
requencies with crystal accuracy (See Sound Take-O甘 Alignment on page 15):
termediate frequencies
4.5 me. 39.25 mc., $41.25 \mathrm{mc} ., 43.5 \mathrm{mc} .45 .75 \mathrm{mc}$.
4725 mc.
Output of these r VHF Heterodyne Frequency Meter with crystal calibrator
if the signal generator is not crystal controlled. UHF Sweep Generator with a frequency range of 470 mc UHF Signal Gens 4A or 41A or their equivalent. UHF Signal Generator to provide the following frequen-
cies with crystal accuracy if RCA Type 41 A is used. Cathode Ray Oscilloscope.-An oscilloscope with a senitivity of 5 millivolts per inch is required. A suitable preElectronic Voltmeter- $A$ voltmeter with a 1.5 volt $D C$ PICTURE I-F TRANSFORMER ADJUSTMENTS.-

Note: All alignment adjustments should be made with
Ores at chassis end of coils except T108 (top) which should be peaked with core at end of coil away from chassis. Connect the i-f signal generator, in series with a 1500 mmf . Connect the "Voltohmyst" to the function of R152, R153 and C122 and to ground. Turn the AGC control to minimum. apreciable current drain and connect the ends of a 1.000 ohm potentiometer across each. Connect the battery positive erminal of one to the chassis and the potentiometer arm to
he iunction of R152. R153 and C122. The second battery Set the bias tor. produce approximately -5.0 volts of bias
will the junction of R152, R153 and C122.
Connect the "VoltOhmyst" to pin 9 of
Sen the VHF signal generator to each of the following fre. quencies and pak the speciiied adjustment or maximum
ndication on the "Voltohmyst." During alignment, reduce
 of d-c at pin 9 of V110 with -5.0 volts of i-f bias or the
unction of R152. R153 and C122.
44.0 mc
$45.5 \mathrm{mc}$.
42.75 mc.
$T 107$
$T 106$
T105

Set the signal generator to each of the following frequen-
ies and adiust the corresponding
circuit for minimum d-c
utput at pin 9 of Vllo. Use sufficient signal input to pro. utput at pin 9 of V110. Use sufticient signal input to pro
duce 30 volts of $d$-c on the meter when the final adjustment
 $\begin{array}{r}47.25 \mathrm{mc} . \\ 4 . \\ \hline\end{array}$ ${ }_{1104}^{1104}$ top core SWEEP ALGNMENT OF PICTURE I-F.--
Models 24-D.542, 24-D. 543 and 24 .D. 544 To align T2 and T104, connect the sweep generator to the
mixer grid test point TP2, in series with a 1500 mmt. cerami capacitior. Use the shoriest leededs possible, with not more than one inch of unshielded lead at the end of the sweep
cable. Connect the sweep ground lead to the top of the Set tas
Connect a 180 ohm composition resistor between terminal
"B" of T105 and the junction of R121 and R125. B" of T105 and the junction of R121 and R125.
Short the grids of the third and fourth picture I-F ampliSort he grias of the hird and lourth
liers to ground, pin lo vlos and V109.
Connet Connect the oscilloscope diode probe to terminal "B" of
T 105 and ground. Set the sweep output for 0.5 volts peak o-peak on the oscilloscope. Couple the signal generator The shunt trimmer C119 across terminals "A" and "F" of rion is variable ond is provided as a bandwidth adiustment
Preset the shunt trimmer to minimum capacity. Adiust Ti reset the shunt trimmer to minimum capacity. Adiust T1
(top) and Tli04 (top and bottom) for maximum gain with 5.75 me. at $75 \%$ of maximum
Adjust the shunt trimmea
esponse with respect to Cl 19 until 42.25 mc. is at $75 \%$
 it is $25 \%$.
To clign the fourth picture i-f transtormer Tlo8 connect
the sweep generator to the fourth picture $\mathrm{i}-\mathrm{f}$ grid, pin 1 of the sweep generator to the fourth picture i-f grid, pin 1 of
V109. Couple the signal generator loosely to obtain markers Connect the oscilloscope to pin 9 of V110 and set to read
3 to 5 volts peak-to peak. to 5 volts peak-to-peak.
Adjust $T 108$ top and b

$$
\begin{aligned}
& \text { Adve shape as shown in Figure } 12 \text {. } \\
& \text { cure } \\
& \text { Adust Co } 93 \text { to pace the } 41.25 \mathrm{mc} .
\end{aligned}
$$

place the 41.25 mc. marker $40 \%$ at 75 | me. marker of $90 \%$. Readjust Tlo8 for flat top aurve as |
| :--- | hown in nigure 12 . NOTE: C193 is incorporated as part of T108, fourth picture

$1-\mathrm{F}$ transtormer. Adjustment is made by varying the pene-- F transformer. Adiustment is made by varying the pene-
ration of the insulated lead, from terminal "E", into the eeramic sleeve ot the bottom of Tlo8 as seen in tigure 26
on page 16 . Care should be taken when adjusting to preven on page 16. Care should be taken when adjusting to prevent
damage to the lead or its insulation. Remove the 180 ohm resistor and the shorts on pin 1 of
V108 and V109. Adjust the bias box potentiometer to obtain - 5.0 volts
bias as measured by a "Voltohmyst" at the junction of of bias as measured
R152, R153 and C122.
TP2 with the shortest leads possible
the the poin 0 volts pear-to-peak on the oscilloscope. Couple the signal generator losely to the grid of the first
pix i amplifier. Adjust the output of the signal generator to


| Figure |
| :---: |
| KRK22D |

Tl and Tliot
Responye
Rotouch Response T 105 , T 106 and T 107 to obtain the response shown Figure 10.
Increase s.
41.25 mce. Adjust output ten times and check attenuation a and 40 times down with curve to set 41.25 m. me. betwe Move the sweep generator to the antenna terminals. Con.
nect -3.0 volts bias to pin 5 of V103. Adjust T106 and T107 slightly to correct for
channel to channel.

To ali ator tolgn the mixer patate circuit, ocnnect the sweep gener
aixer grid test point TP2, in serits with a 1500 mmi ceramic capacitor. Use the shorest leads possible, with weep cable. Connect the sweep ground lead to the top of the tuner.
Set the channel selector switch to channel 4 Connect a 180 ohm composition resistor between terminal
"B" of T105 and the junction of R121 and R125.
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Figure 8-Chassis Bottom View (shown with KRK22D Tuner)

Short the grids of the third and fourth picture 1-F ampli-
fiers to ground, pin 1 of V V 108 ani vile .
 peak on the oscilloscope. Couple the signal gen
10 the diode probe in order to obtain markers. 10 the diode probe in order to obtain markers." and "F" o
The shunt trimmer Clli cross terminals $A$. $A$.
T104 is variable and is provided as a bandwidh adiustment T104 is variable and is provided as a bandwidth adjustment
Preset the shant trimmer to minimum capacity. Adjust T2
 45. Adiust ath shunt trimmer Cll9 until 42.25 mc . is at $75 \%$ response with respect to the low frequency shoulder as
shown in Figure 11 . Readjust $T 2$ and 1104 if necessary to shown in Figure 11. Readjust T2 and T104 if necessory t
obtoin proper wave shape, see Figure 11. Maximum allow
able tilt is $25 \%$. oblan proper whe
able tilt is $25 \%$
To align the
To align the fourth picture I-F transiormer T108, connec
the sweep generator to the fourth picture i -1 grid, pin 1 , the swep generator to the iourt picture i-1 grid, pin
Viog. Couple the signal generator looselv to obtan markers.
Connet the osilloscope to pin 9 of Vil and set to read 3 to 5 volts peak-to-peak.
Adjust 108 top and bottom cores for maximum gain and curve shape as shown in Figure 12.2 mc., marker at $80 \%$ and
Adjust C193 to place the 41.25 me A5.75 me. marker at $90 \%$. Readjust T108 for flat top curve
as shown in Figure 12 . NOTE: C193 is incorp
I-F Transtormer is incorporated as part of T108, Iourth picture iration of the insulated lead, from terminal "E". into the
ceramic sleeve at the bottom of T108 as seen in tigure 26
 damage to the lead or its insulation
Remove the 180 ohm resistor and the shorts on pin 1 of
V108 and V109. Adjust the bias box potentiometer to obtain -5.0 volts of
bias as measured by a "Voltohmyst" at the junction of R152. bias as measured
R15 ${ }^{3}$ and $\mathrm{Cl122}$.
CP2 with the shortest leads poscator to the mixer grid test poin TP with the shortest leads possible.
Adjust the output of the sweeps enerator to obtain 3.0 to
0.5 volts peak-to-peak on the oscilloscope. 0.5 volts peak-to-peak on the oscilloscope.
Couple the signal generator loosely to th Couple the signal generator loosely to the grid of the firs
pix it amplifer. Adust the outut of the signal generato
po produce small markers on the response curve. to produce smail markers on the response curve.


Retouch $\mathrm{T} 105, \mathrm{~T} 106$ and T 107 to obtain the response shown
in Figure 10 . in Figure. 10 .
Increase sweep output ten times and check attenuction at
41.25 mc. Adjust $T 105$ and $T 107$ to set 41.25 mc. between 30 41.25 mc. Adjust T10s and T107 to set 41.25 mc. between
and 40 times down with cure os shown in Figure 10. To align the 1.F amplitier rircuit of the KRK30B. Connect the
VHF swee generator to the front terminal of the N82 Crystal
holder in series with a holder in series with a 1000 ohm resinator and and 1500 mant.
heramic capacitor. Use the shortest leads possible, groundceramic capacitor. Use the shortest leads possible, ground-
ing the sweep ground lead to the tuner cose. To do this.
remove the crystal cover ot the right side of the UHF tuner ene
section. Reefer to Figure 20. .) Cover one lead of the 1000
ohm resistor with a short piece of insulated tubing and tashion a hook al the end of this lead. Connect to the front erminal of the crystal holder through the aperiture under
he crystal cover. Connect the capacitor and generator as stated above. CHANEOVER switch to the UHF position,
Set the UHF CHANGE
and the UHF TUNING between channels 68 and 69 at 800 ${ }^{\text {me. }}$ Connect a 180 ohm composition resistor and a 1500 mmf . Connect a 180 ohm composition resistor and a 150 mmit.
capacitor in series between test point TT3 and ground with
the capacitor connected to TP3 and the resistor to ground. Connect the oscilloscope diode probe to the junclion between Couple the VHF signal
probe in order to obtain markers.
Connect the potentiometer arm of the secon tial o the AGC terminal on the tuner and ground bias supply
pattery meter to praduc the tuner case. Adjust the bias potenti"OoltOhmys" at the AGC terminal on the tuner.
Set the sweep generator to produce 0.5 volt or less peak.
opeak on the oscilloscope.

Adjust C308, on the UHF section, and L9. on the VHF
section, of the tuner tor maximum gain with 45.75 mc . and section, of the funer for maximum gan
42.25 mc. markers as thown in figure 13 . If necessary adjust L27 to place the 45.75 me. marker at
$90 \%$ on the curve. Adjust $\mathrm{L43}$ for minimum tilt of the curve as shown in figure 13 .
Remove the resistor, capacitor and diode probe from TP3
and connect the oscilloscope to pin 9 of V1I0. Use 3.0 to 5.0 and connect the oscilloscope to pin 9
volts peak-to-peak on the oscilloscope.
Connect the VHF sweep generator to the VHF antenna ter-
minale Keep the $A G C$ bias at -3.0 V and the $\mathrm{I}-\mathrm{F}$ bias ai -5.0 volts.
Couple the signal generator loosely to the grid of the first
picture $1-\mathrm{F}$ amplifier. picture i-f ampiliter. VHF channels and check for proper
Switch through all VHF
curve shape as in figure 10 . Retouch T106 and T107 slightly curve shape as in figure 10 Retouch $T 106$ and T 107 slightly
to corract for any overall tilt that is essenticlly the same on
all channels. all channels
Disconnect the VHF aweep generator and connect the UHF
sweep generator to the UHF anienna terminale. Check on all sweep generator to the UHF antenna terminale. Check on all
UHF channels for proper wave shape as shown in figure 10. retouching C 308 and 19 if
filt.
Do not retouch L27, L43, T2, T104, T105, T106 or T107.
Remove the sweep and marker generators and the bias
RRK22D TUNER ALIGNMENT.
Models 24-D-542. 24-D.543 and 24.D-544
A tuner unit which is operative and requires only touch up
adiustments, requires no presetting of dijusimenta. For wuch units, skip the remainder of this paragraph. For nuits which
are compleetly out of adiustment, preset C 2 all the way out.
 T1 slug all the way out. Do not ch
Disconnect the link from terminals "A" and "B" or T104
and terminate the link with a 39 ohm composition resistor. and terminate the link with a 39 ohm composition resistor.
Turn the receiver channel selector switch to channel 2 . The 43.5 mc trap is adjusted with zero bias. To insure that the bias will remain constant thake a clip lead and ehort
circuit the AGC terminal of the tuner at the terminal board to ground.
Co ground.
Connect the oscilloscope to the test point TPI on top of tho
tuner unit. Set the oscilloscope to maximum gain. Connect the output of the VH signal generator to the out-
put of the ontenna matching unit at at the junction of L53 and
C24 at the bottom of the FM trap L53.
Tune the signal generator to 43.5 mc . and modulate it $30 \%$
with a 400 cycle eine wave. Adjust the signal generator for
maximum output. maximum outpul.
ceícono


Figure 1t-KRK22D Tuncr Adiustments
Adjust C 19 on top of the tuner, for minimum 400 cycle ind cation on the oscilloscopes. If necessary, this adjustment can be retouched in the field to provide additional reiection to one speciic frequency in the if band pass However, in
such cases, care should be taken not to tune Ci9 into channel 2, thereby reducing sensitivity on channel 2 .
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery positive terminal to the tuner case. Adjust he bias poternti poneter to produce -3.0 voltis of bias, as measured by the
"Voltohmyst" at the AGC terminal on the tuner.

Sel the channal selector switch to channel 8 .
Presel C5 to read -3.0 volts at the test point TPl, as read
on the "Voltohmyst." The limits for oscillator iniection yolt age are 2 volis minimum and not exceeding a maximum ol age are
f. 5 volis.

Turn the line tuning control fully clockwise Adiust C f or proper oscillator frequency, 227 mc . This
nay be done in several ways. The eaciest way and the way which will be recommended in this procedure will be to use eat the oscillator against the signal generator meter and hne the signal generator to 227 mc . with crystal accuracy. aron ent and a piece of insulated wire into the tuner unit
hrough the hole provided for the adjustment of C10 Be care may cause wire does not touch any of the tuned circuits oas Connect the other end of the wire to the oscillator to shift.
 Turn C2 clockwise until the beat note just begins to change. Then furn one fulif turn in the same clockwise direction.
Return the line tuning control to the mechanical center of its range.
Note. -If on some units, it is not possible to reach the
proper channel 8 oscillator frequency by adjustment of C 3 , switch to channel 13 and adjust $L 42$ to obtain proper channel 3encillaiof switch to channel 12 and adiust Lll to oblain proper channel 12 oscillator frequency. Continue down 10 channel 8 . adjusting the appropriate oscillator trimmer to obtain the adjutc C3 to obtain proper channel 8 oscillator frequency. witch back to channel 13 and read) Set the Tl core for maximum inductance (coro turned counter-Clockwise).
Cornect the swep generator through a suitable attenualor, as shown in fig
antenna matching unit

ligure 15-Siurcep Attenuator Pads
Connect the signal generator loosely to the antenna tor Set the sweep generator to cover channel 8 . Set the oscilloscope to maximum gein and use the miniacilloscope. Excessive input can change oscillator injection during atignment and produce consequent misalignment
ven though the response as an the oscilloscope may
look normal.


Tarker (10-KRK22I) R.F Responses
Insert markers of channel 8 picture carrier and sound
arrier, 181.25 mc and 185.75 mc . Adust C7, C10. C15 and C20 for approximately correct
curve shape, frequency, and band widh as shown in ligure

The corract adjustment of C20 is indicated by maximum
mplitude of the curve midway between the markers. C15 tunes the r-l amplifier plate circuit and alfects the frequency
of the pass band most noticabbly. C7 lunes the mixer grid
 coupling ad
Connect the "VoltOhmys"" to test point TPI. Adjust C5 to
 mum gain at midpoint of the curve. Repeat if necessary until mum gain at midpoint of the cur
the proper response is obtained.
Set the receiver channel switch to channel 13
Adjust the signal generator to the channel 13 oscillator Turn the fine tuning control fully clockwise.
Adjust $L 42$ to obtain an oudible boat. Slightly overshoot
he daustment of L42 by turning the slug an additional turn the adjustment of L42 by turning the slug an additional turn
in the same direction from the original antting then reset the
oscillator to proper frequency by adjusting C2 2 to again obin the beat
Set the sweep generator to channel 1
From the signal generator. insert channel 13 sound and Adjust 143 and L45 for proper response as shown in gure 16.
Turn off the sweep and signal generatore

Check the oscillator injection vollage to be within limita as
reviously specified. Adjust if necessary to bring within previo
If it was necessary to readjuat C5, turn the sweep and sig-
nal generators back on and recheck the channel 13 response. hal generators back on and reche Sot the receiver channel selector switch to channel 8 and
readiust C 2 for propar oscillator frequency, 227 mc. eadjust $C 2$ for proper oscillator frequency. 227 mc .
Set the sweep generator and signal generator to channel 8 . Readiust C7. C10. C15 and C20 for correct curve shape. Requency and band width.
Turn off the sweep and signal generators, switch back to
hannel 13 and check the oscilletor injection voltage oft TPI Channel 13 and chack the oscillator injection voltage at
I $C 7$ was adiusted in the recheck of channel 8 response.


If the initial setting of the oscillator injection trimmer was
far offf it may be necessary to adjust the oscillator frequency and response on channel 8, adjust the oacillator injection on channel 13 and repeat the tracking procedure several time
Turn of the sweep generator and switch the receiver to
channel 6 . Adjust the signal generator to the channel 6 oscillator
frequency 129 mc. Set the fine tuning control to the center of its mechanical
 lor proper curve
oscillotor injection voltage ot TPI, to insure that it is within the limits specilied. Readiuat C5 if necessary. If CS required adjustment, switch the receivor and the shape and recheck C2 and C3 for proper oscillator frequency Check the response of channels 2 through 6 by switching
the receiver channel switch. sweep generator and marke generator to each of these channels and observing the re 16 tor typical response curver. It should be tound that al ther typical response curver. It should be found that al
thase channels have the proper response with the markeri above $80 \%$ response.
II the markers fail to fall within this requirement readjust
L44. L46 and L58 in order to oblain curves within the proper

 aspons
 Adiunt the oscillator to frequency on all channelis by wwitch ing the receiver and the trequency y tandard to each channol
and adiusting the appropriate oscillatorer slug tio and adiuating the appropriate oncillator slug to obtain the



 Templed in the customers home since even siigh1 misclign.

 tenna matchi
be rociligned.
 nent of the unit.
 ${ }^{\text {S4 }}$ With a short jumper, connect the output of the malching

Replace the cover on the matching unit while making all
adiustments. Remove the firt pix i. c amplitier tube Viob.
 Cl20. Set the poientiomeier io produce approximate
volits of bias af the iunction ol M18, R146 and C120.
Connect an oscilloscopo to the iunction of R129 and L103
and set the oscilloscope gain to maximum. and bet the oscilloscope gan to maximum.
Connect aHF signal generator to the amienna input termi-.
nalis. Modulate the tignal generator $30 \%$ with an audio
sign $\underset{\substack{\text { nals } \\ \text { signal. }}}{ }$

 on the oscilloscopope
Tune the signal generator to 41.25 mc. .ad adiust $L 57$ (L1)
Tor minimum cudio indication on the oscilloscope. Remove the jumper trom the output of the matching unit.

 be opproximotelyd 0.03 volis per inch. Set the oscilloscope
gain gain to maximum.
Connect the VHF sweep generctor to the motching unit
antena input terminalse In order to prevent coupling reac-



 $\stackrel{10}{\text { io minctich }}$
Connect the signal generator loosely to the matching unit
antennat terminals.

 With Whagh sweep generators this macy be accomplished by
retuning channel number 2 to cover the tange. in mating these adjustiments on the generator, be sure not to turn the
core too lar clockwise so that it becomes lost beyond the core
core etimining spining.


 consistent with the specitied shape of the response curve. The
adiustments in the matching unit interact to some extent
 necessary



Figure 18-KRK22D or KRK30B Antenna Matching KRK 30B TUNER ALGGMENT
24-D-542U. 24-D. $543 U$ and $24-D-544 U$
VHF ALIGNMENT.-A tuner unit which is operative and requires only touch up adiustments, requires no preselting
of dausiments. For such units, skip the remainder of this parragraph. For units which aree completely out of adjuastment. preset C27 ail the way out. Set channel 7 to 13 oscillator
sugs one turn trom tithat. Turn T2 Slug all the way out. Do not
change any of the adiustments in the antenna matching unit. Disconnect the link from terminals " "A" and " B " of T104 and
erminate the link with a 39 ohm composition resistor. Turn the receiver channel selector switch to channel 2 The 43.5 me. trap is adjusted with zero bias. To insure that the bian will remain constant, take a clip lead and short cir-
cuit the AGC torminal of the tuner of the terminal board to Connect the oscilloscope to the test point TP2 on top
the tuner unit. Set the oscilloscope to maximum gain. Connect the output of the VHF signal generotor to the
oulput of the antenna motching unit ot the junction of $L 5$ and
C4 at the bottom of the FM trap LS .
Tune the signal generator to 43.5 mc. and modulate it $30 \%$
with a 400 crcle sine wave. Adjust the signal generator for
maximum output maximum output.
Adjust C33 on top of the tuner, for minimum 470 cycle indi-
cation on the oscilloscope. If necessary, this aajustment cal be retouched in illos foeld. to perovidery. thit acalustment can one specitic frequency in the i-i band passs. However, in such
cases, care should be taken not to tune C33 into channel cases, care should be taken not to tune C33
, thereby reducing sensitivity on chamnel 2 .
Connect the potentiometer armof one of the bias supplies
to the $A G C$ terminal on the tuner and ground the batitery positive terminal to the tuner case. Adjust the bias potenti Meterer to produce - 3.0 volts of bias, csis meacursed by the
VoltOhmyst ot the AGC terminal on the tuner. Set the channel selector switch to chamnel 8 . Preset C22 to read. - 3.0 volts ot the test point TP1, as read
on the "Voltohmyst." The limits for oscillotor injection voltage ore
5.5 volts.

Turn the fine tuning control fully clockwise.
Adjust C25 for proper oscillalor frequency, 227 me. This
may be done in several ways. The eaxiest way and the way mafy be done in several ways. The earsiest way and the was
which will be recommended in this procedure will be to use the signal generator an a beterodyne frequency meter and
beat the oscilltoro gainst the signal generator. To do this,
tune the signal geneator to Insert one end of a piece of insulated wire into the tune unit through the hole provided for the adjustment of Cle
Be careful that the wire does not touch any of the tuned circuits as it may cawse the frequency of the tuner oscillmor
to shift. Connect the other end of the wire to the irt to shift. Connect the other end of the wire to the "r.i" in
torminal of the signal generator. Adjust C25 to obtcin an
cudible beat with the sigel cudible beat with the signal generator.
Turn C27 clockwise until the beat note juat begins to
change, then turn one full turn in the same clockwise di-
rection
Return the fine tuning control to the mechanical center of its range.
NOTE:-lf on some units, it is not possible to reach the
proper channel 8 oscillotor frequency by adjustment of C25. proper chamnel 8 oscillator frequency by adjustment of C25
switch of channel 13 acd adjust 149 to obtain proper channe 13 oscillator frequency as indicated in the table on page 8 .
Then, switch to channel 12 and adiust $L 60$ to obtcin prope channel 12 oscillator frequency Continue down to channel 8 . adiusting the appropricte oscillator trimmer to obtin the
proper frequency of each chamnel Then agein on channel 8 , adjust C25 to obloin proper chamnel 8 oscillator trequency.
Switch back to channel 13 and readjust L49 and back to Switch back to channel
channel 8 and adjust C 25 .
Set the $\mathbb{T 2}$ core for maximum inductance (core turned
counter-clockwise). counter-clockwise).
Connect the sweep generator through a suitable attenu-
otor, ss shown in if oure 15 to the input terminals of the
antenna motching unit.


Figure 19-KRK30B VHF R-F Response Set the oscilloscope to maximum gain and use the minimum
input signal which will produce a usable pottern on the oscil. loscope. Excessive input can change oscillotor injection during alignment and produce consequent misalignment even
though the response as seen on the oscilloscope may look Insert markers of channel 8 picture carrier and sound
carrier. 181.2 mac. mand 185.75 me. Adjust C22, C16, C11 and C7 for approximately correct
curve shape, frequency, and band width as shown in igure The correct adjustment of C7 is indicaied by maximum
amplitude of the curve midway between the amplitude of the curve mid. funes the ri-i ampliter plate circuit and aftects the requency
of the pass band most noticeably. C21 tunes the mixer grid
circuit and attects the tilt of the eure most circuit and attects the tilt of the curve most noticeably
suming that C7 bas been properly adjusted). Cl6 is the suming that C7 has been properly adiusted. C16 is the
coupling diustment and hence primarily ottects the response
band width

 mum gain at midpoint of the curve. Repect if nec
the proper response is obtained.
Set the receiver
Sel the receiver channel switch to channei 13
Adjust the signal generator to the channel 13 oscillator ire.
quency 257 mc. Turn the fine tuning control fully clockwise. Adiust LA9 to oblain an audible beat. Slightily overshoot the
adjustment of L49 by turning the slug an additional adiustment of Lis by turning the suag an additional turn in
the same direction from the oricinal setting then reset the the same direction from the original setting. then reset the
oscillotor top oroper frequency by adjusting C 27 to agcin ob-
tain the beat tain the beat.
Set the sweep generator to channel 13.
From the signal generator, insert channel 13 sound and pic-
lure carrier markers, 211.25 mc. and 215.75 mc . Adjust 136 and L 20 for proper response as shown in tig.
ure Turn off the sweep and signal generators. Connect the "VoltOhmyst" to the tuner test point TPI. Check the oscillator iniection voltage to be within limits.as
previously specified. Adjust it necessary to bring within
range. was necessary to readiust C22, turn the sweep and If it was necessary to readjust C22, turn the sweep and
signal generotors back on and recheck the channel 13 re-
sponse. Readjust L36 and L20 it necessary. Set the receiver channel selector switch to channel 8 and
readjust C27 for proper oscillotor frequency, 227 mc. Set the sweep generator and signal generator to channel 8 . Readjust $\mathrm{C} 21, \mathrm{Cl6}, \mathrm{C11} \mathrm{and} \mathrm{C7} \mathrm{for} \mathrm{correct} \mathrm{curve} \mathrm{shape}$,
trequency and band width. Turn oft the sweep and signal generators, switch back to
channel 13 and check the oscillator injection voltage at TP1
 and response on chasnel , adjust the oscillator injection on
channel it and repert the tracking procedure several times
belore the proper setting is obtcined.


$$
\text { Figure } 20-K R K 30 \mathrm{~B} \text { Tuncr Adiustmen }
$$

Turn of the sweep generator and switch the receiver to
channel 6 . Chandel
Adjust the signal generator to the channel 6 oscillator frequency 12 in me Adjust L54 for an audible beat. Adjust L14, L48 and L32 for proper curve shape as shown in tigure 19. Recheck the
oscillator injection voltage at TPL, to insure that it is within
 It C22 required. adjustument, switch the receiver and the
signal generator to channel 8 . Readjust C21 for correct curve signal generetor to channel 8. Readjust C21 for correct curve
shape and recheck C27 and C2S for proper oscillortor fre quency.
Check the response of channels 2 hrough 6 by switching
the receiver channel switch swcep generator to each of these channels and observing the re sponse and oscillator iniection voltage obtaned. See tigur
i9 for typical response curves. It should be There chaical response curves. It should be found that all
these chane the proper response with the markera
atove above $80 \%$ response.
II the markers
Laid to tell wiltin this requirement readius
LAB
and $L 32$ in order to obtain curves wilhin the proper $\underset{\substack{\text { limits } \\ \text { Swit }}}{ }$ Switch the channel selector-; signal generator and marker
generator through channels 7 to 13 and observe the respor curves. reterring to tigure 19 for proper warve shape. Chect the injection voltage off each channel to be within ilimitit.
necessary readjust C11, C21 or C16 to obtcin the prope response.
With the
With the receiver and signal generator on channel 13 ad
just $L 49$ for an audible beat with the signal generator. Adjust the oscillator to frequency on all channels by switch
ing the receiver and the frequency standard to each chanel ing the receiver and the frequency
and adiusting the appropriate oscillator slug to oblain the
aud and adiusing the appropriate oscillator slug to oblain the
audible beot. It should be possible to adiust the oscillator t
obtain the audible beat on each hannel Recheck the oscil obtain the audible beat on each channel. Recheck the oscil.
lator injection voltage on each channel to verify that the

UHF ALIGNMENT. - R-F alignment of the UHF section of
the tuner may only be performed with the UHF section re moved from the tuner assembly. R-F adiustments require re UHF tuner separate from its mounti only be done with the HF tuner separate from its mounting.
$1-\mathrm{F}$ and oscillator adjustments may be accomplished with out removing the tuner.
Comnect $a l 00$ ohm
Conductor of the ohm composition resistor between the center
Connect the oscill
Colt and the tuner case. Connect the oscill iscope to the center conductor of W30
at the 100 ohm resistor emploting or the 100 ohm resistor, employing the preamplitier if needed
with the oscilloscope used. Ground the oscilloscope to the tuner case.
Connect
Connect the output of the UHF sweep generator, through
a 300 ohm attenuctor pad, to the ante nna terminals and set the sweep generethor to. sweep channenal terminals contered on
887.5 mc. Adjust the output of the sweep generator to full sweep width
A test dial made to


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| $\underset{\substack{\text { STMBOL }}}{\text { grem }}$ |  | Deschiption |
| :---: | :---: | :---: |
| L304 | 79564 | Board-Antenna terminal board assembly |
|  L308, L309 | 795 | Choke-RF. choke <br> Coil-Mixer coupling coil for oscillator |
| L310 | 79567 |  |
| ${ }_{2}^{12311}$ | 79566 | Coil-Osecillator loop coil |
| R301 | 502222 | Resistor-Fixed, compositio |
| R302 | 512268 | Resistor-Fixed, composition, 68 |
| R303 | 502268 | Resistor-Fixed, composition, 6800 |
| C101, C102 | 73960 | Capacitor-Fixed, ceramic, 01 mf f. 500 v . |
| C103, ${ }^{\text {C10 }} 104$ |  | Part of |
| ${ }^{\text {c } 106}$ |  | Pant of T 102 |
| C107.C108 | 39644 | Capacitor-Fixed, mica, 470 mmf . $\pm 5 \%, 500 \mathrm{v}$. |


|  | STOCK | description |
| :---: | :---: | :---: |
| C109 | 73595 | Capacitor-Fixed, paper, 0022 mf ., |
| C110 | 33748 | Capacitor-Fixed, ceramic, 1500 mmi ., |
| $\mathrm{Cl11}$ | 74521 | Capacitor-Electrolytic, 5 mfd, 50 v . |
| C112 | 76508 | Capacitor-Fixed, paper, 0015 mi $\pm 5 \%$, 600 v . |
| C113 | 73561 | Capacitor-Fixed, paper, 01 mf ., $\pm 10 \%$, 400 v |
| C114 | 73558 | Capacitor-Fixed, paper, . 047 " mf., |
| C115 | 47617 | Capacitor-Fixed, ceramic, 270 mmf ., |
| C116 | 3599 | Capacitor-Fixed, paper, 0027 mf ., <br> $\pm 10 \%$, 600 v . |
| C117 | 73561 | Capacitor-Fixed, paper, 01 mi., $\pm 10 \%, 400$ v. D.C. |
| C118 | 73595 | Capacior-Fixed, paper, 0022 mf ., $\pm 5 \%, 600$ v. D.C. |
| C 119 C 120 | ${ }_{98225}^{71496}$ | Cappacitor-Adicutable mica, 4.70 mmit. Capacitor-Fixed, cercmic, 10 mmit, 500 |
|  |  | Capacitor-Fixed, ceramic, 10 mmin ., 500 v. D.C. |
| C121, C122 | 78905 | Capacitor-Fixed, paper, 0.22 mf . $\pm 20 \%, 200 \mathrm{v}$. D.C |


|  | ${ }_{\substack{\text { STOCI } \\ \text { NO. }}}$ | deschiption | STMBo. | srocr | deschiption | stimbot |  | description |  | Stocr | description |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ${ }_{\substack{\mathrm{C} 123 \\ \mathrm{C} 124 \\ \hline 12}}$ | 77293 |  | C184, C185 | 73597 |  | R131 | ${ }^{766}$ | Resistor-Fixed, wire wound, 4000 ohms, | R189 | 5024 | Resistor-Fixed, composition, 330,000 |
| C12 | 73950 | + $100 \%$, $-0 \%$, 500 v. D.C. |  |  |  |  |  | ${ }_{\text {Same }}^{ \pm 10 \%, 7 \mathrm{w}} \mathrm{F}$ | R190 | 502482 | $\xrightarrow{\text { ohms, }} \pm 100 \%$, $1 / 2 \mathrm{w}$ |
| C125 | 73960 | Capacitior-fixixed, ceramic, 0.001 ml . | C186 | 79022 | Capacaitor-Fixed. micas, 270 mmf . $\pm 20 \%$, $1000 \mathrm{v} . \mathrm{D} . \mathrm{C}$. | ${ }_{\text {R133 }}$ |  | Pame of 1108 |  |  | Resisisor-fixad, conposition, 820,000 |
| $\mathrm{Cl}_{126}$ | 78622 | Capaceitor-Fixixed, coramic, 470 mmf , $\pm 10 \%$, 500 v. D.C. | ${ }_{\text {Cli }}^{\text {C187 }}$ | 79391 | Parr of Yoie Capacitor Fixed, electrolytic, | R134 | 522310 | Resistor-Fixed, composition, 10.000 ohms, $\pm 10 \%$, $2 \mathbf{w}$. | 19 | 50242 | Resistor-Fixed, composition, 220,000 ohms, $\pm 10 \%, 1 / 2 \mathrm{w}$. |
| ${ }^{\mathrm{C} 127}$ |  | Same as C124. |  | 79391 | $\begin{aligned} & \text { Capacitor-Fixed, electrolytic, } 90-20-10 \\ & =10+5 \%, 450 . \quad 70-25-5 \mathrm{mf} .,-10 \end{aligned}$ | R135 | 502239 | Resistors-Fixed. composition, 3900 | R192 | 502368 | Resistor-Fixed, composition, 68,000 |
| ${ }_{\text {c } 129}$ |  | Same as ${ }^{\text {cill }}$ |  | 79292 | Capacitor-Fixed. ${ }^{\text {min }}$ ( ele | R136 | 50203 |  | R193 | 502239 | $\xrightarrow{\text { ohms, } \pm 10 \%, 1 / 2 \mathrm{w}}$ (esistor-Fixed, comp |
| C130 $\mathrm{Cl3}$ C 31 |  | Same as C125 | ${ }_{\text {A B B C, }, ~}^{\text {d }}$ |  | midd. $-10+50 \%$, 400 volts D.C.: 50 | R137 | 502122 | ${ }_{\text {Resisitor-Fixed }}^{ \pm 10 \%}$ |  |  | ohms, $\pm 10 \%$, $1 / 2 \mathrm{w}$. |
| C132A, ${ }^{\text {c }}$ | 79319 | Capacitor-Fixed, ceramic, 0.001/0.001 | C190 | 880 | Capacioror Electrolytic, 20 mf . -10 |  |  | $\pm 20 \%, 1 / 2 \mathrm{w}$, | R194 | 512 | Resistor-Fixed, composition, 100,00 ohms, $\pm 10 \%$, 1 w . |
| $\mathrm{Cl}^{134}$ |  |  | C191 | 79488 | $\stackrel{+250 \%, 25}{ }$ | R138 | 512318 | Resisor-Fixed, comp | R195 |  |  |
| ${ }_{C 135}$ | 75166 | Capacitor-Fixed, ceramic. 1500 mmf . $+100 \%,-0 \%$, 500 v . |  |  | $\pm 5 \%, 500 \mathrm{v}$. Temp. coef. - $750^{\circ}$ noninsulated | R139 | 7664 | Resistor-Fixed wire wound, 6750 ohms , $\pm 10 \%$, 10 w . | R19 | 512356 | Resistor-Fixed, composition, 56,000 ohms, $\pm 10 \%, 1 \mathrm{w}$. |
| C137 $\mathrm{Cl38}$ | 39044 | $\xrightarrow{\text { Part of }}$ Capaitior-Fixed, ceramic, 15 mmf f. 500 | C192 | 73595 | Capaciot-Fixed, paper, 0.0022 mt , | ${ }_{\text {R140 }}^{\text {R141 }}$ | 7644 522282 | Conitol-Contrast control Resistor-Fixed, composition, 8200 ohms, | R197 $\mathrm{R198}$ | 502047 | Same as R169 <br> Resistor-Fixed, composition, 47 ohms, |
|  |  | Pat. D.C. | ${ }_{\text {Cl193 }}^{\text {C194 }}$ | 33380 | ${ }_{\text {Parr of tiog }}^{\text {Capacior- }}$ Fixed. ceramic, | R142 |  | $\xrightarrow{ \pm 10 \% \% 2 \mathrm{~m}}$ ( | R199 | 79378 |  |
| ${ }_{\text {Cli }}$ |  | Part of Lilos |  | 350 |  | R143 | 512282 | Resistor-Fixed, composition, 8200 ohms, |  |  |  |
| C141 | 79019 | Capacitor-Fired. ${ }^{\text {Paper, }} 0.0082 \mathrm{mf}$. $+10 \%$, $400 \mathrm{v}. \mathrm{D.C}$. | ${ }_{\text {C198 }}^{\text {C199 }}$ |  | Same as Cil25 Same as Ciso | ${ }_{\text {R144 }}$ |  | $\stackrel{\text { Same as }}{ }$ | R200 | 522318 | Resistor-Fixed, composition, 18,000 ohms, $\pm 10 \%$, 2 w . |
| C142 | 3942 | Capacitor-Fixed, ceramic, 47 mmf . 500 v. D.C. | C200 |  | (eater | R145 | 502433 | Resistor-Fixed, composition, 330,000 ohms, $\pm 10 \%, 1 / 2 \mathrm{w}$. | R201 | 512339 | Resistor-Fixed, composition, 39,000 |
| Cl43 | 73794 | ${ }_{\text {Same cs }}^{\text {Cling }}$ | ${ }_{\text {F101 }} 101$ | 78214 35787 | Fuse-3 ${ }^{\text {amp }}$, Connector-Ph | R146 | 502447 | Resisior-Fixed. composition, 470,000 ohms, $\pm 10 \%$, $1 / 2 \mathrm{w}$. | R202 | 50242 | Resistor-Fixed cod composition, 270.000 |
| C145, C146 | 73784 |  | ${ }_{1102}$ | 68590 | Comer | R14 | 512522 | Resistor- - Fixed, composition, 2.2 meg - | R203 | 7879 | $\xrightarrow{\text { ohms, }}$, $10 \%$, $1 / 2 \mathrm{w}$ |
| 45, | 7359 | Capacitor - inded paper, 0.1 m.. | 2101 | ${ }_{7}^{79383}$ |  | R148 | 502410 | Resistor-Fixixd, ,oomposition, 10,000 |  |  |  |
| C147 | 7359 | Capacitor-Fixed, paper, 0.0027 mt. | ${ }_{\text {L102 }}^{\text {L103 }}$ | 7347 | Coil-Choke coil Part of T 108 | R149 | 502427 |  | ${ }_{\text {R206 }}$ | 512410 |  |
| C148 | 73920 | Capacitor-Fixed, paper, $0.0047 \mathrm{mt}$. | ${ }_{\text {L104 }}^{\text {L105 }}$ | \% ${ }_{7}^{9848882}$ | Coil-Peaking coil 250 mh Coil-Trap. $4.5 \mathrm{M} . \mathrm{C}$. Irap includes C140 | R150 | 502418 |  | R20 | 793 | Resistor-Fixed, wire wound, 250 ohms, |
| C149 | 39640 | Canpaitor Fixied, mica, 330 mmi . | L106 L107 | ${ }_{765452}^{7564}$ |  | R151 |  |  | R208 | 76989 |  |
| C150 | 73562 | Cappaitor Fixived, paper, 0.022 mf . | ${ }_{1110}$ | 796161 | Coil-horizonal sine wave coil | ${ }_{\text {R152 }}$ | 70320 | Same as R148 |  |  |  |
| C151 | 73552 | Capacitor-Fixed, paper, 0.033 mf . | ${ }_{\text {L112 }}$ | ${ }_{76640}^{7640}$ | ${ }_{\text {Coill }}^{\text {Coil-Widh coil }}$ Corm. choke coil- 1.5 m |  |  |  | R209 | 512327 | Resistor-Fixed, composition, 27,000 ohms, $\pm 10 \%$, 1 w. |
| 52 | 39632 |  | $\underset{\substack{L 113 \\ \mathrm{L14} \\ \hline 10}}{ }$ | 76442 | Coil-Horizontal linecrity cal | ${ }_{\text {R155 }}$ | 439 | Scese as R146 | R210 | 50224 | Resisitor-Fixed, composition, 4700 ohms $+10 \%$, $/ 2 \mathrm{w}$. |
|  |  | ${ }_{\text {Same as Cl41 }}^{ \pm 10 \%}$, 5 v.C. | ${ }_{\text {Lill }}^{\text {Lil }}$ |  | Part of Yoke Choke-File | R156 | 78808 | Control-AGC control | ${ }^{\text {R211 }}$ |  | Same as R164 |
| C154 | 3561 | Capaciior-Fixed. paper, 0.01 mf . | ${ }_{\text {L119 }}^{1119}$ | 793990 | Trap-1.F. grid trap 47.25 MC | R157 | 502539 |  | R212 R 213 | 512347 |  |
| 155 | 250 | Capacitor -Fixed, mica, 560 mmi . |  |  |  | R158 | 502468 | Resistor-Fixed, composition, 680,000 |  |  | ohms, $\pm 10 \%$, 1 w . |
| C156 | 76474 | Capacitor-Fixed, micc, 82 mmI . $\pm 5 \%$, | R102 | 50247 | Resistor-Fixed, composition, 470,000 ohms, $\pm 20 \%$, $/ 1 / 2 \mathrm{w}$ | R159 | 502543 | Resistors-Fixed, composition, 4.7 meg., |  |  | Reshms, $\pm 20 \%$, $1 / 2 \mathrm{w}$. |
| 157 | 79017 | Capacitor-Fixed, paper, 00047 mf . | R103 | 522322 | Resistor-Fixed, composition, $\pm 10 \%, 2 \mathrm{w}$ | R160 | 502427 | $\xrightarrow{\text { a }}$ | R217 | 02010 | Resistor-Fixed, composition, 10 ohms, $\pm 20 \%, 1 / 2 \mathrm{w}$ |
| C158 | 72809 | Capacitor-Fixed, mica, $5 \mathrm{mmf}, \pm 20 \%$, | ${ }^{\text {R104 }}$ |  | Part of T 101 |  |  |  | R218 S101 |  | $\xrightarrow{\text { Some cos Ril2 }}$ Switch-Phono-tone switch |
| C159 | 58476 | ${ }^{1500 ~ v . ~ D . C . ~}$ | R105 | 502210 | Resistor-Fixed, composition, 1000 ohms, $\pm 10 \%$, $1 / 2$ w | R162 | 502312 | Resistor-Fixed, composition, 12,00 ohms, $\pm 10 \%, 1 / \mathrm{w}$ | T101 | 76981 |  |
| C160 | 73920 |  | R106 | 502047 | Resistor-Fixed, composition, 47 ohms, $\pm 10 \%, 1 / 2$ w. | R163 | 502356 | Resistor-Fixed, composition, 56,000 ohms, $\pm 10 \% \% \% / 2 \mathrm{w}$ | T102 | 7212 | Tramfiormer-Ratio dotector cenior fro- |
| C161 | 73592 |  | R107 | 502339 | Resistor-Fixed, composition, 39,000 ohms, $\pm 10 \%$, $1 / 2 \mathrm{w}$. | R164 | 502322 | Resistor-Fixed, composition, 22,000 | T103 | 77821 | Transiormer-Audio output |
|  | 73784 |  | R108, R109 | 502310 | Resistor-Fixicd composition, 10,000 hms, $\pm 5 \%$, $/ 2 \mathrm{w}$. | R16 | 502227 | Oesistor $\pm$ Fired, composition, 2700 | T104 | 79386 | Transiormer-1.F. sound take-off, 4.5 M.C. includes C123, R118 |
| ${ }_{C 163}$ |  |  | R110 | 502610 | Resistor-Fixecod composition, 10 meg | R166 | 502422 |  |  | 76433 | Transtormer-list, 2nd and 3rd px |
|  |  | $\pm 20 \%$, 600 v v. C . | 111A, B | 7655 | Control-Volume-"On-Off" brightne | R167 | 502456 | Retistors, -ixad, composition, 560,000 | T108 | 79389 | ${ }_{\text {Transiormer- }}^{\text {tratiormer }}$ |
| ${ }^{\text {Cl64 }}$ | 73849 73988 |  | R112 | 50231 | $\xrightarrow{\text { control }}$ Resistor-Fixed, com | R168 | 502327 |  |  |  | includes R133, C113, C139, C193, Li03 |
| . 165 | 73798 | Capacitor--Fixed, paper, 0.022 $\pm 10 \%$, 60 v. D.. c. | R113 | 502430 |  | R169 | 502510 |  | T110 | ${ }_{79399} 7$ |  |
| C167. C168 | 76574 | Capacilior-Fixed. ceramic, 39 mmi . $\pm 10 \%$, 3500 v.. C |  |  | Sohms, +2020 , $11 / \mathrm{w}$. |  |  | $\xrightarrow{ \pm}+10 \%, 1 / 1 / w^{\text {w }}$ | T111 T112 | ${ }_{7}^{79382}$ | ${ }^{\text {Transiormer--Verical outpu }}$ |
| C169 | 79021 | Capacitor-Fixed. mica, 220 mml ., | ${ }_{\text {R115 }}$ | 512147 | Resistor Fixed, composition, 470 ohms, |  |  |  | ${ }_{T 113}$ | 78810 | Transiormer-High voltage translormer |
| C170 | 3553 |  | R116 | 522210 |  | ${ }_{\text {R172 }}$ | 502233 |  |  | ${ }_{7}^{79389}$ |  |
| ${ }_{C 172}^{\text {C171 }}$ |  | Same es cili4 | R117 | 502210 | Resistor-Fixed, composition, 100 | R173 |  |  |  |  |  |
| ${ }^{\text {C173 }}$ | 7647 | Capacitor-Fixed, mica, 82 mml . 1000 v. $\mathrm{C} . \mathrm{C}$ | ${ }_{\text {R119 }}^{\text {R118 }}$ |  |  | ${ }_{\text {R175 }}$ | ${ }_{502415}^{79384}$ |  |  |  | $\underset{92586-4 \mathrm{~W}}{\text { SPEARER ASSMBLY }}$ |
| C173 C 174 | 73553 |  | ${ }_{\text {R120 }}$ | 502110 | Resistor Fixed, composition, 100 ohms, | R176 | 78807 | Control-Height conirol |  |  | FOR MODELS |
| ${ }_{\text {C175 }}$ | 73787 | Capacior-Fixed, paper, 0.47 ml . | ${ }^{\text {R1221 }}$ |  | Same as R117 |  |  | $\begin{aligned} & \text { esistor-Fixixed, } \\ & \pm 20 \%, 1 / 2 \mathrm{ww} \end{aligned}$ |  |  |  |
| C176 | 76579 |  | R122 | 36714 | Resistor-Fixed, composition, 15,000 ohms, $\pm 5 \%, 1 / 2 \mathrm{w}$. | R178 | 5022 | Resistor-Fixed, composition, 39 ohms, $\pm 10 \%$, $1 / 2 \mathrm{w}$. |  | 5024 | Cone-Cone and voice coil ( 3.2 ohms ) |
| C177 | 73594 |  | R123 R124 | 50222 | Sesistor-Fixed, composition, 22 ohms, | R179 | 502415 | Resistor--Fixed, composition, ohms, $\pm 10 \%, 1 / 2 \mathrm{w}$. |  |  | with cone and voice coil ( 3.2 ohms) |
| C178 | 543 |  | R125 | 12215 |  | R180 | 522339 | Resistior-Fired, composition, 39,000 ohms, $\pm 5 \%, 2 \mathrm{w}$. |  |  | speaker assembly |
| ${ }^{\text {C179 }}$ |  |  | 126 | 502356 |  | R18 | 502522 | Resisisor-Fixed, composition, 2.2 meg., $\pm 20 \%, 1 / 2 \mathrm{w}$ |  |  | FOR MODELS $24 D 544$ \& U ONLY |
| C180 C 181 | 7.6995 | $\xrightarrow{\text { Capacior-Fixed, paper, } 0.0012 \mathrm{ml} \text {. }}$ | R127 | 50206 |  | ${ }_{\substack{\mathrm{R} 182 \\ \mathrm{R} 183}}$ | 79385 512147 | Control-Vortical linearity control Resistor-Fixed, composition, 470 ohms, |  | 7777 | Speaker-10" PM. speaker Note: II stamping on speaker in instru- |
| 182 | 73557 | Capacitor -Fixed, paper, $0.1 \mathrm{mf}$. . $\pm 10 \%$,600 v. D.C. | R128 |  |  | R185 |  | $\xrightarrow{\text { Reisitor }} \stackrel{1}{ \pm 20 \%}$ Fixed, composition, 15, |  |  |  |
| C182 Cl 183 | 86 | Capacitior -Fixed. paper, 0.27 mi . $\pm 10 \%$, 200 v. D.. | R129 | 247 | (esistor-Fixed, composition, 4700 |  |  |  |  |  | parts by reierring to model number |
| C183 | 73561 | Capacitor-Fixed, paper, 0.01 mf . $\pm 20 \%, 400$ v. D.C. | R130 | 502118 | Resistor-Fixed, composition, 180 ohms, $\pm 5 \%, 1 / 2 \mathrm{w}$. | R188 | 5024 | Resistor-Fixed, composition. 150,000 ohms, $\pm 10 \%, 1 / 2 \mathrm{w}$. |  |  | speaker and full description of part required. |

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Models 17.S.450U, 17.S.451U \& 17.S.453U VHF-300 ohms balanced

## rCA tube complement



A K3D or a 1 N82 crystal is used as the UHF mixer
(1) RCA 6 CF6 All Models
(2) RCA 6CB6
(3) RCA 6 CB 6
4) RCA 6 AN
(6) RCA $6 A \cup 6$
(7) RCA 6AL5
(8) RCA GAVG
(9) RCA 6 ASS
(10) $\operatorname{RCA}$ 12AU7
(11) RCA 6 K6GT (12) RCA 6 SN7GT. ... Horizontal Sweep Oscillator and Control
(13) RCA


 (1) RCA 6 CB6 $\ldots \ldots \ldots \ldots \ldots \ldots \ldots$.................................... chassis designations

KCS87........... Models 17.S.450, 17.S.451 and 17-S.453 employing a KRK32 Tuner.
KCS87A...........Models 17.S.450U. 17.S.451U and 17.S-453U INSTALLATION INSTRUCTIONS
UNPACKING-These receivers are shipped complete in cardboard cartons. The kinescope is sapted ind remove all packing
Take the receiver out of the carton and material.
Make sure that all tubes are in place and are firmly seated
in their sockets.
Check to see that the kinescope high voltage lead clip is in
place.
Plug a power cord into the 115 volt acc power source and into the receiver interlock receptacle.
Turn the receiver power switch to the "on" position, the brightness contr
counter-clock $w$ ise
antenna input
ANTENNA INPUT
Models 17. . 450 . 17 -S. $451 \& 17 . S .453$
The KRK32 tuner unit is designed for VHF reception only Models 17 S 450 U , 17 s 451 L \& 17 S .453 U
The KRK30A tuner unit is designed for UHF.VHF reception with 300 ohm inputs provided for UHF and VHF use. When
using a UHF antenna only or a VHF antenna only connect the single transmission line to the proper receiver antenna
terminals. Do not connect the terminal board jumper W105. terminals. Do not con
(Refer to figure 27.)
(Reter to figure
When $a$ combination UHF.VHF antenna is used, connect the transmission line to the VHF terminals on the terminal
board. Connect the jumper W105 to the UHF terminals as board. Connect the
shown in figure 27.
Signals srom separate UHF and VHF antennas may be fed
to the tuner. To do this connect the individual transmission
to the tuner. To do this connect the individual transmission
lines to their respective terminals on the terminal board. Do
not connect the jumper WiOS. Where a "crossover network"
is employed to match the mon 300 ohm line. connect the line to the VHF terminals. Con board. CHECK FOR PROPER OPERATION.-Turn the power switch to the "on" position and check the operation of the receiver. Each unit has been completely and accurately adjusted at
the factory and should operate normally at this point. However, a check of all the various functions should be performed. Adjustment should be made as outlined below, only where an indication of improper operation is evident. ION TRAP MAGNET ADJUSTMENT.--Set the ion trap magne
approximately in the position shown in Fiqure 3. Starting from this position immediately adjust the magnet by moving it forward or backward at the same time rotating it slightly around the neck of the kinescope for the brightest raster on the screen.
Reduce the brightness control setting until the raster is slighly above average brilliance. Readjust the ion trap magnet for maximum raster brilliance. The final touches of this adjustment should be made with the brighness control at the maximum
clockwise position with which good line focus can be main-


DEFLECTION YOKE ADJUSTMENT.-If the lines of the raster are not horizontal or squared with the picture mask, rotate e knurled yoke nuts.
PICTURE ADJUSTMENTS.-It will now be necessary to obain a test patitern or picture in order to make further adjust.
ments. When the Horizontal Oscillator is operating properly, it
should be possible to sync the picture at this point. However. hould be possible to sync the picture at this point. However.
the AGC LLOCALDISTANT) control is misadiusted on UHF. it the AGC (LOCAL-DISTANT)
VHF receivers, and the receiven
impossible to sync the picture.
Is the receiver is overloading, readjust LOCAL.DISTANT control
synced.


Figure 4-Rear Chassis Adjustments
CHECK. OF HORIZONTAL OSCILATOR ADJUSTMENT.CHECK. OF HORIZONTAL OsCICLA
urn the horizontal (freq.) control clockise untit the picture
is out of sync. with approximately twelve bars slanting down is out of sync. with approximately twelve bars slanting down-
ward to the left. Turn the control counterclockwise slowly. The ward to the diagonal black bars will be gracuaclly reduced and
number only $11 / 2$ to 3 bars sloping downward to the left are
when only when only $11 / 2$ to 3 bars sloping downward to the left are
obtained, the picture will pull into sync upon slight additional counter-clockwise rotation of the control. The picture should
remain in synct of aproximately tof full turns of additional
romaterclockwise totation of the control. Continue counter-
clockwise rotation until the picture falls out of sync. Rotation
beyond fall-aut position hoould produce between 2 and 5 bar
beto before interrupted oscillation (motorboat occurs). Interrupte
oscillation (motorboat) should be reached betore full counte clockwise rotation.
is normal and seiver passes the above checks and the picture is normal and stable, the horizontal oscillator is properly ceed with Centering Adjus
ADJUSTMENT OF HORIZONTAL OSCILLATOR.- If in the turns of counter-clockwise rotation of the cotrol from the pulis will be necessary to make the following adjustment furn the horizontal drive trimmer Cl71 fully clockwise, the The stud flush with the inside edge of the chassis. Se the sin ave coil L121 fully counter.clockwise.
Adjustment of the horizontal frequency control in the cour ter-clockwise direction will show a multiple number of bars belore "motorboat" occurs. Adjust the sine wave coil LIL the horizal frequency control is rited courchs, whis trom the fall-out point.
If it is impossible to sync the picture and the AGC control (UhF, VHF receivers only) is in proper adjustment it will be lised in aly he Horizo outlined in the alignment procedure
CENTERING ADIUSIMENT - The
scope is provided with special centering nets are in the form of two discs moung magnets. These mag tube which is placed around the neck of the kinescomet n inch in brck of the deflectio eis are rotated on the tube so that To shift the picure, other. To shift the picture in the desired direction respect ative centering magnet assembly on the neck of the kinescope. By alternately rotating one magnet with respect to the othe en rotaing the entire assembly around the neck of the tub. proper centering of the picture can be obtained.
WIDTH AND DRIVE ADJUSTMENTS.-Set the
the at "pullin" poin Aduciment of the horizonal drive control aftects the high voltage applied to the kinescope. In order to obtain the highest possible voltage hence the brightes and best focused picture. adjust horizontal drive trimmer coun of the picture then clockwise until the bright line just dis At naximum brightness adjust the width control Llll to obtain correct picture width.
Return the brightness to normal level and readjust the drive Adu
Adjustments of the horizontal drive control aftect horizontal diust hotd and locking range. II he dive $-\frac{1}{}$
HEIGHT AND VERTICAL LINEARITY ADJUSTMENTS Adjust the height control (R165 behind front control panel) until the picture fills the mask vertically. Adjust vertical line arity (R174 behind front control panel), until the test pattern is symmetrical from top to bottom. Adjustment of either con to align the picture with the mask.
FOCUS.-An electrostatic locus type kinescope is employed in these receivers. The receivers operate with fixed focus, ha ing a fixed voltage applied to the focusing electrode


KRK32. or RRK 30A VhF r.F OSClllator adjustments. Tune in all available stations to see it the receiver r-f oscillator ments are required, these should be made by the method outlined in the alignment procedure on page 11 or 14. The adjustments tor channels 2 through 12 are available from the front of the cabinet by removing the channel selector and fine uning knobs and the indicator dial on UHF.VHF models as
shown in Fiqure 5 or 6 . The oscillator for the UHF tuner section of 'the KRK30A tuner should be adjusted by the method outlined on page 14 under Alignment Procedure.
AGC CONTROL-The AGC (LOCAL-DISTANT) control R149 is provided as a customer control on UHF/VHF models. Ad-
justment should be mrde as outlined under "OPERATING justment should
INSTRUCTIONS"

 FM TRAP ADUSSMENT.-In some instances interference CHASSIS TOP VIEW
is provided to eliminate this type of interference. To adjust
the trap tune in the station on which the interference is observed and adjust the FM trap for minimum interterence in the picture. The trap is $L 5$ and is located on the antenna match ing transtorme
CAUTION.-In some receivers, the FM trap 15 will tune down into channel 6 or even into channel 5. Needless to say these channels. It channels 5 or 6 are to be received, check L5 to make sure that adjustment does not affect sensitivity on these two channels.
Heplace the cabinet back and connect the receiver antenno
leads to the cabinet back. Make sure that the serews holding leads to the cabinet back. Make sure that the screws holding
the back are up tight, olherwise it may rattle or buzz when the receiver is operated at high volume.

INTERFERENCE.-Auto igninon, streef cars, electrical ma hich spoils the picture. Whenever possible, the antenna location should be removed as tar as possible from highways. hospitals, doctors offices and similar sources of interference. In mounting the antenna, care must be taken to keep the anenna rods at least $1 / 4$ wave length (at least 6 teet) away from the Shor-wave radio transmixing and receiving equipment may In some instances it may be possible to eliminate the intererence by the use of a trap in the antenna transmission line. However, it the intertering signal is on the same trequency as the television station, a trap will provide no improvement.


| ALIGNMENT PROCEDURE |  |  |  | ${ }_{5}^{54}$ | 711.25 | 715.75 | 757 753 | volls of i.f bias at the junction of R115, R117 and C120. | 5 of V105 and to ground. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| TEST EQUIPMENT.-To properly service the television chassis of these receivers, it is recommended that the followavailable. |  |  |  | 56 | $\begin{array}{r}717.25 \\ 72325 \\ \hline\end{array}$ | 721.75 72775 | 763 769 | 44.5 mc . | Couple the signal generator loosely to the diode probe |
|  |  |  |  | 57. | .729.25 | 733.75 | 775 | $45.5 \mathrm{mc}$. . .......................... ${ }^{\text {T106 }}$ | rder to obtain markers. |
|  |  |  |  | 58 | 735.25 | 739.75 | 781 | $43.0 \mathrm{mc}$. . ${ }^{\text {a }}$ (Note: Peak transformers with cores al end of coils | Adjust 72 (top) and T104 (top) for maximum gain and with |
| vif Sw | Generator | ing the fol | ing require. | 60 | $\begin{array}{r}741.25 \\ 74725 \\ \hline\end{array}$ | 745.75 751.75 | 793 <br> 78 | chassis.) |  |
| ments: ${ }_{\text {(a) }}$ Frequency Ranges |  |  |  | 61. | .753.25 | 757.75 | 799 | Set the signal generator to the following frequency | the oscilloscope when making the final touch on the above |
|  |  |  |  | 62. | 759.25 | 763.75 | 805 | adjust the picture i.f trap for minimum d.c output at junction | adjustment. |
| $35.090 \mathrm{mc} .1.1 \mathrm{mc}$. to $12 \mathrm{mc.s}$ swep width170 to $225 \mathrm{mc}$.12 mc . sweep width |  |  |  | 63 | 765.25 | 76975 | 811 | alt 47.25 the meter when adjustent is made. | Adjust Cl 16 until 42.5 mc . is at $70 \%$ response with respeci |
| (b) Output adjustable with at least 11 voit maximum. |  |  |  | 65. | 771.25 77725 | 775.75 78175 | 817 823 |  | the low frequency shoulder of the curve as shown in Figure |
| (c) Output constant on all ranges. |  |  |  | 66. | 783.25 | 787.75 | 829 | (Note: Core should be at end of coil nearest chassi |  |
|  |  |  |  | ${ }_{68}^{67}$ | $\begin{array}{r}789.25 \\ \hline 79525\end{array}$ | 793.75 7995 | 835 | properiy adusied.) |  |
| (d) Fif Signal Generator to provide the following trequencies |  |  |  | 69 | . 801.25 | 805.75 | 847 | SWEEP ALIGNMENT OF PICTURE LF.- |  |
| crystal accuracy |  |  |  | 70 | 807.25 | 811.75 | . 855 | Models 17-5.450, 17.S.451 \& 17-S.453 |  |
|  |  |  |  | 72 | -81925 | 8837.75 | . 885 | To align the mixer plate circuit. connect the sweep gener | 425 LCC |
|  |  |  |  | 73 | .825.25 | 829.75 | 877 | mmi . ceramic capacitor. Use the shortest leads possible, with |  |
|  |  |  |  | 74. | -831.25 | ${ }^{835.75}$ | 8878 | not more than one inch of unshielded lead at the end of the |  |
|  |  | Sound | Receiver | 76. | 843.25 | ${ }_{847}^{84} 75$ | ${ }^{889}$ | sweep ca |  |
| Channel | ${ }^{\text {Carrier }}$ | Carrier |  | 77 | 849.25 | 8533.75 | 895 | Set the channel selector switch to channel 4. |  |
| Number | $\underset{\substack{\text { Freq. M. } \\ 55.25 .}}{ }$ | 59.95. | ${ }^{\text {Freq. }} 101$ | 78 79 | 855.25 .861 .25 | 859.75 86575 | ${ }^{901}$ | Preset Cll6 to minimum capacity. <br> Adjust the bias box potentiometer to oblain -3.5 volts of |  |
| ${ }_{3}^{2}$ | 61.25 | ${ }_{6}^{65775}$ | 107 | 80 | 867.25 | 871.75 | 913 | bias as measured by a "Voltohmyst" at the junction of R115. | Response l-F Response L9 and C308 |
| 4 | 67.25 | ${ }^{71.75}$ | 113 | 81. | 873.25 | 877.75 | 919 | R117 and C120. | with KRK30A uith KRK30A I-F Response |
|  | 83.25 | 87.75 | 129 | 88 | $\begin{array}{r}8795.25 \\ \hline 8\end{array}$ | 88975 | ${ }_{931}^{925}$ |  |  |
|  | 175.25 | 179.75 | 227 | Catho | Oscillos | scillo |  | 5 of V105 and to ground. | Connect the oscillossope to the junction of R129 and $\mathrm{Ll03}$. |
| 8 | $\begin{array}{r}181.25 \\ 18725 \\ \hline\end{array}$ | 185.75 <br> 191.75 | ${ }_{233}^{227}$ | sitivity | volts pe | required | ble pre. | Couple the signal generator loosely to the diode probe | Leave the sweep generator connected to the mixer grid test |
| 10 | 193.25 | 197.75 | 239 | amplifie | emp | oscil |  | Adjust Tl (top) and 1104 (top) for maximum gain and with |  |
|  | 199.25 <br> 20525 <br> 1 | 203.75 2095 | 245 251 | $\underset{\text { sensilivi }}{\text { Electr }}$ | meter. | er with | DC scale | 45.75 mc. at $75 \%$ of maximum response. | 0.5 volts peak-to-peak on the oscilloscope. |
| ${ }_{13}^{12}$ | 21125 | 215.75 | 257 | is requi | Senior | st" or |  | Set the sweep output to give 0.3 to 0.5 volt peak-to peak on | Couple the signal generator loosely to the grid of the first |
| (c) Output of these ranges should be adjustable and at least 1 volt maximum. |  |  |  | ctu | NSFO | StMen |  | adjustment. | ix i.f amplifier. Adjust the output of the signal generator to roduce small markers on the response curve. |
|  |  |  |  | Conne | ignal | in serie | 0 mmi . | djust C116 until 42.5 mc . is at $70 \%$ response with respe | Retouch T105. T106 and T107 to oblain the response shown |
| VHF Heterodyne Frequency Meter with crystal calibrator if the signal generator is not crystal controlled. |  |  |  | amic | to the | ${ }_{\text {l }}$ lest poin | d | 9. Maximum allowable till is $20 \%$. | Figure 12. |
|  |  |  |  | Otan |  |  |  | Headjust Tl and Tl 04 if necessary to oblain proper shape as in Figure 9. | Increase sweep output ten times and check attenuation at 41.25 mc . Adjust T105 and T107 to set 41.25 mc . between 25 |
| UHF Sweep Generator with a frequency range of 470 mc . to 890 mc . RCA types 40 A or $41 \AA$ or their equivalent. |  |  |  | Oble | rain and | able of | g appre000 ohm | Disconnect the diode probe and the 180 ohm resistor. <br> Connect the oscilloscope to the junction of R129 and L103. | and 35 times down with cuzve as shown in Figure 12. <br> To align the I-F amplifier circuit of the KRK30A, connect the |
| UHF Signal Generator to provide the following frequencies with crystal accuracy if RCA Type 41A is used. |  |  |  | al | cho |  | to the | Leave the sweep generator connected to the mixer grid test | VHF sweep generator to the front terminal of the 1 N82 crystal |
|  |  |  |  | junction | 17 | he seco | will | djust the output of the sweep generator to obtain 3.0 |  |
| ChannelNumbera | Carrier | Carrier | $\mathrm{H}-\mathrm{FO} \mathrm{Oc}$. | Set th | produc | tely - | of bias at | volts peak-to.peak on the oscilloscope | the sweep ground lead to the tuner case. |
|  | Freq. Mc. | Freq. Mc. | 9. M | junc |  |  |  | Couple the signal generator loosely to the grid of the first | To do this, remove the crystal cover and connect the re- |
| is | 477.25 | 481.75 | 523 | Conne | oliohm | junction | and L103 | produce small markers on the response | sistor, arter insulating the lead with tubing, to the crystal front terminal. |
| 1617 | 483.25 | 487.75 | 529 | Set the | gnal ge | each of | wing fre- | 45. | Set the UHF CHANGEOVER switch to the UHF position, and |
|  | 489.25 | 493.75 | 535 | quencie | eak the | adjust | maximum | 7\% | the UHF TUNING between channels 68 and 69 at 800 mc . |
| 18 | + 4 | 499.75 <br> 505.75 |  | indicatio should | d woith | Note: | siormers |  | Connect a 180 ohm composition resistor and a 1500 mmf . |
| 20 | 507.25 | S11.75 | $\begin{array}{r}553 \\ 559 \\ \hline 59\end{array}$ | nearest | sis.) Dur | nent, red | nput sig. |  | capacitor in series between test point TP3 and ground with the capacitor connected to TP3 and the resistor to ground. |
| 22 | 513.25 519.25 | \$ $\begin{aligned} & 517.75 \\ & 523.75\end{aligned}$ | + 559 | ${ }_{\text {nal }}^{\text {nal }}$ if n n | ${ }_{3.5}^{\text {in order }}$ | as 3.0 | at R129 |  | Connect the oscilloscope diode probe to the junction between |
|  | 525.25 | 529.75 | 571 | ${ }_{\text {all }} 17$ |  |  |  |  | he resistor and capacitor. (See Figure 20.) |
| 23 24 | 531.25. | ${ }_{5}^{535} 775$ | 577 |  |  |  |  | T1 and T107 <br> Figure Overall I.F | Couple the VHF signal generator loosely to the diode probe |
| ${ }_{26}^{25}$ | [ 537.25 | 541.75 547.75 | 589 |  |  |  |  | Response $\quad$ Response | in order to obtain markers. |
| 27 | 549.25 | 553.75 | 595 | Sel th | nal gen | e follow | ency and |  | Connect the potentiometer arm of the second bias supply |
| 29 | 561.25 | 569.75 | 607 | adjust | i.f tra | imum d | at R129. | in Figure 10. | to the AGC terminal on the tuner and ground the battery |
|  | 567.25 | 571.75 | 613 | on the | n the $\alpha$ | is made. |  | Increase sweep output ten times and check attenuation at | positive terminal to the tuner case. Adjust the bias potenti- |
| 31 | 573.25 | 577.75 | 619 |  |  | ...... |  | , 5 mc. Adjust $T 105$ and T107 to set 41.25 mc. between 25 | ometer to produce -3.5 volts of bias, as measured by the |
| ${ }_{33}$ | 579.25 585.25 | \$83.75 | ${ }_{6}^{625}$ | ote: | uld be | coil ne | sis |  |  |
| 34 | 591.25 | 595.75 | 637 | properly | 17.5.4 | U 817 |  | Move the sweep generator to the antenna terminals. Con- | Set the sweep generator to produce 0.5 volt or less peak-to. |
| 36 | 597.25 60325 | 601.75 | 643 649 |  | ignal | series | 0 mmf . | slightly to correct for any overall tilt while switching from |  |
| 37 38 | 609.25 | 613.75 | 655 | Conne | OHOhm | e junct | 15. R117 |  | Adjust C308, on the UHF section, and L9, on the VHF sec- |
| 39 | 615.25 | 61975 | 661 667 | ${ }^{\text {d }} \mathrm{Cl} 2$ | volt bat | le of |  | dels 17-S.450U, 17-S-451U \& 17-5.45 | mc. markers as shown in figure 13 . |
|  | 627.25 | 631.75 | 673 | able | ain and | the end | 000 ohm |  | If necessary adjust L27 to place the 45.75 me. marker at |
| 41 | 633.25 | 63775 | 679 | ntio | oss it. | batter | terminal | alor to the mixer grid test point TP2, in series wi | the peak of the curve. Adjust L43 for minimum tilt of the curve |
| 42 | -639.25 | ${ }^{643} 7.75$ | 685 | to chas | he pote | arm to | on R115. | mmf. ceramic capacitor. Use the shortest leads possible, with | as shown in figure 13. |
| 43 44 4 | 651.25 | 655.75 | 697 | ${ }_{\text {cation }}$ | ciducht |  |  | not more than one inch or unshielded lead at the end of the sweep cable. Connect the sweep ground lead to the top of | Remove the resistor, capacitor and diode probe from TP3 |
| 45 | 657.25 66325 | 661.75 6675 | 703 | Conne | oliohm | junction | and L103 | the tuner. | and connect the oscilloscope to pin 8 of V110. Use 3.0 v peak- |
| 47 | 669.25 | 673.75 | 775 | Set | nerator | the foll | s | Set the channel selectior switch to channel 4. | to peak on the oscilloscope. |
| 48 | ${ }_{6}^{675.25}$ | ${ }_{6}^{679.75}$ | 721 | and wis | fiber s | tune th | st. | ${ }^{\text {Preset }}$ Adibs to minimum capacily. | Connect the VHF sweep generator to the antenna terminals. |
| 50 | 687.25 | ${ }_{691.75}^{685}$ | ${ }_{733}$ | tor | $m$ indic | cherked | each | bias as measured by a "Voltohmyst" at the junction of R115. | Keep the R-F AGC bias at -3.5 V and the I-F bias at |
| 515253 | 693.25 | 697.75 | 739 | ibrato | re that | 隹 is on |  | R117 and C120. |  |
|  | 699.25 | 20375 | 745 | Durin | nt. red | put sign |  | Connect a 180 ohm composition resistor from pin 5 of V105 | Couple the signal generator loosely to the grid of the first |
| 53 | 705.25 | 209.75 | 751 | order to | 3.0 volt | R129 a | with -3.5 | to pin 6 of V10s. Connect the oscilloscope diode probe to pin | picture 1.F amplifier. |

Switch through all VHY channels and check for proper
curve shape as in tigure 12 . Retouch T106 and T107 slighly to correct for any overall tilt that is essentially the same on all channels.
Disconnect the VHF sweep generator and connect the UHF sweep generator to the antenna terminals. Check on all UHF
channels for proper wave shape as shown in figure 12. rechannels for proper wave shape as shown in figure 12, re-
touching C 308 and L9 it neesssary to correct any overall tilt. Do not retouch L27, L43. T2. T104. T105, T106 or T107,
Remove the sweep and marker generators and the bias supplies.
KRK32 TUNER ALIGNMENT.-
Models $17.5 .450 .17 .5 .451 \& 17.5453$
unit which is operative and requires
A tuner unit which is operative and requires only touch up adjustments requires no presetting of adjustments. For such
units, skip the remainder of this paragraph. For units which are completely out of adjustment, set channee 71013 oscillator
arn the slugs one turn from tight. Turn T2 slug all the way out. Do
not change any of the adjustments in the antenna matching not ch
unit.
Disconnect the link from the terminals of T 2 and shunt the terminals with a 39 ohm composition resistor.
Connect the oscilloscope to the test point TPI on the side of the tuner unit. Set the oscilloscope to maximum gain.
Connect the potentiometer arm of one of the bias supplie
to the AGC terminal on the tuner and ground the batter 10 the AGC terminal on the tuner and ground the battery ometer to produce -3.5 volts of bias, as measured by the dinhmst at the AGC terminal on the tune.

The limits for oscillator injection vollage are 2 volts mini mum and not exceeding a maximum of 5.5 volts. Since ther is no adjustment for varying the oscillator injection voltage, a
check for injection voltage being within limits should be made after proper oscillator tracking has been established on chan nels 8 through 13.
Turn the fine tuning control to the mechanical center of its range. Adjust C25 for proper oscillator trequency. 227 mc . This may be done recommended in this procedure will be to us the signal generator as a heterodyne frequency meter and beat the oscillator against the signal generator. To do this,
to tune the signal generator to 227 mc . with crystal accuracy
Insert one end of a piece of insulated wire into the tuner unil Insert one end of a piece of insulated wire into the tuner unit
through the hole provided for the adjustment of C18. Be careful that the wire does not touch any of the tuned circuits as it may cause the frequency of the tuner oscillator to shif Connect the other end of the wire to the "rt in lerminal of
the signal generator. Adjust C25 to obtain an audible beat with the signal generato


Figure 14-KRK32 Tuner Adiustments
Note.-lf on some units, it is not possible to reach the proper channel 8 oscillator frequency by adjustment of C25, switch
bo channel 13 and adjust L43 to obtain proper channel 13 channel 13 and adjust 143 to obtain proper

Then, switch 10 channel 12 and adjust L54 10 obbain proper channel 12 oscillator frequency. Continue down to channel 8.
adjusting the appropriate oscillator trimmer to obtain the proper frequency on each channel. Then again on channel 8 , adjust C25 to obtain proper channel 8 oscillator trequency. Switch back to channel ${ }^{13}$ and readjust L43 and back to channel 8 and adjust C2
Connect the sweep generator through a suitable attenuant, as shothin


Figure 15-Sureep Altenuator Pads
Connect the signal generator loosely to the antenna te
minals. minals. nnel 8
Set the sweep generator to cover channel 8 .
Set the oscilloscope to maximum gain and use the maximum Set the oscilloscope to maximum gain and use the maximum
input signal which will produce a a $\begin{aligned} & \text { usable pattern on the }\end{aligned}$ oscilloscope. Excessive input can change oscillator injectio
during alignment and produce consequent misalignment eve though the response as seen on the oscilloscope may look normal.
Insert markers of channel 8 picture carrier and sound car
rier rier. 181.25 mc . and 185.75 mc .
Adjust C13. C18 and C21 for approximately correct curve
shape, frequency, and band width as shown in figure 16 . C. 13 tunes the r.f amplifier plate circuit and affects the fro quency of the pass band most noticeably. C21 tunes the mixer grid circuit and aftects the tilt of the curve most notice ably. C18 is the coupling adjustment and hence primarily affects the response band width.


Figure 16--KRK32 Tuncr R-F Responses
Set the receiver channel switch to channel 13.
Adjust the signal generator to the channel 13 oscillato trequency 257 mc .
Turn the fine funing control to the mechanical center of it range.
Adjust L43 to obtain an audible beat. Slightly overshoa the adjustment of L43 by turning the slug an additional turn oscillator to proper frequency by adjusting C25 to again

Set the sweep generator to channel 13.

Turn off the sweep and signal generators.
Connect the "VoltOhmyst" to the tuner test point TP1 Check the oscillator injection vollage to be within limits previously specified. Where the voltage is not within the previously specified limits after the correct adjustment for scillator tracking on channels 8 through 13 has been achieved, is still outside limits, replace C22.
It it was necessary to replace the 6U8 or C22, turn the sweep and signal generators back on and repeat the oscillator racking procedure for channels 8 through 13 .
Set the receiver channel selector switch to channel 8 and adjust C 25 for proper oscillator trequency, 227 mc
Set the sweep generator and signal generator to channel 8 . Readjust C13, C18 and C21 for correct curve shape. fre quency and band width
Turn oft the sweep and signal generators, switch back to Turn oft the sweep generator and switch the receiver to

$$
\text { nannel } 6 \text {. }
$$

$$
\begin{aligned}
& \text { Adjust the sign } \\
& \text { frequency } 129 \text { mc. }
\end{aligned}
$$

$$
\text { Adjust the signal generator to the channel } 6 \text { oscillator }
$$

Set the fine ange.
Adjust L48 for an audible beat. Adjust L11, L30 and L42 proper curve shape as shown in figure 16. Recheck the the limits speciiied.
The correct adjustment of L11 is indicated by maximum mines the r.f amplitier plate circuit and affects markers. thequency of the pass band most noticeably. L42 tunes the mixer grid
circuit and affects the till of the curve most noticeably (assumm. ing that L11 has been properly adjusted).
Check the response of channels 2 through 6 by switching he receiver channel switch, sweep generator and marker sponse and oscillator injection voltage obtained. See figure
16 to typical response curves. It should be tound that all 16 for typical response curves. It should be found that all hese channels have
If the markers fail to tall within this requirement readjust imits.

Switch the channel selector, signal generator and marker enerator through channels 71013 and observe the response curves, referring to figure 16 for proper wave shape. Check
the injection voltage at each channel to be within limits. if neeessary readjust C13. C21. or C 18 to obtain the proper response.


Figure 17-KRK32 $T_{\text {uner }}$ Oscillator Adjustments With the receiver and signol generator on channel 13 ad Adius the oscillar to troquncy on cll channels by 9 the receiver and the frequency standard to each channel and adjusting the appropriate oscillator slug to oblain the
ablain the audible beat on each channel. Hecheck the oscil. voltage is within the specified limits.
KRK32 or KRK $30 A$ ANTENNA MATCHING UNIT ALIGNMENT The antenna matching unit is accurately aligned at the factory. Adjustment of this unit should not be attempted in the customer's home since even slight misalignment may cause uner unit is aligned with a particular antenna matching trans ormer in place. If tor any reason, a new antenna matching ransformer is installed, the tuner unit should be re-aligned. The F.M Trap which is counted in the antenna matching nent of the unit.
To align the antenna matching unit disconnect the lead
from the F.M trap L5 to the channel selector switch S1D (SIE). With a short jumper, cact the output of the matching unit through a 1000 mmf . capacitor to the grid of the second
pix i-f amplifier. pin 1 of vlo7. Roplace the cover on the matching unit while making all Roplace thestments.
Remove the first pix i.f amplitier tube V106.
Connect the positive terminal of a bias box to the chassis
and the potentiometer arm to the junction of R115, R117 and and the potentiometer arm to the junction of R115, R117 and
C120. Sel the potentiometer to produce approximately -5.0
volts of bias at the junction of R115. R117 and C120. Connect an oscilloscope to the junction of R129 and L 103
and set the oscilloscope gain to maximum.
Connect a VHF signal generator to the antenna input termi.
nals. Modulate the signal generator $30 \%$ with an audio signal. Note.--Inductances in KRK32 matching units are not slug
tuned and therefore must be knited for adustment except
those units in which C1. C2 and C3 are variable. hose units in which $\mathrm{Cl}, \mathrm{C} 2$ and C 3 are variabl
Tune the signal generator to 45.75 mc. and adjust the
generator output 10 give an indication on the oscilloscope. generator output to give an indication on the oscilloscope
Adjust LA (core or knite coill or C3 in the antenna matching unit for minimum audio indication on the oscilloscope.
Tune the signal generator to 41.25 mc . and adjust LI (core or knife coill
oscilloscope.
Remove the jumper from the output of the matching unil Connect a 300 ohm 1,2 watt composition resistor from $\mathrm{L5}$ to ground. keeping the leads as short as possible
Connect an oscilloscope low capacity crystal probe from
L5 to ground. The sensitivity of the oscilloscope shouid be approximately 0.03 volts per inch. Set the oscilloscope gain to maximum.
Connect the VHF sweep generator to the matching uri
antenna input terminals. In order to prevent coupling react antenna input terminals. In order to prevent coupling react
ance from the sweep generator into the matching unit, it is advisable to employ a resistance pad at the matthing uni lesminalt $w$, co-ax output or 300 ohm balanced output. Choose the pad to
match the output impedance of the particular sweep employed. Connect the signal generator loosely to the matching unit antenna terminals.
Set the sweep generator to sweep from 45 mc . to 54 mc
With RCA Type WR59A sweep generators, this may be a complished by retuning channel number 1 to cover this range
With Wh59B sweep generators this may be accomplished retuning channel number 2 to cover the range. In making these adjustments on the generator, be sure not to turn th core too far clockwis
core retaining spring
Adjust L2 and L3 (core or knite coil) of C2 to obtain the response shown in figure 18 . LL is in most eftective in locating the position of the shouler
should be adjusted to give maximum amplite 52 mc . and I should be adiusted to give maximum amplitude a 53 mc . and
above consistent with the specified shape of the respons curve. The adjustments in the matching unit interact to some
extent. Repeat the above procedure until no further adiust extent. Repeat the above procedure until no further adjus
ments are necessary. (Note.- Second harmonic output from the sweep generator may cause distortion of the response. Tun
L5 F.M trap for maximum inductance to elimingte distorion L5 F.M trap for maximum inductance to eliminate distortion
when adjusting the matching unit. $\mathrm{Be}_{\text {e }}$ sure to return the $L$. when adjusting the maiching unit bo sure to return to
slug to its original position after adjusting the matching unit to prevent attenuation on channel 5 or 6 .)
Restore the connection between L5 and SID (S1E). Replace

OJohn F. Rider


Figure 18-KRK32 or KRK30A Antenna Matching

## rRK 30A TUNER ALIGNMENT

Models 17.S.450U, 17.S-451U \& 17-S-453U
VHF ALIGNMENT.-A tuner unit which is operative and
requires only touch up adjustments, requires no preseting requires only touch up adjustments, requires no presetting
of adjustments. For such units. skip the remainder of this paragraph. For units which are completely out of adjustment. preset C27 all the way out. Set channel 7 to 13 oscillato
slugs one turn from tight. Tumn T2 slug all the way out. Do no slugs one turn from tight. Turn change any of the adjustments in the antenna matching unit. Disconnect the link from the terminals of T 2 and shunt the
Prminals with a 39 ohm composition resistor. rminals with a 39 ohm composition resisto
Turn the receiver channel selector switch to channel 2.
The 43.5 mc . trap is adjusted with zero bias. To insure that
the bias will remain consitant, take a clip lead and short cir
the bias will remain constant, take a clip lead and short cir-
cuit the $A G C$ terminal of the tuner at the terminal board to
ground. ground.
Connect the oscilloscope to the test point TP2 on top of the pe to maximum gain.
Connect the output of the VHF signal generator to the
output of the ontenno matching unit at the junction of LS and
C4 at the bottom of the FM trap L5.
Tune the signal generator to 43.5 me. and modulate it $30 \%$
with a 400 cycle sine wave. Adjust the signal generator to wilh a 400 cycle
maximum output.
Adjust C33 on top of the tuner, for minimum 400 cycle ind cation on the oscilloscope. If necessary, this adjustment ca one specilic frequency in the $i \cdot 1$ band pass. However, in suc cases. care should be taken not to tune C33 into channel thereby reducing sensitivity on channel
Connect the potentiometer arm of one of the bias supplies
to the AGC terminal on the tuner and ground the battery to the AGC terminal on the tuner and ground the battery
positive terminal to the tuner case. Adjust the bias potenti-
 ermes ander to
Preset $\mathrm{C}_{22}$ to read -3.0 volts at the test point TP1, a read on the "Voltohmyst." The limits for osclilator injection voltage are
of 5.5 vols.

Tun the fine tuning control fully clockwise.

mum gain at midpoint of the curve. Repeat if necessary until
Set the receiver channel switch to channel 13
Adjust the signal generator to the channel 13 oscillator fre-
quency 257 mc.
Turn the fine tuning control fully clockwise
Adjust L49 to obtain an audible beat. Slightly overshoot the adiustment of L49 by turning the slug an additional turn in he same direction from the originall selting. then reset the oscillator to $p$
tain the beat.
Set the sweep generator to channel 13
From the signal generator, insert channel 13 sound and pic
ure carrier markers. 211.25 mc. and 21575 mc . 215.75 mc

Adjust L36 and L20 for proper response as shown in fig
are 19 .
Turn off the sweep and signal generators.
Connect the "voltokmyst" to the tuner test point TPI, Check the oscillator injection voltage to be wiihin limits as

Il it was necessary to readjust C22, turn the sweep and signal generators back on and recheck the channel 13 re -
sponse. Readiust 36 and I 20 if necesary Set the raceiver channel selector switch to channel 8 and Set hus roteiver channel sellector switch to channel 8 and
fer proper oscillator frequency. 227 me.
Set the sweep generator and signal generator to channel 8 . Readiust C21, C16. C11 and C7 for correct curve shape,
frequency and band width.
Turn off the sweep and signal generators, switch back to
channel 13 and check the oscillator injection voltage at TP1


Figure IV—KRK30A Tuner VHF R-F Responses
If the initial setting of the oscillator injection trim mer was ar off it may be necessary to adjust the oscillator frequency and response on channel 8 , adjust the oscillator injection on
channel 13 and repeat the tracking procedure several times channel 13 and repeet the tracking
before the proper setting is obtained.
Turn oft the sweep generator and switch the receiver to Adiust the signal generator to the channel 6 osecillator frequency 129 mc .
Set the fine
ening control to the center of its mechanical $\underset{\text { adjust } \mathrm{L} 54 \text { for an audible beat. Adjust L14, L48 and L32 for }}{\text { rat }}$ proper curve shape as shown in figure 19. Recheck the oscil-
lator injection vollage at $T P 1$, to insure that it is within the limits specified. Readiust C 22 if necessary.
If C22 required adjustment, switch the receiver and the signal generator to channell 8. Readiust C21 for correct curve
shape and recheck C27 and C25 for proper oscillator frequency.
Check the response of channels 2 through 6 by switching the receiver channel switch, sweep generator and marker enerator to each of these channels and observing the se-
ponse and osillator injection voltage obtained. See figure
ind
these channels have the proper response with the markers
If the markers fail to fall within this requirement readjusi L48 and L.32 in order to obtain curves within the proper limits.
Switch the channel selector signal Switch the channel selector, signal generator and marker
generator through channels 5 to 13 and observe the resconse curves, reterring to figure 19 lor proper wave shape. Check the injection voltage at each channel to be within limits. If
necessary readjust C11, C21 or C16 to obtain the proper rosponse. just L49 for an audible beat with the signal generator. just $L 49$ for an audible beat with the signal generator.


Figure 21-KRK3inA Tumer Oscillator Adjustments
Adjust the oscillator to frequency on all channels by switching the receiver and the frequency standard to each channel and adjusting the appropriate oscillator slug to obtain the
audible beat. It should be possible to adjust the oscillator to btain the audible beat on each channel. Recheck the oscilator injection voltage on each ch
voltage is within the specified limits.
UHF ALIGNMENT R-F.-Alignment of the UHF section of the tuner may only be performed with the UHF section re moved from the tuner assembly. RF adiustments require re moval or the tuner shield which mary only be done with the
UHF tunee separate from its mounting.
$1-\mathrm{F}$ and oscillator adjustment may be accomplished without Coving the tuner
Connect a the l-F composition resistor bet ween the center Connect the oscilloscope to the center conductor of W 301 at the 100 ohm resistor, employing the preamplitier if neded
with the oscilloscope used. Ground the oscilloscope to the uner case.
Connect
Connect the output of the UHF sweep generator. through a 300 ohm attenuator pad, to the antenna terminals and se
width. Adjust the output or
width.
A test dial made to it over the split gear on the tunger shaft
is necessary for accurate alignment. Scribe marks at $0^{\circ}, 5^{\circ}$ is necessary for accurate alignment. Scribe marks at $0^{\circ}$. $5^{\circ}$
and $164^{\circ}$ should be marked on the test dial for reference. The and $164{ }^{\circ}$ should be marked on the test dial for reference. The
$0^{\circ}$ reference point is located with the capacitor plates fully meshed. With the stop pin on the tuner against the stop plate on the gear assembly the plates will be in the proper full
meshed position. neshed position.
Rotate the tunin
Connect the VHF signal generaior in ${ }^{\circ}$, Channel position. he resistor to the iunction of W301 and L 310 . This a may be covered winserting insulated lead fubing, through the aperture provid be or crystal removal. (See figure 20 .) Insert marters provided mc., 43.5 mc . and 45.75 mc .
Connect the UHF marker generator loosely to the antenn lerminals and insert a marker at 887.5 mc .
Adjust R -F trimmer capacitor tabs C304 ana C305 for maximum amplitude overcoupled response curve centered a


Figure $22-K R K 30 A$ Tuner UHF R-F Responses
Adjust the oscillator trimmer capacitor C 306 until the 43.5 me. marker coincides with the marker at 887.5 mc. The
markers tor 41.25 and 45.75 should be symmerrically located on the top of the response curve as in tigure 22 (A).
Set the UF swep Set the UHF sweep and marker generators to 473
Rotale the tuning dial to the $5^{\circ}$. Chamnel 14. position.
Adius the oscillata Adjust the oscillator trimmer C 307 until the 43.5 mc. marker
coincides with the 43.5 mc. marker. with the 41.25 and 45.75 markers as shown. The inductance loop L311 across the oscillator grid coil on some units, may be repositioned, it neces-
sary, to bring the oscillator trimmer within range. Refer to
figure sary. 10 bring the oscillator triminer within range. Refer to
figure 20 for location of the aperture for making this adjustment.
Repeat the above adjustments, as necessary, until the
proper responses are obtained Tune through the proper responses are obtained. Tune through the entire range
and check the tracking. When pertectly tracked the three markers will be on the top of the response curves, however.
mistracking to the extent that the 41.25 mc. and 4575 mistracking to the extent that the 41.25 mc . and 45.75 mc . ride
down the sides of the curves to a poinn not less than $70 \%$ will nol seriously alfect the alignment. Should the markers wall
below this level, it vill be necessary to knite the RF plates to below this level, it vill be necessary to knite the RF plates to
correct the mistracking. The plates musl be knited with the shield cover removed. Always knife the plates while tuning
lower in frequency to prevent lower in frequency to prevent affecting the tracking above the
paint of knifing. Check which section reauires kniting by paint of kniting. Check which section requires kniting by
touching the plates with the kniting tool while observing the response, then proceed with the kniting of the proper section
or of bo:h sections if required or of bo:h sections if required.
Connect the Voltohmyst"
Connect the "VoltOhmyst" between the center conductor
of W301 and ground. Set the "Voltohmyst to to the 1.5 V . DC
scale Tune over the entire range scale Tune over the entire range observing the reading on
the meter. A reading between .03 and .35 volts should be the meter. A reading between 03 and . 35 volts should be
obtained. Voltages outside these limits are an indication of low B voltage. low or high crystal impedance or an oscillator tube outside allowable limits. This voltage is an indication
of crrect crrsstal current and may be varied by repositioning of crirect crystal current and may be varied by repositioning
the flag 1309 with respect to L 303 .
C Connect the "Volto hmyst" to the "bias" terminal of the
tuner (reler to figure 20). A reading between 0.5 and 2.5 volts should be obtained. Readings above or below this range will cause crystall currents outside allowable limits and in such
cases the osillator tube should be replaced. Replacement of cases the oscillator tube should be replaced. Replacement of
the oscillator tube will require recalibration at the high and the oscillator tube will require recalibration at the high a
low frequency ends of the band as previously outlined.
RATIO DETECTOR ALIGNMENT.-Set the signal generator
at $4.5 \mathrm{mc}$. and connect it to the first video amplifier grid. pin at
8 of V108A. in series with a 01 mid. capacitor.
As As an alternate source of signal. the RCA WR39B or WR39C
calibrator may be employed. In such a case. connect the
calibrator to the grid of the third pix r -f amplifier. pin 1 of 107 . calibrator to the grid of the third pix $\mathrm{r}-\mathrm{f}$ amplifier., pin 1 of V 107 ,
Set the frequency of the calibrator to 45.75 mc. (pix carrie) and modulate with 4.5 mc . crystal. The 4.5 mc . signal will be
picked off at pin 6 of V 108 A and amplified through the sound picked oft at
i.f amplifier.
nect the "Voltohmyst" io pin 7 of V102
Tune the ratio detector primary. T102 top core for maximum
d.c output on the "Voltohmyst." (Peak with core at end of d.c output on the voltohmyst. (Peak with core at end of
coil away from chassis.) Adiust the signal level from the signal generator for 5 volts on the "Voltohmyst" when finally peaked.
This is approximately the operating level of the ratio detector This is approximately
tor average signals.
Connect the "Voltohmyst" to the junction of R104 and C107. Tune the ratio detector secondary T102 bottom core for zero
d.c on the "Volthmyst." (Adjust with core at chassis end d.c. on the
of coil.)

Repeat adjustments of T102 top for maximum d-c at pin 7
of Vio2 and T102 botiom for zero d.c at the iunction of R104 of V102 and T102 botiom for zero d.c at the junction of R104
and C107. Make the final adjustments with the signal input level adjusted to produce 5 volts dce on the "Voltohmyst" ai
pin 7 of vlo2. pin 7 of V102.
SOUND TARE.OFF ALIGNMENT.- Connect the signal gen-
erator to the first video amplifier grid. pin 8 of VI08A. erator to the first video amplifier grid, pin 8 of V108A.
As an alternate source of signal. the RCA WR39B or WR39C Astibrator may be employed as above.

Tune the T101 top core for maximum dic on the "Volt
Ohmyst." (Peak with core at chassis end oll coil) Ohmyst." (Peak with core at chassis end of coil.)
The output trom the signal generato should be sel 10 produc The output from the signal generator should be set 10 produce
approxinately $S$ volts on the "Voltohmyst" when the final approxinately 5 voits on the "Vollohmyst
louches on the above adjustment are made.

> (Alternate Method for Ratio Detector and Scund l.F Alignment)
Set the signal generator at 4.5 mc . and connect it to the firs
video amplifier grid, pin 8 of $V 108 \mathrm{~A}$ in series with $a .01 \mathrm{mtd}$ capacitor.
ect the "Voltohmyst" to pin 7 of V102 Tune the ratio detector secondary T 102 bottum core for maxi.
mum doc on the "VQltohmyst." (Peak with core al chassis end of coil.
The the ratio delector primary. T102 top core for maximum d.c output on the "Voltohmyst." (Peak wilh core at end o signal generator for 5 volis on the "Voliohmyst" peake when making the above adjustments.
Tune the T101 (top) core for maximum d.c on the vol The (Peak with core at chassis end of coil.) The output from the signal genetator should be set to
produce appioximately 5 volts on the "Volto Chmyst " when the
final touches on final touches on the T101 adjustment are made. Connect the "Voltohmyst" to the junction of R104 and Cl07
Tune T102 bottom for zero d.c at the junction of R104 and Tune TIO2 bottom for zero d.c at the junction of R104 and
C107. (Make adjustment with core at chassis end of coil.) 4.5 MC. TRAP ADJUSTMENT.-Connect the signal generator
in series with a 1500 mmi. capacitor to pin 8 of $V 108 A$. Set in series with a 1500 mml . capacitior to pin 8 of V108A. Set
the generator to 4.5 mc . and modulate it $30^{\circ}$ with 400 cycles . the generctior to 4.5 mc . and modulate it $30^{\circ}$, with 400 cycles . Short the third pix i.t grid to ground. pin 1. V107, to preven
noise trom masking the output indication. Connect the crystal diode probe of an oscilloscope to the
plate of the video output, pins 1.5 of V109A. Adjust the core of 1109 for minimum output on the oscillo.
scope. (Make adjustment with core at chassis end of coill.) scope. (Make adjustment with core at chassis end of coll)
Remove the short Irom pin 1. V107 to ground. As an alternate method, this step may be omitted at this
point in the alignment procedure and the adjustment made point in the alignment procedure and the adjustment made
on the ait" after the alignment is completed, If this is done. tune in a slation and observe the picture on
the kinescope. If no 4.5 mc beal is present in the picture. when the fine tuning control is set for proper oscillator-fre quency. then L109 requires no adjustment. $11 \alpha a 4.5 \mathrm{mc}$. beat is present. turn the fine tuning control slightly clockwise so as
to exagerate the beat and then adjust Llog for minimum beat
hohizontal oscillator and output alignment. Normally the alignment of the horizontal oscillator is not con
sidered to be a part of the alignment procedure, but since the oscillator waveform adjustment may require the use of an oscilloscope, it can not be done conveniently in the field. The waveform adjustment is made at the factory and normally
should not require readiustment in the field. However the should not require readjustment in the field. However, the
wavelorm adjustment should be checked whenever the receive is aligned.
Turn the horizontal drive trimmer C171 fully clockwise then counter.clockwise one full turn. Set the stud of the width coi
Llll flush with the inside rear edge of the chassis. Llll flush with the inside rear edge of the chassis
Place a jumper across the terminals of the sine wave coil
L 121 and adjust the horizontal (frequency) control until the picture pulls into sync. Remove the short across the sine wave coil.
Connect the low capacity probe of an oscilloscope to the
junction of L 120 , L121 and H 189 . Turn the horizontal (frequency) junction of L120, L121 and R189. Turn the horizontal (frequency
control clockwise until the picture falls out of sync than ter.clockwise until the picture just pulls into sync. The pattern on the oscilluscope should be as shown in Figure 23. Adjusi the sine wave adjustment core 1121 until the two peaks are be kept in sync by readiusting the horizontal (frequency) control if necessary.


This adjustment is very important for correct operation of
he circuit. It the broad peak of the wave on the oscilloscope is lower than the sharp peak, the noise immunity becomes poorer, the stabilizing eflect of the tuned circuit is reduced
and dritt of the oscillator may occur. On the other hand. if and drit of the oscillator may occur. On the other hand. it
the broad peak is higher than the sharp peak. the oscillator is overstabiiized. the pull-in range becomes inadequate and the broad peak can cause double triggering of the oscillator hen the hold control approaches the clockwise position.
Remove the oscilloscope upon completion of this adjustment. Horizontal Drive Adiustment flor correct locking range). Turn
the horizonlal (frequency) control unil the picture (alls the horizontal (frequency) control until the picture falls out
of sync with the diagonal lines sloping down to the left. Slowly turn the harizontal control counterclockwise and note the num. ber of diagonal bars obtained just betore the picture pulls into sync.

With the horizontal control set at the pull-in point. adjust the horizontal drive trimmer C171 counter-clockwise for a bright vertical line in the center of the picture. Turn the rimmer clockwise until the line just disappears.
Set the brighness control to maximum and adjust the width control so the picture fills the mask. Return the brightness
control to normal and readjust the horizontal drive trimmer
as above. The picture should pull into sync with one and one hall to three bars present, remain in sync for approximately two full between 2 and 5 bars present before interrupted sycillation (motorboating) occurs.


Ojohn F. Rider

The following measurements represent two sets of conditions. In the first condition. a 30000 microvolt test pattern signal was fed into the receive the picture synced and the AGC control properly adjusted. The second condition was obtained by removing the antenna leads and short circuiting
the receiver antenna terminals. Vollages shown are read with a type wV97A senior "Voltohmyst" between the indicated terminal and chassis ground and with the receiver operating on 117 volis. 60 cycies, a.c. The symbol < means less than

| $\begin{aligned} & \text { Tube } \\ & \text { No. } \end{aligned}$ | $\begin{aligned} & \text { Tube } \\ & \text { Type } \end{aligned}$ | Function | OperatingCondition | E. Plate |  | E. Screen |  | E. Cathode |  | E. Grid |  | Notes on Measurements |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | $\begin{gathered} \text { Pin } \\ \substack{\text { No }} \end{gathered}$ | Volts | Pin No. | Volts | Pin <br> No. | Volis | Pin No. | Volts |  |
| v1 | 68Q7A | $\underset{\text { Amplifier }}{\text { R.F }}$ | $30000 \mathrm{Mu} . \mathrm{V}$. Signal | 6 | 170 | - | - | 8 | 0.1 | 7 | 0 |  |
|  |  |  | No Signal | 6 | 133 | - | - | 8 | 1.1 | 7 | 0 |  |
| KRK30A |  | $\stackrel{\text { Amplitior }}{\text { R.F }}$ | 30000 Mu . V. Signal | 1 | 270 | - | - | 3 | 170 | 2 | - |  |
|  |  |  | No Signal | 1 | 260 | - | - | 3 | 133 | 2 | - |  |
| v2 | 6x8 | Mixer | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$. | 9 | 160 | 8 | 160 | 6 | 0 | 7 | $\underset{-3.0}{-2.410}$ |  |
|  |  |  | No Signal | 9 | 145 | 8 | 145 | 6 | 0 | 7 | ${ }_{-3.5}^{-2.810}$ |  |
| KRK30A |  | $\stackrel{\text { R.F }}{\text { Oscillator }}$ | $30000 \mathrm{Mu} . \mathrm{v}$. Signal | 3 | 95 | - | - | 6 | 0 | 2 | $\underset{-5.5}{\substack{3.810}}$ |  |
|  |  |  | No Signal | 3 | 90 | - | - | 6 | 0 | 2 | $\underset{-5.1}{-3.010}$ |  |
| v1 <br> KRK32 | ${ }_{6} \mathbf{C 8 6}$ | $\underset{\text { Amplilier }}{\text { R.F }}$ | 30000 Mu . V. Signal | 5 | 260 | 6 | 135 | 2 | 0 | 1 | - |  |
|  |  |  | No Signal | 5 | 250 | 6 | 78 | 2 | 0 | 1 | - |  |
| v2 <br> KRK 32 | 608 | Mixer | $\underset{\text { Slgnal }}{3000 \mathrm{Mu} . \mathrm{V} .}$ | 6 | 103 | 3 | 103 | 7 | 0 | 2 | $\begin{array}{r} -3.010 \\ -4.0 \\ \hline \end{array}$ |  |
|  |  |  | No Signal | 6 | 98 | 3 | 98 | 7 | 0 | 2 | $\begin{array}{r} -3.510 \\ -4.5 \end{array}$ |  |
|  |  | $\begin{gathered} \text { R.F } \\ \text { Oscillator } \end{gathered}$ | 30000 Mu . V. Signal | 1 | 228 | - | - | 8 | 103 | 9 | $\begin{gathered} -4.510 \\ -7.5 \end{gathered}$ |  |
|  |  |  | No Signal | 1 | 224 | - | - | 8 | 98 | 9 | $\underset{-6.5}{-3.510}$ |  |
| v101 | 6AU6 | $\begin{aligned} & \text { Sound } \\ & \text { I.F Amp. } \end{aligned}$ | $30000 \mathrm{Mu} . \mathrm{V}$. Signal | 5 | 126 | 6 | 136 | 7 | 1.2 | 1 | 0.2 |  |
|  |  |  | No Signal | 5 | 121 | 6 | 131 | 7 | 1.1 | 1 | 0 |  |
| v102 | 6AL5 | $\begin{gathered} \text { Ratio } \\ \text { Detector } \end{gathered}$ | $\underset{\text { Signal }}{30000 \mathrm{Mu} .} \mathrm{V}$. | 7 | $-8.0$ | - | - | 1 | -0.3 | - | - | 7.5 ke deviation at 1000 cycles |
|  |  |  | No Signal | 7 | -2.9 | - | - | 1 | -0.1 | - | - |  |
|  |  | $\begin{aligned} & \text { Ratio } \\ & \text { Detector } \end{aligned}$ | $\underset{\text { Signal }}{30000 \mathrm{Mu}} .$ | 2 | -0.4 | - | - | 5 | 7.2 | - | - |  |
|  |  |  | No Signal | 2 | -0 | - | - | 5 | 3.2 | - | - |  |
| v103 | 6Av6 | 1st Audio Amplifier | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 7 | 98 | - | - | 2 | 0 | 1 | -0.8 | At min. volume |
|  |  |  | No Signal | 7 | 96 | - | - | 2 | 0 | 1 | -0.8 | ${ }^{\text {At min }}$. volume |
| V104 | 6AS5 | $\begin{aligned} & \text { Audio } \\ & \text { Output } \end{aligned}$ | $\underset{\text { Signal }}{30000 \mathrm{Mu} .}$ | 7 | 250 | 6 | 262 | 1 | 150 | 285 | 141 | At min. volume |
|  |  |  | No Signal | 7 | 242 | 6 | 253 | 1 | 145 | 285 | 138 | At min. volume |
| v10s | 6CF6 | 1st Pix. I.F <br> Amplifier | 30000 Mu. Signal Signal | 5 | 132 | 6 | 144 | 2 | 0 | 1 | $-4.3$ | -Unreliable |
|  |  |  | No Signal | 5 | 118 | 6 | 129 | 2 | 1.05 | 1 | $\bigcirc 0.4$ |  |
| v106 | ${ }^{6 C B 6}$ | 2nd Pix. I.F Amplidier | $30000 \mathrm{Mu} . \mathrm{V} .$ Signal | 5 | 250 | 6 | 278 | 2 | 145 | 1 | 129 |  |
|  |  |  | No Signal | 5 | 240 | 6 | 263 | 2 | 140 | 1 | 128 |  |


| v107 | ${ }^{6} \mathbf{C b 6}$ | $\begin{gathered} \text { 3rd Pix. I.F } \\ \text { Amplifier } \end{gathered}$ | $\begin{gathered} 30000 \text { Mu. V. } \\ \text { Signal } \end{gathered}$ | 5 | 130 | 6 | 142 | 2 |  | 2.3 | 1 | 0 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | No Signal | 5 | 121 | 6 | 137 | 2 |  | 2.2 | 1 | 0 |  |
| v108K | 6AN8 | $\begin{aligned} & \text { 1st Vidoo } \\ & \text { Amplifier } \end{aligned}$ | 30000 Mu . V. Signal | 6 | 80 | 7 | 110 | 9 |  | 5.0 | 8 | 4.2 | Normal contrast |
|  |  |  | No Signal | 6 | 74 | 7 | 102 | 9 |  | 4.8 | 8 | 3.9 | Normal contrast |
| v1088 | 6ANB | ${ }^{14 t}$ Sync | $30000 \mathrm{Mu} . \mathrm{V}$. Signal | 1 | 27 | - | - | 3 |  | 0 | 2 | -20 |  |
|  |  |  | No Signal | 1 | 11 | - | - | 3 |  | 0 | 2 | -1.0 |  |
| v109 | ${ }_{6} 64$ | $\begin{gathered} \text { Vidoo } \\ \text { Output } \end{gathered}$ | $30000 \mathrm{Mu} . \mathrm{V}$. Signal | 1.5 | 220 | - | - | 7 |  | 10.5 | 6 | 0 | Contrast control at maximum |
|  |  |  | No Signal | 1.5 | 217 | - | - | 7 |  | 10 | 6 | 0 |  |
| viloa | $12 \mathrm{Au7}$ | $\begin{gathered} \text { Sync } \\ \text { Output } \end{gathered}$ | $30000 \mathrm{Mu} . \mathrm{V}$. Signal | 1 | 58 | - | - | 3 |  | 0 | 2 | -1.1 |  |
|  |  |  | No Signal | 1 | 52 | - | - | 3 |  | 0 | 2 | 0.3 |  |
| v1108 | $12 \mathrm{AU7}$ | $\begin{gathered} \text { Vartical } \\ \text { Osicillator } \\ \text { Discharge } \end{gathered}$ | 30000 Mu . V. Signal | 6 | 180 | - | - | 8 |  | 0 | ; | $-63$ | $\begin{array}{\|l\|} \hline \text { Depends on setuing } \\ \text { of Vert. hold control } \end{array}$ |
|  |  |  | No Signal | 6 | 175 | - | - | 8 |  | 0 | 7 | -61 | Voltages hown are synced pix adjustment |
| v111 | 6K6GT | VerticalOutput | $30000 \mathrm{Mu} . \mathrm{V}$. Signal | 3 | 262 | 4 | 280 | 8 |  | 0 | 5 | -29 |  |
|  |  |  | No Signal | 3 | 255 | 4 | 274 | 8 |  | 0 | 5 | $-28$ |  |
| v112 | 6SN7GT | Horizontal Osc. Control | $30000 \mathrm{Mu} . \mathrm{V}$. Signal | 2 | 280 | - | - | 3 |  | 2.5 | 1 | -23.5 |  |
|  |  |  | No Signal | 2 | 274 | - | - | 3 |  | 2.3 | 1 | -21 |  |
|  | 6SN7GT | Horizontal Oscillator | $30000 \mathrm{Mu} . \mathrm{V}$. Signal | 5 | 200 | - | - | 6 |  | 0 | 4 | -75 |  |
|  |  |  | No Signal | 5 | 193 | - | - | 6 |  | 0 | 4 | -74 |  |
| v113 | 6BQ6GT | Horizontal Output | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | Cap | . | 4 | 150 | 8 |  | 9.5 | 5 | -19 | - High Voltage Pulse Present |
|  |  |  | No Signal | Cap | - | 4 | 148 | 8 |  | 9.0 | 5 | -18 | - High Voltage Pulse Present |
| V114 | ${ }^{183 G T}$ | H. V. <br> Rectilier | $\begin{gathered} 30000 \mathrm{Mu.} \mathrm{~V} . \\ \text { Signal } \\ \hline \end{gathered}$ | Cap | - | - | - | 287 |  | 15.800 | - | - | - High Voltage Pulse Present |
|  |  |  | No Signal | Cap | - | - | - | 287 |  | 15,300 | - | - | - High Voltage Pulse Present |
| v115 | 6AX4GI | Damper | $\begin{gathered} 30000 \mathrm{Mu}_{\text {Signal }}^{3} . \mathrm{V} . \end{gathered}$ | 5 | 280 | - | - | 3 |  | - | - | - | - High Vollage Pulse Present |
|  |  |  | No Signal | 5 | 273 | - | - | 3 |  | - | - | - | - High Voltage Pulae Present |
| V116 | 17HP4 | Kinescope | $\underset{\substack{30000 \mathrm{Mu} \\ \text { Signal }}}{ } \mathrm{V}$. | Cap | 15.800 | 10 | 465 | 11 |  | 65 | 2 | 0 | $\underset{\substack{\text { At average } \\ \text { Brightness }}}{ }$ |
|  |  |  | No Signal | Cap | 15,300 | 10 | 450 | 11 |  | 63 | 2 | 0 | At average Brightness |
| V117 | 5U4G | Rectifier | $\begin{gathered} 30000 \mathrm{Mu} . \mathrm{V} . \\ \text { Signal } \end{gathered}$ | 486 | - | - | - | 288 |  | 290 | - | - |  |
|  |  |  | No Signal | 466 | - | - | - | 288 |  | 280 | - | - |  |
| REPLACEMENT PARTS |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | sTock <br> NO. <br> 77894 <br> 75199 <br> 75732 <br> 77252 <br> 75199 <br> 71151 <br> 78276 <br> 71599 <br> 78997 <br> 78603 |  |  |  |  |  |  |  |  |  |  |  |  |



OJohn F. Rider


\begin{tabular}{|c|c|c|c|c|c|c|c|c|c|c|c|}
\hline  \& stock \& description \& \[
\underset{\substack{\text { Symbol } \\ \text { No. }}}{\text { SymoL }}
\] \& ¢ \& description \&  \& stock
No. \& deschiption \&  \& stock \& deschiption \\
\hline \({ }^{\text {R13 }}\) \& \({ }^{502356}\) \& Resisitor-Fixed. Composition, 56,000 ohms.
\(\pm 10 \%\),, \(1 / 2 \mathrm{ww}\). \& \(\mathrm{Cl}_{152}\) \& 73797 \& Capacitor-Fixed, paper, \(0.015 \mathrm{mt} \pm. \pm 10 \%\), \& \({ }^{\text {R110 }}\) \& \({ }^{50243}\) \& Resistor-Fixed, composition, 330,000 ohms. \(\pm 20 \%\), \(1 / 2 \mathrm{w}\). \& \& \& \\
\hline t1 \& 2973 \& Transformer-Antenna matching transiormer. complete with capacitors and coils. (Cl. \& \({ }^{\text {c153 }}\) \& \({ }^{73798}\) \&  \& R111 \& 502482 \& Resistor-Fixed, composition, 820,000 ohms, \(\pm 5 \%\). \(1 / 2 \mathrm{w}\). \& R169 \& 39 \& Resistor-Fixed, composition, 390,000 ohma. esistor-Fixed,
\(\pm 10 \%, 1 / 2 \mathrm{w}\). \\
\hline т2 \& 7973 \& Transtormer-Converter transtormer \& C154 \& 79016 \& \({ }_{\text {Capacilor-Fixed, paper. }} 0.0688 \mathrm{mt}. \pm 10 \%\), \& R112 \& 502510 \& \(\underset{\substack{\text { Resistor-Fixed, composition. } 1 \text { \% } \\ y / 2 \mathrm{w} .}}{\text { meg. } \pm 5 \% \text {. }}\) \& R170 \& 502333 \& Resistor-Fixied, composition, 33.000 ohms. \\
\hline \& \&  \& ciss \& 73798 \& Capacilor-Fixed, paper, \(0.022 \mathrm{mt} . \pm 10 \%\), \& R113 \& 522 \&  \& R171 \& 502 \& Resistor-Fixed, composition, 8200 ohms,
\(\pm 10 \%, 1 / 2 \mathrm{w}\). \\
\hline c101 \& 507 \&  \& C156 \& 78980 \& Capacitor-Fixed. paper. \(0.001 \mathrm{ml}. \pm 20 \%\), \& \({ }^{\text {R114 }}\) \& 502210 \&  \& \(\mathrm{R}_{172}\) \& 502322 \& Resistor-Fixed, composition, 22.000 ohms. \(\pm 5 \%\), \(1 / 2 \mathrm{w}\). \\
\hline C102 \& 332 \& Capacitor-Fixed, ceramic, \(39 \mathrm{nmt}. \pm 10 \%\), \& c157 \& \& Same us clis3
Same us C141 \& R115 \& 30562 \& Resistor-Fixed, composition, 680,000 ohms. \& R173
R174 \& 78 \& Same \\
\hline C103 \& 234 \& Capacitor-Fixed, ceramic, \(56 \mathrm{mmt}\). . \(\pm 10 \%\), \& \({ }_{\text {c }}\) c159 \& 2336 \&  \& \({ }^{1116}\) \& 36714 \&  \& R174
R175 \& \& Contro-vertica \\
\hline C104 \& 73960 \& Capacior -Fixed, ceramic, \(01 \mathrm{mld}+.100 \%\), \& c160
Cl 162 \& \&  \& \& \& \(\pm 10 \%\), \(1 / 2 \mathrm{w}\). Same as R114 \& \({ }_{\text {H176 }}\) \& 62 \& Resistor-Fixed, composition, 680,000 ohms, \(\pm 5 \%\), \(1 / 2 \mathrm{w}\). \\
\hline Cl105
C106 \& 39652 \&  \& \({ }^{\text {c162 }}\) \& 7645 \&  \& \({ }_{\text {R118 }}\) \& 502456 \&  \& R177 \& 502422 \& Resistor-Fixed, composition, 220.000 ohms, \\
\hline C107 \& 79315 \&  \& \(\mathrm{Cl}^{64}\) \& \({ }^{356}\) \& Capacivor-fixed, paper, \(0.022 \mathrm{mt} ., \pm 20 \%\), \& 819 \& 502068 \& Resistor-Fixixd composition, 68 orms. \(\pm 5 \%\) \% \& \({ }_{\text {R178 }}\) \& 79139 \& Control-Brightness control \\
\hline C108 \& 79148 \&  \&  \& \& Same as C120 \& R120 \& \& Same as R114 \& R179 \& 502415 \& Resistor-Fixed, composition, 150.000 ohms, \(\pm 20 \%\), \(1 / 2 \mathrm{w}\). \\
\hline \({ }^{\text {c109 }}\) \& 79017 \& Capacior-Fixed, paper. \(0.0047 \mathrm{ml.}. \pm 20 \%\). \& \({ }_{\text {c16 }}\) \& 73594 \&  \& R121 \& 504168 \&  \& R180 \& 502418 \&  \\
\hline cı10 \& 931 \& Capacaicor-Fixed, paper, \(0.01 \mathrm{ml} . . \pm \pm 0 \%\),
200 \& \({ }^{\text {c169 }}\) \& 59667 \& Capacitor-Fixed, mica, 470 mml , \(\pm 10 \%\). \& R122 \& 50415 \&  \& R181 \& 502433 \& Resistor-Fixed, composition, 330,000 ohms,
\(\pm 10 \%, 1 / 2 \mathrm{w}\). \\
\hline c111 \& 79014 \& Capacitior-Fixed, paper, \(0.01 \mathrm{ml.}. \pm 20 \%\),
200 v. \& C170 \& \& Same as cli3s \& R123
R 124 \& \& Same as R122 \& \({ }^{162}\) \& 502482 \&  \\
\hline c112 \& 75643 \&  \& C171 \& 07 \& Capacitor-Variable mica trimmer, 10.160 mmf. hor. drive \& \({ }^{\text {R12 }} 1\) \& 33568 \&  \& R183 \& 2415 \& Resistor Fixed, composition. 150.000 ohms, \\
\hline \({ }^{1} 113\) \& 73599 \&  \& \(\mathrm{c}_{172}\) \& 76995 \&  \& \[
\begin{aligned}
\& \mathrm{R} 126 \\
\& \mathrm{R} 127
\end{aligned}
\] \& 502118 \& \begin{tabular}{l}
Same as R121. Part of PC102 \\
Resistor - Fixed. composition, 180 ohms.
\end{tabular} \& R184 \& 502382 \&  \\
\hline \(\mathrm{Cl}_{14}\) \& 793 \& Capacitior- Electrolytic. 100 ml .. \(+100 \%\). \& C173
Cl 174 \& \&  \& R128 \& 50414 \& \begin{tabular}{l}
\(\pm 5 \%, 1 / 2 \mathrm{w}\). Part of PC102 \\
Resistor - Fixed, composition, 470 ohms.
\end{tabular} \& R185 \& 502239 \&  \\
\hline C115 \& 79979 \& Capacitor-Fixed, paper, \(0.0082 \mathrm{~m} 1 ., \pm 10 \%\). 1000 v . \& \& \& \[
\begin{gathered}
\text { Capacitor } \\
200 \mathrm{v} .
\end{gathered}
\] \& R129 \& 50233 \& \begin{tabular}{l}
\(\pm 20 \%\). \(1 / 2 \mathrm{w}\). Part of PCl02 \\
Resistor-Fixed, composition, 3900 ohms.
\end{tabular} \& R186 \& 512410 \&  \\
\hline \({ }_{c}^{\text {c116 }}\) \& \({ }_{39044}^{7820}\) \& \begin{tabular}{l}
Capacitor-Fixed, ceramic. 15 mml ., \(\pm 5 \%\). \\
500 v .
\end{tabular} \& \& \({ }_{79922} 7397\) \&  \& 130 \& 22 \& \begin{tabular}{l}
\(\pm 5 \%, 1 / 2 \mathrm{w}\) \\
Resistor-Fixed, composition, 2200 ohms,
\end{tabular} \& \({ }^{\text {R187 }}\) \& 11769 \& Resistor-Fixed, composition, 1.8 megohm, \\
\hline \({ }^{1} 19\) \& 7793 \& \begin{tabular}{l}
Capacitor-Fixed, ceramic, \(470 \mathrm{mmf} .,+100 \%\). \\
- \(0 \%\), 500 v .
\end{tabular} \& c17 \& 79830 \& Capacitor-Fixed, ceramic, \(56 \mathrm{mml} .+10 \%\) \& R131 \& 3219 \&  \& R189 \& 502347 \&  \\
\hline \({ }^{\text {C120 }}\) \& 73787
7293 \& Capacilor-Fixed. paper, \(0.47 \mathrm{ml} ., \pm 20 \%\).
200 v . 200 v . \& C179 \& 29318 \&  \& R132 \& 50247 \&  \& R190 \& 31071 \&  \\
\hline \({ }^{\mathrm{C} 121}\) \& \({ }_{7}^{7293}\) \&  \& \& \& capacilo
200
v. \& R133 \& \& \(\stackrel{ \pm 10 \%}{ \pm 1 / 2}\) \% w. \& R191 \& 11084 \& \(\xrightarrow{\text { Resistor-Fixed, }}\) (10\% \\
\hline C122 \& 77252 \& \begin{tabular}{l}
\(0 \%\), 500 v . Part of PC102 \\
Capacitor-Fixed, ceramic, \(.001 \mathrm{mid} .,+100 \%\).
\end{tabular} \& \begin{tabular}{l}
C180 \\
C181 to
\end{tabular} \& \& Same as C123. Part of PC102 \& R135 \& 502333 \&  \& R192 \& \& Same as R182 \\
\hline C124 \& \& - \(0 \%\), 500 v . Part of PC102 Same as C121 \& C1ib \& \& Same as C122. Part of PC102 \& \({ }^{\text {R136 }}\) \& 50233 \&  \& R193 \& 502510 \& Resistor-Fixed, composition, 1 meg., \(\pm 10 \%\),
\(1 / 2 \mathrm{w}\). Same as R 147 \\
\hline \(\mathrm{Cl}^{\text {c25A, }}\) B \& \({ }^{931}\) \&  \& \({ }^{\text {c186 }}\) \& \({ }^{7252}\) \& Capacitor-Fixed, cera mic, \(0.0001 \mathrm{mt}+.100 \%\), \& R137 \& 50247 \& Resistort-Fixed, composition, 40.000 ohms, \& R194 \& 50247 \& Resistor - Fixed. composition, 47 ohms,
\(\pm 20 \%\).
R. \\
\hline \({ }^{\text {C126 }}\) \& 78623 \& Capacitor Fixed. cerramic, . \(001 \mathrm{~m} t ., \pm 20 \%\), 4. Pat of PC102 \& CR101 \& 26675 \& Rectitier-2nd detector rectilier \& R138 \& 512356 \&  \& R195 \& 79701 \& Resisisor-Fixed, wire wound, 100 ohms, \\
\hline C 127
C 128 \& \({ }_{79164} 33098\) \& Capacitor-Fixed, ceramic, \({ }^{9}\) mmid., \(\pm 0.5\) Capacilor-Fixed, ceramic, 10 mml . \(\pm 1.0\) \& F101

102 \& 78214
68950 \& Fuse- 3 amp .
Plug-Deflection yoke \& R140 \& 502218 \& Resistor-Fixed, composition, 1800 ohms, Resistor-Fixed \& R196 \& 522318 \&  <br>
\hline ${ }^{\text {c12 }}$ \& ${ }_{3}^{33784}$ \&  \& 1102 \& ${ }^{7} 78204$ \& Coil-1st IF. grid trap \& R141 \& 512268 \&  \& ${ }^{\text {R197 }}$ \& \& Same as Ris3 <br>
\hline ${ }_{1} 13$ \& 71614 \& cent \& 2103
$L 104$ \& 76011
71526 \& Coil-Peaking, 36 microhenries Coil-Peaking, 250 microhenries \& R142 \& \& Part of L108 \& $\mathrm{R}^{198}$ \& \& Same as R150 <br>
\hline C131 \& 7914 \&  \& 2105 \& 2767 \& Coil-Peaking, 250 microhenties (with R133) \& R143 \& \& me as R137 \& ${ }_{\text {R203 }}$ \& \& Part of Yoke <br>
\hline C132A. B \& 7914 \& Capar Vior-Electiolytic, 80 80 mi., 400.200 \& 1106 \& ${ }^{75253}$ \& Coil-Peaking. 120 microhenries \& R147 \& 502 \&  \& \& 5024 \& Ressistor-fixed.
$\pm 20 \% \%, 1 / 2 \mathrm{w}$. <br>
\hline  \& \&  \& 2107
1108 \& 72522
71528 \& Coil-Peaking, 500 microhenties
Coil-Peaking, 180 microhenties \& R149 \& 9697 \&  \& R205, R206 \& 502210 \&  <br>
\hline ${ }_{\text {C135 }}$ \& ${ }^{73557}$ \&  \& 2109 \& 79157 \& Coil-4.5 MC trap \& R150 \& 502356 \& Resistor-Fixed, composition, 56.000 ohms. \& T101 \& 7940 \&  <br>
\hline C136 \& 78905 \&  \& 1111
1112 \& 79144
76640 \& Coil-Width coil Choke-R.F. insu \& R151, R152 \& 50251 \&  \& r102 \& 79141 \& Transtormer-Ratio detector transtormer comm <br>
\hline C.37 \& 73960 \& Capacitor-Fixed, ceramic, $0.01 \mathrm{mt}+.100 \%$, \& 1113 \& 27676 \& Choke-Filler choke \& R153 \& 502427 \& Resistoot-Fixed. composition. 270.000 ohms. \& T103 \& 79159 \& Transtormer-Audio output translormer <br>
\hline ${ }^{\text {c138 }}$ \& 73787 \&  \&  \& \& Part of Yoke \& R154 \& 502347 \&  \& T104
T105 10 \& 78203 \&  <br>
\hline ${ }^{\text {c139 }}$ \& 39620 \& Capactior- Fixed, mica, 47 mmt . $\pm 5 \%$, 500 \& 1118. 1119 \& 7347 \& Coil-Filament choke coil. Part of PC102 \& R15s \& \& $\pm 10 \%$. $1 / 2 \mathrm{w}$.
Same as RISI \& ${ }_{T 107}^{7105}$ \& 76433 \&  <br>
\hline C140 \& 39640 \&  \& 1220
L 121 \& 79534
79161 \& Coil-Horizontal trequency coil
Coil-Horizonal sine wave coil \& R156 \& \& Same as R118 \& T108
t110 \& 79143
79735 \& Transformer-Vertical output transformer Transformer-High voltage transformer <br>
\hline $\mathrm{Cl}^{141}$ \& 73551 \&  \& ${ }_{\text {Pc101 }}$ \& ${ }_{79142}$ \& Printed Circuil-1. F . sound assembiy \& ${ }^{\text {R157 }}$ \& \& ${ }^{\text {R135 }}$ \& T111 \& 79162 \& Transtormer-Power transtormer <br>
\hline $\mathrm{Cl}_{142}$ \& 73512 \&  \& PC102 \& 79479 \& Printed Circuit-1.F. picture assembly \& R160 \& 512310 \& Resistor-Fixed, composition, 10.000 ohms. \& \& \& oke and magnet a <br>
\hline C143 \& 2642 \& Capacitror-fixed, mica, 82 mmi., $\pm 5 \%$, \& \& 50334 \& Resistor-Fixed, composition, 47,000 ohms,
$+10 \%, 1 / 2$ w. Part of PC 101 $\pm 10 \%, 1 / 2 \mathrm{w}$. Part ot PC10 \& ${ }^{\text {R161 }}$ \& 502339 \&  \& \& 79460 \& Cushion-Dellection yoke hood cushi <br>
\hline ${ }^{\text {Cl14 }}$ \& 271 \& Capacitor-Fixed, mica, $220 \mathrm{mml} ., \pm 10 \%$.
S00 v . \& R102 \& 503112 \& Resistor-Fixed, composition, 120 ohms,
$\pm 10 \%$. $1 / 2 \mathrm{w}$. Part of PC101. \& R162 \& 502322 \&  \& \& 78309
79695 \& Cushion-Deflection yoke plate cushion Hood-Deflection yoke hood assembly <br>
\hline ${ }^{\text {Cl4 }}$ \& 29315 \& Capacitor-Fixed, paper, $0.0033 \mathrm{mf} ., \pm 10 \%$,
400 v . \& R103 \& 504210 \& Resistro- Fixed, composition, 1000 ohms,
$\pm 20 \%, 1 / 2$ w. Part of PClOi \& R163 \& \& Same as R131 \& \& 76375 \& Magnet-Centering magnet <br>
\hline ${ }^{\text {C146 }}$ \& 79019 \&  \& R104 \& 503339 \& Resistor-Fixed, composition, 39.000 ohms,
$\pm 10 \%$, $1 / 2$ w. Part of PCL10i \& R164 \& 8210 \& frol-Vertical hold cosme \& \& 76141
78817 \& Magnet-lon trap magnet
Plate-Dellection yoke hood plate <br>
\hline C147 \& 78221 \&  \& R105. R106 \& 50231 \&  \& ${ }^{8165}$ \& 78806 \& Control-Height cont:ol \& \& 79687 \& Rod-Dellection yoke rod <br>

\hline $\mathrm{Cl}_{14}$ \& 73594 \&  \& R107 \& 368 \& Resisor--Fi/ed, composition, 68.000 ohms, \& \& \& $$
\begin{gathered}
\text { Resistor-Fixed, } \\
\pm 10 \% .1 / 2 \mathrm{w} .
\end{gathered}
$$ \& \& 2445 \& Spring-Dellection yoke spring

Yoke-Deflection <br>
\hline C150 \& 73595 \&  \& . \& 9699 \& Control-"On-Oth" volume control \& R167 \& \&  \& \& \& SPEAKER
gTh 2308 S. <br>
\hline C151 \& 79317 \& Capacitor-Fixed, paper, $0.056 \mathrm{mt} ., \pm 10 \%$. 600 v. \& R109 \& 502610 \& Resistor-Fixed, composition, 10 meg., $\pm 20 \%$, \& \& 3219 \& Resistor-Fixixd. composition. 18.000 ohms, \& \& 79696 \& Speaker-1" P.M. speaker ( 3.2 ohms) <br>
\hline
\end{tabular}

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## 8 <br> 

## AVERAGE PICTURE

An average picture is portrayed as a guide or reference to enable a better analysis of the conditions when attempting to observe the various distortions and deviations.

## TUNEIR SERVICE MINTS

When attempting tuner servicing, it may prove helpful to bear in mind that when trouble occurs in the oscillator the picture will generally disappear and when there is a defect in the RF or mixer stage a decrease in signal
will usually result. will usually result.
If a condition arises where trouble occurs on either the high or low VHF band only, then it can be assumed that
the trouble is definitely in the VHF tuner or VHF antenna the trouble is definitely in the VHF tuner or VHF antenna
installation. One other possibility may be due to defecinstallation. One other possibility may be due to defec-
tive switch contacts. Defective switch contacts can easily be replaced by removing the two question mark shaped springs, lifting up the switch plate assembly and removing the black switch contact holder and replacing
the switch contact.


## MISTUNING:

Condition is generally caused by a lack of care when tuning in a station. A similar condition may be due to a faulty antenn installation or result from a defective oscillator or RF Amplifier tube.
CHECK:
V-2 VHF RF Amplifier (6BZ7) VHF RF Amplifier (6BZ7)
VHF Oscillator-Converter (12AT7)

REPLACEMENT PARTS

| Ref. No. | Part No. | Description | Ref. No. | Part No. | Description |
| :---: | :---: | :---: | :---: | :---: | :---: |
| C201A-B | 8E-17142 | 5.20 mmf , dual trimmer | L207 | 16A.17128 | RF choke coil |
| C203 | ${ }^{86}$-20880 | 6 mmf , ceramic feed thru | L208 | 13D-12155 | L.B. oscillator coil |
| $\underset{\substack{\text { C207-214-217. } \\ \text { 224-228 }}}{ }$ | 201-22333 | Trimmer condenser | L209 | - 13 13-17170 | H.B. oscillator coil |
| ${ }^{2} 212$ | 201 |  |  | ${ }_{\substack{\text { 2 }}}^{2016-220810}$ | Antenna transtormer assombly |
| C218-225- | 8 G -20878 | 1000 mmf , ceramic feed thru | 202-203 |  | Sliding switeh cont |
| ${ }_{\text {c }}^{226} \mathbf{2 3 1}$ |  |  |  | 5F-16311 | ch |
| T230 | 13E-20882 |  |  |  | eacitor plate assembly |
| T201 | 13E-21673 | L.B. anten na transformer |  | ${ }_{43 \text { A } 2 \text { - } 5444}$ | Core mounting clip |
| L200 | 13 M -20781 | Cascode coil |  | 51A-15713 | Iron core (white) fo |
| 1201 | ${ }^{13 \mathrm{M}-20780}$ | Cascode coil |  | 51A-17162 | Iron core (brown) for L203-205 |
| 1202 | 13E-12046 | L.B. RF primary coil |  | $51 \mathrm{~A}-21200$ | tron core (pint) for L208 |
| 1203 | 13E-17140 | H.B. RF primary coil |  | 51 A-15715 | Iron core (blue) for L202 |
| L204 |  | L.B. RF secondary coil |  | 51A-17161 | Iron core (orange) for L204 |
| L206 | 16A-20777 |  |  | 2M-19150-1 |  |

## 60 CYCLE HUM

sually caused by a filament to cathode short or leakage in the RF, IF or video amplifier tube.
CHECK:

$$
\begin{array}{ll}
\text { V-4-5.6 } & \text { VFAmplifier }(6 C B 6) \\
\text { V-2 } & \text { VFF RF Amplifier }(68 Z 7) \\
\text { V-9 } & \text { Video Amplifier }(25 C 6)
\end{array}
$$

NOTE: A quick method other than substituting tubes, is to short each tube's cathode to ground while observing the picture. Shorting the cathode of the defective tube will produce a radical reduction of hum or a filament failure.



Vhf tuner schematic

## *WEAK PICTURE WITH SNOW

*NO PICTURE WITH SNOW (Raster Visible)
This condition is usually caused by a defective antenna installation or a defective tube or component in the tuner or possibly the first IF Amplifier.
CHECK:

| Antenna Installation and Connections |  |
| :--- | :--- |
| V-2 | VHF RF Amplifier (6BZ7) |
| V-3 | VHF Oscillator-Converter (12AT7) |
| V-4 | IF Amplifier (6CB6) |
| R208 | V-2 Decoupling Resistor |
| L207-301 | B Supply Choke |
| C229 | V-3Plate Capacitor |
| C220-230-231-301 | Decoupling Capacitor |



## SOUND BARS:

The appearance of sound bars may possibly be due to mistuning of the receiver, microphonic station equipment or due to micro phonic $R$ F, IF, or Video Amplifier tubes.

CHECK:

| V-15B | Vertical Blocking Oscillator (12AU7) |
| :--- | :--- |
| V-16 | Vertical Output (6S5) |
| V-4-5-6 | IF Amplifier (6CB6) |
| V-2 | VHF RF Amplifier (6BZ7) |
| V.3 | VHF Converter (12AT7) |
| V-9 | Video Amplifier (25C5) |

NOTE: To determine possible cause of condition, properly tune in a station and then turn the volume control to its minimum volume setting. If the bars remain visible the
trouble is usually due to the station or outside interference If however, the bars disappear and by jarring the cabine they reappear, the cause is most likely due to microphonic tube. Gently tap each tube specified above while observing the picture.

IF AMPLIFIER SCHEMATIC

## REPLACEMENT PARTS



## WEAK PICTUPE

## NO PICTURE (Raster Visible)

These conditions are generally caused by a defective tube or component in the IF or Video Amplifiers. Note the absence of snow.

R409
R409 Picture Control
$\begin{array}{ll}\text { V-5-6 } & \text { IF Amplifier (6CB6) } \\ \text { V-9 } & \text { Video Amplifier (25C5) }\end{array}$
R310-313 Decoupling Resistors
L304-309-310-T300 IF Coils
L312-313-314 Detector Peaking Coil
L400-401-402 V-9 Peaking Coils
$\begin{array}{ll}\text { C404 } & \text { V-9 Coupling Capacitor } \\ \text { R412-413 } & \text { V-9 Plate Resistor }\end{array}$
R412-413
NOTE: Check RF Power and detector output plugs for prope seating.
As a fast method to help localize the defective stage causing the trouble, observe the face of the picture tube a increase in snow is NOT apparent at the maximum picture control setting the trouble is usually in the video amplifier video detector or IF amplifier circuits. If an increase in snow is observed the trouble may be in the tuner or possibly the first IF amplifier stage.

## OVERLOADING WASHOUT


washout condition (or insevere cases overloading) is generally caused by a defect in the IF amplifiers, video amplifier or A.G.C. circuits.

| V-4-5-6 | IF amplifier (6BC6) |
| :--- | :--- |
| V-7 | Video Detector (6AL5) |
| V-9 | Video Amplifier (25C5) |
| V-2 | VHF RF Amplifier (6BZ7) |

NOTE: A defective picture tube may cause a similar condition Check as a last resort

| R400-C400 | AGC Filter Network |
| :--- | :--- |
| C303-309 | AGC Decoupling Capacitors |
| C302-305-313 | IF Grid Coupling Capacitors |
| R314 | Detector Load Resistor |
| R409 | Picture Control |

NOTE: Check RF Power plug for proper seating. For a rapid $A G C$ check disconnect antenna lead-in wire from receive and couple close to antenna terminals to reduce signa
strength. If picture improves the $A G C$ can be suspected Compare AGC and detector output voltage Un unspected operating conditions these two negative voltages should b pproximately equal. If the $A G C$ voltage is low should b pay be due to a gassy RF or IF tube leaky IF grid coupling capacitor or a defective component in the AGC circuit.


## REPLACEMENT PARTS



## POOR VERTICAL LINEARITY

Condition is generally due to a misadjustment of the vertical size, linearity or centering controls.
CHECK
R440 Vertical Size Control Adjustment
R442 $\quad \begin{aligned} & \text { Vertical Linearity Control Adjustment } \\ & \text { Centering Control Adjustment }\end{aligned}$
V-15B Vertical Blocking Oscillator (12AU7)
$\begin{array}{ll}\text { V.15B } & \text { Vertical Blocking Oscill } \\ \text { V.16 } & \text { Vertical Output (654) }\end{array}$
$T 403 \quad$ Vertical Output Transformer
$\begin{array}{ll}\text { R443 } & \text { V.16 Plate resistor } \\ \text { C427 } & \text { V.16 Plate capacito }\end{array}$
C426 Coupling capacitor
$\begin{array}{ll}\text { C402B } & \text { V.16 Cathode by-pass } \\ \text { R441 } & \text { V. } 16 \text { Grid resistor }\end{array}$
NOTE: In the absence of a test pattern it is possible to adjust the receiver for reasonable vertical distribution. Turn the
V. Size and the $V$. Linearity controls to their minimum adjustment position and then with the centering control properly adjust the remaining picture to the vertical center of the tube. Adjust the $V$. Size and $V$. Linearity controls until the picture fills the mask, bearing in mind that the size control effects the bottom portion of the picture and the linearity control aftects vertical distribution, roll the picture slowly using the $V$. Hold Control and observe the blanking bar as it drifts. If the $V$. Size, V. Linearity and centering controls are properly adjusted the thickness of the bar will not change during its movement.


## excessive vertical size

This condition is generally due to misadjustment of the vertical size and linearity controls.
CHECK:
R440
R442
Vertical Size Control Adjustment Vertical Linearity Control Adjustment

INSUFFICIENT VERTICAL SIZE
This condition is usually caused by misadjustment of the vertical ize and linean is usually caused by misadjustment of he vertical ponent in the vertical deflection circuit.
CHECK:
ideo Detector (6AL5)
F Amplifiers (6CB6)
V-9 Plate Resistors Detector Peaking Coils - 9 Coupling Capacitor Detector Load Resistor V. 9 Screen Capacitor V. 9 Screen Resis
Picture Control

## RECK

R440
V.15B

V-16
$T 403$
T 405
R 443
R443
C427
C402B
${ }_{C}{ }^{\text {C42 }} 4$
ertical Size Control Adjustment
Vertical Linearity Control Adjustmen
Vertical Blocking Osclllator (12AU7)
Vertical Output (654)
Vertical Output Transformer
Deflection Yoke

- 16 Plate Resistor

V-16 Plate Capacitor
V-16 Cathode By-pass
REPLACEMENT PARTS

| R437 | 108-17318 | Vertical hold control-3 matile |
| :---: | :---: | :---: |
| R440 | 108-22307 | Vertical size control-750K ohm |
| R442 | 108-22304 | Vertical linearity control-6000 |
| C402B | $8 \mathrm{C}-22523$ | 50 mdd , 50 volt-p |
| $\mathrm{C}_{4} 42$ | 17A-22376 | Printed circuit |
| $\mathrm{T}^{402}$ | $12 \mathrm{M}-18241$ | Vertical oscillator transformer |



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V. Hold:

The Vertical Hold control should be adjusted when the picture is rolling or flipping up or down. The proper setting of the vertical hold control is that point where the picture is moving slowly upward and just locks into tendency to interrupt vertical sync.
V. Size and V. Linearity:

The vertical size and linearity controls should be adjusted while a test pattern is being received. The linearity control affects the upper portion of the picture
while the size control affects the overall size especially the lower portion of the picture. Adjust both controls simultaneously until the test pattern is symmetrical and fills the entire screen vertically. Readjust the vertical hold control if necessary.

vertical deflection schematic

## O VERTICAL SWEEP

This condition is generally caused by a defective tube or comone in the vertical deflection circuit.
CHECK
$\begin{array}{ll}\text { V.15B } & \text { Vertical Blocking Oscillator (12AU7) } \\ \text { V.16 } & \text { Vertical Output (6S4) }\end{array}$ - 16

14


Vertical Output (654)
Vertical Blocking Oscillator Transformer Vertical Output Transforme
Coupling Capacito
$\begin{array}{ll}\text { T405 } & \begin{array}{l}\text { Deflection Yoke } \\ \text { C426-423-424 }\end{array} \\ \begin{array}{l}\text { Coupling Capacitor } \\ \text { R440 }\end{array} & \text { Vertical Size Control }\end{array}$
NOTE: Check Vertical Yoke socket for proper seating. One method of isolating the defective stage is to apply a 60 cycle 6.3 filament voltage through a .5 MFD capacitor to various points in the vertical deflection circuit. If an increase of vertical deflection is not observed as the 60 cycle voltage
is applied the defect is located between the point tested is applied the defect is located between the point tested


## Sync Stabilizer:

The control varies the operational characteristics of the sync clipper stage to obtain the optimum operation point for the least effect of noise interrupting synchron zation. The control should be adjusted for a stead picture.

## REPLACEMENT PARTS

| Ref. No. | Part No. | Description |
| :--- | :--- | :--- |
| R401 | 108-17318 <br> C442 | Sync Stabilizer control-3 meg <br> Printed circuif |



SYNC CLIPPER AND AMPLIFIER SCHEMATIC

## POOR VERTICAL SYNC

Poor vertical sync is generally caused by improper adjustment of the vertical hold control or a defect in the oscillator, sync am plifier or sync clipper circuits.
CHECK:
$\begin{array}{ll}\text { R437 } & \text { Vertical Hold Control Adjustment } \\ \text { R401 } & \text { Sync Stabilizer Control Adjustment }\end{array}$
V-15 Vertical Blocking Oscillator and Sync Am
C422
R435-436-437-438 $\begin{aligned} & \text { Intergrating network } \\ & \text { Vertical Hold Control Resistors }\end{aligned}$
C423 Coupling Capacitor
NOTE: A poor vertical sync condition may possibly be due to
a defect in the RF, If or video amplifier stages. This may
be quickly checked by observing the blanking bar as illus-
not blacker than the blackest portion of the picture an over-
loading condition exists. Refer to overloading, condition
number 33.



## H. Hold:

Set the H. Hold control on the front of the set to the center of its range. Adjust the H . Hold coil on top of the chassis until a steady picture is obtained. Set the $H$ Hold coil to the center of its range (center position be-
fore going out of sync in either direction). To check the ore going out of sync in either direction. To check the controls are properly adjusted the picture will remain in sync at all times.

| $\overline{\text { Ref. No. }}$ | Part No. | Destription |
| :---: | :---: | :---: |
| $\begin{aligned} & \text { R } \\ & \text { L } 40 \end{aligned}$ | 108-17275 $-51 \mathrm{~A}-21740$ | Horizontal hold control-100k ohm Horizontal hold coil <br> Iron core for L405 |



## SEIRVICE HINTS

Whenever the sync, AFC, Horizontal Multivibrator or $H$. Pulse Amplifier stage is suspected as the cause of the trouble, it will prove helpful to short the input grid of the
Horizontal Multivibrator (pin 2, V18) to ground, readjust Horizontal Multivibrator (pin 2, V18) to ground, readjust
the horizontal hold control and then observe the picture. If the condition disappears you can assume that the source of the trouble is before the input grid of the oscillator. If, however, the condition remains, the trouble is probably after

POOR HORIZONTAL SYNC
Poor horizontal sync is usually caused by misadjustment of the horizontal hold control, hold coil or the sync stakilizer contro or due to a defective tube or component in the horizer
CHECK:
$\begin{array}{ll}\text { R457-L405 } & \text { Horizontal Hold Control Adjustment } \\ \text { R401 } & \text { Sync Stabilizer Control Adjustment }\end{array}$ V.15A $\mathrm{V}-15 \mathrm{~A}$
$\mathrm{~V}-8$
L 405
C440
C437-438
C431-439
R458-455
C443-436
R433-434
$\begin{array}{ll}\text { V-18 } & \text { Horizontal Multivibrator (12AU7) } \\ \text { V-17 } & \text { Horizontal AFC Discriminator (6AL5) }\end{array}$ Syrize Ainplififier (12AU7) Sync Clipper (6BE6)
Horizontal Hold Coil
Horizontal Hold Coil
Horizontal Hold Coil Capacitor V-18 Grid Capactitors V-18 Coupling Capacitors V-17 feedback Resistors V-17 Feedback Capacitors V-18 Plate and Grid Resistors Voltage Divider Resistor

## HORIZONTAL DISPLACEMENT

Condition can be caused by improper adjustment of the sync stabilizer or horizontal hold control or a defective tube or comvibrator or pulse amplifier circuits.


CHECK:

| R457-L405 | Horizontal Hold Control Adjustment <br> R401 |
| :--- | :--- |
| Sync Stabilizer Control Adjustment |  |
| V-17 | AFC Discriminator (6AL5) |
| V-18 | Horizontal Multivibrator (12AU7) |
| V-19 | Horizontal Pulse Amplifier (25BQ6) |
| V-15A | Sync Amplifier (12AU7) |
| V-8 | Sync Clipper (6BE6) |
| C503-R503 | Boost Voltage Filter |
| R500 | V-18 Plate Resistor |
| C437-438 | V-18 Grid Capacitor |
| R458-455 | AFC Feedback Resistor |
| C443-436 | AFC Feedback Capacitor |


H. Size:

The horizontal size control should be adjusted until the picture fills the entire screen horizontally. A clockwise rotation will decrease size. To some extent the vertical
size control setting may be affected by a major horisize control size adjustment.
zont

REPLACEMENT PARTS

| Ref. No. | Part No. | Doscription |
| :---: | :---: | :---: |
| C503 | 8C-22544 | 50 mfd .450 volt, lytic |
| C506 | $8 \mathrm{C}-21440$ | $470 \mathrm{mmf}, 1000$ volf, ceramic |
| T500 | 201-22396 | H. V. Deflection transformer |
| T405 | 201-22697 | Deflection yoke assembly |


horizontal output and high voltage schematic
DRIVE BAR
This condition is generally caused by a defective tube or com ponent in the horizontal output section.

## 

| Horizontal Size | Control Adjustment |
| :--- | :--- |
| V-19 | Horizontal Pulse Amplifier (25BQ6) |
| V-20 | Horizontal Damper (6AX4) |
| V-18 | Horizontal Multivibrator (12AU7) |
| R504-505 | V-19 Screen Resistor |
| R502 | V-19 |
| Grid Resistor |  |
| C504 | V-19 Screen Capacitor |
| C501-502 | V-19 Grid Capacitor |
| R500 | V-18 Plate resistor |

INSUFFICIENT HORIZONTAL SIZE This condition is usually caused by misadjustment of the horizontal size control or a defective tube or component in the high voltage circuit.
23
Horizontal Size Control Adjustment
$\begin{array}{ll}\text { V-19 } & \text { Horizontal Pulse Amplifier (25BQ6) } \\ \text { V-20 } & \text { Horizontal Damper (6AX4) }\end{array}$
V-19 Screen Resistor
V-18 Plate Resistor V-19 Grid Resistor
V-19 Grid Capacitor


## NO RASTER WITH NORMAL SOUND

No Raster (no brightness on face of picture tube) with normal sound is usually caused by a defect in the high voltage supply or the components associated with the picture tube

## CHECK:

| R415 | Brightness Control Adjustment <br> lon Trap Magnet Adjustment <br> High Voltage Rectifier (1B3) |
| :--- | :--- |

$\begin{array}{ll}\text { V-21 } & \text { High Voltage Rectifier (183) } \\ V-19 & \text { Horizal }\end{array}$
$\begin{array}{ll}\text { V-19 } & \text { Horizontal Pulse Amplifier (25BQ6 } \\ \text { V-18 } & \text { Horizontal Multivibrator (12AU7) }\end{array}$
$\begin{array}{ll}\text { V-18 } & \text { Horizontal Multivibrator (12AU7) } \\ \text { V-20 } & \text { Horizontal Damper (6AX4) }\end{array}$

R504-505
C504
R500
R500
-19 S Tube (21 YP4)
V-19 Screen Resistor
V-19 Screen Capacitor
V-19 Screen Capacito
H.V. Deflection Transformer

Deflection Yoke
NOTE: Check H.V. Power and H. Yoke plugs for proper seat ing, CRT sockets and high voltage anode lead for proper connections.

## NO RASTER NO SOUND

A condition of No Raster with No Sound is generally caused by
a filament failure in the series filament string or a defect in the
a filament fallure in the
$B$ supply voltage source.
CHECK:

| V-9 | V |
| :--- | :--- |
| V-14 | A |
| V-19 | H |
| R446 | $R$ |
| R447 | S |
| C402A-414C | B |
| R448 | V |
| L404 | B |
| T404 | F |

Video Amplifier (25C5 Audio Output (25C5)
Horizontal Pulse Amplifier (25BQ6)

Resistor Type Fuse, Series Filament Resistor B Supply Filter Lytics
Voltage Divider Resistor
B Supply Filter Choke
Filament Transform
Selenium Rectifiers
NOTE: Check AC line cord, safety interlock and on-off switch.

## EXCESSIVE HORIZONTAL WIDTH

Condition is generally due to improper adjustment of the H . Size
ondrol ins generally due to improper adjustmen of the H . Size line voltage.
CHECK:
V-21
V-19
V-20
V-18
R504-505
C 504
R502
C501-C502
R500
T500
R506

Horizontal Size Control Adjustment High Voltage Rectifier (1B3)
Horizontal Pulse Amplifier ( $25 B Q 6$ )
Horizontal Pulse Amplifier
Horizontal Damper (6AX4)
Horizontal Multivibrator (12AU7)

- 19 Screen Resistor
-19 Screen Capacito
V-19 Grid Resistor
V-19 Grid Capacitor
H.V. Deflection Transformer

V-21 Filament Resistor



| Ref. No. | Part No. | Description |
| :---: | :---: | :---: |
| R446 | 46M-22301 | Rosistor type fuse |
| R447 | 9 M -22837 | 150 ohm, 15 watt, $10 \%$ |
| R448 | $9 \mathrm{M}-22275$ | 2200 ohm, 10 watt, $10 \%$ <br> 1500 ohm, 10 wath, $10 \%$ |
| C402C | 8 C -22523 | 100 mfd , 300 volt-part of lytic |
| $\mathrm{C}_{428}$ | 8 C -22285 | 100 mfd , 150 volt, 1ytic |
| C429 | 8C.22286 | 100 mfd . 150 volt, lytic |
| T404 | 120.22586 | Filament transformer |
| L404 | ${ }^{164-21214}$ | Filler choke ${ }^{\text {cher }}$ C429 |
|  | 158.21186 | Mounting plate for C429 |
|  | 201-22551 | AC line cable assm. |


low voltage schematic

## blooming



The blooming effect will vary with adjustment of the picture and brightness controls and is usually caused by a defective tube or component in the high voltage or $B$ supply voltage circuits. CHECK:
V-21
V-19
V-20
V-10
R506
R503.C503
T500
C402C-428-429 R503-C503
T500 C402C-428-429
L404

High Voltage Rectifier (1B3) Horizontal Pulse Amplifier (25BQ6) Horizontal Damper (6AX4)
Picture Tube (21YP4) V. 21 Filament Resistor Boost Voltage Filter H. V. Deflection Transformer B Supply Filter Lytics Filter Choke Selenium Rectifiers

## NSUFFICIENT HORIZONTAL AND VERTICAL SIZE

This condition can possibly be caused by incorrect horizontal size, vertical size and linearity control adjustments, low B supply voltage or possibly due to low $A C$ line voltage.
CHECK

| V-19 | Horizontal Pulse Amplifier (25BQ6) |
| :--- | :--- |
| V-20 | Horizontal Damper (6AX4) |
| R503-C503 | Boost Voltage Filter |
| C402C-428-429 | B Supply Filter Capacitors |
| Selenium Rectifiers |  |

NOTE: Check H.V. power plug for proper seating and AC line voltage

## POOR FOCUS

This condition is generally caused by an incorrect adjustment of
the ion trap magnet, insufficient high voltage or a defect in the
Bupply voltage source.
CHECK:

| V-21 | High Voltage Rectifier (1B3) |
| :---: | :---: |
| V. 19 | Horizontal Pulse Amplifier (25BQ6) |
| V. 20 | Horizontal Damper (6AX4) |
| V. 18 | Horizontal Multivibrator (12AU7) |
| V. 10 | Picture Tube (21YP4) |
| $\begin{aligned} & \text { C402C-428-429 } \\ & \text { T405 } \end{aligned}$ | B Supply Filter Lytics <br> Detlection Yoke <br> Selenium Rectifiers |

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NOTE: Since the centering control will be effective in either of two positions, the preferred position is approximately 180 degrees away from the magnet of the ion trap to minimize interaction.

## INCORRECT CENTERING

Condition is due to incorrect adjustment of the centering control. CHECK:

Centering Control Adjustment (Refer to page 20)
NOTE: Do not attempt to correct for vertical centering with either the vertical size or linearity controls and do not use the horizontal hold control to affect horizontal centering.



## TILTED PICTURE

This condition is caused by an incorrectly positioned deflection yoke. CHECK:

Deflection Yoke Positioning Adjustmen

## TRAPEZOIDAL RASTER

A trapezoidal raster is generally caused by a defective deflec ion yoke or associated components.
CHECK

| T405 | Deflection Yoke |
| :--- | :--- |
| R444-445 | Yoke Loading Resistors |
| C441 | Yoke Equalizing Capacitors |



## TUBE SHADOW

This condition is usually caused by an incorrectly positioned de flection yoke or a misadjusted centering control or ion trap magnet.
CHECK:
Deflection Yoke Positioning Adjustment
Centering Magnet Adjustment
Ion Trap Magnet Adjustment

## REPLACEMENT PARTS

$\qquad$
201-22697 Deflection yoke assembly 5B-17278-9 CRT socket and cab
$6 \mathrm{M}-19906$ lon trap magnat

Part No.
Doscription
6M-20697 Contering magnet
$\begin{array}{ll}\text { 16M-20697 } & \text { Contering magnet } \\ 16 M-26002 & \text { Lininatity magnot } \\ 16 \mathrm{M}-22607 & \text { Anti-pin cushion magnet }\end{array}$

## Anti-Pin Cushion Magnet:

Adjust centering until left edge of the raster is visible. Loosen the positioning screw and slide the magnet until is noticed adjust magnet in vertical plane.

## Deflection Yoke:

The correct position for the deflection yoke is as far forward on the neck of the picture tube as the shape of result from an incorrectly positioned yoke. If a position adjustment is necessary, loosen the yoke wing nut located at the top of the picture tube assembly.
H. Linearity Magnet:

The horizontal linearity magnet affects the linearity of The horizontal linearity magnet affects the linearity of
the right side of the picture only. The magnet pulls or stretches the right side and has a greater effect when closer to the picture tube.

## Ion Trap Magnet:

If adjustment is determined necessary, loosen the wing nut, rotate and slide the magnet until the position which for maximum illumination. Repeat the above two steps. Rotate and slide the magnet until the best focus position is found without sacrificing brilliance. Tighten wing nut. Adjustment should be made with brightness and picture controls set for normal viewing. The position of the ion (second cylinder from the base identified by a flared forward lip) after the adjustment is complete.

Centering Magnet:
The centering magnet should be rotated and the control adjusted until the picture is properly framed keeping in mind that the effect of the control is governed by the
position of rotation. If the control is above or below the neck of the picture tube, the picture can be moved up or down. To the left or right of the neck of the picture tube, the picture can be moved either to the
left or right. The position of the centering magnet should be $1 / 4$ to $1 / 2$ inch behind the deflection yoke.



## B - NO SOUND

A no sound condition with a normal picture is generally caused by a defective tube or component between the plate of the video amplifier and speaker. CHECK.

| V-11 | Audio I F Amplifier (6AU6) |
| :--- | :--- |
| V-12 | Audio Detector (6AL5) |
| V-13 | Audio Amplifier (6AV6) |
| V-14 | Audio Output (25C5) |
| R422 | V-11 Screen Resistor |
| C410 | V-11 Screen Capacitor |
| R428 | V-13 Plate Resistor |
| R425 | Volume Control |
| C418 | Coupling Capacitor |
| R448 | Voltage Divider Resistor |
| R430 | V-14 Cathode Resistor |
| T401 | Output Transformer |
| T400 | Ratio Detector Transformer |
|  | Speaker |

NOTE: Check Speaker cable connections.

Audio IF Amplifier (6AU6) Audio Detector (bALS) Audio Output (25C5)
V-11 Screen Resistor V-13 Plate Resistor Volume Control Voltage Divider Resisto V-14 Cathode Resistor Output Transformer
Ratio Detector Transformer Speaker

## C. WEAK SOUND

A weak sound condition is generally caused by a weak tube or misalignment of the sound section.

CHECK:

| V-11 | Audio I F Amplifier (6AUG) |
| :--- | :--- |
| V-13 | Audio Amplifier (6AV6) |
| V-14 | Audio Output (25C5) |
| T400 | Ratio Detector Transformer <br>  <br> L4djustment (Primary-Bottom Slug) |
|  | Audio Pick-Off Coil Adjustment |

403

Audio Output (25C5)
Ratio Detector Transformer Adjustment (Primary-Bottom Slug
thill aiways prove helpful when analysing a service condition to first determine if the sound section is functioning normally. Since the receiver is of the intercarrier ype, both the sound and picture information are amp lified simultaneously by the tuner, IF and video amplifier also amplifies both the sound and picture information. By analysing the above, it can be assumed that if the picture appears to be normal and the sound is not unctioning properly the defect is located between th sound take off point (plate of the video amplifier) and speaker.

## EXTEIRNAL INTERFEIRENCE

## SOUND CONDITIONS

## D-DISTORTED SOUND

This condition is usually caused by a defective tube or component in the sound section.
CHECK:

| V-14 | Audio Output (25C5) |
| :--- | :--- |
| V-12 | Audio Detector (6AL5) |
| V-13 | Audio Amplifier (6AV6) |
| C-414A-B-C | Filter Lytic |
| C418 | Coupling Capacitor |
| R428 | V-13 Plate Resistor |
| R430 | V-14 Cathode Resistor |
| T400 | Ratio Detector Transformer <br>  <br> Speaker |
| T400 | Ratio Detector Transformer <br>  <br> $\quad$Adjustment (Secondary-Top Slug) |



NOTE: A fast method of isolating the defective stage when a troublesome sound condition occurs is to apply a 60 cycle 6.3 filament voltage through a .5 mfd capa
citor to various points in the sound section. If an increase citor to various points in the sound section. If an increase
of volume is not observed as the 60 cycle is applied, the defect is located between the point tested and the speaker.

| Ref. No. | Part No. | Description |
| :---: | :---: | :---: |
| R425 | 10A-22305 | On-off volume control-1 |
| C414A-B.C | $8 \mathrm{C}-22524$ | $10 \mathrm{mfd}, 75 \mathrm{volt}-10 \mathrm{mfd}, 25$ $20 \mathrm{mfd}, 300$ volt-lytic |
| T400 | 13M-22303 | Ratio dotector transformer |
| T401 | ${ }^{12 C-22508}$ | Audio output transformer |
| L403 | 201-22581 | Video trap coil |
|  | 51A-22370 | Iron core for L 403 |

E-HUM OR BUZZ IN SOUND
This condition is generally due to a defective tube or component in the sound section or due to a misalignment CHECK:

| V-12 | Audio Detector (6AL5) |
| :--- | :--- |
| V-14 | Audio Output (25C5) |
| V-13 | Audio Amplifier (6AV6) |
| V-11 | Audio I FAmplifier (6AU6) |
| C414A-B-C | Filter Lytic |
| C420 | Speaker Voice Coil Bypass |
| T400 | Ratio Detector Transformer |
| L403 | Adjustment (Secondary-Top Slug) <br> Audio Pick-Off Coil Adjustment |

## REPLACEMENT PARTS

The five service conditions below which are usually caused by external interference have been included in the "Service Saver" as they are common service complaints. These conditions are presented so that they can easily be identified and usually the effects in the picture are little affected by a control adjustment, tube or component substitution or circuit modification. These conditions result
from an interferring external signal and are seldom caused or due to a defect in the receiver.


## CHANNEL CROSS TALK

Due to interference from a nearby station on same channel or due to adjacent channel interference-Orientation, relocation or
an antenna with sharper directivity characteristics and the use of traps are suggested to reduce or eliminate channel cross talk.

## RF INTERFERENCE

Due to a beat frequency between the incoming signal and high powered radio equipment or a local oscillator in a receiver being operated in the vicinity-Crientation, relocation or installing a booster may be effective in eliminating this interference.



## DIATHERMY INTERFERENCE

Caused by X-Ray, commercial RF heating, ultra-violet and fluorescent lights, brush motors and other 60 cycle operated equipof interference may be tried to eliminate the herring-bone pattern from the picture.

## GNITION INTERFERENCE

Caused by ignition systems of cars or trucks or by breaking conact type of electrical appliances in vicinity. Similar condition picture may be reduced by relocation or installing a more directional type antenna, shielding or redressing the transmission line or by installing a power line filter.


GHOSTS
Due to the transmitted signal being reflected from buildings, hills or mountains and other surrounding structures. - To elimor probing, or characteristics should be attempted.

SOUND SECTION SCHEMATIC


Figure 1. Dial Stringing

CIRCUIT CHANGES

| CHASSIS CODE | $\begin{aligned} & \text { SUB } \\ & \text { UNIT } \end{aligned}$ | CODE UNIT | CHANGE | REASON |
| :---: | :---: | :---: | :---: | :---: |
| 233 | DEF | C | R403 (47K) changed to 68 K . | Reduce horizontal phase shift. |
| 633 | HV | G | C507 (.22MF) changed to .1MF, R504 (1800-1W) deleted and T500 part number changed to -1 | To increase high voltage. |
| 134 | RF | L | R306 (33K) changed to 22K. | Improve IF response. |
| 933 | DEF | J | R434 (47K) changed to 100K. | To improve vertical and horizontal sync. |
| 243 | DEF | M | C437 (.22MF) changed to .1MF. | Reduce horizontal waves. |
| 443 | DEF | P | R417 wired to boost instead of 240 V . | Increase resolution. |
| 543 | DEF | Q | R419 (3300) changed to 5600, R418 (1800) changed to 22 K and relocated, and C443 (100) added to pin 2 of V-10. | Improve vertical retrace. |
| 643 | RF | 0 | V-2 (6BQ7A) changed to 6BZ7. | To increase sensitivity. |
| 743 | HV | 5 | V-20 (6AX4) changed to 25AX4, V.1920 filament wiring revised and T404 changed. | Reduce cost. |
| 743 | DEF | 5 | R447 (150-15W) changed to 47-5W. |  |


| $\begin{aligned} & \text { CHASSIS } \\ & \text { CODE } \\ & \hline \end{aligned}$ | $\begin{aligned} & \text { SUB } \\ & \text { UNIT } \end{aligned}$ | CODE UNIT | CHANGE | REASON |
| :---: | :---: | :---: | :---: | :---: |
| 943 | DEF | U | R428 (220K) changed to 470 K and wired to $240 \mathrm{~V}, \mathrm{C} 406$ (5) changed to 3.3 and wired to detector output, L406 (270 UH) and R463 (10K) added to pin 2 of V9. L403 (sound-pick-off coil) changed and C444 (22) added across L403. | Eliminate smear. |
| No Code Change | DEF | V | L407 and C445 added to cathode lead of CRT. | Eliminate sand in picture. |
| No Code Change | DEF |  | C411 (470) replaced by a Trimmer. | Correct unbalance in Ratio Detector transformer. |

NOTE: Earlier code 21 " deflection and high voltage units cannot be interchanged with code " S " units. DEF-Defiection sub-chassis.
H.V.-High voltage sub-chassis.
R.F.-Tuner and If sub-chassis.

PARTS LIST

| Ref. No. | Part No. | Description | Price |
| :---: | :---: | :---: | :---: |
| C406 | 8G-12495-5 | 3.3 mmf. ceramic | 25 |
| C407 | 8G-12198 | 47 mmf , ceramic | 25 |
| C411 | 8E-23378 | $80-480 \mathrm{mmf}$, trimmer | . 55 |
| C437 | 8J-16085 | . 1 mfd , 200 volt, molded | 30 |
| C443 | 8G-22657 | 100 mmf , ceramic | 25 |
| C444 | 8G-11789 | 10 mmf , ceramir | . 25 |
| C445 | 8G-22657 | 100 mmf , ceramic | . 25 |
| C507 | 8J-16085 | . 1 mfd, 200 volt, mo'ded | . 30 |
| R306 | $9 \mathrm{P1-78}$ | 22 K ohm, $1 / 2 \mathrm{watt}, \pm 10 \%$ | . 25 |
| R 403 | 981-84 | 68 K ohm, $1 / 2$ watt $10 \%$ | . 25 |
| R416 | 981-90 | $100 \mathrm{~K} \mathrm{ohm}, 1 / 2 \mathrm{watt}, \pm 10 \%$ | . 25 |
| R418 | 9B1-78 | 22 K ohm, $1 / 2$ watt, $10 \%$ | . 25 |
| R419 | $9 \mathrm{P1-71}$ | 5600 ohm , $1 / 2 \mathrm{watt}, 10 \%$ | . 25 |
| R428 | 9B1-94 | 470K ohm, 1/2 watt, $10 \%$ | . 25 |
| R434 | 9B1-86 | 100K ohm, 1/2 watt, 10\% | . 25 |
| R446 | 46M-23018 | Fuse Resistor, 5.6 Amp. | . 55 |
| R447 | $9 \mathrm{C12-1083}$ | 47 ohm, 5 watt, 10\% | . 30 |
| R 460 | 9B1-88 | $150 \mathrm{~K} \mathrm{hmm}, 1 / 2 \mathrm{watt}, \pm 10 \%$ | . 25 |
| R463 | 981.74 | 10 K ohm. $1 / 2 \mathrm{watt}$, $10 \%$ | . 25 |
| L107-108 | 13E-23181 | UHF Antenna trap coil | . 05 |
| L403 (inc. R420, C407, C406, andC444) | 201-23477 | Sound pick-off coil |  |
| L406 | 16A-20970 | Choke coil-270 UH | . 50 |
| $\begin{aligned} & L 407 \text { (incl. } \\ & \text { C445) } \end{aligned}$ | 201-22571 | Video trap coil | 1.30 |
| T500 | 201-22396-1 | H. V. Deflection transformer |  |
| V -2 | $68 Z 7$ | VHF RF amplifier | 3.80 |
| V.20 | 25AX4 | Damper | 2.75 |

## iscellaneous Part changes

> 2C-21201

Capacitor plate
L403 core and clips assm H. V. Cable assembly R. H. Pilot light socket bracket L. H. Pilot light socket bracket Pilot light shield
Pilot light mounting bracket Pilot light mo
$H$. Hold coil
$\begin{array}{ll}\text { Filament transformer } & 3.66 \\ \text { Vertical oscillator transformer } & 2.05\end{array}$


1. If sweep generator does not have a balanced output, connect a 150 ohm resistor in series with the ground lead and 150 ohms minus the internal resistance of the generator in series with the hot lead.
2. Connect a 1000 mmf capacitor across scope terminals and a 10 K ohm resistor in series with hot lead as close
to test point as possible.
3. Connect signal generator through a 1000 mmf capacitor
4. When aligning the IF Amplifier be sure tuner is set approximately to channel 11 .


* MARKER FREQUENCIES

Figure 2. Top RF Chassis View

## TUNER ALIGNMENT

1. Preset trimmer screws C-212-217-207-214-228-224 to dimensions shown on page 29
2. Preset coil cores L-203-202-205-204-209-208 in the following manner.
(a) In low band position, turn tuner to top of stroke (cores furthest out of coil).
(b) Switch will be in low band position.
(c) Adjust coil cores 1.6 inch from core to end of coil form (use core aligning tool if available)

V-video
S-sound
LOW BAND IRF TRACEING Turn Tuner to Channel 6
S-sound

| $\begin{aligned} & \text { ep } \\ & \text { ator } \\ & \text { me.) } \end{aligned}$ | $\begin{aligned} & \text { Signal } \\ & \text { Input } \\ & \text { Point } \\ & \hline \end{aligned}$ | Output Point | Remarks | Adjust | Response |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 6 | Antenna Terminals | R.F. <br> Test Point | Adjust for maximum response | C.201B |  |
| 6 | Antenna Terminals | R. F. <br> Test Point | Adjust for maximum response | $\begin{aligned} & \mathrm{C}-207 \\ & \mathrm{C}-214 \end{aligned}$ | $m^{3}$ |
| $\begin{aligned} & 5 \\ & 4 \\ & 3 \\ & 2 \end{aligned}$ | Antenna Terminals | R. F. <br> Test Point | Adjust tuner until response curve appears on scope. <br> Adjust trimmers for compromise which will give the best overall response across band. | $\begin{aligned} & \mathrm{C}-207 \\ & \mathrm{C}-214 \end{aligned}$ |  |

HIGH BAND RF TRACKING Turn Tuner to Channel 13.

| 1 | $\begin{aligned} & \mathrm{v}-211.25 \\ & \mathrm{~s}-215.75 \end{aligned}$ | Channel 13 | Antenna Terminals | R.F. <br> Test Point | Adjust for maximum response | C-201-A |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | $\begin{aligned} & v-211.25 \\ & s-215.75 \end{aligned}$ | Channel 13 | Antenna Terminals | R. F. <br> Test Point | Adjust for maximum response | $\begin{aligned} & \mathrm{C}-212 \\ & \mathrm{C}-217 \end{aligned}$ |  |
| 3 | $\begin{aligned} & v-205.25 \\ & s-209.75 \\ & v-199.25 \\ & s-203.75 \\ & v-193.25 \\ & s-197.75 \\ & v-187.25 \\ & s-191.75 \\ & v-18.25 \\ & s-185.75 \\ & v-175.25 \\ & S-179.75 \end{aligned}$ | Channel 12 <br> Channel 11 <br> Channel 10 <br> Channel 9 <br> Channel 8 <br> Channel 7 | Antenna <br> Terminals | R. F. <br> Test Point | Adjust tuner until response curve appears on scope. <br> Adjust trimmers for compromise which will give the best overall response across band. | $\begin{aligned} & \mathrm{C}-212 \\ & \mathrm{C}-217 \end{aligned}$ |  |

LOW BAND OSCILLATOR TRACKING Turn Tuner to Channel 6.

| 1 | 83.25 | Channel 6 | Antenna <br> Terminals | Scope at IF Detector Output | Adjust until marker is 50\% down on low frequency slope | C-224 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | $\begin{aligned} & 67.25 \\ & 55.25 \end{aligned}$ | Channel 4 <br> Channel 2 | Antenna <br> Terminals | Scope at IF Defector Output | Marker should be $50 \%$ down on low frequency slope |  |  |

HIGH BAND OSCLLLATOR TRACKING Turn Tuner to Channel 13

| 1 | 211.25 | Channel 13 | Antenna <br> Terminals | Scope at <br> IF Detector Output | Adjust until marker is 50\% down on low frequency slope | C-228 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | $\begin{aligned} & 193.25 \\ & 175.25 \end{aligned}$ | Channel 10 <br> Channel 7 | Antenna Terminals | Scope at IF Detector Output | Marker should be 50\% down on low frequency slope |  |  |



Figure 3. Top VHF Tuner View



SCHEMATIC DIAGRAM
© John F. Rider



| R420 | 981-86 |
| :---: | :---: |
| R421 | 981.51 |
| R422 | 984.73 |
| R423 | $981-46$ |
| R424 | 981.7 |
| R425 | 10A-22305 |
| ${ }^{\text {R426 }}$ | 981.78 |
| R427 | 981.110 |
| ${ }^{\mathrm{R} 428}$ | 981.90 |
| R429 | $981-94$ |
| R430 | $982-51$ |
| R431 | 9 Cl 11070 |
| ${ }^{\text {R } 432}$ | 981.102 |
| R433-434 | $981-82$ |
| R435 | $981-86$ |
| R436 | $981-108$ |
| R437 | 108-17318 |
| R438 | $981-102$ |
| R439 | $981-86$ |
| R440 | 108-22307 |
| R441 | 981-102 |
| R442 | 108-22304 |
| R443 | $982-89$ |
| ${ }^{\text {R 444-445 }}$ | $981-62$ |
|  | 46M-22301 |
| R447 | $9 \mathrm{M}-22837$ |
| R448 | $9 \mathrm{M}-22275$ |
| R449 | 981.88 |
| R450-451 | 981-102 |
| R452 | 981.88 |
| R453 | $981-94$ |
| R454 | $981-84$ |
| R455 | 981-96 |
| ${ }^{\text {R456 }}$ | 981.64 |
| R457 | 108-17275 |
| ${ }^{R 458}$ | 981.96 |
| R459 | 982.74 |
| R460 | 981.90 |
|  | Chokes, |
| T400 | 13M-22303 |
| T401 | 12C-22508 |
| T402 | 12M-18241 |
| T403 | 12C-20761-2 |
| T404 | 120-22586 |
| T405 (Incl. | 201-22697 |
| ${ }_{\text {C441) }}$ |  |
| 1400 | 16A-2002 |
| L401-402 | 16A. 19486 |
|  | 201-22581 |


| $100 \mathrm{~K} \mathrm{ohm} 1 /$,2 watt, $10 \%$ | 25 |
| :---: | :---: |
| 120 ohm, $1 / 2$ watt, $10 \%$ | 25 |
| 8200 ohm, 2 watt $10 \%$ | 35 |
| $47 \mathrm{ohm}, 1 / 2$ watt. $10 \%$ | 25 |
| 22 K ohm, $1 / 2$ watt, 1 | 25 |
| On-Off Volume control, 1 meg | . 05 |
| 22 K ohm, $1 / 2$ watt, $10 \%$ | . 25 |
| 10 megohm. $1 / 2$ watt, $10 \%$ | 25 |
| 220K ohm, $1 / 2 \mathrm{watt}, 10 \%$ | 25 |
| 470 K ohm, $1 / 2$ watt, $10 \%$ | 25 |
| 120 ohm, 1 watt, $10 \%$ | . 35 |
| 3.9 ohm, 1/2 watt $10 \%$ | 25 |
| 2.2 megohm, $1 / 2$ wath, $10 \%$ | 25 |
| 47 K ohm, $1 / 2$ watt, $10 \%$ | 25 |
| 100K ohm $1 / 2$ watt, $10 \%$ | ${ }^{25}$ |
| 6.8 megohm. $1 / 2$ watt $10 \%$ | 25 |
| Vertical Hold control, 3 meg. | 80 |
| 2.2 megohm. $1 / 2$ watt, $10 \%$ | 25 |
| 100 K ohm, $1 / 2$ watt $10 \%$ | 25 |
| Vertical Size control, 750 Kohm | 75 |
| 2.2 megohm, $1 / 2$ watt, $10 \%$ | 25 |
| Vertical Linearity control, 6000 |  |
|  |  |
| 180K ohm, 1 watt. 10\% | 35 |
| 1000 ohm, $1 / 2$ watt, $10 \%$ | 25 |
| Resistor type fuse | 55 |
| 150 ohm, 15 watt 10\% | 85 |
| 2200 ohm, 10 watt, 10\% | 10 |
| 1500 ohm, 10 wath, 10\% |  |
| 150K ohm, 1/2 wath, 10\% | . 25 |
| 2.2 megohm, $1 / 2$ watt, $10 \%$ | . 25 |
| 150 K ohm, $1 / 2$ watt $10 \%$ | . 25 |
| 470K ohm, $1 / 2$ watt, $10 \%$ | . 25 |
| 68K ohm, 1/2 watt, 10\% | . 25 |
| 680 K ohm, $1 / 2$ watt, $10 \%$ | . 25 |
| 1500 ohm, $1 / 2$ watt, $10 \%$ | 25 |
| Horizontal Hold control 100K |  |
|  |  |
| 680 K ohm, $1 / 2$ watt: $10 \%$ | . 25 |
| 10K ohm, 1 watt, $10 \%$ | . 35 |
| 220K ohm, $1 / 2$ watt, $10 \%$ | 25 |
| Transformers, Coils |  |
| Ratio Detector transformer |  |
| Audio Output transformer | 1.95 |
| Vertical Oscillator transformer | 1.75 |
| Vertical Output transform | 5 |
| Filament transform | . 55 |
| Deflection yoke assembly | 11.30 |
| Peaking coil (130UH) |  |
| Peatking coil ( 380 UH ) | 30 |
| Video Trap Coil assm. | 1.55 |
| Filter choke ( 2.6 H ) |  |
| H. Hold coil assm. | 1.75 |

## Miscellaneous



| Capacitors |  |  |
| :---: | :---: | :---: |
| 8G-19863 | 47 mmf , ceramic | 25 |
| 8F3-121 | 470 mmf , 500 volt, mica | 25 |
| ${ }^{8 J .20589}$ | .0015 mfd , 400 volt, molded | 25 |
| 8C-22544 | $50 \mathrm{mfd}, 450$ volt, Iytic | 2.20 |
| 8J.16081 | . 047 mfd , 400 volt, molded | . 30 |
| ${ }^{81}$ J-21505 | $.47 \mathrm{mfd}, 400$ volt, molded | . 95 |
| 86-21440 | $470 \mathrm{mmf}, 1000$ volt, ceramic | . 30 |
| 8J-16082 | . 22 mfd , 200 volt, molded | 45 |
| Resiste rs |  |  |
| 981.88 | 150K ohm, $1 / 2$ watt, $10 \%$ | 25 |
| $981-50$ | 100 ohm, $1 / 2$ watt, $10 \%$ | 25 |
| 981.94 | 470K ohm, $1 / 2$ watt $10 \%$ | . 25 |
| 984.74 | 10K ohm, 2 watt, 10\% | 35 |
| 982 -65 | 1800 ohm, 1 watt, 10\% | . 30 |
| 984.70 | 4700 ohm. 2 wath, 10\% | . 35 |
| 9 Cl 1070 | 3.9 ohm, 1/2 watt, 10\% | . 25 |

Chokes, Transformers, Coils 201-22396
20-2225 $\begin{gathered}\text { H. V. Deflection transformer } \\ \text { Chassis bolt bracket }\end{gathered} \quad \begin{aligned} 11.25 \\ .10\end{aligned}$


## TUNER SERVICE HINTS

A convenient service check point is provided for measuring the UHF oscillator grid current to determine whether the oscillator is functioning. To measure this current
place a multimeter on the 100 microamperes scale across resistor R106 ( 22 ohms). A reading of 10 to 30 microamperes should be obtained if the oscillator is functioning normally. Another check point has been provided for measuring the crystal current to check both the UHF crystal detector and oscillator. Place a multimeter on
the 100 microamperes scale across resistor R105 (22 ohms) and a reading of 5 to 40 microamperes should be obtained if both the oscillator and crystal are functioning normally.

Before attempting service of the UHF tuner, it may prove helpful to check, if the same condition appear when tuned to a VHF station. If the condition appear
on both UHF and VHF the cause of the trouble wil generally be located in the I F amplifier or Video ampli-
fier circuits. If, however, the condition appears only on antenna installation should be checked for the possible
When attempting UHF servicing, it may prove helpful
When attempting UHF servicing, it may prove helpful o bear in mind that when trouble occurs in the oscilator
the picture will generally disappear and when there is the picture will generally disappear and when there is
a defect in the RF or mixer stage a decrease in signal will usually result.
If a condition arises where trouble occurs on either high or low VHF band only, then it can be assumed that the rouble is definitely in the VHF tuner or VHF antenna installation. One other possibility may be due to defecive switch contacts. Defective switch contacts can easily be replaced by removing the two question mark shaped springs, lifting up the switch plate assembly and re-
moving the black switch contact holder and replacing the switch contact.



UHF TUNER SCHEMATIC


## MISTUNING:

Condition is generally caused by a lack of care when tuning in a station. A similar condition may be due to a faulty antenn tube.
CHECK:
V-1 UHF Oscillator (6AF4) VHF RF Amplifier (68Z7)
VHF Oscillator-Converter (6U8)


Usually caused by a filament to cathode short or leakage in the
CHECK:


38

*WEAK PICTURE WITH SNOW
vHF TUNER SCHEMATIC
*NO PICTURE WITH SNOW (Raster Visible)
This condition is usually caused by a defective antenna installa the first IF Amplifier.
CHECK:
Antenna Installation and Connections

| $V-1$ | UHF Oscillator (6AF4) |
| :---: | :---: |
| V-2 | VHF RF Amplifier- <br> UHF IF Amplifier (6BZ7) |
| V. 3 | VHF Oscillator-ConverterUHF IF Amplifier (6U8) |
| V-4 | IF Amplifier (6CB6) |
| VC-1 | UHF Crystal (1N82) |
| R203 | V-2 Decoupling Resistor |
| R209 | V-3 Decoupling Resistor |
| R210 | V-3 Screen Resistor |
| L212-307 | B Supply Choke |
| C222 | V-3 Plate Capacitor |
| C220 | V-3 Screen Capacitor |
| C210-309-223-224 | Decoupling Capacitor |
| T200 | IF Transformer |
| 5300 | Antenna Switch \& Associated Compon |
| S204 | VHF Oscillator Cathode Switch |
| S100 | UHF Oscillator Switch |

NOTE: Check antenna plugs to tuners and UHF power plug for proper seating.



## SOUND BARS:

The appearance of sound bars may possibly be due to mistuning of the receiver, microphonic station equipment or due to micro-
phonic Vertical, RF, IF, or Video Amplifier tubes.

## CHECK:

$\mathrm{V}-17$
$\mathrm{~V}-18$
V-18
$\mathrm{V}-4-5-6-7$
$\mathrm{~V}-2$
VHF RF Amplifier-
V-3 UHF IF Amplifier (6BZ7)

NOTE: To determine possible cause of condition, properly tune in a station and then turn the volume control to its minimum volume setting. If the bars remain visible the If howeve is usually due to the station or outside interference. they reappear, the cause is most likely due to a microphoni tube. Gently tap each tube specified above while observing the picture.

amplifier schematic

## REPLACEMENT PARTS




POOR VERTICAL LINEARITY
Condition is generally due to a misadjustment of the vertical size，line
CHECK
$\begin{array}{ll}\text { R447 } & \text { Vertical Size Control Adjustment } \\ \text { R450 } & \text { Vertical Linearity Control Adjustme }\end{array}$ Vertical Linearity Control Adjustment Centering Control Adjustment Vertical Output（654） Vertical Output Transformer V － 18 Plate resistor V－18 Plate capacitor Coupling capacitor V－18 Cathode by－pas
NOTE：In the absence of a test pattern it is possible to adjust the receiver for a reasonable vertical distribution．Turn the
V．Size and the $V$ ．Linearity controls to their minimum adjust－ ment position and then with the centering control properly adjust the remaining picture to the vertical center of the tube．Adjust the V．Size and V．Linearity controls until the picture fills the mask，bearing in mind that the size control effects the bottom portion of the picture and the linearity
control affects the upper portion of the picture．To check vertcial distribution，roll the picture slowly using the $V$ Hold Control and observe the blanking bar as it drifts．If the V．Size，V．Linearity and centering controls are properl adjusted the thickness of the bar will not change during it movement．


EXCESSIVE VERTICAL SIZ
This condition is genreally due to misadjustment of the vertical
size and linearity controls．
CHECK：
R447
R450
ertical Size Control Adjustment

INSUFFICIENT VERTICAL SIZE
This condition is usually caused by misadjustment of the vertical size and linearity controls or dus to a defective tube or com

## Ponent in

CHECK：
R447
R450

| R447 | Vertical Size Control AdjustmentVertical Linearity Control Adjustment |  |
| :---: | :---: | :---: |
| R450 |  |  |
| V－17 | Vertical Blocking Oscillator（6BF6） |  |
| V－18 | Vertical Output（654） |  |
| T403 | Vertical Output ${ }^{\text {Deflection Yoke }}$ |  |
| T406 |  |  |
| R451 | V． 18 Plate Resistor |  |
| C437 | V． 18 Plate Capacitor |  |
| C401D | V． 18 Cathode By－pass <br> V－18 Coupling Capacitor |  |
| C435 |  |  |
|  | REPLACEMENT PARTS |  |
| Ref．No． | Part No． | Description |
| C401D | 8C．22536 | $60 \mathrm{mfd}, 50 \mathrm{volt}$ ，－part of lytic |
| C429 | 17 A .22376 8 C .22550 | ${ }^{\text {a }}$ |
| R445 | 108－17318 | V．Hold Control－3M ohm |
| R447 | 108－22307 | V．Size Control－750K ohm |
| R450 | ${ }^{108-22687}$ | V．Linearity Control－5000 ohm |
| T402 | $12 \mathrm{M}-18241$ | Vertical Oscillator Transformer |
|  | 12C－20761－2 | Vertical Output Iranstormer |




V．Hold：
The Vertical Hold control should be adjusted when the picture is rolling or flipping up or down．The proper setting of the vertical hold control is that point where place．At this control setting noise will have locks into tendency to interrupt vertical sync．
V．Size and V．Linearity：
The vertical size and linearity controls should be ad usted while a test pattern is being received．The line－ arity control affects the upper portion of the picture while the size control affects the overall size especially the lower portion of the picture．Adjust both controls fills the entire screen vertically．Readjust the vertical hold control if necesary．

vertical deflection schematic
NO VERTICAL SWEEP
This condition is generally caused by a defective tube or com－ ponent in the vertical deflection circuit．

| V．17： | Vertical Blocking Oscillator（6BF6） |
| :--- | :--- |
| V－18 | Vertical Output（6S4） |
| T402 | Vertical Blocking Oscillator Transformer |
| T403 | Vertical Output Transformer |
| T06 | Deffiection Yoke |
| C430－432－435 | Coupling Capacitor |
| R447 | Vertical Size Control |
| NOTE：Check | Vertical Yoke socket for proper seating．One |
| method of isolating the defective stage is to apply a 60 |  |
| cycle 6.3 filament voltage thriugh a 5 MFD capacitor to |  |
| various points in the vertical deflection circuit．If an increase |  |
| of vertical deflection is not observed as the 60 cycle voltage |  |
| is applied the defect is located between the point tested |  |
| and the deflection yoke． |  |



Vertical Blocking Oscillator（6BF6
Vertical Output Oscillator Transformer Defiection Yoke
Veuptical Capacitor method of isolating the defective stage is to seating．One various points in the vertical deflection circuit．capacitor to is applied the defect is located between theycle voltage and the deflection yoke．


Service Hint
A poor vertical sync condition may possibly be due to a defect in the RF, IF or video amplifier stages. This may be quickly checked by observing the blanking bar as illustrated in condition 16. If the detail in the blanking bar is not blacker than the blackest portion of the picture is notlor condition exists. Refer to overloading, an overloading condition exists. Refer to overloading. condition number 33.


SYNC CLIPPER AND AMPLIFIER SCHEMATIC

## POOR VERTICAL SYNC

Poor vertical sync is generally caused by improper adjustment of the vertical hold control or a defect in the oscillator, sync am plifier or sync clipper circuits.

CHECK: V-16 Sync Amplifier (6AV6) $\mathrm{V}-16$
$\mathrm{~V}-8$
C 429 Sync Amplifier (6AV6) Sync Clipper (6BE6)
Intergrating network
R443-444-445-446
C 430
T 402
Vertical Hold Control Resistors
Coupling Capacitor
Oscillator Transformer


16

afC And horizontal multivibrator schematic

## SERYICE HENTS

Whenever the sync, AFC, Horizontal Multivibrator or H . Pulse Amplifier stage is suspected as the cause of the trouble, it will prove helpful to short the input grid of the Horizontal Multivibrator (pin 2, V21) to ground, readjust the horizontal hold control and then observe the picture. If the condition disappears you can assume that the source of the trouble is before the input grid of the oscillator. If, however, the condition remains, the trouble is probably after the grid of the multivibrator.
H. Drive

The H. Drive control should be adjusted only after a station is properly tuned in and the H . Size and H . Lin
earity controls are adjusted for correct size and good earity contros are adjusted for correct size and good
linearity. The Drive control should be turned clockwise until a fold-over (sectional scan slow down evidenced by a white vertical line) appears in the center portion of the picture. Turn the Drive control counter-clockwise until all traces of fold over disappear and then give an
additional one-eighth turn counter-clockwise. As a check turn the brightness control to maximum and minimum brilliance and observe the face of the picture tube. If the Drive control is adjusted properly a fold over will not appear as the brightness control is varied.


## HORIZONTAL DISPLACEMENT

Condition can be caused by improper adjustment of the Horizon-
tal Hold control or a defective tube or component in the sync clipper or amplifier, AFC, horizontal multivibrator or pulse circuit
CHECK

| R471-L409 | Horizontal Hold Control Adjustment |
| :--- | :--- |
| V-20 | AFC Discriminator (6AL5) |
| V-21 | Horizontal Multivibrator (12AU7) |
| V-22 | Horizontal Puse Amplifier (25CD6) |
| V-16 | Sync Amplifier (6AV6) |
| V-8 | Sync Clipper (6BE6) |
| C502-R502 | Boost Voltage Filter |
| R501 | V-21 Plate Resistor |
| C448-449 | V-21 Grid Capacitor |
| R466-468 | AFC Feedback Resistor |
| C444-447 | AFC Feedback Capacitor |
| NOTE: Check H. V. Power and Yoke plug. |  |

## H. Size and H. Linearity

The H . Size and H . Linearity controls should be adjusted while a test pattern is being received. The Size contro should be adjusted until the raster fills the entire screen horizontally and the Linearity control should be adjusted and Corizontal symmetrical test pattern. The H. Size ime a mering controls may require readjustment. Each controls are made the H . Drive control should be readjusted.

horizontal output and high voltage schematic

## DRIVE BAR

Drive condrol or duerally caused by misadjustment of the H .

## NO RASTER WITH NORMAL SOUND

No Raster (no brightness on face of picture tube) with normal sound is usually caused by a defect in the high voltage supply with the picture tube.
CHECK
R413
$24 \quad \begin{aligned} & \text { Brightness Control Adjustment } \\ & \text { lon Trap Magnet Adjustment }\end{aligned}$
$\begin{array}{ll}\text { V-24 } & \text { High Voltage Rectifier (183) } \\ \text { V-22 } & \text { Horizontal Pulse Amplifier (25CD6) } \\ \text { V-21 } & \text { Horizontal Multivibrator (12AU7) }\end{array}$
$\begin{array}{ll}\mathrm{V} \text { V-21 } & \text { Horizontal Multivibrator (12A } \\ \text { V-23 } & \text { Horizontal Damper (12AX4) } \\ \text { V_10 } & \text { Picture Tube (24DP4) }\end{array}$

- 22 Screen Resistor

V-22 Screen Capacitor
H.V. Deflection Transformer

## V- 21 Plate Resistor <br> $\begin{array}{ll}\text { C505 } & \text { V-21 } \\ \text { R Plate Resist } \\ \text { T500 } & \text { H.V. Deflection } \\ \text { T406 } & \text { Deflection Yoke }\end{array}$

NOTE: Check H.V. Power and H. Yoke plugs for proper seating, CRT sockets and high voltage anode lead for proper onnections.

## NO RASTER NO SOUND

A condition of No Raster with. No Sound is generally caused by Bupply voltage source.
CHECK:

| S-300 | Phono-TV Switch Position |  |
| :--- | :--- | :--- |
| V-18 | Vertical Output (654) |  |
| V-23 | Horizontal Damper (12AX4) |  |
| V-14 | Audio Output (50C5) |  |
| V-19 | Horizontal Pulse Amplifier (25CD6) |  |
| RR56 | Resistor Type Fuse |  |
| R457-458 | Series Filament Resistor |  |
| C401-439-440-441 | B Supply Filter Lytics |  |
| R459 | Voltage Divider Resistor |  |
| L406-407-408 | B Supply Filter Choke <br> T405 | Power Transformer  <br>  Selenium Rectifiers |
| NOTE: Check AC line cord, safety interlock and on-off switch. |  |  |

## EXCESSIVE HORIZONTAL WIDTH

Condition is generally due to improper adjustment of the $H$. Size
control insuff
CHECK
$\mathrm{V}-24$
$\mathrm{~V}-22$
$\mathrm{~V}-23$
$\mathrm{~V}-21$
R505
C505
R503
C501-C502
R500-501
T500
R507
C500

Horizontal Size Control Adjustment High Voltage Rectifier (183)
Horizontal Pulse Amplifier (25CD6) Horizontal Damper (12AX4) Horizontal Multivibrator (12AU7)
V-22 Screen Resistor
V-22 Screen Capacito
V.22 Grid Resistor

V-21 Grid Capacitor
H.V. Deflection Transformer

V- 24 Filament Resistor

- 21 Plate Capacitor



REPLACEMENT PARTS

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LOW VOLTAGE SChematic

## BLOOMING

The blooming effect will vary with adjustment of the picture and brightness controls and is usually caused by a defective tube or component in the high voltage or $B$ supply voltage circuits.
CHECK:
$\begin{array}{ll}\text { V. } 24 & \text { High Voltage Rectifier (1B3) }\end{array}$ V. $23 \quad$ Horizontal Pulse Amplifier 25C Horizontal Damper (12AX4) ow Voltage Rectifier (5Y3) ture Tube (24DP4)
V-24 Filament Resistor
${ }^{\text {R507 }}$
R502-C5
T500
C401-439-440-44 L406-407-408

Boost Voltage Filter
H. $V$ Deflection
. V. Deflection Transformer
B Supply Filter Lytics
Choke
Selenium Rectifiers

## INSUFFICIENT HORIZONTAL AND VERTICAL SIZE

This condition can possibly be caused by incorrect horizontal size, vertical size and linearity control adjustments, low B supply voltage or possibly due to low AC line voltage.
CHECK:
$\begin{array}{ll}\text { V-19 } & \text { Low Voltage Rectifier (5Y3) } \\ \text { V-22 } & \text { Horizontal }\end{array}$ V-23 Horizontal Pulse Amplifier (25CD6
Horizont

C502-R502
C $401-439.440-441$ per (12AX4)
Boost Voltage Filter
B Supply Filter Capacitors
Selenium Rectifiers 24

NOTE: Check H.V. power plug for proper seating and AC line voltage.

## POOR FOCUS

This condition is generally caused by an incorrect adjustment of
the ion trap magnet, insufficient high voltage or a defect in the
$B$ supply voltage source.
CHECK:
Ion Trap Magnet Adjustment
$V-21$
$V-24$
$V-22$
$V-23$
$V-21$
Horizontal Pulse Amplifier (25CD6)
Horizontal Damper (12AX4)
Horizontal Multivibrator (12AU7)
Picture Tube (24DP4)
T406
(24DP4)
B Supply Filter Lytics
Deflection Yoke
Selenium Rectifier

## TILTED PICTURE

This condition is caused by an incorrectly positioned deflection yoke. CHECK:

Deflection Yoke Positioning Adjustment

TUBE SHADOW
This condition is usually caused by an incorrectly positioned deflection yoke or a misadjusted centering control or ion trap magnet. CHECK:

Deflection Yoke Positioning Adjustment
Centering Magnet Adjustment

REPLACEMENT PARTS

If adjustment is determined necessary, loosen the wing nut, rotate and slide the magnet until the position which gives maximum illumination is found. Adjust the screw otate and slide the is found without sacrificing brilliance. Tighten wing nut Adjustment should be made with brightness and picture controls set for normal viewing. The position of the ion trap magnet MUST be over the grid of the picture tube second cylinder from the base identified by a flared forward lip) after the adjustment is complete.

## Centering Magnet:

The centering magnet should be rotated and the conrol adjusted until the picture is properly framed keeping in mind that the effect of the control is governed by the position of rotation. If the control is above or below up or down. To the left or right of the neck of the picture tube, the picture can be moved either to the
left or right. The position of the centering magnet should be $1 / 4$ to $1 / 2$ inch behind the deflection yoke.

Anti-Pin Cushion Magnet:
Adjust centering until edge of the raster is visible
Adjust centering until edge of the raster is visible.
oosen the positioning screw and slide the magnet until the edge of the raster is vertically straight. If keystoning is noticed adjust magnet in vertical plane.

## Deflection Yoke

The correct position for the deflection yoke is as far forward on the neck of the picture tube as the shape of the tube will allow. Tube shadow or a tilted raster may result from an incorrectly positioned yoke. If a position adjustment is necessary, loosen the yoke wing nut located t the top of the picture tube assembly.


## TRAPEZOIDAL RASTER

A trapezoidal raster is generally caused by a defective defle
tion yoke or associated components.
CHECK:
$\begin{array}{ll}\text { T406 } & \text { Deflection Yoke } \\ \text { R453-454-455 } & \text { Yoke Loading Resistors }\end{array}$
C438 Yoke Equalizing Capacitors

## SOUND CONDITIONS

It will always prove helpful when analysing a service condition to first determine if the sound section is functioning normally. Since the receiver is of the intercarrier type, both the sound and picture information are amplified simultaneously by the tuner and IF amplifiers. By analysing the above, it can be assumed that if the picture appears to be normal and the sound is not functioning properly the defect is located between the sound take off point (IF Detector Output) and speaker.

B-NO SOUND
A no sound condition with a normal picture is gener ally caused by a defective tube or component be tween the IF Detector Output and speaker.
CHECK

| S400 | Phono-TV Switch Position |
| :--- | :--- |
| V-11 | Audio I F Amplifier (6AU6) |
| V-12 | Audio Detector (6AL5) |
| V-13 | Audio Amplifier (6AV6) |
| V-14 | Audio Output (50C5) |
| R419 | V-11 Screen Resistor |
| C415 | V-11 Screen Capacitor |
| R427 | V-13 Plate Resistor |
| R422 | Volume Control |
| C422 | Coupling Capacitor |
| R459 | Voltage Divider Resistor |
| R430 | V-14 Cathode Resistor |
| T401 | Output Transformer |
| T400 | Ratio Detector Transformer |
|  | Speaker |

NOTE: Check Speaker cable connections.

## SOUNI CONDITIONS

## D- DISTORTED SOUND

This condition is usually caused by a defective tube or component in the sound section.
CHECK

| V-14 | Audio Output (50C5) |
| :--- | :--- |
| V-12 | Audio Detector (6AL5) |
| V-13 | Audio Amplifier (6AV6) |
| C-419A-B-C | Filter Lytic |
| C-422 | Coupling Capacitor |
| R427 | V-13 Plate Resistor |
| R430 | V.14 Cathode Resistor |
| T400 | Ratio Detector Transformer |
|  | Speaker |
| T400 | Ratio Detector Transformer <br>  <br>  <br>  <br> Adiustment (Secondary-Top Slug) |

## HUM OR BUZZ IN SOUND

This condition is generally due to a defective tube o component in the sound section or due to a misalign ment of the sound coils.

CHECK:

| V-12 | Audio Detector (6AL5) |
| :--- | :--- |
| V-14 | Audio Output (50C5) |
| V-13 | Audio Amplifier (6AV6) |
| V-11 | Audio IF Amplifier (6AU6) |
| C419A-B-C | Filter Lytic |
| T400 | Ratio Detector Transformer <br> L404 |
| Adiustment (Secondary TopSlug) <br> Audio Pick-Off Coil Adjustment <br> C414 | Buzz Control Adjustment |

NOTE: A fast method of isolating the defective stage when a troublesome sound condition occurs is to apply citor to various points in the sound section. If an increase of volume is not observed as the 60 cycle is applied, the defect is located between the point tested and the speaker.

## REPLACEMENT PARTS

| Ref. No. | Part No. | Deseription |
| :---: | :---: | :---: |
| $\mathrm{C}_{414}$ | 8E-22538 | 170.780 mmf , Trimm |
| C419A-B-C | 8C-22524 | $10 \mathrm{mfd}, 75$ volt- $10 \mathrm{mfd}, 25$ volt |
| R422 | $10 \mathrm{~A}-22308$ | Volume Control \& Switch-1 M ohm |
| R428 | 108-19542 | Tone Control-1M ohm |
| T400 | ${ }^{13 \mathrm{M}}$-22303 | Ratio Detector Transformer |
| T401 | 12 C -22508 | Audio Output Transformer |
| 1404 | 201-22582 | Sound Pick-Off Coil |
| 5400 | 20A-22479 | Phono.TV Switch |



SOUND SECTION SCHEMATIC

## EXTEIRNAL INTERFEIRENCE

The five service conditions below which are usually caused by external interference have been included in the "Service Saver" as they are common service complaints. These conditions are presented so that they can easily be identified and usually the effects in the picture are lifte affected by a
control adjustment, tube or component substitution or circuit modification. These conditions result from an interferring external signal and are seldom caused or due to a defect in the receiver.


## Channel cross talk

Due to interference from a nearby station on same channel or due to adjacent channel interference-Orientation, relocation o an antenna with sharper directivity characteristics and the use traps are suggested to reduce or eliminate channel cross talk.

## RF INTERFERENC

Due to a beat frequency between the incoming signal and high powered radio equipment or a local oscillator in a receiver being operated in the vicinity-Orientation, relocation or installing a higher gain and more directional type antenna or the use of a booster may be effective in eliminating this interference.


## DIATHERMY INTERFERENCE

Caused by X-Ray, commercial RF heating, ultra-violet and fluor escent lights, brush motors and other 60 cycle operated equip ment-Filters or other corrective measures installed at the source of interference may be tried to eliminate the herring-bone pat tern from the picture.

## IGNITION INTERFERENCE

Caused by ignition systems of cars or trucks or by breaking contact type of electrical appliances in vicinity. Similar condition may result from arcing in high voltage supply. - Effects in the picture may be reducedilding or redressing the transmission line or by installing a power line filter.


## TUNER DIBIVE ASSEMBLY

## TO REMOVE TUNER DRIVE ASSEMBLY FROM RF CHASSIS

1. Remove coupling arm spring from each side of tuner drive assembly.
. Remove coupling arm connecting bar from each side
Remove the four tuner drive mounting screws from top of RF chassis and remove tuner drive assembly of tuner drive assembly.

## TO DISASSEMBLE TUNER DRIVE ASSEMBLY

1. Place tuner drive assembly on it's VHF side, the end plate assembly is now the top end, which is the UHF side. (See Fig. 1.)
2. Remove coupting arm screw, two washers, lock

Disconnect locking arm spris
4. Loosen tie plate mounting screws and remove the
top one from each tie plate.
5. Loosen four set screws. Two on each locking collar

Located on each end of tuning shaft.
6. Loosen dial cord.
7. Remove top end plate assembly.
8. Remove dial cords.
0. Remove thrust springleys.
11. Remove driven plate assembly.
12. Remove three small and one large ball bearing.
3. Remove drive pulley.


TO ASSEMBLE TUNER DRIV

1. Place tuner drive assembly on it's VHF side.
2. On one end of dial cord tie a tension spring and insert the other through locking collar hole and tie a knot. (See Fig. 2.)
3. Place the above dial cord with tension spring and collar on one end of drive pulley. Place dial cord tension spring on right side of right wing. (on out
side of drive pulley). Wrap around wing and make two full turns in clock-wise direction. Tape may be used on right side of right wing to hold dial cord tight.
4. Place second dial cord with tension spring on left side (on outside of drive pulley) of left wing. Wrap around wing and mave pulley) of letwing. Wrap
counter clock-wise direction. Again tape may be used on left side of left wing to hold dial cord tight.
5. Insert drive pulley over drive pulley shaft.
6. Put the 3 small ball bearings and 1 large ball bearing in their respective holes in drive pulley.
7. Place driven plate assembly over drive pulley shaft . Place thrust spring over driven plate (refer to Figure 1).
8. Insert two idler pulleys at top of end plate assem bly. Make sure excess dial cord is on the outside of dier pulleys.
9. Add end plate assembly, making sure that locking
arm can swing out.
10. Replace three tie plate screws.
11. The next three steps are most easily done with the help of an assistant. Set tuning shaft $6 / 1 / 2$ turns from either stop and hold at that point. Also set drive
pulley to center position, wings will be centered pulley to center position, wings will be centered
looking through hole at top tie plate. Remove tape from right wing. By-pass idler pulley and wrap dial string around knurl end of tuning shaft in a counterclockwise direction. (See Figure 2.)
12. Remove tape from left wing, by-pass other idler pulley and wrap dial string around tuning shaft in
a clockwise direction (looking from knurl end of shaft).
13. Take a small screw driver or pick, and increase spring tension of both dial cords and place over
idler pulleys. Dial cord should be fairly tight. If idler pulleys. Dial cord should be fairly tight. If
not, (keep drive pulley in center of wings and tunnot, (keep drive pulley in center of wings and tun-
ing shaft at $61 / 2$ turns from either stop) take up all ing shaft at $61 / 2$ turns from either stop) take up all
slack of dial cord with locking collars at both ends slack of dial cord with locking collars at both en
of tuning shaft and lock in place with set screws.
14. Tighten all tie plate screws.
15. Hook up locking arm spring.
16. Assemble coupling arm and washers. With both wings in center of top tie plate hole, and tuning
shaft still at $61 / 2$ turns. Coupling arms should both shaft still at $61 / 2$ turns. Coupling arms should both be touching their respective stop dogs.
17. As a check to determine if the tuner drive assembly was assembled correctly, measure distance from
both coupling arms to their respective stop dogs when tuning shaft is turned from one stop to other stop. This distance should be equal (approximately $\left.1 / 8^{\prime \prime}\right)$ ) on both sides. (opposite side of stop dog as in
step 18) step 18)
18. Mechanical tracking is incorrect if distance between locking arm and stop dogs are not equal on
both sides. If not equal, let up on dial string by both sides. If not equal, let up on dial string by
loosening set screws on locking collar on the side which has the locking arm further away from stop dog. Loosen set screw on other locking collar and take up slack in dial cord and tighten screws on that collar. (If so desired, take dial string off of idler
If tuner drive assembly tuses both UHF
19. If tuner drive assembly tunes both UHF and VHF
at same time, the drive assembly has not been cor at same
rectly assembled and the following checks should be made.
(a) Check both coupling arms to make sure that they are touching stop dogs with tuning shaft at $61 / 2$ turns.
(b) Make sure the UHF tuner is set slightly off its


FIGURE 2. DIAL CORD REPLACEMENT
stop at the high frequency end when tuner drive assembly is installed.
(c) Make sure VHF coupling arm hits stop dog be(transfer position)
(d) Where the VHF tuner drives correctly, but UHF funer tends to jam at time of transfer, check collar of UHF tuner coupling arm. Make sur that the UHF switch is open when slightly of the high frequency end stop (ribbons out of bar will fit between the UHF tuner coupling and drive assembly coupling arm. Loosen allen screws on UHF tuner locking collar so connect ing bar will fit, then tighten set screws on HF UHF or VHF tuner stops must not prevent coupling arms on funer crive assembly from
touching their respective stop dogs at time of transfer. Uncouple connecting bars to check if either tuner is causing unit to jam.

## TO INSTALL TUNER DRIVE ASSEMbly INTO RF CHASSIS

1. Make sure that the tuning shaft is $61 / 2$ turns from either stop, wings in center, looking through top tie
plate hole.
2. Replace tuner drive assembly through bottom of RF chassis, and mount with the four self-tapping screws The tuner drive assembly will fit only one way.
3. Set the UHF tuner slightly away from the high frequency end stop where the cam opens up the UHF
switch. Set VHF tuner at the low trequency end. (where cam actuates VHF oscillator switch.
4. Replace coupling arm connecting bars and springs. NOTE: Jamming will result at time of transfer if either tuner reaches its stop and prevents coupling arms on drive unit to reach fheir respective stop dogs. Adjust coupling arm collar set screws on tuners if necessary. Mak
sure tuners actuate their respective switches.

## VIDED IT ALIGNMENT

NOTE: (a) Preheat the unit for at least five minutes.
b) Set VHF tuner to approximately Channel

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | Signal <br> Generator <br> Freq. (mc.) | Sweep Generator Freq (m..) | Signol Input Point | Output Point | Remarks | Adjust | Response |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 43.7 | - | IF Alignment Input "A" | VTVM at IF Detector Output | Adjust generator for output of approx. 2 volts DC on VTVM | T-301 | Maximum Reading |
| 2 | 41.4 | - | IF Alignment Input "A" | VTVM at IF Detector Output | Adjust generator for output of approx. 2 volts DC on VTVM | $\begin{aligned} & \text { L.323A } \\ & (\text { Top })^{*} \end{aligned}$ | Minimum Reading |
| 3 | 45.15 | - | IF Alignment Input "A" | VTVM at IF Detector Output | Adjust generator for output of approx. 2 volts DC on VTVM | $\begin{gathered} \text { L.323B } \\ \text { (BotHom) * } \end{gathered}$ | Maximum Reading |
| 4 | 42.1 | - | IF Alignment Input "A" | VTVM at IF <br> Detector Output | Adjust generator for output of approx. 2 volts DC on VTVM | L-319 | Maximum Reading |
| 5 | 41.25 | - | IF Alignment Input "A" | VTVM at IF Detector Output | Adjust generator for output of approx. 2 volts DC on VTVM | $\begin{gathered} \text { L-313 } \\ \text { (Bottom) } \end{gathered}$ | Minimum Reading |
| 6 | 47.25 | - | IF Alignment Input "A" | VTVM at IF <br> Detector Output | Adjust generator for output of approx. 2 volts DC on VTVM | $\begin{gathered} \text { L-314 } \\ \text { (BotHom) } \end{gathered}$ | Minimum Reading |
| 7 | 41.4 |  | IF Alignment Input "A" | VTVM at IF Detector Output | Adjust generator for output of approx. 2 volts DC on VTVM | $\begin{aligned} & \text { T-300A } \\ & (\text { Top })^{*} \end{aligned}$ | Minimum Reading |
| 8 | Remove VTVM from IF Detector output and substitute an oscilloscope in its place. Calibrate scope for sensitivity of one volt per inch. |  |  |  |  |  |  |
| 9 | $\begin{aligned} & 42.0 \\ & 46.0 \end{aligned}$ | 40 | IF Alignment Input "B" | Scope at IF Detector Output | Adjust wave form for approx. 20 divisions on scope with sweep gen. |  | ${ }_{420 \mathrm{OM}} \int \mathrm{f}_{46 \text { OMC }}$ |
| 10 | $\begin{aligned} & 42.0 \\ & 45.6 \end{aligned}$ | 40 | IF Alignment Input "A" | Scope at IF Detector Output | Adjust wave form for approx. 20 divisions on scope with sweep gen. | T-200 <br> T-300B (Bottom)* <br> C-305 <br> diust for maximum <br> amplitude with <br> proper bandwidth | ${ }_{\text {ar ouch }} \mathrm{fa}_{\mathrm{sbme}}$ |

* NOTE: Two Peaks can be obtained. Use Peak with core furthest out of coil form.

SOUND IF ALIGNMENT
NOTE: Short antenna to ground.

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | Signal Generotor Freq. (mc.) | Sweep Generator Freq (me.) | $\begin{aligned} & \text { Signal } \\ & \text { Input } \\ & \text { Point } \end{aligned}$ | Output | Remorks | Adjust | Response |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 4.5 | - | IF Detector Output | $\begin{aligned} & \text { VTVM } \\ & \text { across } \\ & \text { C. } 413 \end{aligned}$ | - | T400 Primary (Bottom of can) | Maximum Readirg on V.T.V.M. |
| 2 | - | 4.5 | IF Detector Output | Scope across C-413 | Sweep approx. $\pm 100 \mathrm{KC}$. <br> Adjust for maximum Linearity | T400 Secondary <br> (Top of can) |  |
| 3 | - | 4.5 | IF Detector Output | Scope across C. 413 | Sweep approx. $\pm$ to0 KC. Adjust for symmetry of peaks | T400 Primary (Bottom of can) |  |
| 4 |  |  | - | - | Tune in any Station | $\begin{gathered} \text { C-414 } \\ \text { Repeat step } \\ \text { No. } 2 \end{gathered}$ | Adjust for minimum noise in speaker |

OJohn F. Rider

VIDEO TRAP COIL (L-401) ADJUSTMENT
(a) Tune in station.
(b) Adjust tuner until sound bars just appear.
(c) Turn L-401 Slug all the way out (counter-clockwise)
(d) Turn the slug in (clockwise) until the horizonta
canning lines are smooth and continuous.

## ALIGNMENT PLUG

For ease of alignment and to reduce the possibility of regeneration, it is suggested that a simple generator alignment plug be made and used during the alignment.

figure 3. alignment plug

figure 4. top rf Chassis view

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | Signal Generator Freq. (mc.) | Sweep Generator Freq (mc.) | $\begin{aligned} & \text { Signal } \\ & \text { Input } \\ & \text { Point } \end{aligned}$ | Output | Remarks | Adjust | Response |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | $\begin{aligned} & \text { Y - } 83.25 \\ & \text { S } 87.75 \end{aligned}$ | Channel 6 | VHF Antenna Terminals | $\begin{aligned} & \text { RF Test } \\ & \text { Point } \end{aligned}$ | Adjust for max. gain and Flat Response | C208 \& C213 |  |
| 2 | $\begin{aligned} & \text { V - } 83.25 \\ & \text { S. } 87.75 \end{aligned}$ | Channel 6 | VHF Antenna Terminals | RF Test Point | Adjust for max. gain between markers | C204 |  |
| 3 | V-83.25 | Channel 6 Note: 1 | VHF Antenna Terminals | IF Detector Output | Adjust osc. trimmer until marker is $50 \%$ down on video side of curve. | C230 | $\int{ }^{\text {coser }}$ |
| 4 | $\begin{aligned} & \text { V. } 83.25 \\ & \text { S }-87.75 \end{aligned}$ | Channel 6 | VHF Antenna | RF Test Point | Re-adjust for max. gain and flat response | C208 \& C213 |  |
| 5 | V-55.25 | Channel 2 <br> Note: 2 | VHF Antenna | IF Defector Output | Adjust osc. core until marker is $50 \%$ down on video side of curve. | $\begin{gathered} \text { L-213 } \\ \text { (Repeat step 3) } \end{gathered}$ | $\int{ }^{-1}$ |
| 6 | $\begin{aligned} & 42.0 \\ & 45.5 \end{aligned}$ | $\begin{gathered} 40 \\ \text { Note: } 3 \end{gathered}$ | Antenna Input | IF Detector Output | Check over all IF response | C-204 | $T$ |
| 7 | V- 77.25 S-81.75 V. 67.25 S. 71.75 V. 61.25 S. 65.75 V. 55.25 S. 59.75 | Channel 5 <br> Channel 4 <br> Channel 3 <br> Channel 2 | VHF Antenna Terminals | IF Detector Output | Adjust tuner until response curve appears. | Check Point Only | $f$ |

$V-$ Video
$S . S o u n d$

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | $\begin{gathered} \text { Signal } \\ \text { Generator } \\ \text { Freq. (mc.) } \\ \hline \end{gathered}$ | Sweep Generator Freq (me.) | $\begin{aligned} & \hline \text { Signal } \\ & \text { Input } \\ & \text { Point } \\ & \hline \end{aligned}$ | Output Point | Remarks | Adjust | Response |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | $\begin{aligned} & V-211.25 \\ & S-215.75 \end{aligned}$ | Channel 13 | VHF Antenna Terminals | RF Test Point | Adjust for maximum gain and flat response | C-211 \& C-217 |  |
| 2 | $\begin{aligned} & V-211.25 \\ & S-215.75 \end{aligned}$ | Channel 13 | VHF Antenna Terminals | RF Test Point | Adjust for maximum gain between markers | C-205 |  |
| 3 | V. 211.25 | Channel 13 <br> Note 1 | VHF Antenna Terminals | IF Detector Output | Adjust osc. trimmer until marker is $50 \%$ down on video side of curve | C-231 | $\int{ }^{-5}$ |
| 4 | $\begin{aligned} & \text { V }-211.25 \\ & \text { S }-215.75 \end{aligned}$ | Channel 13 | VHF Antenna Terminals | RF Test Point | Re-adjust for maximum gain and flat response | C-211 \& C-217 | $j$ |
| 5 | V-175.25 | Channel 7 <br> Note 4 | VHF Antenna Terminals | IF Detector Output | Adjust osc. core until marker is $50 \%$ down on video side of curve | $\begin{gathered} \text { L-214 } \\ \text { (Repeat Step 3) } \end{gathered}$ | $\sqrt{t^{-902}}$ |
| 6 |  | Channel 12 <br> Channel 11 <br> Channel 10 <br> Channel 9 <br> Channel 8 <br> Channel 7 | VHF Antenna Terminals | IF Detector Output | Adjust tuner until response curve appears on scope | Check point only |  |

FIGURE 6. BOTTOM VHF TUNER VIEW
DWG. NO. 1123

## VHE TUNER ALIGNMENT

NOTE: IF amplifier must be aligned before tuner adjustments are made. Also Low Band of Tuner must be aligned before High Band.

1. Preset trimmer screws as shown in Figure 5.
. Preset coil cores as following
(A) With Band Sw. in Low Band pos., set treadle bar to top of stroke (Cores furthest out of coil)
(B) Adjust Cores: L200, L201, L205, L206, L209, L210 to $1-1 / 2^{\prime \prime}$ from cores to end of coil form.
(C) Adjust Core: L213, L214 to $1-5 / 8^{\prime \prime}$ from cores to end of coil form. (See Figure 6.)

Note 1: From bottom of treadle bar $13 / 4^{\prime \prime}$ to top of tuner chassis. Note 2: From bottom of treadle bar $11 / \mathrm{s}^{\prime \prime}$ to top of tuner chassis. Note 3: From bottom of treadle bar $5 / /^{\prime \prime}$ to top of tuner chassis. Note 4: From bottom of treadle bar $7 / 8^{\prime \prime}$ to top of tuner chassis.

UHF TUNER SERVICE DATA


OSCILLATOR GRID CHECK
To determine whether the oscillator section is functioning, a convenient check point has been provided where the oscillator grid current can be measured. To measure the oscillator grid current, place a Simpson Model 260 Multimeter (or equivalent) on the 100 microamp scale across the 22 ohm resistor (R106). See Figure 8. A reading of 10 to 30 microamperes should be obtained if the oscillator is functioning normally.

## CRYStal Check

Both the oscillator and crystal detector can easily be checked by measuring the oscillator injection current. Place a Simpson Model 260 Multimeter (or equivalent) on the 100 microamp scale across the 22 ohm resistor (R105) at the terminal indicated in Figure 8. A reading of 5 to 40 microamperes should be obtained if both the oscillator and crystal are functioning normally.


FIGURE 8. UHF TUNER

## UHF ALIGNMENT

Read Following Notes Before Proceeding With the Alignment.

NOTE:
(A) Both the VHF Tuner and Video IF must be properly aligned before attempting UHF alignment
(i) Accurate sweep and marker generators are re quired for the alignment. Do not attempt alignment without proper equipment.
(C) Do not remove UHF Tuner from chassis.
(D) Make sure 6AF4 tube is firmly seated in its socket and the shield clip is seated in the tube shield notch.
(E) Check oscillator grid current and crystal current Meter readings must be within specifications. Re fer to page 30.
F) Check mechanical alignment of RF and Mixer ribbons.

1. Disconnect spring and connecting bar on UHF Tuner coupling arm.
2. Turn UHF Tuner coupling arm to its counterlockwise stop
3. RF and Mixer ribbons should be $47 / 8$ inches as indicated in Figure 8.
4. If ribbons are not at correct distance loosen pulley positioning screw slightly and reposi-
tion by turning drive pulleys. For tion by turning drive pulleys. For easy acces-
sibility of the pulley positioning screw it is suggested that the High Voltage Chassis be removed.
5. Reinstall spring and connecting bar on UHF Tuner coupling arm.

## UHF ALIGNMENT PROCEDURE

STEP 1: Use a 10 K ohm isolation resistor in series with hot lead of the oscilloscope and connect to IF De tector output.
STEP 2: Connect a 6 volt bias battery to the $A G C$ with positive to ground and negative to pin 8 of RF power socket. Connect a jumper between pins 7 and 8 of RF power socket.
STEP 3: Connect sweep generator with output impedance of 300 ohms to the UHF antenna terminals and loosely couple signal generator to sweep generator leads.

STEP 4: Set RF and Mixer ribbons to the dimensions listed in the chart below and adjust the sweep generator until the response curve indicated in figure 9 appears on the scope.
STEP 5: Adjustments should be made for maximum gain with marker appearing at the 6 d b or $50 \%$ point on the video slope of the IF response curve (see Figure 9).

| $\begin{aligned} & \text { STEP } \\ & \text { NUMBER } \end{aligned}$ | $\begin{aligned} & \text { RIBBON } \\ & \text { DIMENSION } \\ & \text { IN INCHES } \end{aligned}$ | $\begin{aligned} & \text { SWEEP } \\ & \text { GENERATOR } \\ & \text { FREQ. (MC) } \end{aligned}$ | SIGNAL GENERATOR FREQ. (MC) | $\begin{gathered} \text { ADJUST } \\ \text { TRACKING } \\ \text { SCREW PAIR } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: |
| 1 | 43/4 | 890 | 895 | See Note "I" |
| 2 | 45/8 | 865 | 870.5 | \# 1 |
|  | 4-3/16 | 715 | 780.5 | \# 2 |
| 4 | 37/8 | 726 | 731 | \# 3 |
| 5 | 3-7/16 | 671 | 676 | \# 4 |
| 6 | $31 / 8$ | 624 | 629.5 | \# 5 |
| 7 | 23/4 | 585 | 590 | \# 6 |
| 8 | 2-7/16 | 545 | 550 | \# 7 |
| 9 | 2-1/16 | 507 | 512 | \# 8 |
| 10 | 1-11/16 | 478 | 483.5 | \# 9 |
| 11 | 13/8 | 455 | 460 | \#10 |



FIGURE 9.

NOTE "I" Loosen two oscillator cavity screws and turn oscillator adjustment so that the 895 MC marker falls at the point indicated in Figure 9. Tighten
both oscillator cavity screws.

OTE "II" Adjustment of tracking screws must be made sequence from 1 through 10 .
NOTE "III" To reach position number 11 it may require disconnecting the spring and connecting bar on the coupling arm clockwise.


SCHEMATIC DIAGRAM

REPLACEMENT PARTS LIST


REPLACEMENT PARTS LIST

| Ref. No. | Part No. | Description | Solling Price | Ref. No. | Part No. | Description Selling | Selling Price |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 40MC RF CHASSIS (cont'd |  |  |  |  |  |  |  |
| Miscellaneous (Cont'd) |  |  |  |  |  |  |  |
|  | 201-22414 | 1F Output lea | . 15 |  | ${ }^{2} \mathrm{C}-22146$ | Tie plate (3 used) |  |
|  | $2{ }^{201-22421}$ | UHF Ant. tra | ine assm. . 25 |  | ${ }^{534} 4.22815$ |  | . 12 |
|  | $200-22400$ $2 \mathrm{C}-22167$ | Tuner coupling Couplin bar | bushinga <br>  <br>  <br> 05 <br> 0 |  | ${ }^{49 \mathrm{~A}-22277}$ | Cord tension spring ( 2 used) Drive pulley | 1.20 |
|  | - $49 \mathrm{C}-22122223$ | Coupling bar | . 05 |  | ${ }_{3 \text { S-22136 }}$ | Drive pulley shaft | . 10 |
|  | 2M-22209 | Antenna switco | . 02 |  | 55C-22139 | Large metal ball | . 02 |
|  | 14MA-18253785-6 | Antenna swit | 3pring.05 <br> 15 |  | 55C-22140 $200-2153$ | Small metal ball ( 3 used) | $\stackrel{.02}{85}$ |
|  | ${ }_{200-22417}^{1404}$ | Antenna swit | . 75 |  | 29E-22144 | Driven plate thrust spring (2 used) |  |
|  | $200-22413$ | Antenna switc | asm. $\quad .60$ |  | 2C-22148 | End plate (2 used) | . 65 |
|  | 3A-22135 | Tuning shaft | . 95 |  | 2M-22270 | Locking arm (2 used) | . 15 |
|  | 2C-22271 | Shaft follower | . 05 |  | $3 \mathrm{M}-22138$ | Locking arm pin ( 2 used) | . 04 |
|  | 2M-22554 | Shaft followe | . 05 |  | 49A-22273 | Locking arm spring (2 used) | . 04 |
|  | - | Driv.lok pin | (sed) $\quad .02$ |  | $29 \mathrm{C}-22395$ $200-22152$ | Rotaining "E" ring (2 used) | . 10 |
|  | ${ }_{52 \mathrm{C}-11339}$ | Collar sat scrater | d) ${ }^{\text {dsed }}$ |  | ${ }_{20} 20.22165$ |  | . 05 |

24 INCH DEFLECTION CHASSIS

| Capacitors |  |  |  | Resistors |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | ${ }_{8}^{8 J-16082}$ | $.22 \mathrm{mfd}, 200$ volt, molded | 45 | R 40 | 2 | 47K ohm, $1 / 1 /$ watt, $10 \%$ | . 25 |
|  |  | 10 mfd ., 300 volt: 30 mfd . 300 | 3.95 | R401 R402 | $\xrightarrow{981.102} 981.100$ |  | . 25 |
|  |  | volt: 60 mfd , 300 volt; 60 |  | R403 | 981.76 | 15 K ohm $11 / 2$ wat $10 \%$ | . 25 |
|  |  | mfd, 50 volt, 1ytic |  | R404 | 981.86 | 100 K om, $1 / 2 \mathrm{watt}$, $10 \%$ | . 25 |
| C402 | $\begin{aligned} & 8 G-13962 \\ & 8 J .16085 \end{aligned}$ |  |  | R405 | 982.86 | 100 K ohm, 1 watt $10 \%$ |  |
| $\mathrm{C}_{4} 3$ |  |  |  | R406 | 781.76 | 15 K ohm, $1 / 2$ watt, $10 \%$ | 25 |
|  | ${ }_{8}^{8 J J 16081}$ | Included with 4001 |  | R407 | 108-223 | Contras |  |
| C4 |  | .033 mfd, 200 volt, molded .25 |  | R408 | 981.82 | 47 K ohm | 25 |
| C406 |  |  |  | R40 | $981-76$ | 15 K |  |
| C407- | 8G-13962 |  |  | R410 | 981 | 220K ohm, $1 / 2$ watt, $10 \%$ |  |
| C409 |  | $.1 \mathrm{mfd}, 400$ volt, molded .022 mfd, 400 volt, molded | . 25 | R411 | 984.71 | 5600 oh |  |
| C410 | 8M-22982 $8 \mathrm{M}-22694$ |  | . 35 | R412 | $981-71$ | 5600 oh |  |
| C411 |  |  |  | R413 | 108-21456 | Brightness Control, 500 K ohm |  |
| ${ }^{\text {c412 }}$ | ${ }_{8}^{8 G-20269}$ | . 0.00 mfd ceramic disk |  | R414 | 981.86 | 100 K ohm, $1 / 2$ watt, $10 \%$ | 25 |
| $\mathrm{C}_{413}$ |  |  | . 25 | R415 | $981-68$ | 3300 ohm, $1 / 2$ watt, $10 \%$ | 25 |
| C414 | $8 \mathrm{E}-22538$ <br> 8J-20634 | 170.780 mmf, frimmer | . 70 | R416 | 981.65 | 1800 ohm, $1 / 2$ watt, $10 \%$ |  |
| C415 |  | $.0022 \mathrm{mfd}, 400$ volt, molded | . 30 | R41 |  | Included with 140 |  |
| C416-417 |  |  | 5000 mmf , ceramic disk <br> $10 \mathrm{mfd}, 75$ volt; 10 mfd 25 volt; |  | R418 | 981 | 120 ohm, $1 / 2$ watt, $10 \%$ |  |
| ${ }^{\text {c418 }}$ | ${ }_{8}^{8 \mathrm{CC}-22524}$ |  |  |  | R419 | 984-73 |  |  |
| C419A-B.C |  |  |  |  | R420 |  | , $1 / 2$ wat, $10 \%$ |  |
|  | 8G-20269 | ${ }^{20}$ mfda, 300 volt, 1 ltric | 2.10 .25 |  | $981-82$ | ohm, $1 / 2$ wath, $10 \%$ | 25 |
| $\mathrm{C}_{422}$ |  | . 01 mfd, 400 volt, molded | . 25 | R422 | 10A-22308 | Volume Co |  |
| ${ }^{\text {c } 423}$ | ${ }^{86}$-20269 | 01 mfd, ceramic disk | . 20 | R423 | 981.78 |  |  |
| C424 | 8 Cl 20587 | $47 \mathrm{mfd}, 200$ volt, molded | . 55 | R424 | 981.46 | 47 ohm, $1 / 2$ watt, $10 \%$ | 25 |
| 25 | ${ }^{8.1 .16085} 8 \mathrm{8C-20557}$ | mfd 200 volt, molded | 30 | R425 | 981.78 | 22 K ohm, $1 / 2$ watt, 10 |  |
| $\mathrm{C}_{426}$ |  | 5 mfd, 50 volt, 1 ytic | 1.25 | R426 | 981.110 | 10 M |  |
| $\mathrm{C}_{427}$ | ${ }_{8}^{8 C .20557}$ | . 1 mfd, 200 volt, molded | . 30 | R427 | 981 | 470 K |  |
| C428 |  | . $47 \mathrm{mfd}, 200$ volt, molded | . 55 | R428 | 108.19 | Tone Contro |  |
| C429 |  | Printed circuit | . 75 | R429 | 981.94 | 470 K ohm, $1 / 2$ watt $10 \%$ |  |
| C430 | $\begin{aligned} & 8 \mathrm{~J}-20592 \\ & 8 \mathrm{~J}-16081 \end{aligned}$ | . 0047 mfd, 400 volt, molded | . 25 | R43 | 982 | 120 |  |
| ${ }^{C 432}$ |  | . 0477 mfd, 400 volt, molde | 30 | R431 | 981.82 | 47 K ohm, $1 / 2$ watt, $10 \%$ | . 25 |
| ${ }^{\text {c }} 433$ | 8G-13962 | 5000 mmp , ceramic disk | 25 | R432 | 9 Cl 1.1072 | 5.6 ohm, $1 / 2$ watt, $10 \%$ |  |
| ${ }_{C} \mathbf{C 4 3 4}$ | 8 J .16096 8J. 20607 | . 047 mfd mfd, 200 volt, 600 | .30 .50 | ${ }^{\text {R 434. }}$ | 911-82 | 47 K ohm, $1 / 2$ watt, $10 \%$ |  |
| C436 | $\begin{aligned} & 8 J .20001 \\ & 8 C-22550 \\ & 8 J-16097 \end{aligned}$ | $20 \mathrm{mfd}, 450$ | 1.40 | ${ }^{\text {R436 }}$ | 981.90 | 220K ohm, $1 / 2 \mathrm{watt}, 10 \%$ | . 25 |
| ${ }^{4} 437$ |  | . 01 mfd, 600 volt, molded | . 30 | R437 R 438 | 981.95 981.104 | 530k ohm, $1 / 2 \mathrm{waftr}$ ( $10 \%$ | . 25 |
|  | 8 C -22730 | Included with T406 |  |  |  |  |  |
| C439A |  | $30 \mathrm{mfd}, 150 \mathrm{volt;} 200 \mathrm{mfd}$. |  | R440 | 781-110 | 10 M ohm, $1 / 2$ watt, $10 \%$ |  |
|  | 8C. 22463 $8 \mathrm{C}-2246$ | 150 volt, lytic | 3.00 | R441 | 981.84 | 68 K ohm, $1 / 2$ watt, $10 \%$ | . 25 |
| ${ }_{C 441}$ |  | $150 \mathrm{mfd}, 150$ volt, Iytic | 2.15 | R44 | $981-82$ | 47 K oh |  |
| C442 | cicle | . $22 \mathrm{mfd}, 400$ volt, molded | . 30 | ${ }^{\text {R } 443}$ | $981-86$ | 100K ohm, $1 / 2$ watt, $10 \%$ | 25 |
| 443 |  | 47 | . 25 | R444 | 931.108 | 6.8 M ohm, $1 / 2 \mathrm{wat} .10 \%$ |  |
| C444 |  | $220 \mathrm{mmf}, 500$ volt, mica | . 25 | R446 | $981-106$ |  | . 25 |
| C445 | 8F3-123 | 680 mmf , 300 volt, mica | . 30 |  |  |  | 25 |
| C447 |  | 220 mmf , 500 volt, mica | . 25 |  |  | 2. Size Control-tsok ohm |  |
| $\mathrm{C}_{4} 48$ |  | . 1 mfd, 200 volt, molded | . 30 | R449 | 981-102 | 2.2 Mk ohm, $1 / 2$ watt. 10 | 25 |
| C449 |  | . 0022 mfd, 200 volt, molded | 25 |  |  | ohm, $/ 2$ wath, $10 \% 00$ anm | . 75 |
| C450 | ${ }_{8 F 111132}$ | $3900 \mathrm{mmf}, 500$ volt, mica | 1.15 | R451 | $981-90$ | 220 K ohm, $1 / 2 \mathrm{watt}, 10 \%$ | . 25 |
| ${ }_{6} 451$ | ${ }_{\substack{\text { 8F3.21 } \\ 86.21440}}$ | 470 mmf , 500 volt, mica | . 23 | R452 | 981.62 | 1000 ohm, $1 / 2$ watt, $10 \%$ | . 25 |
|  |  | $470 \mathrm{~mm}, 1000 \mathrm{vol}$ |  | R453-454-4 |  | Included with T406 |  |



| 24" HIGH VOLTAGE SUPPLY |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Capocitors |  |  |  | Miscellaneous |  |  |
| C500 | 8F3-118 | 270 mmf. 500 volt, mics | . 25 | 20-22253 | Chassis bolt bracket | . 10 |
| $\mathrm{C}^{501}$ | 8E-22538 | 170.780 mmf . H. Drive trimmer | . 70 | ${ }^{394} 9.222232$ | Brackot insulator | 05 |
| C502 | 8 C -19546 | 20 mfd , 150 volt, 1ytic | 1.05 | 158-22335 | Yoke socket | . 25 |
| C504 | 8J-20596 | . 068 mid, 400 volt, molded | . 35 | 158-10440 | $25 C D 6$ tube socket | . 15 |
| C505 | ${ }^{\text {8J-16081 }}$ | . 047 mfd, 400 volt, molded | 30 | 158.-20860 | $12 \mathrm{AX4}$ tube socket | . 20 |
| C506 | 8J-16096 | . 047 mfd, 200 volt, molded | . 30 | ${ }_{201202591}$ | Dual H. V. power plug | 1.70 |
| Resistors |  |  |  | ${ }_{\text {201-20817-1 }}$ | 1 Mo3 Socket assembly | 1.20 |
| R500 | $981-71$ | 5600 ohm, $1 / 2$ watt, $10 \%$ | . 25 | 6M-20298 | Socket cover |  |
| R501 | $981-88$ | 150 K ohm, $1 / 2$ watt $10 \%$ | . 25 | 14C-22282-20 | H. V. Cable assembly | . 55 |
| R502 | 984-72 | $6800 \mathrm{chm}, 2$ watt, $10 \%$ | . 35 | $6 \mathrm{M}-14372$ | Cable clamp | 10 |
| R503 | 981.98 | 1 megohm, $1 / 2$ watt, $10 \%$ | . 25 | ${ }^{28-22162}$ | Shield can |  |
| R504 | $981-54$ | 220 ohm, $1 / 2$ watt, $10 \%$ | . 25 | ${ }_{4}^{28-221824}$ | Shield can cover |  |
| R505 | 984.80 | 33 K ohm, 2 wath $10 \%$ | . 35 | ${ }^{49 \mathrm{~A}-22633}$ | RRing Retainer spring |  |
| R506 | 982.14 | 1500 ohm, 1 watt, $10 \%$ | . 30 | 49A-23029 | Rotainer spring |  |
| R507 | 982.38 | 10 ohm, 1 watt, $10 \%$ | . 30 |  | lron core for L500 | . 15 |
| Chokes, Transformers, Coils |  |  |  | 49A.19012 | Core spring for L500 |  |
| T500 | $201-22382$ | H. V. Deffection transformer | 11.25 |  |  |  |
| L500 | 201-20188-1 | H. Linearit | . 75 |  |  |  |
| CRT MOUNTING ASSEMBLY |  |  |  |  |  |  |
|  | 200-22852 | Tube strap assm. | 2.00 | ${ }^{384-22678}$ | H.V. Cable retainer shield | ${ }^{03}$ |
|  |  | (Includes 3 items below) |  | 16M-22873 | Anti-pin cushion magnet | . 75 |
|  | 2M-22665 | Tube strap | . 95 | $16 \mathrm{M}-20697$ | Contering magnet | 1.00 |
|  | 2 C 22666 | Tube strap bracket | . 25 | 16M-19906 | lon trap magnet | 1.00 |
|  | ${ }^{2} \mathrm{LD} 22$ 22660 | Tube mounting bracket | . 50 | ${ }_{\text {201-22857 }}$ | Ooke wing nut |  |
|  | ${ }_{23 \mathrm{M}-22706}$ | Carriage bolt (2 used) | . 10 |  | (includes 5 items below) | 7.50 |
|  | 43A14-22707 | Carriage bolt nut | . 05 | 13M-22810 | Deflection yoke |  |
|  | 200-22872 | Tube support bracket assm. | 2.25 | 981.62 | 1000 ohm, $1 / 2 \mathrm{watt}, 10 \%$ | 25 |
|  | 25M-22754 | Retaining ring | 35 | 8G-22875 | $47 \mathrm{mmf}, 1000$ volt, ceramic | 35 |
|  | 3M-22727 |  | 25 | 201-22489-1 | Horizontal yoke cable | 85 |
|  | 49A-22865 | Spring | . 25 | 201.22690 | Vertical yote cable | 40 |

[^15]| 1260 | 20" Mahogany Table Model Television Receiver <br> With Built-in Antenna |
| :--- | :--- |
| 1261 | 20" Mahogany Table Model Television Receiver <br> With Built-in Antenna |
| 1266 | 20" Mahogany Consolette Model Television <br> Receiver with Built-in Antenna |

1268-21 21" Mahogany Console Model Television Receiver With Built-in Antenna

1270-21 21" Mahogany Console Model Television Receiver With Built-in Antenna

1271-21 21" Mahogany Console Model Television Receiver With Built-in Antenna

1272-21 21" Oak Console Model Television Receiver With Built-in An:enna

1273-21 21" Oak Console Model Television Receiver With Built-in Antenna

1274-21 21" Maple Console Model Television Receiver With Built-in Antenna

1275-21 21" Maple Console Model Television Receiver With Built-in Antenna

1120 20" Table Model Television Receiver With Built-in Antenna, Available in Mahogany, Maple, Oak, and Walnut

## TUBE COMPLEMENT

| V1 | 6CB6. | .. |
| :--- | :--- | :--- |
| V2 | 6CB6. . . . . . . . . . |  |

TUNER
456.150
456.150-2
tube size and type, The chassis used the mossociated picture tube mounting parts. Chassis 456.150 and 456150 , use a 20 and a 21 inch metal rectangular picture tube. Chassis 456.150 differs somewhat in tube complement and circuitry from its successors chassis 456.150-1 and 456.150-2. The vertical sweep output tube in the 456.150 chassis was a type 6 S 4 . This was changed in the later models to a type 12BH7. Other changes were made in the video amplifier output circuits. These differences can be seen in the schematic diagrams and Repair Parts List.
456.150-1

## NOISE BALANCE CONTROL

This Silvertone television chassis is equipped with a unique circuit which allows it to perform satisfactorily in the presence of interference of the type encountered in fringe areas and congested business locations. It is particularly effective on the type of noise caused by automobiles,. street cars, electrical storms, etc. To adjust for best performance under these conditions turn the channel selector to the strongest station which can be received. Start with the Noise Balance control in the fully clockwise position and then adjust it slowly counterclockwise until the picture just starts to show a distorted shape, then advance the control slightly so that the picture shape is normal. Turn the channel selector to all other stations one at a time. If the picture shape is distorted on any channel advance the control slightly clockwise to restore normal shape. The Noise Balance control is now set.
456.150-1
456.150-1
456.150
456.150-2

Vertical Deflection Amplifier Horizontal Oscillator and Control Tube Horizontal Deflection Amplifier Damper High Voltage Rectifier Low Voltage Rectifier 20" Rect. Glass Picture Tube (Chassis 456.150 and 456.150-2)
$21 "$ Rect. Metal Picture Tube (Chassis
456.150-1)

NOTE - WHENEVER DISTORTED PICTURES OR SLANTING BARS ARE ENCOUNTERED WHICH CANNOT BE ADJUSTED CORRECTLY WITH THE HORIZONTAL LOCK OR FINE TUNING CONTROLS ALWAYS SET THE NOISE BALANCE CONTROL FULLY CLOCKWISE BEFORE MAKING OTHER ADJUSTMENTS.


FIGURE 4

CHASSIS 456. 150, $-1,-2,-3,-5,-6,-7,-9,-11,-12,-13,-14,-15,-17,-18,-19,-21,-22,-51,-61,-81$ Wनावा Redoमाइडक्यो

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## I. F. ALIGNMENT

Irim front screw to get approximately 3 bars breakout with HORIZONTAL LOCK in maximum clockwise position when switching channels. Sync should hold in maximum counterclockwise position and picture should not jitter at any position of the HORIZONTAL LOCK control. If it does jitter leave the HORIZONTAL LOCK in maximum counterclockwise position and adjust front screw of the synchroguide 3 in clockwise direction until the jitter stops. Recheck breakout on clockwise end when switching channels. Horizontal sync should pull in when switching channels 4 over at least $1 / 2$ of the rotation range of the HORIZONTAL LOCK control. If it does not, unscrew sync amplitude control C5la $1 / 4$ turn at a time until correct lock-in range is established.

TELEVISION ALIGNMENT PROCEDURE

## NOTE:

Always set noise balance control fully clockwise before making any alignment tests or adjustments.
Preliminary
This alignment is an exacting procedure and should be undertaken only when necessary. Before deciding that alignment is necessiry, check whe following:

## IN HOME OF CUSTOMER:

l. Be sure of the antenna installation.
2. Check all operating controls and adjustments.
3. Check reception on all channels.
4. Check tubes by substitution of known good tubes.

## IN THE REPAIR SHOP

5. Substitute a known good picture tube.
6. If picture definition is still inadequate, observe the overall I.F. response curve by following step (11) below

Lift the top section of the shield on the 6J6 mixer so that the shield does not make electrical contact with the base of the shield. Connect the output of the AM signal generator to the shield, and the ground lead to the chassis.
Connect the VTVM across R12, 4.7K video detector load.
Set the volume and contrast controls to minimum position.
Tune the signal generator to 24.35 Mc . and attenuate the signal generator output for a reading of -1 to -1.5 volts to avoid overload and consequent inaccurate alignment.
5. Peak the fourth I.F. transformer T2 to 24.35 Mc . keeping the VTVM reading at -1 to -1.5 volts by adjustment of the attenuator on the signal generator.
6. Connect a 1 K resistor from the grid of $V 1$ to the junction of $R 2$ and $R 4$. Adjust the first I.F. coil located (L9 Fig. I) on the tuner for a maximum reading on the VTVM of between -1 and -1.5 volts. Remove the 1 K resistor.
7. Place the tuner turret so that it is between any two channels and adjust Ll for maximum indication on the VTVM. (Note: On sets below serial number 10525 L 1 is fixed and step 7 should be disregarded for these sets.)
8. Peak the third I.F. coil L3 to 23.2 Mc. keeping the VTVM reading at -1 to -1.5 volts.
7. Tune the signal generator to 25.2 Mc . and adjust the second I.F. transformer Tl for maximum keeping the VTVM reading at -1 to -1.5 volts.
10. Adjust the signal generator to 21.6 Mc . and tune the trap L 2 for a minimum reading
11. The I.F. passband may be observed by connecting a sweep generator across the terminals of the AM signal generator, connected as in (1), and substituting an os cilloscope for the VTVM as described in the above procedure. Place a 3 V battery with the positive terminal connected to the chassis and the negative terminal connected to the junction of R2 and R4. The sweep generator should be set to approximately 24.35 Mc . and then adjusted to center the waveform on the scope face. To avoid overload, and to assure a true view of the wave shape, the output of the sweep generator should be attenuated until further attenuation has a minimum effect on the curve shape.
If necessary a slight adjustment of the I.F. transformers may be made to obtain a close approximation to the ideal curve. Adjustment of $T 2$ affects the slope of the top, while adjustment of L3 or Tl affects the bandwidth.

## ALIGNMENT PROCEDURE

## TEST EQUIPMENT

## CATHODE RAY OSCILLOSCOPE

SWEEP GENERATOR - The sweep generator used should cover the range from 20 to 220 megacycles. The output should be flat over a sweep range of 20 Mc . It should be capable of an output of about 0.1 volt.

AM SIGNAL GENERATOR - This generator should have a frequency range of from 4.0 to 220 megacycles. As this generator is used occasionally as a marker generator, accuracy is an important factor. It should be capable of 0.1 volt output.

VACUUM TUBE VOLTMETER - Almost any standard VTVM will do. It should prefer-


FIGURE 15
ably have a reversible polarity switch.

## OJohn F. Rider

CHASSIS $456.150,-1,-2,-3,-5,-6,-7,-9,-11,-12,-13,-14,-15,-17,-18,-19,-21,-22,-51,-61,-81$ Woild Radio History


3．Connect the negative side of a 1.5 volt battery to the AGC lead of the tuner which is soldered to the blank lug of L2．The positive side of the battery should be con－ nected to the receiver chassis
4．Set the FINE TUNING control at the approximate midpoint of its tuning range．
5．Connect the sweep generator to the 300 ohm antenna terminals and adjust the out－ put to sweep Channel 12.
6．Loosely couple the output from the marker generator to the antenna terminals． Use the minimum amount of coupling and signal from the marker generator re－ quired to give a good marker or pip on the oscilloscope pattern．
7．Adjust Al，A2，and A16 in the tuner for maximum gain and flat－top response curve approximately 4.5 mc ．wide．All other channels should be checked to be sure they have approximately the same responses．The correct marker frequencies for each haver Cound Carrier columns of the chart channel are given in the Picture Carrier and 16 ．The response to the two marker frequencies should be essentially equal．
8．Disconnect the battery used to obtain negative bias．
9．Disconnect the test equipment and air check the receiver on all active channels If it is possible to receive a normal picture on all active channels by adjusting the Fine Tuning control，further alignment will not be necessary．

## OSCILLATOR ALIGNMENT

1．Set the Fine Tuning control at the approximate midpoint of its tuning range．
2．Place a non－metallic screwdriver through the openings provided in the front of the chassis and the tuner assembly and adjust the individual oscillator coil slug for each active channel to give the best possible picture．（A3－A14 Fig．1）This is usually the point just before sound breakup occurs．

If the oscillator slug adjustment does not have sufficient range to tune in a good picture on any active channel，it will be necessary to adjust（Al5）in the tuner． The procedure for this adjustment is as follows：

## WITH INSTRUMENTS

3．Set the Channel Selector to Channel 12.

4．Connect the marker generator to one of the 300 ohm antenna terminals and ground．Set the generator to 209.753 Mc．
5．Connect the output of another signal generator through 47，000 ohm re－ sistor to Pin 3，the cathode of V4，the 12AX7 video detector and adjust the signal generator frequency to 26.1 Mc ．

## WITHOUT INSTRUMENTS

3．Set the Channel Selector switch to any channel on which a picture or test pat－ tern can be received．Preferably se－ lect a station operating on the highest frequency．
4．Adjust Al5 for best possible picture．

5．Repeat steps 1 and 2.


FIGURE 17
SOP VIEW－COMPONENT LOCATION

6．Repeat steps 3 through jif nce ssary

Connect the VTVM across C 26 and adjust Al5 for a zero reading on the VTVM between a positive and negative peak.
7. Use the lowest signal generator output which will provide an adequate meter indication.
8. Repeat steps 1 and 2.

Repeat steps 3 through 8 if necessary.

## NOTES

Last C - 62; last $R-88$. All capacitors in UUF, all resistors $1 / 2$ watt, unless otherwise noted.
2. Pin voltages taken with VTVM. Antenna shorted. TV-PHONO switch in TV position Contrast control minimum contrast. Noise Balance control maximum clockwise Other controls at normal operating position. All voltages positive DC unless otherwise noted. All readings to ground except Pin 3 to Pin 4 on Vll.
3. Wave form peak to peak voltages taken with video output 45 volts peak to peak.
4. PRODUCTION CHANGES:
a. Previous serial No. 39,818 , Terminal l, N2 connected directly to $290 \mathrm{~B}+$.
b. After serial No. 46,264, Linearity coil (L-ll) and capacitor C-63 eliminated from circuit and Pin 3, V16, directly connected to jumper between terminals $7 \& 8, \mathrm{~T} 9$.
c. After serial No. 46,889 by-pass capacitors C-70 \& C-71 eliminated from primary of T-5.
d. After serial No. 46,610, a 220 UUF by-pass capacitor (C-73) added from Pin 7, V4 to ground
e. Previous serial No. $47,610 \mathrm{C}-25$ connected Pin 2 to Pin 7, V8.

C-19 100 UUF, 456.150-2
470 UUF, 456.150-1.


FIGURE 18
VOLTAGE CHART
CHASSIS NOS. $\begin{aligned} & 456.150-1 \\ & 456.150-2\end{aligned}$
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CHASSIS MODEL 456.150 SCHEMATIC

$$
\begin{aligned}
& \text { Last "R" } 84 . \\
& \text { Last "C" } 71 .
\end{aligned}
$$

All Resistors $1 / 2$ Watt unless otherwise noted.
All Capacitors in UUF unless other-


(c) John F. Rider

PMA-31B-302 thru 31B-313 (channels 2 thru 13) Antenna Coil Assemblies

| PMA-31B-410 thru 31B-413 (channels 10 thru 13) | $\begin{array}{l}\text { Ansenna } \\ \text { Oscillator Coil Assemblies }\end{array}$ |
| :--- | :--- |
| PMA-31B-422 thru 31B-429 (channels 2 thru 9) | Oscillator Coil Assemblies |
| Fine Tuning Assembly |  |


| All items same as chassis $150-1$ and $150-2$, except: |  |  |
| :---: | :---: | :---: |
| C65 | PMB-40003-17 | Capacitor - $56 \mathrm{mmf}, 1000 \mathrm{~V}$, Mica |
| R56 | PMA-45015-65 | Resistor - $2.2 \mathrm{Meg}, 1 / 2 \mathrm{Watt}$. |
| R77 | PMA-45019-6 | Resistor - $8.2 \mathrm{~K}, 2 \mathrm{Watt}$. |
| R19 | PMA-45015-53 | Resistor - 220K, $1 / 2 \mathrm{Watt}$. |
| R49 | PMA-18014-4 | 1 Meg. Variable. Vertical Hold |

CHASSIS $456,150,-1,-2,-3,-5,-6,-7,-9,-11,-12,-13,-14,-15,-17,-18,-19,-21,-22,-51,-61,-81$

CHASSIS 456. $150,-1,-2,-3,-5,-6,-7,-9,-11,-12,-13,-14,-15,-17,-18,-19,-21,-22,-51,-61,-81$
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This supplement covers certain modifications in the basic 456.150 Series television receiver chassis described in 57 RL 639. These modifications entail the use of one or more of the following:
A. Electrostatic focus picture tube.
B. Twenty tube chassis.
C. Rotary switch tuner (PMB-57003).

The model numbers of chassis which have these modifications, are:

| CHASSIS MODEL | ELECTROSTATIC•FOCUS PICTURE TUBE |  | R-F TUNER | CHASSIS CIRCUIT |
| :---: | :---: | :---: | :---: | :---: |
| NUMBER | SIZE | TYPE |  |  |
| 456.150-3 | $21^{\prime \prime}$ | $21 \mathrm{MP4}$ | Turret Pentode (PMB-57001)* | 20 Tube |
| 456.150-6 | 20" | 20HP4/20MP4 | Rotary Switch (PMB-57003) $\dagger$ | 21 Tube* |
| 456.150-7 | $17^{\prime \prime}$ | 17HP4 | Rotary Switch | 20 Tube |
| 456.150-9 | $17{ }^{17}$ | 17HP4 | Turret Pentode* | 21 Tube* |
| 456.150-12 | $17{ }^{\prime \prime}$ | 17HP4 | Turret Pentode* | 20 Tube |
| 456.150-13 | 20" | 20HP4/20MP4 | Turret Pentode* | 21 Tube* |
| 456.150-17 | $17^{\prime \prime}$ | 17HP4 | Rotary Switch | 21 Tube* |

*This is the chassis circuit and tuner described in Service Instructions 57. RL 639.
tChassis $456.150-6$ used the Rotary Switch tuner only in limited production. It is now being produced with Turret Pentode tuner.

The Chassis Listed Above Are Used in the Following Models:

| CATALOG NO. | TYPE | CHASSIS NUMBERS |
| :---: | :---: | :---: |
| 1260* | Table Model. | 456.150-6 |
| 1266* | Consolette | 456.150-6 |
| 1299 | Table Model | 456.150-7; 456.150-9; 456.150-12; 456.150-17 |
| 2260* | Table Model. | 456.150-6 |
| 2266 | Consolette | 456.150-6 |
| 2280 | Table Model | 456.150-6; 456.150-13 |
| 2286 | Consolette | 456.150.6 |
| 2287 | Consolette | 456.150-6 |
| 2289 | Table Model | 456.150-9; 456.150-12; 456.150-17 |
| 2290 | Consolette | 456.150-9; 456.150-17 |
| 2297 | Consolette | 456.150-3 |
| 2298 | Consolette | 456.150-3 |



## ALL MODELS USING THE TWENTY TUBE CHASSIS

The twenty tube chassis is similar to the basic chassis described in Service Instructions 57 RL
omission of the Noise Balance circuit.
The second half of V-4 (Type 12AX7), which formerly funcThe second haf or
tioned as the Noise Balance Control, is used as the audio tioned as the Noise Balance Contro, is used as the audio
amplifier in these models, and $\mathrm{V}-8$, the type 6 AV 6 tube, which was formerly used for audio amplification is omitted. There is no coupling between the two halves of the twin triode V-4, in the twenty tube receivers even though they
are in the same envelope. The output from the first half, are in the same envelope. The output from the first half,
the video detector, is coupled to the video amplifier ( -5 ) the video detector, is coupled to the video amplifier (V-5)
only. The signal input to the second half of V-4 is taken off only. The signal input to the second half of V. 4 is taken off the potentiometer, RI3A (Volume Control), across which is
ereading on thep lows:
PIN NO. VOLTAGE function pin No. voltage $\begin{array}{lcll}0 & \text { Plate } & 6 & 100\end{array}$ $\begin{array}{cccc}-.25 & \text { Control Grid } & 7 & -.75 \\ 0 & \text { Cathode } & 8 & 0\end{array}$ 6.3 AC Filament

Pin No. 9 is a common ground for both halves of the filement. The voltage readings on the pins of the other tubes in the twenty tube chassis are the same as for the twenty
one tube chassis described in Service Instructions

## ALL MODELS USING AN ELECTROSTATIC FOCUS PICTURE TUBE

The use of an electrostatic focus picture tube requires no change in the basic 456.150 Series chassis circuit described in Service Instructions The voltage for the focusing element. Pin 6 (Omitted on electromagnetic focus tubes), is applied to the corresponding pin in the picture ube socket of all chassis. This voltage is taken from a binding post on a terminal strip, and is derived, by means of a umper, from the red lead of the vertical output transformer T-7). This terminal is aso the source for the voltage on n 17 HP4 type picture tube (And all electromagnetic ,

## ALL MODELS USING THE ROTARY SWITCH TUNER — PMB-57003

The Rotary Switch tuner has an R-F selector that is electrically equivalent to a tapped coil whose inductance is reduced from its maximum value by means of a rotary switch. This switch progressively shorts additional taps to
ground as the selector knob is rotated and the oscillator

To remove or install an electrostatic focus picture tube, follow the directions given in 57 RL 639 on picture tubes except for reference to the focus assembly and focus adjusting screw, which are not used with these tubes. Centering adjustment is accomplished by the Centering spect to each other. These rings should be located as far forward on the neck of the tube as possible. To make the centering adjustments, rotate each of the Centering Rings separately until the picture is properly centered. With the picture properly centered, set the Brightness control slightly above its normal value and re-adjust the Ion Trap Magnet for maximum brightness.
oils are switched in and out of the circuit from channel 2 to channel 13.
The R-F amplifier tube is a type 6AG5, 6BC5, or 6CB6. A twin triode, type 6J6, is used for the combination mixer and oscillator.

## ALIGNMENT PROCEDURE

Note: This tuner has been carefully checked and aligned at the factory to give the best possible performance. Alignment should not be necessary in

## OSCILLATOR ADJUSTMENT

1. Turn station selector to channel 13 .
2. Connect signal generator, adjusted to correct channel 13 oscillator frequency, to the antenna.
3. Connect oscilloscope to test point through 10,000 ohms.
4. Set fine tuning in center of range. Check channel 13 and 6 for zero beat on scope.
If necessary to make adjustments to the oscillator, the following steps should be followed:
A. Align high channels for correct frequency with channel non-metallic screwdriver is advisable.
B. Align low channels for correct frequency with channel 6 B. Align low channels for correct fr
oscillator, screw (Adjustment E).
C. Adustment of channel 13 and channel 6 oscillator brings all other channeis in adjustment. Do not back up the screws more than 8 turns from tight. At that point the electrical effect has ceased. Further backing will cause the screw to drop out.
Notes: Cover and tube shields to be on. Have rated supply voltages fed to tuner. Allow at least 3 minutes to warm up. When replacing oscillator tube, solect one which requires minimum touch-up. Clockwise rotation of screws increases frequency.
BAND PASS ALIGNMENT
5. Use R-F sweep to antenna and oscilloscope to the test point through 10,000 ohms.

RFEAND PASS
2. The oscillator must be operating for each channel at nearly the correct frequency.
3. Align channel 13 R-F plate (Adjustment B) and R-F grid (Adjustment A) end inductances. Align channel 13 mixer grid end inductances by spreading or pushing together the turns. The band pass should include both carriers, have steep sides, and maximum gain.
4. Align the incremental loops of the R-F plate, R-F grid, and mixer grid from 12 to 7 , in that order. Pushing the loops inwards increases the frequency.
5. Align channel 6 R-F plate, R-F grid, and mixer grid to obtain a flat response with maximum gain. Spreading clude both carriers and have steep sides.
6. Align incremental coils of R-F plate, R-F grid, and mixed grid from 5 to 2 in that order. Spreading coils increases the frequency. A tuning wand may be used to determine what change is necessary.
CAUTION: Band pass alignment is carefully made at the factory. Attempt this alignment only with proper equipment and set-up.
B+ Supply
120 Volts
Heater Supply

Grid Bias
Voits A.C.
-.5 Volts


DIAGRAM R-F TUNER PMB-57003


REPAIR PARTS LIST TV CHASSIS


OJohn F. Rider


| SChematic location | PART No. | DESCRIPTION | beakS RL PRICE |
| :---: | :---: | :---: | :---: |
| $\begin{aligned} & \mathbf{N} 1 \\ & \mathbf{N} 2 \end{aligned}$ |  | PRINTED CIRCUIT |  |
|  | PMA-95001 | Vert, Integrating Notwork | 1.10 |
|  |  | Audio Couplet ............... |  |
|  |  | POSITION, RESISTORS |  |
| $\mathrm{RB1}^{\text {R }}$, $7 .$. | PMA-45013-1 <br> PMA-45015-9 <br> PMA-45015-12 | 3.3 Ohms $\qquad$ $1 / 2$ Watt | 15 |
| R3, R7, R88. |  | 47 Ohms $\qquad$ $1 / 2$ Watt | . 15 |
| ${ }_{\text {R1, R10 }}$ |  | 82 Ohms .................................... 1/21 Watt | . 15 |
| R27 | PMA-45015-18 | 270 Ohms ............................................... 1/2 Watt | .15 |
| R4 | PMA-45015-19 | 330 Ohms ......................................1/2 Watt | .15 |
| R33 | PMA-45017-19 | 330 Ohms ................................... 1 Watt | . 30 |
| R57 | PMA-45015-21 | 470 Ohms .....................................1/2 Watt | . 15 |
| ${ }_{\text {R34, }}^{\text {R560 }}$ | PMA-45015-22 | ${ }_{820}^{560}$ Ohms | . 30 |
| $\mathrm{RSF}_{\text {R3 }}$ R8, R1I, R26, R79.. | PMA-45015-25 | ${ }^{820}$ Ohms .............................................................. $1 / 2$ Watt | . 15 |
| R78 | PMA-45017-25 | IK .................................................... ${ }^{1 / 2}$ Watt | . 30 |
| R44 | PMA-45015-28 | 1.8 K ............................................. 1/2 Watt | . 15 |
| 245. R84, R85. | PMA-45015-29 | 2.2 K .................................................. $1 / 2 \mathrm{WaH}^{\text {a }}$ | . 15 |
| $\mathrm{R}^{R 43}$ | PMA-45015-30 | 2.7 K . ............................................... 1/2 Wat | . 15 |
| R2, <br> R17, <br> R12 <br> 17 | PMA-45019.35 |  | . 15 |
| R9 | PMA-4501470 | 7.5K* ..............................................1/2 Watt | . 30 |
| R55, R68, R73. | PMA-45015-36 | 8.2K ............................................... 1/2 Watt | . 15 |
| R6, R30, R31, R61, R83 | PMA-45015-37 |  | . 15 |
| R39 | PMA-4501.5.44 | ${ }_{39} 27 \mathrm{~K}$............................................... $1 /$ Wat | . 30 |
| R16. R18 | PMA-45015-45 | 47K ............................................ $1 / 2$ Watt | . 15 |
| R66, R74 | PMA-45017-47 | 68 K ................................................ ${ }^{1 / 2}$ Watt | . 30 |
| R20, R21, R22, R63.. | PMA-45015-49 | 100K ............................................. 1/2 Watt | 15 |
| ${ }^{R 711}$ | PMA-45017.49 | 100K ................................................ 1 Watt | . 30 |
| R64 | PMA-45015.51 |  | . 30 |
| R48, R62 ...... .-................................ | PMA-45015-51 |  | . 15 |
| R697 R87 R7\% | PMA-45015-53 | 220 K ......................................................... 1/2 Watt | . 15 |
| R24. RE2 ... .i. .i. .i. ... .. ............ | PMA-45015-54 | 2701 | .15 |
| R41, R42, R75......... | PMAA.45015.57 | 390K ............................................ $1 / 1 / 2$ Wat $^{\text {Wat }}$ | . 15 |
| R80 | PMA-45017.57 | 470K ........................................................1/ $1 / 2 \mathrm{WaH}^{\text {Wat }}$ | . 30 |
| R50, R67 | PMA-45015-60 | 820 K .............................................1/2 Watt | . 15 |
| R14, R56 |  | 1 MEG ........................................1/2 Watt | . 15 |
| R72 R40 | PMA-45015-69 |  | .30 .15 |
| R29 R29 | PMA-45015-73 | 10 MEG ............................................... $1 / 2$ Wat | . 15 |
|  |  | WIRE WOUND RESISTORS |  |
| R35 | PMB 47007.4 | 60 Ohms ..................................... 6 Wath | . 68 |
| R76 | PMB -47007-3 | 220 Ohms $\qquad$ 4 Watt | . 68 |
|  | PMB -47007.5 PMB -47007.1 |  | . 68 |
|  |  | VARIABLE RESISTORS | . 68 |
| R58 | PMA-48016 | 5K, Linearity, Vertical | 1.45 |
| R65 | PMB. 480141 | 50K. Control, Horizontal Hold......................... | 1.45 |
|  |  | $100 \mathrm{~K}, \mathrm{Brightness}$, Voun Col. | 1.45 |
| R13a, R13b, SWI. | PMB -48015 PMB -48014.7 | . 5 Meg . 750 Ohms. Volume, Contrast SW Contral | 3.95 |
|  |  | 1.5 Meg. Control, - Vertical Hold .-...... | 1.45 |
| R53 | PMB -48014.5 | 2.5 Meg , Control-Vertical Height ................ | 1.45 |
|  |  | TRANSFORMERS |  |
| T1. T2 | PMA. 52029 | Bifiliar I. F. Coil. | 1.28 |
| T3 | PMA-52027 | 4.5 MC Ratio Detector. | 3.70 |
| T4 | PMB .51005 | Audio Output Transformer | 2.63 |
| T5 | PMB. 50003 | Power Transformer | 21.84 |
| T6 | PMA-55005 | Vertical Oscillator Transformer | 3.07 |
| T7 | PMA-56004 | Vertical Output Transformer ........ | 4.64 |
| ${ }_{9}^{78}$ | $\begin{aligned} & \text { PMB - } 52019 \\ & \text { PMC- } 56002 \end{aligned}$ | Synchroguide ${ }_{\text {Horizontal }}$ Output Transformer | 3.60 |
|  |  | Horizontal Output transformer | 8.43 |

Resistors Marked * $\pm .5 \%$ Tolerance.


## TELEVISION RECEIVER REPAIR PARTS LIST and SERVICE INSTRUCTIONS

This supplement covers certain modifications in the basic 456．150 Series television receiver chassis described in Service In structions 57 RL 639．These modifications entail the use of either or both of the following
A．Turret cascode R－F tuner，PMB－57002 or PMB－57002－1．
B． 24 inch picture tube，type $24 \mathrm{AP4}$ ．
The model numbers of the chassis in which these modifications appear，are：

| CHASSIS MODEL NUMBER | PICTURE TUBE TYPE | R－F TUNER |
| :---: | :---: | :---: |
| 456．150－5 | 24AP4 | Turret Pentode（PMB－57001）＊ |
| 456．150－11 ${ }^{+}$ | 21 AP4 | Turret Cascode（PMB－57002 or PMB－57002－1） |
| 456．150－15 $\dagger$ | 20HP4／20MP4 | Turret Cascode |
| 456．150．16 $\dagger$ | 17HP4 | Turret Cascode |
| $456.150 .21 \dagger$ | 20CP4 | Turret Cascode |
| 456．150－51 | 24AP4 | Turret Cascode |
| 456．150．81＋ | $21 \mathrm{MP4}$ | Turret Cascode |

＊Described in Service Instructions 57 RL 639
＊Described in Service Instructions 57 RL 639. Except for
vice Instructions．

The Chassis Listed Above Are Used in the Following Models：
 All models marked with＊were also
57 RL 639 and Supplement No．I．

See Service Instructions


sI－七1 39Vd $\wedge 1$ yวngヨoy＇syVヨs

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CHASSIS $456.150,-1,-2,-3,-5,-6,-7,-9,-11,-12,-13,-14,-15,-17,-18,-19,-21,-22,-51,-61,-81$

\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline \multicolumn{4}{|c|}{\begin{tabular}{l}
REPAIR PARTS LIST \\
TV CHASSIS 456.150.5 \& 456.150-51
\end{tabular}} \& schematic location \& RT No \& description \& SEARS
RL PRICE \& < \\
\hline schematic location \& part no. \& description \& \(\underset{\substack{\text { SEARS } \\ \text { RLICE }}}{\text { chem }}\) \& \({ }_{\text {R1, }}^{\text {R1, }} \mathrm{R10}\) \& PMAA-4015.15 \& (150 Ohms \({ }^{170} \mathrm{hms}\) \& . 15 \& m \\
\hline \& \& COMPOSTTION CAPACITORS \& \& \& PMAA-45015-19 \& \({ }_{330}^{330}\) Ohms \(\quad\) Onm \(\quad\). \& . 15 \& \\
\hline \(\mathrm{Cl2}_{\text {C2 }}\) \& PMA-40519-1 PMA-40519.] \& 2 UUF \& . 17 \& \& PMA-45015-21 \& 470 Ohms \(\cdots \cdots 1 / 2\) Watt \(^{\text {a }}\) \& . 15 \& I \\
\hline \& \& ceramic capacitors \& \& R59, R60 \& PMAA-45019.24 \& \({ }_{820}^{560}\) Ohms \& . 45 \& \\
\hline \(\mathrm{Cl} \mathrm{\prime}\)
Cl

Cl \& PMB -40518.1 \&  \& 1.78 \& R5, R8, R11, R26, R79. \& PMA-40015.25 \& IK \& 15 \& <br>
\hline $\mathrm{Cl}_{14} \mathrm{Cl}_{4} \mathrm{C}_{23}$
c47 \& \& 56 UUF (Part of L8 \& L9) 500 DCWV \& 1.70 \& \&  \& ${ }_{1.8 \mathrm{~K}}^{1 \mathrm{k}}$.... \& . 15 \& <br>
\hline ${ }^{\text {C8, }} \mathrm{Cl}{ }^{\text {c19 }}$ \& PMB -40518.14 \&  \& . 26 \& R45, $884, \mathrm{RB5}$. \& PMA.45015-29 \&  \& . 15 \& <br>
\hline  \&  \&  \& . 29 \&  \& PMAA-45015-33 \& 4.7k \& . 15 \& <br>
\hline ${ }^{\circ} 72$ \& PMB. $405500^{2} \cdot 23$ \& 470 UUF \& . 50 \& ${ }_{\text {R17, }}^{\text {R }}$ R 77 \& PMAA.4019.35 \&  \& . 45 \& \% <br>
\hline  \& PMB . 40518.24 \& 1500 UUF .... \& \& R55, R68, R73. \& PMA.45015.36 \& 8.2 k ... \& . 15 \& 20 <br>
\hline C37, C38, C42, C67, C68, C69, \& PMA-40517.2 \& 1500 UUF .- \& ${ }^{34}$ \&  \& PMAA-40015-37 \&  \& . 15 \& <br>
\hline  \& ${ }_{\text {PMM - }}$ \&  \& . ${ }^{.52}$ \& ${ }_{\text {R39 }} \times$ \& PMAA.4050.42 \&  \& . 30 \&  <br>
\hline C12. C31 \& PMA.40517.3 \&  \& . 34 \&  \& PMA.4015.44 \& 4k 3 . \& .15 \&  <br>
\hline $\mathrm{Cl}_{15}$ \& PME 41007.74 \& . 02 MFD ...) \& 40 \& ${ }_{\text {R }}^{\text {R60, }}$ R20, R21, R22, R63, R88, R86 \& PMAA-45017-47 \&  \& . 15 \& <br>
\hline C35
C62
662 \& ${ }_{\text {PM8 }}$ PM 4007.85 \& 02 MFD
.03 MED \& ${ }_{4}^{49}$ \&  \& PMA-4017.49 \& 100 K \& . 30 \& <br>
\hline  \& PME -41007.30 \& .05 MFD \& . 52 \& \& PMA.45017-50 \& ${ }_{150 \mathrm{~K}}^{120 \mathrm{~K}}$ … \& . 15 \& <br>
\hline \& PMB -4007-51 \& ${ }_{21}{ }^{1}$ MFPD \& \&  \& PMA-45017-51 \& 150 K \& 30 \& <br>
\hline  \& PMB -41007-17 \& ${ }^{2} 5 \mathrm{MFD}$ (APE CAPACTOR 200 DCWV \& . 82 \& R5, ${ }_{\text {Reb }}$ \& PMA-45015.53 \& ${ }_{270 k}^{220 \mathrm{~K}} \ldots \ldots \times$ - \& . 15 \& <br>
\hline \& \& 001 MED PAPER CAPACITORS 600 V \& \& \& PMAA-45015.56 \&  \& . 15 \& <br>
\hline C58 \& PMA-41009 \& .01 MFD Oil Filled 200 y \& 34 \& ${ }_{\text {R880 }}^{\text {R41, }}$ R42, R75, R89, R90. \& PMA.45015.57 \&  \& . 35 \& <br>
\hline C32 \& PMB -4006-45 \&  \& . 34 \& R50, R67 \& PMAA-45015-60 \&  \& . 15 \& <br>
\hline C53 \& PME -4006-28 \& . 02 MFD \& ${ }^{34}$ \& R14,
R72
R32, R56 \&  \& 2.7 MEG M - ${ }_{\text {M }}$ \& 30 \& <br>
\hline C600 \& PMB -41006-47 \& ${ }^{.025}$ M M P..- \& . 52 \& \& PMA.45015.69 \& 4.7 MEG 10 MEG - - \& . 15 \& <br>
\hline ${ }_{5} 54$ \& PMB -41006-30 \& .05 MFD … ${ }^{2}$ \& . 40 \& $\frac{\text { R29 }}{\text { Resistor Volues } \pm 10 \% \text { Tolerance, }}$ \& PMA-45015-73 \& \& \& <br>
\hline C45. C66 \& PMB-41006-51 \& ${ }_{21}^{15}$ MFD \& . 50 \& Rosisitor Volues $\pm 10 \%$ Toiorance, \& Excopt ${ }^{\text {5 }}$ \& \& \& <br>
\hline \& \& M MICA CAPACITORS \& \& \& \& 60 WIRE WOUND RESISTORS \& \& <br>
\hline  \& PMB -40003.15 \& ${ }_{47}^{47 \text { UUFW }}$ - \& . 34 \& R25 \& PMB 4 -4007-3 \& ${ }_{220} 0 \mathrm{Ohms}^{\text {man }}$ \& ${ }_{\text {. } 68}$ \& <br>
\hline  \& PMB -40003-29 \&  \& . 34 \& R33, R38 \& PMB -47007-1 \&  \& \& <br>

\hline ${ }_{5}$ \& PMB 400003 -37 \& 390 UUFF \& ${ }_{2}{ }^{\text {2 }}$ \& R55 \& PMA-48016 \&  \& | 1.45 |
| :--- |
| 1.45 | \& <br>

\hline C64 \& PMA. 40003 -47 \& 1000 UUFt - \& ${ }^{2} .59$ \& ${ }_{R 23}$ \& PMB 48014.9 \& 100k, Brightnoss --\% \& 1.45 \& <br>
\hline ${ }_{C} \mathrm{C} 49$ \& PMB -40003-55 \& 2200 UUFP - - $\quad 500$ v \& 1.83
1.28 \& \& PMB -48014.3 \& ${ }^{250 \mathrm{~K}}$ Control, Noito Convortor..... ${ }^{5}$ W Contol \& li.45 \& <br>

\hline C41 \& PMB -40003.63 \&  \& \& R130, R13b, SWI. \& ${ }^{\text {PMB }}$ PM 488014.10 \&  \& | 3.45 |
| :--- |
| 1.45 | \& <br>

\hline ${ }_{\text {C43 }}{ }_{\text {C29 }}$ \& PMA-42002

PMA-42006 \& | 1 |
| :--- |
| 20 MFD |
| 2 MFD | \& 1.48

2.62 \& R53 \& PM -48014.5 \& 2.5 Mog Control-Vortical Height \& 1.45 \& <br>

\hline \& \& 450 v \& \& T1. ${ }^{1} 2$ \& PMA-52029 \&  \& | 1.28 |
| :--- |
| 3.70 | \& <br>

\hline  \& PMA.42001 \&  \& . 06 \& ${ }_{T 4}$ \& PMB. 510005 \& Audio Outupt Transformer \& ${ }_{2}^{2.63}$ \& <br>
\hline \& \& \& \& ${ }^{15}$ \& PMA-56005 \& Vertical Osscillator Transformer \& 3.07 \& <br>
\hline  \& PMA.42000 \&  \& 4.90 \& \& PMA-50004 \& Vertical Output Transformer Synchroguida \& ${ }_{3}^{4.60}$ \& <br>
\hline C51a. C5Ib \& PMA.43001 \& MICA TRIMMER CAPACITORS \& 1.37 \& PMA.90021
PMA \& ${ }_{8}^{8 \prime \prime}$ \& ..... \& \& <br>
\hline Clar Copacitor Volues $\pm 20 \%$ Toleran \& Excopt * $\pm 5$ \& it $\dagger \pm 10 \%$. \& \& PMA.90017 \& $10^{\prime \prime}$ \& \& ${ }_{8.40}^{6.00}$ \& <br>
\hline \& \& COILS \& \& \& \& \& \& <br>
\hline  \& PMA. 52021 \& 21.5MC 1. F. C. Coil. \& 1.40 \& \& \& \& \& <br>
\hline 14. \& PMAA 52023 \& ${ }^{100}{ }^{100}$ UH Pooking Coil \& . 68 \& \& \& \& \& <br>
\hline  \& PMA. 522025 \& 200 UH Peosking Coil Wound on 22K Resistor.... \& . 83 \& \& \& \& \& <br>
\hline  \& PMA.52220-2 \& ${ }_{\text {Y }}^{4.5}$ MC Toke-Off Trap..... \& ${ }_{9.57}^{1.70}$ \& \& \& \& \& <br>
\hline  \& PMAA-56003 \&  \& 2.34
4.93 \& \& \& \& \& <br>
\hline  \& PMB 566011 \& Filter Choke PRINTED CIRCUITS \& 4.93 \& \& \& \& \& <br>
\hline  \& PMA. 95000

PMA. 95001 \& | Vert. Integrating Network (Centralab PC-100).. |
| :--- |
| Audio Couplate (Centralab PC-70). | \& ${ }_{1.10}^{1.70}$ \& \& \& \& \& <br>

\hline \& \& 3.3 Comp \& \& \& \& \& \& <br>
\hline  \& PMA-45015.9 \&  \& . 15 \& \& \& \& \& <br>
\hline
\end{tabular}

(c) John F. Rider


TV CHASSIS 456.150-14 \& 456.150-61


| SChematic location | PART NO. | description | $\begin{aligned} & \text { SEARS } \\ & \text { RL PRICE } \end{aligned}$ | M. U. ${ }_{\text {COD }}$ |
| :---: | :---: | :---: | :---: | :---: |
|  |  | COMPOSITION RESISTORS |  |  |
| R8) <br> R3. R7, R90 | PMA. 4501 3-1 PMA. 45015.9 | ${ }^{3.3}$ Ohms ............................... $1 / 2$ Watt | . 15 |  |
| R25 ...... | PMA-45015-12 | 82 Ohms .............................................1/2 Wath | .15 |  |
| R1, RIO, R92. | PMA-45015-15 | 150 Ohms ........................................1/2 Watt | . 15 |  |
|  | PMA-45015-18 | 270 Ohms ....................................... 1/2 Wart | . 15 |  |
| ${ }_{\text {R43 }}$ | PMA-45015.19 |  | . 15 |  |
| R57 | PMA-45015-21 | 470 Ohms ............................................1/2 Watt | . 15 |  |
| R59, R60 | PMA.45015-22 | 560 Ohms .....................................1/2 Watt | . 15 |  |
| ${ }^{2} 34$ | PMA.45019.24 | 820 Ohms ........................................ 2 Wart | . 45 |  |
| R5, R8, R26, R79 | PMA-45015-25 |  | . 15 |  |
|  | PMA-45015-28 | 1.8 K .....................................................1/2 Wat | . 15 |  |
| R45, R84, R85... | PMA-45015-29 | 2.2 K ..................................................1/2 Watt | . 15 |  |
|  | PMA.45015-30 |  | . 15 |  |
| R2. R12 | PMA.45015-33 |  | . 15 |  |
| R817, R177 R93......... | PMA-45019.35 | 4.8K .................................................. 2 Wath | . 45 |  |
|  | PMA.45014.70 |  | . 15 |  |
| R55, R68, R73. | PMA-45015-36 | 8.2 K ............................................ $1 / \mathrm{W}^{\text {Watt }}$ | . 15 |  |
| R46 .................... | PMA.45015.42 |  | . 15 |  |
| R39 | PMA.45017.42 | 27K ......................................... I Watt | . 30 |  |
| R16, R18 - | PMA.45015.44 |  | . 15 |  |
| R28, R54, R91.. | PMA.45015-45 |  | . 35 |  |
| R20, R21, R22, R63, R82, R86.. | PMA-45015-49 |  | . 15 |  |
|  | PMA.45017.49 | 100K ............................................. I Wath | . 30 |  |
| R64 | PMA.45017.50 |  | . 30 |  |
| ${ }^{\text {R48, }}$, Rb2 | PMA-45015-51 |  | . 15 |  |
| R691, R87 R89 | PMA.45015.53 | 220 K ........................................................ $1 / 2$ Watt | . 15 |  |
| R24, R52 | PMA.45015-54 | 270K ............................................... $1 / 2$ Wath | . 15 |  |
|  | PMAA-45015-56 |  | . 15 |  |
| R41, R42, R75... | PMA.45017.57 | 470K ......................................... $1 / 2$ Watt | ${ }^{15}$ |  |
| R50, R67 ......................................... | PMA.45015.60 | 820K ..........................................1/2 Wath | . 15 |  |
|  | PMA.45015.61 | 1 MEG ....................................... 1/2 Wat | . 15 |  |
|  | PMA.45017.66 | 2.7 MEG ....................................... $1 /$ Wat | . 30 |  |
| R20 R29 | PMA.45015.73 | 4.7 MEG ................................. $1 / 2$ Wat | . 15 |  |
|  |  | WIRE WOUND RESISTORS |  |  |
| 35 | PMB -47007-4 | 60 Ohms ........................................ 6 Wat | . 68 |  |
| ${ }^{\text {R77 }}$ R ... | PMB-47007.3 |  | ${ }^{.68}$ |  |
| R336, R388........................ | PMB 847007.1 | 1 k ....................................................... 7.5 WaH | . 68 |  |
|  |  | VARIABLE RESISTORS |  |  |
| R58 | PMA-48016 | ${ }^{51}$ K, Linearity Vertical..................... | 1.45 |  |
|  | PMB -48014-8 | 50K. Control, Horizontal Hold........................... | 1.45 |  |
|  | PMB -48814.9 | 250k, Control, Noise Inverter | 1.45 |  |
|  | PM8.48015 | . 5 Meg , 750 Ohms , Volume, Contrast SW Controil | 3.95 | A5 |
| R49' .................. | PMB.48014-10 | 1.5 Meg , Control,-Vertical Hold .................. | 1.45 |  |
|  | PMB -48014.5 | 2.5 Meg, Control-Vertical Height .................. | 1.45 |  |
| Resistor Values $=10 \%$ Tolerance, Except * 5\%. |  |  |  |  |
| T1, T2 ............................................. |  | TRANSFORMERS |  |  |
|  | PMA. 52029 | Bifilar 1. F. Coil. | 1.283 | $\begin{gathered} \text { AAO } \\ A A O \\ \text { B5 } \\ \text { AAO } \\ B 5 \\ \text { A5 } \\ 85 \end{gathered}$ |
| T3 | PMA-52027 | 4.5 MC Ratio Datactor. |  |  |
|  | PMB -51005 | Audio Output Transformer | 2.63 |  |
| T5 | PMB-50003 | Power Transformer | 21.84 3.07 |  |
| T6 | $\begin{aligned} & \text { PMA-56005 } \\ & \text { PMA. } 56004 \end{aligned}$ | Vartical Output Transformer .............. | 4.64 |  |
| T8. | PMB. 52019 | Synchroguide ........................... |  |  |
|  | PMC-56002 | Horizontal Output Transformer ................... | 8.43 |  |
|  |  |  |  |  |
| 12 |  | $24 \mathrm{MC} \mathrm{I}. \mathrm{F}. \mathrm{Coil}$. <br> 100 UH Peaking Coil <br> 450 UH Peaking Coil <br> 200 UH Peaking Coil Wound on 22K Resistor |  |  |
| LI, L3 |  |  | $\begin{array}{r} 1.40 \\ 1.48 \\ . .68 \\ .83 \end{array}$ |  |
|  |  |  |  |  |
| L5, L6 |  |  |  |  |
| 17 \& R15 |  | 200 UH Peaking Coil Wound on 22K Resistor.... |  |  |

## Silvertane

IV CHASSIS NO. PICTURE TUBE

### 456.150-14 20HP4/20MP4



Silvertone

IV CHASSIS NO. PICTURE TUBE 456.150-8 20HP4/20MP4


$V 9$
sunio
sunt
and



NOTES:
Last C.73; last R.90. All capacitors in UUF, all resistors $1 / 2$ watt. unlon;
otherwise noted
2. Pin voltages taken with VTVM. Antenns shorted. TV.PHONO switch in TV position. Contrast control minimum contrast. Noise Balance control
maximum clockwise. Other controls at normal operating position. All voltages positive $0 C$. Unless otherwise noted. All readings to ground except
Pin 3 to Pin 4 on $V$. 11 .
Wave form peak to pask voltages takan with vidao output 45 volts peak to peak

- PRODUCTION CHANGES:
a. Previous serial No. 39,828. Terminal 1, N2 connected directly to 290 V
b. Previous serial No. 46,264, Linearity Coil was used, connected from Pin

3. V16 to Terminal 8, T9 with tap to Terminal 7, T9. Also Terminals

,889, each side T5 primary by-passed to ground
d. Previous serial No, 47,610, C25 connectad Pin 6to Pin 7 , V6.


| MODEL NUMBER | DESCRIPTION | TV CHASSIS NUMBER | $\begin{aligned} & \text { RADIO } \\ & \text { CHASSIS NO. } \end{aligned}$ | $\begin{aligned} & \text { RECORD } \\ & \text { CHANGER } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: |
| 2276 | Consolette Combination .................. | $\begin{aligned} & 456.150 .8 \\ & 456.150-14 \\ & 456.150-18 \end{aligned}$ | 456.155 | 456.216 |
| $\begin{aligned} & 3276 \\ & 2277 \end{aligned}$ | Consolette Combination Consolette Combination | $\begin{aligned} & 456.150-61 \\ & 456.150-8 \\ & 456.150-14 \end{aligned}$ | $\begin{aligned} & 456.155 \\ & 456.155 \end{aligned}$ | $\begin{aligned} & 456.216 \\ & 456.216 \end{aligned}$ |
| $\begin{aligned} & 3277 \\ & 2278 \end{aligned}$ | Consolette Combination $\qquad$ Console Combination $\qquad$ | $\begin{aligned} & 456.150-61 \\ & 456.150-11 \\ & 456.150-81 \end{aligned}$ | $\begin{aligned} & 456.155 \\ & 456.860-1 \end{aligned}$ | $\begin{aligned} & 456.216 \\ & 456.216 \end{aligned}$ |
| 2279 | Console Combination ....................... | $\begin{array}{r} \text { 456.150-11 } \\ 456.150-81 \\ \hline \end{array}$ | 456.860-1 | 456.216 |

Models 2276 and 2277
Chassis $456.150-8$, used in models 2276 and 2277, is a 20 tube chassis with a 20 inch electrostatic focus picture tube type $20 \mathrm{HP4}$ or $20 \mathrm{MP4}$, and Rotary Switch tuner, PMB-57003. For a description of a chassis of this design, see Supplement No. I.
Chassis 456.150-14, also used in models 2276 and 2277, is a 21 tube chassis with a 20 inch electrostatic focus pictur tube, type 20HP4 or 20MP4, and Turret Pentode tuner, PMB-57001. A chassis of this design is also described in
Supplement No. 1. Chassis $456.150-18$ is the same as chassis $456.150-14$ except that it uses a Turret Cascode tuner,

## PMB-57002-1.

Models 3276 and 3277
Chassis $456.150-61$, used in models 3276 and 3277, is a 21 tube chassis with a 21 inch electrostatic focus picture tube, type 21MP4, and a Turret Cascode tuner, PMB-57002-1. For a description of a chassis of this design, see

Supplements No. 1 and No. 2.
For radio reception, these four models use chassis 456.155, a two tube A-M radio tuner. Chassis 456.155 has a built-in loop For radio reception, these four models use chassis 456.155, a two tube A-M radio tuner. Chassis
antenna and uses a type 6BE6 for the converter tube, a type 6BA6 for the 455 Kc I-F amplifier tube, and a crystal diode detector, type IN65.
Models 2278 and 2279
Models 2278 and 2279 , 2278 and 2279, is a 21 tube chassis, with a 21 inch electromagnetic focus picture tube, Chassis $456.150-1.1$, used in models 2278 and 2 2
type 21AP4, and a Turret Cascode tuner, PMB-57002-I. For a description of this chassis, see Service Instructions

Supplement No. 2.
456.150-81, the alternate chassis used in these models, is a 21 tube chassis with a 21 inch electrostatic focus picture tube, type 456.150-81, the alternate chassis used in these models, is a 21 tube chassis with a 21 inch electrostatic focus pict
21MP4, and a Turret Cascode tuner, PMB-57002-I. For a description of this chassis, see Service Instructions

Supplements No. 1 and No. 2.
A-M - F-M radio chassis No. 456.860-I is an eight tube superheterodyne radio receiver. For a complete description of this radio see Service Instructions
Both the television and radio units are complete within themselves, with separate chassis and control panels. However, only one speaker is used, with the secondaries of the two voice coils coupled in parallel. The radio's AC power is supplied from the television's AC power line. The phonograph o
receives its power from the radio's $A C$ power line.

## Silvertone

## TELEVISION RECEIVER REPAIR PARTS LIST and SERVICE INSTRUCTIONS

This Supplement covers 456.150-Series television receivers that use a type 2IYP4/21AFP4, electrostatic focus, glass CRT. There are also repair parts, listed in this supplement, for catalog numbers not covered previously, that contain a 456.150 Series chassis.
Chassis No. 456.150-19 has 21 tubes and uses the turret cascode tuner, PMB-57002-I. It is identical to chassis No. 456.150-81 except for the substitution of a 2 IYP4/2IAFP4 for the 2IMP4 CRT. See Service Instructions 57 RL 639 and Supplement No. 2 for a complete description of this chassis.
No. 456.150-19 is used in the following catalog numbers:

| 3260 | Table Model | 3272 | Console | 3280 | Table Model | 3298 | Consolette |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 3261 | Table Model | 3273 | Console | 3295 | Consolette | 4114 W | Table Model |
| 3268 | Console | 3274 | Console | 3296 | Consolette |  |  |
| 3271 | Console | 3275 | Console | 3297 | Consolette |  |  |

These catalog numbers may also use chassis No. 456.150-81.
Chassis No. 456.150-22 has 23 tubes, including the two tube AM radio tuner 456.155, and also uses the turret cascode tuner PMB-57002-1. This chassis is an alternate and is identical to No. 456.150-61 except for the CRT substitution. See Sen vice Instructions 57 RL 639 and Supplement No. 3 for a complete description of this chassis.
No. 456.150-22 is used in the following catalog numbers:
3276 Consolette Combination
3277 Consolette Combination
These models have a 456.216 record changer. See Service Instructions 57 RL 570, Supplement No. 1, for description.

Chassis No. 456.150-16 has 21 tubes, and uses the PMB-57002-I tuner and a 17HP4 CRT. See Service Instructions 57 RL 639 and Supplements Nos. 1 and 2 for description.
No. 456.150-22 is used in the following catalog numbers:
3263 Table Model 3289 Table Model 3290 Consolette 3299 Table Model


## SPECIFICATIONS

| schematic location | part no． | description | $\xrightarrow{\text { RLEARS }}$ PRICE | $\mathrm{MO}_{\text {MODE }}$ |
| :---: | :---: | :---: | :---: | :---: |
|  | $\begin{aligned} & \text { PMA-52028.2 } \\ & \text { PMA } 50600 \\ & \text { PMAA-50003 } \end{aligned}$ | 4．5 MC Take－Off Trap． <br> Width Coil | $\begin{aligned} & 1.75 \\ & \hline .57 \\ & \hline .54 \end{aligned}$ | ${ }^{85}$ |
|  |  | Antenna <br> Knife Disconnect（21＂CRT Only） <br> Tube Mount Strap $\left(21^{\prime \prime}\right.$ CRT）． Tube Mount Strap $20^{\prime \prime}$ CRT） <br> Plastic Ring（21＂CRT）． <br> Plug－Yoke Connection <br> Receptacle－Yoke Connection <br> Ion Trap Focus Ma <br> Focus Magnet（21AP4 CRT Only） <br> Centering Magnot（21MP4，20HP4 CRT＇s） <br> Jack． 4 Amp．， 250 Volts，Yype 3AG <br> Tube Socket，Octal Molded（Vis \＆Vil）． <br> Tube Socket，Octal Molded（V－15）． Tube Socket， 9 Pin Molded（V．13） <br> Turret Pentod 9 Pin Molded（V－13）．． <br> Turret Pentode Tuner Turret Cascode Tuner <br> Rotary Switch Tuner |  | AO <br> 85 <br> 85 <br>  <br>  <br> 85 <br> 85 <br> 85 <br> 85 |

## POWER SUPPLY

All models 117 volts AC， 60 cycle unless other－ wise specified．Power Consumption 105 watts．

FREQUENCY RANGE
$\begin{array}{lr}\text { Standard Broadcast } & 540-1600 \mathrm{KC} \\ \text { Frequency Modulation（FM）} & 88-108 \mathrm{MC}\end{array}$ ANTENNA．EQUIPMENT

These models have a Silvertone built－in an－ tenna system which will provide excellent

INTERMEDIATE FREQUENCIES
AMIF Carrier
455 KC ． 10．7 MC．
POWER OUTPUT

## Undistorted

2． 75 Watts Maximum 4．50 Watts
local reception on both the AM and FM bands． For locations where an outside antenna is nec－ essary a special Silvertone AM－FM Antenna Kit Catalog No． 6710 is available．

## ALIGNMENT PROCEDURE

WARNING：No attempt should be made to adjust the alignment of this receiver without using the following equipment：Signal Generator，FM Sweep Generator，Cathode Ray Oscilloscope，Output Meter insulated Screw Driver
AM ALIGNMENT

Output meter connection
Generator ground lead connection $\qquad$ Across speaker voice coil Generator modulation －Receiver chassis
Position of volume contro $\qquad$ $30 \% 400$ cycles
Position of tone control $\qquad$ Fully counterclockwise

A Hazeltine loop may be used to radiate a signal into the receiver loop instead of the dummy antenna connections listed below．

| $\begin{aligned} & \text { TUNER } \\ & \text { POSITION } \end{aligned}$ | GENERATOR FREQUENCY | $\begin{aligned} & \text { DUMMY } \\ & \text { ANTENNA } \end{aligned}$ | GENERATOR CONNECTION | CORE \＆ TRIMMER ADJUSTMENTS （IN ORDER SHOWN） | CORE OR TRIMMER FUNCTION |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Open | 455 KC ． | 0.1 Mfd ． | Transl－Grid | T4－A，T4－B | I．F． |
| 1650 KC． | 1650 KC． |  |  | T2－A，T2－B |  |
| 1400 KC ． | 1400 KC ． | 50 M | Ext．Ant． <br> Ext．Ant | $\begin{aligned} & \text { C11 } \\ & \mathrm{C} 5 \end{aligned}$ | Osc． <br> Ant． |

FM IF ALIGNMENT
wweep generator frequency $\qquad$ 10.7 MC.
weep generator deviation $\quad 300 \mathrm{KC}$. Sweep generator ground lead connection Receiver chassis． position of tuner r chassis
Open
Position of volume contro Fully on
Position of tone control
Position of FM－AM－PHO switch Fully counterclockwise

Make shielded probe shown in Figure 1 for use with Oscilloscope where indicated below．

| GENERATOR <br> CONNECTION | OSCILLOSCOPE <br> CONNECTION | CORE <br> ADJUSTMENTS | ADJUST FOR <br> CURVE IN | CORE <br> FUNCTION |
| :---: | :---: | :---: | :---: | :---: | :---: |
| FM－First <br> IF grid | Probe－across <br> T5－Primary | T3－A，T3－B | Figure 2 | IF |
| Trans－Grid | Probe－across <br> T5－Primary | T1－A，T1－B | Figure 2 | IF |
| FM－Second <br> IF grid | Across C35 | T5－A，T5－B | Figure 3 | Disc． |

TV CHASSIS NO．456．150－11 \＆NO．456．150－8
See Service Instructions 57 RL 639 and Supplements No． 1 and No． 2
CABINET ACCESSORIES

| part no． | DESCRIPTION | SEARS RL PRICE | $\begin{aligned} & \text { MU } \\ & \text { CODE } \end{aligned}$ |
| :---: | :---: | :---: | :---: |
| PMB－80098 | Back，Models 2276 \＆ 2277 |  |  |
| PMB－80104 | Back，Models 2278 \＆ 2279 | 4.63 | ${ }_{\text {AO }}$ |
|  | Back，Modols 3276 \＆ 3277 ． | 2.63 | AAO |
| PMA－80053－2 | Knob，Picture Contrast，Models 2277 \＆ 22279 ． | ． 34 |  |
| PMA－80138－1 | Knob，Picture Contrast，Models 3276 \＆ 3277 | ． 57 |  |
| PMA－80054．1 | Knob，Fine Tuning，Models 2276 \＆2278．．．． | ． 34 |  |
| PMA．80054－2 | Knob，Fine Tuning，Models 2277 \＆ 2279 | ． 34 |  |
| PMA－80055－1 | Knob，Fine Tuning，Modols 3276 \＆ 3277 ， | 1.03 |  |
| PMA－80136－1 | Knob，On－Off Volume，Model 3276．．．．．．．．．．．．．．．．．．．．．．． | 1.14 |  |
| PMA－80136－2 | Knob，On－Off－Volume，Model 3277 | 1.14 |  |
| PMA－80056－1 | Knob，Channel Solector，Models 2276，2277，2278 \＆ 2279 | 1.71 |  |
| PMA－80137－1 | Knob，Channel Seliector，Model 3276 | 1.48 |  |
| PMA－80137－2 | Knob，Channel Solector，Modal 3277 | 1.48 |  |
| PMA－80068－2 | Knob，Radio Tune \＆Tone，Models 2276 \＆ 2278. | ． 65 |  |
| PMA－80068－6 | Knob，Radio Tune \＆Tone，Models 2277 \＆2279． | ． 65 |  |
| PMA－80087．1 | Knob，Radio Tuno \＆Tone．Models 3276 \＆ 3277 ．．．7 | ． 73 |  |
| PMA－80087－3 | Knob，Radio Function Switch，Models 22277 \＆ 2279 | ． 73 |  |
| PMA－80097．5 | Knob，Radio Function Switch，Models 3276 \＆ 3277 | ． 73 |  |
| PMB－80097 | Dial Glass， 155 Radio | 1.78 |  |
| PMD－7031 | Mask，Models 2278 \＆ 2277 | 5.83 |  |
| PMA． 80107 | Mask，Models 2278，2279，3276，\＆ 3277 | 5.18 | B5 |
| PMB－80151－2 | Safety Glass， $166^{\prime \prime} \times 201 / 2^{\prime \prime}$ ．．．．．．．．．．．．．．．．．．．．．．．． | ${ }^{6.78}$ | ${ }_{\text {B5 }}^{\text {B5 }}$ |
| PMB－30007－1 | CRT Protection Cup， $2^{\prime \prime}$ Deop． | 1.07 |  |
| PMA－90021 | CRT Protection Cup，${ }^{\text {che }}$ Deep． | 1.28 |  |
| PMAA－90019 | Speaker，${ }^{\prime \prime}$ | 4.30 6.00 |  |
|  | Speaker，10＂ | 8.40 | B5 |
|  | Speaker，12＂．．．．． | 8.80 | ${ }^{85}$ | FM

IF grid

FM RF ALIGNMENT

| Output meter connection |  |  |
| :--- | ---: | ---: |
| Sweep generator deviation | Across speaker voice coil |  |
| Dummy antenna | 22.5 KC |  |
| Sweep generator connection | Two | 120 ohm resistors |
| Position of volume control | FM antenna board |  |
| Position of tone control | Fully on |  |
| Position of FM-AM-PHO switch | Fully counterclockwise |  |
|  |  | FM |



FIG. 1 - SHIELDED PROBE FOR FM I. F. ALIGNMENT


FIG. 2-FMI.F. RESPONSE



FIG. 5 - RADIO CHASSIS LAYOUT - TOP VIEW


FIG 6 - RAD:O CHASSIS LAYOUT - BOTTOM VIEW


The models covered in this RL are fundamentally the same, differences being mainly in values of com ponent parts rather than in basic circuit arrangement. All employ a 23 tube circuit and provide for 82 channel reception by the use of a 12 channel, turret type, VHF tuner, and a continuous tuning UHF converter. See Fig. 1 for tubes and function.

Chassis 528.247, 528.247-1, 528.247-2 and 528.256 use a 21 AP4 Silvertone metal picture tube; all other chassis use a 21 ZP4 Silvertone glass picture tube. In addition all chassis except 528.256, 528.263, 528.263-1 and 528.263-2 are equipped with a tone control, and phono jack and switch for use with any standard phonograph.

Component parts differences within the four basic chassis groups of 528.247, 528.256, 528.263 and 528.266 are shown in the parts price lists at the rear of this booklet, and in the schematic diagrams of all the models.

vi-6aug, soundi.f. v2- GTB, FM. DET, a Ist AUDIO v3-6A05. avolo cutput 55-6cab, 2 No I.F. amp. v6-6cet, JRD I.f AMP. vT-6ALS, VIDEO DETECTOR ve- GACT. video amp. vg-láut, swec. LIMa d.c. Restorer
VIO- GSNT/GT,VERT. BLOCKING OSC. vil- Gaha, vert output vil. Gama, vert ount
viz-gaug, a.c. VI2-6AUG. A.C.C. via-6SN//GT, HORIZ OSC. Vi. -SESES, Mopiz output

 VIT-6W4, DIODE DAMPER
VIB-SU4G, LOW-VOLT. RECTIFIER ViB-5U4G, LOW-VOLT: RECTIFIER VII -212P4, PCTCURE TUBE V20. 6807. R.F. AMP. V21-6J 6. OSC. MIXER V22-6af4. OSC (UHF) V23-6C96. R.f. AMP (Untr)

Fig. 2 Top View-Chassis 528.247, 247-1, 247-2 and 528.266, 266-1 (Components shown in broken lines can be reached from bottom of chassis.)


Fig. 4. Rear view of chassis showing controls
(Chossis 528.256, 263, 263-1 and 263-2 do not contuin Phono Jock.


VI- ${ }^{2 a u g}$, SOUND I.F V2- бTG, FM. Det.a ist audio v3-6A05, AUDIO OUTPUT V4-6C86, IST I.F. Amp. v5-6CB6, 2ND I.F. AMP. v6-6CB6, 3RD I.f AMP. vT-GALS, VIDEO DETECTOR ve- 6 act, video amp. vg-12AUT, SYMC. LIM, D.C. RESTORER VIO- 6SNT/GT, VERT. BLOCKING OSC. VII- GAHA, VERT. OUTPUT viz- Gaus, a.c.c. VI3-6ALS, PHASE DETECTOR VIA-6SNT/GT, HORIZ. OSC. VIS-6B66, HORIZ. OUTPUT VI6-IB3. HIGH-VOLT RECTIFIER VIT-6W4. DIODE DAMPER VIB-5U4G, LOW-VOLT. RECTIFIER VI9-21ZP4, PICTURE TUBE V20-6B07, R.f. AMP. V21-6J6, OSC. MIXER v22-6AF4. O5C (UHF) v23- 6CB6, R.f. AMP (UHF)

Fig. 3. Top View-Chassis 528.256 and 528.263, 263-1, 263-2 (Components show in broken lines can be reached from bottom of chassis)

## TELEVISION SERVICE ADJUSTMENTS

CAUTION HIGH VOLTAGES are used in the operation of this receiver. The back cover, while in ploce, prevents occide
THE HIGH VOLTAGE LEAD, which supplies 12 to 16 kilovolts to the picture tube, should be momentarily shorited to the THE HIGH VOLTAGE LEAD, which supplies 12 to 16 kilovolits to the picture tube, , hhould be momentarily shoried to the
chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents chassis whenever it is disconnected the service pufpes it hos been turned off
THE PICTURE TUBE is highly evacuated ond if broken, glass fragments will be violently expelled. Scratching, chipping, undue pressure, or careless hondling such as lifting the tube by its neck is dangerous ond should be aloided. It it
net necessary to hondle the picture tube, use safety goggles ond heovy gloves. Be sure to discharge the yoltoge developed
ocross the copacitor formed by the inner ond outer coating of the picture tube. This con be done by connecting the ocross the copacitor formed by the inner ond outer
high voltoge socket on the tube to the outer cooting.

HORIZONTAL OSCILLATOR ADJUSTMENT Mointain sync, the horizontal oscillator should be reset. To reset this screwdriver.adiustment, If the Horizontal Hold control fails to mointain sync, the horizontal oscillator should be reset. To resel this screwdriver.adiusten
sol the horizontal hold control in the center of its range and syc the picture with the horizontal oscillator adiustment screw,
Check the control action on various channels and alter the screw adjustment as required to provide sync on all chonnels with these two controls.
deflection yoke, ion trap adjustment
Forllowing is the proper procedure for adiusting the Deflection Yoke, Ion Trap and Focus.
The receiver should be turned on but not connected to an antenna. These steps should then be taken in the following order

1. The Deflection Yoke should be moved os far forward as possible on the neck of the picture tube.
2. The Brightness control should be turned to maximum (clockwise) and the Picture control should be turned to minimum解 The lon Trap should be rotated and at the same time moved forward and backward to
brightest raster an the screen. 4. The Deflection Yoke should be rotated so that the top and bottom edges of the raster are paraliel to the top of the
chassis. 4. chassis.
3. The Brilliance control should now be reduced (ccw) to a point where the raster is slightly above normal brilliance.
4. Center the picture within the opening of the mask and eliminate shaded corners by adiusting the three positioning wing
nuts on the focus coil. Corner-cutting or shadows at the corners may be caused by mis-adiustment of either the ion trap nuts on the focus coil. Corner-cutting or shadows at the corners may be coused by mis-adiustment of either the ion trap
magnet or the Focus coil, and the two may require simultaneous adiustment to secure the brightest, yet evenly distributed magnet or the Focus coil, and the two may require simultaneous adiustment to secure the brightest, yet evenly distributed
light on the screen. Four self-tapping screws on the focus coil U-bracket are provided to permit vertical movement of the focus coil when necessary.

(c) John F. Rider

ALIGNMENT PROCEDURE
I-F ADJUSTMENTS

| Step No. | Connect Signal Generator to | Signal Gen. frea. Mc. | Connect Voltmeter to | Miscellaneous Connections and Instructions | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Raise tube shield on V21 (tuneroscillator), so that it is not grounded, then clip the "hot" lead of the signal generator to the tube shield. | 25.2 | Junction R29 and 19 on Chassis 528.247, 247-1 247-2, 266 and 266-1. <br> Junction R29 and 110 on Chassis 528.256, 263, 263-1 and 263-2 | Disconnect the antenna. Set channel selector to channel on which there is no signal and no interference such as harmonics or I.F.). | T5 (5ottom maximum |
| 2 |  | 23.2 |  |  | T4 maximum |
| 3 |  | 26.1 |  |  |  |
| 4 |  | 24.0 |  |  | $\begin{gathered} \text { L102 } \\ \text { maximum } \end{gathered}$ |
| 5 |  | 21.75 |  |  | T5 (top) minimum |

RATIO DETECTOR AND SOUND I-F ALIGNMENT

| Step No. | Connect Signal Generator to | Signal Gen. Freq. Mc. | Connect <br> Voltmeter to | Miscellaneous Connections and Insiructions | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Video Grid <br> (pin 4, V-8) | 4.5 <br> . 1 volt output | $\begin{aligned} & \text { Pin } 2, \\ & \text { V2, } \end{aligned}$ | Meter on 10 Volt scale | II (bottom) and L7 for max. on meter. |
| 2 | Video Grid <br> (pin 4, V-8) | 4.5 <br> . 1 volt output | See Note 1 | Meter on 3 volt scale | II (top) <br> for zero (center) on meter |
| 3 | Junction C36, R39 | 4.5 <br> . 1 volt output | $\begin{gathered} \text { Pin } 2, \\ \mathrm{~V}-2, \end{gathered}$ | Meter on 10 Volt scale | L12 for min. on Chassis 247, 247-1, 247-2, 266, 266-1. 113 for min. on Chassis 256, 263, 263.1, 263-2 |

Connect one end to pin 2 of V 2 (678) a
NOTE 1: Connect two 100 K ohm resistors in series. Connect one end to pin
Connect the hot side of VTVM to center of the two 100 K resistors, and ground side to following:
(a) In chassis 528.247, 247-1, 247-2, 266, 266-1, connect to junction of R89 (150 ohms) and R88 ( 47 K ohms).
(b) In chassis $528.256,263,263-1,263-2$, connect to

## VHF TUNER ALIGNMENT PROCEDURE

Before attempting to align the VHF tuner it is necessary that the IF amplifier be correctly aligned. It is deBefore attempting to align the VHF funer iade at channel No. 12. Where schematic locations are given in the instructions below, refer to tuner schematic diagram - Fig. 14. Refer also to Figs. 8 and 9 for adjustment points. To align the tuner proceed as follows:
(1) Connect an RF sweep generator to the antenna terminals, and a 3 volt negative bias battery to AGC bus.
(2) If the generator is not provided with internal crystal controlled or crystal calibrated markers, connect a marker generator to the antenna terminals.
(3) Connect a cathode ray oscilliscope across the picture detector diode load resistor ( 6.8 K ohms)
(4) Adjust the RF generator for a 10 Mc . sweep width with a center frequency at approximately 207 Mc
(5) Adjust the marker generator for the sound carrier of channel 12 ( 209.75 Mc .).
(6) Set the range switch to channel 12 with the fine tuning in the middle of its range.
(7) Turn the receiver on and allow it 15 minutes to warm up and stabilize.
(8) Set the PICTURE control for 1 volt, measured from pin " 5 " of Video Amplifier to chassis.
(9) Align C101, C102, and C103 for a curve similar to that shown in Fig. 7.
(10) Change the station selector to the various channels and using the correct setting of the RF sweep generator (to center it in the channel) and the correct marker frequency for the sound carrier, ad just the core in 101 so that the sound marker will be in the proper position on the curv (Fig. 7).
NOTE. Each core is independent of those for other channels. This enables you to adjust any one channel with out changing the adjustment on all other channels.


Top View of VH
Cascode
Cascode Tuner T95-31,
Showing Adjustments




## ON AIR ADJUSTMENTS

Fig. 12, below, formations in the below instructions, refer to schematic diagram, Figer also to

1. VHF should be aligned properly before setting up UHF.
2. Tune UHF receiver to a UHF staing. 12. UHF Converter T95-31 - Side View Showing Adjustments
3. Adjust transformer (T201, T202) on UHF tuner for best sound and picture
4. Remove UHF Oscillator 'Tube 6AF4 from socket; connect VTVM across video detector laod resistor of receiver. (L101, Fig. 12), same as on all VHF channel oscillator slugs.
5. Turn chnanel knob to UHF position.
6. Note that the oscillator slug for converter channel ( 124 Mc ) is accessible from the front end of the tuner slugs.
7. Adjust oscillator slug for converter channel with 124 Mc signal into UHF antenna lead. Use 124 Mc signal from VHF Marker Generator Hickok 680
8. Replace 6AF4.
9. A UHF signal from a suitable UHF signal generator should be fed into the antenna terminal of the UHF converter; attach vacuum tube voltmeter or detector probe to TV set detector.

C2O2 MIXER TRIMMER


OJohn F. Rider



REPAIR PARTS LIST

| Schematic Location | Part Number | description | $\begin{gathered} \text { Soars } \\ \text { Sriceling Each } \end{gathered}$ | code |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CAPACITORS |  |  |  |  |  |  |
|  |  | Part of coil 4.5 Mc sound toke.off (t7) |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| $\mathrm{Cl}_{4}{ }^{+}$ | 115.211 |  |  |  |  |  |
| C8 | 115-242 |  |  |  |  |  |
| C9 | 115.228 |  |  |  |  |  |
| C12, C30, 446 | 118.292 |  |  |  |  |  |
| $\left.\begin{array}{c} C 14, C 18, ~ C 60, ~ C 74,\} \\ C 75 \end{array}\right\}$ | 116-237 | Capacitor, molded; 01 mfd . $800 \mathrm{v}$. ............................. |  |  |  |  |
| C15, C41, C47, C48 | ${ }^{115} 5120$ |  | $\begin{aligned} & .30 \\ & .50 \end{aligned}$ |  |  |  |
| C16 | $\underline{16.188}$ |  |  |  |  |  |
| C17 | 118.308 | Capacior, tubular; 2.2 mdd .400 Copacior, electrolytic; 40 mdd . | 2.20 |  |  |  |
| $\begin{aligned} & \mathrm{c} 19, \mathrm{c} 29, \mathrm{c} 58, \mathrm{c} 69,\} \\ & \mathrm{c} 72, \mathrm{c} 73 \end{aligned}$ | 118.295 | Cepacitor, electrolytic; 40.40 mfd .450 v .; 100 mfd 200 v . | 5.10 |  |  |  |
| C31 | 116.241 | Capacitor, ceramic; 1500 mmfd . <br> Capacitor, ceramic; 5 mmfd. $10 \%$ <br> Capacitor, molded rubular: .47 mfd .200 v. <br> Part of coil, 4.5 Mc Trap (LI3) |  | $\begin{aligned} & .25 \\ & .20 \end{aligned}$ |  |  |
| C32 | 115.222 |  |  |  |  |
| C34 | 116.240 |  |  |  |  |  |
| C35 |  |  |  | Part of coil, 4.5 Mc Trap (Ll3) |  |  |
| C36 | T16-212 |  |  |  |  |  |
| C37* | 116.240 |  | . 70 |  |  |  |  |
| ${ }^{\text {c38 }}$ | 116.234 |  | . 40 |  |  |  |
| C39, C51, C62 | 116.233 |  | . 35 |  |  |  |
| C40, C56, 688 | T16.238 |  | . 65 |  |  |  |
| ${ }^{\text {c } 42}$ | ${ }^{118.276}$ |  | 2.15 |  |  |  |
| C43 | 115.239 |  | 1.50 |  |  |  |
| ${ }^{\text {c } 44}$ | ${ }^{115-235}$ |  | . 25 |  |  |  |
| C45, 663 | 116.235 |  | . 40 |  |  |  |
| C49, C50, 552 |  |  | Parts of Vertical Integrator Network |  |  |  |
| C54 | 116.218 | {Copacior, molded; tubular; $22 \mathrm{mfd}$. . 600 vCopacitor, molded; .056 mfd. $600 \mathrm{v} 10 \$.} & . 95 & \hline C55 & 116.236 & & 45 & \hline C57 & 118.298 &  & 1.65 & \hline ${ }^{\text {c59 }}$ | 116-187 | Capacitor, tubular, 1 mfd. 400 v . (1............................. ${ }^{\text {a }}$. 30Part of coil, Horizontal Oscillator (Li) |  |  |
| C61 |  |  |  |  |  |  |
| C64 | 115.226 | Capacitor, silver mica; 330 mmfd . $10 \%$Capacitor, mica; 390 mmid. | 45 |  |  |
| ${ }_{6} 65$ | ${ }^{115} 5231$ |  | . 30 |  |  |  |
| ${ }^{666}$ | ${ }^{120.145}$ |  | . 50 |  |  |  |
| ${ }_{\text {c }} \mathrm{C} 70$ | - 116.231 |  | .25 1.00 |  |  |  |
| C71$C 76$ | 116.239 | Capacitor, molded; . 047 mfd. 1.000 v . ............................. . . 60 Part of Deflection Yoke (L15, L19) |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  | RESISTORS |  |  |  |  |
| R1, R28 | 160.730 |  | . 20 |  |  |  |
| R2, R31 | ${ }^{124.206}$ |  | 2.25 |  |  |  |
| R3, R92 | T80.811 |  | . 20 |  |  |  |
| R4, R72 | T80.779 |  | . 20 |  |  |  |
| R5, R44 | T60.747 |  | . 20 |  |  |  |
| R6 | 160.788 | Resistor, 180K ohm, $1 / 2 \mathrm{w} .5 \%$ | . 20 |  |  |  |
| $\underset{\substack{\text { R71 } \\ \text { R73 }}}{\text { R39, R43, R70, }}\}$ | T60.801 |  | . 20 |  |  |  |
| ${ }^{\text {R88 }}$ | T60.787 |  |  |  |  |  |
| R9 | ${ }^{1600.800}$ |  |  |  |  |  |
| ${ }^{\text {R10, }} \mathrm{R} 41$ | T60.816 |  | . 30 |  |  |  |
| R11, R29, R48 | 160.882 | Resistor, 3.3 K ohm, $1 / 2 \mathrm{w} .10 \%$ | . 20 |  |  |  |
| $\left.\begin{array}{c} \mathrm{R} 12, \mathrm{R} 13, \mathrm{RIO}, \mathrm{R17}, \\ \mathrm{R20}, \mathrm{R23} \end{array}\right\}$ | T60.703 |  | 20 |  |  |  |
| R14, R18 | T60.806 | Resistor, 56 ohm, $1 / 2 \mathrm{w} .10 \%$. $10 \%$Resistor, 18 E ohm, $1 / 2 \mathrm{w} .10 \%$ | . 20 |  |  |  |
| R15 | 160.777 |  | . 20 |  |  |  |
| R19 | T60.807 | Resistor, 18 l ohm, $1 / 2 \mathrm{w} .10 \%$Resisor, 680 K ohm, $1 / 2 \mathrm{w} .10 \%$Resistor, 15 K ohm, $1 / 2 \mathrm{w} .10 \%$. | 20 |  |  |  |
| R21, R32, R55, R66 | T60.783 |  | . 20 |  |  |  |
| R22, R88, R91 | ${ }^{160.767}$ |  | . 20 |  |  |  |
| R24, R80 R25, R35 | T60-898 | Resistor, $150 \mathrm{ohm}, 1 / 2 \mathrm{w} .10 \%$ Resistor, 2.2 megohm, $1 / 2 \mathrm{w}$. $10 \%$ | . 20 |  |  |  |
| R26, R58, R87, R93 | T60.672 | Resistor, 33 K ohm, $1 / 2 \mathrm{w}$. $10 \%$ Resistor, 220 K ohm, $1 / 2 \mathrm{w}$. $10 \%$ eesistor 470K ohm 1/2 w $10{ }^{\circ}$ | . 20 |  |  |  |
| R27 | T60.902 |  | 20 |  |  |  |


| $\begin{array}{c}\text { Schematic } \\ \text { Cocation }\end{array} \begin{array}{c}\text { Part } \\ \text { Numbe }\end{array}$ |
| :--- |

$\substack{\text { Schematite } \\ \text { Locatio }}$
R20
$\qquad$

TRANSFORMERS AND COILS

| 11 |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
| 12 | T80-253 | Transformer, Ratio Detector, 4.5 Mc | 3.15 2.25 |  |
| 13 | T10.541 | Ṫranstormer, 2nd I.F. (blue) | 1.05 |  |
| 14 | 110.542 | Transformer, 3rd I.F. (white) | 1.05 |  |
| 15 | 110.588 | Transformer, 4th I.F. (sound trop; (inc. 21.75 wave trap) | 1.05 |  |
| 16 | ${ }^{\text {P80.284 }}$ | Transformer, Vertical Blocking | 2.15 |  |
| 17 | т80-277 | Transformer, Vertical Output | 3.60 |  |
| ${ }^{18}$ | ${ }^{\text {P80.278 }}$ | Transformer, Horizontal Output | 9.60 | AO |
| 19 | т80.264 | Transtormer, Power | 19.00 | AO |
| 17 | ${ }^{110.587}$ | Coil, 4.5 Mc sound take.off | 2.30 |  |
| 18 | T33-236 | Choke, Insulated; I uh, $10 \%$ | . 30 |  |
| 19 | ${ }^{\text {T33.226 }}$ | Choke, 14 uh, 10\% | . 75 |  |
| ${ }^{19+}$ | T33.237 | Choke, 20 uh, 10\% | . 45 |  |
| ${ }^{110}$ | 110.579 | Coil, Peaking; (white and black) 550 uh | . 45 |  |
| ${ }^{1} 10+$ | T10.609 | Coil, Peaking; (black and blue) 220 uh | . 45 |  |
| 111 | ${ }^{110.557}$ | Coil, Peaking; (orange) 90 uh | . 45 |  |
| L11* | T10.607 | Coil, Peaking; (black and orange), 120 uh, wound on 10 K ohm, | . 45 |  |
| ${ }^{12}$ | 110.580 | Coill Peakings: (yellow and black) 175 uh, wound on 8.2 K ohm, |  |  |
| 12\% |  |  | . 45 |  |
| $12+$ | T10.610 | Coil, Peakingi (white and brown) 262 uh, wound on 10 K ohm, | 45 |  |
| ${ }^{113}$ | T10.581 | Coil, 4.5 Mc Trap | 1.20 |  |
| 114 | 110.578 | Coil, (yellow and red) Peaking: 410 uh , wound on 10 K ohm, $1 / 2 \mathrm{w}$. resistor (includes R34) | . 45 |  |
| 114* | 110.608 | Coil, Peaking; (white and blue), 463 uh , wound on 10 K ohm, $1 / 2 \mathrm{w}$. resistor (includes R34), .......................... | 45 |  |
| 115, 119 | T83.743 | Leflection Yoke (includes R63, R64) | 9.10 | AO |
| 116 | 110.560 | Coil, focus | 8.70 | AO |
| 117 | ${ }^{110.583}$ | Coil, Horizontal Oscillator (includes | 2.70 |  |
| ${ }^{168}$ | 110.551 | Coil, Width Control | 1.05 |  |
| 120 | T10.582 | Coil, Horizontal Linearity Control | 1.05 |  |


|  | CABINET REPAIR | PARTS LIST |  |
| :---: | :---: | :---: | :---: |
| Part Number | description |  | $\mathrm{Mu}_{\text {code }}$ |
| T779.398 |  | ${ }_{4}^{4.00}$ |  |

production changes
(See schematic diagram - Fig. 17.)
The following changes were made on the above chassis as production progressed. These changes, while representing certain improvements, are not retroactive. .
change except to correct an actual complaint. *To prent overtoading of the
528.256 and 263 do not contain this resistor. With this change, capacitor C37 changed value. Chassis $528.263-1$ and $263-2$. Chassis 528.263 .1 and 263 -2 the capacitor (C37) marked""*" has replaced the other listed.
${ }^{\text {ton }}$ On chassis 528.263 -2 these parts replace the others listed.
production changes
schematic diagram - fig. 16 )
The following changes were made on the above chassis as production progressed. These changes, while representing cewion "To supply reduced $\mathrm{B}+$ voltage to the UHF convertier, the resistor R94 has been added to all chassis except early models of chassis 528.247. These early models do not contain this resistor. 28.247. Chassis 528.247 does not contain this resistor. With this change capacitor C 37 changed value. On chassi ton chascito (C37) marked " $*$ *"' is used in place of the other tisted.

TOn chassis $528.247-2$ this part has replaced the other listed.
t'On chassis 528.266 , this part has replaced the other part listed.

This diagram has incorporated the following changes, which were made on these chassis as production progressed, in order to make certain improvements. Thes changes are not retroactive. If you have an earlier production chassis which does no include them, do not make the change except to correct an actual complaint.

| Schematic Location | Connected: | Change: |
| :---: | :---: | :---: |
| *R94 | In series with screen grid of V8. | Added to chassis $528.263-1$ and 263.2 (To prevent overloading of V8.) |
| *C37 | Pin 6 of V 8 to B minus. | Changed value - . 005 mfd . in chassis 528.256 and 263; now .47 mfd ., in chassis 528.263-1 and 263-2, as shown. (This change accompanied change in R94 above.) |
| tC4 | Junction of L7 and C3, to B minus | Changed value - . 005 mfd . in chassis 528.256, 263, and 263.1; now 01 mfd., as shown. (To eliminate regeneration in sound IF.) |
| $\dagger$ tr3 | T6 to Vertical Hold (R54). | Changed value - 1.2 megohm in chassis 528.256, 263 and 263-1; now 1 megohm as shown. (To provide better centering | 528.256, 263 and 263-1; now 1 megohm as shown. (To provide better centering

of Vertical Hold.)

The changes in the coils.listed below were made simultaneously in order to improve video response.

L9 Pin 7 of V7 to LII.
Changed value- 14 uh in chassis 528.256 , 263 and 263-1; now 20 uh as shown
tlio
111 to P29
Changed value - 550 uh in chassis 528.256, 263, and 263-1; now 220 uh as shown.

Changed value- 90 uh in chassis 528.256 , 263 and 263-1; now 120 uh, wound on 10K ohm resistor (R96), as shown.

Changed value - 175 uh, wound on 8.2 K ohm resistor in chassis 528.256 , 263 and 263-1; now 262 uh, wound on 10K ohm resistor (R30) as shown.

Changed value - 410 uh in chassis 528.256, 263 and 263-1; now 463 uh as shown.

## TELEVISION ALIGNMENT PROCEDURE

## PRELIMINARY

This alignment is an exacting procedure and should be undertaken only when necessary. Before fully decidin that alignment is necessary and before removing the chassis from the customer's home:

1. Be sure of the antenna installation.
2. Check all operating controls and adjustments including the channel selector
3. Check reception on all channels.
4. Check tubes by substitution of known good tubes.

## TEST EQUIPMENT REQUIRED

1. Signal generator (with an output variable and at least 0.1 volt max.) to provide the following frequen
(a) 4.5 mc Sound IF
(d) 25.5 mc 2nd IF (T5)
(b) 21.75 mc Trap (L8)
(e) 23.8 mc 3rd IF (T4)
(c) 24.0 mc 1st IF (LG)
(f) 26.1 mc 4th IF (T3)
2. R.F. Sweep Generator with a frequency range from 40 to 220 megacycles with a sweep width of 10 megacycles and an adjustable output of at least 0.1 volts.
3. Crystal controlled or crystal calibrated markers for the sound carrier of each channel. Picture carriet markers are desirable but not necessary.
4. Cathode ray uscilloscope, preferably with a wide band vertical amplifier and an input calibrating source
5. Vacuum tube voltmeter (VTVM).

## ALIGNMENT PROCEDURE

I-F ADLUSTMENTS

| Stop No. | Connect Slignal Generotor to | Slapal Gen. | $\begin{gathered} \text { Connect } \\ \text { Voltmestar to } \end{gathered}$ | Miscellaneous Connectlons and instructlons | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 3 | Raise tube shield on V18 (tuneroscillator), so that it is not grounded, then clip the "hot" lead of the signal generator to the tube shield. | 26.1 | $\begin{gathered} \text { Junction } \\ \text { R13 and L2 } \end{gathered}$ | Disconnect the antenna. Set channel selector to channel on which there is no signal and no interference ( such as harmonics of I.F.). | T3 (top) maximum |
| 4 |  | 23.8 |  |  | T2 (top) maximum |
| 5 |  | 25.5 |  |  | Ti (top) maximum |
| 6 |  | 24.0 |  |  | $\begin{gathered} \text { L15 } \\ \text { maximum } \end{gathered}$ |
| 7 |  | 21.75 |  |  | $\stackrel{\text { L14 }}{\text { minimum }}$ |

## ALIGNMENT TABLE

 DISCRIMINATOR AND SOUND I-F ALIGNMENT| $\begin{aligned} & \text { serep } \\ & \text { No. } \end{aligned}$ | Connect Slgnal Generator to | SIIgnal Gen. Preq. Mc. | $\begin{aligned} & \text { Connect } \\ & \text { Voltmefer to } \end{aligned}$ | Mlscellaneous Connections and Inatructions | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Video Grid (pin 1, V-8) | $\begin{gathered} 4.5 \\ .1 \text { volt output } \end{gathered}$ | $\underset{\mathrm{V} \cdot 2}{ } 2$ | Meter on 10 Volt scale | T1 (bottom) and L7 for max. on meter. L12 for min. |
| 2 | Video Grid (pin 1, V-8) | 4.5 . 1 volt output | See Note 1 | Meter on 3 volt scale | T1 (top) for zero on meter |

NOTE 1: Connect two 100 K resistors in series. Connect one end to pin of V-2 (6T8) and the other end tion of R4 ( 150 ohms ) and R5 ( 47 K ohms).

HORIZONTAL OSCILLATOR ADJUSTMENT
If the Horizontal Hold control fails to maintain sync, the horizontal oscillator should be reset. To reset this screwdriver adjustment, set the horizontal hold control in the center of its range and sync the picture with the horizontal oscillator adjustment screw. Check the control

## DEFLECTION YOKE, ION TRAP ADJUSTMENT

Following is the proper procedure for adjusting the Deflection Yoke, Ion Trap and Focus.
The receiver should be turned on but not connected to an antenna. These steps should then be taken in the following order
2. The Brightness control should be turned to maximum (clockwise) and the Picture control should be turned to minimum (counterclock wise).
3. The Ion Trap should be rotated and at the same time moved forward and backward to find the position which produces the brightest
4. The Deflection Yoke should be rotated so that the top and bottom edges of the raster are parallel to the top of the chassis.
5. The Brilliance control should now be reduced (ccw) to a point where the raster is slightly above normal brilliance.
6. Center the picture within the opening of the mask and eliminate shaded corners by adjusting the three positioning wing-nuts on the focu coil. Corner-cutting or shadows at the corners may be caused by mis-adjustment of either the ion trap magnet or the Focus coil, and the two may require simultaneous adjustment to secure the brightest, yet evenly distributed light on the scrent
the focus coil U-bracket are provided to permit vertical movement of the focus coil when neessary
HORIZONTAL DRIVE, WIDTH AND LINEARITY ADJUSTMENTS
The horizontal drive control should be adjusted by the following procedure:
Turn the Channel Selector off of a station and loosen the Horizontal Drive Control screw until a white vertical line appears approximately /3ifrom the left edge of the raster. Then slowly tighten the Horizontal Dive until the line just disappears. Readjustment of the horizontal drive control may necessitate readjustment of the horizontal oscillator
horizontal and linearity control for proper width and linearity picture.
On this receiver ( $20^{\prime \prime}$ ) chere are two points on the adjustment of the the horizontal linearity control where good linearity is obtained
 The proper inearity adjustment is with the core screwed down is wist the adjustment screw protruding from the classis to a greater extent. (Do not leave it in this position or other troubles improper) is with the adjustment screw protruding from the classis to a greater extent. (By
may develo.) Recheck horizontal drive control setting and adjustment of focus control.
The Width control (in the H.V. cage) should be adjusted to give a picture that will fill the mask horizontally height and focus adjustments
To adjust the overall size and linearity of the picture it is almost mandatory that a test pattern transmitted from a local station be used. tinearity adjustments, particularly, cannot be accurately made on moving transmissions. It should also be remembered that in areas where more than one station is being received, that pictures transmitted from different stations will vary slightly in size. The smallest transmitte picture should be made to fill the area delineated by the mask.
(rear of chassis) for well The Height and Vertical Linearity controls (both rear of chassis) should then be adjusted for a linear picture that will fill the mask verti cally. At his point the Focus adjustment previously set, should be retouched for maximum definition of the lines in the vertical wedge of 4.5 MEGACYCLE TRAP ADJUSTMENT

The adjustment of the 4.5 megacycle trap (L12) as given in the alignment table is a very critical adjustment; very often, satisfactory results may be obtained by adjusting this coil very slightly while looking at the picture on the raster. If this coil is adjusted very slowly and careThis the 4.5 megacycle interference can be cleaned up.
This interference may be described as a noving, shadowy bead-like appearance in the picture which is caused by a break-up at extremely
close intervals in the horizontal lines. This is, most lose intervals in the horizontal lines. This is most easily discernable in the neutral grey shades in the raster

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Chassis 528.258 and 528.268 are 22 tube receivers providing for 82 channel reception by the use of a 13 position, turret type VHF tuner, and a continuous tuning UHF converter (see Fig. I for tubes and function).

These receivers employ a 41 Mc . Intermediate Frequency in place of the more common 21 Mc . IF. The higher IF is produced by increasing the frequency output of the local oscillator circuits in the VHF tuner and UHF converter, and is designed to eliminate harmonic interference in the IF strip. Proper amplification of the signal carrying IF is obtained by the addition of a 4 th pentode stage to the stagger tuned, unity coupled If circuit. In the video detector stage a IN64 crystal is used, providing demodulation within the higher intermediate frequency range.

Chassis 528.258 and 528.268 are basically the same except that chassis 528.258 contains a tone control and phono circuit for hook-up with any standard phonograph. Other differences are outlined in the parts list and schematic diagram included with this RL.


Fig. 2. Top View - Chassis 528.258


Fig. 4. Rear View Chassis Showing Controls
(Chassis 528.268 does not contain Phono Jack)


Fig. 3. Top View - Chassis 528.268

## TELEVISION SERVICE ADJUSTMENTS

CAUTION HIGH VOLTAGES are used in the operation of this receiver. The back cover, while in place, prevents accide
serviceman.
THE HIGH VOLTAGE LEAD, which supplies 12 to 16 kilovol's to the picture tube, should be momentarily shorted to the chassis whenever it is disconnected for service purposes. This discharges the high voltage filter condenser and prevents a shock hazard when workir. 3 on the receiver after it has been turned off
THE PICTURE TUBE is highly evacuated and if broken, glass fragments will be violently expelled. Scratching, chipping,
undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be avoided. If it is undue pressure, or careless handling such as lifting the tube by its neck is dangerous and should be ovoided. if it is
necessary to handle the picture tube, use safety goggles and have gloves. Be sure to discharge the voltage developed necessary to handle the picture tube, use safety goggles and heavy gloves. Be sure to discharge the voltage developed
across the capacitor formed by the inner and outer coating of the picture tube. This can be done by connecting the across the capacitor formed by the ine outer coating.

## DEFLECTION YOKE, ION TRAP AND FOCUS ADJUSTMENTS:

Follow this procedure in adjusting the Deflection Yoke, Ion Trap and Focus Coil:

1. Turn the receiver on and disconnect the antenna.
2. Move the Deflection Yoke as far forward as possible on the neck of the picture tube by loosening wingnuts $A$ and $C$, and by loosening wingnut $B$, rotate it so that the top and bottom edges of the raster are parallel to the chassis. See Fig. 5.
3. Turn the Brightness control to maximum (clockwise) and the contrast control to minimum (counterclockwise).
4. Rotate the lon Trap while moving it forward and backward on the neck of the picture tube to find the position which produces the brightest raster.
5. Reduce the brightness to a point slightly above normal.
6. Center the raster within the opening of the mask and eliminate shaded corners by adjusting the three wing-nuts on the Focus Coil. Corner cutting or ors at the corners may be caused by maladjustment of either the Focus Coil or the lon Trap and the two may require simultaneous adjustment to obtain the brightest, yet evenly distributed light on the screen. Four self-tapping screws on the Focus Coil U-bracket are provided to permit vertical movement of the Focus Coil if necessary.

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CAUTION: While adiusting the focus coil, mode sure there is no strion exiented by the focus coil on the neck of the picture tube. The focus coil is supporled by a U-shaped brack
bracket until focus coil is centered about neck of tube.

## HORIZONTAL OSCILLATOR ADJUSTMENT

If the Horizontal Hold Control cannot be positioned to lock the picture in, the Horizontal Oscillator Coil may require adjustment. To reset this screwdriver adjustment, place the Horizontal Hold Control in the center of its range and lock the picture in with the Horizontal Oscillator Coil adjustment screw. Check the Horizontal Hold Control range on various channels and alter the screw adjustment as required to provide lock-in on all channels

## HORIZONTAL DRIVE, WIDTH AND LINEARITY ADJUSTMENTS

 vertical line appears approximately $1 / 3$ from the left edge of the raster. Then slowly tighten the Horizontal Drive Control screw until the white line just disappears. This adjustment may necessitate readjustment of the Horizontal Oscillator. Adjust Width and Horizontal Linearity Controls for proper picture.

| SOUND ALIGNMENT |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Step | Signol Generator |  | $\begin{aligned} & \text { Output } \\ & \text { Indicotor } \end{aligned}$ | Connoct to | adiust | Remarks |
|  | Freauency | Connect to |  |  |  |  |
| 1 | 4.5 Mc | $\begin{gathered} \text { Junction } \\ \text { of } \\ \mathrm{R}_{4}=5 \text { and } \mathrm{L} 4 \end{gathered}$ | VTVM | See Note 1 | 1.1 Bottom for maimum readine, T1 Bottom for maxime:n reading | Signal generator output below . 1 volts, VTVM on low range (0.3 volts). |
| 2 | 4.5 Mc | Salut | Same | $\begin{aligned} & \text { lunction of } \\ & \text { R6 und } \mathrm{CO} \\ & \hline \end{aligned}$ | T1 ThD for zero (mid-scale) |  |
| 3 | 4.5 Mc | $\begin{aligned} & \text { Junction in } \\ & \text { C } 45 \text { and R. } \end{aligned}$ | Same | Siee Note 1 | $\underset{\substack{\text { Lo for } \\ \text { minimum reading }}}{\text { and }}$ | This adjusts the 4.5 Mc sound trap. For field adjustment see Note 2. |

NOTE 1. Connect two 100K ohm matched resistors in series between Pin 2 of V2 ( $6 T 8$ ) and ground. Connect negative lead of VTVM to the juntion of the $\mathbf{t w}$ ) resistors and the positive lead to junction of RG and C .

If the range of the Fine Tuning Control is not sufficient to tune the picture in clearly, set the Fine Tuning Control in the center of its range as shown in Fig. 15. Insert a screwdriver into the opening provided and tune the picture in difficulty is experienced.

## television alignment procedure

## PRELIMINARY

Alignment is an exacting procedure and should be undertaken only when necessary. The following equipment is required for alignment work. Signal generator, with an output of at least 1 volt maximum. Crystal controlled or calibrated markers for the sound ( 41.25 Mc ) ( 5.7 Mc ) IF carriers are required in addition to the following variable frequencies.

| 4.5 | Mc | Intercarrier Sound IF |
| :---: | :---: | :---: |
| 41.25 | Mc | Sound IF Trap (T-3, top) |
| 42.9 | Mc | 1st \& 3rd I.F. (T-3, bottom; T-5 bottom) |
| 44.1 | Mc | Converter and I.F. input (L-2 bottom: L-102 top) |
| 45.2 | Mc | 2nd \& 4th I.F. (T-4 bottom; T-6 bottom) |
| 47.25 | Mc | Adjacent Sound Trap (T. 4 Top) |

. Electronic voltmeter (VTVM)
R.F. sweep generator with a frequency range of 40 to 220 Mc with a sweep width of at least 10 Mc , having an adjustable output of
at least 0.1 volts.
4. Cathode ray oscilloscope, preferably with a wide band vertical amplifier and an input calibrating source.

VIDEO IF ALIGNMENT

| Stop | Signal Generator |  | Output Indieator | Connest to | Adjust | Remarks |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Freauency | Connect to |  |  |  |  |
| 1 | 42.9 Mc | Floating shield on mixer tube, V-21 | VTVM | Junction of R35 and L4 | T3 Botiom for maximum reading | Apply - 4.5 volt bias to AGC line, - side to C-24, + side to chassis. Short antenna terminals |
| 2 | 42.9 Mc | Same | Same | Same | Ts Bottom for <br> maximum reading |  |
| 3 | 45.2 Mc | Same | Same | Same | $\begin{aligned} & \text { T4 Bottom for } \\ & \text { maximum reading } \\ & \hline \end{aligned}$ | chassis. Short antenna terminals, set channel selector to unused |
| 4 | 45.2 Mc | Same | Same | Same | $\begin{aligned} & \text { T6 Bottom for } \\ & \text { maximum reading } \\ & \hline \end{aligned}$ | channel free of harmonics or other interference. Adjust signal |
| 5 | 41.25 Mc | Same | Same | Same | $\begin{gathered} \text { T3 Top for } \\ \text { minimum reading } \\ \hline \end{gathered}$ | generator to give reading of approximately 2.5 volts on VTVM. |
| ${ }^{6}$ | 47.25 Mc | Same | Same | Same | $\begin{array}{\|c\|} \hline \text { T4 Top for } \\ \text { minimum reading } \\ \hline \end{array}$ | reduce generator output so that VTVM reading does not exceed |
| ? | 42.9 Mc | Same | Same | Same | T3 Bottom for maximum reading | 2.5 volts. On minimum adjustments increase generator output |
| 8 | 45.2 Mc | Same | Same | Same | $\begin{array}{\|c\|} \hline \text { T4 Bottom for } \\ \text { maximum reading } \\ \hline \end{array}$ | to provide definite dip on meter. |
| ${ }^{9}$ | 44.1 Mc | Same | Same | Same | $\begin{array}{\|l\|} \hline \text { L2 Bottom for } \\ \text { maximum reading } \\ \hline \end{array}$ |  |
| 10 | 44.1 Mc | Same | Same | Same | $\begin{aligned} & \text { L-102 Top for } \\ & \text { maximum reading } \end{aligned}$ |  |
| 11 | Sweep 44 Mc 10 Mc Sweep, Marker to freqs. in Fig. 4 | $\begin{aligned} & \text { See } \\ & \text { Fig. } 7 \end{aligned}$ | Oscilloscope | Vertical terminals to junction of R35 and L4. Horizontal terminals to sweep Gen. | T6 for 45.75 Mc $50 \%$ position. L2 for correct tilt. See Fig. 6 for correct wave form | When sweeping overall pattern do not exceed 2 volts P.P (or approximately 3 volts D.C. at delector load resistor) to avoid overload and distortion of response curve. |




NOTE 2. As a field adjustment, the 4.5 Mc trap (L6) may be set on a signal by adjusting L6 for a minimum amount of graininess in the
picture. This interference can be described as a moving hadow, bead picture. This interference can be described as a moving, shadowy, bead-like appearance in the picture which is caused by a break-
up at extremely close intervals of the horizontal lines. This is most easily seen in the neutral grey shades in the raster.
4. Adjust output transformer slug for maximum meter indications. MIXER TRIMMER

OSC. TRIMMER
Fig. 13. Top and Bottom Views of UHF Converter T95-34 Showing Parts Locations PARTS LIST - UHF CONVERTER (See Fig. 13 above)


1. Tune UHF receiver to a UHF station.
2. Adjust output transformer on UHF tuner for best sound and picture.


CHASSIS 528.258, 528.268


## REPAIR PARTS PRICE LIST (Cont.



| CHASSIS 110.817.10, -11, $110.821 \mathrm{M}-10,-35$ |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| FUNCTION | type |  | FUNCTION |  | TYPE |  |
| RF AMPLIFIER | V1 | 6BZ7 | VERTICAL SWEEP OSCILLATOR V14A $1 / 212 \mathrm{BH} 7$ |  |  |  |
| RF CONVERTER | v2 | 6x8 | VERTICAL SWEEP OUTPUT V14B $1 / 2$ 12BH7 |  |  |  |
| 1ST IF AMPLIFIER | v3 | 6CB6 | HORIZONTAL PHASE DETECTOR V15 6AL5 |  |  |  |
| 2ND IF AMPLIFIER | V4 | 6CB6 | HORIZONTAL SWEEP OSCILLATOR V16 12BH7 |  |  |  |
| 3RD IF AMPLIFIER | V5 | 6CB6 | $\begin{array}{llll}\text { HORIZONTAL SWEEP OUTPUT } & \text { V17 } & \text { 6BQ6GT } \\ \text { HI-VOLTAGE RECTIFIER } & \text { V18 } & \text { 1AX2 }\end{array}$ |  |  |  |
| VIDEO DETECTOR | V6 | 6AL5 | HI-VOLTAGE RECTIFIER V18 1AX2 |  |  |  |
| 1ST VIDEO AMPLIFIER | V7A | 1/2 12BH7 | HORIZONTAL DAMPER POWER SUPPLY RECTIFIER |  | V19 | 6W4GT |
| 2ND VIDEO AMPLIFIER | V7B | 1/2 12BH7 |  |  | V20 5U4G |  |
| RATIO DETECTOR DRIVER |  | 6AU6 | $\begin{array}{cc}\text { PICTURE TUBE } & \text { V21 } \\ \text { V21 For } 110.817-10 & 17 \mathrm{HP} 4\end{array}$ |  |  |  |
| RATIO DETECTOR (AUDIO) | v9 6AL5 |  |  |  |  |  |
| AUDIO AMPLIFIER | V10 | 6AV6 |  |  | 17HP4 |  |
| AUDIO OUTPUT | V11 6V6GTV12A $1 / 212 \mathrm{BH} 7$ |  |  |  | 21MP4 |  |
| SYNC AMPLIFIER |  |  | 21 MP4 |  |
| PHASE INVERTER | V12B $1 / 212 \mathrm{BH} 7$ |  |  |  | V22 | 6AF4 |
| SYNC SEPARATOR | V13 12BZ7 |  |  |  | UHF OSCILLATOR |  |  |  |

GENERAL SPECIFICATIONS

| MODEL | 3102 | 3112 | 3131 | 3151 | 4103 | 4106 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Chassis | 110.817-11 | 110.821M-10 | $110.821 \mathrm{M}-35$ | $110.821 \mathrm{M}-10$ | 110.817-10 | 110.817-10 |
| TYPE | Table | Table | Table | Open Face | Table | Table |
| PICTURE TUBE | 17" Rect. | $21^{\prime \prime}$ Metal Rect. | 21" Metal Rect. | $\begin{array}{\|l} \text { 21" Metal } \\ \text { Rect. } \end{array}$ | 17" Rect. | 17" Rect. |
| Cabinet | Leatherette | Leatherette | Wood Mah. | Wood Mah. | Leatherette | Wood Mah. |
| BUILT-IN ANTENNA | Yes | Yes | Yes | Yes | Yes | Yes |
| ANTENNA IMPUT | 300 ohm | 300 ohm | 300 onm | 300 ohm | 300 ohm | 300 ohm |
| IMPEDANCE SPEAKER | 5" PM | 6" PM | 6" PM | 6" PM | - | - |
| TOTAL POWER |  |  |  |  |  |  |
| CONSUMPTION | 210W | 210W | 210W | 210W | 210W | 210W |
| AUDIO OUTPUT |  |  |  |  |  |  |
| MAX. WATTS | 2.5 W | 2.5 W | 2.5W | 2.5W | 2.5W | 2.5 W |
| PACKED WEIGHT | 73 lbs . | 95 lbs . | 105 lbs . | 115 lbs . | 73 lbs . | 81 lbs . |
| CABINET WID'TH | $18{ }^{\prime \prime}$ | 233/" | 231/2" | 241/2" | 18" | 19" |
| CABINET DEPTH | $18^{1 / 2}{ }^{\prime \prime}$ | 1934" | 221/"' | $23^{\prime \prime}$ | $181 / 2{ }^{\prime \prime}$ | 19 " |
| CABINET HEIGHT | $16^{15} / 16^{\prime \prime}$ | 223/26" | 221/2" | $361 / 2{ }^{\prime \prime}$ | 1615/16" | 173/4 |

CABINET PARTS LIST

|  | 3102 | 3112 | 3131 | 3151 | 4103 | 4106 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Cabinet | 60192 | 60190-15 | 60185 | 60186 | 60220 | 60224 |
| Trap Door |  | 44105 | 44105 | 44105 | 44105 | 44105 |
| Safety Glass | 62457-1 | 62457-21 | 62457-22 | 62457-21 | 62457-1 | 62457-24 |
| Mask | 62475 | 62608 | 62467 | 62476 | 62475 | 62473 |
| Back Cover | 62354 | ${ }_{5}^{6872}$ | 62454-3 | 62454-3 | 62354 | 62474 |
| Speaker | $5866{ }^{\text {"PM }}$ | $5866{ }^{\text {" }}$ PM | 58130-2 6"PM | 58130-2 6"PM | $58665^{\text {"PM }}$ | $58665^{\prime \prime} \mathrm{PM}$ |
| Knob Channel Sel. | ${ }_{39271}$ | 39271 39273 | 39267 39269 | ${ }_{39271}$ | 39267 39269 | 39267 |
| Knob On-Off-Vol. |  | 39273 | 39269 | 39273 | 39269 | 39269 |
| Knob Pix Control | 39274 | 39274 | 39270 | 39274 | 39274 | 39274 |
| Knob Vernier | ${ }_{39272}^{39268}$ | 39272 | 39268 | 39272 | 39272 | 39272 |
| Indicator Disc | 40151 | 40151 | 40151 | 40151 | 40151 | 40151 |
| Knob Phono/ TV Switch | - | - | 39249 | - | - | - |

## GENERAL INFORMATION

The information contained in this service RL Supplement covers the Catalog Nos. listed on the cover page.
The chassis used in these receivers are basically similar to the chassis covered in 57RL650, differing as described below:

1. Chassis $110.817-10,110.817-11,110-821 \mathrm{M}-10$ similar to $110.817-1$ except magnetic centering is used in

If the picture requires centering;
The angle between the vanes on the deflection yoke cover, moves any small area of the picture in a straight line along a radius. See Fig. 1.

Rotating the vanes simultaneously, moves the same small area along the circumference of a circle. See Fig. 2.

${ }^{519.1}$
2. All the chassis covered in this supplement use VHF Cascode Tuner PC541336 in conjunction with UHF Tuner PC541335 to provide complete VHF and UHF band coverage.
3. Chassis $110.817-10$ and $110.821 \mathrm{M}-10$ have Focus, Brightness, Vertical and Horizontal Hold Controls located on the front chassis apron.
4. Chassis $110.821 \mathrm{M}-35$ has Brightness, Vertical and Horizontal Hold Controls and Phono TV switch in place of Focus Control on front chassis apron. Focus Control is on rear chassis apron.



## VHF CASCODE SWITCH TYPE TUNER


R. F. AMPLIFIER

The signal from the television receiving antenna is brought into the cascode R.F. amplifier through a coupling transformer which couples the balanced-to-ground twin-lead transmission line to the unbalanced single-ended grid drive of this stage. The channel switch picks out suitable lumped resonant elements in the circuits of this stage to permit selective amplification of the desired requencies. A.G.C. is introduced at the grid of this stage also. The values of the shunt loading, the degree of the transformer coupling, and the values of the tuning inductances are chosen by the selector switch to provide uniform bandpass on all channels.



$$
\frac{\text { TUNER SCHEMATIC \& TUBE LOCATION }}{\text { CASCODE VHF TUNER PC-541336 }}
$$

## R. F. CONVERTER

The amplified signals from the previous R.F. stage are delivered to the input grid of V2. The 2 nd section of the V2 is a modified Hartley oscillator, and the output of this local oscillator is heterodyned with the amplified R.F. in the mixer load. The channel selector functions in this circuit to select suitable fixed tank circuit elements so that the local oscillator frequency is always above the R.F. frequencies by an amount equal to the desired I.F. frequencies. The front panel "Fine Turing" is mechanically connected to a variable capacitor in this oscillator tank circuit to provide vernier adjustment on the local oscillator frequency.

## VHF TUNER RF BANDPASS ALIGNMENT

NOTE：DO NOT ATTEMPT RF bANDPASS ALIGNMENT UNTIL THE IF AMPLIFIERS ARE PROPERLY ALIGNED．
1．Connect the R．F．Sweep Generator，Marker Generator，and Oscilloscope as shown in Fig．9a．Refer to Fig． 11 for instruments setting for each channel alignment．Put minus 3 volt bias between ground and AGC by means of the 3 volt battery．（Figs．refer to instruction manual 57RL650）．
2．Set the RF sweep generator for 10 mc ．sweep width，and its center frequency at 213 mc ．
3．Set the CHANNEL SELECTOR to channel 13，and the fine tuning control at the middle of its rotation range．
4．Turn on the television receiver and test equipment and allow about 15 minutes for the set to warm up and stabilize
Set the oscilloscope gain control for a maximum gain and the sweep attenuator for minimum output necessary to give a convenient size trace．
6．The response curve of the tuner should be flat over a 4.5 mc band between the limits of 211.25 mc and 215.75 mc ．If it is not L5，L6 and L8（see Tuner Schematic and Tube Location）should be adjusted so the response is as near to this specification as possible．（See Sketch）．



The RF Band passalignment for all other channels is a factory adjustment

## VHF TUNER LOCAL OSCILLATOR ALIGNMENT

1．Connect the RF sweep generator to the antenna terminals as in figure 9A．Put minus 3 volt bias between ground and an AGC terminal by means of the 3 volt battery．
2．If the sweep generator is not provided with internal crystal－controlled or crystal－calibrated markers connect a marker generator to the antenna terminals as in figure 9A
3．Connect the cathode ray oscilloscope across the video detector load resistor R113．See figure 9B．
4．Adjust the R．F．sweep generator for 10 mc ．sweep width，with center frequency at approximately 213 mc ．
5．Adjust the marker generator for the picture carrier of channel $13(211.25 \mathrm{mc}$ ．）
6．Set the Channel Selector switch to channel 13，with the fine tuning control at the middle of its rota－ tion range
7．Turn on the receiver and test equipment and allow about 15 minutes for it to warm up and stabilize
8．Set the oscilloscope gain control for a convenient size picture on the oscilloscope
9．Adjust L3，the slug in Channel 13 oscillator coil，so the marker pip（ 211.25 mc ）is at the $50 \%$ point on the overall response curve．（See sketch）


The oscillator alignment for all other high band channels is a factory adjustment
10．Set the Channel Selector to Channel 6，the sweep generator frequency to approximately 85 mc and the marker generator to the picture carrier $(83.25 \mathrm{mc})$ of Channel 6
11．Adjust L4，the slug in Channel 6 oscillator coil so the marker pip $(83.25 \mathrm{mc})$ is at the $50 \%$ point on the slope of the overall response curve．（see sketch）


The oscillator alignment for all other low band channels is a factory adjustinent．


TELEVISION ALIGNMENT PROCEDURE，UHF
Alignment of the UHF Tuner is a simple procedure since its bandpass is essentially predetermined by the fixed characteristics of original component design，physical layout and associated circuitry． Except as stated otherwise in this procedure，band－ pass is not subject to serious change during align－ ment，however，replacement of any component with－ herteristics Accordingly whenever parts within hese circuits are replaced electrical and physical specifications of the original components must be duplicated as closely as possible．Wires，parts and ther accessories must be replaced in their forme positions．
Complicated or specially designed test equipmen is not required for practical alignment of the UHF Tuner．Instruments used for testing VHF sets are usually satisfactory．However，the following instru－ ments are needed；

1．VHF signal generator with AM output and a sweep modulation of at least 12 megacycles
2 Oscilloscope or vacuum tube volt－ohmmeter for measurement of the relative signal
The oscilloscope or VTVM should be connected to the TV set video detector load resistor R113 The procedure for alignment consists of the follow ing steps in the suggested sequence given：

1．Adjustment of the oscillator for proper band coverage．
2．Alignment of R －F－circuits for maximum effec tiveness．
Transfer the Sweep Signal Generator output terminals to the VHF tuner UHF input terminals on top of the UHF tuner．（Connecting to terminals 4 and 5 on the VHF tuner terminal strip－see schematic．） Set the Channel Selector to UHF，and the sweep Generator to 127 mc center frequency（or use the second harmonic of Channel 3 on selector $s$ witch type generators）
Adjust C25 so a marker generator 125.25 mc pip is at the $50 \%$ response point on the overall respons curve．（See sketch）．

## OSCILL ATOR ADJUSTMENT

1．Adjust UHF channel tuning control to ex treme counter－clockwise position．
2．Feed a 465－megacycle AM signal to the UHF Tuner antenna terminals through a resistive matching network，consisting of 50 ohms across the generator output with 120 ohms in ne side of the line to the tuner and 150 ohms in the other．The input impedance of the tuner is 300 ohms balanced．Adjust oscillato retallic alignment tool）（When using a VHF signal generator，a fundamental of 93 mega cycles may be employed to produce the 5th harmonic energy of 465 megacycles．）
3．Adjust VHF channel to extreme clockwise position．
4．Set signal generator for a 900－megacycle output（5th harmonic of 180 megacycles） Carefully spread or pinch together the legs of the oscillator end－inductor（L3）for a maximum signal

5．Repeat above steps until no further improve ment in signal is apparent．（The oscillato alignment figures of 465 and 900 megacycles isely at the maximum dial settings however in every case the oscillator must be aligned so that both frequencies can be tuned by normal manipulation of the dial．）

## R．F．ALIGNMENT

1．Adjust UHF channel tuning control to extreme counter－clockwise position．
2．Feed a 465 －megacycle signal into the UHF tuner antenna terminals（as indicated abov for oscillator alignment）．
3．Adjust $R-F$ trimmers（ $C 1 \& C 2$ ）for maximum signal．
4．Readjust
5．Set signal generator for 900 －megacycle output
6．Adjust end－inductors（ $\mathrm{L} 1 \& \mathrm{~L} 2$ ）for maximum signal．
7．Repeat above steps until no further improve Repeat above steps until
ment in signal is apparent．

## O John F．Rider



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CHASSIS $110.817-10,-11,-43,-46,-81,-86,110.821 \mathrm{M}-10,-35$




Catalog No． 4170 a $27^{\prime \prime}$ Console Model UHF－VHF Television Receiver with full doors．（Mahogany）

SPECLFICATIONS

| Power Supply Rating．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 300 watts 105－120 volt 60 cycle AC |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Audio Power Rating．．．．．．．．．．．．．．．．．．．．．．． 3.5 watts maximum 1.5 watts undistorted |  |  |  |  |  |
| Antenna | Input Impeda |  |  |  | 300 ohm |
| Video Response ．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 4 м． 4 ． C．$^{\text {．}}$ |  |  |  |  |  |
| Fосия ．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．Magn |  |  |  |  |  |
| Sweep Deflection．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．Magneti |  |  |  |  |  |
| Picture Carrier．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 45.75 MC |  |  |  |  |  |
| Sound Carrier ．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 41.25 MC |  |  |  |  |  |
| Adjacent Channel Sound Traps．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 47.25 M MC |  |  |  |  |  |
| Adjacent Channel Picture Traps．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．．． 39.75 MC M |  |  |  |  |  |
| TUBE COMPLEMENT |  |  |  |  |  |
| V1 | 6AU6 | Intercarrier Sound Amp． | V13 | 6AL5 | Horizontal Discr． |
| V2 | 6BN6 | Sound Limiter Detector | V14 | 6SN7GTA | Horizontal Oscillator |
| v3 | 6BK5 | Audio Output | V15 | 6CD6G | Horizontal Output |
| V4 | 6CB6 | First Picture I．F． | V16 | 183GT | Hi－V Rectifier |
| V5 | 6CB6 | Second Picture I．F． | V17 | 6AX4GT | Damper |
| V6 | 6CB6 | Third Picture I．F． | V18 | 5U4G | Power Rectifier |
| v7 | 6CB6 | Fourth Picture I．F． | V19 | 5U4G | Power Rectifier |
| V8 | 6CL6 | Video Amplifier | V20 | 27EP4 | Picture Tube |
| v9 | 6AU6 | AGC Tube | V21 | 6BZ7 | R．F．Amplifier |
| V10 | 6BE6 | Sync Separator | V22 | $6 \mathrm{J6}$ or |  |
| V11A | 6SN7GTA | Sync Splitter |  | $6 \times 8$ | R．F．Oscillator |
| V11B | 6SN7GTA | Vertical Oscillator | V23 | 6AF4 | UHF Oscillator |
| V12 | 6AH4GT | Vertical Output | V24 | $6 \mathrm{BZ7}$ | UHF I．F． |

Operation of this receiver outside the cabinet or with covers removed involves a shock hazard from the receiver power supplies．Work on the receiver should not be attempted by personnel not thoroughly familiar with the precautions necessary when working on cover remuved．

PRODUCTION CHANGES
Schematic diagrams packed with Chassis 132．068，Model 4170，were in error in the connections to the Phono－TV switch（SW1C）．The correct portion of this schematic is shown below


ION TRAP
A single－magnet＂beam bender＂is used with the picture tube．Rotate the trap around the tube neck and slide it forward or back until a light appears on the screen．Adjust the screen．for point closest to the bakelite tube base which gives maximum light on


TUNER ADJUSTMENT


VHF TUNER (FRONT)

NOTE: The design purpose of A3 and A4 is for adjustment for channel 13 and channel 6--for High and Low channels coverage. The above procedure gives optimum adjustment for any available stations.

The UHF position oscillator trimmer (C20-A5) should not be adjusted unless some type of interference is present at the 127 megacycle frequency. This adjustment (C20-A5) corresponds to the adjustments A3 and A4 for the VHF ranges.

If the tuning knobs need to be pulled off, the Channel Selector knob must be removed first and the "C" washer must be taken out before the Fine Tuning knob can be removed (See Figure No. 1). The UHF indicator disc is held on by a compression spring and is not keyed to the shaft. Install the "C. washer in place before attempting to remove the UHF indicator disc, to prevent breakage of the VHF Fine Tuning drive wheel.


CHANNEL SELECTOR KNOB

## stagger-tunedi.e alignment procedure AlIGNMENT

. Set tuner to channel 9-10 or 11 .
2. Pull AGC tube V9 out.

Connect -2.5 volta bias from function R304 and R303 to ground with triple power switch in Suburban poaition. 4. Connect VTVM acros: R217\&R218. Isolate VTVM with 18 K resistor. Use -5 V scale.
5. Connect RF signal generator to ungrounded mixer tube shelld i.e. lift mixer tube sheild until it is just ungounded 6. Good R.F. grounding between TV receiver on test and teat equipment is necessary. A metal surface bench top should be used to insure proper RF grounding.

| STEP | FREQUENCY | ADJUSTMEITT | INSTRUCTIONS |
| :---: | :--- | :--- | :--- |
| 1. | 39.75 mc | Top T201 for min. |  |
| 2. | 41.25 mc | Bottom T202 for min. | Outer peak |
| 3. | 47.25 mc. | Bottom T203 for min. | Outer peak |
| 4. | 43.2 mc UHF-VHF | Tuner coil for max. | Note: Turn bottom T201 completely out before <br> mading this adjustment. |
| 5. | 42.8 mc VHF | 45.2 mc UHF-VHF | Bottom T201 for max. |

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## OVERALL SWEEP CHECK

. Connect RF signal generator to chassis near V4 for marker generator. Pish shield down on mixer tube . Connect oscilloscope across R217 \& R218. Isolate oscilloscope lead with 300 uuf to ground and 18 K
Increase bias to -3.5 volts. To chassis $\underbrace{18 K}$ To scope
3. Increase bias to -3.5 volts.
4. Connect sweep generator to antenna terminals. Adjust sweep generator \& tuner to channel 10 . $\frac{1}{\frac{1}{\sim}} 300$ uuf

| ADJUSTMENT | INSTRUCTIONS |
| :--- | :---: |
| T205 | T205 positions 45.75 marker |
| T206 | T206 adjusts tilt of curve |
| Note: If desired curve cannot be obtained, slight adjustment of tuner <br> coil and bottom T201 may be necessary. |  |

SOUND AND 4.5 MC TRAP ALIGNMENT

1. Tune in available TV station and reduce signal into set until hise is heard with sound. This can be done by inserting an attenuator in the antenna lead-in or by removin
in signal by placing lead-in in close proximity of the set.
2. Set buzz control in the middle of its range. Adjust take off coil L201, top and bottom T101, Quadrature coll (L101) and buzz control for cleanest sound and minimum buzz. If any adjustment causes hise to disappear reduce signal into set until hise reappears and continue with adjustments
Note: If difficulty is encountered either in reducing signal sufficiently or adjustments being very broad. The following proceedure may be used.

SOUND ALIGNMENT

| STEP | EQUIPMENT | CONNECTION | FREQUENCY | ADJUSTMENT | INSTRUCTIONS |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | Det. Jig * | Input of jig to pin 2 of V2 |  |  | Keep lead between 15K resistor and pin 2 as short as postible |
| 2. | VTVM | out put of jig | Tune in available channel | L201-T101 (top and bottom) for max. | Adjust L201 on inner poak |
| 3. |  | remove jic | Same | Quadrature coll (L101) for max. sound | Set bues control in middie of its range before adjusting L101 |
| 4. |  |  | Same | Busz contral for minimum buss | Correct adjustment of buss contral is approx. middle of it: range |
| 5. | Dot. Jig * | $\begin{aligned} & \text { Junction L205 } \\ & \text { and L206 } \end{aligned}$ |  |  | Comnect VTVM to outpout of His |
| 6. | RFsignal senerator | Pin 9 (V8) | 4.5 mc | Tume 4.5 me trap (L205) for minimum |  |

*Detector jig
Input $\sim$ ~~ 1 70K $\left\{\begin{array}{l}\text { - } 1 \mathrm{~N} 34\end{array}\right.$ \%

VTVM


(NOTE: SEE PARTS LIST FOR PART NUMBER AND DESCRIPTION OF PARTS DELETED \& ADDED.)
I. Chassis TE 132.045-1 differs from 132.045 as follows:

1. VHF tuner ohanged from pentode to cascode circuit.
2. Horizontal and vertical hold controls and circuits changed to provide a wider operating
3. A dissapation change made in low voltage power supply to limit peak current in 504 tube.
II. Chassis 132.045-2 differe from 132.045-1 as follows:
4. Combination tuner connection changed to minimize regeneration.
5. New design volume and channel seleotor knobs.
III. Chassis 132 045-3 differs from 132.045-2 as follows:
6. Lllo and Lll2 peaking coils revisedto reduce smear and ringingo
7. GC4 tube (V25) and associated circuit added to improve vertical noise immunity.
IV. Chassis 132.045-4 differsfrom 132.045-3 as follows:
8. B plus voltage to VHF tuner is changed from 100 volts to 135 volts to improve
9. Band elimination filter redesigned to improve sensitivity.
PARTS LIST CHANGR CHASSIS 132.045-1
PARTS DELETET

Catalog No. 3146 is a $17^{\text {m }}$ Con- Catalog No. 3106 is a $17^{\prime \prime}$ Table Model cole Model SHP-VEF Toletiaion Recoiver.

R204-1
${ }^{\mathrm{R} 1768}$
C165
R214

|  | PARTS ADDED |  |  |  |
| :---: | :---: | :---: | :---: | :---: |
|  | N25267-7 | Combination Tuner | \$65.00 | B5 |
|  | 1140547-1 | V HF Tuner (Cascode) | 35.03 | B5 |
| R204-2 |  | Hesistor, 50 ohm, 5w, $10 \%$ | . 15 |  |
| R178-1 |  | Kesistor, $12 \mathrm{~K}, 5 \%$, $1 / 2 \mathrm{~W}$ | .15 |  |
| C165-1 |  | Capacitor, 022 ufd, 20\%, 200 V | . 23 |  |
| 2iflz-1 |  | Resistor, $6.8 \mathrm{~K}, 10 \%$, 1/2W | . 15 |  |
| R214-1 |  | Resistor, 1800 ohms, $10 \%$, 20 F | 1.08 |  |
| P224 |  | Resistor, $100 \mathrm{ohm} 30 \%$, | 1.08 |  |
| C189 |  | Capacitor, $22 \mathrm{ufd}, 20 \%, 400 \mathrm{~V}$ | . 43 |  |
| R101 |  | Fesistor, 47 C ohm, $10 \%$, 1 W | . 15 |  |

N40543-1

PA RTS

PARTS DELETED
Combination Tuner VYF Tuner
Resistor, 300 orm.
Resistor 10K.
Capacitor, 033 mfd .
Resistor 15 K
Resi stor 2200 ohm.
PARTS ADDED
Combination Tuner
Kesistor, 50 ohm, $5 \mathrm{~W}, 10 \%$
Resistor, $12 \mathrm{~K}, 5 \%, 1 / 2 \mathrm{~W}, 200 \mathrm{~V}$
Resistor, $6.8 \mathrm{~K}, 1 \mathrm{~m}, 1 / 2 \mathrm{~W}$
esistor, 1800 ohms, $10 \%$, 20
Capacitor, . 22 ufd, $20 \%, 400 \mathrm{~V}$

Chamel Indicato
Knob, Volume
PARTS ADDED
Capacitor, 1000 unf, 500 V
Knob, Channel Indicator
knob, Volume

Porer Supply Rating Audio Power Rating Antenna Input
Video Kesponse Focus
Sweop Deflection
Picture Carrifer
Sound Carrier
Adjacent Channel Sound Traps
Adjacent Channel Picture Traps Rejection Trap
3.2 Watts

300 Ohn
Electrostatio
Lagnetic
45.75
4.
45.75 II.C.
$41.25 \mathrm{M} . \mathrm{C}$.
47.25 M. $\mathrm{C}_{\text {. }}$
39.76 K.C.
41.6 K.C.
4.5 H.C.

## TJBE COMPLEGFN

SPECIFICATIONS


## I. VHF OPGRATION

The VHF tuner is a conventional 12-position-switch type where the Fine Tuning is accomplished with a variable capacitor in the R.F. oscillator tuning circuit. This variable capac
There is an additional position on the VHF tuner (between Channels 6 and 7) which is used during UHF tuner tubes during VHF operation; however, the $B$ plus voltage is applied to the UHF tuner only during UHF operation.

## - ADJUSTMENP

The frequency of the VHF R.F. osatllator may be adjusted as follows: A High-Channels adjustment (A3). oscillator is accessible when the channel tuning knobs are removed. (See Figure 2):

1. Eigh-Channels.
a. Set the Channel Selector Switch to the highest available station between channels 7 and 13
b. Adjust (A3) so that the picture will just dis. ppear at one point when turning the Fine-Tuning control clockwise.
c. The remaining lower "High-Channels" should be within the ranie of the Fine-Tuning.
2. Low Channels
a. Set the Channel Selector Switch to the highest .
b. Adjust (A4) so that the picture will just dis. appear at one point when turning the Fine-Tuning control clockwise.
c. The remaining lower "Low-Channels" should be within the range of the Fine-Tuning.
NOTE: - The design purpose of A3 and A4 is for adjustment for channel 13 and channel 6 -.- for $H i g h$ and Low channels and available stations. (S20 - A5) (See Figures The UHF positid not be adjusted unless some type of interference is present at the 127 megacjcle (list I.F.) frequency. This adjustment (C20-A5) corresponds to the adjustments A and A4 for the VHF ranges.


VHF SECTION


UHF SECTION

## A GENERAL

double conversion superheterodyne system is employed when the receiver is operating in a UHF position. The UHF tuner consists of a three-element oncentric line tuning elenient which is used as two ircuit. A crystal diode serves as a mixer and from it a 127 megacycle signal is applied to the UHF I.F. amplifier. The R.F. tube in the VHF tuner is used as an extra 127 megacycle I.F. amplifier for HF operation. The oscillator mixer tube in the HF tuner converts this 127 megacjele signal to the 41 megacycle I.F. frequency of the television chassis. See Block diagram (Figure No. 3). As ollowing connections are made.

1. The B plus voltage is applied to the UHF tuner unit. transformer which is switched into the input circuit of the VHF tuner.
2. The conventional VHF tuner input circuit is isolated and grounded by this switching operation.
(A4) LOW CHANNELS ADJUSTMENT B. ADJUSTMENT

The alignment or a UHF tuner is quite similar to the alignment encountered in a VHF tuner. The most noticeable problem when using these high frequencies is that of obtaining a suitabie test signal. If suitable UHF test equip ment is not available, it is sug eested that harmonics from a VHF signal generator be used to obtain these signals. It is well to bring out at this point that the harmonics will be so small in magnitude that it will probably be necessary to use the entire television chassis in order to get enough amplification to see the response curve on an oscilloscope. when using the television chassis to obtain a complete rescurve on the face of the oscilloscope tube before attempting UHF alignment. The VHF adjustments should not be changed after UHF alignment is undertaken as it would be possible to misalign the VHF circuits making complete realignment necessary It is well to point out that each UHF tuner has been carefully tracked over the entire UHF range and that major realignment should not be necessary. In general the two tubes or the crystal detector can be replaced with little or no best overall performance trackinf) replace crystal with same type; iee at IN72 INB2, IN110. do not move or rearrange any of the components as this would easily change the distributed capacity enough to cause serious misalignment. If it is necessary to replace a component, make sure that the exact lead length component. The following checks can be made:

1. Oscillator section and crystal detection -... the grounding wire from the tuner test point (See Figure No. 5) can be unsoldered and a 0 to 5 milliampere meter inserted from this tuner test point to the chassis. A . 001 capacitor should be connected from the tuner test point to chassis to keep R.F. from the meter leads. With the meter in this position, a reading from 0.5 to 2.5 millamperes should be resulting from oscillator injection) at no reading or incorrect readint is indicated, replace either oscillato tube or crystal detector. If trouble is still evident, replace both items. (Note: Be sure to resolder grounding wire from tuner test point to chassis.)


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## SCHEMATIC DIAGRAM 132.045



## SCHEMATIC DIAGRAM 132.045-1




SCHEMATIC DIAGRAM 132.045-2


SCHEMATIC DIAGRAM 132.045-3

## SCHEMATIC DIAGRAM 132.045-4



CHASSIS $132.045,-1,-2,-3,-4$

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## GENERAL DESCRIPTION




POWER REQUIREMENTS

## 117 volts 60 cycles $\quad 200$ watts <br> ANTENNA INPUT IMPEDANCE

PICTURE SIZE
21" Rectangular
R. F. TUNER

Turret type construction; individually removable coil assemblies for all
channels. All componets TUBE COMPLEMENT

| Tube No. | Tube Type |
| :---: | :---: |
| V | 6CB6 |
| V2 | 6CB6 |
| v3 | ${ }_{6}$ CB6 |
| V4 | 6 CL 6 |
| vs | 6aub |
| v6 | 6BES |
| $V 7$ A8B | 12AT7 |
| V8 A8B | 6SN7Gt |
| v9 | 6BqSGT |
| V10 | 183GT |
| VII | 6AX4Gt |
| V12 | Suag |
| V13 | gaug |
| V14 | 6т8 |
| V15 | 6AQS |
| V16 | 6AH4Gt |
| V17 | 21 MPA |
| V18 | 6BQ7, or 6BZ7 |
| V19 | 656 |

Function
Ist I.F. Amplifier
2nd I.F. Amplifier
3rd I.F. Amplifier
Vidoo Amplifior
Gated Sync. Soparator
Sync. Amplifier-Verticol Blocking Oscillator
Horiz. A.F.C.-Horiz. Blocking Ose
oriz. Scanning Output
High Voltage Rectifier
Horizontal Damping
Rectifier
Sound I.F. Amp.-limiter
ertical Scanning Output
R.F. Amplifier
R.F. Amplifier
© John F. Rider

## PHONOGRAPH CONNECTIONS

 impedance pick-up unit is connected as described in the following para. wall outlet. Slide the "PHONO TELEV" switch (located under the name
ither raphs, the television receiver serves to faithfully reproduce the recorded plate) to the up position, then turn on the televisian recciver. Operate sund. A pin-jack type phono-socket, located at the back of the tele- the record player in the prescribed manner. If the phonograph has vision chassis is used for the connection of the phonograph unit. Record soparate volume control, that control should be set to nearly the maximum players have a cable for connection to an amplitying device which con- UME" knot on the television receiver.
lains two wires (or one wire and a braided shield). The end of this cable When it is desired to agcin use the recciver for regular television recap which is to be connected to the television chassis must be equipped with a tion it is not necessary to disconnect the record player; merely slide the ordered from any Sears Store by requesting a Phone Plug W500966. "ON-OFF" switch to the "OFF" position.

## CLEANING GLASS WINDOW AND PICTURE TUBE FACE -

These reccivers are equipped with removable glass windows for easy leaning. Removal can be accomplished by following the procedure below

Carafully remove ing or chipping it.

Remove power cord from wall outlet
4sing a slightly dampened lint froe soft cloth, carefully wipe the inside of the glass window and the face of the picture tube. Avoid any Take of the gold colored picture frame or escutcheon that retains glass window by taking out the cross-lotted screws in this frame while at the

## - SYNCROGUIDE TRANSFORMER ALIGNMENT -

Alignment of the Syncroguide transformer, circuit diagram \#128, which IMPORTANT: The first peak of the wave form should never be higher
is used in the Horizontal Oscillator circuit, can be accomplished by utiliz. than the second peak nor should the first peak be lower than the second
 ing the procedure oullined below. To perform this alignment, it will be peak by more than $3 \%$. Also when odiusting the "Bottom Slug," the
necessary to use an oscilloscope, preferably one that has a 2 megacycle picture must be in sync, therefore it may be necessary to tyrn the "Horiresponse and a low input capacity probe-under 100 mmfd . to ground.
.- Sot the "Top Slug" ond "Botrom Slug" of the Syncroguide transShort together terminals $C$ and $D$ of the Syncroguide transformer.
3. Set "Horizontal Range" control, located on rear of chosis pan, to

Set "Horizontal Hold" control, located at front of chassis to its maximum counter-clockwise position.
5. Turn on receivar and tune in any local TV channol. Adiust "Top Slug" clockwise until picture iust locks in horizontally. Remove short from terminols C and D . If picture does not hold sync
when short is removed, adiust "Bottom Slug" clockwise until picture locks in
8. Connect'scope to terminal C of Syncroguide transformer and adjust sweep rate of 'scope until two cycles of oscillogram remain stationary. Turn "Bottom Slug" dockwise until wave form peoks are equal in Yurn Bottom slug dockw
conrel must be in sync, therefore it may be necessary to tyrn the "Hor adiustment has been completed, disconnect 'zeope from receiver.
9. Set "Horizontal Hold" control counter-clockwise and adiust "Top
Slug" until picture is locked in and does not lose sync when
 counter-cloct
in Fig. 24.
. Horizontal holding action of receiver should now be as follows: a. When "Horizontol Hold" control is at its moximum counter-clock wise position and "Channol Solector" knob is swithod, picture
may oppar an own in may appear as shown in fig. 24 or be out of sync. b. When "Horizontal Hold" control is at its moximum dockwise posi
tion, picture may lose sync when switching "Channal Selep Hion,
knob.
Whe. c. When "Horizontal Hold" control is in the center or near the
center of its range, picture remains stoble when switching "Channel
Selector"t to center of its range, picture remains stoble when switching "Channel
Solector" knob.

1. If the foregoing steps fail to carrect for low of horizontal teld If the foregoing steps fail to carroct for loss of horizontal holding
action under normal receiver operation, be sure that condenser 130
$(.01$ mfd.)
 transformer is part W512311, tubular, 01 mfd ., 400 V . Do not use transiormer is part
incorrect
Fig. 22
Fig. 22

COREST

## - ALIGNMENT PROCEDURE

The receiver chassis must be removed
complish alignment of all tuned circuits.
Alig f all RF and IF iuned is in this reciv complished by utilizing the procedures described in the following charts These procedures should preferably be applied in the order in which they are presented. Alignment of Sound Channel or IF Channel may be ac complished individually if desired.
The RF Amplifier and Mixer alignment may also be accomplished inde pendent of Sound or IF Channel alignment, but oseillator calibration can only be done ofter IF Channel has been correctly aligned.

## CAUTION

The picture tube is highly evacuated and if broken fragments will be violently expelled. Handle with care. Avoid contact with metal shell of picture tube as this is part of the high voltage circuit.

INSTRUMENTS: The following instruments will be required as signal sources and output indicotors during the alignment. Since accurate alignment of a television receiver is heavily dependent upon the performance of your instruments, it is imperative that thay meet the essential specifications described here.
I. standand signal genirator to provide unmodulated (pure

RF) signals at the following frequencies. Maximum output on all
SOUND CHANNEL ALIGNMENT PROCEDURE
Shart antenna terminals together with a jumper wire.
Set recoiver Channel Selector to any inacive vilevision channel and
picture control to iss maximum counter-clockwise position; other con trols may be left at any desired setting.

| standand signal GENERATOR |  | VTVMCONNECTIONS | miscellaneous INSTRUCTIONS | TRIMMER OR SLUG | TYPE OF ADJUSTMENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: | :---: |
| CONNECTIONS | frequency |  |  |  |  |
| Connect as shown in Fig. 1. |  | Connect ${ }_{\text {Fig. }}^{\text {as }}$ 2. ${ }_{2}$ Shown in | 1. Sot pitcture control tio its maximum <br> 2. A spocial detoctor must bo vilizod whon oligning the 4.5 Mc. Sound Irap Coic. This unit can be constructed in occordance with the information eorn- toinod in fig. 3 . $1 f$ VTM containing a high freauency A.c. probe is ovail abla, hiss probe can bectoritized in plice. 2. <br> 3. During this odiussmant only, remove onbes (V1, V2 or V3). This will proverit noise in the rF sloges from offecting the voltoge reading white odiusting the sound trap. | $\begin{aligned} & \text { \#1 } \\ & \text { 4.5 MC Sound } \\ & \text { (See Fig. } \end{aligned}$ | Adiust for minimum reoding |
| Same as obove | Same as above. | Connest fig. ${ }_{\text {fig }}$ shown in | A "swishing", sound moy be hoord in the speaker during Sound channel Alignmenizontol sweep volloge boing picked up in the oudio system ithu stroy coupling of os it will hove no effect on olignment of the sound chonnel. | \#2 <br> Discriminator Secondary <br> (See Fig. 10 | Adjust for maximurn reading on VIVM. |
|  |  |  |  | \#3 <br> Discriminator Primary (See Fig. 11) | Adiust for maximum reading |
|  |  |  |  | \#4 Sound IF Transformer (Soe Fig. 10) | Adiust for maximum reading on VTVM. |
| Some os | Some as |  | To obtoin zero bolonce of the discriminotor required. These resistors must bo molthod so that their respective ienistonces do not difor by more thon it io the oficiol. <br>  os shown in Fig. 5 . | \#2 <br> Discriminator Secondory (See Fig. 10) | Note that as sluy \#2 is rotatod, - point will be tound where the Yy from a positive to a negativo rooding or vies verss. is ito cor- Coct $\# 2$ is <br>  |
| amount of "Intercarrier Buzz" |  |  |  |  |  |

INSTRUMENT CONNECTIONS FOR SOUND CHANNEL ALIGNMENT
If CHANNEL ALIGNMENT PROCEDURE


FIG.
Generator Connections
for Sound Channel and 4.5 Mc. Sound Trap Alignment


FIG. 2
Crystal Detector and VTVM Connection for 4.5 Mc . Sound Trap

Alignment


FIG. 3
Circuit Diagram for Crystal Detector shown in Fig. 2


FIG. 4
VTVM Connections
for Sound IF Alignment


FIG. 5
VTVM Connections for Sound Discriminator Alignment

## REDUCTION OF INTERCARRIER BUZZ

Under actual reception canditions slight "dynamiz" unbalance of the dis-
criminatar secondary con emphasize intercarrier buzz due to incomplete amplitude madulation reiection. Therefare it is vitally important to obtain an accurate setting of the diseriminator secondary slug undor these con-
ditions. Disconnect all instrumcnts (Ee sure that I.F. fube removed for the adiust-
ment of Sound Trap has been replaced) and then connect an antenna to tent of Sound rap has been replaced) and then connest an antenna to
the receiver to obtain program reception from o lozal station. If inter.
corrier buzz is prominent, a slight read justment of the dicsrint corrier buzz is prominent, a slight readiustment of the discriminotor
secondary slug (\#2) should be made to obtain the "dip"" point for the
buzzing sound. Note that progrom sound will be dear ond freo thom buzzing sound. Note that progrom sound will be clear ond free from
distartion at this point. Buzz should now be at an acceptable minimum distrartion at this point. Buzz should
sirable to to eliminote the possibility of spurious oscillations, it is de accamplished by insulating oscillilator inoporativive. This may be readily bottom shiedd and place a pieco of transparant collulose tape on the first two contacts (from front) of drum apsembly. Use any inoperativo
channel and rotate drum to this insulated position.
ar with a jumper wire.
torminal of battery connects to the AGC line ond positive terminal af bottery connects to receiver chassis. See Fig. 11 for convenient point of
connection.
cur. Such oscillation shows up as an oxcesuive voltage across the
video detector load, circuit refarence number cated by the VTVM, circuit reference number 42 and 43 , and is indi-
connected to this point during alignment. It should be noted that voltage due to IF ascillation is unaffected by
strength of signal from the generator. Where If ocillat is generato
Where If oscillation is oncountered, it is generally possible to correct
the condition by detuning the IF coils in different directions. If that the condition by detuning the IF coils in difforent directions. If that
does not have the desirad offect, increase fixed bias on AGC line by using a $41 / 2$ volt battery instoad of the 3 volt battery referred to in
instruction \#3. After stopping the oscillation in this monner it will instruction \#3. After stopping the oscillation in this monner io will
then bo possible to align all If stages using the following prod however, the AGC bias battory must be changed back to 3 procts when
using the oscilloscope to observe band pass charateritio

$$
\begin{aligned}
& \text { 4. If the If channel is bodly misaligned ond two or more immediately od. } \\
& \text { ioining if stages are tuned to the same frequency, oscillation may ac- }
\end{aligned}
$$ using the oscilloscope to observe band pass characteristics. Once all stages have been aligned using the

should be stable with roduced bias.

| standard signal Generator |  | SWEEP GENERATOR |  | CONNEC-IIONS | 'SCOPE CONNECTIONS | miscellaneous INSTRUCTIONS | TRIMMER OR SLUG | TYPE OF ADJUST. MENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CONNECTIONS | frequency | CONNECTIONS | freq. |  |  |  |  |  |
|  | 23.4 MC. | Not usod. | - | Connect as shown in Fig. 9. | Not usad. | 80, sure that RF os- cillotor has bean cillotor rendered has beperan tive as outlined in instruction \#1 at of thead of this chart. |  | Adiust for maximum reading on VTVM. |
| Same as | 24.2 MC. | Not used. | - | Same as <br> above. | Not used. | Same as above. |  | Adiust for maximum reading on VTVM. |
| $\begin{gathered} \text { Same as abse } \\ \text { above. } \end{gathered}$ | 26.2 MC. | Not usod. | - | Same as above. | Not usod. | Same as above. |  | Adiust for maximum reading on VTVM. |
| Some as | 25.4 MC. | Not used. | - | Same as <br> above. | Not used. | Same as <br> above. | $\begin{gathered} \text { 3rd } \\ \text { (Soo Fig. } \\ \text { Fig } \end{gathered}$ | Adiust for maximum reading on VTVM. |
|  | 26.6 | Connect as Shown in Fig. 8 . | $\begin{gathered} 25 \text { MC. } \\ \substack{\text { Swade. } \\ \text { Widdt } \\ \text { Bomc. }} \end{gathered}$ | Some as above. |  |  | Should this observa ments, the comp of the marker gen former siug frequencies. | acteristic can naw be observed Its general shape and contour he curve shown in Fig. 6. The position of the curve os shown <br> FIG. 6 CURVE <br> fail to meet the obove requireolignment procedure must be and adjusting the I.f. trangnum output of the prescribed |
| $\underset{\substack{\text { Same } \\ \text { above. } \\ \text { as }}}{ }$ | 22.1 | $\begin{aligned} & \text { Same as as } \\ & \text { abower. } \end{aligned}$ | ${ }_{\substack{\text { Samo a } \\ \text { above.a }}}$ | Same as ${ }_{\text {abobes }}$ | Same as ${ }_{\text {abo }}$ | Same os above. | The saund corri by the ye of of on 'scope in orde response curro. properly position corrier marker a | (22.1 Mc.) can be observed crease the wericol main nergify the sound portion of the rker should appear at the positShould the sound morker not be tock in the proting of the the |




- John P. Rider


## PARTS LIST

SCHE

| Schte |  |  |  |
| :---: | :---: | :---: | :---: |
| Hoil | Part. | description |  |

RESISTORS-Continued

 | esistar-corbon 82,000 |
| :--- |
| Ohms $\pm 10 \% ~$ | $1 / 2 \mathrm{w}$. Resis

Resis

Resis | Resis |
| :--- |
| Resis |
| Resis |
| Resis | 17,000 Ohms $\pm 10 \% 1 / 2$

18,000 Ohms $\pm 10 \% 1 / 2$ .12
.12
.12

W520687-A Knab, Picture (Beige)....
$\begin{array}{lll}\text { W520436 } \\ \text { W52078-B } & \text { Mask for picture tube } \\ \text { Nomeplate (Green) (includes spring and }\end{array}$ W170986 Scrow-\#0-32, Phillips aval brass head;

 COILS AND TRANSFORMERS

#  



$$
\begin{aligned}
& \text { thap (ineludas slug and con- } \\
& 4.5 \text { Mc. trap coill... }
\end{aligned}
$$

$$
\begin{aligned}
& \text { W507584 Coil-chake } \\
& \text { W508341 } \\
& \text { Chako-filtor }
\end{aligned}
$$

$$
\begin{aligned}
& 7.50 \\
& 7.50 \\
& 1.50
\end{aligned}
$$

$$
\begin{array}{cc}
\text { W510129 } & \text { Resistor- } \\
\text { W5510130 } & \text { Resis } \\
\text { W510172 } & \text { Resistor- }
\end{array}
$$

$$
\begin{array}{r}
1.40 \\
.1 .40 \\
\hline 10
\end{array}
$$

$$
\begin{array}{r}
1.40 \\
\hdashline .12 \\
.12 \\
.12
\end{array}
$$

$$
\begin{array}{ll}
510150 & \text { Resistor Corbon } 5600 \mathrm{OHms} \pm 10 \% \\
51 / 2
\end{array}
$$

$$
\begin{array}{lll}
3 & \text { W510172 } & \text { Resistor-corbon } 100,000 \\
\hline
\end{array}
$$

$$
\begin{aligned}
& \text { W510139 } \\
& \text { W510357 } \\
& \text { w51010159 }
\end{aligned}
$$

$$
\begin{aligned}
& \text { Resistor-corbon } \\
& \text { Resistor-corbon } 18 \\
& \text { Rese }
\end{aligned}
$$



$$
\begin{aligned}
& \text { 1-A,B.W520942 }
\end{aligned}
$$



## SCHEMATIC AND PARTS LIST DIAGRAM FOR CHASSIS 100.400





## VOLTAGE MEASUREMENTS

All voltages measured with a 20,000 Ohm per volt meter with the receiver connected to a 117 volt 60 cycle power supply.
Tuner set to an inactive channel with antenna terminals shorted and connected to ground.
Controls set for normal reception - Power Booster control completely counterclockwise.
Voltages marked with an asterisk (*) will vary widely with control settings.
R.F. tuner voltages were measured with tubes removed from sockets.
No voltage reading at a tube element indicates zero voltage or voltage which cannot be accurately measured with a 20,000 Ohm per volt meter

## OSCILLOGRAMS

All oscillograms taken with ground lead of 'Scope connected to receiver chassis and controls set for normal reception. Power Booster control adjusted to give 55 volts peak to peak at cathode of picture tube. Oscilloscope vertical amplifier response was flat to within $\mathbf{2 0 \%}$ at 2 MC .

Number appearing to the left of oscitlogram specifies setting of horizontal sweep frequency control on 'Scope.
 (SHOWN WITH SIDE SHIELD REMOVED)



Fundamentally, the Sears Model 6950 UHF Converter operates in the same manner as the superheterodyne "front end" and the first I-F stage employed in many makes of VHF television sets. The primary difference is the operation of the Model 6950 on a higher frequency band--470 mc . to 890 mc . Allowing for this difference in operatingfrequency, the converter can VHF VHF counterpart.

Alignment of the Model 6950 is a simple procedure since its bandpass is essentially predetermined by the ixed characteristics or original circuitry. Except as stated otherwise in this

ALIGNMENT
The Sears UHF Converter to be tested should be connected to the VHF television set in the usual manner. The oscilloscope or VTVM should then be connected to the TV setion a point which permits sat and character of the AM (or sweep-modulated) signal introduced into the con-


Figure 2
bulletin, band-pass is not subject to serious change during alignment adjustment; however, replacement of any component within the R-F or -F circuits may disturb the band-pass characeristics of the instrument. Accordingly, whenver parts within these circuits are replaced nal comp and physical specifications of the orig as possible Wis must be duplicated as closely must be replaced in their former positions

Complicated or specially-designed test equipment is not required for practical align ment of the Model 6950. Instruments used in sually are satisfactory for aligning the con verter. In addition to these tools, the follow ing instruments are needed: a VHF signal generator with AM output and a sweep modulation of at least 12 megacycles ; an oscilloscope or vacuum tube volt-ohmmeter for measurement of the relative signal; and an perating VHF television set. The latter is suggested as a practical amplifier for $r$ a is in the output signal of the Converter to a level which permits convenient observation.

Before attempting to align the Model 6950, ac ceptability of the resistance and voltage values, which are found at each tube socket, should be determined by comparison with typical values isted below. The 6AF4 osclllator voltages, in particular, should be examined carefully. Whe tuning from one end of the dial to the other, plate pescribed Separate charts have been prepared for early and late 1952 models.
verter. The procedure for alignment consists of the following steps in the suggested sequence hown: (1) alignment of the I-F stage, ( age; and (3) alignment of $R-F$ circuits for maximum effectiveness.

1. Connect the VHF signal generator, through a suitable resistor-matching network (Fig. at the junction of Items $21,29,45$ and 51 (Fig. 3). Apply an AM signal centered at 82 megacycles.
2. Align in put and output I-F transformers (Items 5 and 6, Fig. 3) to obtain the maximum signal. Location of I-F alignment points is shown in Figures 5 and 6.
3. Replace AM signal with a sweep of at least 12 megacycles centered at 82 megacycles.
4. Readjust slugs of double-tuned, I-F out put transformer (Item 6, Fig. 3) for equal signal response at VHF channels 5 and 6 . The I-F amplifier must be aligned for a minimum $\frac{12-m e g a c y c l e ~ b a n d-w i d t h, ~ a n d ~ t h e ~ m a x i-~}{\text { mum gain possible with this band-width. }}$

## Chassis 725.10

1. Adjust tuning control so that indicating pointer is positioned at extreme left-hand pointer is po
2. Feed a 465-megacycle AM signal into converter antenna terminals through a matchng network described in Figure 2. Adjust oschator trimmer (tem 4, rig. ${ }^{\text {s }}$ ) for ment tool). When using a VHF signal gnment tool). When using a VF signal genmay be employed to produce the 5th harmonic energy of 465 megacycles.
3. Adjust the Converter tuning control so that indicator is positioned at extreme righthand edge of dial.
4. Set signal generator for 900-megacycle output ( 5 th harmonic of 180 megacycles). output (5th harmonic of 180 megacycles). of the oscillator end-inductor (Fig. 5) for maximum signal.
5. Repeat above steps until no further im provement in signal is apparent. The oscillator alignment figures of 465 and 900 megacycles are approximate only, and may not fall precisely at the maximum and minimum dial settings; however, in every case, the oscillator must be aligned $s$ that both frequencies manmal manipulation of the dial

6. Connect the VHF signal generator, through a suitable resistor-matching network (Fig. 1), to the crystal mixer of the Converter (Fig. j) 82 megacycles.
7. Align input and out put I-F transformers (Items 5 and 6, Fig. 4) to obtain the maximum signal. Location of I-F alignment points is shown in Figures 7 and 8.
8. Replace AM signal with a sweep of at least 12 megacycles centered at 82 megacycles.
9. Readjust slugs of double-tuned, I-F output transformer (Item 6, Fig. 4) for equal signal response at VHF channels 5 or 6 . The I-F amplifier must be aligned for a minimum 12-megacycle band-widh, and the maximum gain possible with this band-width.

Chassis 725.101-1

1. Adjust tuning control so that indicating point is positioned at extreme left-hand point is of dial.
2. Feed a 465 -megacycle AM signal into the converter antenna terminals through a matching network (described in Fig. 2). Adjust oscillator trimmer (Item 21, Fig. 6) for maximum signal. When using a VHF acyales may be mployed to produce the 5 htharmonic energy of 465 megacycles.
3. Adjust the Converter tuning control so that indicator is positioned at extreme righthand edge of dial.
4. Set signal generator for 900 -megacycle output (5th harmonic of 180 megacycles). Carefully spread or pinch together the legs of the oscillator end-inductor (Fig. 6) for maximum signal.
5. Repeat above steps until no further improvement in signal is apparent. The oscillator alignment figures of 465 and 900 megacycles are approximate only, and may not fall precisely at the maximum and minimumdial settings; in every case, however, the oscillator must be aliged so that both frequencies can be tuned by normal manipulation of the dial

$\qquad$
$\qquad$
$\qquad$

Bottom View

## Chassis 725.101

1. Adjust tuning control so that indicator is positioned at extreme left-hand edge of dial
2. Feed a 465 -megacycle signal into the Converter antenna terminals (as indicated verter antenna torminals oscillator alignment).
3. Adjust R-F trimmers (Item 72, Fig. 5) for maximum signal. Physical location of $R-F$ maximum signal. Physical locationor $R-F$ and 6.
4. Readjust tuning control so that indicato rests at extreme right-hand edge of dial.
5. Set signal generator for 900 megacycles output.
6. Adjust end-inductors (Fig. 5) for maximum signal.
7. Repeat above steps until no further improvement in signal is apparent.
8. Readjust tuning control so that indicator is positioned at extreme left-hand edge of dial.
9. Adjust coupling trimmer (Item 74, Fig. 6) for maximum signal.

## Chassis 725.101-1

1. Adjust tuning control so that indicator is positioned at extreme left-hand edge of dial
2. Feed a 465-megacycle signal into the Converter antenna terminals (as indicated above for oscillator alignment).
3. Adjust R-F trimmers (Item 5, Fig. 8) for maximum signal. Physical location of $R-F$ alignment points is shown in Figures 7 and 8.
4. Readjust tuning control so that indicato rests at extreme right-hand edge of dial.
5. Set signal generator for 900-megacycle output.
6. Adjust end-inductors (Fig. 7) for maxi mum signal.
7. Repeat above steps until no further im provement in signal is apparent.

## VOLTAGE MEASUREMENTS

Note: -- Voltage measurements, made by means f a electronic voltmeter (VTVM), should be aken between tube socket terminals and the
hassis. Measurements within 20 per cent of the pecified value usually will assure satisfactory performance of the Converter

| Chassis 725.101 |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| TUBE | USE | $\begin{aligned} & \text { PIN } \\ & \text { NO. } 1 \end{aligned}$ | $\begin{aligned} & \text { PIN } \\ & \text { NO. } 2 \end{aligned}$ | $\begin{aligned} & \text { PIN } \\ & \text { NO. } 3 \end{aligned}$ | $\begin{aligned} & \text { PIN } \\ & \text { NO. } 4 \end{aligned}$ | $\begin{aligned} & \text { PIN } \\ & \text { NO. } 5 \end{aligned}$ | $\begin{gathered} \text { PIN } \\ \text { NO. } 6 \\ \hline \end{gathered}$ | $\begin{gathered} \text { PIN } \\ \text { NO. } 7 \end{gathered}$ | $\begin{gathered} \text { PIN } \\ \text { NO. } 8 \end{gathered}$ | $\begin{gathered} \text { PIN } \\ \text { NO. } 9 \\ \hline \end{gathered}$ |
| 6X4 | Rect. | 170VAC | NC | 0 | 6.3VAC | NC | 170VAC | 190VDC | --- | --- |
| or | I-F AMP | 120VDC | 0 | .85VDC | 6.3VAC | 0 | 125 VDC |  | 1 VDC | 0 |
| $\begin{aligned} & \text { 5BQ7 } \\ & \text { 6AF4 } \end{aligned}$ | OSC. | 85VDC* | 5.7VDC* | 0 | 6.3VAC | 0 | 5.7VDC* | 85VDC* | --- | --- |


| Chassis 725.101-1 |  |  |  |  |  |  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 6CB6 | I-F AMP | 0 | 1.3 VDC | 6.3 VAC | 0 | 98 VDC | 98 VDC | 1.3 VDC | --- | -- |
| 6AF4 | OSC. | 85VDC* | $5.7 \mathrm{VDC} *$ | 0 | 6.3 VAC | 0 | $5.7 \mathrm{VDC} *$ | 85 VDC | --- | -- |

Selenium Rectifier " $K$ "' Terminal 125VDC
*Measurement made with 15 K isolating resistor in series with voltmeter probe.

Note: -- Resistance measurements, made by means of an electronic ohmmeter (VTVM), should e taken between tube socket terminals and the hassis. Measurements within 20 per cent of the specified value usually will assure satisfactory
performance of the Converter When taking these measurements, the Converter switch must be urned to the "UHF" position and the line cord detached from the house circuit.

| Chassis 725.101 |  |  |  |  |  |  |  |  | $\begin{gathered} \text { PIN } \\ \text { NO. } 8 \end{gathered}$ | $\begin{gathered} \text { PIN } \\ \text { NO. } 9 \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| TUBE | USE | $\begin{aligned} & \text { PIN } \\ & \text { NO. } 1 \end{aligned}$ | $\begin{gathered} \text { PIN } \\ \text { NO. } 2 \end{gathered}$ | $\begin{gathered} \text { PIN } \\ \text { NO. } 3 \end{gathered}$ | $\begin{gathered} \text { PIN } \\ \text { NO. } 4 \end{gathered}$ | $\begin{aligned} & \text { PIN } \\ & \text { NO. } 5 \end{aligned}$ | $\begin{gathered} \text { PIN } \\ \text { NO. } 6 \end{gathered}$ | $\begin{aligned} & \text { PIN } \\ & \text { NO. } 7 \end{aligned}$ |  |  |
| 6X4 | Rect. | 130 | NC | 0 | . 3 | NC | 130 | 50 K or More | --- | --- |
| $\begin{aligned} & \text { 6BK7 } \\ & \text { or } \\ & \text { 6BQ7 } \end{aligned}$ | I-F AMP | 50 K or More | 0 | 56 | . 3 | 0 | 50 K or More |  | 56 | 0 |
| 6AF4 | OSC. | 50K or More | 12 K | 0 | . 3 | 0 |  | 50 K or More | --- | --- |


| 6CB6 | I-F AMP | 0 | 150 | 0.6 | 0 | 50 K or | 50K or | 150 | --- | --- |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 6AF4 | OSC. |  | 12K | 0 | 0.3 |  | $\begin{aligned} & \text { Mor } \\ & 12 \mathrm{~K} \end{aligned}$ |  | --- | -- |
|  | Osc. | More | 12 K | 0 | 0.3 |  |  | More | --- | --- |

Selenium Rectifier "K" Terminal to Chassis 50K or More.


## HOW TO ORDER PART

1. Use the Correct Order Form.
2. On the Purchase Order always give the following information:
(1) PART NUMBER (number printed on the part if different from that shown in this rdered. WhCRIPTION for each par igned, order by description and rating. Also give PRICE of part (indicate if no selling).
2) The CHASSIS NUMBER, which is 725.101 T his number is found on a metal plate (picture on page 1) at the rear of
3. ORDERING INSTRUCTIONS

Send Purchase Orders DIRECT to SOURCE No. 725. See "DIV. 57, STANDARD NOMENCLATURE INDEX", for source name
. MARK-UP: Selling prices in the following produce a MARK-UP of AA5 unless other-
here will be a minimum charge of $50 ¢$ made by the source on each parts order totaling less than $50 \%$ (cost to Sears). The customer is to be charged only the actual selling price shown in this RL.

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## SPECIFICATIONS

POWER SUPPLY
105 to 125 Volts - 60 Cycle AC
POWER CONSUMPTION 290 Watts

POWER OUTPUT (AUDIO) 2 Watts (undistorted)
INPUT IMPEDANCE
72 Ohms. or 300 Ohms.

## PICTURE SIZE

 $101 / 8^{\prime \prime} \times 133 / 4^{\prime \prime}$PICTURE TUBE 16" Rectangular
585

## SPEAKER

$4^{\prime \prime} \mathrm{x}$ 6"Oval P.M.-Voice Coil-3 Ohms.
VERTICAL SCANNING FREQ.
60 cycles per second
HORIZONTAL SCANNING FREQ.
15,750 cycles per second

## GENERAL DESCRIPTION

This Silvertone console receiver consists of a combination television, standard broadcast and frequency modulation broadcast receiver and a record changer. A
BUILT-IN-ANTENNA system permits reception of local television, FM or AM broadcasting facilities directly without external antenna equipment. Where required, external antennas may be readily connected to the receiver.
Features of the television receiver include full twelve channel coverage, an intercarrier sound system, automatic frequency control horizontal hold, and stabilized vertical hold.

The high sensitivity AM-FM broadcast receiver is also used to furnish the audio power for the television sound output.

The record changer will automatically play standard 78 RPM, fine-groove 45 RPM and long-play $33-1 / 3$ RPM records of standard commercial dimensions.

## FREQUENCY RANGE

Radio -
dio - Standard Broadcast (A.M.) - 535-1600 K.C Standard Broadcast (A.M.) $-535-1600$ K.C.
Frequency Modulation (F.M.) $-88-108$ M.C.
Television -
Channels 2 through 13.
or channel frequencies, see table

## TUBE COMPLEMENT

| Television Chassis |  |  |  |
| :---: | :---: | :---: | :---: |
| 1. | $6 \mathrm{J6}$ | V 16 | RF Amplifier |
| 2. | 6AG5 | V 17 | Mixer |
| 3. | 6J6 | V 18 | R.F. Oscillator |
| 4. | 6CB6 | V 1 | 1st Video I.F. Amplifier |
| 5. | 6CB6 | V 2 | 2nd Video I.F. Amplifier |
| 6. | 6CB6 | V 3 | 3rd Video I.F. Amplifier |
| 7. | 6AL5 | V 4A | Video Detector |
|  |  | V 4B | A.G.C. Detector |
| 8. | $12 \mathrm{AU7}$ | V 5 | 1st \& 2nd Video Amplifier |
| 9. | 6aU6 | V 14 | 4.5 M.C. Amplifier |
| 10. | 6AL5 | V 15 | Ratio Detector |
| 11. | $\begin{aligned} & \text { 6SN7 } \begin{array}{l} \text { or } \\ 7 N \mathrm{~N} \end{array} \end{aligned}$ | V 7 | Sync Separator |
| 12. | 6SR7 or | V 6A | Sync Limiter |
|  | 6BF6 | V 6B | Vertical Sweep Oscillator |
| 13. | 6S4 | $\checkmark 8$ | Vertical Sweep Amplifier |
| 14. | $\begin{aligned} & \text { 6SN7 or } \\ & \text { 7N7 } \end{aligned}$ | V9 | Horizontal Sweep Oscillator Sync Guide |
| 15. | 6BG6 | V 10 | Horizontal Sweep Output |
| 16. | 6W4 | V 12 | Damper |
| 17. | 1B3 | V11 | High Voltage Rectifier |
| 18. | 5U4 | V 13 | Power Rectifier |
| 19. | 16TP4 or 16RP or 16XP4 | V 19 | Picture Tube |
| A.M.-F.M. Radio Chassis |  |  |  |
| 1. | 6BJ6 | V 20 | R.F. Amplifier (F.M.) |
| 2. | 12AT7 | V21 | Mixer and Oscillator (F.M.) |
| 3. | 6BE6 | V 25 | Mixer and Oscillator (A.M.) |
| 4. | 6BJ6 | V 22 | 1st I.F. Amplifier (A.M.-F.M.) |
| 5. | 6BA6 | V 23 | 2nd I.F. Amplifier (F.M.) |
| 6. | $6 T 8$ | V24 | Detector, A.V.C. and 1st Audio Amplifier |
| 7. | 6AS5 | V27 | Audio Output |
| 8. | 6X4 | V 26 | Power Rectifier |

OUTDODR THILVISTON ANTENNA INSTALLATION
(Note: Disconnect Built-in-Antenna)


FIG. 3B

## television <br> ALIGNMENT PROCEDURE

The alignment of this Receiver can be broken down into three basic parts.

$$
\begin{aligned}
& 1 \text { - Video IF Alignment } \\
& 2 \text { - RF Alignment } \\
& 3 \text { - Sound Alignment } \\
& \text { TEST EQUIPMENT }
\end{aligned}
$$

CATHODE RAY OSCILLOSCOPE - The tube size is relatively unimportant, however, anything under $5^{\prime \prime}$ usually makes fine adjustment quite difficult.
SWEEP GENERATOR-The sweep generator used should have linear coverage of a center range from 30 to 220 megacycles. The output should be fairly flat over wide frequency variation of the sweep. It should be capable of an output of about 0.1 volt with attenuation. It is preferable that the generator have a deflection output for the test oscilloscope.
TELEVISION RECEIYER REAR CHASSIS CONTROLS


AM SIGNAL GENERATOR - This generator should have a frequency range of from 4.5 to 220 megacycles. As this generator is used occasionally as a marker generator, accuracy is an important factor. It should be capable of 0.1 volt output with attenuation and should be linear through the range.
VACUUM TUBE VOLTMETER - Any standard make VTVM will do. It should preferably have a reversible polarity switch.
WAVE TRAP - 32.8 M.C.

## TEST SOCKET

In this model a Test Socket is provided which gives convenient access to the various points where either 2 vacuum tube voltmeter or an oscilloscope must be inserted for proper alignment. A letter diagram in the margin of the schematic will locate these points by means of corresponding letters in the schematic proper. A typical Octal socket is used and it should be noted that the diagram shows a TOP VIEW. Two ground points are supplied on separate pins of the test socket for easy metering. Reference is made, in the following Alignment Procedures, to the pins on this Test Socket.

## R.F. OSCILLATOR ALIGNMENT

To align the R.F. oscillator it is first necessary to connect a working antenna to the set. Turn the selector switch to the channel to be aligned. With the fine tuning control set at the center of its range, adjust the correct brass slug (see Fig. 8) until the best picture is obtained. Adjusting channel 2 will affect all other channel adjustments, therefore, channel 2 should not be disturbed after aligning channels 3 to 13 .

## VIDEO IF ALIGNMENT

An adequate signal can be fed through the video IF string by feeding the output of the signal generator into a tube shield placed over the mixer tube (GAG5) (V-17). Care should be taken that this shield is NOT grounded. The ground side of the Generator output can be conveniently grounded to the shield of the adjacent oscillator tube.
The vacuum tube voltmeter should be connected across the 8200 ohm detector load resistor (Pin B Test Socket) and should be set on the minus 3 Volt scale Set channel lector to an unused low band channel
The Signal generator should be set to a frequency of 36.9 MC The output of the generacor should be adjused to the point where the reading on the VTVM is between minus 1 to minus 1.5 voits.
The First and Third I.F. coils should be peaked for a maximum reading on the VTVM. As the voltage reading increases with tuning, the generator should be attenuated to maintain a maximum of minus 1.5 volts.

Set the Signal Generator to a Frequency of 34.8 MC and tune the Second and Fourth I.F. coils in the same manner as above:
The Generator should now be shut off (or tuned to
different band) and the VTVM should read no more than minus .5 volt. If there is a higher voltage reading, check for regeneration in the I.F. stages.
To look at the actual response curve of the I.F. Amplifie connect the Sweep Generator and the A.M. Signal Gener ator to the antenna. Then connect "hot" or "high" side of the Oscilloscope to Pin B of the Test Socket. The "low or ground side should be connected to the nearest convenient ground point. Care should be taken to separate the Oscilloscope leads from the Generator leads.
The Sweep Generator is set at the approximate mid frequency of an unused low channel and the Signal Generator is set at the sound carrier frequency of the channel ator is set at the sound carrier frequency of the channe VTVM will read - 1.5 volts D.C. at test point B. Loosely couple a wave trap tuned to 32.8 MC into one of the I.F coils until a small dip is noticed on the trace (see Fig. 9) The fine tuning control on the tuner should now be ad justed to make the Signal Generator marker coincide with the trap valley. The Signal Generator can now be tuned to the R.F. Picture Carrier frequency and the position of the Picture Carrier on the response curve noted. It should be between the $40 \%$ and $60 \%$ points on the slope of the curve. The band width between $50 \%$ points should be ap proximately 3.2 MC . Slight readjustment of the 1.F. trans formers may be mecessary to obtain the desired response. small variations from the ideal are acceptable as stown in Fig. 9.


SOUND ALIGNMENT
Sound alignment on these receivers is best accomplished by using an actual transmission received on an antenna and fed in the normal manner to the antenna terminals. A Vacuum Tube Voltmeter should first be inserted between the output plate of the Ratio Detector Diode (pin 2 V15) and ground. This point may be reached through pin C of the Test Socket. The meter should be set on the minus 10 volt scale. With the equipment so placed the 4.5 MC pickoff coil (T8) and the primary of the Ratio Detector Trans former (bottom adjustment, T9) should be adjusted for a maximum deflection of the meter. The hot lead of the meter should now be moved to the junction point of R71, C 60 and C61 (Pin A Test Socket), and the secondary of the Ratio Detector Transformer should be adjusted for a ZERO reading. (Note: There are 3 points at which the meter will zero. Only one of these is correct. At the proper setting the meter should swing negative on one side and positive on the other side of zero). In cases where it is
necessary to align the sound section when no station trans mission is available a single frequency signal generato uned to 4.5 megacycles may be fed into the output circuit of the Video Detector (Pin B Test Socket). The receive should then be aligned in the same manner as described above. The disadvantage of this method is that any in accuracy in your signal generator will show up as misalign ment when the set is in actual operation, since proper ad justment is very critical.



FIG. $10 B$

test socket bottom view FIG. 10C

PICTURE ADJUSTMENTS


## ION TRAP MAGNET ADJUSTMENT

Position the ion trap so that the arrow points toward the second anode contact.
The ion trap rear magnet poles should be aproximately over the ion trap flags in the picture tube. The ion trap flags are smali, rectangular plates in the neck of the picture tube about 1 inch from the black base of the tube. Starting from this position, adjust the magnet by moving it forward or backward until the raster (illuminated area of picture tube within the mask) is observed. Rotate it slightly around
the neck of the picture tube for the brightest raster on the screen, and at the same time reduce the brightness control setting until the raster is slightly above average brilliance. Adjust the focus adjustment screws (see Fig. 11) until the line structure of the raster is clearly visible. Readjust the ion trap magnet for maximum raster brilliance. The final touches on this adjustment should be made with the brightness control at the maximum position with which good line focus can be maintained.

## DEFLECTION YOKE ADJUSTMENT

If the lines of the raster are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is obtained. Tighten the yoke adjustment screws NOTE: Be sure the deflection yoke as well as the picture tube mounting is positioned forward as far as possible against the flare of the picture tube.
It will now be necessary to obtain a test pattern picture in order to obtain further adjustments.

## FOCUS MAGNET ADJUSTMENT

A permanent magnet type focus control is used in some receivers. The two focus adjustment screws shown in Fig. 11 should be adjusted for sharpest focus. It is recommended that a brass screw-driver be used for this operation, otherwise the focus will change slightly when the screw-driver is removed.

Centering is accomplished by loosening the two wing nuts on the back of the focus control and shifting the control both vertically and horizontally in a vertical plane until proper centering is obtained. Rotation of the focus magnet about its axis will result in an optimum position for the removal of any remaining shadows in the corners of the picture. The wing nuts should then be tightened.
The ion trap magnet should now be rechecked for maximum brilliance.

## CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT

Turn the horizontal control (on the front panel) to the extreme counter-clockwise position. The picture should remain in sync. Momentarily remove the signal by switching to another channel and then switching back again. The picture should break horizontal sync and the picture will be resolved into a series of black bars sloping down to the left.
Turn the horizontal control clockwise slowly bringing the picturc into sync again. At the extreme clockwise pos tion the picture will again show a tendency to break sync
as indicated by anything from a shimmy to $21 / 2$ black diagonal bars sloping down to the right.

If the receiver passes the above checks and the picturc is normal and stable, the horizontal oscillator is adjusted and need not be aligned.

## HORIZONTAL OSCILLATOR ALIGNMENT

1. The HORIZONTAL HOLD CONTROL should be set at approximately the center of its mechanical range. The HORIZONTAL LOCKING RANGE and the HORIZONTAL DRIVE trimmers should be set at two full turns counter-clockwise from maximum capacity.
2. Turn the HORIZONTAL DRIVE trimmer clockwise until the bright, vertical bars running through the picture are eliminated. If, in so doing, the picture should fall out of sync it should be brought back by readjusting the Horizontal Oscillator Transformer. This is the long screw adjustment which extends through the side of the chassis (see Fig. 12). (SEE NOTE).
3. Rotate the HORIZONTAL HOLD CONTROL (front panel auxiliary control) to the maximum clockwise position. The Horizontal Oscillator Transformer should now be adjusted to a point where the black horizontal blanking bar starts to come into the picture from the left side.
4. The HORIZONTAL HOLD CONTROL should now be rotated to its maximum counter-clockwise position. The picture should stay in sync. However, shorting the antenna terminals or rapidly switching to an un used channel and back should cause the picture to fall out of sync. If this condition does not exist readjus in accordance with step 3 above.
5. When the HORIZONTAL HOLD CONTROL is rotated to maximum clockwise position it is acceptable for the picture to vary in sync from a shimmy to $21 / 2$ bars sloping downward to the right. The picture should stay locked, however, through approximately $3 / 4$ of the mechanical rotation of the HORIZONTAL HOLD CONTROL.
6. If the HORIZONTAL DRIVE Trimmer must be readjusted at this time for improved width or linearity steps 3, 4 and 5 should be rechecked.

NOTE: In the above procedure adjustment of the Hori zontal Oscillator Transformer is mentioned a number of times. The adjustment referred to is the long scréw
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which extends from the Horizontal Oscillator Transformer (T6) through the chassis and which would be adjusted from the outside of the chassis. There is an ad justment at the other (inside) end of this same coil can. This is the HORIZONTAL PHASE CONTROL adjustment. IT IS IMPORTANT TO NOTE THAT this latter adustment should not be TOUCHED IN THE FIELD. This is a Factory adjustment and should not be attempted in the service shop If this circuit is suspected of being defective or mis tuned the entire assembly including the .01 mfd . 600 volt Molded Paper condenser (C-43) should be re
moved and returned to the factory as a defective part.

## HEIGHT, WIDTH AND LINEARITY

To adjust the overall size and linearity of the picture it is almost mandatory that a pattern transmitted from a local station be used. Linearity adjustments, particu larly, cannot be accurately made on moving transmissions. It should also be remembered that in areas where more than one station is being received, that pictures transmitted from different stations will vary slightly in size. The smallest transmitted picture should be made to fill the area delineated by the mask.
The first step in linearity and size adjustment is to turn
the WIDTH control (rear of chassis) all the way in (clockwise).
The HORIZONTAL DRIVE trimmer should then be adjusted for the best compromise between maximum brightness and good horizontal linearity. This contro will affect the left side of the picture primarily. The HORIZONTAL LINEARITY control (rear of chassis) should then be adjusted for linearity of the right side of the picture. If it has been found necessary to adjust the HORIZONTAL DRIVE trimmer, steps 3, 4 and 5 of Horizontal Oscillator Alignment must be repeated.

The WIDTH Control should now be readjusted to
achieve a picture that will fill the mask horizontally. If necessary the width coil may be entirely removed from the circuit of the WIDTH SWITCH on rear of chassis.

The HEIGHT and VERTICAL LINEARITY controls (both rear of chassis) should then be adjusted for a linear picture that will fill the mask vertically. At this point the FOCUS ADJUSTMENT screw previously set should be retouched for maximum definition of the lines in the vertical wedge of the test pattern. Prope adjustment and alignment of the receiver should result in clear and sharp definition.

PARTS LOCATION - TELEVISION CHASSIS - TOP VIEW
Fig. 12



| RESISTANCE CHECK CHART TELEVISION CHASSIS |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SCHEMATIC <br> location | tube function | TUBE | PIN NUMBERS |  |  |  |  |  |  |  |  |
|  |  |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| v 1 | 1st Vid. I.f. | ${ }^{6} \mathbf{C B 6}$ | 700k | 47 | 0 | Fil. | 10K | 10K | 0 |  |  |
| V 2 | 2nd vid. I.F. | $6 \mathrm{CB6}$ | 700k | 47 | 0 | Fil. | 10k | 10K | 0 |  |  |
| V 3 | 3rd Vid. I.F. | 6CB6 | 0 | 100 | 0 | Fil. | 10K | 10K | 0 |  |  |
| ${ }^{\text {V } 4}$ | Vid. Detector \& A G. C. | 6AL5 | 0 | 120k | Fil. | 0 | 1. Ik |  | 3.9K |  |  |
| V 5 | $1 \mathrm{st} \& 2 \mathrm{nd}$ Vid. Ampl. | 12 U 7 | 12K | 1 meg . | 5 K | Fil. | Fil. | 13K | 1 Meg . | 47 | 0 |
| V 14 | 4.5 M. C. Ampl. | 6av6 | 1.5 | 0 | 0 | F11. | 10k | 10K | 180 |  |  |
| $\checkmark 15$ | Ratio Detector | 6AL5 | 15K | 15K | 5.1 | Fil. | Inf. | 0 | Inf. |  |  |
| v 7 | Symc. Separator | $\begin{gathered} \text { 6SN7 } \\ \text { or } \\ 7 \mathrm{~N} 7 \end{gathered}$ | 1. 2 Meg . | 27 K | 0 | 5 Meg . | 10K | 6. 8 K | Fil. | 0 |  |
|  |  |  | Fil. | 0 | 27K | 1.2 Meg. | 5 Meg . | 10K | 6. 8 K | 0 |  |
| v 6 | ```Sync. Limiter and Vertical Oscillator``` | 6BF6 <br> or <br> 6SR7 | 1.8 Meg. | 0 | 0 | F11. | 4 meg. | 4 meg . | 1.8 meg. |  |  |
|  |  |  | 0 | 1.8 Meg . | 0 | 4 Meg. | 4 Meg . | 1.8 Meg . | Fil. | 0 |  |
| V 8 | Vertical Amplifier | $6 \mathrm{S4}$ |  | 3 K |  | Fil. | 0 | 22 Meg . |  |  | 120 K |
| v 9 | ```Hor. Oscillator and Sync. Guide``` | $\begin{gathered} 65 \mathrm{~N} 7 \\ \text { or } \\ 7 \mathrm{~N} 7 \end{gathered}$ | 1.6meg. | 60K | 450K | 50\% | 100K | 800 | Fil. | 0 |  |
|  |  |  | 0 | 450K | 60K | 1.6 Meg. | 500k | 100K | 800 | F11. |  |
| V 10 | Horizontal Output | 6BG6 |  | Fil. | 950 |  | 1 Meg . |  | 0 | 16K |  |
| V 12 | Damper | 6\%4 |  |  | 330к |  | 10K |  | ${ }^{8 K}$ | 8 K |  |
| V 13 | Power Rectifier | 504 |  | 10K |  | 850 |  | 850 |  | 10K |  |

## CONDITIONS:

1. All readings taken with RCA Volt-Ohmist.
2. All controls at "Normal Setting".
3. Switch off-line cord disconnected.
4. All tubes left in sockets.

Note: Filament resistance too lon to read.

| schematic location | tube function | TUBE | Pin numbers |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| V 1 | 1st Vid. I.F. | 6С86 | -. 5 | 1 | 0 | 6.3 A C. | 110 | 110 | 0 |  |  |
| v 2 | 2nd vid. I.F. | $6 \mathrm{Cb6}$ | -. 5 | 1 | 0 | 6.3AC. | 110 | 110 | 0 |  |  |
| $\vee 3$ | 3rd vid. I.f. | 6C86 | 0 | 1.2 | 0 | 6. 3 Ac | 110 | 110 | 0 |  |  |
| $\bigcirc 4$ | Vid Detector \& A G.c. | 6NL5 | 0 | -. 2 | 6.3 A c. | 0 | 1.2 |  | -. 5 |  |  |
| $\vee 5$ | 1st \& 2nd Vid. Ampl. | $12 \mathrm{AU7}$ | $120^{\circ}$ | -3. 5 | $3.5{ }^{\circ}$ | 6.3 AC. | 6.3 Ac | 160 | -1* | . 8 | 0 |
| V 14 | $4.5 \mathrm{M} . \mathrm{C} . \mathrm{Ampl}$. | ${ }_{6}{ }^{\text {aU6 }}$ | 0 | 0 | 0 | 6.3 Ac . | 110 | 110 | 1.2 |  |  |
| v 15 | Ratio Detector | 6AL5 | . 4 | -. 4 | 1 A.c. | 6.3 A C. | 0 | 0 | 0 |  |  |
| v 7 | Sync. Separator | $\begin{aligned} & 6 S N 7 \\ & \text { or } \\ & 7 N 7 \end{aligned}$ | -3.5 | 0 | 0 | -15* | 235 | 4 | 6.3 A.c. | 0 |  |
|  |  |  | 6.3 A C. | 0 | 0 | -3.5 | $-15^{*}$ | 235 | 4 | 0 |  |
| v 6 | Sync. Limiter <br> and <br> Vertical Oscillator | $\begin{aligned} & 6 \mathrm{BFf} \\ & \text { or } \\ & \text { 6SR7 } \end{aligned}$ | $-25+$ | 0 | 0 | $6.3 \mathrm{Ac}$. | $-15^{\circ}$ | -15* | 100** |  |  |
|  |  |  | 0 | -25* | 0 | -15* | -15* | 100+* | 6.3 A. c. | 0 |  |
| v 8 | Vertical Amolifier | 684 |  | -90 |  | 6.3 A C. | 0 | -90 |  | 270 |  |
| v 9 | $\begin{aligned} & \text { Hor. } 0 \text { scillator } \\ & \text { and } \\ & \text { Sync. Guide } \end{aligned}$ | $\begin{gathered} 6 S N 7 \\ \text { or } \\ 7 N 7 \end{gathered}$ | -100 | 35** | -125 | -180 | 110 | - 105 | 6. 3 A.c. | 0 |  |
|  |  |  | 0 | -105 | $35^{\circ}$ | -100 | -180 | 110 | -125 | 6.3 A. C |  |
| V 10 | Hor. Output | 6BG6 |  | 6.3 A c. | -95 |  | -110 |  | 0 | 180 |  |
| V 12 | Damper | $6{ }_{6} 4$ |  |  | 475 |  | 280 |  | 120 | 120 |  |
| v 13 | Power Rectifier | 504 |  | 300 |  | -90 |  | -90 |  | 300 |  |

## CONDITIONS

1. Switch on - set connected to 117 volt 60 cycle AC.
2. No antenna connected and set tuned to unused channel.
3. All controls at "Normal" setting
4. Measurements taken with RCA volt-Ohmist.

## Notes:

- Reading will vary with setting of Picture Control.
- Reading will vary with setting of Horizontal Hold Control
+ Reading will vary with setting of Vertical Hold Control.
+ Reading will vary with setting of Height Control.


## AM-FM RADIO ALIGNMENT PROCEDURE

## preliminary:


 Generator modulation ...................................................................................................................................................................................................................................

|  | generator frequency | DUMMY ANTENNA |
| :---: | :---: | :---: |
| Open 1620 Kc 1400 Kc | 455 Kc 1620 Kc 1400 Kc | . 05 Mfd |
| *Connect generator lead to a Standard Hazeltine Test Loop, M inches in diameter, placed about one foot from the set loop. <br> **With a generator signal of 600 Kc , tune the set to the point the dial. Adjust antenna section plates of variable for maximum The alignment procedure should be repeated in the original order |  |  |
| The alignment procedure should be repeated in the original order Always keep the output from the signal generator at its lowest |  |  |
|  |  |  |
|  |  |  |

block diagram for i.f. and detector alignmen using signal generator and oscilloscope. FIG. 16
high side of vol. control

detector alignment connections

Position of volume control Sot Dial Pointer
Set band switch

top view of radio chassis
FIG. 14
Set band switch
-3/32" from center of right shaft, variable condenser closed
To left for AM alignment; to right for FM alignment
 GENERATOR
ONNETION
HIGH SIDE
Mixer grid
\#Tost Hop
*Tost Hop
*TT loop

TRIMMER FUNCTION
l.f. ${ }^{\text {Oscillator }}$

Antenna
Antenna
bottom view of radio chassis

FIG. 15
GENERATOR
CONNECTION
GROUNDLEAD
Chassis
Tsst loop
Test loop
Test loop

*Connect generator load to a Standard Hazeltine Test Loop.
inches in diametor, placed about one foot from the set loop.
$* *$ With a generator signal of 600 Ke , tune the set to the point where
the dial. Adjust antenna section plates of variable for maximum output.
for $g$ reatest accurac

af alignment connections
FIG. 17


Fig. 1

## FM ALIGNMENT

## detector and if alignment using signal generator and oscilloscop

. Connect vertical input of scope across volume control of receiver (Grounded terminal to chassii, ungrounded terminal to high side of the control). Connect FM Generator, High Side, to grid of 2nd IF tube through . 01 mdd . dummy, Low Side, to chassis.
Connect swoep voltage of generator to horizontal terminals of seope.
Set generator frequency to 10.7 Mc modulated either 60 cycles or 400 cycles, 250 Kc sweop ( 125 Kc deviation).
Sot volume control to maximum, variable condensor fully open, band switch to right (FM)
Adut docter plery slug \# 5 for maximum verrical sweop of the scope pattern.
(hend look like Fig. 19, with the same amount of curre on both end high side, to mixer coil as in Fig. 17 , low side to chassis.
hassis ar junction of R125 and 212 . 1
11. Connect vertical input of scope across RI24. (Grounded terminal to chassis, ungrounded terminal to high side of resistor.)
13. Adjust IF slugs 7, 8, 9,10 for groatest vertical sweop of the pattern. Stagger tune (detune) slightly so that pattern looks like Fig.22. 3. Reside the negative lead of condenser disconnected after alignment is completed

NOTE: A double trace pattern, as in Fig. 20 or Fig. 21 for detector alignment, of Fig. 23 for $1 F$ alignment, may be ceused by a slight out of phase
condition between the sweep voltage to the horizontal terminals of the scope and the modulation on the o dition, connect a condenser of about .0005 mf . across the horizontal input terminals of the scope and a 1 megohm variable resistance in serios with the lead to the ungrounded terminal. Adiust the resistance until the two traces coincide.
oscilloscope patterns

detctor alignient

\# 5 is adiusted for maximum A. V. C. voltage. A vacuum tube voltmeter or a 20.000 ohm per volt voltmeter with a low V. range can be urd \#*6 is adiusted for zero reading of a vacuum tlead to junction of R125and R1290n band switch and positive lead to the chassis. \#*b is adiusted for zero reading of a vacuum tube voltmeter or a 20,000 ohm per volt voltmeter, connected as shown in Fig. 18 . Rock this adiust-
ment through the zere point to see that the voltage is positive on one side of the zero point and negative on the other. NOTE: If 107 MC FM ,
NOTE: If a 10.7 Mc FM generator is not available foi alignment of det toctor, an unmodulated signal of 10.7 Mc from an accurataly calibrated
conventional AM type generator can be used. (Voltmetor alignment only). I.F. alignment using signal generator and V.T.Y.M. not recommended


All RF trimmers are ed qusted for maximum output, measured with output meter across speater waice coil
For RF alignment, use FM generator signal modulated with 400 cycles 45 Kc swoep ( 22.5 Kc deviation).
dial stringing arrangement
FH. 24



(C) Set the FINE TUNING CONTROL to tne center
(D) Use a non-metallic screwdriver such as polysterene

Adjust the individual oscillator screw for best picture deAail. A slight adjustment in either direction is all that is
necessary. CAUTION: DO NOT ADJUST INDISCRIM.
INATET necessary, CAUTION: DO NOT ADJUST INDISCRIM
INATELY, this may cause the adjustment screw to fall from its locking position.

ADJUSTMENT FOR STATION BUZZ If station buzz is excessive and is NOT DUE to "contrast the locality adjuster control in the incorrect position or the locality adjuster control in the incorrect position, ad-
just the ratio detector secondary adjustment screw located on top of the ratio detector for minimum kuzz. MAKE
SURE THAT THIS POSITION IS BETWEEN the MAXIMUM buzz peaks that will be noticed when adjustment screw is turned to the right or left of the m n numm buzz position.


## UHF TUNER DATA

The UHF TUNER has been aligned for optimum operation by special factory equipment and should not require alignment.
The 6T4 OSCILLATOR TUBE and 1N82 CRYSTAL are parts that may require replacement. The 1 N82 crystal, located on top of UHF TUNER under square metal cover, is a snap-in type and no soldering is required.
In the UHF position, the 6BZ7 and 6U8 are used as additional IF stages.
Great care should be taken that parts location and lead dress are not altered in UHF TUNER. UHF ALIGNMENT SHOULD NOT BE ATTEMPTED UNLESS ABSOLUTELY NECESSARY
UHF TUNER ALIGNMENT

## EQUIPMENT REQUIRED UHF MARKER GENERATOR PRF MARKER GENERATO

 UHF SWEEP GENERATORCATHODE RAY OSCILLOSCOPE
Set VHF tuner to UHF por to UHF antenna terminals.
note: Sweep generator must match the 300 Ohm input mpedance Loosely couple
generator leads
Connect oscilloscope to test point on VHF tune
Locality adjuster
Locality adjuster switch in weak position.
Carefully detune TU-2 mixer IF coil located on VHF Carefully detune TU-2 mixer IF
tuner by turning core OUT exactly 10 located
Note: Radiated horizontal pulses may appear on the response curve. This will not affect the response or cilt
of curve. DO NOT disalle the horizontal sweep circuit;


FIG. I
(1) Set sweep and marker generator to 460 MC . Set UHF tuner to maximum counter-clockwise posi-
tion. Adjust CU- 26 until marker is in the center of response
curve. If marker cannot be centered on response curve: carefully bend and move oscillator inductor tab Fig. 1 and

re-adjust CU-26 until marker is in center of response | $\begin{array}{l}\text { re-adjust } \\ \text { curve. }\end{array}$ |
| :--- |

(2) Leave marker and sweep generator at 460 MC .
Leave $U H F$ tuner at maximum counter-clockw Leave UHF tuner at maximum counter-clockwise
position. Carefully bend and move PRESELECTOR INDUC TOR TAB Fig. 1 for maximum response and minimum tilt. See response curve Fig. 2 .
Repeat steps 1 and 2 .
(3) Turn TU-2 mixer IF coil located on VHF tuner IN 10 turns
alignment.

DO NOT BEND OR MOVE INDUCTOR TABS
INDISCRIMINATELY OR EXCESSIVELY


TILT
 IDEAL


Note:
To complate circuit for models $721,724,762,765$
768 and 791 open page it ond fold page 6 over page
8.


MODELS 1U-701, $-711,-714,-721,-724,-752,-755,-762,-765,-768,-791$

| 9 | Ungrounded convertor tube (6U8) shield | 4.5 Mc . | In series with 47,000 ohm res. to junction of R-46 and L-16. See fig. 6 | Tuner on channel 3. 3 volts bias across C-49 positive side to ground. Locality switch in strong NOTE: Position. See fig. 6 slug out as far as possible. | $\begin{aligned} & T-1 \text { (top) for } \\ & \text { maximum reading. } \\ & \text { Soe fig. } 5 \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 10 | Ungrounded converter tube (6U8) shield | 45.75 MC . | In series with 47,000 ohm res. to iunction of R-46 and L-16. See fig. 6 | Tuner on channel 3. 3 volts bias across C-49 positive side to position. See fig. 6 | $\begin{aligned} & \text { T-10 (top) for } \\ & \text { maximum foading. } \\ & \text { Soo fig. } 5 \end{aligned}$ |

NOTE 3: For visual check of IF response curve (see fig. 3) connect signal and sweep generator to ungrounded converter tube shield (6J6). Connect oscilloscope in series with $\mathbf{4 7 , 0 0 0}$ ohm resistor to iunction of $R-46$ and L-16.

## TUNER R-F ALIGNMENT

note 4: never adjust C-3, C-4 and C-12 UNLESS absolutely necessary. (CU-4, CU-5 and CU-15 on Vhf-uhf tunor). they ARE FACTORY PRESET BY SPECIAL EQUIPMENT

| $\begin{aligned} & \text { Stopp } \\ & \text { No. } \end{aligned}$ | Connect Morker Generotor to | $\begin{gathered} \text { Marker } \\ \text { Gen. Freq. } \end{gathered}$ | $\begin{gathered} \text { Connect Sweep } \\ \text { Gen. to } \end{gathered}$ | $\begin{gathered} \text { Sweep } \\ \text { Gen. Chon. } \end{gathered}$ | $\begin{gathered} \text { Connect } \\ \text { Oscilloscope to } \end{gathered}$ | Miscellaneous Connections | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 11 | Loosely couple to sweep gen. leads. | $\begin{aligned} & 205.25 \mathrm{Mc} \text {. } \\ & 209.7 \mathrm{nd} \mathrm{Mc} \text {. } \end{aligned}$ | 300 ohm an. tenna terminals. | 12 | Lead extending from top of tuner. See fig. 5 | Tuner on channel 12 3 volt bias to junc. switch in strong position. | C-3, C-4 and C-12 for max, response having inear peaks with pic fure and sound markcesponse. See fig. 4 |

NOTE 5: FOR rf oscillator alignment set vhf tuner to highest vhe operating channel in your area set fine tuning control to center position (flat of shaft facing up.) adjust C-is (Cu-18 ON Vhfulu tuner) for best picture detall on a test pattern of a iv station.
adjust individual channel slugs for best picture detail on all operating channels with a tes pattern of a tv station. note: use a non-metallic screwdriver.
NOTE 6: T-2 (TU-1 in VHF-UHF Tuner, see fig. 5) part of a 40 MC . tuned trap noed only be odiusted when local interferences from 40 TRIMMER LOCATION AND ALIGNMENT CONNECTION POINTS


FIG. 5
OJohn F. Rider



HEIGHT CONTROL
This control increases the overall height of the picture When making this adjustment it is sometimes necessary to also adjust the VERTICAL LINEARITY to obtain a picture that is correctly proportioned.

## ELECTRICAL SPECIFICATIONS

Power Supply................ 110 to 120 Volts 60 Cycle AC Power Consumption $\qquad$ 130 Watts

Antenna Input $\qquad$ 300 Ohms Balanced
Tuning Rang ..... 12 Channel C2 Chan Mode 921. 924, 991
Tuning Range . Channel Models 921, 924, 991 Loud Speaker $\qquad$ " PM Models 901, 911, 921, 991 $8^{\prime \prime}$ PM Models 914, 924

Voice Coil Impedance 3.2 Ohm at 400 Cycles I.F. CIRCUIT Inter-Carrier Sound
R.F. STAGE One
I.F. STAGES Three "Combined Picture and Sound" and one "Sound" 21.9 M.C. Sound Carrier 26.4 M.C. Video Corrier
4.5 M.C. Inter-Carrier Sound

## CABINET AND CHASSIS

## REMOVAL INSTRUCTIONS

IMPORTANT: The cabinet of the table model receivers can be removed from cabinet base for serv ice adjustments. Care should be taken that only the proper screws are removed when separating cabinet from cabinet base

REMOVING CABINET FROM CABINET BASE (TABLE MODELS ONLY)

1. Remove all control knobs and cabinet back.
2. Remove antenna terminal plate from cabinet and disconnect speaker leads.
3. Place cabinet face down on a soft clean cloth. 4. Remove ONLY the cabinet mounting screws located under and on the outer edges of cabinet base. DO NOT REMOVE CHASSIS MOUNTING SCREWS. Remove the 2 wood screws from the lower rear corner support braces of cabinet.
4. Carefully guide cabinet and cabinet base to its normal upright position. Remove cabinet by lifting straight up.

## REMOVING CHASSIS BASE FROM CONSOL

 CABINETS1. Remove all knobs and cabinet back.
2. Remove antenna terminal plate from cabinet and disconnect speaker leads
3. Remove the screws under guide rails of chassis base and the one screw under center support bridge
4. Slide chassis base out.


DEFLECTION YOKE ADJUSTMENT The deflection yoke must be positioned as far forward as possible on the neck of the picture tube and centered
around the picture tube neck at the same time. To make this adjustment, loosen screws " $A$ " and " $B$ " enough to permit the yoke bracket to be pushed forward. While holding the bracket in this position, tighten screws " $A$ " and "B." If the picture is tilted, loosen wing nut " C " on the top side of the yoke. Then, rotate the yoke to left or right as required to make the picture parallel with respect to top and bottom of window frame. Be sure to hold the yoke in position while tightening the wing nut.

## VERTICAL LINEARITY CONTROL

This control increases or decreases the height of the upper portion of, the picture.

## BRIGHTNESS, CONTROL

This control is used in adjusting for brilliance or light inThis control is used in adjusting for brilliance or light in-
tensity of the screen. When picture is too light adjust tensity of the scree
Brightness Control.
NOTE: The Brightness Control has an extended shaft that permits adjustment from the rear of the cabinet without removing the cabinet back.

## ION TRAP ASSEMBLY

Maximum brightness will be determined by the position of the ION TRAP ASSEMBLY:
I. Advance BRIGHTNESS CONTROL on rear of chassis to maximum brightness position.
2. Adjust the ION TRAP ASSEMBLY for maximum bright ness by sliding back and forth and rotating to right or left.
3. Reduce BRIGHTNESS with BRIGHTNESS CONTROL and repeat adjustment of ION TRAP for best positioning.
CAUTION: IF A SEMI-CIRCULAR SHADOW AROUND CORNER O PICTURE OR PATTERN IS OBTAINED, DO NOT ELIMINATE WITH
ION TRAP, IF BY SO DOING THE INTENSITY OF THE PATTERN is decreased.
BUZZ CONTROL See "Sound Alignment" SERVICING FRONT OF CHASSIS

It may be possible to obtain better focus with reDisconnect picture tube socket ion trap, IIV con- placement picture tubes, if the electronic focus nector, and AC receptacle before removing chassis anode is connected to a point other than the +150 rom chassis base.
If picture tube is required while servicing front of chassis, proceed as follows:
Remove yoke wingnut, and turn yoke around This receiver employs a series-parallel filament circuit to face rear of chassis.
2. Turn chassis around and carefully slide round neck of picture tube
3. Tape yoke to bell of picture tube.
4. Add a jumper wire between HV connector and
econd anode of picture tube.
5. Replace ion trap and picture tube socket.

Receiver should never be operated with any tube removed

1. VISUAL INSPECTION: Turn receiver "ON" and make a visual inspection of all tubes to see if they light up. All tubes except 1X2B will have an apparent glow.
2. IF ALL TUBES DO NOT LIGHT UP: Replace the 12 AX 4 (V-111), 12BH7 (V-110), 6SN7 (V-107) Check continuity across pins 1 and 12 of picture tube.
Check resistance of R-153 (tube life extender) - 125 ohms (cold).

## FOCUS


#### Abstract

\section*{HORIZONTAL LOCK}

If the range of the Horizontal Hold Control is insufficient to lock in a single stationary picture the Horizontal Lock trimmer will require adjustment. See "Horizontal Blocking Oscillator Alignment' ${ }^{\prime}$

CENTERING MAGNET ADJUSTMEN If the picture is off center and or has neck shadow rotate either or both centering magnet levers to the right or left is free of all neck shadow. Then readjust the lon Trap.

HORIZONTAL FREQUENCY ADJUSTMENT If the Horizontal Hold Control is insufficient to lock in a ingle stationary picture, the Horizontal Frequency Ading Oscillator Alignment ${ }^{\prime \prime}$


Suggested points to try are : chassis ground, +260 volts, +285 volts (picture tube pin 10) and +480 volt line.




## SOUND ALIGNMENT

| $\begin{aligned} & \text { Step pp } \\ & \text { No. } \end{aligned}$ | Connect Signal Generator Through a ol Capacitor | Signal Gen. Freq. MC. | Connect | Miscellaneous Connections and Instructions | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Cathode of Pic- ture Tube | 4.5 mc . | Across secondary of output trans. Tio5. | Use a high input level on signal generator. | Adiust Llo9 (rear slug) for minimum reading. |
| 2 | Pin 8 of V104. | 4.5 mc . <br> FM modulated <br> 400 c.p.s. <br> 25 kc <br> deviation | Across secondary of output trans. Tlo5. | Set Burz Control (R132) to approximatoly $90^{\circ}$ from clockwise stop. Sot the Volume Control (R135) at a low level. | L106 for maximum reading. |
| 3 | Pin 8 of V104. | 4.5 mc . <br> FM modulated <br> 400 c.p.s. 1 <br> 25 kc. <br> deviation | Across secondary of output trans. TIO5. | Set Buzz Control (R132) to approximately $90^{\circ}$ from clockwise stop. Set the Volume Control (R135) at a low level. | LIII for maximum reading keeping in put signal at a low level (below limiting). |
| 4 | Pin 8 of V104. | 4.5 mc . <br> FM modulated <br> 400 c.p.s., <br> 25 kc . <br> deviation | Across secondary of output trans. Tlo5. | Set Buzz, Control (R132) to approximatoly $90^{\circ}$ from clockwise stop. Set the Volume Control (R135) at a low level. | Ll09 (front slug) for maximum reading keoping input signal at a low leval. |
| 5 | Pin 8 of V104. | $\begin{aligned} & 4.5 \text { mc. } \\ & \text { AM modulatod } \\ & 400 \text { c.p. } . \text {. } \end{aligned}$ | Across second ary of output trans. TIO5. | Use a high input level on signal generator. | Buzz Control (R132) for null (minimum reading). |
| 6 | Pin 8 of V104. | 4.5 mc <br> FM modulated <br> 400 c.p.s. <br> 25 kc <br> deviation | Across secondary of output trans. Tlo5. | Set the Volume Control (R135) at a low level. | Re-peok LiOb for maximum reading. |

## I.F. ALIGNMENT

All lead connections from the signal marker generator and sweep generator must be shielded. Keep exposed ends and round leads as short as possible (about one inch). Always locate the ground lead connections as close as possible $t$ their respective "hot" leads in the television receiver chassis. The sweep generator output, signal generator output, and
VIDEO I. F. ALIGNMENT (with VTVM)

| $\begin{aligned} & \text { Step } \\ & \text { No. } \end{aligned}$ | Connect Signal Generator Through a . 01 Capacitor | Signal Gen. Freq. MC. | Connect VTVM | Miscellaneous Connections and Instructions | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Test Point No. 2 on Tuner (closest to $\mathrm{L9}$ slug adiustment). | 24.4 mc. | Junction of RII 8 and ClI 3 and chassis. | Connect 3 volt bias battery negative lead to white lead from tuner, positive lead to chassis. | T101 for maximum indication on moter limit input to make peak less than -2 volts D.C. on VTVM. |
| 2 | Test Point No. 2 on Tuner (closest to L9 slug adjustment). | 22.9 mc . | Junction of RII8 and CII3 and chassis. | Connect 3 volt bias battery negative lead to white lead from tuner, positive lead to chassis. | L103 (rear slug) for maximum. Use first peak from tinnerman clip end of coil. |
| 3 | Test Point No. 2 on Tuner (closest to L9 slug adiust ment). | 21.9 me . | Junction of RII 8 and Cll3 and chassis. | Connect 3 volt bias battery negative lead to white lead from tuner, positive lead to chassis. | L103 (front slug) for minimum. Input lovel should be high enough to produce at least 5 volts at null on VTVM. Use first null obtained from end of coil form opposite tinnerman clip. |
| 4 | Repeat steps 2 and 3. |  |  |  |  |
| 5 | Test Point No. 2 on Tuner (closest to L9 slug adiust ment). | 25.5 mc . | Junction of R1I8 and Cll3 and chassis. | Connect 3 volt bias battery negative lead to white lead from tuner, positive lead to chassis. | LI02 for maximum. |


| 6 | Test Point No. 2 on Tuner (closest to $\mathrm{L9}$ slug adiustment). | 25.1 mc. | Junction of R1I8 and Clis and chassis. |
| :---: | :---: | :---: | :---: |
| 7 | Test Point No. on Tuner (closest to $\mathrm{C}_{2} 1$ trimmer screw). | 25.1 mc. | Junction of RII 8 and Clis and chassis. |


| Connect 3 volt bias battery negative lead to white lead from tuner, positive lead to chassis. | LIO1 (front slug), for maximum. Use first peak from tinnerman clip end of coil. |
| :---: | :---: |
| Connect a 100 ohm resistor in series with a 1000 mmf cap. across LIOI. | L9 (brass screw) on the Tuner for maximum. |

TO CHECK I. F. ALIGNMENT (with scope)
Excessive sweep input will overload the circuit and cause distortion in the wave form. Check for possible overload by
temporarily increasing and decreasing the signal input level and noting any change in the wave form.
esable amplitude. from the marker generator will also distort the wave form. Be sure to keep the marker at the minimum $\underset{\substack{\text { Sweep Gen. } \\ \text { Connected to }}}{\substack{\text { and }}}$

| Sweep Gen. Connected to | $\begin{gathered} \text { Scope } \\ \text { Connected to } \end{gathered}$ | Bias | Sweep Gen. Set to | Remarks |
| :---: | :---: | :---: | :---: | :---: |
| Ungrounded shield of $V_{2}$ and chassis. | High side of contrast control R120 and chassis. Con trast control at minimum contrast. | Connect 3 volt bias battery negative lead to white lead from tuner, positive lead to chassis. | Sweep from 20 to 30 megacycles. | Provide markers as shown on curve. <br> NOMINAL OVERALL I.F RESPONSE CURVE <br> A slight deviation in response curve is tolerable, but if any great deviation is noted, the I. F. stages will have to be realigned. |

A slight deviation in response curve is otolerable, but if ony
deviation is noted, the I. F. stages will have to be redigned.
R.F. AND MIXER ALIGNMENT

| $\begin{aligned} & \text { Stop } \\ & \text { Nop. } \end{aligned}$ | Station Selector | Oscilloscope | Bios | $\begin{aligned} & \text { Signal Generator } \\ & \hline 0 \end{aligned}$ | Adjust |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1. | Chan. \#10 | High side through a 10.000 ohm resistor to TPl on Tuner. GCo lead to Tuner Case | -1.5 volts to white load on tuner. | Signal Generator set to 195.5 MC ., 400 eycle 30\% AM modulated. Through Dummy Antenna to the Antenna lead-in. | C-3 for maximum 400 cyele response on scope. Remove signal Generator. |
| 2. | Chan. \#10 | High side through a 10,000 ohm resistor to Tpl on Tuner. Ground lead to Tuner Case. to Tuner Caso. | - 1.5 volts to white lead on tuner. | Sweep Generator to Antenna leadin through dummy antenna. Set Generator to sweep Channel 10 freq. Loosely couple Marker Generator to sweep output cable. Set marker to either 21.9 or 26.4 mc . | Adjust C5 \& C9, to produce a response curve similar to R.F. and Mixer Response Curve. |
|  |  |  |  |  |  |

Without disturbing the R.F. grid, R.F. plate, and mixer-grid trimmer, check the response on the other VHF TV channels by setting the station selector to the desired channel and changing the frequency of the sweep generator to correspond to the channel being checked. The response curve should be essentially the same on all channels and the markers should fall in similar positions on the response curve. A slight amount of tilt can be tolerated. The amount of tilt indicated by the relative amplitudes of the response curves where the picture and sound I.F. Markers rest should not exceed $30 \%$ of the over-all response curve amplitude.

## VHF OSCILLATOR ALIGNMEN

or rf oscillator alignment, set vhf tuner to highest vhf operating channel in your area. set fine tuning CONTROL to CENTER POSItion (flat of shaft facing up.) adjust C-2i oscillator tank trimmer for best picture detall on a test pattern of a tV station.
adjust individual channel slugs for best picture detall on all operating channels with a test pattern of a tV Station. note: use a non-metallic screwdriver.

John F. Rider


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SPECIFICATIONS

- Finest Dark Mahogany veneers and Blonde Oak cabinets - Filter-Ray tinted glass is removable from front by remov-- Access to chassis is accomplished by removing 2 screws - Luma-Dials provide soft indirect lighting of channel se-
lector and radio dial. - Picture tube guaranteed for one full year.

Model 551-210
Model $552-21^{\circ}$ Console TV. TV wi
With super-powered 3 gang AM radio.
Model $553-21^{\circ}$ Console TV with super-powered 3 gang AM
radio and slide out phono compartment (for VM 3-speed radio and slide out phono compartment (for VM 3-speed Record Cha
spindle).
 SHIPPING WEIGHT 140 lbs .
Model 5501-27" Console TV.
Model 5502-27"
Console TV with super powered 3 gang AM radio. ${ }^{\text {Model } 5503}$. ${ }^{27^{\prime}}$ Console TV with super powered 3 gang AM radio and slide out phone compartment (for VM
3-speed Record Changer with Hi-Fi Tone Arm and 45
RPM spindle).
 SHIPPING WEIGHT 167 lbs .
Model VM 950-271 Record Changer: $91 / 2 \mathrm{lbs}$. (packed sep-
arately).

## CABINET

## CHASSIS

 channcl selection lighter-durable. audio range.

Models 553 and 5503 are equiped with "slide our" Models 55 and 503 are equiped with slide our
compartments to accommodate an automatic 3 . comparmenecord Changer with a High Fidelity
speed VM Rece
tone arm that opens a new world of listening pleas. tone arm that opens a new world of listening pleas-
ure when records are played through SETCHELL ure when records are played thr
CARLSON'S HI-FI sound system.

- Chassis has ample power to produce a brilliant picture on tube sizes ranging from ic Self-Focusing ALUMINIZED Picture Tub for finest picture detail.
- Cascode tuner with dial controlled vernier.
- VHF and UHF pre-tuned strips assure instant accurate "snap-in"

Lifetime aluminum chassis-excellent conductor-rust-proof-

- 4 double tuned stages of IF and crystal video detector.
-44.25 M.C. Sound, 48.75 M.C. Pix, I.F. Pass Band.
- Horizontal output tube protected by automatic bias.
- Simplified picture centering. $\bullet$ Simple, efficient width control sleeve - Shielded horizontal deflection and hi-voltage supply
- Push-pull audio for high level wide range sound output 30 CPS
- Individual bass and treble tone controls permit full adjustment of
- Improved keyed A. G. C. circuit minimizes interference and incrases locking stabilit
Fused power nput circuit 105 to 125 volts AC - 220 watts.
radio). Plus 2 crystals and 2 rectifier tubes and picture tube (with
- Filaments of TV tubes turn off when radio or phonograph is in use - High gain, selective superheterodyne ( $535-1700 \mathrm{KC}$ ) AM radio with tuned RF Stage, 3 gang condenser.
New coupling utilizes T.V. antenna for radio reception
- Ahipping weithtadio include phono jack and AC phono outlet.


## INSTRUCTIONS AND INFORMATION

The Model K-56 black and white Television Monitor is a high quality low priced instrument for television broadcasting stations and other places where it is important to know the quality of picture, information which is being transmitted. Special care has been taken to insure a brilliant image acceptable for studio use, and a wide band video amplifier suitable for control room use. The "unitized" construction offers simplicity and speed of maintenance. It can be supplied to include audio amplifier and twin $6^{\prime \prime}$ speakers.

The video amplifier has internal-external sync provisions where composite and non-composite video signals may be encountered, and, rear chassis plug for wiring to permit remote switching. Local sync input is negative from .5 to 4 volts peak to peak.

The $17^{\prime \prime}$ kinescope is of the self or electrostatic focus type. This type of tube was chosen to insure finest full face focus regardless of line voltage changes and/or high voltage variation. The type 17 KP 4 as made by Dumont will be used as standard equipment unless otherwise specified. For replacement purposes any spherical face $17^{\prime \prime}$ tube can be used, such as the $17 H P 4$ made by RCA, Sylvania and other tube manufacturers. The type li7KP4, however, as made by Dumont produces a very small spot size which is far superior to older type selfduces a very
focus tubes.

Care should be taken to adjust the ion trap for best brilliance and focus after the centering magnets have been positioned.

Secondary controls are located in the front panel and are clearly identified. Instructions as to the adjustment of the yoke, centering and ion trap are located inside of the back cover.

The main power transformer is located on the chassis proper and all other units are removable. It was desirable to place the power transformer as far from the neck of the tube as possible to prevent sweep distortion.

The "E" unit, which is plug-in and removable, incorporated the vertical oscillator and output tube and is available with or without audio. All main chassis are wired to use either unit--with or without audio. The audio power output is 1.7 watts at 400 cps . at less than $10 \%$ distortion.

The "D" unit, which is plug-in and removable, incorporates two stages of video amplification, $D C$ restorer, wyc separator, sync amplifier, $A F C$ detector and internal-external sync control ampiifier.

The "F" unit, which is plug-in and removable, incorporates the horizontal oscillator, horizontal output, damper, high voltage rectifier, flyback transformer, etc.
Type designations of the units are as follows:


Speakers - 6" round, 312 ohm V. C.
Ion Trap - 55 gausses.
Kinescope - 17 KP 4 (preferred).
It is advantageous to have an extra unit or part as listed above to facilitate immediate service or repair of monitor, thus avoiding "time out."
The Model K-56 Monitor is covered by the standard RrMA warranty, which includes one year guarantee on the kinescope.

## SERVICE HINTS

It is recommended that a chassis having all units in good working order be used for checking units that are doubtful or after repair has been made. The resistance values as shown on the schematic were all taken with units removed from main chassis,
therefore, an "ohm meter" is all that is necessary for locating $90 \%$ of unit trouble.

1. If television reveiver is completely dead, no picture tube illumination and no soun check the power fuse located at the rear of the chassis. If all tubes (except piciure tube) light up check the B yoltage as supplied by the G Unit. Check the focus picture tube) coil continuity
short circuit. If picture tube face illuminates but no picture or sound, check first video amplifier 6AU 6 tube in D Unit. Check all tubes of the A and B Units. Check A, B and C Units. Check 2 K ohm 10 watt resistor supplying $B$ voltage to terminal $D-11$ of the $D$ Unit.
2. If there is picture information and no sound, check the tubes in the C Unit. Check the C Unit. Check the speaker voice coil. Check 2 K ohm 10 watt resistor connected to terminal C-10.
3. If there is sound but not picture information, and picture tube face is illuminated check the 3 ohm filament resistor on the 6AU6 tube ( $\mathrm{V}-15$ ) of the D Unit. Check all of the tubes of the D Unit. Check the D Unit. Check the 1 N 60 germanium crystal connected to terminal B-12 of the B Unit. Check the picture tube socket connections. Check the contrast control.
4. If there is sound and picture tube face does not illuminate, check the ion trap on the neck of the picture tube. Check the brightness control. Check all of the tubes in the F Unit. Check the F Unit. Check for continuity the horizontal coils of the yoke. Check the cathode voltage of the picture tube as shown on schematic pin \#11. Check the picture tube.
5. Excessive interference or sync buzz in the sound. This is usually remedied by adjusting the top slug of the ratio detector coil B13M19257, or replacing 6AL5 (V-9) tube in the $C$ Unit.
Be careful when adjusting C-4501, which is the sound take-off coil located in the C Unit This should be adjusted to exactly 4.5 mc . and not necessarily maximum sound. Adjustment of this coil may be made on station by noting the removal of 4.5 mc . Sound frequencies from appearing on the picture tube. Correct adjustment of this coil will eliminate the jagged vertical lines between the horizontal trace lines. The adjustment of this coil is critical as it not only is a sound frequency take-off coil, but is a 4.5 mc . trap to reduce or eliminate unwanted frequencies from appearing on picture tube.
6. Poor vertical linearity can usually be traced to the 6 V 6 GT tube or the output transformer of the vertical or E Unit.
7. Insufficient contrast may be caused by a weak 6AU6 first video amplifier (V-16) or $6 \overline{\mathrm{~K}} 6(\mathrm{~V}-14)$ second video amplifier. Too much contrast causing picture bending and/or pulling may also be traced to the first video amplifier 6AU6 tube located in the D Unit.
8. If poor picture information, check the D-2000 coils in the D Unit. Check the IN60 germanlum crystal in the $B$ Unit. Check all resistors and condensers associated with V-14 and V-16 tubes located in the D Unit. Check the alignment of the I.F. coils. Check the picture tube.
9. For poor vertical locking, check the resistors and condensers on terminals E-1 E-2, E-3 and E-4 of the E Unit. Check the resistor connected to terminal D-3 of the D Unit. Check the 12BH7 tube of the D Unit. Check the 6AU6 tube (V-15) of the D Unit and its 3 ohm filament resistor. Check the E Unit. Check the D Unit.
10. For poor horizontal locking, check the 12 BH 7 tube ( $\mathrm{V}-19$ ) in the F Unit. Try more than one tube before determining that it is not tube trouble. Check the 3.9 K resistor which connects the plate of the 12BH7 tube to the horizontal frequency coil. Check the 1500 ohm cathode resistor on the 12 BH 7 tube. Check the two 270 mmfd . silver mica condensers-use only $5 \% 500$ Volt DC silver mica condensers for replacement. Check the 6AL5 (V-12) and the 12BH7 (V-13) of the D Unit. Check the F Unit. Check the D Unit.
11. Insufficient width--check the 5 U 4 tube (V-23) in the G Unit. Check the 6BQ6 tube (V-20) in the F Unit. Check the 6W4 tube (V-22) in the F Unit. Check the horizontal drive condenser. Check the position of the yoke on the neck of the tube as it must be as far forward as possible. Check the F Unit. Check the G Unit. It is satisfactory to use a 24 ohm resistor in series with the selenium rectifier, however, the D-2002 choke provides for higher second anode voltage. The use of a 24 ohm resistor in place of this choke provides for additional sweep with about 1000 volts decrease in second anode voltage.
12. Blooming or loss of picture when attempting to increase brightness is usually caused by a poor 1X2A high voltage rectifier tube located in the $F$ Unit. It is possible, however, for a poor 6 BQ 6 or 6 W 4 tube to be responsible for such trouble.
13. To eliminate high voltage arcing around the \#2 anode terminal of the picture tube, it is recommended that at least a $6^{\prime \prime}$ area around the terminal be cleaned periodically with carbon tetrachloride
carbon tetrachloride " 15 . High frequency "sing" or noise coming from the F Unit is usually traced to the 6 W 4 tube $\frac{1}{(V-22)}$ or bracket of flyback transformer.
14. All units should be secured fairly tight to the main chassis by their mounting bolts for good grounding reasons.
15. On TV \#151 series, the yoke and focus coil housing should be grounded to the top of the F Unit by means of a metal strap at least $1 / 2^{\prime \prime}$ wide and no longer than necessary. This eliminates or reduces barkhausen.
16. Excessive vertical lines or shading on the left side of the picture tube can usually be traced to the yoke coil itself or the flyback transformer. The horizontal drive con denser, note 3 on schematic, should be properly adjusted before looking for this
trouble elsewhere.
17. Parts that have given some trouble in the field are as follows:
(a) The 3 ohm filament resistor on 6AU6 tube (V-15) of the D Unit. Do not eliminate but replace with new resistor.
(b) The $270 \mathrm{mmfd} .5 \%$ silver mica condenser located in the F Unit may test okay, but may cause an unstable horizontal oscillator condition.
(c) The 25 ma . selenium rectifier in the $F$ Unit should be replaced with a 65 ma selenium rectifier as the actual running load is 20 to 25 ma .
(d) The . 00047-20 KV condenser located in the F Unit has in some cases developed a partial short, thereby, causing arcing under 1X2A tube socket or loss of high voltage.
(e) The. 25 mfd .400 volt coupling condenser connected to the grid of the 6 V 6 tube (V-18) of the E Unit, in some cases has developed a leakage, thereby, causing poor vertical linearity.
(f) The 120 mmfd . condenser connected from terminal \#5 of the coil strip to ground of the A Unit has shorted out occasionally, which in turn burns out the 1 K ohm resistor. This refers to the pentode unit as well as the cascode unit.
(g) The 2000 ohm 4 watt focus control can be damaged if the set is turned on with the focus coil and yoke assembly plug disconnected.
(h) The use of the 3.9 K ohm resistor connecting the plate of the 12 BH 7 tube (V-19) to the horizontal frequency coil located in the F Unit provides a less critical circuit for 12 BH 7 tubes.
(i) 12AU7 tubes may be used as substitutes for 12BH7 tubes in the F and D Units.

## OJohn F. Rider



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ALIGNMENT PROCEDURE UNMODULATED (CW) GENERATOR METHOD
Step One: SOUND TRAP ALIGNMENT
A. Adjust all controls to normal operating position. Connect the R. F. Signal Generator to the grid of V-2 (Point A.) I. F. input adapter, as shown below.

C. Connect a 4.5 volt bias battery between Point $G$ and ground. (Positive terminal of battery to chassis ground.) Remove 6AU6 (VB).
D. Set R. F. Tuner to channel which gives minimum indication of voltmeter.
E. Adjust L25 and L26 for minimum indication on voltmeter at the specified frequency:

$$
\begin{aligned}
& \mathrm{L} 25=27.75 \mathrm{mc} \\
& \mathrm{~L} 26=21.75 \mathrm{mc}
\end{aligned}
$$

Step Two: PIX I F ALIGNMENT
A. Adjust L10, L27, L28, L29, L30, for maximum indication on voltmeter at the specified frequency.

| L10 | 22.5 | mc |
| :--- | :--- | :--- |
| L 27 | 25.25 mc |  |
| L 28 | 24.25 mc |  |
| L 29 | 23.25 | mc |
| L30 | 26.0 | mc |

Step Three: SOUND IF ALIGNMENT
A. Connect the R. F. Signal Generator to Point C.
B. Inject the 4.5 mc signal. (Frequency accuracy important
C. Connect VTVM from Point E to ground. Use - 10 volt DC Scale.
D. Adjust L33, T1, and T2 primary for maximum indication of voltmeter.
. Connect VTVM from Point F to ground. Use lowest D. C. Scale. Adjust secondary of T2 for zero output, as indicated by voltmeter. Note: It is possible to produce a positive or negative voltage indicated by varying this adjustment. The point where the voltage swings rom positive negatis improvement can be made.) F. Connect VTVM with detector probe from Point D
G. Adjust L37 for minimum indication on voltmeter.


Power supply. LeCTRICAL SPECIFICATIONS
A. Adjust all controls to normal operating position. Connect the sweep generator to the grid of V2 (point A). Connect a 4.5 volt bias battery between point G and ground. (Positive terminal of battery to chassis ground).
B. Connect the oscilloscope across R56 (point C) by means of the shielded cable and filter system shown below.

C. Adjust the R. F. sweep generator so that it sweeps from approximately 20 to 30 mc .
D. Adjust the oscilloscope so that the I.F. response is visible. (Set tuner to channel
where rotation of Fine Tuning does not change observed response.)
E. Inject proper marker signals as recommended by manufacturer of R. F. sweep generator used.
F. Observe the band width, relative position of the picture carrier, and flatness of the overall I.F. response curve. If necessary, slightly vary the tuning of the picture I.F. coils L10, L27, L28, L29, L30 until the picture I.F. response shown is obtained

- The solid curve depicts the ideal I.F. response while the dotted curves show permissable variatigns.



## alignment

. Set station selector to Channel 12
2. Connect oscilloscope thru 10,000 ohms to test point $T$ (Wire loop on top of tuner.)
3. For negative bias connect -3 volts DC to A.G.C. lead (white covered wire) from tuner.
4. Feed sweep generator into antenna terminals, sweeping Channel 12.
5. Adjust C3, C6 and C13 (upright screws on top of tuner) for flat top response curve and maximum gain. Check markers on all channels. They should fall in automatically on all channels.
VHF OSCILLATOR ALIGNMENT

1. Turn on set and select channel to be viewed.
2. Center fine tuning control.
3. Place a non inductive screwdriver through opening, and adjust oscillator coil for best picture and sound.
4. Repeat this adjustment for each channel that can be viewed in the area.

ADJUSTMENT SUGGESTIONS FOR PM FOCUS UNIT
UNDER NORMAL CONDITIONS, ALL FOCUS ADJUSTMENTS CAN BE MADE BY INSERTING A SCREWDRIVER THRU THE HOLE IN THE BAGK OF THE CABINET AND INTO THE SLOTTED END OF THE FOCUS CONTROL SHAFT. ROTATE THE SHAFT EITHER
CLOCKWISE OR COUNTER-CLOCKWISE UNTIL BEST OVERALL FOCUS IS OBTAINED. CLOCKWISE OR COUNTER-CLOCKWISE UNTIL BEST OVERALL FOCUS IS OBTAINED.

1. IT IS RECOMMENDED THAT THE PHYSICAL POSITIONING OF THE PM FOCUS UNIT BE PLACED SO THAT THE MOUNTING
BRACKET HAS THE TWO SELF-TAPPING SCREHS IN THE CENTER OF THE SLOT. bRaCKET HAS THE TWO SELF-TAPPING SCREWS IN THE CENTER OF THE SLDT.
2. IN THE EVENT THE BRIGHTNESS VARIES WHILE ADJUSTING THE FOCUS UNIT FOR BEST OVERALL FOCUS, MOVE THE FOCUS UNIT ASSEMBLY FORWARD (TOWARD THE YOKE) APPROXIMATELY 3/8" AND RESET THE ION TRAP FOR MAXIMUM bichtness then refocus (pm) Unit.
3. FOR BEST COMPROMISE, TO OFFSET VARIATIONS IN FOCUS WITH DIFFERENT BRIGHTNESS SETTINGS, MAKE ALL FINAL FOCUS ADJUSTMENTS AT A HIGH BRIGHTNESS CONTRIL, SETTING. -


## MISCELLANEOUS SERVICE HINTS

Horizontal Drive Adjustments:
With 125V.A.C. line adjust vertical deflection for $10 \%$ over-scan with best linearity then adjust horizontal linearity control for best linearity and follow with adjustment of horizontal width control for maximum width. Adjust horizontal hold control to its maximum counter-clockwise position. De crease horizontal drive control resistance until the compression near the center of the picture disappears. Reset horizontal hold control to its mid-
With 117 A . C. line volts the cathode current of the 6 CD 6 must not exceed 140 Ma . with zero beam current.

Hor. Oscillator Adjustment:
With 117 A. C. line volts and the horizontal hold control set at the mid-point of its range, adjust L-41 for synchronization with approx. zero volts from Pin $\# 1$ of V20 to ground as measured with a vacuum tube or other high impedance voltmeter. Vertical Peaking Control R130 (Part No. PA4465-1)

This control has been added on later models due to variation in 6BX7GT tubes. The control is adjusted for best vertical linearity at the top of the raster.

Adjustment of Anti-Pin Cushion Corrector Magnets:
These magnets are mounted on the deflection coil mounting bracket and can be moved in and out by first loosening the mounting screws. Under certain conditions it may be necessary to form, or bend the flexible arms which support the magnets. The above adjustment is made at the factory and should not require re-adjustment unless the original position of the magnets is accidently disturbed. Adjustment can be made in the following manner:
until the sides are visible.
2. Adjust the corrector magnets for straightest possible raster edges.

Restore the picture to normal size.




John F. Rider

VISUAL ALIGNMENT CHECK USING SWEEP GENERATOR
MARKER GENERATOR, AND OSCILLOSCOPE.
A. Adjust all controls to normal operating position. Connect the sweep generator to the grid of V2 (point A.) Connect a 4.5 volt blas battery between point G and ground. (Positive terminal of battery to chassis ground.)
B. Connect the oscilloscope across R32 (point C ) by means of the shielded cable and filter system shown below.

C. Adjust the R. F. sweep generator so that it sweeps from approximately 20 to 30 mc .
D. Adjust the oscilloscope so that the I.F. response is visible. (Set tuner to channel where rotation of Fine Tuning does not change observed response.)


Inject proper marker signals as recommended by manufacturer of R.F. sweep generator used.
F. Observe the band width, relative position of the picture carrier, and flatness of the overall I.F. response curve. If necessary, slightly vary the tuning of the picture I.F. coils L11, L13, L14, L15, until the picture I.F. response shown is obtained.

The solid curve depicts the ideal I.F. response while the dotted curves show permissable variations.


ALIGNMENT PROCEDURE UNMODULATED (CW) GENERATOR METHOD Step One: SOUND Trap alignment
A. Adrust all controls to normal operating position. Connect the R.F. Signal Generator to the
grid of $V-2$ (Point A.) I.F. input adapter, as shown below.

B. Connect VTVM across R32 (Point C.) Use low volts D. C. Scale
C. Connect a 4.5 volt bias battery between Point $G$ and ground. (Positive terminal of battery
D. Set R.F. Tuner to channel which gives minimum
D. Set R.F. Tuner to channel which gives minimum indication on voltmeter.
E. Adjust L12 for minimum indication on voltmeter at the specified frequency

$$
\mathrm{L} 12=21.75 \mathrm{mc}
$$

Step Two: pix if alignment
A. Adjust L11, L13, L14, L15, for maximum indication on voltmeter at the specified

| L 11 | 22.5 mc |
| :--- | :--- |
| L 113 | 25.0 mc |
| L 14 | 23.8 mc |
| L 15 | 26.0 mc |

Step Three: SOUND IF ALIGNMENT
A. Connect the R.F. Signal Generator to Point C.
B. Inject the 4.5 mc signal. (Frequency accuracy important.)
C. Connect VTVM from Point E to ground. Use -10 volt DC Scale,
E. Adjust L 25 and T1 primary for maximum indication on voltmete
for zero output, as indicated by voltender . Nowest D. C. Scale. Adjust secondary of negative voltage indicated by varying this adjust it is possible to produce a positive or from positive to negative is zery output and Indicates The point where the voltage swings from positive to negative is zero output and Indicates correct alignment. (If Ratio Detector is
seriously misaligned repeat alignment of primary and seriousiy misaligned repeat alignment of primary and secondary until no improvement
F. Connect VTVM with detector probe from Point D to ground. Use lowest DC Scale.
G. Adjust L19 for minimum indication on voltmeter.
electrical specifications


* CONversion "Sthips and converters" are available for standard TUNEE TO CONVERT REGULIR VHF TUNERS FOR RECEPTION OF SIGNALS I ANY UHF TELEVISION BAND.


## miscellaneous servicemints

VHF R.F. AND MDEER ALIGNMENT

1. Set station selector to Channel 12.
2. Connect oscllloscope through 10,000 ohms to test point $T$ (Wire loop on top of tuner.)
3. For negative blas connect -3 volts DC to A.G.C. lead (white covered wire) from tuner.
4. Feed sweep generator into antenna terminals, sweeping Channel 12.
5. Adjust C3, C8 and C13 (upright screws on top of tuner) for flat top response curve and maximum gain. Check markers on all channels. They should fall in automatically on all channels.

## vhF OSCILLATOR ALIGNMENT

1. Turn on set and select channel to be viewed.
2. Center fine tuning control.
3. Place a non inductive screwdriver through opening, and adfust oscillator coil for best picture and sound.
4. Repeat this adjustment for each channel that can be viewed in the area.

## MISCELLANEOUS SERVICE HINTS

## Horizontal Drive Adjustments:

With 125V.A.C. line adjust vertical deflection for $10 \%$ over-scan with best linearity then adjust horizontal linearity control for best linearity and follow with adjustment of horizontal width control for maximum width. Adjust horizontal hold control to its maximum counter-clockwise position. Decenter of the picture dive control resistance until the compression nar the position.

With 117 A.C. line volts, the cathode current of the 6BQ6 must not exceed 110 Ma . with zero beam current.

Horizontal Oscillator Adjustment:
With 117 A.C. line volts and the horizontal hold control set at the mid-poin of its range, adjust L-36 for synchronization with approx. zero volts from Pin \#1 of V-17 to ground as measured with a vacuum tube or other high impedance voltmeter.

INSTRUCTIONS FOR INSTALLATION OF UHF CHANNEL IDENTIFICATION NUMBERS.

UPON INSTALLATION OF THE UHF CONVERTER STRIPS, YOU MAY CHANGE THE ORIGINAL vHF dentification number on the channel selector knob to the desired uhf channel NOMBER. THE FOLLOWING INSTALLATION PROCEDURE IS SUGGESTED:

1. remove channel selector knob
2. REMOVE THE TWO SCREWS HOLDING CHANNEL INDICATOR INSERT.
3. WITH A SHAFP KNIFE OR SIMILAR INSTRUMELT, SCRAPE TEE UNDESIKED VHF CHANNEL NUMBEE FROM FRONT OF INDICATOR INSEKT. CAUTION:

4. MOISTEN ADHESIVE ON UHF STICKER aND PLACE IN POSITION.
5. ASSEMBLE INDICATOR INSERT TO KNOB, USING CAUTION NOT TC STRLP SCREWS
6. REPLACE KNOb.

SELECTOR IDENTIFICATION NUMEERS ARE SOPPLIED IN GREEN AND MAROON TO MATCH BOTH LOND AND MAHOGANY MODELS, AND WILL BE SHIPPED WITH YOUR SPAFTON TV FECEIVER. hey may be found in the custouer instruction envelope attached to thi back of THE SET.




OJohn F. Rider

ALIGNMENT PROCEDURE UNMODULATED (CW) GENERATOR METHOD
Step One: SOUND TRAP ALIGNMENT
A. Adjust all controls to normal operating position. Connect the R.F. Signal Generator to the grid of V-2 (Point A.) I.F. input adapter, as shown below.

B. Connect VTVM across R32 (Point C.) Use low volts D. C. Scale.

Connect VTVM across RS2 (Point C.) Use low voits D. C. Scale.
Connect a 4.5 volt blas battery between Point $G$ and ground. (Positive ter minal of battery to chassis ground.)
D. Set R.F. Tuner to channel which gives mimmum indication on voltmeter.

$$
\mathrm{L} 12=21.75 \mathrm{mc}
$$

Step Two: PEX if Alignment
A. Adjust L11, L13, L14, L15, for maximum Indication on voltmeter at the specified frequency:

| L 11 | 22.5 mc |
| :--- | :--- |
| L 19 | 25 mc |
| L 14 | 29.8 mc |
| L 15 | 26.0 mc |

Step Three: SOUND IF ALIGNMENT
A. Connect the R.F. Signal Generator to Point C.
B. Inject the 4.5 mc signal. (Frequency accuracy important.)
B. Inject the 4.5 mc signal. (Frequency accuracy important.)
C. Connect VTVM from Point $E$ to ground. Use -10 volt DC Scale.
D. Adjust L25 and T1 primary for maximum indication on voltmeter
E. Connect VTVM from Point $\mathbf{F}$ to ground. Use lowest D. C. Scale. Adjust secondary of T1 for zero output, as indicated by voltmeter. Note: It is possible to produce a positive or negative voltage indicated by varying this adjustment. The point where the voltage swings from positive to negative is zero output and indicates correct alignment. ( L Ratio Detector is seriously misaligned repeat alignment of primary and secondary until no improvemen
F. Connect VTVM with detector probe from Point D

Adjust L19 for minimum indication on voltmeter.

## electrical specifications

Power Supply. .......................................235 Watt
uwer Consumption ...................................... Maximum
Audio Power Output.. ............................... Tuning Range. $\qquad$ .............................. T.V. Channelss 2 thru 89
300 Ohms Balan

Antenna Input Impedance.. Intermeaiate Frequencies.
Intercarrier Sound System. Intercarrier Sound syst


ISUAL ALIGNMENT CHECK USING SWEEP GENERATOR, MARKER GENERATOR, AND OSCILLOSCOPE.
A. Adjust all controls to normal operating position. Connect the sweep generator to the grid of V2 (point A.) Connect a 4.5 volt bias battery between point $G$ and ground. (Positive terminal of battery to chassis ground.)
B. Connect the oscilloscope across R32 (point C) by means of the shielded cable and filter system shown below.

C. Adjust the R. F: sweep generator so that it sweeps from approximately 20 to 30 mc
D. Adjust the oscilloscope so that the I.F. response is visible. (Set tuner to channel where rotation of Fine Tuning does not change observed response.)
E. Inject proper marker signals as recommended by manufacturer of R.F. sweep generator used.
F. Observe the band width, relative position of the picture carrier, and flatness of the overall I.F. response curve. If necessary, slightly vary the tuning of the picture I.F. colls L11, L13, L14, L15, until the picture I.F. response shown is obtained. The solid curve depicts the ideal I.F. response while the dotted curves show permissable variations.


## MISCELLANEOUS SERVICE HINTS

## Horizontal Drive Adjustments:

With 125V.A.C. line adjust vertical deflection for $10 \%$ over -scan with best linearity then adjust horizontal linearity control for best linearity and follow with adjustment of horizontal width control for maximum width. Adjust with adjustment of horizontal width control for maximum width. Adjust horizontal hold control to its maximum counter-clockwise position. Decenter of the picture disappears. Reset horizontal hold control to its midposition.

With 117 A.C. line volts, the cathode current of the 6BQ6 must not ex ceed 110 Ma . with zero beam current.

Horizontal Oscillator Adjustment:
With 117 A.C. line volts and the horizontal hold control set at the mid-point of its range, adjust L-36 for synchronization with approx. zero volts from Pin \#1 of V-17 to ground as measured with a vacuum tube or other high impedance voltmeter.

## Adjustment of Anti-Pin Cushion Corrector Magnets:

These magnets are mounted on the deflection coil mounting bracket and can be moved in and out by first loosening the mounting screws. Under certain conditions it may be necessary to form, or bend the flexible arms which support the magnets. The above adjustment is made at the factory and should not require re-adjustment unless the original position of the magnets is accidently disturbed. Adjustment can be made in the following manner:

1. With the size controls reduce the size of the raster until the sides are visible.
2. Adjust the corrector magnets for straightest possible raster edges. Restore the picture to normal size.

Misadjustment of the corrector magnets may cause barreling, keystoning and/or poor linearity.


CHASSIS 24U214



Sparton 21 Inch Cornell Mahogany Console Mahogany Console


Sparton 21 Inch Princeton Mahogany Console Model 12A210

*Total harmonic distortion $8 \%$ at 400 cycles.
Power Supply.

105-125 Volts AC 60 Cycle only
Power Consumption $\qquad$
Audio Power Output
$\qquad$
Antenna Input Impedance. $\qquad$ Maximum 2.5 Watts *
Intermediate Frequencies m..
Intercarrier Sound Syst
Voice Coil Impedance.

Sparton 21 Inch Stanford Mahogany Table Model Mahogany Table Mode

BRIEF ELECTRICAL SPECIFICATIONS

SUGGESTED ALIGNMENT PROCEDURE
Since the picture I. F. system in the receiver consists of a flat staggered triple (V4, V5, \& V6) preceded by a double tuned, over coupled converter stage, it is necessary to align the picture I. F. in two steris. First, the triple is aligned for a flat overall response from the first picture 1. F. grid. Second, the coupled converter stage is aligned against the flat response of the triple to produce the desired I. : response characteristic.

Picture I. F. Alignment -
Conditions:
A. V7 (6AU6) tube removed from socket
B. -4.5 volts applied across C48, Test Point \#7
C. Tuner set to Channel $\# 12$ or some other high channel
D. Adjust all other controls for normal picture
E. Signals applied to grid of V4 (1 st Pix I. F.) thru suitable adapter (Fig. \#1).
F. Connect V.T.V.M. across diode load R48 using low volts DC scale, Test Point \#3


Note: When applying signal to V2 remove 6 U8 (converter) and wrap small insulated wire around Pin \#2. Strip enough to go around and make contact on Pin \#2. Replace tube.

ALIGNMENT OF TRIPLE
FIG. \#1

Step 1. Unmodulated generator set at 43.8 Mc then adjust T 1 for maximum meter indication on V.T.V.M.
2. Unmodulated generator set at 45 Mc adjust L32A (bottom) for maximum meter indication on V.T.V.M.
3. Unmodulated generator set at 42.7 Mc adjust L31A (bottom) for maximum meter indication on V.T.V.M.
4. Unmodulated generator set at 47.25 Mc adjust L32B (top) for minimum dip indication on V.T.V.M.
5. Unmodulated generator set at 41.25 Mc adjust L31B (top) for minimum dip indication on V.T.V.M.
6. Remove V.T.V.M. and connect scope to Test Point \#3. Adjust generator to sweep 40 to 50 Mc . Touch up T1, L32A, L31A for flat response from 42.7 Mc to 45.0 Mc . Fig. \#3.
7. Inject marker signal at 41.25 Mc and 47.25 Mc as recommended by manufacturer of R. F. Sweep generator used. Check alignment of traps L31B and L32B. This completes alignment of triple.

OVERALL ALIGNMENT
Step 1. Apply signal to grid of V2 (converter) thru suitable adapter. Fig. \#1. (For overall response curve check).
2. Apply -3 volts bias to tuner, Test Point \#2 thru 100K resistor (see Fig. \#1). ( -4.5 volts remains connected to Point \#7).
3. Remove scope and connect V.T.V.M. to Test Point \#3.


VERT.


FIG. \#2
4. Unmodulated generator set at 41.25 Mc adjust L 30 B for minimum dip indication of V.T.V.M.
5. Detune L 14 on tuner to high frequency limit. (Core out of coil-maximum counter-clockwise)
6. Unmodulated generator set at 43.8 Mc align L30A (bottom) for maximum meter indication on V.T.V.M.
7. Shunt L30A with 1 K resistor.
8. Unmodulated generator set at 43.8 Mc align L14 (Tuner output) for maximum meter indication on V.T.V.M.
9. Adjust generator to sweep from 40 to 50 Mc . Observe the bandwidth, relative position of pix carrier, and flatness of the overall I. F. response curve. Fig. \#3. If necessary, slightly vary the tuning of L14 and L30A for flat response between 42.7 Mc and 45.0 Mc . Picture carrier ( 45.75 Mc ) should be down $50 \%$.
10. Inject markers at 41.25 Mc and 47.25 Mc , check alignment of traps (over swept curve) L31B (top) and L32B (top).


FIG．\＃3 DEAL I．F．RESPONSE WITH PERMISSABLE VARIATIONS

Sound I．F．Alignment：
A．Connect R．F．Signal Generator set at 4.5 Mc between the anode of the crystal video detector and chassis ground．

B．Connect V．T．V．M．across R77，Test Point \＃5（use－10V scale）．
C．Adjust L45 for maximum indication．
D．Align T2 primary（bottom）and secondary（top）for maximum indication．
E．Align T3（bottom only）primary for maximum indication．
F．Connect V．T．V．M．across C85，Test Point \＃6．
G．Using lowest DC scale，adjust T3 Ratio Detector secondary（top）to zero output， as indicated by V．T．V．M．

Note：It is possible to produce a positive or negative indication by varying this adjust－ ment．The point where the voltage swings from positive to negative is zero output and indicates correct alignment．（If Ratio Detector is seriously misaligned，repeat align－ ment of primary and secondary until no improvement can be made）．

H．Using an R．F．Probe，connect V．T．V．M．across R57，Test Point \＃4．
I．Adjust L38（ 4.5 trap ）for minimum dip indication．
General Note：It may be possible to find two positions at which tuning slugs resonate coils being aligned．In the case of all multiple winding coils only one position，the one with the tuning slug nearest the end of the coil form，is correct．The other slug position will change coupling between windings and cause improper circuit operation．

## INSTALLATION INSTRUCTIONS



Ion Trap and Focus
THIS ADJUSTMENT IS IMPORTANT TO LIFE OF PICTURE TUBE AND SHOULD BE MADE ON EVERY SET AS FOLLOWS：
1．With brightness control set for low brilliance，move trap forward or backward and at the sam time rotate until maximum brightness of raster is obtained
2．Readjust raster brilliance to normal．
3．Adjust focus control until best picture detail is observed over entire face of picture tube．
4．Readjust ion trap once more for maximum brilliance．
THERE MAY BE TWO LOCATIONS WHERE ION TRAP WILL PRODUCE BRILLIANCE ON CRT； USE ONLY THE POSITION NEAR THE CRT BASE SOCKET；NEVER USE THE FORWARD POSITION Deflection Yoke
1．The yoke must be held firmly against the flare of CRT．
2．To level picture，loosen and adjust wing nut on yoke．
Centering Raster
1．Center with magnet control tab on focus unit．
2．Readjust ion trap for maximum brilliance．
Picture Symmetry
Sometimes linearity and corresponding size controls may have to be re－adjusted．A test pattern is most practical for these adjustments which consist of HEIGHT，VERT LIN．，WIDTH，and HOR LIN．
Peak Performance Contro
1．With receiver operating，set the peak performance control to extreme counter－clockwise position （fringe area）．
2．Tune in strongest signal in your area．
3．Set contrast to maximum（extreme clockwise position）．
4．If picture appears normal leave control set in fringe position．
5．If picture shows any signs ov overload，rotate control clockwise towards local position until picture becomes normal．
6．Do not turn control toward local position any more than necessary
Horizontal Oscillator（Make only when necessary）
1．Pull 6AL5（phase detector）．
2．Set hor．hold to center of range．
．Shunt L47 with ． 1 MFD 400 V condenser from test point on high voltage transformer to ground．
4．Adjust R133 until picture floats in horizontal sync
5．Remove .1 condenser and adjust L47 until picture floats in horizontal sync．
7．Replace 6aL5．
Pull－in should occur when 2 or 3 diagonal bars are observed as hor．hold is rotated towards center of range


## CAUTION: DOUBLE TUNED I. F. COIL ASSEMBLY PERMITS ADJ. OF BOTH SLUGS FROM TOP OR BOTTOM OF CAN.

A. This tool end permits adj. of top slug (from
top) and bottom slug (from bottom).
B. This tool end permits adj. of both from either end since it will pass on thru the tuning slug.
1.F. Tube Replacement

Due to the fundamental characteristics of 45 Mc I.F. circuits we would like to express a word of caution. To minimize any detuning effects caused by differences in interelectrode capacities it is suggested that several tubes of same type and make are tried to obtain original quality picture.

## pooks

The damper-tube current rises from zero to a maximum of 300 to 400 milliamperes in $1 / 10$ microsecond or less. A wave form with such a short rise time is certain to contain many harmonics (of 15,750 cycles). If these harmonics are allowed to radiate and be picked up by the RF and IF circuits they will there be amplified, detected, and applied to picture tube, resulting in a narrow vertical line "Dery close to the left edge of raster. Since the damper is the principal offender, the SPARTON Dyna-Volt" chassis incorporates RF chokes in cathode and plate to minimize the "spook". Since the energy in each higher harmonic becomes progressively less, the spook is most noticable in the ower VHF channels.

TUNER DISASSEMBLY:
CAUTION: TUNER MUST BE IN THE VHF POSITION WHEN REMOVING TURRET TO PREVENT DAMAGE TO UHF DECADE STRIPS. WHEN REPLACING COVER, NOTE POSITION OF PIGTAIL LEADS TO ROCKER BAR SO AS NOT TO PINCH OR SHEAR WIRES UNDER COVER

## FOCUS ADJUSTMENTS:

Under certain conditions the focus may be improved by adjusting focus unit mounting brackets to ocate the focus unit approximately $4-1 / 4$ to $4-3 / 8$ inches from the base of the picture tube (meas ured from the end of center locating key of duodecal base). With the ion trap set as previously described, adjust the focus control for best overall picture detail.
CAUTION: READJUST ION TRAP AFTER ALL ADJUSTMENTS OF FOCUS.

## Replacing Crystal Video Detector:

If replacement of crystal becomes necessary, be sure to prevent exposing crystal to excessive heat Holding crystal lead with long nose pliers placed between crystal and soldering lug will help conduc heat away from crystal.

## Horizontal'Drive Adjustments:

With 125V A.C. line adjust vertical deflection for $10 \%$ over-scan with best linearity, then adjust horizon tal linearity control for best linearity and follow with adjustment of horizontal width control for maximum width. Adjust horizontal hold control to its maximum counter-clockwise position. Decrease horizontal are control resistance until the compression near the center of the picture disappears. Reset horizontal hold control to its mid-position

## Adjustment of Anti-Pin Cushion Corrector Magnets

These magnets are mounted on the deflection coil mounting bracket and can be moved in and out by firs loosening the mounting screws. Under certain conditions it may be necessary to form, or bend, the flexible arms which support the magnets. The above adjustment is made at the factory and should not require made in the following manner:

1. With the size controls, reduce the size of the raster until the sides are visible.
2. Adjust the corrector magnets for straightest possible raster edges. Restore the picture to normal size.

## Cleaning Picture Tube Face:

Remove three screws in the decorative bottom rail and carefully lower safety glass from cabinet. Observe great care while cleaning picture tube face, especially when replacing safety glass. A sharp blow on face of exposed tube could result in personal injury.

NOTE: Relocation of Horizontal Oscillator Tank Coil, L-47.
The accessibility of the adjustment for the L47 has been sacrificed in favor of improved set performance by relocating the L47. The new position is indicated on chassis top and bottom view diagrams.

$\qquad$

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## GENERAL

The Standard Tuner is the "front-end" in millions of television receivers. It is a vacuum-tube frequency selecting device whereby the television receiver may be selectively "tuned" to any one of twelve available television channels.
Electrically, the tuner consists of a runed r-f amplifier
stage with resonant grid and plate circuirs, a tuned mixer stage with resonant grid and plate circuits, a tuned mixer
stage, and a variable frequency oscillator. The input cirstage, and a variable frequency oscillator. The input cir-
cuit of the tuner accepts the modulated picture and sound carriers; the output circuit delivers individual or common sound and picture i-f output for further processing in the receiver. The input circuit of the tuner is designed for use with balanced 300 -ohm transmission lines. The mixer output circuits are designed to supply i-f signals between 19 and 26 mc in one group of tuners, and from 40 to 46 frequencies are subject to specific selection to suit different designs of receivers.


Fig. 1. A view of the rurret and a matched pair of channel-9 coil strips.

Selection of television channel frequencies is accomplished by changing the position of a rotatable rurret which plished by changing the position of a rotatabe turret which
carries the coils for the tuned circuits. The resonant coils for each television channel are divided between two mounting strips which are spring attached to the turret. One strip carries the antenna coils and grid coil for the r-f stage; the other strip mounts the tuned plate coil for the r-f stage, the grid coil for the mixer, and the oscillator coil. The remaining circuit components are fixed
in position on the tuner chassis, A view showing the in position on the tuner chassis, A view showing the
turret and a "matched-pair" of coil strips for television channei 9 , removed from their places on the turret, appears in Fig. 1. The entire mechanical arrangement gives rise to the term "turret tuner" as identification of the Standard Tuner.

Rotating the turret by means of the station selector shaft connects the appropriate coils to the tubes and associated circuitry, by placing the coil contacts in elecrrical junction with a set of fixed position contact fingers ments. The contact finger mounting is illussrated in Fig 2 Eight basic types of the Standard Tuner have been upplied to the TV receiver manufacturing industry. Each bears a type number indicative of the basic tuner design series. These tuners differ in a number of ways, among these being the type of tube used for the r-f amplifier and the circuitry. The first four types use a pentode r-f mplifier, hence they bear the general identification of "pentode" tuners. The remaining four types of tuners of the circuit arrangement used in their r-f amplifie stage. These four use a dual-triode r-f stage, described in complete detail under the heading of The Cascode Series of Tuners (as is the circuitry used in the pentode group)
Regardless of differences in tubes and circuitry, a gen eral order of identifying features has been retained. Being distinctive and unique, these features enable immediate recognition of the Standard Tu


Fig. 2. Photograph showing the contact-finger mounting Fig. 2. Ph version of the Standard Tuner (TV 200 series)

## Identifying Features

An early version of the Standard Tuner is shown in Fig. 2. Specifically this is the second production (Type TV 200 series), but with few exceptions, its genera
which followed are identical to its predecessor, and those hich followed.
The general physical outline of the device is a rectangular box, with two shielded tubes mounted on the top. Two tubes with shields of like diameter and beight to thify the entire pentode series of tuners. Adjacent
to tube farthest from the front wall of the tuner is the antenna input. This location is consistent in all models of the Standard Tuner and is another identification. Also mounted on top of the tuner are three, four, or five variable adjustments, as the case may be. In addition, the top of the tuner is the location for the r-f test" point used for runer response curve determination. dielectric disc attached to the outer drive shaft, more appropriately identified as the "fine tuning" shaft. This disc tunes the oscillator. All versions of the Standard Tuner, except the very first, mount the fine tuning dielectric disc on the outside of the front wall. The early production of TV 100 series tuners used a circular dielectric disc for the same purpose, except that it was located inside the tuner, behind the front wall. In all instances, he dielectric disc moves between a "hot stator plate tration.
The TV 100 series used rivet shaped contacts for the stator as well as drum contacts. The stator contacts were staked to flat, dual, cantilever springs which were in turn riveted to molded strips in the stator bracket. All other
series of the Standard Tuner use stator contacts of series of the Standard Tuner use stator contacts of
flat spring stock, folded into a "kidney shaped" loop. In flat spring stock, folded into a "kidney shaped" loop. In conjunction with the change to this "kidney spring" conact, the rivet contacts on the coil drum were raised above ribs along the plastic segments.
A later version of the Standard Tuner is shown in Fig. 3. It is representative of the entire cascode group. One distinctive feature added to the others enables immediate


Fig. 3. Later version of the Standard Tuner which is representative of the cascode group.
recognition of the cascode series: a wider and bigher tube shield for the r-f stage is used on the tube near est the antenna input than for the mixer-oscillator tube When the Standard Tuner uses differently dimensioned rubes (and shields) it is a cascode tuner; when it use mensioned tubes and shields it is a pentod tuner.
A feature common to all cascode tuners and pentode tuners after the TV 200 series, is complete shielding minimizes radiation from the tuner. The orher identify ing features are the same as previously described in con nection with Fig. 2 .
Attention is called to possible departures from the ap pearance of the top of the Standard Tuners shown Figs. 2 and 3. These may be encountered in television re special traps or even the first video i-f transformer in the tuner. These components are usually, though nor al ways, mounted on the top of the tuner, consequently modifying its physical outline. They do not, however alter the general identifying features as described here Hence ease of recognition of the Standard Coil produc is not reduced.
in Fig. 4. The numbers refer to the part's nuer is shown in Fig. 4. The numbers refer to the part's nomenclature a number of desirable electrical features, as well as con venient accessibility and disassembly. The underside of the chassis is divided into two compartments by the shield (22). The turret is removable as a unit. When set to a specific relevision channel, the turret is held firmly in place by means of the spring (8) pressure exerted on a detent roller (7), which is in firm contact with the from the center of the turret. The detent roller spring is another positive identification of the Standard Tumer. The contact finger bracket (21) is shown in position and also removed from the unit. The lugs at the top o the contact bracket are the connecting points for the circuit components (the capacitors and resistors). Re moving the side wall shield affords access to some of the components and also to the pins on the tube socket the coil mounting strips (4i through 52 and 53 removed from the turret. These snap into position (on the turret) and are held firmly in place by spring ten sion. The fingers of the spring can be seen on the fron side of the turret, similar spring fingers are located on the opposite end. The smaller coil strips mount the antenna transformer primary and secondary windings the larger strips mount the r-f tube plate winding, the mixer grid winding, and the oscillator tank coil. The coils vision channel. They can be removed instantly from the turret by lifting the appropriate spring fingers.
The oscillator coils (one for each channel) have ind vidual tuning slugs (25). This adjustment is accessible through the hole shown directly above the fine-tune ground retainer spring (11) on the front wall of the tuner The complete listing of the parts' numbers for these mechanical items for each type of tuner is given else where in this manual


Fig. 4. Exploded view of a typical Standard Tuner.

## Basic Type Identification Numbers

While the series numbers of the Standard I uner using the pentode r-f amplifier are below 2000 , the chrono logical sequence in which the series were introduced is

## TV 100

TV 134, the original turret tuner. This series ran through
TV 200, introducing mechanical improvements in con tact structure and lower torque positive detent action
This series ran through TV 353 .

TV 1000, electrically the same as TV 200 but with additional shielding to make possible compliance with the oscillator radiation recommendations of the RTMA and

TV 2000 inprev Paror TV 1357.
ode r-f amplifier. This series ran through TV 2047.

TV 3000, adaption of the TV 2000 circuitry for use with 42 mc . i-f amplifier. This series ran through TV 3005 TV 2200, improved performance over TV 2000 TV 3100, improved performance over TV 3000 TV 1500, an improved performance tuner over TV 1000 but at lower cost than the cascode group.
The TV 1500, TV 2200 and TV 3100 are current Fodels, the others having been discontinued
ype number to the tuner, but retains the series iden cation; for example 101, etc., for the basic 100 sidentifi201, 230, 241, etc., for the basic 200 series, etc. It is o be noted, however, that some other manufacturers of receivers assign their own distinctive part numbers which bear no relation to the basic series numbers as used by type is possible only by comparisontion of the specific type is possible only by comparison of the circuitry, exbeen added to the mixer-output system.

## DESCRIPTION OF "PENTODE" TUNER CIRCUITS

The schematic wiring diagrams of the four pentod tuners appear in Figs. 5,6 , and 7. The circuit description given here is for the TV 100 and TV 200 series. Signi ficant variations between this design and those which followed using a pentode for the r-f amplifier, will be stated individually in connection with the respective sche matics.
Referring to Fig. 5, the antenna transformer primary (L1) is designed for a balanced input. The inductively coupled secondary ( $L 2$ ) is connected to the control-grid
circuit of the r-f amplifier tube. Resistor $R 1$ is the grid circuit loading resistor for proper bandwidth, and $C 1$ is the pre-set general coverage trimmer which tunes the r-f grid coil. Resistor R2 is the decoupling resistor in the age bus; the bus is stared as being a white lead bur in some of the very early TV 100 series tuners it was a green lead. The antenna transformer coils, $L 1$ and $L 2$, are mounted on the smaller coil The plate circuit of the r-f amplifier is tuned. The related circuit elements are the plate coil $L 3$, the plate tank loading resistor $R 3$, and the general coverage tuning trimmer C3. Resistor R3 loads the plate coil to produce the required bandwidth on each channel; resistor RS and capacitor C4 are the decoupling elements for the B+ supply. In turn, $L 6$ and $C 17$ are the r-f isolating and by pass elements in the r-f tube heater circuit
the mixer coil, $L 4$. The mixer tube is one half of a to The mixer grid coil is tuned by the pre-set general coverage trimmer C6. The grid blocking and resonating capacitor is $C 5$ and the grid leak and grid coil loading for the mixer is the series network of $R 4$ and $R 6$. These resistors develop the grid bias for the mixer, and the junction between them is the r-f test point for use in
determining the response curve of the uned of and mixer stages.

The oscillator is the second hif of GJ6. Coil is the tank coil and is permeability tuned by a slug and by the general coverage pre-set trimmer $C 2$ The ascil lator fine-tuning capacitor using the dielectric disc pre viously mentioned is labeled "fine tuning." The operation of this capacitor is as follows: Using two fixed plates, one "hot" and the other grounded, changing the position of the dielectric disc in relation to the two plates changes the dielecric change is about 3 mc on the high-frequency channels and about .7 mc on the low-frequency channels.
The oscillator-blocking capacitor is C1O and the related grid leak is $R 7$. The coupling from the oscillator to the mixer is through the mutual inductance between $L A$ and $L 5$. Capacitor C8 is a part of the oscillator feed-back system. The heater circuit of the oscillator is isolated from the remainder of the tube system with respect to rThe plate circuit of the mixer may contain a variety of devices, but in the basic unit it is as shown. The r-f bypass capacitor is $C 7$, the permeability tuned first i-f stage picture i-f coil is $L 11$, which is in series with the fixed resonating capacitor, C18. The plate circuit of the mixer also contains the sound i-f trap and transformer, consist ing of windings $L 10$ and $L 12$, as well as the fixed tuning is permeability tuned. The sound i-f transformer, which is the upright unit shown in back of the tubes in Fig 1 , is deleted from tuners used in intercarrier systems.
Summarizing the TV 100 and 200 series, the circuitry is the same; the difference between them is the contac structure

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Fig. 5. Schematic diagram of the TV 100 and TV 200 series pentode tuner


Fig. 6. Schematic diagram of the TV 1000 series pentode tuner


Fig. 7. Schematic diagram of the TV 1500 series pentode tuner

TV 1000 Series. The TV 1000 series tuner schematic appears in Fig. 6. It is very much like the TV 100 and 200 series except for the sound i-f trap and transformer which has been removed, and a side and bottom cover shield have been added. These changes were made to RTMA prop sed limits.
The mixer plate load resistor is $R 8$. The 130 volt $\mathrm{B}+$ bypass capacitor was changed from $1000 \mu \mu \mathrm{f}$ to a low in ductive feed-through type of $800 \mu \mu$. In addition, feed through bypass capacitors of $800 \mu \mu \mathrm{f}$ each, were added to the agc bus and to the live heater wire

TV 1500 Series. The TV 1500 series schematic appears in Fig. 7. It is like the circuit used in the TV 1000 series with a few changes in circuit constants. The r-f stage
plate coilloading resisor, R3, used in earlier models, wa removed from across the plate coil, changed to 2200 ohms (R3) and placed in series with the r-f tube screen and the B+ end of the r-f plate coil. The antenna coil creased gain and reduced the noise The plate load resistor ( $R 8$ ) ser
was lowered from 15000 ohms to 6800 the mixer tube ohms, thus inL10, was added in series with the output of the mixe plate system. This coil raises the gain on the higher chan nels by providing an inductive plate load for the mixer on chaner C2, was removed from the oscillaror system. This reduced the number of pre-set trimmers located on to of the tuner from four to three.

## THE CASCODE SERIES OF TUNERS

The cascode series of tuners introduced a new design The four versions are shown schematically in Figs. 8, 9,
10 , and 11. The major differences between these and 10, and 11 . The major differences between these and plifier tube and circuitry

The TV 2000 series. The TV 2000 was the first use dual triodes as r-f amplifiers. Later tuners are modi fications of this design. The circuit change resulted in a achieved before.

With reference to Fig. 8, the two halves of the dual riode (either 6BK7 or 6BQ7) comprise the two r-f amplifying stages connected in series. The antenna trans$L 1$ and $L 2$. The primary, $L 1$, is designed for a balanced input. The inductively coupled secondary, $L 2$, is connected into the grid circuit of one half (V1A) of the dual riode. The shunt resistor R8, 22,000 ohms, is the grid loading resistor used to provide a specific bandwidth for the antenna transformer. The trimmer C13 is the preset general coverage trimmer for the antenna transformer.
frequencies. the circuit.

The capacitor C9 of $2.2 \mu \mathrm{f}$, is used to neutralize the tuned r -f stage; also to offset to some degree the loading
effect of the tube grid on the tuned circuit at the high
The V1B section of the dual-triode functions as a grounded-grid amplifier. As far as signal voltages are concerned, the control grid is effectively grounded by the $800 \mu \mu \mathrm{f}$ feed-through capacitor C1. The cathode (8) of the grounded grid stage is connected to the plate of the other half-triode through the coil $L 7$. In effect this is series connection of the two amplifiers, and whatever signal voltage is delivered from the V1A section is ap-
plied between the cathode and control grid of the V1B section. This circuit arrangement places the cathode of V1B above the chassis by a voltage equal to the plate voltage applied to the V1A triode plate.
The coupling choke, $L 7$, performs two functions in

1. It provioies an inductive load for the plate of the grounded cathode section of the cascode amplifier, thus reducing the loading of the grid circuit at
2. $L 7$, the plate to groun cathode section, and the cathode to ground capacitance of the grounded-grid section form a $\pi$ ype impedance transforming network, resonating above the operating frequency of the amplifier. This presents the plate with a higher impedance load at the higher frequencies.
The bias for the grounded grid half-section is obrained from the voltage divider $R 1-R 2$ which is seen connected
across the high voltage B circuit. With the cathode of


Fig. 8. Schematic diagran of the TV 2000 series cascode tuner
the control grid of V1B must receive a slightly less posicive porential that: its cathode. The tuned plate coil $L 3$
is resonated by the pre-ser general purpose trimmer is resonated by the pre-set general purpose trimmer C3.
This is the same as in all of the previous tuners. The $\mathrm{B}+$ plate supply dropping resistor is $R S$ and its relared bypass capacitor is $C 4$. The heater bypass capacitor is $C 2$, and the $r-f$ isolating coil in the heater system of the $r-f$ amplifiers is $L 6$.
The transfer of the signal from the V1A section to the V1B section occurs in the following manner: With the cathode of the V1B section directly coupled to the plate of the V1A section, a change in effective voltage at the plate V1A control grid, results in a corresponding change in voltage at the cathode of the former, and an opposite polarity change in voltage at the grid of V1B. Thus the swing in voltage at the plate of V1A appears as a changing signal voltage between cathode and control grid of V1B. From this point on V1B behaves as a convenional amplifier.
The general design of the mixer-oscillator section of the tuner is the same as has been described for the TV 100 through the
not be repeated here. However, some changes in the circuit constants warrant comment. The grid capacitor CS in the mixer circuit is $100 \mu \mu \mathrm{f}$. The oscillator tank capacior C8 is changed to $10 \mu \mu$ f because the general purpose oscillator, pre-set trimmer C11, is restored to the circuit. The TV 2000 series tuners, therefore, mount four trimmers on the top of the chassis.
Because individual $\mathbf{B}+$ voltages are required by the r-f and mixer-oscillator stages, two B+ supply lines are used


Fig. 9. Schematic diagram of the TV 2200 series cascode tuner


Fig. 10. Schematic diagram of the TV 3000 series cascode tuner.

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The plate circuits of the mixer and oscillator systems
are the same as the TV 1000 series with two exceptions: are the same as the 10 a
One is the addition of a resistor R11 in series with the converter plate for i-f isolation purposes, the other is the increase in value of the oscillator plate resistor R10 to 10,000 ohms.
TV 2200 Series. The TV 2200 series tuner schematic appears in Fig. 9. It is like the TV 2000 except for changes in circuit constants. To improve the neurraliza-
tion of the r-f system, another neutralizing capacitor, C11, is added between the cathode of the grounded-grid amplifier and the low end of its tuned plate coil.
The plate circuit of the mixer tube is altered by the addition of a peaking coil $L 10$ and by the reduction in value of the resonating capacitor $C 7$ to $6.8 \mu \mu \mathrm{f}$. The mixer plate voltage is increased by replacing the plate-load re sistor with an r-f choke L9. This change increased the mixer gain. The remainder of the mixer-o
remained as before in the
The oscillator stage-was subjected to several changes The pre-set trimmer is removed and the oscillator-tan capacitor decreased to $5.0 \mu \mu$. The oscillator grid capaci tor is reduced in value from the previously used $20 \mu \mu$ to $10 \mu \mu \mathrm{f}$.
The TV 3000 Series. This series, shown schematically in Fig. 10, heralded a new set of output-intermediate frequencies. The basic $\mathrm{r}-\mathrm{f}$, mixer, and oscillator circuitry resembles the circuit changes. The r-f tube is a dual-triode a number $A$

6BK7. The i-f signal-output frequencies are 41.25 mc sound, and 45.75 mc picture.
The antenna input circuit contains two i-f traps, L12. C12 and L13-C13, one trap in each leg of the antenna feeder. Each is tuned between 43 and 44 mc . An adjustable series-resonant trap, L11-C19, in the input circuit of the grid-tuned r-f stage is intended for the elimination of local interference, which might otherwise pass through the r-f stystem and appear in the output of the mixer Slight changes appear in the grid circuit of the grounded
grid amplifier in the form of reduced constants for the grid amplifier in the form of reduced constants for
divider network $R 1$ and $R 2$, thus altering the grid bias A feedback control circuit L9 and C18 is added between the input and output circuits of the mixer. This is used to reduce i-f reflections and to prevent regeneration. The i-f output is via the transformer $T 1$. In series with the primary of the output i-f transformer is a voltage-drop ping resistor R11. This is a change from the plate co

IDENTIFICATION OF COILS IN TUNERS
To aid recognition and replacement of coils used in the different series of tuners, each set of coils require tor a chansists of two labels, a number followed by a letter. The number indicates the channel; for instance coils numbered 2 are intended for channel 2; coils num bered 3 are intended for channel 3, etc. Since the tuners of all series are designed for use on the same television

Fig. 11. Schematic diagram of the TV 3100 series cascode tuner

The TV 3100 series is shown in schematic form in
the TV 3000 except that some of the constants ar The TV 3100 series is shown in schematic form in
Fig 11. The organization of the circuitry is like that of

channels, like numbers will be encountered on the coil strips in each series of tuners.
The number designating the coils intended for a chan nel is duplicated on each coil strip of the two used for each channel. Thus if the channel is number 3, the anenna coil mounting strip will bear the number 3 , and so will the mounting strip which carries the r-f plate coil, channel. This can be seen in any of the illustrations channel. This can be
which show the turret.

The letter designation also is duplicated on both mounting strips of a pair, but in this case the letter difers according to the series tuner for which they were esigned. The following is the list of letter identifica ions relative to the different tuner series
TV 100 series
Channel number only. No suffix letter.
TV 200 series
Channel number suffixed by " $F$ " in green
TV 1000 series
Channel number 2 through 9 suffixed by " G " in green Channel number 10 through 13 suffixed by " $F$ " in green
TV 1500 series
Channel number suffixed by " H " in black
TV 2000 series
Channel number suffixed by " K " in black.
TV 2200 series
Channel number suffixed by "Q" in red
ry 3000 series
Channel number suffixed by " $M$ " in black.
TV 3100 series
Channel number suffixed by " $R$ " in red.
Interchangeability of coils is limited to coils of like chan work number and like suffix letter. No other combination will to make them function in a tuner should not be attempted When replacing a set of coils removed from a tuner, the replacement must bear the same suffix letter.
Many manufacturers of receivers assign their own dis cinctive part numbers to the different coil strips. This sit uation does not modify the conditions set forth above Even these coils bear the aforementioned channel numbe

MAINTENANCE AND REPAIR

## Alignment

Proper alignment of the Standard Coil tuner in every television receiver determines the kind of performance which the receiver will deliver. Improper alignment will not only degrade the quality of the picture, but it can very easily defeat the usefulness of the receiver completely. Four sections of the tuner are related to alignment operations. These are the r-f stage (two trimmers), the mixer stage (one trimmer), the oscillator stage (possibly one trimmer and always a slug), and the i-f system in the ments, other than the i-f system are to be made, are pre scribed for all Standard Coil tuners. The frequency a which the i-f components contained in the tuner are ad justed is a variable; it is determined by the specific picture and sound intermediate frequencies used in the receive and the i-f amplifier design. Since these vary greatly, the
data given here are based on the basic procedure tathe than specific frequencies, with the exception of an example which assumes a specific set of conditions. follows sub stantially the same method ward Coil tuners forcions. Th variables appear in the amount of grid bias which mus be applied to the agc bus. This is critical and the informa tion given here should be followed. If this is in conflict manual, the latter should be followed. In the absence of such information, the instructions contained herein should be observed.

Because of the general similarity between all pentode cype tuners, and because of the general similarity between all cascode type tuners, complete instructions will be given for the first type in each group. Reference to these instruc tions is made under the alignment instructions for each specific type, and variations from the basic procedures are indicated. The location of the adjustment elements for appropriate tuner headings.
The adjustment of the oscillator-coil slug for each chan nel is the same on all tuners. In order to obtain access to this slug through the hole in the front wall of the tune it is necessary to position the fine-tuning dielectric disc correctly. It is set to its mid-range position as shown in Fig. 12. Since this practice is standard in all instances, no


Fig. 12. Front view of tuner showing fine-tuning control set to its mid-range position
further reference to positioning of the fine-tuning disc will be made; simple reference to adjustment of the oscillator slug is deemed sufficient.

All shields must be in place before and during alignment.

## Test Equipment Required

The test equipment required for proper alignment is the following:

A sweep generator affording frequency-modulated test signals on all twelve VHF television channels, and at intermediate frequencies from 20 to 45 mc . The frequency serting should be adjustable according to frequency calibrations secured from an internal crystal calibrator or marker or from an external device. millivolt sensitivity in the vertical amplifiers and with good low-frequency response and low-phase distortion. A scope which passes $60-\mathrm{cps}$ square wave properly is satisfactory.
3. An electronic voltmeter
4. An a-m signal generator which affords accurately An a-m signal generator which
set frequencies from 20 to 45 mc .
5. Suitable non-metallic alignment tools with $1 / 8$ inch heads.
6. Proper means for matching the output of the sweep generator to the balanced 300 -ohm input of the tuners.

## Alignment of TV 100 and TV 200 Series

Some of these series tuners contain a sound i-f trap and sound take-off point as well as a resonant picture i-f system corresponding to the first video i-f input. Adjustment described here should be made at the frequencies prescribed for the sound i-f and for the first picture i-f stage in the receiver. As a typical case we are assuming that the stagger-tuned picture i-f system, wherein whe sound a stagger-tuned picture i-f system, wherein the sound i-f mc . If the sound i-f and the first picture i-f stage use other frequencies, the instructions given herein apply, except for the specific frequencies stated. The locations of the alignment adjustments are shown in Fig. 13.

ig. 13. Location of alignment adjustments in TV 100 and TV 200 series tuners.
It is further assumed that, regardless of the nature of the sound and picture i-f systems used in the receiver, their electrical condition is satisfactory. Finally, it is stressed
that these instructions apply to the basic Standard Coil that these instructions apply to the basic Standard Coil cuners listed herein, whether found in a receiver or to be used as a replacement in the receiver.

## I-F and Trap Alignment

1. Connect a VTVM through a 10,000 -ohm isolating resistor across the video-detector load resistor
2. Remove the mixer-tube shield on the tuner
. Feed an unmodulated signal, corresponding to the sound $i-f$, to the mixer tube in the tuner by any one
of a number of possible methods. The use of capacity coupling, via a tightly fitting ungrounded shield placed around the outside of a mixer tube, is satisfactory. Feed a substantial signal to the ungrounded shield. Tune L12 for minimum indication on the VTVM.
3. Tune the unmodulated signal source to the frequency of the first picture i-f stage. Tune L11 for maximum indication on the VTVM. Use the lowest possible signal output from the unmodulated generator
sistent with a usable indication on the VTVM.
Note: Assuming a sound i-f of 21.25 mc , and the first picture i-f stage frequency in a stagger-tuned receiver being 21.8 mc , step 3 refers to a $21.25-\mathrm{mc}$ setting of the unmodulated oscillator, and step 4 refers to a $21.8-\mathrm{mc}$ setting of the unmodulated oscillator. Assuming use of the tuner in an intercarrier receiver, step 3 would be eliminated, and step 4 would involve
the frequency stipulated for the first stage of the comthe frequency stipulated for the
mon video-sound i-f amplifier.

## R-F and Mixer Alignment

1. Set station selector dial to channel 12 .
2. Connect test oscilloscope vertical input through loop) on top of tuner, and ground close by
3. Apply a fixed negative bias of -1.5 volts to feed to tuner. This is white or green lead. Value of bias must be exact, otherwise distortion of the response curve may result.
4. Connect sweep generator to antenna terminals. Make certain that proper impedance match exists and that Set swin correct
Use minimum output from sweep generator consis. tent with readable trace on oscilloscope screen.
5. Loosely couple marker generator to sweep-output cable at antenna terminals. Set marker generator to sound or picture i-f. Feed minimum signal from marker, consistent with seeing marker on response
curve on scope screen.
Adjust antenna ( $r$-f grid) trimmer; then the r-f plate
circuit trimmer, and finally the mixer-grid trimmer, to produce a response curve similar to thar shown in Fig. 14. The response curve should be symmerrical, the depth of the valley between the peaks should not exceed 30 percent in over-all amplitude.

$$
\text { In production, tolerances of } 30 \text { percent differences in }
$$



Fig. 14. R-f and mixer response curve of the tuner.
pattern height at or between the carrier frequencies are permissible. In the alignment, care should b taken not to "stagger tune" these circuits. This can
best be accomplished by tuning for maximum pat tern height at the point midway between the two carrier frequencies. The skirts of the curve will not fall to zero if the sweep width is less than 12 mc . The adjustments should result in the maximum amplitude of the response curve, proper positioning of the two marker frequencies, the closest possible ap and minimum valley in between. Figure 14 is the r-f and mixer response curve of the tuner and should not be confused with the overall r-f and i-f response 8 curve.
8. Without disturbing the r-f grid, r-f plate, and mixer grid trimmer, check the response curves on the orher The desired channel and changing the frequency to the desired channel and changing the frequency of being checked. The response curves should be substantially the same on all charinels and the two marker frequencies should fall in similar positions on the response curves. A slight amount of tilt can be tol erated. The amount of tilt indicated by the relative amplitudes of the response curves where the picture and sound i.f markers rest should not exceed 30 percent of the overall response curve amplitude. The

## Oscillator Alignment for Split Sound I-F Circuits

1. Set the station selector to channel 12.
2. Connect the a-m signal generator, or a marker calibrator, or whatever other type of signal capable of supplying an accurately calibrated unmodulated signal over the television clannel frequencies is available, to the antenna terminals. (Remove the sweep generator connection to the antenna terminals, unless that device also is the source of the Set the unmodulated signa
frequency which, when mixed with the local oscillato for channel 12, will produce the sound i-f required by the receiver. For example, if the sound i-f is 21.25 mc , set the signal generator to exactly 209.75 mc which is the sound-carrier frequency for channel 12 . Connect the VTVM to the output of the sound dis Adjust the or ratio detector)
tion on the VTVM between positive and negative peaks. If zero cannot be attained proceed as described peaks. If zer
in step 6 .
3. Check all channels by setting the station selector dial to the desired channel, and changing the frequency of the signal generator to correspond with the soundcarrier frequency for each channel as described in step 3. If it is found necessary to further adjust the oscillator coils on channel 12, or on any channel, this is done by means of the individual oscillator-coil slugs as described in steps 7 and 8 .
as shown in Fig. 12
4. With the turret set for the desired channel, and with the appropriate generator frequency as indicated in step 3 applied to the antenna, insert a non-metallic screw driver through the hole in the front face of the uner and adjust the slug until the VTVM connected oo the sound-discriminator output indicates zero
between the positive and negative peaks. Only a small movement of the slug will generally be necessary. (See below.)
Note: Be careful when adjusting the oscillator-coil slug. If turned too far the slug will fall into the coil. If this happens, remove the coil mounting strip from the turret. Remove the retaining spring which normally holds the slug in place. Upend the coil so that the hole is facing downwards and lightly tap the retaining spring. replace the coil strip in the turret and adjust as described.

## Oscillator Alignment for Intercarrier Sound I-F Circuits

1. Set the station selector to the alignment channel Connect the oscilloscope across the load resistor of the deo detector
With the sweep generator fed into the antenna and he marker generator set at the frequency of the video carrier of the channel, adjust the oscillator tank trimcude) on the migher is at the Gdb point (half ampli-

Adjust the oscillator coil slug for each of the other channels with the generators set to the proper frequencies for each channel.
Note: Types TV 1500, TV 2200, TV 3000 and TV 3100 do not use a common oscillator tank trimmer and the oscillator-coil slug must be individually adjusted

V 1000 Series Alignmen
The reference alignment instructions are those stated for the TV 100 and 200 ser
tions are shown in Fig. 15

I-F Alignment
R-F and Mixete steps 1, 2, and 4.
Complete steps 1 throug
Oscillator Alignment
Complete alignment as shown under intercarrier i-f


Fig. 15. Location of alignment adjustments in TV 1000 series tuners.

TV 1500 Series Alignment
The reference alignment instructions are those for TV 100 and TV 200 series. The adjustment locations are shown in Fig. 16.
I-F Alignment
Complete steps 1, 2, and 4
R-F and Mixer Alignmen
Complete steps 1 through 8. The alignment channe Oscillator Alignment
Complete alignment as shown under intercarrier iusing slugs only as the oscillator trimmer is omitted
Note: The adjustment of the TV 1500 series tuner requires extreme care.


Fig. 16. Location of alignment adjustments in TV 1500 series tuners.
TV 2000 Series Alignment
The reference alignment instructions are those given for the TV 100 and TV 200 series. The TV 2000 series cuners were designed for $21.25-\mathrm{mc}$ sound i-f and 25.75 . picture i-f. The tuner is set nominally for 22.3 mc bu can be tuned to any desired i-f between 19 and 26 mc . The adjustment locations of the TV 2000 series tuners are given in Fig. 17.
I-F Alignment
Complete steps 1,2, and 4
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R-F and Mixer Alignment
Complete steps 1 through 8. The alignment channel is number 12. The fixed bias required for the agc

Oscillator Alignment
Complete alignment as shown under intercarrier i-f.


Fig. 17. Location of alignment adjustments in TV 2000 series tuners.

TV 2200 Series Alignment
The reference alignment instructions are those given for TV 100 and 200
given in Fig. 18.

I-F Alignment
Complete steps 1,2 , and 4.
R-F and Mixer Alignment
Complete steps 1 through 8 . The alignment channel is 10 . The fixed-bias voltage for the agc is exactly
-3 volts. It is possible that adjusting the r-f grid (or antenna) trimmer may have little effect. In that event channel 6 should be used for readjustment of this trimmer (C13) only.
Oscillator Alignment
Complete alignment as shown under intercarrier i-f using slugs only as oscillator trimmer is omitted.


Fig. 18. Location of alignment adjustments in TV 2200 series tuners.

## TV 3000 and 3100 Series Alignment

The reference alignment instructions are those given for the TV 100 and TV 200 series tuners, except that the TV 3000 and 3100 series are designed for 41.25 -mc sound i-f, and 45.75 -mc picture $i-$. Ass 1 in the schematics of Figs. 10 and 11. The locations of the adjustments referred to in the alignment instructions are shown in Fig. 19.

## I-F Alignment

Complete steps 1,2, and 4. The reference to $L 11$ in the alignment instructions is the primary of the i-f transformer in the TV 3000 and 3100 series tuners.

R-F and Mixer Alignment
Complete steps 1 through 8 . The alignment channel is 0 . The fixed bias required for the agc is exactly TV2200 also applies.

Oscillator Alignment
Complete alignment as shown under intercarrier i-f using slugs only as oscillator trimmer is omitted.

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Fig. 19. Location of alignment adjustments in TV 3000 and TV 3100 series tuners.

## Servicing

In the event servicing of the tuner is necessary, the following disassembly instructions should be followed.

## Removing Tuner Turret

When removal of the turret is necessary, proceed as fol lows, using the parts identifications in Fig. 4 for guidance

1. Remove bottom cover shield.
2. Remove the fine tuning ground plate (12)
3. Remove the fine tuning control shaft (28) and dielectric disc. Also remove the fine tuner ground spring (11) and the fibre washer (14). For reas sembly note reverse order of disassembl)
4. Remove front and rear shaft retaining spring, (9) tuner chassis.
5. Grasp tuner drum and slip out of end bearings by a slight rolling action.

## Adjusting Contact Finger Springs

In the event that the stationary contact fingers make poor contact with the studs on the coil strips, the tensio of the springs can be increased.

1. Remove the shield on the contact bracket side and the bottom shield.
2. Remove a number of coil strips and rotate the turret so that the fingers on the contact mounting bracke (21) are accessible. With a thin, narrow blade screw driver, adjust the contact finger ard until the highes point on the spring contact is about $9 / 64$ th of an inch above the surface of the plastic mounting plate. Adjust each spring separately. With correct tension, the contact finger will clear the flat service of the mounted coil strip by about $1 / 64$ th of an inch.

## Removing Coil Strips

1. Remove bottom cover shield of tune
2. Insert thin screwdriver between end plate of turret and appropriate coil retainer spring. Twist the blade away from the turret and raise end of coil. Front rear retainer spring holds antenna coil strips.

Cleaning and Lubrication
When it becomes necessary to clean the contacts and springs, proceed as follows. Contacts on coil strips can using a toorhbrush dipped in carbon tetrachloride; do not douse coils. Allow a few minutes for evaporation and then wipe the coil contacts with a lint-free cloth to remove any film deposit.
To clean the stationary contacts, remove several coil srips so as to expose them. Clean with stiff brush dipped into carbon tetrachloride and remove film deposit with clean lint-free cloth. Remove any accumulation of dirt and rease from contact plate surface in the same manner. see procedure for adjusting contact finger springs.
In the event that lubrication of tuner contacts is nece sary, which is generally so after cleaning, use a sulphur and acid free, non-drying lubricant such as Viscosity Oil Company \#7069. Do not use any so-called noise-eliminating

UHF ADAPTABLITY


Fig. 20. Photograph of uhf strips for Standard Tuners.
Conversion "strips" are available for the Standard Tuner convert regular VHF tuners for reception of signals wich can be inserted in the coil drum in place of any of the normal VHF channel strips. Fig. 21. erted in the coil drum. of the proper series.
ubricants or cleaning substances. Lubricate all moving parts including the stationary and moving coil contacts, the inner side of the outer shaft, and all bearings and springs. For lubricating bearings use Viscosity Oil Company \#8857 lubricant or light vaseline

## Parts Replacement

When it becomes necessary to replace elecrrical parts in he tuner, extreme care must be exercised. The constants of the different electrical components are given in the parts lists elsewhere in this manual. The replacement part to its electrical value, tolerance and temperacure coefficient if applicable physical dimension, location, and lead length. The lead dress is extremely important. Observe the lead dress arrangement before making parts changes. In the case of fixed resistors which must be replaced, make certain that the type used is that originally used in he tuner

These UHF strips operate by double conversion of the signal, using a harmonic frequency of the local oscillator in the first conversion and the fundamental frequency for the second conversion as shown in the circuit of
Since the width of the structure extends well toward the center of the drum, only six UHF strips may be in-

Different series of these converter strips are supplied for each series of tuners and are identified by the same
While production the VHF coil assemblies. strips of one series to work in a tuner of another series, optimum performance can be obtained only with strips
UHF strips should be ordered by channel number and coil series letter. Presently available are:
series letter. Presently available are:
F/G Series for TV 200 and TV 1000
F/G Series for TV 200
H $\quad$ Series for TV 1500
K Series for TV 2000
$\begin{array}{ll}\mathrm{Q} & \text { Series for TV } 2000 \\ \mathrm{R} & \text { Series for TV } 2200 \\ \text { Series }\end{array}$
R Series for TV 3100 and TV 3000
CONEECTOR DETUEEN
CONVEATEA AEAT SEG


Fig. 21. Circuit arrangement of the Stundur:l Tuner uhf strip

## General Parts List

For
Standard Tuners

 RESISTORS - All $1 / 2$ watt insulated compositug resistors are sultable replacements, except those marked with asteriak which ahould be IRC type BTs.

| part no. | value | TV-100/200 | TV-1000 | TV-1500 | TV-2000 | TV-2200 | TV-3000 | TV-3100 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 12TAE100M | 108 $\pm 20 \%$ |  |  |  | R-11 |  |  |  |
| $12 \mathrm{TAE471M}$ | $4700 \pm 20 \%$ |  |  |  |  |  | R-5 | R-5 |
| 12 TAE102M | $10008 \pm 20 \%$ |  |  | R-5 | R-5 |  |  |  |
| $12 \mathrm{TAEL5} 2 \mathrm{~K}$ | $1500 \Omega \pm 10 \%$ |  |  |  |  | R-5 |  |  |
| $12 \mathrm{TAE222M}$ | $2200 n+20 \%$ | R-5 | R-5 | R-3 |  |  |  |  |
| $12 \mathrm{TAES92K}$ | 3900n $\pm 10 \%$ | R-1 |  |  |  |  |  |  |
|  | $47000 \pm 10 \%$ $88008 \pm 5 \%$ | R-4*, 10 | R-4*, 10 | $\begin{aligned} & \mathrm{R}-40 \\ & \mathrm{R}-8 \end{aligned}$ | R-4* |  | R-10 | R-10 |
| 12 TAE103k | $10 \mathrm{~K} \Omega=10 \%$ | R-3, 7 | R-3, 7 | R-7 | R-7, 10 | R-4*; 7 | R-7 | R-7 |
| 12 TAE153K | $15 \mathrm{~K} \Omega \pm 108$ |  | R-8 | R-1*, 10 | R-12 | R-8*, 10 | R-80, 11 | R-8*, 11, 4 |
| 12TAE223M | 22KR $\pm 20 \%$ |  |  |  | R-8** |  | R-4* |  |
| 12 TAE473M | $47 \mathrm{~K} \Omega=208$ | R-2 | R-2 | R-2 | R-9 |  | ${ }^{\mathrm{R}-9}$ | R-9 |
| $12 \mathrm{TAE104K}$ | $100 \mathrm{~K} 2 \pm 10 \%$ |  |  |  |  | $\mathrm{R}_{\mathrm{R}-\mathrm{s}, 2}$ | R-3 | R-S |
| 12 TAE164J 12 TAE184K | $100 \mathrm{~K} \Omega \pm 5 \%$ $180 \mathrm{~K}, ~$ 20\% |  |  |  | R-2 |  | R-2 | R-2 |
| 12 TAE224K | 220 K ¢ $\pm 10 \%$ |  |  |  | R-1 |  |  |  |
| 12TAE224M | 220Kス $\pm 20 \%$ | R-6 | R-6 | R-6 | R-6 | R-8 | R-0 | R-6 |
| 12TAE334K | 330K8 $\pm 10 \%$ |  |  |  |  |  | R-1 | R-1 |

CAPACITORS - Since small disc capacitors are now avallable, it is recommended that they be used for service in the eariler models except in critical circuits. Care must be taken to keep the leads as close to
the same as the capacitor replaced.

| part no. | capacitance | TV-100/200 | TV-1000 | TV-1500 | TV-2000 | TV-2200 | TV -3000 | TV-5100 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 13L8C-1R5M | $1.5 \mu \mathrm{I}$ NPO |  |  |  |  | C11 |  |  |
| 13L8GP-2R2C | $2.2 \mu \mu \mathrm{t}$ |  |  |  | c9 |  | C11 |  |
| $131.8 \mathrm{C}-030 \mathrm{C}$ | 3.0 us? NPO |  |  |  |  | C9 |  | C9 |
| 13L8C-050C | 5. 0 usi NPO |  |  |  |  |  |  |  |
| ${ }^{13 L 8 U-050 C}$ | 5. $0 \mu \mu \mathrm{fl}$ N750 |  |  | C8 |  | ${ }^{\text {C8 }}$ | ${ }^{\text {C8, }} 9$ | C8 |
| 13 LBC -6R8C | 6.8 \% ${ }^{10}$ NPO |  |  |  |  | C7 | C7 | C7 |
| ${ }^{13110 C-100 K}$ | $10 \mu \mu \mathrm{NPO}$ $10 \mu \mu \mathrm{~N} 750$ | C7 c8 | C7 c8 | C7, 10 | $\mathrm{C7}$ CB | C10 | C10 | C10 |
| $13 \times R 1-20 \mathrm{CH} 200 \mathrm{~K}$ | $20 \mu \mu \mathrm{NPO}$ | C10 | C10 |  | C10 |  |  |  |
| 13L8Q-470K | 47 цut N1400 |  |  |  |  | C5, 4 | C4, 3 | C5 |
| 13L8Q-510J | $51 \mu \mu \mathrm{f}$ |  |  |  |  |  |  |  |
| $19 \times \mathrm{Rl}$-30UK101K | 100 unt N750 | C5 | C5 |  | C5 |  |  |  |
| 13XR1-30UK121J |  | C4 | C4 |  |  |  |  |  |
| 13L8D-121K | 120 н 4 ? | C18 | C18 |  | C4, 18 | C18 |  | C4 |
| 13D-153 | ${ }^{800} \mu \mu \mathrm{M}$ GMV |  | C14, 15, 16, 17 | C14, 15, 16, 17 | C1, 14, 15, 16, 17 | C1, 14, 15, 16, 17 | C1, 14, 15, 16, 17 | C1, 14, 15, 16, 17 |
| ${ }_{13 \mathrm{C}}^{13 \mathrm{LPX}-052} \mathrm{~L}$ | 1000 u $\mu \mathrm{I}$ GMV | ${ }_{\text {C14 }}^{\text {C15, 17, }} 21$ | C21 | $\mathrm{c} 2,21$ | C2, 21 | C2, 21 | $\mathrm{C} 2,18,21,22$ | C2, 18, 21, 22 |



24" Rectangular Picture Tube Model 24C-9360A (Mahogany)
Model 24C-9360AB (Blond)
GENERAL SPECIFICATIONS dIMENSIONS

| Model | Height | Widrh | Depth |
| :--- | ---: | ---: | ---: |
| $24 .-9360 \mathrm{~A}$ | $401 / 1^{\prime \prime}$ | $26^{\prime \prime}$ | $23^{\prime \prime}$ |
| $24 C .9360 A B$ | $40 / 4^{\prime \prime}$ | $26^{\prime \prime}$ | $23^{\prime \prime}$ |

WEIGHT (packed)

| Model | Weight |
| :--- | ---: |
| 24 C .9360 A | 172 lbs |
| 24 C .9360 AB | 172 lbs. |

## POWER REQUIREMENTS

t17 volts 60 cycles
PICTURE SIZE DEFLECTION FOCUS 24" Rectangular Magnetic

$$
\begin{aligned}
& \text { Sound Carrier-41.25 Mc. } \\
& \text { Picture Corrier-45.75 Mc. }
\end{aligned}
$$

I.F. SYSTEM
Three Stages-overcoupled-for composite signal.

## SPEAKER

$\begin{array}{lccc}\text { Model } & \text { Type } & \text { Size } & \text { V.c. Imped. } \\ 24 C .9360 \mathrm{~A} & \text { P.M. Dynamic } & \delta^{\prime \prime} \times 9^{\prime \prime \prime} & 3.2 \text { ohms } \\ 24 C .9360 \mathrm{AB} & \text { P.M. Dynamic } & \delta^{\prime \prime} \times 9^{\prime \prime} & 3.2 \text { orms }\end{array}$



[^16]
## VHF RF CHANNEL ALIGNMENT PROCEDURE

| The procedure listed is onty for the VHF RF Channels. If it ever becomes necessary to align the UHF RF Channels, the RF Tuner, part 521150 . must be returned to the factory. <br> 1. Connect a 3 volt battery to the receiver $A G C$ system so that negotive terminal of battery connects to $A G C$ line and positive terminal of bat- |  |  |  |  |  | 2. During alignment, it is necessary to set the Fine Tuning control so that Fine Tuning Quadrant is in the center of its range (correct position shown in Fig. 17). |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { STANDAR } \\ & \text { GENEI } \end{aligned}$ | RD SIGNAL ERATOR | SWEEP G | Rator |  |  | miscelianeous |  | TYPE OF A |
| CONNECTIONS | frequency | CONNECTIONS | Frea. |  |  |  |  |  |

RF AMPLIFIER AND MIXER ALIGNMENT

|  | $197.75 \mathrm{MC}$. . Sound Corrier Pieture Mc. Pistri. er Marker. |  | $\underset{\#}{\text { CHANNEL }}$ | Not used. |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Some as |  | Some as |  | Not used. | Some as | Set chanel lot celotior observent. |  |  |

IMPORTAN: Before undernaking oschlator alignment be sure IF
cirevits are correctly aligned for band pass characteristic illustrated
2. During this step and thru-out all succeeding steps it is necessary to
keep output of sweep gener
On VTVM to exceed one volt
Keep output of standard signol generator at a level thut provides a
readable marker but does not distort the curve that on the 'scope.
s.sion
instrument connections for r.f. CHANNEL ALIGNMENT


FIG. 11 Generator Connections RF Channel Alignmen


FIG. 12
Oscilloscope Connections for RF Amp. and Mixer Alignment


FIG. 13
M and Oscilloscope Connections
for Oscillator Alignment

| CHANNIL <br> NUMAER | PICTURE CARRIER <br> MARKER FREQ. | SOUND CARRIER <br> MARKER FREQ. |
| :---: | :---: | :---: |
| 13 | 211.25 MC. | 215.75 MC. |
| 12 | 205.25 MC. | 209.75 MC. |
| 11 | 199.25 MC. | 203.75 MC. |
| 10 | 193.25 MC. | 197.75 MC. |
| 9 | 187.25 MC. | 191.75 MC. |
| 8 | 181.25 MC. | 185.75 MC. |
| 7 | 175.25 MC. | 179.75 MC. |
| 6 | 83.25 MC. | 87.75 MC. |
| 5 | 77.25 MC. | 81.75 MC. |
| 4 | 67.25 MC. | 71.75 MC. |
| 3 | 61.25 MC. | 65.75 MC. |
| 2 | 55.25 MC. | 59.75 MC. |

FIG. 14


FIG. 17 Front View of
RF Tuner Unif


FIG. 18
Trimmer Location of
RF Tuner

All voltages measured with a $\mathbf{2 0 , 0 0 0}$ Ohm per volt meter with the receiver connected to a 117 volt 60 cycle power

Tuner set to an inactive channel with antenna terminals shorted and connected to ground.
Controls set for normal reception-Power Booster control completely counterclockwise.

Voltages marked with an asterisk (*) will vary widely with control settings.
No voltage reading at a tube element indicate zero voltage or voltage which cannot be accurately measured with a



The circuit shown on this page applies
to "SERIES ABCDEF" chassis


| LETTER DESIGNATION | description of change |
| :---: | :---: |
| UNCODED | INITIAL PRODUCTION |
| "A" |  |
| "B" | The following chonge, was incorporoted to improve sync. stability in the Presence of electricol interferenceo or weok signol. plate of tube VA-128Y7 <br>  Nome: The sound toke.af tor tube v14 (Sound I.F. Amp.) remains con nected to the plote of tube V4 (Video Amp.) <br> The following chonge was innorparoted to provide for adequate width of The eititure under the condition of low line yoltoge. 1. Change resistor 88 in 270 volt supply from 400 hms to 200 Ohms . The following change was incorporated to provide al sofety for the plate laad resistor of fube V7A (12AUT). 3. Change resistor los locoted it plote circuit of tube V7A (Sync. Amp.) from 4700 Ohms $1 / 2$ wott to $4700 \mathrm{Ohm}^{1}$ watt. |
| " ${ }^{\prime \prime}$ " | The following change was incorporoted to protect resistor 88 , located in the 270 volt supply, in the event of abnormal current drain in the high voltage system. <br>  |
| "D" | The following chonges were incorporoted to improve the ronge of the horizontal hold contiol. <br> Change resistor. 120 , locoted in the plate circuit of tube V7A (Horiz. <br> Chonge resistor 12.00 Ohms to 68.000 ohms. <br>  <br> hhe above change should only be undertaken when cluded in the SERIES designation at rear of chassis. |
| "E" | The fallowing change was incorparated ta protect the filament winding power transtormer the event this tube develops o cathode to filoment short. 100,000 Ohms Change resistor 18,000 ohms 23, |
| ''F'' | The following changes were incorporatiod to improve pitture quality br reducing the noise level (snow) in video Amp. spstem. 1. Add resistor 442 veroo ( (hms) in porollel with peaking coil 41 located <br> 2. in gride circuito of VA (Video A Ap.) <br>  <br> 3. (single pi, coded with green jort). <br>  trom pert (single pi, coded with red cod <br> 4. Changi feristor 52 located ocrosss peaking coil 51 in plate circuit of <br> 5. Change (Video Amp.) trom tring coil 53 Iocoted in plate circuit of tube <br>  (single pi, coded with white dat). |

## PRODUCTION CHANGES

The following tabulation furrishes complefe details on changes which occurred during receiver
pooduction. The ereceivers incorportin these henges ore identifed by coding


TUBE AND
CONTROL LOCATIONS

© John F. Rider


MODELS $24 \mathrm{C}-9360 \mathrm{~A}, \mathrm{AB}$

## PARTS LIST



## TV PAGE 14-6 STEWART-WARNER

## ©John F. Rider



Fig．21－chassis and picture tube assembiy


The receiver chossis must be removed t.
complish olignment of oll funed circuits.
Alignment of all VYF RF and If tuned circuits in this receiver moy be oe-
complished by utilizing the procedures doseribed in the following charts. These procedures should preferobly be opplied in the order in which they
ore presented. Alignment of Sound Channel or If Chonnel may be acore presented. Alignment of Sou
complished individuolly if desired.
The VHF RF Amplifier and Mixer alignment may also be accomplished
independent of Sound or If Chonnel olignment but oscillotor colibation independent of Sound or If Chonnel alignment, but ossillotor
con only be done after If Chonnel has been correctly oligned.

## CAUTION

The picture tube is highly evacuated and pelled. Handle with care.
 ance of your instruments, it
specificotions described here.

1. STANDARD SIGNAL GENERATOR to provide unmodulatod (pure ranges should be of leost .1 trelt with provision for attenuation ail
rent desired. This instrument must hove good frequency stoblifity and bo

NTERMEDIATE FREQUENCIES
Sound Corrier- 4.25 Mc .
Picture Carrier-45.75 Mc.

## F. SYSTEM

Three Stages-overcoupled-for composite signol.

## DEFLECTION

## focus

R.F. TUNER

Turret type
83 channels.

## ALIGNMENT PROCEDURE

accurately colibroted.

Short antenna terminals together with a iumper wire
Set receiver Channel Selector to ony inoctive television channol and
Power Boostor control to its maximum counter-clockwise position; other ower Boostor control to its maximum coun
ontrots may be left ot ony desired setting.

STANDARD SIG

| STANDARD SIGNAL <br> GENERATOR |  |
| :---: | :---: |

CONNEC-
TIONS

| VTVM CONNECTIONS |
| :---: |
|  |

## SOUND CHANNEL ALIGNMENT PROCEDURE <br> GMENT PROCEDURE

a. If Frequencies:

4F Frequenciess
4.5 Me. Sound Chanel
39.75 Mc. to 47.25 Mc. If
b. RF Frequencies:

54 to 88 Mc .
174 to 216 Mc.
No frequencies ore listed for the UHF RF Chanels. If it ever
becomes necessory to align the UHF RF Chonnels, the RF Tuner,
part 521150 , must be returned to the foctory.
vacuum tube voltmeter. The
strument should preferably permit a lowest voltoge range of this inof full scale deflection.
3. rf sweip generator to observing the over-all bandposs choracteristic and RF Channel for ing froquencies:
40 to 50 Mc . With 10 Mc. sweep width.
54 to 88 Mc with $10 \mathrm{Mc}$. swoop width.
174 to 216 Mc . with 10 Mc . sweep width.
No frequencies are listed for the UHF RF Channels. If it ever becomes necessary to align the UHF RF Channeli,
part 521150 , must be refurned to the factory.
4. CATHODE RAY OScllloscope, preferably a unit with vertical omplifier having wide range frequency response and low eapacity
pick up probe. This isstrument is sud for if ond RF Comnel olign-
ment of Sound IFer (preferably non-metallic) can be used for alignof the tronsformer.

|  |
| :---: |
| 2. mum |
|  |  |
|  |
| $\begin{aligned} & \text { abhip, } \\ & \text { abip } \\ & \text { ploce } \\ & \text { fig. } \end{aligned}$ |
|  |  |
|  |
| noise sound |
|  |  |


| $\substack{\text { MISCELLANEOUS } \\ \text { INSTRUCTIONS }}$ | $\begin{array}{c}\text { TRIMMER } \\ \text { OR SLUG }\end{array}$ | $\begin{array}{c}\text { TYPE OR ADJUSTMENT } \\ \text { AND OUTPUT INDICATION }\end{array}$ |
| :---: | :---: | :---: |

Power boiter
$\square$
maxi-
\#1

$$
\begin{aligned}
& \text { Adivst for minimum. reoding } \\
& \text { oo VIVM. }
\end{aligned}
$$

| ${ }_{\substack{\text { S }}}^{\substack{\text { Same as as } \\ \text { above }}}$ | Same asabave. |  | $A$ "swishing"" saund may be heard in the speoker during Sound Channel Alignment:this sourious oscillation is coused by harizontal sweep voltage being picked up in the audio system thru stray coupling of as it will have no effect on olignment of the sound channel. | \#2 <br> Discriminatar <br> Secondary <br> (See Fig. 10) | Adiust for maximum reading on VIVM. |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  | \#3 <br> Discriminator Primary (See Fig. 8) | Adiust for maximum reading on VTVM. |
|  |  |  |  | \#4 <br> Sound IF Tronsformer (See Fig. 10) | Adiust for moximum reading on $V I V M$. |
| Some ${ }_{\text {Soser }}^{\text {above. }}$ | Same as | Connect fig. fig. shown in | To obtain zero bolance af the discriminotar circuit, two 68,000 ohm resistors will be circuit, two 68,000 ohm resistors will be required. These resistors must be matched so that their respective resistances do not differ by more than $1 \%$-.the accuracy of the total resistance is nat critical. Connect the two resistars in series from pin shown in Fig. 5 . | \#2 <br> Discriminatar <br> Secandary <br> (See Fig. 10 | Note that as slug \#2 is rotatod, - point will be found where the <br>  reading or vice versa. in cor- rect seting of stug $\# 2$ is obtroined When the the slug is moter roods thry this point this point. |

Replace the type GCB6 tube previously removed in the obove procedure and turn set on. Tune in to a lo
omount of "Intercarrier Buzz" refer to procedure on odioining page to remove this oforementioned fault.
amount of "intercarrier Buzz" refer to procedure on adioining page to remove this ofore mentioned foult.
INSTRUMENT CONNECTIONS FOR SOUND CHANNEL ALIGNMENT

FIG. 1
Generator Connection
for Sound Channel and $\mathbf{4 . 5} \mathbf{M c}$. Sound Trap
Alignment


Crystal Detector and VIVM Connections
for 4.5 Mc . Sound Trap


FIG. 3
Circuit Diagram for
Crystal Detector shown in Fig. 2


VTVM Connections
for Sound IF Alignment

for Sound Discriminator
Alignment
REDUCTION OF INTERCARRIER BUZZ
Under actuol reception conditions slight "dynamic" unbolonce of the dis.
criminotor secondory can Under octual reception conditions slight "dynamiic" unbolonce of the dis.
criminotor secondory con emphasie intercorrier buzz due to incomplete
amplitude modulation refeection. Therefore it is vitolly important to obtoin
 an accurctiter
ditions.
Disconnect all insiruments (be sure that 1.F. tube removed for the adiust. ment of Sound Trop has been reploced) ond then comneact on on ontenna to
the receiver to obtain program reception from a local stotion. If inter the receiver to obtoin proenram recection from a lacolststation. If intior-
corrier buzz is prominent, a slight reodiustment of the discriminotor carrier buzz is prominent, a slight readiustment of the discriminotor
secondary slug
(\#2) should be made to obloin the "dip" point for the buzzing sound. Note that program sound will be clear pond free from
distortion ot this point. Buzz should now be ot an occeptable minimum dizstorition of this pooint. Buzz should
if stotion transmission is not of foult.


## VHF RF CHANNEL ALIGNMENT PROCEDURE

| STANDARD SIGNAL GENERATOR |  | sweep generator |  | $\begin{gathered} \text { VTVM } \\ \text { CONNEC- } \\ \text { TIONS } \end{gathered}$ | $\begin{aligned} & \text { SCOPE } \\ & \text { CONNEC- } \\ & \text { TIONS } \end{aligned}$ | MISCELLANEOUS instructions | TRIMMER or stug | type of adjust MENT AND OUTPUT indication |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CONNECTIONS | frequency | CONNECTIONS | frea. |  |  |  |  |  |
| RF AMPLIFIER AND MIXER ALIGNMENT |  |  |  |  |  |  |  |  |
| $\begin{aligned} & \text { connect } \\ & \text { ons os } \\ & \text { fig. } \\ & \text { is. } \end{aligned}$ |  |  | $\underset{~ C H A N N E L}{ } \underset{ }{\$ 10}$ | Not usod. | $\begin{aligned} & \text { Connoct } \\ & \text { sis } \\ & \text { sig. } \\ & \text { fig. } 12 . \end{aligned}$ |  |  |  |
| Some as |  | Same as |  | Not used. | $\begin{gathered} \text { Samo as as } \\ \text { obove. } \end{gathered}$ | Sel chonnol solector tol observod. |  |  |
| 1. IMPORTANT: Before undertaking oscillator alignment be sure IF circuits are correctly aligned for band pass characteristic illustrated in If alignment procedure. <br> 2. During this step and thru-out all succeeding steps it is necessary to |  |  |  |  |  | keep autput of sweep generator at a level that does not allaw reading on VTVM to exceed one valt. <br> 3. Keep autput of standard signal generatar at a level that pravides a readable marker but does not distort the curve that is being abserved on the 'scope. |  |  |
| $\left\|\begin{array}{l} \text { conoct } \\ \text { chnor } \\ \text { sho } \\ \text { Fig. } \\ \text { Fin. } \end{array}\right\|$ | 197.75 MC. Sound Carrier Marker. 193.25 MC. Picture Carri- er Marker. |  | CHANNEL |  |  |  |  |  |
| Some os |  | (tame ${ }_{\substack{\text { Same } \\ \text { above. }}}$ |  | Same aso. | Same as |  |  |  |
| If an oscillator slug "falls into" its coil form during adjustment, remove the Channel Coil from the turret assembly and lift the Slug Retaining Spring aside. By tapping the coil form it should be possible to make <br> the slug move taward the end so that its threads will Slug Retaining Spring when that spring is returned |  |  |  |  |  |  |  |  |
| If an unsatisfactory overall response is obtoined for a porticular channel, observe RF Amp. and Mixer respanse curve for that channel. If characteristic daes not conform reasonably well within the typical surve |  |  |  |  |  | shown in Fig. 15, then, (1) attempt to obtain a better compromise for RF response on all channels by realigning RF Amp. and Mixer circuits, or (2) try replacing Antenna, RF and Oscillotor coils for the particular channels. |  |  |

INSTRUMENT CONNECTIONS FOR R.F. CHANNEL ALIGNMENT


FIG. 11
Generator Connections
-


FIG. 12 Oscilloscope Connections
for RF Amp. and Mixer Alignment


| ChANNEL NUMBER | picture carrier marker fria. | sound canrier MARKER FREQ. |
| :---: | :---: | :---: |
| 13 | 211.25 MC . | 215.75 MC . |
| 12 | 205.25 MC. | 209.75 MC. |
| 11 | 199.25 MC . | 203.75 MC. |
| 10 | 193.25 MC . | 197.75 MC . |
| 9 | 187.25 MC . | 191.75 MC . |
| 8 | 181.25 MC . | 185.75 MC . |
| 7 | 175.25 MC . | 179.75 MC . |
| 6 | 83.25 MC . | 87.75 MC . |
| 5 | 77.25 MC . | 81.75 MC . |
| 4 | 67.25 MC . | 71.75 MC . |
| 3 | 61.25 MC . | 65.75 MC . |
| 2 | 55.25 MC . | 59.75 MC . |

FIG. 14


FIG. 17
Front View of
RF Tuner Unit


RF Tuner
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## SYNCROGUIDE TRANSFORMER ALIGNMENT

 Alignment of the Syncroguide transformer，circuit diagram \＃128，whichis sued in the Horizontol Oxeillotor circuit con be occomplishod by utiliz．
ing the procedure outlined below．To perform his alignment，it will be ing the procedure outlined bolow．To perform this alignment，it will be
nectussary to use on oscillascope，preferably one that has a 2 megacyd necussary to use on aseillascope，preferably one that has a 2 megacyle
response and a law input capacity prabe－Under 100 mmid ．to ground．
1．Sot the＂Tap Slug＂，and＂Bottom slug＂of the Syncroguide trons
former to their maximum caunter－clockwise positions．
Short logether lerminals $C$ and $D$ of the Syncroguide Pronsformer．
3．Adjust＂Horizontal Drive＂control，located on rear of chossis pan，
Set＂Horizontol Hald＂control，located at front of chosie，to is
4．Set＂Horizontol Hald＂contra，
moximum clockwise position．
5．Turn on receiver and tune in ony local TV channal．
6．Adiust＂Top Slug＂clackwise unili picture just locks in horizontally．
7．Remove short fram rerminols C and D ．If picture doess not hold syn when sho
8．Connect＇seope to terminal C of Syncroguide transformer and adiust ionary．To seope until two cycles of oseillogrom remain sto lionary．Turn＂Bottom slug＂clockw
equol in height as shown in Fig． 19.
IMPORTANT：The first peak of the wove form should never be highe han the second peak nor should the first poak bo lower than the second peak by more than $3 \%$ ．Also，when odiusting the＂Bottom Slugg，＂the
picture must be in sync，therefore，it may be necessary to turn the picture must be in sync，herefore，it moy be nececsary to thin the After this adjustment has been completed，disconnect＇scope from receiver．
9．Set＂Horizontal Hold＂control counter－clockwise ond odiust＂Top
Slugg＂until picture is locked in ond does not lose sync when swich． Slug＂．＂until picture is locked in and daes not lose oync when switce
ing＂Channel Solector＂knob．Then，Yurn＂Top Slugg＂slowiy counter＂ clockwise until picture is iust ready to lose sync as shown in Fig． 22.
0．Horizontal Halding action of receiver should now be as follow： a．When＂Horizontal Hold＂＂control is at its maximum counter．
clockwise position and＂Channel Selector＂＂
knob
is swithed， clockwise position ond＂Channel Selector＂knob is swit
picture may appear as shown in Fig． 22 or be out of sync．
b．When＂Horizontal Hold＂＂control is ot its maximum colockwise post． b．When Horizontal Hold control tion ture may lose sync when switching＂Channel selector＂ c．When＂Horizontal Hold＂control is in the center or near the center of its ronge，
nel
Selector＂＂knob．


CORRECI
Fig 19


Ncorate
Fig 21
ncorrect
fig． 20


Fig． 22

PRODUCTION CHANGES






| LETTER |
| :--- | :--- |
| DESIGNATION |

## VOLTAGE MEASUREMENT

All voltages measured with a 20,000 Ohm per volt meter with the receiver connected to a 117 volt 60 cycle power supply．
Tuner set to an inactive channel with antenna terminals shorted and connected to ground．

Controls set for normal reception－Power Booster contro completely counterclockwise．
Voltages marked with an asterisk（＊）will vary widely with control settings．
No voltage reading at a tube element indicate zero voltage or voltage which cannot be accurately measured with a

## OSCILLOGRAMS

All oscillograms taken with ground lead of＇Scope connected to receive chassis and controls set for norma reception．Power Booster control ad justed to give 50 volts peak to peak at cathode of picture tube．Oscillo－ scope vertical amplifier response was flat to within $20 \%$ at 2 MC

Number appearing to the left of oscil－ logram specifies setting of horizontal sweep frequency control on＇Scope．

$\qquad$ $-1$
ll－bl 3OVd AL dコNUVM－1丈VMヨIS




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 All voltages measured with a 20,000 Ohm to ground. B supply voltages were measured under the above conditions. cannot be accurately measured with a $\mathbf{2 0 , 0 0 0}$ Ohm per volt meter


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## replacement

The reverse order of the removal procedure should be followed while a the same time exercising the following precoutions:
Corner brackets and tube mounting strap must be assombled to the picture tube before it is installed into the cabinet and this is accomplishod as follows:
a. Brackets can be temporarily attrched to each corner of the picture tube by the use of adhesive tape. Thoy must be placed on each corner of the twbe so thot the curve of the bracker conforms between the conters of the square mounting holes, in the brackets will be $24^{\prime \prime}$ on the long side of the tube and $17 / z^{\prime \prime}$ on the shori side of the tube. (Soe fig. 24 for proper method of measurement.)

Set the tube mounting strap into rocesses on corner brackets, and tighten nut labeled C unit strip is iour. Heel of strap bracket w start to kick up when this tautness is reachoc.
2. Lower tube into cabinet by grasping it under its foce-CAUTION: DO NOT GRASP OR LIFT TUBE BY ITS NECK. Should wood stanchions foil to keep tube from seating properly (due to a tolerance difformove tube and to spread distance berween stanchions. To do this, loos. en ceiling nuts labeled $D$ in Fig. 24 and chassis mounting shelf bolts labeled $E$.
After re-inserting tube into cabinet, and before tightening nuts la. beled $B$, be sure that stanchions are up against corner mounting brack. ets as far as possible, that there is equal distance on eoch side between side of stanchion and side wall of cabinet and that ceiling nuts labeled $O$ and chassis mouning shelf bolks labeled $F$ are securaly tightened
After tube has been seecured and yoke and focus coil mounting assem. bly has been reassembled to tube, cabinet can be raised to its normul posion. Any forwa by loosening nuts labeled $D$ and bolts labeled E and odiusting position of slanchions.

## PICTURE SIZE

27"' Rectangular
DIMENSIONS


## HORIZONTAL OSCILLATOR ADJUSTMENTS

NOTE: These odiustments ore very critical and shauld only be performed by a qualified serviceman. Failure to comply with this If adiustment of the "Horizontal Hold" contiol as explained in step 3 under the section entitled "Control Adjustment Procedure" fails to lock the picture horizontally, it will be necessary to moke the following adjustments:
e until picture is iust about reody to lock in sync as shown in fig. 23.

1. Set "Hoizontal Hold" control to its maximum counter-clockwise posi-
tion"
Set "Top Slug" of Syncroguide transformer to its maximum counterclockwise position. Then, adiust "Top
Slug" clockwise untit Slug" clockwise untit
picture locks in and picture locks in and
does not lose sync when switching "Chan-


Fig. 23
5. If the preceding steps fail to correct for horizontal movement, then
proceed as follows
position. See Fig. 21 for location of control
Repear steps $1,2,3$ and 4.
b. If any vertical bars appear near the left counter of the picture, removed.
The receiver chassis must be removed from the cabinet in order to oc-
Alignment of all RF and if tuned circuits in this recsiver may be ac-
complished by utilizing the pracedures describod In the following charts.
These procedures should preferably be applied in the order in which they


The RF Amplifier and Mixer alignment may also be accomplished inde pentent of Sound or If Channel alignment, buto osecillator calibrotion can
only be done offer If Channel has been correctly aligned.

## CAUTION

The picture tube is highly evacuated and
if broken, fragments will be violently ex pelled. Handle with care, using safety goggles and gloves.

NSTRUMENTS: The following instruments will be required as signal sources ond output indictorors during the olignment process. Since ocecurate
 ance of your instruments, it
specifications described here.

## SOUND CHANNEL ALIGNMENT PROCEDURE

2. Set receiver Channel Selector to any inactive tolevision channel and of the transtorme
Power Booster control to its maximum counte
controls may be left at any desired setting

| STANDARD SIGNALGENERATOR |  | VTVMMCONNECTIONS | MISCELLANEOUS INSTRUCTIONS | TRIMMER <br> OR SLUG | TYPE OF ADJUSTMENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: | :---: |
| CONNECTIONS | frequency |  |  |  |  |
| Connect at shown in Fig. 1. |  | ${ }^{\text {Connect }}$ Fig. ${ }^{\text {as }}$ 2. Shown in | 1. Set Power Booster control to its maxi- mum counter-clockwise position. <br> 2. A special detector must be utilized when oligning the 4.5 Mc . Sound Trop Coil. Oligning the 4.5 Mc. Sound Trop coil. cordance with the information coina high frequencey A.C. probe is avail able, this probe con be utilized in place of the erystal detecter shown in <br> During , this adiustment only, remove ond of the throd ${ }^{\text {bcCB }} 15$ amplifioer noise in the RF stages from affocting the voitage reading while adiusting the sound trap. sound trap. |  | Adiust for on minimum. reading |
| Some as above | Some as |  | A "swishing" sound may be heord in the speaker during sound Channol Alignment. zontal sweep voltage being picked tu in instrument leods; it should be dizregarded as it will have no effect on alignment of the sound channel. | \#2 <br> Discriminator (See Fig 10 ) (See fig. 10) | Adiust for maximum reading |
|  |  |  |  | \#3 Discriminator (See Fig. 11) | Adiust for maximum rooding |
|  |  |  |  | $\begin{gathered} \text { \#4 } \\ \text { Sound If } \\ \text { Transformer } \\ \text { (See Fig. 10) } \\ \hline \end{gathered}$ | Adjust for maximum roading |
| Some as | Same as | Connect ary fig. shown in | To obtain nero bolance of the distriminotor circuift dwo theiono othm rosistors wilt bod so that their respective rosistancos do not difar by more than $1 \%$ or the orccu- racy of the total rositionce is not critical. <br>  ass shown in Fig. 5. | \#2 <br> Discriminator Secondary (See Fig. 10) | Note that as slug \#2 is rotated a point will be found wharg the Iy from a positive to a negative rect sotting of slug \#2 is obtained When slug is moved thru this point |
| Replace the type OCB6 tube previously removed in the above procedure ond turn set on. Tune in to a local channel ond should there be an unusual amount of "Intercarrier Buzz" refer to procedure on adioining page to remove this aforementioned fault. |  |  |  |  |  |


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Connect o 3 volt battery to the receiver AGC system so that negative
terminal of battery connects to $A G C$ line and positive terminal of bottery connects to receiver chassis. (See fig. 11 for convenient point tery connects
of connection.)

| STANDARD SIGNAL GENERATOR |  | SWEEP Generator |  | $\begin{aligned} & \text { VIVM } \\ & \text { CONNEC- } \\ & \text { TIONS } \end{aligned}$ | SCOPECONNECTIONS | miscellaneous INSTRUCTIONS | TRIMMER OR SLUG | TYPE OF ADJUSTMENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CONNECTIONS | frequency | CONNECTIONS | frea. |  |  |  |  |  |

RF AMPLIFIER AND MIXER ALIGNMENT


## OSCILLATOR ALIGNMENT

. IMPORTANT: Before undertaking oscillator alignment be sure If
circuits are
in $F$ Fig. 6.
2. During this step and thru-out all succeeding steps it is necessary to
keep output of sweep generator at a level that does not ollow reading
on VTVM to exceed one-half volt. on the 'scope.

| $\left\|\begin{array}{lll} \text { Connect os os } \\ \text { shown } \\ \text { fig. } & 12 . & \text { in } \end{array}\right\|$ | 197.75 MC . <br> Sound Carrier Morker. <br> 193.25 MC . <br> Picture Marker. |  | $\begin{gathered} \text { CHANNEL } \\ \# 10 \end{gathered}$ | $\left\{\begin{array}{l} \text { connenctos os } \\ \text { shong. } 14 . \end{array}\right.$ |  | Set Chonnel Selector to Channel \#10. Be sure thot generator's output does specified in instrue- pions obave. |  <br>  curve so that pieture corrier, morker is located ot thi position indicoed in fig. 17 . Pasition of sound carrier morker should appeor as indicoted in Fig. 17. |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Some es ${ }_{\text {above. }}$ | The bandpass chat a c - teristic for eoch of the sive channels be abserved ing iv id - ually. For frequency setting of marker signals see tobl in Fig. 15. | Same os above. |  | Some as | Same os above. | Set channel selector to channel being to chann abserved. |  |
| If an oscillotor slug "folls into" its coil fom during odiustment, remove the Chonnel Coil from the turret ossembly and lift the Slug Retoining Spring aside. By tapping the coil farm it should be possible to make |  |  |  |  |  |  |  |
| If an unsatisfoctory overall response is obtained for a particular channel, observe RF Amp. and Mixer response curve for that channel. If characteristic does not conform reasonably well within the typical curve shown |  |  |  |  |  | in Fig. 16, then, (1) ottempt to obtain a better compromise for RF response on oll chonnels by realigning RF Amp. and Mixer circuits, or (2) try replacing Antenna, RF and Oscillator coils for the particular channels. |  |

## SYNCROGUIDE TRANSFORMER ALIGNMENT

As used in the Horizontal Oscillator circuit con tire aicegram by which ing this procedure. To perform this olignment, it will be necessary to use an oscilloscope, preferobly one that has a 2 megacyct
low input capacity probe-under 100 mmfd to ground.

1. Set the "Top Stug" and "Bottom Slug" of the Syncroguide trans otheir maximum caunter-clackwise positions.

Short together terminals $C$ and $D$ of the Syncroguide transformer,
3. Adiust "Horizontal Drive" control, located on rear of chassis pan,
one-holf turn out from its maximum clockwists position,

Set "Horizontal Hold" control, located at front of chassis, to its
maximum clockwise position.
5. Turn on receiver and tune in any local TV channel.
o. Adiust "Top Slug" clockwise until picture iust locks in horizontally.
7. Remove short from terminals $C$ and $D$. If picture does not hold sync when short is removed, odiust "Bottom Slug" clockwise until picture
cos
B. Connect 'scape to terminal C of Syncroguide transformer and adiust
sweep rate of 'scope until two cycles of oscillogram romain sto.

$\underset{\substack{\text { corret } \\ \text { Fig. } 24}}{ }$
incorret
Fig. 25
tionary. Turn "Bottom Slug" clockwise until wave form peaks are
equal in height as shown in Fig. 24. MPORTANT: The first peak of the wave form should never be tioher thon the second peak nor should the first peak be lower than the second citure must be in sync, therefore, it may be necesary to wiug," the "Harizontal Hold" control counter-clockwise when performing this stiep.
9. Sef "Horizontal Hold" conirol counterelockwise and adiust "To Slug", until picture is locked in ond does not lose sync when switch ing "Channel Selector" knob. Then, turn "Top Slug"" slowly counter.
clockwise until picture is just ready to lose sync. as shown in Fig. 27.
10. Horizontol Holding action of receiver should now be as follows: a. When "Horizontol Hold" control is at its maximum cunter
dlackwise position and "Chonnel Selector" knob is switched pitture may appear as shown in Fig. 27 or be out of sync.
b. When "Horizontal Hold" control is at its maximum clockwise posi
tion, picture may lose sync when switching "Chonnel Soloctar" knob. When "Horizontal Hold" control is in the contor or noar the
conter of its range, picture remains stable when switching "Chan-
nel Solector" knob.

Fig. 27

INSTRUMENT CONNECTIONS FOR R.F. CHANNEL ALIGNMENT


FIG. 12
Generator Connections

conoenser acros
as An R.F.FILER

FIG. 13
Oscilloscope Connections for RF Amp. and Mixer Alignmen


FIG. 14
VTVM and Oscilloscope Connections for Oscillator Alignment

| CHANNEL <br> NUMBER | PICTURE CARRIER <br> MARKER FREQ. | SOUND CARRIIR <br> MARER FRE. |
| :---: | :---: | :---: |
| 13 | 211.25 MC. | 215.75 MC. |
| 12 | 205.25 MC. | 209.75 MC. |
| 11 | 199.25 MC. | 203.75 MC. |
| 10 | 193.25 MC. | 197.75 MC. |
| 9 | $187.25 \mathrm{MC}$. | 191.75 MC. |
| 8 | $181.25 \mathrm{MC}$. | 185.75 MC. |
| 7 | 175.25 MC. | 179.75 MC. |
| 6 | 83.25 MC. | 87.75 MC. |
| 5 | 77.25 MC. | 81.75 MC. |
| 4 | 67.25 MC. | 71.75 MC. |
| 3 | 61.25 MC. | 65.75 MC. |
| 2 | 55.25 MC. | 59.75 MC. |

Fig. 15


FIG. 16


FIG. 17


FIG. 18 Front View of



FIG. 19
Trimmer Location of R.f. Tuner

## CIRCUIT DESCRIPTION FOR 521068 RF TUNER

The turret type tuner incorporoted in this chassis is of the latest design
ond urilizes a 6807 or 6827 tube os the R.F. amplifier (V5) and a 016
Channel selection is occomplished by rotation of the turret cantaining dividual antenno cail sectians consist of o balanced primary to minimize noise pick-up on the transmission line and on R.F. grid coil which cauples
the incoming signal to the grid of the first section of the R.F. Ampli: fier tube (V5). The inductance ond amount of coupling of the tuned antenno input circuit are changed for each channel so that a constant
nput impedance of 300 ohms is maintoined. This provides moxin ransfer af energy to the R.F. Amplifier stoge, particularily when interconnection between on ou
300 ahm transmission line.

The R.F. Amplifier tube is a duol.triode tube and is conected in the circuit as a direct caupled grounded-grid type amplifer. This circuit wa merepearly meet the demand for an R.F. Amplifier that would pravide
gore near on both the law ond high televisisan Channels,
 Unit octing not as an amplifier, but rother as an ontenna impedonce
matehing device ond also as ariable cathote impedance, or bias
source, for the secand, or graunder-grid unit. In addition the first unit of the R.F. Amp. acts as a pawer amplifier due ta its extremely low plate
impedonce, which is in reality the cothode circuit of unit two, and canmpedorce, which is in reolity the cothode circuir of unit two, an
verts the weok signal valtage fram the ontenno to a low valtage-high current signol which is then opplied to the cathode of unit number twa
The signol coupling unit between the first and secand units is a series peaking coil, symbol 406 , similor to that found in a video amplifier
circuit. ths purpose is to form o series resonant circuit with the input frequency stightly higher unit. The cail is shannel made as to resonate of a
amplifier, the goin falls of rapidly as progressively higher chanrels aro
selecied. With the use of the plate to cathode peaking coil an olmost equal gain con be realized for all channell

The R.F. Amp. tube has inherently low interelectrode capacity due to physi the first section is responsible for the low noise factor at this slage White neutrolization of the first unit is not necessarily due ta its low anly a slight decrease in gain, by the addition of a neutralizing can denser, item 405. Due to the low output impedance of the stage, it is Because of the cirevits' excellent internal shielding, low input impedance and rodiatian reiection, the second section of the R.F. Amp. is connected
as a driven grounded-grid amplifier. While this might not be apparent a as a driven grounded-grid ampififier. While this might not be apporent at
first glance due to the foct that grid has no direct D.C. return, it will be found upon further examination that ony high frequency A.C. pO tentials are by-passed
The second sectian of turret coils includes the tuned R.F. omplifier plate
coil, tuned mixer grid coil, ond oscillotor coil. The output of the R.F. amplifier stoge is coupled to the grid of the mixer stoge, which utilize one triode section of a 606 tube (V6). The ather hall of the 616 i
connected os a modified Colpitts oscillatar which injects accillator walt inta the mixer stage thraugh cuupling between the oscrilitatar coil ond the
mixer grid coil. Course oscillator tuning is occamplished by odiusting mixer grid coil. Course oscillator tuning is accamplished by adiusting
the pasitions of the slugs in the individual ocillot coill Tun:ng is obtained when using candenser $\# 417$ in the ascillatar plate circuit. This Fine Tuning candenser is campased of two fixed plates, ond
its capacitonce is changed by the insertion af a bakelite cam between these plates.

Signal output from the mixer stage is coupled to the If amplifiers through
the canverter plate I.F. cail, diagram $\# 427$. lacated an the tuner unit

SERVICE PRECAUTIONS

| sumbect | precautrons |
| :---: | :---: |
| ELECTRICALCOMPONENTS | The high frequencies used in the RF section af a televisian receiver make it necessary that cansiderable care be exarcised in servicing the tuner. Lead dress and location of components are very critical at these frequencies. |
|  | When replacing parts, it is important ta use camponents of identical electrical characteristics and physical size. Always recannect the replacement item in the some lacation ond pasition in the tuner as the original campanent. |
| tubes | Replacement of tubes in the Tuner Unit may cause slight detuning of RF circuits due to inherent differences in inter-electrade copacitances. When replacing tubes (especially $6 J 6$ mixer-oscillatar tube) make sure that Fine Tuning cantral will tune in televisian statians at appraximately the middle of its range. It may be necessary ta change the setting of the individual oscil- |


-
lator cail slugs for same channels to accomplish this

| subject | PRECAUTIONS |
| :---: | :---: |
| ChANNEL COILS AND SLUGS | Channel Cails must be handied with care. Do not disturb coil windings. If on ascillotor slug "folls into" its coil form during odiustment, remove the Chonnel Coil from the furret assembly ond lift the Slug Retoining Spring aside. By topping the cail form it should be possible to moke the slug move toward the end sa that its threads will be engoged by the slug Retain. ing Spring when that spring is returned to its normol position. |
| FINE TUNING CONTROL | Rubbing of the bakelite Fine Tuning Com agoinst the Fine Tuning Condenser Plote is intentionol in arder to ovaid vibrotion with resulting microphonics. However, the Fine Tuning Cam should not rub or contoct the smoll circular plate locoted on the body of the tuner. |

REMOVAL AND REPLACEMENT OF PARTS

| Item |
| :---: |
| RF TUNER UNIt |
|  |
|  |

CHANNELS COILS

## tuner turret

assembir
-
stator contac
assembiy

## procedure

To remove the Tuner Unit from receiver chassis, proceed as follows:

1. Remove shannel selectar dial lomp socket.
2. Remove screws which hold funer to front and rear support brackets.
3. Discannect the leads from the tuner ta the main chossia. See illustration on circuit diagram page showing tuner connec.
4. Tuner unit may now be withdrawn fram underside of chassis

It is not necessary to remove entire tuner unit to replace a snap-in channel coil but removat of bottam shield will be re-
auired. This may be occomplished by grasping the frant end of the shield and pulling dawnward and unhooking it fram reor of tuner frome. Insert a screwdriver blade between Cail Retainer Spring and the end af the Tuner Turrot. Twist the blade to pull spring away
fram the molded body of hannel Cail. Lift this end of cail body upward ond remove individual cail assembly fram funer. When replecing Channel Cails, be sure they are reinstolled in their correct positions. Coil numbers should increase consecu Whely in o counter-slockwise direction whon funer is viewed fram the frant If all the Channei Cails hove been removed fram the Tuner Turret, rotate furret until flat surface on end of funer shatt points down. Instal
ather coils.
To remove furret fram RF Tuner Unit, remove camplete :uner and battom shield as described in previaus sectians and proceod as follows:

1. Remave rear Turret Shoft Retaining Spring by disengaging straight end af spring fram proiection an tuner frame
2. Remove Fine Tuning Candenser. Plate fram front of Tuner Unit. This plcte farms ane side of Fine Tuning cantral candenser
and is held in ploce by ane serew.
3. Slide Fine Tuning Cam and Shaft off af main Channel Selectar Shatt
4. Remave Spring Cantactor Washer and Fiber Spacer Washer fram Channel Selectar Shatt
5. Remave Shaft Retaining Spring of frant of tuner by disengoging straight end of spring fram proiection an frame.
6. Remave furret assembly fram frame.

Ta replace turret, reverse the above procedure. Taoth an bakelite Fine Tuning Cam should point downward during ossembly
sa that it daes not became locked between the staps an the fine Tuning Condenser Plote. Also be sure to reploce bottam so that it
shield.
Ta remave this assembly, remave complete tuner as described in previous sectians and praceed as fallaws:
Remave side shield by taking out the twa retoining screws and unsolder shield at ane point. Naw, disengage shield fram upper edge of funer frome.
2. Remave the twa screws at the frant and rear af the Stotar Cantact Assembly
3. Unsalder all electrical cannections to cantact plate.
4. Unsolder five saldered ions be with Stotar Cantoct Assembly and Tuner Unit

Ta reinstall this assembly:
Place Statar Contact Assembly in pasitian and replace, but da not tighten, the twa screws of the frant and rear af the assembly.
2. Remove 3 cansecutive pairs of Channel Cails from the furret (far example, the antenna ond rfoosc. coils far chonnels
\#5, 6 and 7 ). Turet sa that the edges of the next highest Channel Cails (in this case, the cails far chonnel \#8) just
3. Pasitian Tuner Turret sa that the edges of the next highest
pass the row of 11 contacts an the Stotar Cantact Assembly.
4. Adiust pasition of the Statar Cantoct Assembly sa thot there ore a few thausandths of an inch spacing between the can 4. Adiust pasition of the Statar Cantoct Assembly so that there ore a few
tacts an the contoct plate and the malded bady of the Chonnel Coils.

The Contact Assembly is naw carrectly pasitioned and screws at frant and rear may be tightened.
5. The Contact Assembly is naw carrectly pasisianed and serews at front and rear may be
6. Salder Statar Cantact Assembly ta funer frame at some points that were used previausly.
7. Make all electrical cannections to contoct plate.
8. Replace Channel Cails.

## CIRCUIT DIAGRAM FOR 521068 RF TUNER



## VOLTAGE MEASUREMENTS

## All valtages meosured with a $20,000 \mathrm{Ohm}$ per valt meter with the receiver connected to a 117

 valt 60 cycle power supply.Tuner sot to on inactive channel with ontenno
terminols sharted and cannected to graund. Contrals set for narmol receptian-Pawer Baaster cantral completely caunterclockwise.
Valtoges marked with an asterisk (*) will vory widely with contral rettings.
B supply valtages were measured under the abave conditians.
R.F. tuner socket valtage measurements were taken with tubes remaved fram sacket.
Na valtage reoding at a tube element indicote zera valtage ar voltage which cannat be aceurarely measured with o $20,000 \mathrm{Ohm}$ per valt meter




## VOLTAGE MEASUREMENTS

All voltages measured with a 20,000 Ohm per volt meter with the receiver connected to a 117 voit 60 cycle power supply.

Tuner set to an inactive channel with antenna terminals shorted and connected to ground.
Controls set for normal reception--Power Booster control completely counterclockwise.
Voltages marked with an asterisk (*) will vary widely with control settings.

No voltage reading at a tube element indicates zero voltage be accurately measured with a $20,000 \mathrm{Ohm}$ per volt meter.

## OSCILLOGRAMS

All oscillograms taken with ground lead of 'Scope connected to receiver chassis and controls set for norma reception. Power Booster control ad justed to give 50 volts peak to peak at cathode of picture tube. Oscillo scope vertical amplifier response wa flat to within $20 \%$ at 2 MC .

Number appearing to the left of oscil logram specifies setting of horizontal sweep frequency control on 'Scope


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## ALIGNMENT PROCEDURE

The receiver chassis must be removed from the cobinet in order to ac－b．RF Frequencies： 54 to 88 Mc．
complish alignment of al tuned circuls．
Alignment of all VHF RF and If funed circuits in this receiver may be ace－
complished by utilizing the procedures described in the following charts． These procedures should preferably be applied in the order in which they are prosented．Alignment of Sonnd．
complished individually if desirad．
The VHF RF Amplifier and Mixer alignment may also be accamplished independent of Sound or IF Channel．－lignment，but oscillotor calibration
can only be done afier If Channel has been correctly oligned． CAUTION
The picture tube is highly evacuated and
if broken，fragments will be violently ex－
pelled．Handle with care．Avoid contact with metal shell of picture tube as this is part of the high voltage circuit．
INSTRUMENTS：The following instruments will be required as signal
sources and output indicators during the alignment．Since accurate sources and output indicators during the alignment．Since aceurate
alignment of a television reeciver is heovily dependent upon the perform． once of your instruments，it is imperative that they meet the ossentiol
specifications described here． cifications described hero
STANDARD SIGNAL GENERATOR to provide unmodulated（pure ronges should be ot least．1．volv with proverision for ortipuvutaion as
desired．This instrument must hove good frequency stablifity and be desired．This instrument must have good frequency stability and be
a．If frequencies：
4．5 Mc．Sound Channel
39.75 Mc．to 47.25 Mc．If Channel
54 to 88 Mc ．
174 to 216 Mc ．
No frequencies are listed for the UHF RF Channels．If it ever
becomes neecessary to align the UHF RF Channels，the UHF becomes necessary to align we URF RF Channels，the UH
Tuner，part 521170 ，must be refurned to the factory in ac Tuner，part 521170 ，must be returned to the factory in ac
cordance with the removal instructions，listed in a subsequent section under the heeding＂VHF．UHF Tuner Servicing Procedure＂
localed on poge 1953．33． 2．Vacuum tube voltmeter．The lowest voltage range of this in strument should preferably permit a 1.0 volt readin
at not less than one third of full scale deflection．
3．RF SWEEP GENERATOR to provide frequency modulated signal for observing the over－all bandpass characteristic and RF Channel alig ，
40 to 50 Mc ．with 10 Mc ．weep width．
55 to 88 Me with 10 Mc ．seop width
174 to 216 Mc with 10 Mc ．sweep widh．
No frequencies are listad for the UHF RF Channels．If it ever becomes necessary to align the UHF RF Channels，the UHF
Tuner，part 521170 ，must be returned to the factory in ac－ cordonce with the removal instructions，listed in a subsequent
section under the hooding
＂VHF．UFF Tuner Servicing Procedure＂ section under the heading
located on page 1953．33．
4．Cathode ray oscilloscope，preferably a unit with vertical amplifier having wide range frequency response and low capacity pick－up probe．This instrument is used for observing the over－all band
pass characteristic and for RF Channel alignment．

## SOUND CHANNEL ALIGNMENT PROCEDURE

 of the transformer．

| standard signal GENERATOR |  | $\underset{\substack{\text { VTVM } \\ \text { CONNECTIONS }}}{ }$ | miscellaneous instructions | TRIMMER OR SLUG | TYPE OF ADJUSTMENT and output indication |
| :---: | :---: | :---: | :---: | :---: | :---: |
| CONNEC． TIONS | frequency |  |  |  |  |
| Connect os shown in Fig． 1. |  |  | 1．Sef Power gooster control to its moxt． <br> 2．Aumpeciol dorecector muss bo utilizod when aligning the 4.5 Mc．Sound Trop Coil． <br>  toinod in Fige 3．${ }^{17}$ ．．VTVM contoining able，this probe con bo witizod in place of the crystol detector shown in pig． 2 of the crystor detector shown in <br> ．During this，odiustment only，remove <br>  noiso in the RF sogen from affocting sound trap． |  | Adiust for min minum．${ }^{\text {and }}$ |
| Some as obove | Some as above． | Connect pig．shown in | A＂swishing＂sound moy be heard in the speaker during Sound Chonnel Alignment．This sourious oscillation is cousod by hori－ zontol sweep voltoge being picked up in the oudio system，thru stroy coupling of os it will have no beffect on alignment of ihe sound channal． | \#2 <br> Discriminator （See Fig． 10 ） | Adiust for onoximum reading |
|  |  |  |  | \＃3 Discriminator （See Fig．8） | Adiust for moximum reading |
|  |  |  |  |  | Adiust for maximum reoding |
| Same ${ }_{\text {cose }}^{\text {abobe．}}$ | Same as | Connect or fig．s．${ }^{\text {chown }}$ in |  | \＃2 <br> Discriminator Secondary （Se＊Fig． 10 ） | Note that as slug \＃2 is rotated， point will swing rother sharD ly from o positive to a negative rect setting of slug \＃2 is oblained when slug is moved thru this point |
| Reploce the type BCB6 tube proviously removed in the above procedure ond purn set on．Tune in to a local channel and should there be on unusual omount of＂Intercarrier Buzz＂refer to procedure on adjoining page to remove this aforementioned fault． |  |  |  |  |  |

GZ－ヤI ヨ9Vd ヘ1 \＆ヨNZVM－18VMヨIS
MODELS 21C－9325F，G

5. Adius. output ontenuator on sweop
V.T.V.M. is not in excess of one volt
6. Koep
readoble morker but does not diston the at a level that provides o on the 'scope.
Certoin olignment steps will require a fixed 3 volt A.G.c. bios. When necessary, connect negative lerminal of bottery to the receciver A.G.C. line and posiive iorminol to receiver chossis. See Fig. 8 for convenient

| trimmer or slug | TYPE OF ADJUSTMENT and output indication |
| :---: | :---: |
| \# 5 and \# 6 <br> 3rd IF Trans. (See fig. 9) | Adjust trimmers for maximum ampliand correct positioning of markers as shown. |




$$
\begin{aligned}
& \begin{array}{l}
\text { REDUCTION OF INTERCARRIER BUZZ } \\
\text { Under actuol reception conditions slight "dynomic" unbolance of the dis- }
\end{array} \\
& \begin{array}{l}
\text { Under actual reeception conditions slight "dynomic" unbolonce of the dis- } \\
\text { criminotor seocondory con emphasize intercorrier buzz due to incomplete }
\end{array} \\
& \begin{array}{l}
\text { omplitude modulation reiection. Therefore it is vitolly importont too obloin } \\
\text { on aceurate setting of the discriminotor secondory slug under these con }
\end{array} \\
& \text { ditions. } \\
& \begin{array}{l}
\text { Disconnect all instruments (te sure that 1.f. tube removed for the odiust. } \\
\text { ment of Sound Trop hos been replaced) and then connect an ontennu to }
\end{array} \\
& \begin{array}{l}
\text { The reeseiver to oblain program recoption from a local station. If intor- } \\
\text { carrier buzz is prominent a }
\end{array} \\
& \begin{array}{l}
\text { secondary slug (\#2) should be mode to obtoin the "dip" point for the } \\
\text { buzzing sound. Note that program sound will be chect }
\end{array} \\
& \begin{array}{l}
\text { buzzing zound. Note that progrom sound will be clace and free from } \\
\text { diztontion on this point. Burz should now be ot on acceptable minimum } \\
\text { if stotion tronsmission is not of foult. }
\end{array} \\
& \begin{array}{ll}
\text { OROUND TO } & \text { distotrion ot this point. Buzz should } \\
\text { it } \\
\text { ICEIVER CMASSIS }
\end{array}
\end{aligned}
$$

## VTVM Connections

of the IF transtormers to prevent ofolse indication.
In order to eliminole the possibility of spurious oscillotion, is ir bea
able to render the VHF RF oseillotor inoperative. This may be oc
the first two contacts (from front) of drum osspembly. Use ony inopero
Short antenna torminals togather with a iumper wire.

| generator CONNECTIONS |  |
| :---: | :---: |
|  |  |



[^17]

Bottom View of Chassis VHF RF CHANNEL ALIGNMENT PROCEDURE Top View. of Chassis The pracedure listed below is only for the VHF RF Channels. If it ever
becomes necesary to align the UHF R Chanels, the UHF THner, port
521170 , must be returned to the factary in accordance with the removal instructions, listed in a subsequent section under the heading "VHF.UHF Funer Servicing Pracedure," lacoted an page 1953-33.
. CAUTION: The shell of the picture tube has o high voltoge patentiol,
opproximotely 14,000 volts, ond contact should be ovoided

| standard signal GENERATOR |  | SWEEP GENERATOR |  | $\begin{aligned} & \text { VTVM } \\ & \text { CONNEC- } \\ & \text { TIONS } \end{aligned}$ | $\begin{aligned} & \text { SCOPE } \\ & \text { CONNEC- } \\ & \text { TIONS } \end{aligned}$ | miscellaneous instructions | TRIMMER OR SLUG | tYPE OF ADJUSTMENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| CONNECTIONS | frequency | CONNECTIONS | frea. |  |  |  |  |  |
| RF AMPLIFIER AND MIXER ALIGNMENT |  |  |  |  |  |  |  |  |
|  |  |  | CHANNEL | Not used. | $\begin{aligned} & \text { Connoct } \\ & \text { os } \\ & \text { sho } \\ & \text { sig. } \\ & \text { fin. } \\ & \text { on. } \\ & \text { in } \end{aligned}$ |  |  |  |
| Same os <br> above. |  | Same os above. |  | Not used. | Same as above. | Sat channel solector observed. |  |  |

## OSCILLATOR ALIGNMENT

1. MPORTANT: Before undertoking oscillator alignment be sure lf
circuits ore correctly olignod for bond pass choracteristic illustrated in IF alignment procedure.
During ascillatar alignment, it is necessory to set the Fine Tuning
(correct pasition to this contro this sine tuning com poins dewnword
During this step ond thru-out all succeeding steps it is necessary to keep output of swoep gener
on VTVM to exceed one volt. aidable morker but doess not distort the curve that is being observed


Same as
obove


$$
\begin{gathered}
\text { Same as. } \\
\text { obove. }
\end{gathered}
$$



Same as
obove.
Some as
obove:
$\left\lvert\, \begin{aligned} & \text { Sel channel sel } \\ & \text { to chonnol } \\ & \text { obsorved. }\end{aligned}\right.$
 If on ossillatar slug "folls into"" its coil form during adiustment remove the slug move toward the end so that its threads will be ongoged by the
the Chonnel Coil from the turret ossembly ond lift the Slug Retaining
Spring aside. By topping the cail form it should be passible to moke Retoining Spring when that spring is returned to its normal position. If on unsatisfactory overall response is obtained for o particular shown in Fig. 15 , then, (1) attempt to attoin a better campromise for RF
channel, observe RF Amp. ond Mixer respanse curve for that chand channel, observe RF Amp. ond Mixer respanse curve for that channel. response on all channels by realigning RF Amp. ond Mixer circuiss, or (2)
If characteristic does nat conform reasonably well within the typical curve

## INSTRUMENT CONNECTIONS FOR R.F. CHANNEL ALIGNMENT





conoenser across scope terminals
as an r.f.fiter
FIG. 12


MODELS 21C-9325F,

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## V．H．F．－U．H．F．TUNER SERVICING PROCEDURE


 When it is neeessary to romove the tuning units for service，it con be oc． complished by following the procedure given in the ofolowing poragrophs．
For simplicity，here is o separate removal procedure for euch of the Forp simplicity，there is a separate removol procedure for euch of the
tunes．
俍 Instructions for ree
also
aive below．

## REMOVING U．H．F．TUNER

（Numbers which oppear after parts mentioned in．
taxt rafer to parts shown in in illstration obover．）

 2．Romove Bracket and Triangular Shaped Guard（7）stielding U．．．F． 2．Romove Bracket．



 strands of cord as near as possible to the puiler．
arround Diol Pulley ond Shat（12）in this monnere）
 （not shown in illustratio）
Bracket（1）
5．Loosen the two set screws on U．H．F．Tuning Gear（5）and free tuner
 now be completety）removed by sliding it toword rear of chassis，thus
disengaging unit from Coar（5）ond pulley Brackets（10）． If tuner is returned tof foctory for repair it must be shipped with all parts


## REMOVING V．H．F．TUNER

 （Numbers which oppear ofter ratst mentioned intext refer to ports hhown in illustration above）．
Remove U．H．E．tuner as described above．
2．Disconnect leads marked $M, N, P, Q$ ， end $U$ on＂Botrom view of Chas． iis Showing Connections of R．F．Rund white ond yellow leads from
$(17)$ ；at erminals 58 ond 517 ，
3．Rotate Channel Selector knob until v．．F．Selector Swith Actuotor Cam is completely dis dis
switch mounting screws．
．Remove channel selector knob，Fino Tuning knob and U．H．F．Dial

5．Remove Fiber Bracket（11）which supports tuner operating shofth Also emove fiber dial lite shid
fiber bracker mounting screws．
6．Remove the four Tuner Mounting Screws（15）and lift V．f．f．tuner
（160）Fom chosis．
7．Renow Clio（13）which retains U．H．F．Dial Shatt and Pulloy（12）

8．Remove u．f．f．Tuning Belt（9）from pulloys
9．Lossen two set screws ond remove U．H．F．Tuning Pulley（1）．
10．Remove U．H．F．Turing Pulley and Bracker Assembly（10）．
11．Remove front Mounting Bracker（3）and Rear Mownting Bracker（1）． 12．Losen see screw and remove v．H．F．Selector Switch Actuator Com
mounted on rear of turret shaft． If tunere is referned to foctory for repair it must be shipped with all parts removed os indicated obove．

## REINSTALLING TUNERS

The reinstallation of the tuner can be made in the reverse
the removal procedure，observing the following precaution
The reinstallation of we tunerang te following precautions．
the removal procedure，observing the for in
1．Remount v．．．．F．Tunere（ 16 ）in mounting holes that place tuner as far
2．Position coaxial cable load
2．Position cooxiol cable or Sed
3．Whecenor Switch Actuator Cam． shact to its extreme countercilockwise position ond turn Drive Pulloy
（6）until the opening in its rim is as shown in lower illustration before tishtering pulley set screws．

5．Before replacing U．t．f．dial，be sure that＂Fine Tuning＂shaft

REPLACING U．H．F．DIAL DRIVE CORD
As it it neesesty to remeve drive cord when roplocing U．H．F．Tuning Belt
（9），the belt should be replaced ot this time if it is worn．The method of
 accomplishing his is given in a slep So peocecurd（7）．
2．Turn U．H．F．Funer shatif folly countior．clockwiso and if necessary

3．String divive cord by placing ring at end of cord over tongue of Dive
4．Replace U．H．F．dial by following procedure given in paragroph 5 in


REPLACING U．H．F．TUNING BELT 1．Follow teps 2 and 3 in Urocedroe entited＂Removing U．H．F．Tuner＂ 2．Remove old Tuning belt（9）by pulling it over Drive pulleys（6）and 2．Remone old Turing Belt（9）by pulling it over Drive Pulleys（6）and 3．Install new belt by ving teverse of procedure given in yiep 2 above． 3．Insall new belt by using reverse of procedure given in wep 2 above
4．Replace Drive puley（6）following procedure given in paragrophs 3 ． 4 ond 5 in section＂Reinstaling Tuner．＂


DIAL DRIVE CORD ARRANGEMENT
 The circuit shown on this page applies
to＂SERIES ABCD＂，chassis


| Eetir |  |  |  |
| :---: | :---: | :---: | :---: |
|  |  |  |  |

UNCODED $\quad$ INITIAL PRODUCTION

 ．Chonsoo oakings coil 53 in in late circuit of tube $V 4$（Vidoo Amp．）from







 2．Chongo connection of sitid pin io，of tube 177 （Pisture Tube）from




$$
" \mathrm{E}{ }^{\prime \prime}
$$



## PARTS LIST

| $\begin{aligned} & \text { DIA } \\ & \text { GRAM } \\ & \text { NO. } \end{aligned}$ |  |  | ${ }_{\text {List }}^{\text {Liste }}$ |
| :---: | :---: | :---: | :---: |
| CONDENSERS |  |  |  |
| 2 | 513038 | Condenser-ceromic 1500 Mmpd .400 volt | 35 |
|  | 513038 | Condenser-ceramic 1500 Mmfd .400 volt | 35 |
|  | ${ }^{513038}$ | Condenser-ceromic 1500 Mmfd . 400 volt | 35 |
|  | 513013 513013 |  | 36 <br> .36 |
|  | 513455 | Condenser-ceramic $8.2 \mathrm{Mmfd} .=5 \% 400$ volt (Temperafure compensating) | 25 |
|  | 513038 | Condenser-ceramic 1500 Mmid .400 volt | 35 |
| 14 | 513037 | Condenser-ceramic $470 \mathrm{Mmfd}$. | 35 |
|  | 513037 513038 | Condenser-ceramic 470 Mmfd . 400 volit...... Condenser-ceramic 1500 Mmidd .400 volt |  |
| 20 | 513448 | Condenser-ceramic $12 \mathrm{Mmfd} .=5 \% 500$ volt (Temperature campensating) | 1.05 |
| 24 | 513449 | Candenser-ceramic $5 \mathrm{Mmfd} . \pm 1 \% 500$ valt (Temperafure campensating) | 05 |
| 28 | 513038 | Condenser-ceromic 1500 Mmfd .400 val | 35 |
| 30 | 513037 <br> 513038 | Condenser-ceromic 470 Mmfd . 400 vall | 35 35 35 |
| $\left\lvert\, \begin{aligned} & 34 \\ & 35 \end{aligned}\right.$ | 513038 513044 | Condenser-ceromic 1500 Mmfd .400 volh Condenser-ceramic $680 \mathrm{Mmfd}$. . 400 valt | 35 25 25 |
|  | 513454 | Condenser-ceramic $4 \mathrm{Mmfd} . \pm 1 \% 500$ (Temperoture compensoting) | 25 |
|  | 513432 | Condenser-ceramic $5 \mathrm{Mmfd} . \pm 10 \% 500$ volt (Temperature compensoting) |  |
|  | 513013 | Condenser-ceramic 5000 Mmidd . 450 volt | 36 |
|  | 512238 513438 |  |  |
|  |  | compensoting) | 45 |
|  |  | - |  |
| $\left\lvert\, \begin{aligned} & 61 \\ & 62 \end{aligned}\right.$ | 513032 512216 | Condenser-ceramic 220 Mmfd .1000 Condenser-. 1 Mfd. 200 volp. | 40 30 |
| 6s | 512235 | Condenser-. $047 \mathrm{Mfd}$. | 30 |
| 7 | 512210 | Condenser- 03 Mid. 200 volt | 35 |
| 79 | 513013 | Condenser-ceramic 5000 mmFd . | 36 |
| BS-A, | 72 | Conderser- ole ectiolytit 450 <br>  | 5 |
|  | 150095 | Condenser-electrolytic 40 Mfd . 300 | 2.00 |
| 90.A.8.... | 50902 | Condenser-electrolytic <br> $\left.\begin{array}{l}\text { A- } 80 \mathrm{Mfd} . \\ \mathrm{B}-100 \mathrm{Mfd} . \\ 250 \\ \text { volt } \\ \text { volt }\end{array}\right\}$ | ) |
|  | 504719 | Condenser--electrolytic 4 Mfd. 450 volt | 100 |
| $\begin{aligned} & 95 \\ & 98 \end{aligned}$ | 512235 51239 | Condenser- 0047 mpd .200 vol | 30 <br> 75 <br> 5 |
| 103 | 512205 | Candenser-0. 01 mid .400 voll | 25 |
| 107 108 | 512502 50807 | Condenser-mico 100 Mmfd . $\pm 10 \% 500$ volt | . 25 |
| 108 | 508071 | Condenser-trimmer 10.160 Mmfd. (Horizon- tal Drive) | 40 |
| 109 | 513030 | Condenser-ceromic 47 Mmfd .1000 voit. |  |
|  | 5122 | Condenser-m022 Mfd. 400 volt |  |
| $\begin{aligned} & 115.5 \\ & 119 . \end{aligned}$ | 512233 | Condenser-. 047 Mfd. 200 volt..... Condenser-. $47 \mathrm{mid}$.200 volt. |  |
| 121 | 512236 | Condenser- 047 mfd. 400 volt | 30 |
| 122 | 512233 | Condenser-022 mid. 400 volt. |  |
| 127 | 513427 | Condenser-ceramic $200 \mathrm{Mmfd} . \pm 2 \% 500 \mathrm{v}$. (Temperafure compensaliag) | . 65 |
| 130 ... | 512311 | Condenser- 01 Mfo. 400 volr (Special Characteristic |  |
| 131 | 512547 | Condenser-mica 820 Mmfd . $\pm 5 \%$ 500 volt |  |
| 132 | 513009 | Condenser-ceromic 1000 Mmfd . 500 volt.... |  |
|  | 513006 | Condenser-ceramic 270 Mmifd .500 vol Condenser-. 22 Midd 200 volt..... |  |
| 137 | 512218 | Condenser-. 1 mid. 600 volt... | . 55 |
| 141 142 | 512237 | Cendenser-. 047 Mid. 600 voit |  |
|  | $\begin{aligned} & 512234 \\ & 520990 \end{aligned}$ | Condenser-. 022 mid. 600 volt. |  |
| 147 | 512235 | Condenser- 0.47 Mfd. 200 volt | 30 |
| 150 | 513027 | Condenser--teramic 56 Mmid. $\pm 10 \% 1500 \mathrm{v}$. | 45 |
|  | 513001 | Condenser-ceromic 2.2 Mmidd . 500 volt |  |
|  | \$513013 | Condenser-ceromic 5000 Mmfd. 450 volt Condenser-ceromic 5000 Mmifd 450 volt |  |
| $158 . \mathrm{A}$ | 509706 | Condenser ceromic 10 Mmfd . (port of sound discriminotor |  |
| 158-B. | 509706 | Condenser-ceramic 95 Mmfd . (part of sound discriminator) |  |
|  | 513010 | Condenser-ceramic 1500 Mmfd . 350 volt. |  |
| 1162 | 513013 | Condenser-ceromic 5000 Mmid . 450 volt.... |  |
| 165 | 513013 | Condenser-ceromic 5000 Mmfd . 450 volt.... | ${ }^{36}$ |
|  | 512235 | Condenser-.047 Mfd. 200 vo | ${ }^{30}$ |
|  | 513013 505174 | Condenser-ceromic $5000 \mathrm{Mmid}$. . 450 volt Condenser-electrolytic $10 \mathrm{Mfd}$.150 volt | . 36 |
|  | 513010 | Condenser-ceramic $1500 \mathrm{Mm} \mathrm{m}^{\text {d }}$. 350 volt | 30 |
| 173 | 513006 | Condenser-ceromic 270 Mmfd. 500 volt | 25 |
| 174 | 512205 | Condenser-. 01 Mfd. 400 vo | 25 |



625 SERIES (CONSOLE) TELEVISION RECEIVER

tube voltage chart

1. Moasurements are made at 117 Volts line using vacuum fube voltmetor. All voltages are D.C. and are . Measurements are made at 117 Voltr line using vacuum tube
2. Contrast and brightness controls set at minimum, antenna disconnectod.

|  |  |  | PIN 1 | PIN 2 | PIN 3 | PIN 4 | PIN 5 | PIN 6 | PIN 7 | PIN 8 | PIN 9 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| V-10 | 6CB6 | Ist VIDEO I.F.-.......... | . 0 | . 65 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | $\begin{aligned} & \mathrm{AC} \\ & 6.3 \end{aligned}$ | 97 | 90 | Gnd. |  |  |  |
| V-11 | 6CB6 | 2nd VIDEO I.F........... | . 0 | . 65 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | 95 | 96 | Gnd. |  |  |  |
| V-12 | 6CB6 | 3rd VIDEO I.F. | . 0 | . 9 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | 97 | 99 | Gnd. |  |  |  |
| V-13 | 608 | 1st VIDEO AMP. <br> \& 1st SYNC. CLIPPER | 32 | -. 25 | 86 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | Gnd. | 92 | Gnd. | Gnd. | -1.8 |  |
| v. 14 | 6W6 | 2nd VIDEO AMP....... | 8.2 | $\begin{gathered} A C \\ 6.3 \end{gathered}$ | 265 | 112 | 7.8 | 425 | Gnd. | 23 |  |  |
| V. 16 | 6 O8 | Ist AUDIO I.f. \& NOISE CANCEL..... | 91 | . 0 | 110 | Gnd. | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | 106 | . 6 | -. 1 | -. 7 |  |
| v. 17 | 6AU6 | Ratio det. driver... | -. 46 | Gnd. | Gnd. | $\underset{6.3}{A C}$ | 75 | 83 | Gnd. |  |  |  |
| V.18 | 678 | RATIO DEt....-.-....... | -. 43 | -1.65 | -. 58 | Gnd. | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | . 0 | Gnd. | . 13 | 47 |  |
| V. 19 | $6{ }^{6} 6$ | AUDIO OUTPUT........ | NC | Gnd. | 225 | 245 | . 0 | NC | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | 13 |  |  |
| V-20 | 6AU6 | KEYED A.G.C....---.-... | 97 | 112 | 110 | 112 | 2.4 | 300 | 112 |  |  |  |
| V-21 | $12 \mathrm{AU7}$ | PHASE INV. <br> a 2nd SYNC. CLIPPER | 38 | Gnd. | 6.0 | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | 91 | 10 | 15 | Gnd. |  |
| $\underline{\mathrm{V}-22}$ | $6 \mathrm{C4}$ | VERT. OSC...------ | NC | NC | Gnd. | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | 180 | -43 | . 0 |  |  |  |
| v. 23 | 6BL7 | VERT. OUTPUT........... | . 0 | 278 | 18 | 0 | 278 | 18 | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | Gnd. |  |  |
| v. 24 | 6Al5 | PHASE DET....-_----. | . 0 | . 0 | Gnd. | $\begin{gathered} A C \\ 6.3 \end{gathered}$ | 12 | NC | -5.7 |  |  |  |
| V. 25 | 6SN7 | HORIZ. OSC...-------. | -15 | 190 | 13 | 4.8 | 290 | 13 | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | Gnd. |  |  |
| V-26 | 6CD6 | HORIZ. OUTPUT...-.-- | NC | Gnd. | 20 | 135 | 7.2 | 7.2 | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | 135 |  |  |
| v-27 | 6AX4 | DAMPER................... | NC | NC | 565 | NC | 255 | 255 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | Gnd. |  |  |
| v-29 | 504 | L.V. RECTIFIER .-........ | NC | 335 | NC | Plate | NC | Plate | NC | 335 |  |  |
| V-30 | 504 | L.V. RECTIFIER........... | NC | 335 | NC | Ptote | NC | Plote | NC | 335 |  |  |
| v-31 | 6AX4 | DAMPER..----------- | NC | NC | 565 | NC | 255 | NC | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | Gnd. |  |  |
|  |  | DEFLECTION SOCKET | NC | NC | NC | 600 | 560 | Gnd. | 290 | 290 |  |  |
| TUNER | termin | al STRIP Voltages: |  |  |  |  |  |  |  |  | PIN | 10 |
|  |  | V.H.F. TUNER (V.H.F. POS.) | 110 | 113 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | -1.0 | . 0 | . 0 | 0 | -. 5 | . 0 | 225 |
|  |  | UHF POSITION......... | 110 | 112 | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | 110 | . 0 | . 0 | $\begin{aligned} & \text { AC } \\ & 6.3 \end{aligned}$ | -. 5 | . 0 | 225 |
| v. 15 | 24CP4A | KINESCOPE.............- | PIN 1 Gnd. | PIN 2 | $\begin{array}{r} \text { PIN } 10 \\ 440 \end{array}$ | $\begin{array}{r} \hline \text { PIN } 11 \\ 94 \end{array}$ | $\begin{array}{r\|r} \text { PIN } 12 \\ \text { AC } \\ 6.3 \end{array}$ |  |  |  |  |  |

## ALIGNMENT PROCEDURE

Apply A.G.C. bias of approximately-2 2 Io A.G.C. Line (across C.202). Maintain the oulput level of the
NOTE-USE A NON-METALLIC ALIGNING TOOL AND LIGHT PRESSURE ON ALL SLUGS.


## Alternate Trap Alignmen

IF THIS METHOD IS USED, IT SHOULD BE PERFORMED BEFORE THE I.F. CURVE ALIGNMENT

| Signal Generalor Connection | Oscilloscope or VTVM Connection | Adiustments |
| :---: | :---: | :---: |
| 1. Connect a modulated ( 400 cycle) 39.75 me . signal to grid, pin 1 of the 1 st video I.F. Tube-V-10. | Same as Step \#1. | 1. Adjust bottom of T. 6 for minimum response on scope. |
| 2. Connect a modulated ( 400 cycle) 41.25 mc . signal to the grid, pin of 1 st video I.F. Tube 6CB6- V. 10 . | Same as Step \#1. | 1. Adjust bottom of T. 9 for minimum response on scope. |
| 3. Connect a modulated ( 400 cyele) 47.25 me . signal to grid, pin 1 of 1 st video I.F. Tube 6CB6- $\mathrm{V}-10$. | Same as Step \#1. | 1. Adjust lop of T.9 for mínimum response on scope. |

general assembly

| description | 625 CM | 625 CDM | 625 CDO |
| :---: | :---: | :---: | :---: |
| baCK PANEL ASSEMBIY ......................... | 101229 | 101229 | 101235 |
| Cabinet .-.-.-..................................... | 108320 | 108325 | 108324 |
| CASTER -......................................... | 147047 |  |  |
| CHASSIS ASSEMBIY .............................. | 112160 | 112160 | 112160 |
| DECAL ............................................... | 121176 | 121176 | 121176 |
|  | 122041 | 122041 | 122041 |
| DOOR PULL .................................- |  | 132229 | 132228 |
|  | 81890 | 81890 | 81890 |
|  | 81891 | 81894 | 81895 |
| kNOB TUNING .....-........................... | 134195 | 134195 | 134195 |
| KNOB-CHANNEL INDICATOR ............... | 134197 | 134197 | 134205 |
|  | 134196 | 134196 | 134196 |
|  | 134199 | 134199 | 134207 |
|  | 134202 | 134202 | 134204 |
|  | 134201 | 134201 | 134203 |
|  | 138039 | 138039 | 138039 |
| MASK .---....................................... | 174045 | 174045 | 174046 |
| nut-"T" SPEAKER MTG. ..................... | 163182 | 163182 | 163182 |
| PAD-LENS REST ................................. | 133133 | 133133 | 133133 |
| SCREEN-CHASSIS Shelf ..................... | 130194 | 130194 | 130194 |
|  | 203549 | 203549 | 203549 |
| SCREW-LENS MOULDING ............-....... | 524206 | 524206 | 524206 |
| SCREW-BACK PANEL ....-.................... | 521076 | 521076 | 521076 |
|  | 105412 | 105412 | 105412 |
|  | 147053 |  |  |
|  | 155730 | 155730 | 155730 |
| SPEAKER ASSEMBIY ............................ | 155735 | 155735 | 155735 |







| $\begin{aligned} & \text { Circuit } \\ & \text { Sumbit } \end{aligned}$ | $\begin{gathered} \mathrm{S}-\mathrm{C} \\ \text { Part No. } \end{gathered}$ | Capacity |
| :---: | :---: | :---: |
| C. 202 | 110823 | $\begin{aligned} & 1 \mathrm{MF} \\ & .005 \mathrm{MF} \end{aligned}$ |
| C. 203 | 110586 |  |
| C-204 |  |  |
| C. 210 | 110705 | $\begin{aligned} & .1 \mathrm{MF} \\ & .01 \mathrm{MF} \end{aligned}$ |
| C. 211 | 110718 |  |
| C.212 |  |  |
| C. 220 | See M-1 | .0022 MF .0047 MF .0047 MF |
| C. 221 | See M-1 |  |
| C.222 | See M-1 |  |
| C.223 | 110718 | .01 MF .068 MF |
| C.224 | 110745 |  |
| C. 225 | 110560 |  |
| C.226 | 110557 | . 022 MF |
| c-227 |  |  |
| C-230 | 110561 | $\begin{aligned} & .1 \mathrm{MF} \\ & .1 \mathrm{MF} \end{aligned}$ |
| C.231 | 110561 |  |
| C.232 |  |  |
| C.233 | 111105 | 20 MF.001 MF |
| C. 240 | 110534 |  |
| C.241 | 110534 | $\begin{aligned} & .001 \mathrm{MF} \\ & .0047 \mathrm{MF} \end{aligned}$ |
| ${ }_{\text {C-243 }}$ C-242 11076 |  |  |
|  |  |  |  |
| C-250 | 110722 | . 047 MF |
| C.251 | 110309 | 3900 MMF390 MMF |
| C. 252 | 110262 |  |
| C.253 | 110291 | 100 MMF |
| C.254 | 110260 | 270 MMF |
| C.256 110262 390 MMF |  |  |
|  |  |  |  |
| C.260 | 110737 | $\begin{aligned} & .01 \mathrm{MF} \\ & 5 \mathrm{MF} \\ & .22 \mathrm{MF} \end{aligned}$ |
| C-261 | 111093 |  |
| C. 262 | 110548 |  |
| C.263 |  |  |
| C.270 | 110722 | . 047 mF |
| C-271 | 110722 | $\begin{aligned} & .047 \mathrm{MF} \\ & .1 \mathrm{MF} \end{aligned}$ |
| C.272 | 110743 |  |
| C-273 | 110562 | . 2001 MF |
| C. 274 | 110548 |  |
| C. 275 | 110825 | 180 mmF |
| C.276 | 110311 | 120 MMF |
| ${ }_{\text {c. } 278}^{\text {c.278 }} 110291100 \mathrm{mMF}$ |  |  |
|  |  |  |  |
| C-279 | 110718 | $\begin{aligned} & .01 \mathrm{MF} \\ & 500 \mathrm{mMF} \end{aligned}$ |
| C-280 | 110820 |  |
| C.281 |  |  |
| C.290 | 111095 | $\begin{aligned} & 40-40 \mathrm{MF} \\ & 40-20-10 \mathrm{MF} \\ & 100 \mathrm{MF} \end{aligned}$ |
| C.291 | 111104 |  |
|  |  |  |
| C. 292 | 110568 | .01 MF |
| C-293 | 110568 | . 01 MF |
| C-294 | 111104 | 40-20-10 MF |
|  |  | 100 MF |

[^18]OJohn F. Rider


## TUBE VOLTAGE CHART

1. Measurements are made at 117 Volts line using vacuum tube voitmeter. All voltages are D.C. and are positive with respect to chassis ground except where noted.
2. Contrast and brightness controls set at minimum, antenna disconnected.


Apply A.G.C. bias of approximately- 2 V to A.G.C. Line (across C-202). Maintain the output level of the sweep generator sucb that the second detector output is 2 volts peak to peak. Scope Cal. $1-V$ per inch.
NOTE-USE A NON-METALIC ALIGNING TOOL AND LIGHT PRESSURE ON ALL SLUGS.

| Signal Generator Connection | Oscilloscope or VTVM Connection | Adjustments |
| :---: | :---: | :---: |
| 1. Output of 40 mc . Sweep Generolor to grid of 3rd I.F. Tube, pin 1 of 6CB6 V-12 thru 100 MMF isoloting copacitor. | Input of scope to grid of Video Amplifier, pin 2 of 6 U8 V. 13 thru 47K ohm isoloting resistor. | 1. Adiust top and bottom of T-11 for morker positions as shown on curve figure 1. |
| 2. Output of 40 mc . Sweep Generator to grid of 2nd I.F. Tube, pin 1 of 6CB6 V-11 thru 100 MMF isoloting capacitor. | Same as Step \#1. | 1. Adjust top and bottom of T-10 for marker positions as shown on curve Figure 2. |
| 3. Output of 40 mc . Sweep Generator to grid of 1st I.F. Tube, pin 1 of 6CB6 V-10 thru 100 MMF isolating capacitor. | Some as Step \#1. | 1. Adjust top of T.Q for marker position of $\mathbf{4 7 . 2 5 \mathrm { mc } \text { . }}$ <br> 2. Adjust botlom of T.9 for marker positions al 41.25 mc . <br> 3. Adjust bottom of T-6 for marker position of 39.75 nic. <br> 4. Adjust bottom of T-7 and T-8 to produce curve as shown on Figure 3. |
| 4. Roise converter tube shield from ground ond connect oulput of 40 mc . sweep generator to the shield. | Same os Step \#1. | 1. Adjust top of $\mathrm{T}-6$ ond $\mathrm{L}-4$ on tuner (1-14 on standord coil luner) assembly to produce a curve as shown on Figure 4 . |
| 5. Connect 0400 cycle modulated 4.5 mc . signal to the junction of Video detector M-13 and C-130. Adjust generator output to a VTVM. | Connect 2-100 resistors in series from plote of atio detector pin 2 of V-18, 6 T8 to ground. Connect VTVM from iunction of the $2-100 \mathrm{~K}$ resistors to ground. | 1. Adjust L-21, T-15 and bottom slug of $\mathrm{T}-16$ for maximum indication. |
| 6. Same as Step \#5. | Connect - VTVM ground lead to the junction of the 2-100K resistors (see 5 above). Connect VTVM D.C. lead to the junction of C-183 and R-182. | 1. Adiust the secondary (Top slug) of $\mathrm{T}-16$ for zero volts belween the positive and negative exput for good deflection). |



## PARTS LIST

| Circuit Symbol | $\begin{aligned} & \text { S-C } \\ & \text { Part No. } \end{aligned}$ | TUBES | Circuit | S-C | COILS |
| :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{v}-1$ | 162100 | 6BQ7 RF Amplifier |  |  | Description |
| $v-2$ | 162118 | $6 \mathrm{J6}$ Converter | t-1 | 171280 | 40Mc Trap |
| V.3 |  | CCB6 la Video If Amplifer | L-2 | 171280 Soe T-1 | VHF and UHF Antenno Coil |
| V-10 | 162092 | 6CB6 1st Video I.f. Amplifier | 1.4 | See T-1 | YHF and UHF Antenna Coil |
| V-11 | 162092 | 6CB6 2nd Video I.F. Amplifier | 1.5 | Seer |  |
| V. 12 | 162092 | 6CB6 3rd Video I.F. Amplifier | 1.5 | 171281 | 40 Mc Trap |
| V.13 | 162171 | 608 1st Video Amp. \& ist Sync Clipper | 1.6 | 17122 | Cuhoda Choke |
| V-14 | 162101 | OW6GT Video Output | -7 | 17220 | filoment Chit |
| V. 15 | 162178 | 24CP4A Kinescope | 1-8 | See T-1 | VHF and UHF Ossciloor Coil |
| V. 16 | 162171 | oU8 1st Audio I.F. Amplifier and Noise Concellation Amp. | $\begin{aligned} & L-90 \\ & L-10 \end{aligned}$ | $\begin{aligned} & \text { See T.1 } \\ & 171237 \end{aligned}$ | VHF and UHF Oscillator Coil Filament Choke |
| V-17 | 162032 | 6AUS Ratio Detector Driver | L-11 | See T-1 | VHF and UHF Oscillator Coil |
| V. 18 | 162077 | 6T8 Ratio Detector and 1st Audio Amplifer | L-12 | 171282 | Neutralizing Coil |
| V. 19 | 162136 | 6V6GT Audio Amplifier | L-13 | 171283 | Mixer Plate Choke |
| V -20 | 162032 | 6AUC Keyed AGC | L-14 | 171284 | I.F. Output Adiust |
| V -21 | 162042 | 12 AUY 2nd Sync Clipper and Phase Inverter | L-15 |  | 40 Mc Reiection |
| V-22 | 162030 | 6 C 4 Vertical Oscillator | -20 | 1440 | doma Reiection |
| V -23 | 162102 | 6 6L7 Vertical Output | -21 | 114480 | Pr Audio |
| v -24 | 162022 | 6AL5 Phase Detector | L-22 | 114748 | Peaking Coil |
| V-25 | 162018 | 6SN7GT Horizonial Oscillator | -2, |  | Peaking Coil |
| V. 27 | 162161 | 6AX4 Damper | -224 | 114749 | Peaking Coil |
| V -28 | 162029 | 1B3GT H.V. Rectifier | 1.25 | 114750 | Peaking Coil |
| V. 29 | 162107 | 5 SUG L.V. Rectifier | [-26 | 114115 | ${ }^{\text {Peaking Coir }}$ |
| V-30 | 162107 | 5U4G L.V. Rectifier | -127 | 114132 | Horizontal Oscillator |
| V-31 | 162161 | 6AX4 Damper | -1.28 | 114125 | Horizontal Horizontal Linearily |
|  |  | TRANSFORMERS | L-30 | 114129 | Horizontal Size |
| Clrevit | s-c |  | L-31 | 161030 | Filter Choke |
| Symbol | Part No. | $\begin{aligned} & \text { Description } \\ & \binom{\text { VFH and UHF ARtenna and }}{\text { Oscillator Transformer }} . \end{aligned}$ | ${ }_{\text {L-32 }}^{\text {L-32 }}$ | 114746 | Deffection Yoke |
|  | 171502 |  | - | 114693 | 2.2 uh Choke |
| thru | 171583 |  | ${ }_{\text {L-101 }}$ | See T-6 | 39.75Mc Trap |
| T-3 |  |  | t-102 | See T -9 | 41.25Mc Trap |
| T-4 |  |  | L-103 | See T-9 | 47.25Mc Trap |
| T. 5 |  |  | t. 104 |  |  |
| T-6 | 171246 | Converter Secondary and 39.75Mc Trap Coil 1st Vidoo 1.F. Output |  |  |  |
| T.7 | 171247 |  |  |  |  |
| T-8 | 171248 |  |  |  |  |
| T-9 | 171249 | 41.25Mc and 47.25Mc Trap |  |  |  |
| T. 10 | 171250 | 4 th Video l.f. |  |  |  |
| T-11 | 171251 |  |  |  |  |
| T.12 |  |  |  |  |  |
| T. 13 |  |  |  |  |  |
| T. 14 |  |  |  |  |  |
| T-15 | 114401 | 2nd Audio I.F. |  |  |  |
| T-16 | 114375 | Ratio Detactor |  |  |  |
| T. 17 | See M-8 | Vertical Blocking |  |  |  |
| T-18 | 161254 |  |  |  |  |
| T.19 | 161266 | Verfical Output |  |  |  |
| T-20 | 161045 | Horizontal Output |  |  |  |
| T-21 | 161444 | Power Transformer <br> Sawlooth Transformer |  |  |  |
| T-22 | 114127 |  |  |  |  |

21T-22T Series Television Receiver


NOTE: 1N105 Diode Detector is Located Under Removable Shield Cover of T-10 4th Video IF Trans.

GENERAL ASSEMBLY

| description | 2170 | 21 M | 2270 | 22 M |
| :---: | :---: | :---: | :---: | :---: |
| back panel assembly | 101240 | 101240 | 101243 | 101243 |
| CABINET ASSEMBIY | 108351 | 108350 | 108351 | 108350 |
| CHASSIS ASSEMBLY | 112167 | 112167 | 112165 | 112165 |
| DECAL | 121079 | 121079 | 121079 | 121079 |
| DIAL - U.H.F. ................................................. |  |  | 122044 | 122044 |
| EXTENSION TUBE FOR KNOB ASSEMBLY | 125069 | 125069 | 125069 | 125069 |
| GRILIE ASSEMBIY ............................................................. | 130211 | 13021.1 | 130211 | 130211 |
| KNOB - VOLUME-OFF-ON SWITCH ....................................... | 134225 | 134225 | 134225 | 134225 |
| KNOB - CONTRAST .......................................................... | 134234 | 134234 | 134234 | 134234 |
| KNOB - CHANNEL INDICATOR............................................ | 134229 | 134229 | 134224 | 134224 |
| KNOB - FINE TUNING V.h.F. - TUNING U.H.F. | 134233 | 134233 | 134233 | 134233 |
| KNOB - VERTICAL, HORIZONTAL, BRIGHTNESS...................... | 134232 | 134232 | 134232 | 134232 |
| LENS ................................................................................ | 138041 | 138041 | 138041 | 138041 |
| MASK .............................................................................. | 174048 | 174048 | 174048 | 174048 |
| PAD - LENS REST........................... | 133133 | 133133 | 133133 | 133133 |
|  | 130204 | 130204 | 130204 | 130204 |
| SCREW - ANTENNA BINDING POST................................. | 521016 | 521016 | 521016 | 521016 |
| SCREW - STRIP ......................................................................... | 163211 | 163211 | 163211 | 163211 |
| SCREW - BACK PANEL....................................................... | 521076 | 521076 | 521076 | 521076 |
|  | 203549 | 203549 | 203549 | 203549 |
| SPEAKER ASSEMBLY..................................................................... | 155821 | 155821 | 155821 | 155821 |
| SPEAKER - MOUNTING BOIT ........................................ | 132241 | 132241 | 132241 | 132241 |
|  | 105445 | 105445 | 105445 | 105445 |
|  | 105446 | 105446 | 105446 | 105446 |
| LOCKWASHER - SPEAKER MOUTNTING ........................................ | 526042 | 526042 | 526042 | 526042 |
| NUT - SPEAKER MOUNTING .............................................. | 525050 | 525050 | 525050 | 525050 |
| TABS ...... ...................................................................... | 146563 | 146563 |  |  |





- John F.-Rider


## ALIGNMENT PROCEDURE

Apply AGC bias of approximately 3 volls to AGC line（across C－160）
Maintain the outpul level of the swees generator io oblain a second detiecior outipul of 2 volis peak－ 10 －
peak．Oscilloscope should be calibrated to read 1 －Volt per inch vertical deflection．
NOTE：To Perform IF Ailignment it is not necessary to Remove Picture Tube．Use a non metallic aligning tool such as Walsco No． 2526 or equivalent which permits all slugs to be adjusted from the underside of the chassis．


5．Raise convertior tube shield Same as Slep \＃1
from ground and connect oul－
put of 40 MC sweep generator
to the shield．


IF THIS METHOD IS USED，it Should be performed before the if curve alignment




MODELS $21 \mathrm{TQ}, 22 \mathrm{TQ}, \mathrm{TM}, 21 \mathrm{~T}-22 \mathrm{~T}$ Series


OJohn F. Rider



UHF TUNER ALIGNMENT




| W BAND OS |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| - |  | ${ }^{\text {cimsuc }}$ | 15.51 sc |  |  |  | s. Sumen |  |
| - |  | ${ }_{70 \times}$ | 15.3sc | 7.3suc | ${ }^{\text {ar oupam }}$ | comen coil |  | smixio iores |
| 10 |  | (6uct | 19.78 sc | 0.25 sc | nrovore |  |  | 12, end |
|  |  | ${ }_{\text {coma }}$ |  |  |  | comolij coin |  |  |
|  |  |  | 18.75 sc |  |  | comel |  |  |
| HIGH AND LOW BAND RF ALIGNMENT |  |  |  |  |  |  |  |  |
|  |  |  |  | ${ }^{215}$ | Reotme |  |  |  |
| 2 | ${ }^{10}$ | ${ }^{*} \times 0$ |  |  | Ir oupe | cin | $\sqrt{21}$ | AJues tor mox |
| - | ${ }^{10}$ | s.a. |  | cil |  | 10 screv |  |  |
| - |  |  |  | come |  | cememe |  |  |
|  |  | ${ }^{\text {comolic }}$ |  | , | nrotal |  |  |  |
| - |  |  |  |  | , |  |  |  |
| - |  | cimici |  | intirs |  | Chanis icom |  |  |
| - |  |  |  | \% $13 \times 1.3$ cis |  |  |  |  |
|  |  | ${ }^{1717 \times 1}$ |  |  | No | $5$ |  |  |
| ${ }^{10}$ |  | \%anco |  |  | nf | Channel Colta on Weters 1,3 |  |  |
| ${ }^{1}$ |  | - ${ }_{\text {nuc }}$ |  |  | nootm |  |  |  |
| - |  | \%ict |  |  | womm | Cmonitcoits |  |  |
| 12 | , | $\operatorname{com}^{40}$ |  |  |  |  |  |  |
| $\cdots$ |  | ${ }^{19012}$ |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

REPAIR PARTS LIST

## SChEMATIC LOCATION

| ation | PART No. | descruption |
| :---: | :---: | :---: |
| CAPACITORS |  |  |
| ${ }_{c}^{c} 100$ | ${ }_{\substack{166-0010 p \\ 168.00110}}$ | 10 Mmpta - Soov. -Cera |
| c102, C103, C104 |  | Lated under Miscelina |
|  | (181-1001 |  |

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MODEL I210X

## SPECIFICATIONS

## Frequency Range

All 12 television channels,
54 Mc . to 88 Mc ., 174 Mc . to 216 Mc . Picture IF Carrier $\quad 45 \mathrm{Mc} \quad 26.4 \mathrm{Mc}$.

Power Supply
117 Volts 60 cycle AC, 275 Watts
Loud Speaker
$51 / 4^{\prime \prime}$ P. M.
CabinetDimensions (inches) Width Height Depth $22.0 \quad 19.8 \quad 21.0$

Weight (pounds) Net Gross $68.5 \quad 88.0$

Antenna Input Impedance
This receiver has an antenna input impedance of 300 ohms and is shipped to the customer with the built-in antenna connected. This must an external antenna. tach an external antenna.

SYIVANIA TUBE COMPLEMENT
(includes rectifiers and picture tube)

| Symbol | Function | Type |
| :---: | :---: | :---: |
| V1 | RF Amplifier | $6 \mathrm{CB6}$ |
| V2 | Oscillator-Mixer | 6 J 6 |
| V3 | 1st Video IF Amplifier | $6 \mathrm{CB6}$ |
| V4 | 2nd Video IF Amplifier | $6 \mathrm{CB6}$ |
| V5 | 3rd Video IF Amplifier | 6 BC 5 |
| V6 | Video Detector - AGC Line Clamper | 6AL5 |
| V7 | Video Amplifier | 6BF5 |
| V8 | Sound IF Amplifier | 6AU6 |
| V9 | Sound IF Limiter | 6AU6 |
| V10 | Ratio Detector - 1st Audio Amplifier | 6T8 |
| V11 | Audio Output | 6V6GT |
| V12 | AGC Amplifier - Sync Amplifier \& Clipper | 12AU7 |
| V13 | AGC Rectifier - Sync Separator | 12AX7 |
| V14 | Vertical Oscillator \& Output | 6BL7GT |
| V15 | Horizontal Discriminator | 6AL5 |
| V16 | Horizontal Control | 6AU6 |
| V17 | Horizontal Oscillator \& Discharge | 12AU7 |
| V18 | Horizontal Output | 6BQ6GT |
| V19 | Damper | 6W4GT |
| V20 | High Voltage Rectifier | 5642 |
| V21 | High Voltage Rectifier | 5642 |
| V22 | Low Voltage Rectifier | 5U4G |
| V23 | Low Voltage Rectifier | 5U4G |
| V24 | Picture Tube | 16AP4 |

## GENERAL DESCRIPTION

Model 1210X is a direct viewing television receiver which provides reception of all 12
commercial television channels.
The telecommercial television channels. The tele-
vision picture is reproduced on a round 16 inch white-faced, electromagnetically deflected, tetrode type picture tube.

## ADJUSTMENT OF

## HORIZONTAL AFC CIRCUIT

## Check of Operation

The operation of the AFC circuit should be checked as follows:
A. Tune the receiver to a channel on which no signal is received and return to the original channel. The picture should immediately fall into synchronization.
B. Switch off the power to the receiver for Switch off the power to the receiver for
about five minutes and then switch back on. Picture should immediately fall into sync.
C. Check for correct phasing of Horizontal AFC circuit by noting that there is ap-
proximately $1 / 8$ " of blanking visible on the right hand edge of the picture. It will be necessary to turn the contrast control to minimum and readjust the brightness control to see the blanking.


FIGURE 3 - PICTURE TUBE INSTALLATION

NOTE: Before making check $C$ above be sure the horizontal drive control is correctly adjusted. Refer to "Prese Controls Adjustment," page 8. If the receiver passes the above checks, no adjustments to the horizontal AFC circuits need be made.

If the receiver cannot pass checks "A," "B," or "C" the adjustment of the Horizontal Hold Control as noted under "Horizontal Hold Adjustment" should be made.

## Horizontal Hold Adjustment

A. Tune in a station and adjust the tuning control for best picture quality. Adjus the contrast and brightness controls for normal picture.
B. Remove V15 - 6AL5 - Horizontal Dis criminator tube
C. Turn the Horizontal Hold Control until the picture moves back and forth across the screen with blanking bars vertical.
D. Replace the Horizontal Discriminator tube and repeat $\mathrm{A}, \mathrm{B}$, and C under "Check of Operation" above.
E. If receiver still will not pass these checks, it will be necessary to proceed with "Phase Adjustment."
F. Check the "free-running" of the horizontal oscillator as described under paragraphs readjust the frequencs adjustment screw, on top of horizontal discriminator tras on top of horiz
G. Make a final check of the phasing as described in paragraph "E" above. It is important that both the "free-running" and the phasing are correct.
H. Remove the short from across the 4700 ohm resistor R226 and re-adjust the ohm resistor R226 and re-adjust the horizontal drive control as described in "ringing" coil clockwise until approximately $1 / 8$ " of "blanking" is again visible on the right-hand edge of the picture.
I. Before the horizontal synchronization circuit is adjusted to the final position, it cuill be necessary to check the operation as follows:

Slowly turn the oscillator frequency adjustment screw (top of transformer T62) in either direction until the picture suddenly falls out of synchronization as indicated by the presence of a number of diagonal bars. The total number of bars visible must not be less than six. These
bars may consist of either several full bars and two half bars for the total number or they may be all full bars for the same total number. Slowly turn the adjustment screw so as to decrease the number of bars and note the total number again falls into synchronization. The last number of bars visible must not be less than three, or more than four. In order to get an accurate indication of the minimum number of bars obtainable, the adjustment screw must be turned very slowly and carefully once the number of bars has been reduced to four or five.

Turn the adjustment screw in the opposite direction until the picture suddenly falls out of synchronization in the opposite direction and repeat the foregoing pro-
cedure. Again, the total number of bars visible when the picture falls out of synchronization must not be less than six, and not less than three or more than four bars must be visible just before the picture falls into synchronization.

J. After checking the operation as in I, it is necessary to repeat the procedure described in paragraphs "B," "C," and
"D." "D."
K. Remove the signal by tuning to a "free" channel, then retuning to the original channel. The picture should immediately fall into synchronization.
L. Switch "off" the power to the receiver or about five minutes and then switch receiver "on" and check that the pic-

Phase Adjustmen
A. Turn the core in the horizontal "ringing" coil all the way out (counterclockwise). Short out the 4700 ohm horizontal charge circuit peaking resistor R226.

With the horizontal size coll set for ap proximately the correct picture width and with the horizontal linearity coil ad justed for best linearity, rotate the hori


Slowly turn the drive control clockwise
until crowding is visible in the center of the picture. Now carefully turn the contro back (counterclockwise) only enough to remove the crowding in the picture or pattern. On some chassis, it may not be possible to obtain crowding of the picture. In such cases the control should be set to the fully clockwise position.

NOTE: Do not operate the receiver with the horizontal drive control mis-adjusted.
B. Remove V15-6AL5 - Horizontal Discriminator Tube from its socket.
C. Carefully turn the frequency adjustment screw (top of discriminator transformer T62 until the picture moves back and forth across the screen of the picture
tube with the blanking bar vertical tube with the blanking bar vertical.
D. Replace the 6AL5 - Horizontal Discrim-

E. Adjust the phase adjustment screw (under side of discriminator transformer T62) until approximately $1 / 8^{\prime \prime}$ of "blanking" is visible on the right-hand edge of the piccontrast control almost to minimum, rurn adjust brightness control, and reduce picture size.

AGC CONTROL ADJUSTMENT This control has been correctly adjusted at the factory and should require no further adjustment. If adjustment becomes necessary as evidenced by poor horizontal or vertical sync; or a video signal with poor contrast, proceed as follows:

1. Connect a good antenna installation to the

2. Tune the receiver to a channel on which no picture is received.
3. Set the contrast control to mid-position.
4. Turn the AGC control fully clockwise. The AGC control is located on the rea panel of the chassis
5. Connect a VTVM from the AGC Amplifier plate to ground (V12, 12AU7, pin 6) an set volt reading. Note: On some proach to this reading will be the fully elockwise position.
6. With the AGC Control set as above, turn the contrast control almost to maximum (about $7 / 8$ ) and tune in the strongest station available in the area.
7. Again read the AGC Amplifier plate voltage; if reading is less than a negative 2. volts leave the control as set.
8. If the AGC Amplifier plate voltage is more than 2 volts negative, slowly turn the AGC control counterclockwise observing the picture.
9. The picture will get darker and then finally start to fall out of sync as evidenced by a ither the horizontal or vertical direction. Do not turn beyond this point.
10. Back off (clockwise) slowly on the control until the picture holds in sync without flutter and turn slightly beyond. (Exper ence will dictate how far beyond to turn).
11. Rock the tuning control slightly either side of the best tuning point to insure picture stays in sync; if not, turn slightly further clockwise and check again.
12. As a final check, turn the volume contro up to normal level. Intercarrier buzz should be negligible.
13. Remove objectionable intercarrier buzz by turning the AGC control slightly further clockwise. (Note: The intercarrie buzz is merely a reference for correct adjustment of the AGC control and only a slight touch-up should be necessary. It much adjustment is required to remove intercarrier buzz, the sound section is maladjusted and requires realignment.
14. Rock the tuning control slightly either side of the best tuning point and turn the AGC control slightly more clockwise as necessary to remove objectionable intercarrier buzz.

The intent of the above AGC control adjustment is to provide a maximum of AGC action consistent with proper sync and minimum inter carrier buzz on strong signals.

TEST EQ $_{\text {RF }}$ UIPMENT REQUIREMENTS requency generator or generators with requency range from $4-220 \mathrm{Mc}$. havin sweep width adjustable from 50 Kc . to 10 Mc . With an output of at least 0.1 volt, a marker system, either built-in or external type and flat within +1 Db .
Signal generator or generators with a fre-
quency range from $4-222 \mathrm{Mc}$. and an adjustable output of at least 0,1 volt an ad
3. Sylvania cathode ray oscilloscope type 400 or equivalent capable of passing a 60 cycle square wave.
. Sylvania Polymeter type 221 or equivalen
5. Sylvania High Voltage Probe Adapter type 225 or equivalent with $0-30 \mathrm{KV}$ DC range (not shown).
6. Sylvania tube tester type 220 or equivalent capable of testing shorts with proper vollages and performance under dynamic conditions.
7. Jig Tube Shield - made by insulating or cutting off a tube shield, so it will no tube. The existing shield around V2, oscil-lator-converter tube, may be temporarily insulated from ground for use as a jig shield.
 FIGURE 7 - SYLYANA TEST EQUPMENT

## ALIGNMENT PROCEDURE

Should any chassis under service require complete realignment, the alignment procedure
should be carried out in the following listed order.
PRE-ALIGNMENT INSTRUCTIONS - READ CAREFULLY BEFORE ATTEMPTING ALIGNMENT .

Lay chassis on left side for alignment. Ground all equipment to receiver chassis. Use special alienment tool Service Part No. 898-0003.

## VIDEO IF ALIGMMENT

1. Connect signal generator to the jig shield on the Oscillator-Converter tube. Allow generator and set to warm-up for fifteen minutes.
2. Connect the negative lead of a 3 volt battery to the AGC Line, positive lead to ground.
3. Connect D.C. VTVM across the diode load resistor R145-3900 ohm.
4. Tune generator to $\mathbf{2 7 . 9} \mathbf{~ M c}$. and adjust trap coil L55 for minimum output. Keep voltmeter reading under 2 volts by reducing generator output as required.
5. Adjust the cores of the Video IF Trans formers in the following order. Reduce enerator output to keep voltmeter reading benerator output to 1 and 2 volts.
et Signal
Generator At:
Adjust:
6. 2 Mc . Core on 2nd Videolf Transformer $24.1 \mathrm{Mc} \quad$ T57 for maximum output
7. 1 Mc . Core on 1st Video IF Transformer
8. 3 Mc . Core on Converter Coil L8 for
9. 9 Mc . Core on trap coil L 55 for minimum output
10. Disconnect signal generator and VTVM
11. Connect sweep generator (frequency 25 Mc . weeping 10 Mc .) using a . 005 Mfd . citor to pin 1 of 3rd Video IF Amplifier 6 BC 5 .
12. Connect oscilloscope to junction of diode load resistor R145 - 3900 ohm and coil L58.
13. Adjust primary (top core) and then sec ondary (bottom core) of IF Bandpass T58 to obtain curve shown in Figure 8. (Both cores adjusted from bottom of transformer using hex end of special alignment tool)


FIGURE 8 - IF BANDPASS RESPONSE
10. Disconnect Sweep Generator from 3rd IF Grid Conver ct it to the Jig Shield on nal generator this point for markers.
11. Observe IF Response Curve and if nec essary adjust IF Transformer Cores slightly to obtain response curve shown in Figure 9. Keep oscilloscope gain high enough to prevent overload of the receiver as overload will distort the curve.


FIGURE 9 - OVERALL IF RESPONSE

## SOUND TAKE-OFF a 4.5 MC. TRAP

 ALIGMMENT1. Connect a 4.5 Mc . sweep generator having 250 Kc . sweep through . 005 Mfd . to pin 7 of video detector - 6AL5. Loosely connect signal generator for use as markers.
2. Connect oscilloscope to limiter grid resistor R104-47M through a 270 M isolating re marker is centered at the peak of the response curve. See Figure 10.


FIGURE 10 - SOUND IF RESPONSE



## FIGURE 12 - TUNER ALIGNMENT SETUP

sOUND DHECRIMIMATOR ALIGMMENT Connect oscilloscope across the Volume Control.
2. Adjust the cores of the discriminator trans formers T52 and T53 until the discrimhat in Figure 11. Note especially that:
(a) 4.5 Mc. marker is exactly in the
(b) The curve is linear between the out-
(c) side two markers.
(c) The amplitude is the greatest obtainable. TUnER allomment
NOTES ON TUNER ALIGNMENT SETUP
In reference to Figure 12, the following precautions should be taken in making the equipment setup.

1. The detector circuit should be so constructed as to maintain leads as short as possible. Connection of the detector cir
cuit to the 1st IF grid terminal (see Fig 12 for location) should also be made with short leads.
2. Shielded leads should be used in making the following connections to reduce hum and synchronous voltage pick-up.
(a) The lead for observation of the RF response from the scope isolating resistor ( 10,000 ohms located at the put switcher point") to the RF out-
(b) The connection from the IF detector circuit output to the IF switch position of the scope switch.
(c) The connection from the sweep generator to the horizontal input of the sweep instead of internal oseilloscope sweep in order to obtain synchronization).
3. The single pole double throw"Scope Switch" should be located at the vertical input ter minals of the scope. This switching ar the IF response or the overall RF response. The aforementioned positions will be re ferred to in subsequent text as the "IF" and "RF" positions respectively
4. The marker generator coupling condenser should be as small a value as possible to prevent any effect on tuner response, out must be large enough to permit easy response or overall RF response (Ap proximately 2 or 3 MMF should be satisfactory in most cases).
5. For all tuner alignment tests which are outlined in this text, remove the second IF amplifier tube or bypass its plate circuit with approximately 1000 MMF to preven coupling back from the receiver IF system.
6. In all of the following tests the oscilloscope vertical gain should be as close to maximum gain as possible, consistent with ham and synchronous voltage interference imitations. This precaution will allow the use of low levels from RF sweep Generator and increase the visibility of IF and RF markers.

## OSCILLATOR ALIGNMENT

In making adjustments of the oscillator alignment it should be noted that any change in the setting of the high band oscillator trimmer will also effect the low band oscillator tuning, how ever, because of switching, the adjustment of the low band oscillator trimmer will not affect high band oscillator tuning. Also, there is a sligh shift of oscillator frequency in the high band position only when the bottom cover is removed.

High Band Oscillator Alignment

1. Remove the bottom cover and rotate the Remove switch to the high band position.
2. Rotate variable capacitor to maximum position of tuning control knob).
3. Tune sweep generator to channel 7 and set scope switch to IF output position.
4. With a spacing on the high band oscillator coil L9 until markers coincide (squeezing the coil lowers the oscillator frequency and spacing the turns farther apart raises oscillator frequency.

5. Replace bottom cover and check for shift of markers. If there is a shift remove the bottom cover and compensate by readjusting Lo as necesth Repeat unt markers coincide with bottom cover in
7 place
Rotate variable capacitor to minimum capacity (fully clockwise position of tuning control knob)
6. Tune sweep generator to channel 13
7. Inject 215.75 Mc . and 26.4 Mc . markers.

With bottom cover in place, adjust oscillator grid trimmer C23 to make markers coincide

11. Repeat steps one through ten untll proper end frequencies are reached at madmum and minimum capacity settings.

## Low Band Oscillator Alignment

12. Remove bottom cover, turn band switch to low band position and rotate variable capacitor to maximum capacity (tuning
13. Tune sweep generator to channel 2.
14. Tune sweep generator to channel 2 .
15. Inject 56.75 Mc . and 21.9 Mc . markers.
16. Using a non-metallic pick adjust the spact between turns on the low band oscillator coil L 9 until the markers coincide.

17. Rotate the variable capacitor to minimum capacity (tuning control knob fully clockwise).
18. Tune sweep generator to channel 6.

18 Inject 84.35 Mc . and 26.4 Mc . markers.
19. Adjust oscillator plate trimmer C26 to make markers coincide.
20. Replace bottom cover and recheck in steps

21. Recheck all four oscillator frequencies as in steps 1-19.

## R. F. PASSBAND ALIGNMENT

1. If only the RF Passband is being aligned it is advisable to check oscillator coverage 25 noted under Oscillator Alignment step 21 above. to high band position channel 7 on the dial calibration.
2. Tune sweep generator to channel 7. Set scope switch to the IF output.
3. Inject 175.25 Mc . and 26.4 Mc . markers and adjust tuning control so the markers coincide. Leave tuning control at this justment.
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4. Change scope switch to the RF output

Check that the RF response curve is similar
the shown in Figure 13.
If the response curve differs much from ance and coupling of the high band RF plate coll L3, the high band mixer grid coil L4, and the high band antenna coll L1, for proper band width and symmetry. In determining the band width, it will be necessary to switch the marker generator alternately between channel 7 picture carrier ( 175.25 Mc .) and
The high band PF plate
The high band RF plate coil L3 and the high band mixer grid coil L4 are properly ductance of either coil will result in a frequency shift of the entire response with no noticeable narrowing of the band width.
10. The high band antenna coil L1 is properly adjusted when a slight variation of its inductance will cause both peaks to rock slightly. If only one peak moves, the high mand antenna coil L 1 is staggered away from the center of the passband.
11. The inductance of these coils ( $\mathrm{L} 1, \mathrm{~L} 3, \mathrm{~L} 4$ ) is varied by pushing the coil on or off the will raise the frequency and pushing the coil off the stud will lower the frequency.
12. The band width of channel 7 interstage transformer (L3, L4) is controlled by dressing the ground leads of these coils past the cut out in the RF shield plate (see Fig. 13). When both leads cross the cutout the greater separation of peaks occurs. For maximum that the response is no greater than that required to keep the sound and picture carrier frequency markers on the peaks of the overall RF curves.
13. Replace tuner bottom cover and check RF passband response.
14. If necessary, remove bottom cover and
make slight compensating adjustments.
15. With the bottom cover in place, rotate the tuning control knob
dicates channel 13 .
16. Tune sweep generator to channel 13 and change scope switch to IF output
17. Inject 215.75 Mc . and 21.9 Mc . markers and adjust tuning control so markers co-
incide. Leave tuning control as set for remainder of channel 13 adjustments.
18. Change scope switch to RF output position, if RF response differs noticeably from the curves in Figure 14. (The antenna and mixer grid trimmer (C15) must be adjusted for proper passband and maximum amplitude of response
19. Return tuner and sweep generator to channel 7 and check response as in part 13 above. A slight compensation of coils $\mathrm{L} 1, \mathrm{~L} 3$, and L 4 may be necessary.
20. Recheck passband on both channel 7 and channel 13, compromising adjustments for tilt as necessary until satisfactory High
Band RF passband responses are obtained.

Low Band RF Alignment
21. Rotate band switch to Low Band position. 22. Tarn the tuning control knob so that the pointer indicates channel 2 on the dial.
33. Set the scope switch to the IF output po sition and inject 59.75 Mc . and 21.9 Mc . markers. Adjust the tuning control so the trol as set for the remainder of the channel 2 adjustments.
24. Change the scope switch to the RF output position.
25. If the desired passband response is not obtained (as shown in Fig. 14) the Low Band RF coil L5, the low band mixer coil (T1) secondary must be adjusted until the desired passband is obtained.
26. When the low band RF coil (L5) and the low band mixer coil are aligned slight variation in the inductance of either should cause no noticeable narrowing of the passband.
27. When the secondary of the low band antenna transformer is properly adjusted, a slight variation in its inductance should cause peak moves, the T1 secondary is staggered away from the center of the double tuned circuit response.
28. The low band mutual coil (L7) varies the band width of the interstage coupling circuit. Squeezing the turns together broadens the band width and separating the turns narrows the band width. The band width should be adjusted so that it is not the picture carrier and sound carrier markers at the peaks of the response curve.
. Replace the tuner bottom cover and check passband response.
. Remove bottoin cover and make any com-
pensating adjustments as needed.
31. With the bottom cover in place, rotate the tuning control knob to align the pointer with channel 6 on the dial
32. Tune the sweep generator to channel 6 and change the scope output switch to the IF output position
33. Inject 83.25 Mc . and 26.4 Mc markers and adjusting tuning control to make the markers coincide. Leave the tuning control at this setting for the remainder of the channel 6 adjustments
34. Change the scope switch to the RF output position.
35. Check the response curve. If not as desired, remove the bottom cover and slightly coil L5, the low band mixer coil (L6), the low band mutual coil (L7) and the secondary of the low band antenna transformer (T1) as necessary, keeping in mind that these adjustments must be compromised with those made or channel 2 in steps 21-30
36. Recheck passband on channel 2 and channel 6 and re-adjust as necessary to obtain acceptable passband on both channel 2 and
 reception throughout the life of the chassis. However, if service other than alignment is required, return the complete tuner to the factory for replacement.

## FIGURE 14 - TUNER LAYOUT

## GENERAL DESCRIPTION

Sylvania Model 1110X is a direct viewing television receiver which provides reception of the 12 commercial television channels 2 through 13. The television picture is reproduced on a round 16 inch, electromagnetically deflected,
tetrode type picture tube.

The 1-329 chassis used in Model 1110X very closely resembles the 1-381 chassis described in Bulletin 9-15.
Circuitwise, chassis 1-329 differs from the 1-381 in that a new type RF Tuner Unit is used and the High Voltage Scan circuit has been modified to eliminate the Heater Isolation Transformer for the 6 W 4 GT Damper tube 1
The 1-329 chassis uses GSN7GT tubes for V12 and V17, but the associated circuits remain the same as those of the 1-381 where V12 and V17 are 12AU7 tubes.

Front panel controls on the 1110X are On-Off $\&$ Volume, Tuning, and Brightness. No Band Switch is needed on this model because of the continuous tuning feature of the new type RF Tuner Unit.

## LOW BAND ALIGNMENT

1. Tune sweep generator to channel 6. Rotate tuner drive shaft to channel 6. (Correct position may be determined by rechannel number should be vertical at top of dial.)
2. Load T2-C, Low Band RF coil (touch C12 stator plate, as described in 6 of "Notes on Tuner Alignment"), adjust C9, Low Band mixer trimmer, until the single peaked response curve falls midway between the RF carrier markers (Fig. A).

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3. Load L3, High Band RF coil (touch \#7 switch lug as described $\quad$ oust C20, High Band mixer trimmer so the single peaked Bosponse curve falls midway between the RF carrier markers (Fig. A).
4. Repeat step 2, only loading L4, High Band mixer coll (touch \#4 switch lug) and adjusting C 19, High Band RF trimmer.


FIGURE C
4. Without loading, adjust C17, High Band oscillator trimmer, so the IF marker and


sound carrier marker are coincident. (Fig. C) Should either carrier, or carrier markers, fall below the $70 \%$ level, increase
coupling between the double tuned coils by decreasing the angle made by L4, mixer grid coil strap and the ground leg of L3, the RF coil (see Fig. 21).
5. Adjust sweep generator and tuner drive shaft to channel 7.
6. Spread or compress L5, High Band oscillator coil, turns as necessary to make the sound arrier marker and IF marker coincide. Load L3, High Band RF coil (touch \#7 Switch lug), and bend L4, mixer coil strap slightly in or out as necessary to make the mixer grid coil response curve fall about midway between the RF carrier markers (Fig. A).
7. Repeat step 6, only loading L4, mixer coil (touch \#4 switch lug), and adjusting L3, RF coil, turns so its response is at same frequency as the mixer response
8. Without loading, adjust turns on L5, High Band oscillator coll, so the iF marker (Fig. B)
9. If peak to or less than $30 \%$, change mixer coil-RF coll angle (Fig.21) as necessary to achieve this optimum coupling.
10. Repeat steps 1 to 8 to obtain optimum adjustments
 quired, réturn the complete tuner to the factory for replacement.

Note 1: The terms "Horizontal," "Vertical" or "60 cps sine wave" refer to the oscilloscope sweep employed. Note 2: All waveforms are taken with the oscilloscope horizontal sweep direction from left to right and with upward deflection corresponding o positive polarity
Note 3: In some instances the identical with those shown, due to the electrical characteristics of the oscilloscope used. Note 4: All waveforms are measured with respect to chassis unless otherwise indicated. Note 5: Contrast maximum unless otherwise indicated.
*The peak to peak ( $\mathrm{P} / \mathrm{P}$ ) voltages of these waveforms are dependent on the depth of modulation of the transmitted signal; voltages shown are obtained when modulation is approximately 90 percent.

NOTE: This RF tuner has been thoroughly tested at the factory and should provide trouble-free reception throughout the life of the chassis. However, if service other than alignment is re


12AX7 (V13) Sync Separator Plate (Pin 1) 25 Volts $\mathbf{P} / \mathbf{P}$ Vertical


FIGURE 21 - TUNER LAYOUT
maveronms

*6BF5 (V7) Video Amplifier Control Grid (Pins 1 and 7) 3.5 Volts $P / P$ Vertical


6BF5 (V7) Video Amplifier Plate (Pin 5) 55 Volts $\mathrm{P} / \mathrm{P}$ Vertical


6BL7GT (V14) Vertical Oscillator Plate (Pin 2) 235 Volts $\mathrm{P} / \mathrm{P}$ Vertical


12AX7 (V13) Sync. Separator Plate (Pin 1) 25 Volts P/P 60 cps sine wave

*6BF5 (V7) Video Amplifier Control Grid (Pins 1 and 7) 3.5 Volts $P / P$ Horizontal

*6BF5 (V7) Video Amplifier Plate (Pin 5) 55 Volts P/P


12AU7 (V12) Sync. Amp. and Clipper Plate (Pin 1) 110 Volts $\mathbf{p} / \mathbf{p}$ Vertical




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## SPECIAL INSTALLATION AND SERVICE INSTRUCTIONS



CHASSIS REMOVAL AND PICTURE TUBE INSTALLATION

To remove the picture tube, observe the following procedure. Refer to Picture Tube Installation illustration. GOGGLES AND GLOVES SHOULD BE WORN and specia caution exercised while handling the picture tube.

1. Disconnect receiver from power outlet; remove antenna connection and rear interlock cover.
2. Disconnect the following items prior to removal of receiver chassis:
a. High voitage anode lead
b. Speaker plug.
and vertica
e. HaloLight connector plug
e. Ground strap to chassis.
3. Remove front panel knobs, chassis mounting bolts, an tenna terminal board from chassis and slide chassis
4. Lay cabinet on front side. Remove Ion Tra magnet.
5. Unscrew four Mounting Fasteners until heads can be removed through enlarged openings in Picture Tube Sup-
port; remove Mounting Rods from Mounting Brackets in cabinet.
6. Remnve Picture Tube Support with yoke and Focus and Centering unit attached.
7. TWO PERSONS should now reach down along opposite sides of picture tube, reach under face of tube with
fingers, and lift tube from cabinet. DO NOT GRASP NECK OF TUBE AT ANY TIME.
8. To install a new picture tube, reverse the preceding snugly. Apply just enough pressure against Mounting Rods to seat them properly at cabinet Mounting Brackets. Be careful that dust or dirt does not get inside mask Be careful that dust or
or on picture tube face.

## HORIZONTAL AFC CIRCUIT ADJUSTMENT

1. Tune in a normal air signal and adjust $\mathbf{L} 71$ Horizonta size control for
locked-in picture.
. Turn receiver power "off" and connect shorting jump ers as follows
a. From junction of R212 (330 ohm) and T60 sync phase splitting coil to chassis.
b. Across terminals of L68 Horizontal Frequency coil

Turn receiver power "on" and tune in a normal air signal.
4. Rotate R259 Horizontal Hold control to center position
5. Adjust R280 Horizontal Range control until picture moves 5. Adjust R260 Horizontal Range control until picture moves
back and forth across screen with blanking bar vertical
6. Remove shorting jumper from L68 Horizontal Frequency
7. Adjust $L 68$ Horizontal Frequency coil until picture moves back and forth across screen with blanking bar vertical.
8. Remove shorting jumper from junction of R212 $(330 \mathrm{ol} \mathrm{m})$ and $T 60$ sync phase splitting coil to chassis.


CHASSIS BOTTOM PARTS LAYOUT


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## SPECIAL SERVICE INSTRUCTIONS

1. To maintain the correct electrical relationships between circuits, all cabinet mounted components (except Halo-
Light) should be connected to chassis during any elec-
2. An extension cable assembly to accomplish the above requirements may be constructed using extra plugs an
3. The metal shorting bar on high voltage shield must be held in a forward (non-shorting) position; place a plate bar high voltage shield hole through which the shorting
. removal and calibration of channel selec TOR KNOB:
a. To remove Channel Selector knob, loosen (do not Knob may then be pulled off tuner shaft
b. To calibrate Channel Selector knob, rotate Channel hicr that tuner is set to appears behind picture

ing its gears with those of the dial. Make an number corresponds to tuner setting


- 



| 118-0010 | Coil - Filter |
| :---: | :---: |
| 118-0010 | Coil - Filter |
| 132-0003 | Coil - Horizontal Size Adjustment |
| 141-0041 | Transformer - HaloLight Power |
| 141-0042 | Transformer - Power-117v |
| 128-0008 | 60 Cycle |
| 143-0033 | Transformer - Audio Out put |
| 119-0003 | Transformer - 1st Video IF |
| 119-0004 | Transiormer - 2nd Video if |
| 119-0005 | Transformier - 3 rd Video IF |
| 126-0002 | Transformer - Video IF Output |
| 120-0003 | Transformer - Sound IF |
| 243-0001 | Transformer - Sync Phase Splitter |
| 241-0018 | Transformer - Vertical Scan |
| 241-0013 | Transformer Assembly - <br> Horizontal Sca |
| 153-0023 | HaloLight |
| 157-0033 | Volume, Brightness \& On/Off Switch |
|  | Volume - 1.0 Megohm <br> Brightness - 1.0 Megohm |
| 153-0038 | Contrast - 250 Ohm |
| 153-0014 | Vertical Hold - 1.5 Megohm |
| 153-0014 | Height - 1.5 Megohm |
| 153-3011 | Vertical Linearity - $2,500 \mathrm{Ohm}$ |
| 153-0042 | Horizontal Hold - $50,000 \mathrm{Ohm}$ |
| 153-0007 | Horizontal Range - $250,000 \mathrm{ohm}$ |
|  | TORS |
| carbon uni | otherwise specified. |
| 183-0274 | $270,000 \mathrm{Ohm}-2 \mathrm{~W}$. |
| 183-0274 | 270,000 Ohm - 2 W . |
| 183-0563 | $56,000 \mathrm{Ohm}-2 \mathrm{~W}$. See "Controls' |
| 181-0102 | $1,000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 181-0331 | 330 Ohm - $1 / 2 \mathrm{~W}$. |
|  | See "Miscellaneous Electrical Part |
| 181-0104 | $100,000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. <br> See "Controls" |
| 181-0223 | $22,000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 181-0683 | $68,000 \mathrm{ohm}-1 / 2 \mathrm{~W}$. |
| 181-0156 | 15 Megohm - $1 / 2 \mathrm{~W}$. |
| 181-0224 | 220,000 Ohm - $1 / 2 \mathrm{~W}$. |
| 181-0685 | 6. $8 \mathrm{Megohm}-1 / 2 \mathrm{~W}$. |
| 181-0334 | $330,000 \mathrm{ohm}-1 / 2 \mathrm{~W}$. |
| 181-0334 | $330,000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 181-0474 | 470,000 $\mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 182-0391 | 390 Ohm - 1 W . |
| 181-0470 | $47 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 187-0021 | 1,500 Ohm - 5 W . |
| 183-0272 | 2,700 Ohm - 2 W . |
| 181-0473 | $47,000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 181-0272 | 2,700 $\mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 181-06255 | 6. 2 Megohm - $1 / 2 \mathrm{~W}$. - $5 \%$ |
| 181-03945 | $350,000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. 5 \% |
| 181-0102 | 1,000 $\mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 181-01245 | $120,000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. 5 \% |
| 181-0102 | 1,000 Ohm - $1 / 2 \mathrm{~W}$. |
| 181-03335 | $33,000 \mathrm{Ohm}-1 / 2 \mathrm{~W} .-5 \%$ |
| ${ }_{181-0682}^{181-04705}$ | ${ }_{6,800}^{47 \mathrm{Ohm}-1 / 2 \mathrm{~W} .1 / 2 \mathrm{~W}}{ }^{50}$ |
| 181-0102 | 1,000 $3 \mathrm{hm}-1 / 2 \mathrm{~W}$. |
| 181-0272 | 2,700 $\mathrm{hm}-1 / 2 \mathrm{~W}$. |
| 181-0102 | 1,000 Ohm - 1/2W. |
| 181-04705 | $47 \mathrm{Ohrl}-1 / 2 \mathrm{~W} .-5 \mathrm{t}$ |
| 181-0682 | 6,800 Ohm - $1 / 2 \mathrm{~W}$. |
| 181-0102 | 1,000 Ohm - 1/2W. |
| 181-0152 | 1,500 Ohm - $1 / 2 \mathrm{~W}$. |
| 181-0181 | $180 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 181-0102 | 1,000 Ohm-1/2W. |
| 181-0102 | 1, $000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| ${ }^{181} 181-0.0321$ | ${ }_{3}^{1,2000} 0 \mathrm{hm}-1 / 2 \mathrm{~W}$. |
| 181-0102 | 1,000 Ohm - $1 / 2 \mathrm{w}$. |
| 181-0103 | $10,000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 181-0102 | 1,000 Ohm - $1 / 2 \mathrm{~W}$. |
| 181-0331 | $330 \mathrm{Ohm}-1 / 2 \mathrm{~W}$. |
| 181-0823 | $82,000 \mathrm{Ohm}-1 / 2 \mathrm{~W}$ |
| 181-0393 | 39,000 Ohm - 2 W . |

> MISCELLANEOUS ELECTRICAL PARTS

## VIDEO IF ALIGNMENT *

1-Connect the common lead of a Vacuum Tube Volt Meter to chassis ground. Sєt the meter on - volts setting, and connect DC probe to junction of L188 and R1 37 (load resistor of second pix detector).

2-Remove 6AU6 AGC control tube (V132).
3- Apply - 3 volts bias to the AGC line (junction of C230, R255, and R260). This bias voltage may be obtained by connecting two 1.5 volt flashlight batteries in series. The positive end should be connected to ground and the negative end to AGC line. (For fringe areas, -1.5 V bias should be used)

4- Turn the tuner channel selector to a station which does not have a local signal, (i. e., in New York City, channel 6).

5- Apply the IF signal with an accurate generator ( 20 to 30 Mc range) to the 6 J 6 tube in the tuner. This may be done by placing an ungrounded shield over the 6 J 6 tube and applying the signal to the shield. The ground connection for the IF signal generator should be kept as short as possible. However, under no circumstances should the shield over the 6 J 6 tube be allowed to touch ground during alignment.
6- Set the generator to 23.4 Mc with high output and adjust Ll 85 for maximum reading on the VTVM (keep meter on lowest scale). Always keep generator output low enough to prevent VTVM from reading over 1.5 volts during all alignment steps.

7-Set signal generator to 25.2 Mc and adjust L 183 for maximum reading on VTVM, as above.

8- Set VTVM to 21.25 Mc and adjust T 105 for minimum reading on VTVM.
9a- Set signal generator to $19.75 \mathrm{Mc} \dagger$ and adjust T 104 (top) for minimum reading on VTVM.
b- Set signal generator to 22.3 Mc and adjust T 104 (bottom) for maximum reading on VTVM, as in step 6.
c- Repeat steps 9a and 9b.
10a-Set signal generator to 27.25 Mc and adjust T 103 (Top) for minimum reading on VTVM.
b- Set signal generator to 25.3 Mc and adjust T 103 (bottom) for maximum reading on VTVM, as in step 6.

11-Set signal generator to 21.8 Mc and adjust Lll on tuner (see figure 2 ) for maximum reading on VTVM, as in step 6.

* All wired and tested chassis are completely aligned before shipment from our factory.


## SOUND IF ALIGNMENT

1-Connect signal generator to pin 1 of V106 and set it accurately at 21.25 Mc . The setting of the signal generator should be kept at 21.25 Mc for this complete section. Commence alignment with high generator output and reduce output whenever necessary to keep meter reading within specified scale.

2- Connect the VTVM common lead to ground and the other lead in series with a one megohm resistor to the junction of the diode resistors R219 and R220. Do not remove the discriminator shield to make these connections as it can be made by fashioning a hook on the 1 megohm resistor lead and making connection to the transformer lug " $C$ " through the hole provided for the adjusting tool The meter should be set on the +10 volt scale and the primary of T113 (top) should be adjusted for maximum reading on the VTVM. (A20,000 ohm per volt meter may be used on the 2.5 V scale in series with a 150,000 ohm resistor)
$\dagger$ On 2430 chassis, (without sound trap on tuner) T 104 top should be adjusted for minimum response at 21.25 Mc .
3- Connect meter common lead to ground and other lead to junction of R236 and C205. The VTVM should be set to plus 3 or 5 volt scale. Adjust T113 (bottom) for zero reading on meter. It will be found that it is possible to produce either a positive or negative voltage on the meter depending upon this adjustment. T113 (bottom) should be adjusted so that the meter indicates zero output as the voltage swings from positive to negative.

4- Connect probe of VTVM to terminal A of T112. Set meter on -3 or 5 volt scale and adjust both top and bottom of T112 for maximum reading of the VTVM. (a $20,000 \mathrm{ohm}$ per volt meter may be used on 10 V scale)

5- Apply 21.25 Mc signal to the 6 J 6 tube in the same manner as that done in step 5 of the "Video IF Alignment" section. Adjust T111 top and bottom for maximum reading of the VTVM.

6*Adjust L12, sound takeoff trap on tuner (see figure 2 ), for maximum reading of the VTVM.

## RF OSCILLATOR ALIGNMENT

The RF unit, or tuner, is factory pre-aligned and requires only oscillator adjustment for each channel.

1- Connect an antenna having 300 ohms input impedance to the antenna terminal posts of the receiver. Make certain all tubes are placed firmly in their proper sockets. Turn on the set.

2- Set the channel selector to any channel that is known to be on the air.
3- Set the fine tuning control to its midway position. This will expose a $1 / 4^{\prime \prime}$ hole to the right of the tuner shaft when the chassis is viewed from the front. (see figure below)


MODEL 2430


MODEL 630

FIG. 2

* Model 2430 does not have this coil.

4- Insert a fibre or plastic screw driver through the oscillator adjustment hole and slightly turn the adjustable slug in or out until maximum volume without distortion is obtained. Do not screw slug more than $3 / 16^{\prime \prime}$ from its flush position or it will fall out of the coil, necessitating removal of the coil from the tuner and replacement of the adjustable screw.

5- Keep the fine tuning vernier in the center of its range and adjust each individual channel from which a signal can be received in your location as described in steps 1 through 4 above.

6- Disconnect the antenna from the television chassis.

## OVERALL ALIGNMENT

While it is generally unnecessary to use a sweep generator, it may be desirable to view the overall response curve. This curve should be similar to that illus trated below. To obtain it, a $50-216 \mathrm{Mc}$ sweep signal generator is used together with a standard signal generator and an oscilloscope.

1- In a normal signal area, the $-3 V$ bias should be applied to the IF strip, as in steps 2 and 3 of the Video IF Alignment section. For fringe area reception, -1.5 V bias should be used in the same manner.

2- Connect the RF sweep generator to the receiver antenna terminals and set to channel 12 or 13. Set the receiver channel selector to the same channel.

3- Connect the common lead of a VTVM to ground and the DC probe to the junction of L188 and R137. Set the meter to -3 or -5 V scale.

4- Connect the ground lead of an oscilloscope to the chassis ground and the vertical input lead to the junction of L188 and R137.

5- Set the sweep generator to high output and adjust the fine tuning control on the receiver until a response curve appears on the oscilloscope screen. Reduce generator output until a reading of .3 volts is obtained at the VTVM. Readjust oscilloscope gain if necessary to get an adequate sized pattern.

6- Connect the signal generator to the antenna terminals through a small capacitor and feed in a 25.75 Mc IF picture carrier marker.

7- Observe and analyse the response curve obtained. If necessary, the IF adjustments should be slightly retouched in order to obtain a curve similar to the one illustrated below.


FIG. 3 - OVERALL PICTURE I-F RESPONSE.

8- If Tlo4 (bottom) requires any adjustment, it may be necessary to readjust Tl 04 (top). When all final adjustments are made, the picture carrier marker 25.75 Mc should be at approximately $50 \%$ response. The curve must be approximately flat top with a 22.3 Mc marker at approximately $100 \%$ response (a 22.3 Mc marker may be obtained by readjusting the signal generator, as in step 6 above).

9- Throughout the video IF alignment, care should be taken to see that no two transformers are tuned to the same frequency as IF oscillation may result.

10- Check response curve in like manner on several other channels. Slight differences are acceptable.

11- Replace 6AU6 AGC tube and remove bias batteries.
12- Turn off receiver.


FIG. 2



| KINESCOPE | FRONT BKT, HOLES USED |  | REAR EKT. HOLES USED |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SIZE | MP 74 | MP 72 | 4 P 62R | MP 618 | MP 129R | NOTES |
| 20" RECT. GLASS | ${ }^{4} 35$ | 8183 | C4 HOLES | 07 A 5, OIO HOLES | E183 | Class |
| 19" RO. METAL | A14, ${ }^{\text {a }}$ | 8185 | C4 HOLES | O7 a 5, OIOHOLES | EIa 3 | TUBES. |
| $17^{\prime \prime}$ RECT. Glass | A485 | B1a 2 | C3 HOLES | D6 a 3, D8 HoLES | E1a 3 | 0:6-32x |
| Rect. metal | A3 ${ }^{\text {a }} 5$ | 8183 | C3 HOLE | - ${ }^{\text {a }}$ - Mos | Ela 3 |  |




IN SOME CABIMET INSTALLATIONS, IT MAY BE NECESSARY TO REMOVE MP 75, THE BRIGHTNESS CONTROL BRACKET. FOR SUCH





1- After mounting the kinescope, the deflection yoke should be placed all the way up on the neck of the tube as far as it will go. On some tubes, it is necessary to remove the rubber cushion from the deflection yoke mounting hood and replace them with strips of tape. This will allow the deflection yoke to be moved closer to the bell portion of the tube.

2- Center the yoke around the neck of the tube by inserting a thin fibre or plastic strip between the inside of the yoke and the neck of the tube.

3- Mount the focus coil, with gap forward, so that the neck of the tube passes through the center of the coil with equal spacing all around the neck. The focus coil should be about $1 / 4^{\prime \prime}$ behind the yoke and should be parallel to it, not tilted.

4- Mount the ion trap on the kinescope tube near the base. Be certain that the proper type of ion trap magnet is used for the particular kinescope being utilized.

5- Carefully place kinescope socket on the base of the tube, making certain the kinescope grid lead (green lead) is separate from all other leads.

6- Remove insulation from the end of the high voltage lead and solder on proper anode connector. Connect to the picture tube.

## PRELIMINARY ION TRAP ADJUSTMENT

Turn on receiver
Adjust the brightness control to about $3 / 4$ clockwise position. Then slowly rotate ion trap while moving it gently forward and backward until a bright area begins to appear on the picture tube face. Continue rotating while reducing the brightness control setting until the best brightness has been obtained on the face of the picture tube for a retatively low setting of the brightness control. If either a single horizontal bright line or a vertical bright line appears, turn off receiver to avoid burning the picture tube screen, and check the vertical or horizontal deflection circuits for errors (see trouble shooting chart). If, for any reason, no brightness appears after several trials, rotate the krightness control completely counter clockwise until the trouble is found as picture tube damage may result from incorrect placement of the ion trap.

## PRELIMINARY ADJUSTMENTS ON AIR SIGNAL

Before final adjustments can be made, several preliminary adjustments must be made on an air signal. Connect an antenna having 300 ohms input impedance to the antenna terminal posts on the receiver. Turn on the set, and set the channel selector to any channel that is known to be on the air.

1- Turn brightness control completely counter clockwise and then slightly clockwise until a glow begins to appear on the face of the picture tube.

2- On receivers with a rear panel AGC level control, turn control 3/4 clockwise.
3- Turn up contrast until a series of diagonal or horizontal black and white lines are seen on the face of the tube.

4- Adjust secondary of synchrolock transformer, T108 (i. e., located on rear of chassis) until a single picture is seen on the screen. If it is rolling up or down, adjust the vertical hold control until it remains stationary.

Set the horizontal hold control to the extreme clockwise position and readjust the rear screw of synchrolock transformer, if necessary to lock the picture. Next, set the horizontal hold control to the extreme counter clockwise position and readjust the synchrolock transformer as stated above. Observe the number of turns necessary for readjustment of the synchrolock transformer. Set the horizontal hold control to the center of the range and readjust the synchrolock transformer by $1 / 2$ the number of turns between the clockwise and counter clockwise positions of the horizontal hold control. When functioning properly, the horizontal hold control may be varied to approximately $80 \%$ of its extreme positions and still maintain proper horizontal sync.

5- Adjust the width and horizontal drive controls so that both edges of the picture may be observed.

6- If foldover (i. e., a bright vertical band at either extreme of the received picture) is observed, a slight adjustment of the phasing screw may be necessary This screw is in the primary of the synchrolock transformer and must be reached from the inside of the chassis. W ith the horizontal hold control completely clockwise, adjust the phasing screw until the foldover just disappears. Then rotate the horizontal hold control completely counter clockwise. If no foldover occurs, the adjustment is complete. if there is slight foldover, readjust the phasing screw, so that the foldover line is $1 / 2$ as wide as previously. The foldover should then disappear over the greatest part of the horizontal hold range.

7- If necessary, readjust the rear screw of the synchrolock transformer according to the instructions in step 4 above.

8- On receivers having an AGC level control, set receiver on strongest channel, turn control clockwise until picture just begins to overload, then back off slightly.

## FINAL ADJUSTMENTS ON AIR SIGNAL

For the following adjustments, a test pattern is required:
1-Adjust the deflection yoke so that it is snug against the bell portion of the picture tube, and the top and bottom of the test pattern are in a straight horizontal line, parallel with the floor and table top.

2- Adjust the focus control until the picture is as clear as possible.
3- Adjust vertical linearity and height controls until the top half and bottom half of the test pattern are equal in height and just fill the cabinet mask. The height control has the greatest effect on the bottom half of the picture while the linearity control has the greatest effect on the top half of the picture. It may be necessary during these adjustments to occasionally reset the vertical hold control.

4- Adjust the horizontal and vertical centering controls* until test pattern is properly centered on face of tube.

5a- For picture tubes requiring from 53 to 60 degrees horizontal deflection (i. e. 12LP4, 16AP4, 16DP4, etc.) the width plug on the rear of the chassis should be placed in the 60 degree position.
b- For tubes requiring from 63 to 70 degrees horizontal deflection, (i. e., 19AP4, 16 GP4, all rectangular tubes, etc.) the width plug should be placed in the 70 degree position.

6- Adjust horizontal drive control for greatest width without excessive stretching of left hand portion of picture. If width is excessive, turn width screw out. If too narrow, turn width scrèw in. $\dagger$

7- A slight readjustment of the ion trap and focus control may be required.

* On some models, a slight adjustment of position of focus coil will correct centering.
$\dagger$ On some models, a separate width coil is provided for 60 degree adjustments.


1-Place components on neck of tube using appropriate mechanical mounting brackets.
2-Connect all plugs and connectors to their proper receptacles.
3-Place deflection yoke forward as close to the bell of the picture tube as possibla.
4 -Mount the focus coil about 1/4" behind the yoke and parallel to it, leaving an equal clear space around the picture tube neck.
5-Mount the ion trap near the base of the picture tube. Make sure ion trap is correct for picture tube being used.
6-Fasten high voltage connector to picture tube.
7-Turn set on. Adjust "BRIGHTNESS" control 3/4 clockwise. Slowly rotate ion trap magnet while moving it back and forth until best brightness is obtained. If, after several times, no brightness appears or single line is seen, turn "BRIGHTNESS" control completely counterclockwise until trouble is found.
8 -Move centering rod, on focus coil, up and down to center picture horizontally and left to right to center vertically.
O-Reduce brightness to slightly above normal, readjust ion trap for maximum brightness, then screw focus rod in or out until the picture is sharpest.
10-If shadows appear at any corner of the raster, recheck position of yoke and focus coil. The ion trap may be moved slightly provided that it is kept within the range of maximum brightness. A careless adjustment may injure the picture tube.
B. Operating Instructions (applicable only after receiver nas been properly set up and adjusted)
1-Turn set ON by rotating "VOLUME" control clockwise.
2-Set "CHANNEL SELECTOR" todesired station.
3-Turn"BRIGHTNESS" control clockwise until a faint glow appears on screen.
4-Adjust "CONTRAST" control for desired contrast.
5-Adjust "FINE TUNING" control for clearest sound and then set "VOLUME" for adequate sound level.

6-If the picture rolls vertically, adjust "VERTICAL HOLD" control. 7-If diagonal lines rather than a stationary pattern appear, adjust "HORIZONTAL HOLD" control.
8-When switching to another station, it may be necessary to repeat step 4.

9-For phonograph operation, turn "BRIGHTNESS" control completely counterclockwise until click is heard. Then turn phono motor on.
C. Rear Control Adjustment (if required)
l-The "VERTICAL LINEARITY" and "HKIGHT" controls are used to obtain a linear vertical pattern. The "HEIGHT" control affects mainly the bottom half of the picture while the "VERTICAL LINEAR ITY" control affects the top half. Adjust these controls a little at a time, first one, then the other, and repeat. It may be necessary when adjusting these controls to readjust the "VERTICAL HOLD" control on
2-Screw "HORIZONTAL DRIVE" control in until one or two white vertical lines appear near the center of the screen, back off control until lines just disappear.
3-Rotate "HORIZONTAL HOLD" control (front panel) completely clockwise. Picture may start to pull out at right hand side or one to three diagonal bars slanting down to right may appear. This is normal. Rotate horizontal hold control completely counter-clock-wise. Picture may fall out of sync with one to six bars slanting to left. Slowly rotate "HORIZONTAL" control clockwise. Picture should pull in at about two to four bars. The picture should remain in sync over at least $75 \%$ of the horizontal range.

If control does notperform as above, first rotate "HOLD" control to extreme clockwise position. Adjust horizontal oscillator slug in rear until picture is in sync and about to pull out to the right. Recheck operation as in preceeding paragraph. If control does not performas described, or excessive bend appears in picture a complete readjustment of both horizontal stabilizing coil and oscillator coil is indicated.
a) Temporarily short out stabilizing coil with a very short wire (3'). b) Turn "HORIZONTAL HOLD" control completely clockwise
c) Adjust horizontal oscillator coil until picture is in sync and about to pull out to the right.
d) Remove short. Attach oscilloscope through 3 mmf . capacitor to tap on ascillator coil and observe waveform
e) Adjust horizontal stabilizing coil until broad and sharp peaks are equal in amplitude, keeping picture in sync with "HOLD" control if necessary. Readjust horizontal oscillator coil if required as in step
f) If oscilloscope is not available, a fairly satisfactory adjustment of the stabilizing coil may be had by turning it out until the picture is centered in the raster without foldover on either side. (To observe this, width must be reduced to expose at least one edge of the picture, contrast must be reduced and brightness increased so that raster is visible.)
g) Recheck horizontal oscillator coil setting as in "C" above.

4- Adjust "WIDTH" coil for proper width; clockwise rotation to increase width; counter-clockwise to reduce width.
5- Adjust "HORIZONTAL LINEARITY" coil for best horizontal linearity with no white vertical lines in raster.
Set "AGC LINK" to open or closed position, depending on signal strength in area.

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## ALIGNMENT INSTRUCTIONS

Check other possible causes carefully before considering realignment. The following adjustments rarely require attention and alignment should not be attempted unless the circuits are definitely known to be out of adjustment and suitable equipment is available to make these adjustments.
Refer to Figs. 9 and 10 for location of alignment adjustments. Refer to the schematic for location of the test points indicated by the circled letters in the following chart.

PRESETTING IF TRAP COILS USING AM SIGNAL GENERATOR AND VTVM
Connect the negative lead of a 3 -volt battery at point (B) shown on the schematic diagram; connect the positive lead to the chassis.
Connect the signal penerator to the grid of the 1 st IF tube. Connect the DC probe of the VTVM at point (A); connect the Connect the negative lead of a 3 -volt battery at point (B) shown on the schematic diagram; connect the positive lead to the chassis
Connect the signal generator to the grid of the 1 st IF tube. Connect the DC probe of the VTVM at point (A); connect the
negative lead to the chassis. Set the picture and fine tuning controls fully clockwise. Set the receiver to chanel (12.


| $\begin{aligned} & \text { DUMMY } \\ & \text { ANTENNA } \end{aligned}$ | SIGNAL GENERATOR coupling | SIGNAL generator frequency | Channel | CONNECT vTVM | ADJUST | remarks |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Direct | To 1st IF grid | $\begin{gathered} 20.6 \mathrm{Mc} \\ \text { (Unmod.) } \end{gathered}$ | 12 | $\begin{gathered} \hline \text { DC probe to } \\ \text { point }(A) \text {. } \\ \text { Common to } \\ \text { chassis. } \end{gathered}$ | Bottom adiustments of $\mathrm{L}-42 \mathrm{~B}$ and L-42C. | Adiust for maximum voltage VTVM. |

CAUTION-Once the IF trap coils have been preset, no further adiustment with these coils will be necessary. Proceed to the overall
IF response as described below to complete the alignment.

## OVERALL IF AMP. RESPONSE CHECK

Connect the synchronized sweep voltage from the sweep signal generator to the horizontal input of the oscilloscope for horizontal deflection. Connect the sweep generator to the loosely coupled shield of the 6 J 6 tube, making certain that the shield is not grounded connect the ground lead to the chassis.

| DUMMY ANTENNA | $\begin{aligned} & \text { SWEEE } \\ & \text { GENERATOR } \\ & \text { COUPLING } \end{aligned}$ | SWEEP GENERATOR FREQUENCY | MARKER GENERATOR FREQUENCY | channel | $\underset{\substack{\text { CONNECT } \\ \text { SCOPE }}}{\text { Col }}$ | ADJUST | remarks |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Direct | High side to loosely coupled 6J6; low side to chassis. | $\begin{gathered} 24 \mathrm{Mc} \\ (10 \mathrm{Mc} \end{gathered}$ sweep) | $\begin{aligned} & 21.75 \mathrm{Mc} \\ & 26.25 \mathrm{Mc} \end{aligned}$ | 12 | $\begin{aligned} & \text { Vertical } \\ & \text { amplifier to } \\ & \text { point (A). } \\ & \text { Common to } \\ & \text { chassis. } \end{aligned}$ | $\begin{aligned} & \mathrm{L}-13 \mathrm{~A} \\ & \mathrm{~L}-42 \mathrm{~B} \\ & \text { (top) } \\ & \text { L-42C } \\ & \text { (top) } \\ & \mathrm{L}-6 \\ & \mathrm{~L}-38 \end{aligned}$ | Check for response curve similas to Fig. 6 with markers as shown. It is generally necessary to retouch settings of L-13A, L-42B (top), and L-42C (top) for proper response. Note that the adjustment of L-13A will affect the video side of the curve, $L$ - 42 B (top) the audio side, and L-42C (top) the intermediate range. It may be necessary to touch up settings of L-6 necessary to touch up setrings or and L-38 for proper symmetry, flatness, and bandpass. A pass band width of 3.5 Mc measured at the $50 \%$ response points is recommended at this point. |


| arceiver ANT. TEPMINALS SIGNAL GENERATOR OUTPUT CABLE. |
| :---: |
| R-150 OHM LESS ONE HALF THE OUTPUT IMPEDANCE OF SIGNAL GENERATOR |

FIG. 4. Dummy Antonna Dotail

| TO TEST POINT 1000 mmis | TO DC PRODE Of VTVM $\overbrace{\sim}^{100.000}$ |
| :---: | :---: |
| OREQSAL ${ }_{\text {IN }} \rightarrow$ |  |
| TO Chassis - | Mmon |
|  | TV.LD. 7 |

FIG. 5. Diode Dotector Dotail
SOUND IF AMP ALIGNMENT USING AM SIGNAL GENERATOR AND VTVM

| DUMMY ANTENNA | signal generator COUPLING | signal generator frequency | Channe | CONNECT VTVM | ADJust | remarks |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Direct | High side to point (A). <br> Low side to chassis. | $\begin{gathered} \text { 4.5 Mc } \\ \text { (Unmod.) } \end{gathered}$ | Any channel unused locally. | Dc probe to point (C). <br> Common to chassis. | L-16A and bottom adjustment of L-17. | Adjust for max. voltage at VTVM. |
| " | " | " | " | $\begin{gathered} \hline \text { DC probe to } \\ \text { point (E). } \\ \text { Common to } \\ \text { chassis. } \end{gathered}$ | $\begin{aligned} & \text { Adjust top } \\ & \text { slug of } \mathrm{L}-17 \text {. } \end{aligned}$ | Adjust for zero voltage. A positive and negative reading will be obtained on either side of the correct setting. |

CHECK ON SOUND IF AMP ALIGNMENT USING FM SIGNAL GENERATOR AND OSCILLOSCOPE
Connect the synchronized sweep voltage from the signal generator to the horizontal input of the oscilloscope for horizontal deflection


Unless the tuner assembly has been serviced (tube or parts replacement) an adjustment of the RF stage trimmers will generally not be required. Tuner service, wherever possible, should be restricted to the adjustment of the oscillator trimmers outlined under INSTALLATION AND SERVICE ADJUSTMENTS.
Alignment of the tuner assembly should not be attempted unless suitable equipment is avallable.
Connect the synchronized sweep voltage from the sweep signal generator to the horizontal input of the oscilloscope or horizontal deflection.
Connect the negative lead of a 3 -volt battery at point (B) shown on the schematic diagram; connect the positive ead to the chassis.

| DUMMY ANTENNA | $\begin{gathered} \text { SWEEP } \\ \text { GENERATOR } \\ \text { COUPLING } \end{gathered}$ | SWEEP GENERATOR FREQUENCY | $\begin{aligned} & \text { MARKER } \\ & \text { GENERATOR } \\ & \text { FREQUENCY } \end{aligned}$ | CHANNEL | CONNECT SCOPE | ADJUSt | remarks |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Two carbon resistors. See Fig. | To receiver antenna terminals. | $\begin{gathered} 207 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 205.25 \mathrm{Mc} \\ & 209.75 \mathrm{Mc} \end{aligned}$ | 12 | Vertical <br> amplifier <br> input to <br> point ( $\Lambda$ ). <br> Common to <br> chassis. |  | Adjust C-3 RF amp. trimmer, C-6 mixer trimmer, and $\mathrm{C}-13 \mathrm{RF}$ amp. trimmer for proper pass band and symmetry. Adjust oscillator coil to place the video marker at the $50 \%$ response point. Refer to Fig 8. |
| " | " | $\begin{gathered} 213 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 211.25 \mathrm{Mc} \\ & 215.75 \mathrm{Mc} \end{aligned}$ | 13 | " | Osc. 13 | Check frequency response for symmetrical peaks as above and if necessary touch-up adiustments C.3, C.6, and C-13. Adjust oscillator coils 30 that the video marker will be at the $50 \%$ response poiat of the curve. Note that the oscillator adjustment screw is found to the right of the fine tuaing shaft and is made accessible as the channel selector is rotated to each channel. |
| " | " | $\begin{gathered} 201 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 199.25 \mathrm{Mc} \\ & 203.75 \mathrm{Mc} \end{aligned}$ | 11 | " | Osc. 11 |  |
| " | " | $\begin{gathered} 195 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 193.25 \mathrm{Mc} \\ & 197.75 \mathrm{Mc} \\ & \hline \end{aligned}$ | 10 | " | Osc. 10 |  |
| " | " | $\begin{gathered} 189 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 187.25 \mathrm{Mc} \\ & 191.75 \mathrm{Mc} \end{aligned}$ | 9 | " | Ox. 9 |  |
| " | " | $\begin{gathered} 183 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 181.25 \mathrm{Mc} \\ & 185.75 \mathrm{Mc} \end{aligned}$ | 8 | " | Osc. 8 |  |
| " | " |  | $\begin{aligned} & 175.25 \mathrm{Mc} \\ & 179.75 \mathrm{Mc} \\ & \hline \end{aligned}$ | 7 | " | Orc. 7 |  |
| " | " | $\begin{gathered} 85 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 83.25 \mathrm{Mc} \\ & 87.75 \mathrm{Mc} \end{aligned}$ | 6 | ' | Or. 6 |  |
| " | " | $\begin{gathered} 79 \text { Mc } \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 77.25 \mathrm{Mc} \\ & 81.75 \mathrm{Mc} \end{aligned}$ | 5 | " | Orc. 9 |  |
| " | " | $\begin{gathered} 69 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 67.25 \mathrm{Mc} \\ & 71.75 \mathrm{Mc} \end{aligned}$ | 4 | " | Osc. 4 |  |
| " | " | $\begin{gathered} 63 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep }) \end{gathered}$ | $\begin{aligned} & 61.25 \mathrm{Mc} \\ & 65.75 \mathrm{Mc} \end{aligned}$ | 3 | " | Orc. 3 |  |
| " | " | $\begin{gathered} 57 \mathrm{Mc} \\ (10 \mathrm{Mc} \text { sweep) } \end{gathered}$ | $\begin{aligned} & 53.25 \mathrm{Mc} \\ & 59.75 \mathrm{Mc} \end{aligned}$ | 2 | " | Osc. 2 |  |

fold up, indicating over-drive and finally turn the screw clockwise slightly to eliminate this folding action. With this setting tiie receiver is operating at maximum anode potential necessary for maximum picture brilliance and also eliminates linearity distortion at the center of the picture due to over-drive. (Do not confuse this linearity distortion with the overall linearity adjustment made with the HORIZ. LINEARITY control.)
Because of manufacturing tolerances, not all receivers can be over-driven to the extent that fold-over will be observed. In these cases, the HORIZ DRIVE triminer screw should be set near minimum capacity (counterclockwise) for optimum performance
2. Check the horizontal linearity of the test pattern. It should be symmetrical from left to right and the center Check the horizontal linearity of the test pattern. It should be symmetrical from left to right and the center
of the pattern should line up with the center of the escutcheon. If not, turn the HORIZ. LINEARITY screw of the pattern should line up with the center of the escutcheon. If not, turn the H
adjusiment in the direction that produces a symmetrical pattern from left to right.
3. Check the width of the test pattern. If it does not match the escutcheon, turn the HORIZ. WIDTH screw in the direction that produces the desired picture width. If this adjustment affects horizontal sync., reset the HORIZ. FREOUENCY adjustment.
height and vertical linearity-Set the VErT. HEIGHT and VERT. LINEARITY controls for vertical size and symmetry. These two controls interact somewhat and are usually adjusted together to obtain the desired effect.

## FOCUS AND CENTERING

1. Chassis $46 \mathrm{~A} 3,46 \mathrm{~A} 4$, and 46 B 3 -The picture tubes used in these chassis are electrostatically focused by means of a focus electrode in the gun assembly connected to the primary B+ in the receiver. The picture is centered to the escutcheon by removing the cabinet back and adjusting the centering device at the rear of the deflection yoke. The ion trap adjustment described under ION TRAP ADJUSTMENT should be made before pro-
ceeding to center the picture. To shift the picture, rotate the centering device and adjust the two tabs which ceeding to center the picture. To shift the picture, rotate the centering device an
project from this device until the pattern is centered without shadowed corners.
2. Chassis 46 C 3 and 46 C 4 -These chassis employ a P.M. focusing unit located on the neck of the picture tube directly behind the deflection yoke. The picture is centered to the escutcheon by removing the cabinet back* and adjusting the position of the metal tab located at the top of the focusing unit. The metal tab is held in position with a retaining screw and bracket. To re-set the tab, first loosen the retaining screw to permit movement of the tab. Centering can be accomplished by moving the tab in the required direction until the pattern is centered without shadowed corners. Tighten the retaining screw to prevent the tab from shifting. To focus
the picture adjust the focusing stud, projecting from the focus unit along the neck of the picture tube, until proper focus is obtained. Focusing can be accomplished without removing the cabinet back. The cup on the cabinet back is provided with a hole to permit focus adjustment. Locate the sloted end of the focus stud and by means of a screwdriver, rotate the stud until the picture is in focus. Care must be used not to disturb the position of the ion trap when making the focus adjustment without removing the cabinet back.
DEFLECTION YOKE ADJUSTMENT-If the picture is tilted at an angle, it may be straightened out by removing the cabinet back* and loosening the single deflection yoke locking screw at the top center of the deflection yoke and cabinet back* and loosening the single deflection yoke locking screw at the top center of the deflection yoke and
rotating the yoke slightly as desired. Tighten the screw after adjustment making certain that the yoke is pushed forward against the flare of the tube.
OSCILLATOR TRIMMER ADJUSTMENTS-The oscillator trimmer adjustments have been set at the factory so that the picture just begins to appear and the sound is at maximum when the fine tuning control is about centered. Check the reception on all active TV channels in the area. When the oscillator trimmers are properly adjusted, the fine be about centered when optimum picture quality and sound volume are established. If extensive use of the fine tuning control is necessary when changing stations, proceed as follows:
3. Turn the receiver on and allow 15 minutes to warm up.
4. Select the desired television station by rotating the channel selector control. Set all other controls for a nor mal picture.
5. Set the fine tuning control in the center of its range.
6. Remove channel selector and fine tuning knobs.
7. The oscillator adjustment is found to the right of the fine tuning shaft. Insert a non-metallic screwdriver with a $1 / 8$ " wide tip and about 5 inches long and adjust for best picture and sound. The slug requires a slight rota remove the chassis from the cabinet. Remove the bottom cover of the tuner and remove the coil. Hold the retaining spring to one side and lightly tap the open end of the coil until the slug slips out. Then replace the slug and reset the retaining spring.
8. With the fine tuning control still set as in step 3 , repeat the procedure in steps 4 and 5 for each active tele vision channel in the area.


Alignment Adjustment end Tube Location Chart


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UNITED STATES TELEVISION TV PAGE $14-1$
CHASSIS KRV-15932

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Fig. 5-Bottom Socket Voltages

## ALIGNMENT PROCEDURE

IEST EQUIPMENT - To service this receiver properly, it is recommended that the following test equipment be avail-R-F Sw

GENERATOR meeting the following requirements: (a) Frequency ranges:

18 to $30 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
40 to $90 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
170 to $225 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide SIGNAL GENERATOR to provide the following frequencies: Output on these ranges should be adiustable and at least . 1 volt maximum.)
(a) Intermediate alignment frequencies
23.1 mc firs picture li- coil.
24.1 mc third picture I-F coil.
25.9 mc second picture I-F coil.
1.7 mc sound trap.
4.5 mc video trap \& sound I-F.
heterodyne frequency meter with crystal calibrator if the signal generator is not crystal controlled.

ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 20 kilovolts. SERVICE PRECAUTIONS - To service the receiver remove the chassis from the cabinet. To do so, remove the knobs, the cabinet back, disconnect the leads from the speaker, remove the antenna terminal board at rear of cabinet, and then the 5 chassis mounting bolts. The chassis may be serviced with the picture tube in place provided the chassis is furned on its side with the power transformer on the bottom. The weight of the chassis wil be supp CAuTON: Do not pernit the kin
CAUTION: Do not permit the kinescope second-anode ead to become shorted to the chassis. To do so will cause a considerable overload on the high voltage filter resistor

## ALIGNMENT PROCEDURE

P. Unmodulated R-F signal into Converter Grid by means volts DC. Apply -4.5 V battery bias on AGC line. (Junction of R-28 \& R-32).


25.2 MC Converter plate coil on top of
ADJUST funer for maximum dc at picture detector.
2. $23.1 \mathrm{MC} \quad$ 1st picture 1-F coil ( $\mathrm{T}-1$ ) for maximum de at picture detector.
3. $25.9 \mathrm{MC} \quad$ 2nd picture I-F coil (T-2) for 2nd picture I-F coil (T-2) for
maximum dc at picture detector.
4. $24.1 \mathrm{MC} \quad$ 3rd picture $1-\mathrm{F}$ coil (T-3 below chassis) for maximum de at pic. ure detector.
5. $21.7 \mathrm{MC} \quad 3 \mathrm{rd}$ picture I-F trap ( $\mathrm{T}-3$ in can above chassis) for minimum dc at picture detector.
B. I-F Sweep Generator into converter grid by means of tube shield insulated from base.
Connect oscilloscope across R-100 (in place of VTVM) Apply -4.5 V bias (DC) to AGC line (battery)
Tuner should be switched to dead channel so as not to cause interference.


fig. 11-Overall Response Curve
Observe overall I-F response, which should be as shown above: A slight touch-up may be required. At no time should the trap coil be re-adjusted, nor should it be neces sary to turn any of the picture I-r coils more than $1 / 2$ turn of the slug. The following comments are suggestions only:

1. The height of the 26.2 MC marker is controlled by the 25.2 MC (Converter Plate Coil on tuner) and the 25.9 MC (2nd P.I.F.) coils.
2. The uniformity of response (flatness across top and position of 23.5 MC ) marker is controlled for the most pan by the 24.1 MC third picture 1 F coil.
3. The 23.0 MC marker position is controlled by the first picture I-F ( 23.1 MC coil). However, it is NOT advisable to change the setting of the coil, due to its effect on sound rejection. Its adjustment should be avoided unless believed to be absolutely necessary.

## VIDEO

With 4.5 MC unmodulated signal from a high impedance source, ( 10,000 ohms in series with the generator) into plate of the picture detector tube (Pin 2-6AL5) and VTVM on picture tube grid, tune 4.5 MC trap (L-7 Top) for minimum
response. VTVM on 0.10 V AC scale. This adjustment can also be made while observing a picture from a station. Tune trap for least 4.5 MC beat in picture.

## AUDIO I-F

: Wish signol generator set to 4.5 connected to junction of R-62 and C-46, adjust sound take-off coil (Li3 Top) and sound IF transformer slug (T. 6 Top \& Bottom) for maximum.

2: With VTVM connected to pin 7 of V-12 (6AL5) adjust the ratio detector primary ( $\mathrm{T}-7$ Bottom) for maximum
3: With VTVM connected to junction of R-66, R-69 and C. 50 , adjust ratio detector secondary (T. 7 Top) for cross over (zero voltage) on lowest scale.
NOTE - If no signal generator is available, the pro cedure above may be followed by tuning in a station and using the 4.5 MC beat between picture and sound carrier.

## OJohn F. Rider

## OSCILLOSCOPE WAVEFORM PATTERNS

## TUNER ALIGNMENT

A. Sweep generator with balanced 300 ohm output to antenna terminals. Marker generator output to antenno erminals. Oscilloscope to iest poini Figure 12) on uner. Connect $1 / 2 \mathrm{~V}$ bias to AGC line at junction o $\mathrm{R}-33$ and $\mathrm{C}-20$ on the receiver.


B RF AND COnverter adjustment

1. With channel selector on Channe! 12, adjust C-201 slightly favoring the Pix carrier, then adjust C-206 and C -209 for response as in Figure 13. Picture and sound markers at $90 \%$ maximum response.
2. Check response on all channels. If markers are below $70 \%$ on any channels, readjust C-201, C-206, and C-209. Recheck all channels.


Fig. 13-Pix \& Audio Markers
C. OSCILLATOR ADJUSTMENT

1. Apply -4.5 volits on I-F AGC line at junction of R-1 and C.21.
2. Connect oscilloscope to output of video detector. Place fine funing in center of range. Check response on all channels. Sound marker should be in notch and picture marker at $50 \%$. (See Figure 11).
3. If markers are off, individual oscillator coil slugs will require adjustment. Adjust each channel slug, accessible through hole in front of chassis with a non-metallic screwdriver to bring sound marker to correct position.


Fig. 15-Tuner Schematic Diagram

The waveforms on this page were taken with the receiver uned to a normal picture. The numbers on the waveforms correspond to the numbers on the schematic diagram which dentifies each test point.
The voltages shown on each waveform are the approximate peak to peak amplitudes. The frequencies shown indicate


No. 1-6Al5 Pix Dat. Plate 2.8V P.p 60 C.p.s.



No. 2-12AT7 Plate 4.1V p.p 60 C.p.s.
No. 2-128Y7 Grid


## No. 7-12AT7 Phase Splititer Plate

No. ${ }^{14-6 S N 7-G T A-H o r . ~ O s e . ~ P l a t o ~}$
47V P-P 15,750 C.P.S.
oscilloscope. If the waveforms are observed on the oscilloscope with a poor high frequency response, the corners of the pulses will tend to be more rounded than those shown below and the amplitudes of any high fre quency pulse will tend to be less.

No. 8-6SN7.GTA-Vert. Ose. Plato



No. 9-GSN7.GTA Vert. Ose. Grid
160 V P.P 60 C.P. S.



No. 17-68Q6 Grid
150 V P.P 15.750 C.P.S.


No. 18-6AXA-GT Damper Plate
No. $12-6 A U 6$ A.G.C.
Slov p.p 15,750 C.P.S.



No. 6-12AT7 Phase Spliter Cathode
33V P.P 15.750 C.P.S.
No. 13-6AL5 Phase Dot.
18V P.P 15,750 C.p.S.


In earlier production R-86 w.1s 1.8 K , R-87 was 5.6 K , $\mathrm{R}-88$
was $220 \mathrm{~K}, \mathrm{R}-90$ was $47 \mathrm{~K} 1 / 2 \mathrm{~W}$ and $\mathrm{R}-114$ was not used.


## OPERATING INSTRUCTIONS

## FACTORY MODEL 621CW7

## INSTALLATION

## Instructions

The complete installation of your new Television Receiver and the Television Antenna should be made by a qualified Television Service Technician. The Western Auto Store from whom you purchased the receiver will arrange for its unpacking and proper installation, and instruction in the use of the receiver for best results.

PLACEMENT -- The location in the room for your new Television Receiver should be given careful consideration

Choose the location .. Where no bright light will fall directly on the picture. (Some illumina tion in the room is desirable.)
-- To give easy access for operation and comfortable viewing.
-- To permit a convenient connection to the antenna.
-- Convenient to an A-C electrical outlet of the proper voltage and frequency.
-- To allow adequate ventilation.
POWER SUPPLY .. This receiver is designed to operate on $105-125$ volts A.C. power only. If plugged into an incorrect power supply, damage to the receiver may result.

CAUTION .- The receiver is provided with adequate ventilation holes in the bottom, back and the top of the cabinet. Care should be taken not to allow these holes to be covered or ventila tion impeded in any way.

ANTENNA .- A correctly designed antenna, properly installed, is essential for good picture and sound reception.

Reception up to and sometimes beyond the line of sight to the transmitted antenna may be obtained if local interference conditions permit.

Whenever trouble is experienced, call the Western Auto Store from whom you purchased
instrument. He will arrange for a competent Service Television Technician to service the the instrument. He will artange for a competent Service Television Technician to service the receiver.

This Television Receiver produces high definition pictures with fine detail and brilliance. Reception of these pictures is easily accomplished by following the instructions outlined below.


## TUNING

All the controls normally used in tuning in a program -- both picture and sound -- are located on the front of the receiver. At the rear of the set are several controls which are pre-set at the factory and may need slight readjustment at the time of installation. After installation, they
should not be adjusted further, unless required by replacement or aging of tubes, variations in power-line voltage, or other external conditions.
(1) Turn OFF-ON SOUND volume control slightly clockwise to switch the receiver on. Then turn the control clockwise to increase the sound volume.
(2) Set STATION SELECTOR to the desired channel.
(2) Allow a brief warm-up period.
(4) If the station is broadcasting, music or speech will be heard and the FINE TUNING control should be reset for best picture quality. Adjust SOUND volume control to the desired level.
(5) If necessary, adjust PICTURE control so that the picture is clear on the screen.

If the receiver has been in previous operation and other controls have been disturbed besides the OFF-ON knob then proceed as follows:

After switching on and setting for channel and volume as explained previously in steps 1 to 5, proceed as follows:
(a) Turn BRIGHTNESS control fully clockwise.
(b) Turn the PICTURE control fully clockwise until a picture becomes apparent.
(c) If the pattern is moving up or down adjust VERTICALHOLD control until pattern is stationary in vertical direction.
(d) Adjust PICTURE control until picture is suit able and if necessary make a readjustment ot the BRIGHTNESS at the same time.
(e) Adjust FINE TUNING for best picture quality. The sound will always be automatically optimum when the picture is cor on for some time, the receiver has be necessary to readjust FINE TUNING for improved picture quality.

## GENERAL DESCRIPTION

The model covered in this manual is a 21 tube, (including the picture tube and rectifiers) $A C$ operated, direct view, 21 -inch rectangular television receivers. The receiver is complete in one unit and features full coverage of all 12 V.H.F. channels (with easy conversion to U.H.F.) automatic gain control, automatic horizontal frequency control, inter-carrier sound system, electrostatic focusing, magnetically deflected picture tube and vertical and horizontal blanking circuit to improve picture quality.

At the rear of the receiver is a safety interlock to prevent dangerous electrical shock and as an added safety measure, a fuse is located in the low voltage power supply as well as in the A.C. input to protect the receiver in case of overloading.

## OPERATOR'S CONTROLS

## Toble Model

## FRONT

ON-OFF VOLUME - Turns the receiver on or of and adjusts the sound volume level.
PICTURE - Varies in contrast between the light and the dark portions of picture

CHANNEL SELECTOR - Selects and indicates desired station or Channel. May be turned in eithe direction.

FINE TUNING - Tuning receiver for best picture.
BRIGHTNESS - Adjusts picture brilliance, ligh dark.
HORIZONTAL HOLD - Stops picture from moving side to side.

VERTICAL HOLD - Stops picture from moving up or down.

Console Molel

## FRONT

ON-OFF VOLUME - Turns the receiver on or of and adjusts the sound volume level.

PICTURE - Varies in contrast between the light and the dark portions of picture

CHANNEL SELECTOR - Selects and indicates desired station or Channel. May be turned in either direction
FINE TUNING - Tuning receiver for best picture.

## REAR

BRIGHTNESS - Controls the brilliance of the picture.

HORIZONTAL HOLD - Controls synchronization of the picture horizontally.

VERTICAL HOLD - Controls synchronization of the picture vertically.
V. SIZE - Controls the size of the picture vertically.
V. LINEARITY - Controls vertical distribution of picture.
H. SIZE - Controls the size of the picture horizontally.

H: LINEARITY - Controls horizontal distribution of right side of picture.

CENTERING MAGNET - Controls positioning of picture for proper framing.

ION TRAP MAGNET - Controls focus and picture tube illumination.


Figure 3. 21-inch Tube Assembly

## SERVICE DATA

## The front and rear controls are located as shown in figures 1, 2 and 3. All identifying names stamped on chassis.

## SERVICE ADJUSTMENTS

## VERTICAL Size and vertical linearity controls

The vertical size and linearity controls should both be adjusted at the same time while a test pattern is being transmitted. The linearity control affects the upper portion of the picture while the size control affects the overall size especially the lower portion of the picture. Adjust both controls simultaneously until the test pattern is symmetrical and fills the entire screen vertically. Readjust the Vertical Hold control if necessary.

ION TRAP MAGNET (Figure 3)
The position of the ion trap magnet MUST be over the grid of the picture tube (second cylinder from the base identified by a flared forward lip). If adjustment is necessary loosen the tape and rotate until the position which gives maximum illumination is found. Rotate and slide magnet until the best focus position is found. Adjustment should be made with brightness and picture controls set for normal viewing.

HORIZONTAL SIZE CONTROL (Figure 2B)
The horizontal size control should be adjusted until the picture fills the entire screen horizontally. A clockwise rotation will increase size. To some ex tent the vertical size control setting may be affected by a major horizontal size adjustment.

## HORIZONTAL AFC CONTROL (L-5

The horizontal AFC control is located on the rear flange of the chassis and should be adjusted in the following manner. Set the Picture control to its normal operating position. Turn the AFC Stud with a small screwdriver or adjustingotool until the picture is steady (no horizontal movement). Set the core to the middle of its range (Straight vertical wedges).

## CENTERING MAGNET

The centering magnets should be rotated and adjusted until the picture is properly framed keeping in mind that the effect of the magnet is governed by the position of rotation.

## DEFLECTION YOKE

The correct position for the deflection yoke is as far forward on the neck of the picture tube as the shape of the tube will allow.

Tube shadow or a tilted raster may result from an incorrectly positioned yoke. If a positioning adjustment is necessary, loosen the yoke wing nut located at the top of the picture tube assembly.

## HORIZONTAL LINEARITY COIL

The horizontal linearity coil affects the linearity of the right side of the picture only. It also affects phasing of the picture.

## SPECIFICATIONS

## Sensitivity at the Antenna

Audio - 5 microvolts
Video - 75-100 microvolts
(20V.P.P at Kinescope)

## Antenna Impedance Requirements

Balanced 300 -ohm
Audio Power Output Rating
3 watts undistorted

## Speaker

Permanent magnet type
3.2 ohm voice coil impedance

## Power Supply Rating

115 volts 60 Cycles, AC
Power Consumption, 190 watts

## Intermediate Frequencies

Video-26.0 MC
Audio - 21.5 MC
Intercarrier Sound - 4.5 MC

## WARNING

High voltage on the plate caps of the $1 B 3$ high voltage rectifier and the GAVS horizontal pulse amplifier. DO NOT MEASURE this voltage.

## SCHEMATIC DIAGRAM:

The schematic diagram located at the rear of this manual shows all the values of resistance and capacitance and the Voltage Measurements Chart gives all the proper voltages at the pins of the tube sockets. The voltage readings were taken with a 20,000 ohm/volt volemeter with normal operation, no signal input, and line voltage at 115 volts A . C .

## REPLACING TUBES

Before replacing the tubes the cabinet back must first be removed. Removing the cabinet back disengages the safety interlock and removes the

## TUBE COMPLEMENT

| Schematic <br> Ref. No. | RTMA Type | Tube Function |
| :---: | :--- | :--- |
|  |  |  |
| V1 | 6AU6 | Ratio Det. Driver |
| V2 | 6ALS | Ratio Detector |
| V3 | 6AV6 | Audio Amplifier |
| V4 | 6K6GT | Audio Output |
| V5 | 6AU6 | 1st IF Amplifier |
| VGV77 | 6CB6 | 2nd and 3rd IF Amplifier |
| V8 | 6AL5 | Video and AGC Det. |
| V9 | 12BH7 | Video Amplifier |
| V10 | 21FP4 | Picture Tube |
| V11 | 12AU7 | Sync. Sep. and Sync. Amp. |
| V12 | 6C4 | Vert. Osc. |
| V13 | 6V6GT | Vert. Output |
| V14 | SU4G | L. V. Rectifier |
| V15 | 6AL5 | Hor. Phase Det. |
| V16 | 12BH7 | Hor. Osc. |
| V17 | 6AV5GT | Hor. Output |
| V18 | 6W4GT | Damper |
| V19 | 1B3GT | H. V. Rectifier |
| *V20 | 6AG5 | R. F. Amplifier |
| V21 | 6J6 | R. F. Osc. and Mixer |

* May be a 6BCS or 6CB6.
power to the receiver. Do not tamper with or attempt to defeat the purpose of the safety interlock as shock may result.

Before replacing the High Voltage tubes first be sure the power is turned off and then short the H. V. anode cap to the chassis.

## WARNING:

If the receiver has been in operation for some time, the tubes become hot and gloves should be used when replacing tubes to prevent finger burns.

## PICTURE TUBE HANDLING:

Due to the large surface and extreme high vacuum of the picture tube, care should be used when handling the chassis outside the cabinet. Do not subject the tube to excessive pressure or rough handing as an implosion may result causing serious personal injury.

## HIGH VOLTAGE POWER SUPPLY:

In the process of inspection, repair, changing of tubes or transformers, or for any other reason where it is necessary to work within the high voltage power supply, the following should be closely observed.

1. The corona insulator should not be omitted.
2. The corona insulator must be dressed in such a way as to make its presence useful; that is, covering the top socker terminals.
3. All leads must be dressed as far away as possible from the transformer winding. Ex-
cess lead length should be transferred to the top side of the chassis.
When replacement of the H. V. deflection transformer is necessary, be sure to closely foilow the precautions listed above. The transformer can easily be replaced with the chassis in the cabinet by the following procedure.
4. Remove the hex head screw holding the $H$. V. cage.
5. Remove the H. V. assembly hex screws.
6. Remove flyback hex screw.

SERVICE DATA - TELEVISION FREQUENCY RANGES
(All figures represent megacycles)
$\left.\begin{array}{l}\text { Channel } \begin{array}{c}\text { Channel } \\ \text { Frequencies }\end{array} \\ \begin{array}{l}\text { Picture Carrier } \\ \text { Frequency }\end{array}\end{array} \begin{array}{c}\text { Sound Carrier } \\ \text { Frequency }\end{array} \quad \begin{array}{c}\text { Receiver RF } \\ \text { Oscillator Frequency }\end{array}\right]$

## VHF TUNER:

The Tuner is composed of a separate sub-chassis consisting of a 6C136 pentode RF Amplifier and a 6 tube (twin triode) for the oscillator and con
verter. Separate high and low band coils and verter. Separate high and low band coils and to change bands. The tuner selects and amplifies the station's signal and converts it to the carrier IF frequency of 26.0 NiC for video and 21.5 MK for sound which in turn is then fed to the IF amplifiers for further amplification.

## VIDEO IF AMPLIFIER:

The Video IF Amplifiers are mounted on a separate sub-chassis along with the low level circuit. The IF amplifier section consists of three (3) staggertuned stages with an over-coupled output IF trans tubes with self-resonant core-tuned coils. Since the receiver is of the intercarrier type both the video and sound IF frequencies are amplified simultaneously and then detected by a 6ALS. The signal is then coupled to the video amplifier and the sync clipper. The A. G. C. network, R-11 and C-7, develops a negative bias voltage pro

## VIDEO AMPLIFIER:

The Video Amplifier section consists of a 12 BH17 duo-triode tube with a degenerative picture (or grid of the picture tube. The audio signal is alsn amplified in this stage and then separated by a 4.5 MC trap ( $\mathrm{T}-4$ ). This trap also serves to separate or keep the audio from appearing in the picture.

## SOUND SECTION:

The Sound Section consists of a GAU6 (pentode) 4.5 MC audio IF amplifier, GALS twin diode ratio detector, GAV6 (triode) audio amplifier and a GKG (pentode power amplifier) output tube. Due to the hetrodyne action between the video and sound IF frequencies at the video detector, a 4.5 NC signa' After the video detector the audio information is amplified by the video amplifier, separated fron the video by the trap, amplified, detected and further amplified before being coupled to the speaker.

## SYNC. CLIPPER

The Sync. stage utilizes a 12AU7 (duo-triode) tube which functions as a sync. separator and noise clipper. The signal from the output of the video amplifier is coupled to pin 8 through R-27 and C-29. With the negative going signal at Pin 8 and the low plate voltage, sync. separation is accomplished.

## VERTICAL DEFLECTION:

The Vertical Deflection section consists of a 6C4 and 6V6 tube, being used as a blocking the plate of the sync. separator is coupled through the plate of the sync. Separator is coupled through
the Vertical Integrating Network to the grid of the blocking osciilator. The vertical hold control ( R -54) in the grid circuit varies the oscillator operating frequency, thus providing adjustment for synchronization. The vertical size control (R-58) varies the amplitude of the pulse to the grid of the amplifier and controls the amount of vertical deflection. The vertical linearity control ( $\mathrm{R}-60$ ) varies the cathode resistance, in the
tical output tube circuit thus adjusting the operating characteristics of the amplifier to provide the proper wave shape to obtain a linear picture vertically. The blanking network is designed to eliminate vertical retrace lines at high brightness levels.

## AFC DISCRIMINATOR:

The Automatic Frequency Control section utilizes a GALS (twin-diode) tube which functions as discriminator. The horizontal sync. pulses from the output of the sync separator are coupled to the AFC tube. At the same time a comparison sawtooth is applied from the horizontal sweep amplifier. Any phase shift between the horizontal cause one diode section to conduct mure than the other. This will result in a DC bias voltage applied to the grid of the multivibrator and change the operating frequency. The output of the AFC discriminator thus synchronizes the horizontal sync. pulse.

## HORIZONTAL MULTIVIBRATOR:

The Horizontal Multivibrator uses a 12 BH 7 (twintriode) tube and is of the conventional cathode coupled type. The core-tuned parallel resonan circuit (L-5 and C-42) is used as a hold adjustnent to stabilize the frequency of oscillation. Because of the wide pulron range of the autois not necessary. The oumput signal of the multi vibrator is coupled to the horizontal pulse amplifier. Capacitor C58 is a negative peaking device to aid in cutting off the pulse amplifier tube at the proper time.

## HORIZONTAL PULSE AMPLIFIER:

The Horizontal Pulse Amplifier utilizes a GAVS (beam pentode) tube to develop the necessary power for the fly back pulse and the horizontal winding of the deflection yoke.

## TROUBLE SHOOTING

## DAMP ER:

The 6 W 4 Damper tube (diode) performs three functions:

1. Aids in horizontal scanning
2. Suppresses oscillations which occur over part of the horizontal scanning cycle; and
3. Gives an increase in plate supply voltage for the vertical blocking oscillator, vertical out put amplifier and first anode of the pciture tube.

## HI-VOLTAGE SUPPLY:

The High Voltage (second anode voltage) is obained from the primary winding of the HV deflec tion transformer. When the plate current of the Hor. pulse amplifier tube is cur off, the field

## SERVICE HINTS

## V. H. F. TUNER:

Before looking into the tuner for a particular Before first make the following observations Since the receiver is of the inter-carrier type both the sound and video information are amp
lified simultaneously by the runer, IF and video amplifiers. Therefore, if the sound section is functioning normally it can be assumed that there are no defects in the tuner, IF or video amplifiers. If the receiver is "dead" (no sound The A. G. C. is a negative bias voltage propor or picture - raster normal) first determine whether tional to the average composite video signal apa signal is being transmitted and then check the plied to the $R F$ and first and second $1 F$ ampliNext, rotate the contrast or picture control com- vary according to the strength of the signal being pletely to the left (counter-clockwise) and ob- received. However, it will closely correspond to serve the face of the picture tube. Advance the the detector output voltage. As a fast and simple control to the extreme clockwise position and check to determine whether the A. G. C. voltag agàin observe the face of the picture tube. If is normal, measure both the A. G. C. and de no snow appears check the video amplifier, de- tector output voltage. Under normal operating tector and second and third IF amplifiers. If, conditions these two voltages will be approxihowever, an increase of "snow", appears check mately the same.
the first IF amplifier before looking into the
uner.

## VERTICAL DISTRIBUTION (LINEARITY)

hen working inside the tuner do not move any distributed capacity may result and offset the distributed capacity may result and offset the alignment. When replacing components be sure to obtain the same lead length and replace them in the same position.
fast and simple method to check the vertical distribution of a TV picture, without a test pat sern, rotate the vertical hold control until the picture is moving slowly downward. Observe the black horizontal bar. If the vertical size A majority of tuner troubles are often open and and linearity controls are properly adjusted, igh resistance ground or coil solder connections, the bar will not change in thickness as it move defective trimmers or coils and defective switch from top to bottom.
contacts.

Open or high resistance connections can easily be repaired by placing a hot soldering iron at

Defective switch contacts may cause an intermittent condition.

No Picture - No Sound
Raster Normal


## © John F. Rider



## ALIGNMENT PROCEDURE

Test－socket pins are numbered like tube－sockets，i．e．clockwise from the keyway at the lug side of the socket．

## I．Video I．F．Spot Frequency Alignment．

A．Connect 3 volts bias between pins 1 and 2 of the Test－Socket，with negative lead connected to pin 2.
B．Set tuner on a low band channel which does not have a strong local station．Shor Set tuner on a low band channel which does not have a strong local station．
the antenna input terminal．Set Picture control at maximum clockwise position．
C．Feed the output of an audio－modulated signal generator through a condenser to the cuner test point．
D．Connect the high side of an AC Voltmeter to the Test－Socket，pin no．4，and low side of the meter to pin no．I．If necessary，the kinescope lead may be removed．
F．Control output of the signal generator so that the reading on the $A C$ voltmeter goes no higher than 20 volts．
F．Use the proper alignment tool－－an intemal male screwdriver for the coil studs and proceed as follows

| Step <br> Number | Signal Generator Frequency | Adjust | Remarks |
| :---: | :---: | :---: | :---: |
| 1 | 25.7 MC | T3－Top | Adjust for maximum read－ ing of volt－ meter |
| 2 | 25.7 MC | T1－Top | Same |
| 3 | 23.6 MC | T2－Top | Same |
| 4 | 23．6 MC | Tuner Top Slug | Same |

II．Intercarrier Sound I．F．Alignment．
A．Remove the 6AL5 video detector from its socket．Set Picture control at maximum clockwise．
B．Connect the high side of the signal generator，through a condenser，to pin 7 of this tube socket．Connect the low side to the chassis．（NOTE：Pins are numbered from the lug side of the socket．）
C．Connect a $D C$ voltmeter or VTVM to the Test－socket，the negative lead to pin 1 and the positive lead to pin 6 ．
D．Set the signal generator to 4.5 MC ，unmodulated，and adjust output of generato so the DC meter reads no higher than 10 volts．
E．Use proper alignment tool：one internal male tool for stud；one external male tool for K－tran Ratio Detector．

Proceed as follows:

| Step <br> Number | Signal Generator <br> Frequency | Adjust |  |
| :---: | :---: | :---: | :--- |
| 5 | 4.5 MC | Remarks |  |
| 6 |  | T4-Top | Adjust for <br> maximum read- <br> ing of volt- <br> meter. |
| Same |  |  |  |

F. Now disconnect voltmeter from Test-Socket, and replace with a matched pair of resistors. (NOTE: These resistors should be around 270 K each, and should be connected in series between pins 6 and 1 of the test-socket.).
G. Connect the positive lead of the voltmeter to the mid-point of these resistors, and the negative lead to pin 7 of the test-socket.
H. Use-5-volt range of meter, and proceed as follows:

| Step <br> Number | Signal Generator <br> Frequency | Adjust | Remarks |
| :--- | :---: | :---: | :--- |
| 7 | 4.5 ME | Ts-Top | Adjust for zero <br> which occurs <br> between a maximum <br> negative and a <br> maximum positive <br> reading. |

III. Tuner Oscillator Alignment.
A. Set fine-tuning in mid-position of its range.
B. Align all twelve channels with either an "off the air" station or a monoscope modulated local transmitter.
C. Procedure: Tune oscillator screws un il $4.5 \mathrm{~m} . \mathrm{c}$. sound "wiggles" are just visible at all vertical edges.

CHART OF VOLTAGE MEASUREMENTS at tube pins relative to chassis

|  |  |  | PIN NUMBER |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{aligned} & \text { TUBE } \\ & \text { NO. } \end{aligned}$ | $\begin{array}{\|l\|} \hline \text { TUBE } \\ \text { TYPE } \end{array}$ | FUNCTION | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | 6AU6 | Ratio Detect. Driver | -. 5 | 0 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | 0 | 195 | 80 | . 5 |  |  |  |  |  |
| 2 | 6AL5 | Ratio Detect. | 18 | 18 | 0 | $\begin{aligned} & A C \\ & 6.3 \\ & \hline \end{aligned}$ | 48 | 0 | 0 |  |  |  |  |  |
| 3 | 6AV6 | Audio Amp. | -. 8 | 0 | $\begin{array}{\|l} \hline \mathrm{AC} \\ 6.3 \\ \hline \end{array}$ | 0 | 0 | 0 | 75 |  |  |  |  |  |
| 4 | 6K6 | Audio Out. | 0 | 0 | 210 | 225 | 0 | 240 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | 17 |  |  |  |  |
| 5 | 6AU6 | 1st I. F. | -2.8 | 0 | 0 | $\begin{aligned} & \mathrm{AC} \\ & 6.3 \\ & \hline \end{aligned}$ | 130 | 130 | . 25 |  |  |  |  |  |
| 6 | 6CB6 | 2nd I. F. | -2.8 | . 3 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | 0 | 135 | 135 | 0 |  |  |  |  |  |
| 7 | 6CB6 | 3rd I. F. | 0 | 2.3 | $\begin{aligned} & A C \\ & 6.3 \end{aligned}$ | 0 | 135 | 135 | 0 |  |  |  |  |  |
| 8 | 6AL 5 | Video Detect. - AGC | 0 | -3.3 | $\begin{array}{\|c\|} \hline A C \\ 6.3 \\ \hline \end{array}$ | 0 | 5 | 0 | -4.5 |  |  |  |  |  |
| 9 | 12BH7 | Video Amp. | 155 | -7.2 | 0 | $\begin{aligned} & A C \\ & 6.3 \\ & \hline \end{aligned}$ | $\begin{array}{\|l\|} \hline A C \\ 6.3 \\ \hline \end{array}$ | 120 | -4.5 | 5 | 0 |  |  |  |
| 10 | 21FP4 | Picture Tube | 160 | 110 |  |  |  | 540 |  |  |  | 540 | 160 | 160 |
| 11 | 12AU7 | Sync. Amp. | 86 | 18 | 16 | 0 | 0 | 18 | -2.5 | 12 | $\begin{array}{\|l\|} \hline A C \\ 6.3 \\ \hline \end{array}$ |  |  |  |
| 12 | 6C4 | Vert. Osc. | 155 | 155 | 0 | $\begin{aligned} & \mathrm{AC} \\ & 6.3 \end{aligned}$ | 155 | -82 | 0 |  |  |  |  |  |
| 13 | 6V6 | Vert. Out. | 36 | $\begin{array}{\|l\|} \hline A C \\ 6.3 \\ \hline \end{array}$ | 240 | 380 | 0 | 36 | 0 | 36 |  |  |  |  |
| 14 | 5U4 | Low Volt. Rect. | $\begin{aligned} & \mathrm{AC} \\ & 6.3 \\ & \hline \end{aligned}$ | 260 | 150 | - 20 | 0 | -20 | 150 | 260 |  |  |  |  |
| 15 | 6AL5 | Horiz. Phase Detect. | 0 | 0 | $\begin{aligned} & \mathrm{AC} \\ & 6.3 \end{aligned}$ | 0 | 12 | 0 | - 12 |  |  |  |  |  |
| 16 | 12BH7 | Horiz. Osc. | 110 | -4.2 | 10 | $\begin{aligned} & \hline A C \\ & 6.3 \\ & \hline \end{aligned}$ | $\begin{aligned} & \hline A C \\ & 6.3 \\ & \hline \end{aligned}$ | 210 | . 3 | 10 | 0 |  |  |  |
| 17 | 6AVs | Horiz. Out. | -28 | $\begin{array}{\|l\|} \hline A C \\ 6.3 \\ \hline \end{array}$ | 0 | 0 | * | 0 | 0 | 130 |  |  |  |  |
| 18 | 6W4 | Horiz. Damper | 240 | 0 | 540 | 230 | 200 | 0 | 150 | 150 |  |  |  |  |
| 19 | 183 | High Volt. Ret. | 140 | 000 | V | OL |  | D. | - C. |  |  |  |  |  |

* Do Not Measure

All voltages are with respect to chassis.
Measurements were made with receiver controls set for normal picture with 117 volts line volt-
age. Normal signal applied to antenna terminals. VTVM used for all readings.

## REPLACEMENT PARTS <br> RESISTORS

CHART OF RESISTANCE MEASUREMENTS
AT TUBE PINS RELATIVE TO
CHASSIS

|  |  |  | PIN NUMBER |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} \text { TUBE } \\ \text { NO. } \end{gathered}$ | TUBE TYPE | FUNCTION | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 1 | GAUG | Ratio Detect. Driver | 50K | 0 | . 1 | 0 | 30K | 30K | 100 |  |  |  |  |  |
| 2 | 6ALS | Ratio Detect. | 1.5M | 1.5 M | 0 | 0 | 30K | 0 | 0 |  |  |  |  |  |
| 3 | 6AV6 | Audio Ainp. | 7M | 0 | . 1 | 0 | 0 | 0 | 500K |  |  |  |  |  |
| 4 | 6K6 | Audio Out. | 0 | 0 | 30 K | 30K | 500 K | 30K | . 1 |  |  |  |  |  |
| 5 | 6aU6 | 1st I. F. | 1.1M | 0 | 0 | . 1 | 30K | 30K | 80 |  |  |  |  |  |
| 6 | 6CB6 | 2nd I. F. | 1.1M | 50 | . 1 | 0 | 30K | 30K | 0 |  |  |  |  |  |
| 7 | 6CB6 | 3 3rd I. F. | . 8 | 150 | .1 | 0 | 30K | 30K | 0 |  |  |  |  |  |
| 8 | 6ALS | Video Detect. - AGG Detect. | . 2 | 200K | . 1 | 0 | 2 K | 0 | 5K |  |  |  |  |  |
| 9 | 12BH7 | Video Amp. | 40K | 1 M | 0 | . 5 | . 5 | 30K | 5K | 0-2K | 0 |  |  |  |
| 10 | 21FP4 | Picture Tube | 400 K | 30K |  |  |  | Inf. |  |  |  | Inf. | 400K | 400K |
| 11 | 12AU7 | Sync. Amp. | 40K | 1.5M | 3 K | 0 | 0 | 1.5M | 55K | 200K | . 1 |  |  |  |
| 12 | 6C4 | Vert. Osc. | Inf. | $\begin{aligned} & .5- \\ & 3 M \end{aligned}$ | 0 | . 1 | $\begin{aligned} & .5- \\ & 3 M \end{aligned}$ | 1.5M | 0 |  |  |  |  |  |
| 13 | 6V6 | Vert. Out. | $\begin{array}{r} 200 \\ -5 \mathrm{~K} \\ \hline \end{array}$ | . 1 | 30K | 500M | 7M | 12K | 0 | $\begin{array}{\|l\|} \hline-2 \mathrm{~K} \\ \hline-5 \mathrm{~K} \\ \hline \end{array}$ |  |  |  |  |
| 14 | SU4 | Low Volt. Rect. | . 1 | 30K | . 5 M | 20 | Inf. | 20 | . 5 M | 30K |  |  |  |  |
| 15 | 6ALS | Horiz. Phase Detect. | 400 | 400 | . 1 | 0 | 3M | 0 | 3M |  |  |  |  |  |
| 16 | 12BH7 | Horiz. Osc. | . 2 M | . 2 M | 2 K | . 1 | . 1 | 35K | 3.5M | 2K | 0 |  |  |  |
| 17 | 6av5 | Horiz. Out. | . 5 M | . 1 | 0 | Inf. | . 5 M | Inf. | 0 | 40 K |  |  |  |  |
| 18 | 6W4 | Horiz. Damper | 30K | Inf. | . 5 M | 30K | 30K | Inf. | . 5 M | .5M |  |  |  |  |
| 19 | 1B3 | High Volt. Rect. | Inf. | Inf. | Inf. | Inf. | Inf. | Inf. | Inf. | Inf. |  |  |  |  |

Resistance values are in ohms.

$$
\begin{aligned}
\mathrm{K} & =1 \text { Thousand } \\
\mathrm{M} & =1 \text { Million } \\
\text { Inf. } & =\text { Infinity }
\end{aligned}
$$

| SYMBO NO. | $\begin{aligned} & \text { PART } \\ & \text { NO. } \end{aligned}$ | DESCRIP | IPTION |
| :---: | :---: | :---: | :---: |
| R-1 | 201472-32 | 4.7 K Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-2 | 20T820-32 | 82 Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-3 | 20T101-32 | 100 Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-4 | 20T331-32 | 330 Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-S | 20T103-32 | 10 K Ohms | $\pm 10 \% 1 / 2 \mathrm{w}$, Carbon |
| R-6 | 20T470-32 | 47 Ohms | $\pm 10 \% 1 / 2 W$, Carbon |
| R-7 | 20T101-32 | 100 Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-8 | $20 \mathrm{~T} 331-32$ | 330 Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-9 | 20T101-32 | 100 Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-10 | 20T223-32 | 22 K Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-11 | 201824-32 | 820 K Ohms | $\pm 10 \% 1 / 2$, Carbon |
| R-12 | 20T151-32 | 150 Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-13 | 20T101-32 | 100 Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-14 | 20T333-32 | 33 K Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-15 | 20T101-32 | 100 Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-16 | 20T224-32 | 220 K Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-17 | 20T101-32 | 100 Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-18 | 201472-32 | 4.7 KOhms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-19 | 50 T 10 | K | 1/2W, Carbon, |
| R-20 | 50 T 10 | Meg . Vol | lume, On-Off |
| R-21 | 20T332-42 | 3.3 KOhms | $\pm 10 \% 1 \mathrm{~W}$, Carbon |
| R-22 | 20T822-32 | 8.2 K Ohms | $\pm 10 \% ~ 1 / 2 w, ~ C a r b o n$ |
| R-23 | 20T105-32 | Meg. | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-24 | 20T822-32 | 8.2 KOhms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-25 | 20T182-42 | 1.8 K Ohms | $\pm 10 \% 1 w$, Carbon |
| R-26 | 20T104-42 | 100 KOhms | $\pm 10 \%$ 1w, Carbon |
| R-27 | 20T332-32 | 3.3 KOhms | $\pm 10 \%$ 1/2w, Carbon |
| R-28 | 20T332-52 | 3.3 K Ohms | $\pm 10 \%$ 2W, Carbon |
| R-29 | 20T152-42 | 1.5 K Ohms | $\pm 10 \% 1 \mathrm{w}, \mathrm{Carbon}$ |
| R-30 | 20T334-32 | 330 KOhms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-31 | 50 T 16 | 25 KOhms | $1 / 2 \mathrm{~W}$, Carbon Pot., Brightness Control |
| R-32 | 20T392-32 | 3.9 K Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-33 | 20T822-32 | 8.2 K Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-34 | 20T473-32 | 47 K Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-35 | 20T101-32 | 100 Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-36 | 20T473-32 | 47 K Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-37 | 201473-42 | 47 KOhms | $\pm 10 \% 1 \mathrm{~W}$, Carbon |
| R-38 | 20T102-32 | K Ohms | $\pm 10 \%$ 1/2w, Carbon |
| R-39 | 20T153-32 | 15 KOhms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-40 | 20T333-32 | 33 KOhms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-41 | 201685-32 | 6.8 Meg | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-42 | 20T474-32 | 470 K Ohms | $\pm 10 \%$ 1/2W, Carbon |
| R-43 | 201474-32 | 470 KOhms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-44 | 20T561-42 | 560 Ohms | $\pm 10 \%$ 1W, Carbon |
| R-45 | 20T471-42 | 47 Ohms | $\pm 10 \%$ 1w, Carbon |
| R-46 | 20 T 10 | 2750 Ohms | $\pm 10 \% 10 \mathrm{~W}$, Wirewound |
| R-47 | 20T155-32 | 1.5 Meg | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-48 | 20T224-32 | 220 K Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-49 | 20T563-32 | 56 K Ohms | $\pm 10 \% 1 / 2 \mathrm{~W}$, Carbon |
| R-50 | 20T272-32 | 2.7 K Ohms | $\pm 10 \% 1 / 2 w$, Carbon |
| R-S1 | 20T392-32 | 3.9 K Ohms | $\pm 10 \%$ 1/2W, Carbon |

## RESISTORS (Continued)



- All paper capacitors tolerance $\pm 20 \%$.


## CAPACITORS (Continued)

| $\begin{aligned} & \text { SYMBOL } \\ & \text { NO. } \end{aligned}$ | $\begin{aligned} & \text { PART } \\ & \text { NO. } \end{aligned}$ | DESCRIPTION |  |  |
| :---: | :---: | :---: | :---: | :---: |
| C-7 | 33 Tl 5 | 0.25 mf | 200 V , | Paper |
| C-8 | 35 T 16 | 5000 mm | $\mathrm{f}, 500 \mathrm{v}$ | $-0 \%+100 \%$, Ceramic Disk |
| C-IU | 35T27. | 2 $\times 5000 \mathrm{mmf}$ | 500 V | $-0 \%+100 \%, \underset{\substack{\text { Ceramic } \\ \text { Disk }}}{\substack{\text { is }}}$ |
| C-11 | 35 T 35 | 3.3 mmf |  | $+10 \%$, Tubular Ceramic. |
| C-12 | 35 T 32 | 470 mmf | 500 V | +10\%, Mica |
| C-13 | 35T15 | 100 mmf | 500 V | $\pm 10 \%$, Tubular Ceramic. |
| C-14 |  |  |  |  |
| C-15 | 35 T 27 | 2X5000 mmf | $500 \mathrm{~V}$ | $-0 \%+100 \%$, Ceramic Disk |
| C-16 | 35 T 23 | 10 mmf | $500 \mathrm{~V}$ | $\pm 10 \%$ Ceramic Tubu- <br> lar. |
| C-17 | 35T24 | 120 mmf | $500 \mathrm{~V}$ | $\pm 10 \%$, Ceramic Tubular. |
| C-18 | 33 T 6 | 0.05 mf | 600 V | Paper Tubular |
| C-19 | $35 T 4$ | mmf | $500 \mathrm{v}$ | $\pm 10 \%$, Ceramic Tubular. |
| C-20 | 35T14 | 39 mmf | $500 \mathrm{~V}$ | $\pm 10 \%$, Ceramic Tubular. |
| C-21 |  |  |  |  |
| C-22 | 35727 | 2X5000 mmf | $500 \mathrm{~V}$ | $-0 \%+100 \%$, C eramic Disk |
| C-23 |  |  |  |  |
| C-24 | 35T30 | 1500 mmf | $500 \mathrm{~V}$ | $-0 \%+100 \%$, Ceramic Disk |
| C-25 | 33 T 19 | 0.005 mf | 200 V , | Paper Tubular |
| C-26 | 33 T 12 | 0.02 mf | 600 V , | Paper Tubular |
| C-27 | 33 T20 | 0.005 mf | 600 V , | Paper Tubular |
| C-28 | 33 T23 | 0.05 mf | 200 V , | Paper Tubular |
| C-29 | 33 T 27 | 0.2 mf | 600 V , | Paper Tubular |
| C-30 | 35725 | 220 mf | $500 \mathrm{~V} \pm$ | $\pm 10 \%$, Ceramic Tubular. |
| C-31 | 33 T 26 | 0.002 mf | 200 V , | Paper Tubular |
| C-32 | 35 T 21 | 4700 mmf | $500 \mathrm{~V} \pm$ | $\pm 10 \%$, Mica |
| C-33 | $33 \mathrm{T6}$ | 0.05 mf | 600 V , | Paper Tubular |
| C-34 | 33 T 7 | 0.1 mf | 600 v , | Paper Tubular |
| C-35 | 33 T 27 | 0.2 mf | 600 V , | Paper Tubular |
| C-36 | 33 T 27 | 0.2 mf | 600 v , | Paper Tubular |
| C-37 | 33 T 18 | 0.001 mf | 600 V , | Paper Tubular |
| C-38 | 33 T 18 | 0.001 mf | 600 V , | Paper Tubular |
| C-39 | 33 T 11 | 0.01 mf | 200 V , | Paper Tubular |
| C-40 | 33 T 19 | 0.005 mf | 200 V , | Paper Tubular |
| C-41 | 33 T 23 | 0.05 mf | 200 V , | Paper Tubular |
| C-42 | 35 T 20 | $3900{ }^{\circ} \mathrm{mmf}$ | $500 \mathrm{~V} \pm$ | $\pm 5 \%$, Silver Mica |
| C-43 | 35 T 19 | 330 mmf | $500 \mathrm{~V} \pm$ | $\pm 10 \%$, Mica |
| C-44 | 35 T 3 | 470 mmf | $500 \mathrm{~V} \pm$ | $\pm 10 \%$, Mica |
| C-45 | 36T2 | $25-280 \mathrm{mmf}$ | Trimme | er, Drive Control |
| C-46 | 33 T 6 | 0.05 mf | 600 V , | Paper Tubular |
| C-47 | 33 T 20 | 0.005 mf | 600 V , | Paper Tubular |
| C-48 | 33 T 6 | 0.05 mf | 600 V , | Paper Tubular |
| C-49 | 33 T29 | 0.01 mf | 600 V , | Paper Tubular |
| C-50 | 33 T 7 | 0.1 mf | 600 V , | Paper Tubular |
| C-51 | 33 T 27 | 0.2 mf | 600 V , | Paper Tubular |


|  | INDUCTANCES (Continued) |  | MISCELLANEOUS (Continued) |
| :---: | :---: | :---: | :---: |
| SYMBOL NO. | PART NO. DESCRIP TION | PART NO. | DESCRIP TION |
| L-15 | Peaking Coil Yellow, 0.120 mh On 8.2 K Ohms 1/2W Res. | 15 T 2 37 T 1 | Min. Tube Base Clip <br> Couplate (Verticle Integrator) |
| L-16 | Peaking Coil Green, 0.120 mh . | 42 T 15 | "K" Tran Clip |
|  |  | 42 T 17 | H. V. Condensor Standoff |
|  |  | 42 T 22 | Antenna Binding Post Assembly |
|  |  | 42 T 24 | 3 Amp. 125 Volt Fuse |
|  |  | 42 T 28 | Fuse, 3 AG 1/4 amp. |
|  |  | 44 Tl | Line Cord |
|  | MISCELLANEOUS | 44 T 2 | Line Cord |
|  |  | 56 T 1 | 12 Channel Tuner |
| PART NO. | . DESCRIPTION | 63 T 11 | Ion Trap (30 Gauss) |
| 10 T 7 | Bracket for Horizontal Oscillator Coil | 63 T 24 | Centering Device |
| 10T8 | Shaft Support for R. F. Unit | 10 T 14 | Tube Strap |
| 10 T 23 | H. V. Mounting Bracket | 10T17 | Tube Support |
| 10 T 24 | H. V. Cage | 10 T 56 | Right Stop |
| 10 T 26 | Coil Sup. Bracket | 10 T 57 | Left Stop |
| 10 T 32 | Yoke Mounting Brace | 11 T 29 | Tube Cup |
| 10 T 54 | Cable Clamp | 11 T32 | Speaker Plug |
| 11 T 3 | Line Cord Socket | 11 T52 | Speaker Shell |
| 11 T 4 | 9 Pin Min. Wafer $11 / 8$ | ${ }^{12 \mathrm{~T} 1}$ | Indoor Antenna |
| 11 T | 7/8' Min. Socket, 7 Pin Wafer | 55 T 3 | 5"' Speaker Assembly (2D2302) |
| 11 T 12 | Octal Wafer Socket | 5514 | $6^{\prime \prime}$ Speaker Assembly (2D1303) |
| 11 T 28 | 9 Pin Molded $11 / 8$ Socket | 100T2 | Carton (2D1303) |
| 11 T 30 | 11. V. Condensor Plate | 100 T 3 | Carton (2D2302) |
| 11 T 33 | Speaker Receptacle | ${ }^{120} \mathrm{~T}_{9}$ | Cabinet (2D2302) |
| 11 T 40 | Octal Wafer $15 / 16$ Socket | 120T18 | Cabinet (2D1303) |
| 11 T41 | Octal Molded $11 / 2$ | 122 T 10 | Channel Selector Knob |
| 11 T46 | Fuse Holder | $122 \mathrm{Tl1}$ | Fine Tuning Knob |
| 11147 | Octal Molded Plug | 122 T 12 | On-Off Volume Knob |
| 11T50 | H. V. Cap and Lead | 122 T 13 | Contrast Knob |
| 11 T59 | Kin Socket $w /$ leads | 123 T3 | Mask |
| 11 T60 | H. V. Socket Insulator | 125 Tl | Back |
| 11 T 61 | One Prong Plug | $126 \mathrm{Tl1}$ | Front Control Plate |
| 15T1 | Min. Tube Shield | 130 T 10 | Glass, Safety |

MISCELLANEOUS (Continued) YMBOL
NO. -15 63T13 Peaking Coil Yellow, 0.120 mh On 8.2 K 15 T2 Min. Tube Base Clip 37T1 Couplate (Verticle Integrator) 42 T 17 H. V. Condensor Standoff 42 T 22 Antenaa Binding Post Assembly 42T24 3 Amp. 125 Volt Fuse 42T28 Fuse, 3 AG 1/4 amp. 44 T 2 Line Cord
56 TI 12 Channel Tuner
63 Tll lon Trap ( 30 Gauss)
10T14 Tube Strap $\begin{array}{llll}\text { Shaft Support for R. F. Unit } & 10 \mathrm{~T} 14 & \text { Tube Strap } \\ \text { H. } & \\ 10 \mathrm{~T} 17 & \text { Tube Support }\end{array}$ H. V. Coil Sup. Bra
Yoke Mounting Brace Cable Clanp 9 Pin Min. Wafer $11 / 8$ 7/8', Min. Socket, 7 Pin Wafer Octal Wafer Socket 11. v. Condensor Plate Speaker Receptacle Octal Wafer $15 / 16$ Socket Fuse Holder Octal Molded Plug Kin Socket w/leads H. V. Socket Insulator One Prong Plug Min. Tube Shield

Right Stop
Left Stop
Speaker Plug
Speaker Shell
5" Speaker Assembly (2D2302)
$6^{\prime \prime}$ Speaker Assembly (2D1303)
Carton (2D2302)
Cabinet (2D2302)
Cabinet (2D1303)
Channel Selector Knob
Fine Tuning Knob
Contrast Knob
Back

Glass, Safety


Figure 6.
Tube Layout.


John F. Rider

MODEL IDENTIFICATION CHART

| MODEL | CHASSIS | CABINET | TYPE |
| :---: | :---: | :--- | :--- |
| 2D-1316A | $21 T 2 A$ | Console | Mahogany |
| 2D-2313A | $17 T 2 A$ | Mantel | Leatherette |
| 2D-2315A | $21 T 2 A$ | Mantel | Leatherette |

This booklet has been prepared to enable you to tune in better television This booklet has been prepared to enable you to tune in better television
pictures more easily and to acquaint you with some facts about television of inpictures more easily and to acquaint you with some facts about television of inmore than amply repaid.

The functions of the controls and the operating procedure are presented first for ready reference. Information concerning installation and other general
facts are placed at the rear of the booklet; however, they should be read carefully before the set is operated.
CONTROLS
(a)
Figure 1. Front Controls.
Figure 2. Reor Controls.

## FUNCTIONS OF THE CONTIROLS

All the controls normally used in tuning in a program -both picture and sound-are located on the front of the receiver and at the top of the back of the cabinet. At the rear of the set are several controls which are preset at the factory and may need slight readjustment at the time of installation. After installation, they should the time of installation. After installation, they should or aging of tubes, variations in power-line voltage, o other external conditions.

The models covered in this manual are an 18 cube, including the picture tube, 20 tubes with the UHF Tuner incorporated, AC operated, direct view, 17 and 21 -inch rectangular television receivers. The receivers are complece in one unic and feature full overage of all 12 V.H.F. channels and complete coverage of the entire UHF band with the UHF Tuner, automatic gain control, automatic horizontal frequency control, inter-carrier sound system,
electrostatic focusing, magnetically deffected picture cube and sync stabilizer switch and control to adjust the operational charac ceristics of the receiver for various signal areas

At the rear of the receivers is a safety intenlock to preven dangerous electrical shock and as an added safety measure, tect the receiver in case of overloading.

## WARNING

At all times during operation the top chassis plate is at 125 volts DC potential above ground and it also may be at the line-voltage potential depending on how the line cord plug is inserted in the power receptacle.

Extreme caution must be observed when working with the chassis outside the cabinet and when power is applied to the receiver with the cabinet back removed. SEVERE SHOCK may result from contact with chassis.

Use an isolation transformer between the line cord plug and power receptacle when service is required. This removes all shock haz ards and is the ONLY safeguard. Damage to the receiver and test equipment may result without the use of an isolation transformer.

The receiver actually requires only three controls when tuning in a program; on-off volume, tuning and picture. The on-off volume and tuning controls are located in the center (dual knob) while the picture control is a finger-tip knob to the left.
The other front controls, brightness and the selector switch, need only be adjusted when required. The front controls are shown below.

The controls at the rear of the receiver should be properly adjusted at the time of installation and should only require readjustment occasionally. The V. Linearity, Ion Trap and Centering control adjustments should not be attempted by the operator as they should be made only by a serviceman.

## FRONT CONTROLS

On-Off Volume - Turns the receiver on or off and adjusts the sound volume level.
Tuning-Tunes the receiver to the desired channel or station. This knob may be turned in either direction. Picture - Varies the contrast between the light and dark portions of the television picture.
Bightness - Varies the brightness of the television picture.
Selector Switch-Selects either the VHF or UHF tele vision band for operation.

REAR CONTROLS
VHF Antenna Knob-Tunes the built-in VHF antenna for maximum signal.
V. Size-Changes size of picture vertically.
V. Hold - Stops picture from moving up or down Syne Stabilizer Adiust Control-Changes the opera yional characteristics of the receiver for the area in hich the receiver is located
Fringe-Suburban-Local Switch - Selects the proper Fringe-Suburban-Local Swat the receiver for various signal strength areas.
H. Hold-Provides adjustment for a steady picture, no horizontal movement.
H. Size-Changes size of picture horizontally.
V. Linearity-Changes vertical distribution of picture. Ion Trap-Controls illumination and focus of picture. Centering-Centers picture for proper framing.

## OPERATION

When once you have become familiar with the use of the controls, tuning in a television program- picture and sound - is a simple matter. Carefully follow the procedure detailed below; you'll find the set as easy to operate as your present radio.
Note that the dial at the right is calibrated in VHF channel numbers and the dial at the left in UHF channel numbers. Each station in the country is assigned
a definite channel number which represents operating frequencies.
Before attempting to tune in a station, check with your newspaper to see if the station is on the air, and note the channel number. If you experience any difficulty with the operation of the set, try a different sta tion or turn off the set and tune in again at a later time the fault may have been in the transmission.

## TUNING PHOCEDURE

1. Turn the ON-OFF VOLUME control clockwise to turn the set on. Allow one-half minute for the set to warm up. 2. Place the SELECTOR SWITCH in the proper position for the desired television range.
2. Turn the Picture control fully clockwise.
3. Rotate the TUNING knob until the indicator points to the desired channel number.
4. Turn the TUNING knob back and forth until the best picture is obtained with adequate sound.
5. Turn the PICTURE control fully counter-clockwise.
6. Turn the BRIGHTNESS control fully counter-clock wise, and then turn it slowly clockwise until the picture tube just becomes light.
7. Adjust the PICTURE control until the proper contrast between black and white is obtained. Readjust the BRIGHTNESS control if necessary.
8. Adjust the VOLUME control for the desired sound level.
9. When tuning from one station to another, it may be necessary to readjust the PICTURE control.

## CONTROL ADJUSTMENT HINTS

VHF ANTENNA KNOB—The antenna tuning knob for the built-in VHF antenna should be used as a fine tuning control and should be adjusted until the best picture is obtained. In order to eliminate "Body Effect" when adjusting the antenna, stand in front and reach over the top of the set. Do not at any time force the knob in either direction if it becomes difficult to turn.


Figure 3 A
17-inch Tube Assembly

TUNING-The tuning knob should be used as a tuning knob on an ordinary home radio. Rotate the knob so the indicator points to the desired chanel number. Turn the knob back and forth until the best picture is obtained with adequate sound, and then adjust the picture control for proper picture contrast.


Figure 38. 21-inch Tube Assembly

## ADJUSTMENT OF PICTURE

The following pictures illustrate the results of misadjustment of various controls on the receiver and also the effects on the picture of certain conditions external to



TOO BRIGHT-Adijust brightness and
picture controls for proper controst.


the set. Underneath each picture is the correction to be made, if one is available. Some of these adjustments should be made only by a serviceman.


OFF CENTER HORIZONTALYServiceman should adauls
CENTERING Control.



VERTICAL MOVEMENT UP OR DOWN
-AdiUSt Y. HILO Control.


HORRZONTAL MOVEMENT:EEFT
OR RIGHT-AdiUSH. HOLO Control


DIATHERMY INTERFERENCE-DUE +o
Ceftroin


## INSTALIATION

## POWEIR SOUIBCE

The set should be operated from a 115 -volt, 60 cycle, AC power source. The power consumption is 230 watts.

## LADCATION OF IRECEIVEIR

The set should be so located in the room that no direct light strikes the face of the picture tube. (The surface on which the picture appears is the end of a

## BUULTT-IN VIE TE

## The new Built-in VHF Television Antenna incorporated

 in your receiver eliminates the need of an outside VHF antenna in most locations. In areas too distant for normal reception with a built-in antenna, provision is made for outside antenna connections. If any other type of antenna is used with the set disconnect the transmission line from the builtin antenna to the aterna When connetions are made, When connections are made, check to see that the an tenna terminal screws are moderately tight.The antenna is mounted inside the cabinet and is operated by the use of a knob at the top of the back of the
large, horizontally mounted tube.) However, some in direct illumination in the room is desirable; it is not necessary to darken the room completely for proper viewing of the picture. Due consideration should be given also to the convenience of the electric outlet, and to the position of the receiver which gives the best reception with the built-in antenna.

EVISION ANTENNA
cabinet. Since the antenna is fastened to the cabinet, it may be necessary to orient the cabinet to obtain the best reception. It is desirable that either the front or the back of the cabinet face the transmitting station. If however, "ghosts" or multiple images appear, the cabinet may be rotated slightly to minimize this condition. In some cases it may be necessary to face the back or the front of the cabinet toward a window to obtain a television picture. This may be due to walls, water pipes, or a steel structure in your location preventing television reception.

OJohn F. Rider

## SERVICE DATA

## SPECIFICATIONS

## SERVICE ADJUSTMENTS

Vertical Size and Vertical Linearity Controls (R-73 and R-75):Horizantal Size Control (Figure 2):
The vertical size and linearity controls should both be adjusted The horizontal size control should be adjusted until the picture at the same time while a test pattern is being transmitted. Thefills the entire screen horizontally. A clockwise rotation will inearity control affects the upper portion of the picture while thedecrease size. To some extent the vertical size control setting size control affects the overall size especially the lower portionmay be affected by a major horizontal size adjustment.
of the picture. Adjust both controls simultaneously until the test
pattern is symmetrical and fills the entire scteen vettically. Horizontal Hold Control (L-30):
Readjust the vertical hold control if necessary.
The horizontal hold control is located on the rear flange of the
CAUTION:
hassis and should be adjusted in the following mannet.
Set the picture control to its normal operating position. Turm解 the thumb screw clockwise until it reaches its stop. Turn tw fore, severe shock may result from contact. If an isolation trans-complete turns counter-clockwise. The thumb screw is a vernie former is unavailable, use an insulated screwdriver for the adjustment and will then be in the cencer of its range.

Turn the iron core with a small screwdriver or adjusting too nil the picture is steady (no horizontal movement). Set the cor to the middle of its range.
Fringo-Suburban-Locol Switch (Figure 2): After the iron core has been properly adjusted the thumb screw

The three position switch selects the proper operational characte istics of the receiver for the signal strength area in which located The position of the switch is governed by the signal strength a vailable.

## Centering Magnet (Figure 3 )

In the Fringe position the A.G.C. voltage is reduced to a bar lipping level to reduce noise affects.
until the picture is properly framed keeping in mind that the effect
In the Suburban position full A.G.C is applied ane sicture tube, the picaut h the Suburban position full A.G.C. is applied and ill be moved up or down. To the left or right of the neck of the

In the Local position full A.G.C. is applied and the sync stabilizer adjust control is disabled.

## Deflection Yoke (Figure 3)

The correct position for the defection yoke is as far forwar
Sync Stabilizer Adjus, Control (R-61): on the neck of the picture tube as the shape of the tube will allow.
The sontro! varies the operational characteristics of the sync Tube shadow or a tilted raster may result from an incorfectly clipper stage to obtain the optimum operation point for the least positioned yoke. If a positioning adjustment is necessary, loose effect of noise interrupting synchronization. The control should the yoke wing nut located at the top of the picture tube assembly be adjusted for a steady picture. (fig 2).

Horizontal Linearity Magnet - 17' only (Fig. 3A):

## On Trap Magnet (Figure 3)

The position of the ion trap magnet MUST be over the grid the picture tube (second cylinder from the base identified by tight side of the picture only. The magnet the picture tube. a flared forward lip). If the adjustment is necessary, loosen the nation is found. Adjust the screw for maximum illumination. Re-
adjust centering until an edge of the raster is visible. Loos focus position is found. Tighten wing nut. Adjustment should the positioning screws and slide the magnet backward or forward be made with brightness and picture controls set for normal until the edge of the raster is vertically straight. If keystoning is viewing.

Sensitivity at the Antenno
Video- 150 mi crovolts
Audio - 150 microvolts
(one volt above noise at detector)
enna Impedance Requirements
Balanced 300 -ohm
Audio Power Output Rating
2 watts undistorted
Speaker
Permanent magnet type
3.2 chm voice coil impedance

Power Supply Rating
115 volts 60 Cycles, AC
Power Consumption, 220 watts
Intermediate Frequencies
Video - 26.75 mc .
Audio - 22.25 mc
Intercarrier Sound 4.5 mc
Dimensions
$17^{\prime \prime}$ Chassis $-16^{\prime \prime} \times 16^{\prime} 1_{2}^{\prime \prime} \times 2 \frac{12^{\prime \prime}}{\prime \prime}$
$21^{\prime \prime}$ Chassis $-19^{\prime \prime} \times 17^{\prime \prime} 2^{\prime \prime} \times 2!^{\prime \prime}$

## TUBE COMPLEMENT

| Schematic | RTMA |  |
| :---: | :---: | :---: |
| Rof. No. | Type | Tube Function |
| 1 | $6 \mathrm{BK7}$ | VHF, RF Amplifier |
| 2 | 12 AT 7 | VHF Oscillator-Converter |
| 3-4-5 | 6CB6 | IF Amplifiers |
| 6 | 6.atig | Video Amplifier |
| 7 | $17 \mathrm{HP4}$ | Cathode-Ray Tube |
| 7 | 215 P 4 A | Cathode-Ray Tube |
| 8 | 6 GU6 | Audio IF Amplifier |
| 9 | gals | Audio Detector |
| 10 | GAV6 | Audio Amplifier |
| 11 | 25l.gGT | Audio Output |
| 12 | 6BE6 | Sync Clipper |
| 13 | 128H7 | Vert. Blocking Osc. and Output. |
| 14 | 6als | A.F.C. Discriminator |
| 15 | 6SN7GT | Horizontal Multivibrator |
| 16 | 25bQ6GT | Horizontal Pulse Amplifier |
| 17 | $6 \mathrm{AX4GT}$ | Damper |
| 18 | $1 \times 24$ | High Voltage Rectifier |
| 19 | 6AF4 | UHF Oscillator |
| 20 | 6 BK 7 | UHF Pre-IF Amplifier |

icture Tube Handing
Due to the large surface and extreme high vacuum of the picture WARNIN
be, care should be used when handling the chassis outside the $1 \%$ not remove any tubes while the receiver is in operatio abinet. Do not subject the tube to excessive pressure of rough ${ }_{\text {as }}$ over-loading and component failures may result. Also contac andling and injury

High Voltage Power Supply:
the process of inspection, repairs, changing of cubes or affors, or for any ocher reason where it is necessary to transfors, or for a be closely observed.

1. Terminals on the $1 \times 24$ socket must be dressed toward the inside of the corona ring and be free of sharp protrusions.

The corona ring must be dressed in such a way as to make its presence useful; that is, properly centered and about $1 / 8$ inch below the socket terminals.
All leads must be dressed as far away as possible from the transformer winding. Excess lead length should be transferred o the top side of the chassis.

When replacement of the II.V. deflection transformer is neces sary, be sure to closely follow the precautions listed above. The ansformer can easily be replaced with the chassis in the cabine by the following procedure
Remove two (2) hex head screws on either side of the II. Size conerol.
Disengage the H.V. lead holder ring. (back side of shield can)
. Remove $25 \mathrm{H} Q 6$ plate cap
4. Remove shield can by pushing back side of shield can toward front and lifting up.

## warning:

High voltage on the plate caps of the 1X2A high voltage rectifie and the 25BQ6 horizontal pulse amplifier. DO NOT'MEASURE this voltage.

## Schematic Diagram:

The schematic diagram located at the rear of this manual all the values of resistance and capacitance and gives the proper voltages at the pins of the sube sockets. The voltas readings were taken with a $20,000 \mathrm{ohm} / \mathrm{vole}$ voltmeter with norma operation, no signal inpur, and line voltage at 115 volts A.C

## Replacing Tubes

Refore replacing the tubes the cabinet back must first be moved. Removing the cabinet back disengages the safety interlo and removes the power to the receiver. Do not camper with attempt to defeat

Beroe rima the High volaze whes frsi sure power is turned off and then short the corona ting of the $1 \times 2$ to the chassis.

## SERVICE DATA

TELEVISION FREQUENCY RANGES

| Channel | Channel Frequencies | Picture Carrier Frequency | Sound Carrier Frequency | Receiver RF Oscillator Frequency |
| :---: | :---: | :---: | :---: | :---: |
| Low Band |  |  |  |  |
|  |  |  |  |  |
| 3 _ $60-66$ |  |  |  |  |
|  |  |  |  |  |
| 5 [ ${ }^{76-82 \ldots \quad \text { _ }} 77.25$ _ 81.75 _ 104 |  |  |  |  |
| $\mathrm{High}_{6}^{6}$ Band |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| 10 - $192198 \ldots 193.25-197.75-220$ |  |  |  |  |
| 11 - 198-204_ 199.25 _ 203.75 - 226 |  |  |  |  |
|  |  |  |  |  |
|  | -210-216 | 211.25 | 215.75 | - $\quad 238$ |

R.M.A. WIRE COLOR CODE

Listed below is a R.M.A. wire color code chart to oid
in eireuit tracing

| Wire Color | Where used |
| :--- | :--- |
| Black | B- or Ground leads |
| Brown | Filament leads |
| Red | B+leads |
| Orange | Screen leads |
| Yellow | Cathode leads |
| Green | Grid or Control leads |
| Blue | Plate leads |
| Violet | Not used |
| Gray | A.C. leads |
| White | Bias leads |

## COIL DC RESISTANCE CHART

The DC resistance readings shown in the chart below have been taken with a ohmmeter directly across the coil heing measured. The coils not listed in the chart have a DC resistance reading of less than one ohm. A tolerance of $\pm 5 \%$ is per missible.

| COILS | RESISTANCE IN OHMS | COILS RESISTANCE IN OHMS |  |
| :---: | :---: | :---: | :---: |
| L17 | 1.5 | T3 pri. | 4.7 |
| 120 | 1.5 | T4 pri. | 170 |
| L22 | 2.2 | TS pri. | 960 |
| L23 | 2 | sec. | 160 |
| L24 | 2 | T6 pri. | 1100 |
| L25 | 2 | sec. | 6.6 |
| L27 | 8 | T7A | 68 |
| L28 | 8 | B | 12.5 |
| L29 | 1.5 | T8 25 RQQ6 plate to 1X2A plate | 180 |
| L30 | 80 | 25 BQ 6 plate to term 4 | 9.5 |
| L31 | 2.3 | 25BQ6 plate to term 3 | 17.5 |
| L32 | 72 | 25 BQ6 plate to term 1 | 25.5 |
| L33 | 8.5 | term 7 to term 8 | 2.6 |
| L34 | 2.3 | term 7 to term 10 | 5.4 |
| T3 pri. | 4.7 | T9 pri. | 7 |

## WARNING

Before the chassis can be removed from the cabinet the escutcheon, on-off-volume and tuning knobs mus be removed. Pull knobs straight out and remove the two outside escutcheon screws and escutcheon.

## REMOVABLE SAFETY GLASS

To clean the inside of the safery glass or the face of the 2. Remove the safery glass holdes picture tube, simply follow the procedure below.

1. Remove the three (3) phillips head screws in the satety glass holder directly above the escutcheon.
2. Carefully remove the safety glass bypulling out and down from the bottom.


## DIAL CORD REPLACEMENT

DIAL CORD STRINGING: Two sepatate dial cords ar
used and can be restrung separately if replacement it
necessary neces sary.
POINTER PULLEY STRINGING: Follow the above diagram (tront view) and start by attaching the dial cord to
the tension spring, route to pointer pulley and make $21 / 2$ clockwise turns around pulley. Route under tuning shat to small pulley of driven pulley assembly, make $21 / 2$ clock
wise turns around pulley and connect to other end of ten sion spring. Tension spring must be in location shown when
tuning shaft is rotated to extreme clock wise position.

MECHANICAL TRACKING: If for any reason the stop washers do not correspond to the stop position of the tuner, loosen the two (2) drive pulley allen head set screws and
reposition. Turn both the tuning shaft and tuner shaft to the extreme counter clock wise position. Turn uning shaft only
$1 / 6$ turn clock wise. Tighten allen head set screws. $1 / 6$ turn clock wise. Tighten allen head set screws.
POINTER POSITIONING: If when a station is properly
tuned in and the pointer is off calibration, reposition the pointers as follows.

1. Remove the or-off volume and tuning knobs. (pull
straight out)
2. Remove two outside escutcheon screws and es-
3. Remove pointer indicator and reposition.

DRIVE PULLEY STRINGING: Dive pulley restringing re
quires removal of the mounting plate assembly. To remove the mounting plate assembly follow the simple instructions
below.
below.

1. Remove two (2) star knobs
2. Remove two (2) pilot light shields and pilot light
bulbs.
3. Loosen
4. Loosen two (2) drive pulley allen head set screws.
5. Remove three (3) space screws
6. Pulley assembly straight out.

To restring the drive pulley turn the tunnag shaft completely
counterclockwise. Follow the above diagram (back view) count start by attaching the dial cord to the (back view) shown at the extreme left on the drive pulleys. Route the
cord through the opening in the pulley counterclockwise turn aroun the pulley and make a $1 / 2$ the tuning shaft. Make s $1 / 2$ countercloy and route under Then make between mounting plate and lugged washer. Mhen make one counterclockwiss pum around lug on washer.
and continue in the counterclockwise direction and sher $1 / 2$ rurnue and the counterclockwise direction and make
1 tuningshaft between the lugged wash er. Route to the la late driven pulley and make $11 / 2$ turn
around the pulley and route to the drive pull complete counter-clockwise to the drive pulley. Make ${ }^{2}$ foute through the opening and attach to the tension spring Replace mounting plate assembly and follow directions fo
mechanical tracking.

OJohn F. Rider


MODELS 2D-1316A, 1326A, 2315A, Ch. 21T2A; 2D-2313A, Ch. 17T2A


## OJohn F. Rider



## PRE-ALIGNMENT PRECAUTIONS

If 5 weep generator does not have a balanced output, connect
. the hot lead.
Connect a 1000 mmf capacitor across scope terminals and a 10 K ohm resistor in series with hot scope lead as close to tes point as possible.


Figure 6. Top Chossis View


Floure 7. Bottom Chossis View

VHF TUNER DIAGRAM


## TUNER ALIGNMENT

1. Preset trimmer screws C11-14-18-22-28-31- $t 0$ dimensions shown
2. Presec coil cores $\mathrm{L} 3-5-7-8-10-11$ in the following manner
(a) In low band position, curn tuner to top of stroke (cores furchest out of coil).
(c) Adjust coil cores 1.6 inch from core to end of coil form (use core aligning tool if available).

| V-vid $\text { S. } 500$ | LOW BAND RF TRACKING Turn Tuner to channel 6. NOTE: Low Band must be aligned before high band. |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| No. Step | Signol Generotor Freq. (mc.) | Sweep Generotor Freq. (mc.) | Signol Input Point | Output Point | Remorks | Adjust | Response |
| 1 | $\begin{aligned} & v-83.25 \\ & S-87.75 \end{aligned}$ | Channel 6 | Antenna <br> Terminals | Test Point (cerminal 6) | Adjust for maximum response | C-2B | $\int^{5}$ |
| 2 | $\begin{aligned} & V-83.25 \\ & S-87.75 \end{aligned}$ | Channel 6 | Antenna <br> Terminals | Test Point (terminal 6) | Adjust for maximum response | $\begin{aligned} & \mathrm{C}-18 \\ & \mathrm{C}-22 \end{aligned}$ |  |
| 3 | $\begin{aligned} & \text { v-77.25 } \\ & \text { S-81.75 } \\ & \text { v-67.25 } \\ & \text { S-71.75 } \\ & \text { v-61.25 } \\ & \text { S-6.75 } \\ & \text { S-55.25 } \end{aligned}$ | Channel 5 <br> Channel 4 <br> Channel 3 <br> Channel 2 | Antenna <br> Terminals | Test Point (terminal 6) <br> See sketch on schematic | Adjust cuner until response curve appears on scope. Adjust trimmers for compromise which will give the best overall re sponse across band. | $\begin{aligned} & \mathrm{C}-18 \\ & \mathrm{C}-22 \end{aligned}$ |  |

HIGH BAND RF TRACKING Turn Tuner to channel 13.

| 1 | $\begin{aligned} & \mathrm{V}-211.25 \\ & \mathrm{~S}-215.75 \end{aligned}$ | Channel 13 | Antenna <br> Terminals | Test Point (cerminal 6) | Adjust for maximum response | C-2A |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | $\begin{aligned} & V-211.25 \\ & S-215.75 \end{aligned}$ | Channel 13 | Antenna Terminals | Test Point (terminal 6) | Adjust for maximum response | $\begin{aligned} & \text { C-11 } \\ & \text { C-14 } \end{aligned}$ |  |
| 3 |  | Channel 12 <br> Channel 11 <br> Channel 10 <br> Channel 9 <br> Channel 8 <br> Channel 7 | Ancenna Terminals | Test Point (terminal 6) <br> See sketch on schematic | Adjust tuner until response curve appears on scopc. Adjust trimmers for compromise which will give the best overall response across band. | $\begin{aligned} & C-11 \\ & C-1 i \end{aligned}$ |  |

LOW BAND OSCILLATOR TRACKING Turn Tuner to channel 6.

| 1 | 83.25 | Channel 6 | Ancenna <br> Terminals | Scope at junction of L25, R27, C58 | Adjust until marker is $50 \%$ down on low frequency slope | C-31 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | $\begin{aligned} & 67.25 \\ & 55.25 \end{aligned}$ | Channel 4 <br> Channel 2 | Anconna <br> Terminals | Scope at junction of L25, R27, C58 | Marker should be $50 \%$ down on low frequency slope | - |  |

HIGH BAND OSCILLATOR TRACKING Turn Tuner to channel 13

| 1 | 211.25 | Channel 13 | Antenna <br> Terminals | Scope at junction of L25, R27, C58 | Adjust until marker is $50 \%$ down on low frequency slope | C-28 |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | $\begin{aligned} & 193.25 \\ & 175.25 \end{aligned}$ | $\begin{aligned} & \text { Channel } 10 \\ & \text { Channel } 7 \end{aligned}$ | Ancenna Terminals | Scope at junccion of L25, R27, C58 | Marker should be $50 \%$ down on low frequency slope | - |  |

UHF TUNER SERVICE MANUAL


GENERAL DESCRIPTION
The UHF Tuner is a single conversion, continuous cuning device which mechanically mounts directly
over the VHF tuner in the receiver. The cuner is coupled over the VHF tuner in the receiver. The cuner is coupled
to the VHF cuner by drive ears which thus provides. to the VHF cuner by drive gears which thus provides
cuning of boch UHF and VHF by the same cuning knob. cuning of both UnF and VHF by the same cuning knob.
 the desired tuner for operation. Signal points and fila ment leads are not switched.

Two variations of LHF cuners may be encountered. Only minor differences exist as can be secn by refer-
(later version). ring to figures 3 (early version) and 4 (later version).
The later version euner can easily be identified by the terminal strip below resistor R-2. (see figure 5).
The UHF Tuner selects the UHF stactions video and sound carrier and convers them to the carriet if fre-
quency of 26.75 MC for video and 22.25 . MC for sound which is coupled to the IF amplifiers in the receiver
by 10 inches of RG- 62 U cable.

## CIRCUIT DESCRIPTION

The UHF Tuner employs a double coaxial line R cavity pre-selector. The coaxial line arrangement has
the advantages of high selectivity, low insertion losses the advantages of high selectivity, low insertion los ses lator radiation. The coaxial cavity is basically a onequarter wave shorted tuned stub. The electrical length
of the cavities is varied by a ribbon which is attached to the dial cord and pulley arrangement. In this manne tuning is accomplished similar to varying the length of a tuned stub which would change the resonant length
for various frequencies. The dial cord is of a special for various frequencies. The dial cord is of a special
material which is not affected by temperature or moisture and is locked to the pulleys which eliminates the possibility of slippage. Tracking screws are provided
in the cavities to obtain uniform band width and sensiin the cavities to obtain uniform band width and sensi-
tivity. The tracking screws vary the capacity between tivity. The tracking sctews vary the capacity between
the ribbon and the caviry wall and thus vary the elec-
trical length of the ribbon.

The oscillator rube used is a GAF4 which is similar to the 6F4. Oscillator tuning is accomplished by a one-quarter wave shorted parallel wire transmission line arrangement. It differs from the RF cavities, in of the lines. This method provides very stable operaion.
Inductive or link coupling is employed to rransfer the signal between stages. The arrangement of link coup-
ling gives maximum selectivity and constant band-
width over the entire UHF band. The signal from the output coupling link is mixed and detected by a CK-710
crystal detector and then applied to the tuned input o the cascode Pre-IF amplifier which is tuned to a center frequency of 25 MC and has the features of low noise
and broad band-width. The signal is amplified by the cascode amplifier and then coupled to amplified by the cascode amplifier and then coupled to the IF amplifie
section in the receiver through 10 inches of RG-62U
coaxial cable.

The UHF Tuner maintains a fairly constant antenn input impedance of 300 ohms, has an overall band width of 6 to 8 megacycles and has an oscillator in amplification of the signal takes place in The only amplifier. The signal is not amplified in the RF cavities therefore, the sensitivity of the receiver on UHF will not quite equal that of VHF. A receiver equipped with
a UHF tuner will have an overall UHF sensitivity of approximately 150 microvolts.

Service features of this tuner provides a convenien check point for measuring the oscillator grid curren Also provisionsther the oscilacor is functioning oscillator injection current to check both the crystal for coupling to the An opening is also provided the cascode amplifier is necessary.

SERVICE HINTS

If the receiver is "dead" when attempting to view a UHF program, first check the position of the selector
switch, then determine whether a signal is being transswitch, then determine whether a signal is be ing trans-
mitted and then check the antenna and lead-in con-

Also as a fast check, view the face of the picture tube at minimum contrast or picture control setting and advance the control to maximum. Compare the difference. If there is hittle or no difference (no "snow") check "snow" appears at maximum control setting, check the first IF stage before looking to the tuner for a

If the UHF tuner is not functioning properly, first substitute the oscillator ( 6 AF4) and cascode amplifier 6BK7) tubes. Next check the voltages at the UHF
pover socket or cable connections in the receiver
If soldering iron servicing, crystal detector or component parts replacement is necessary, the picture tube must be removed. Removing the picture tube
makes the maiority of the UHF Tuner components within easy reach and most of the parts can be serviced The tuner should not be semoved from the chassis , service is required, also caution must be observed not to lay the chassis
to the UHF Tuner may result.
CAUTION: When attempting to service the Tuner, do as a change in distributed capacity may result and off set the alignment. When replacing a component, b sure to obtain the same lead lengths and replace the same physical position.


Figure 2 -- Early Version


Figure 3 -- Later Version

## SERVICE DATA

To determine whether the oscillator section is function－ ing，a convenient check point has been provided where the oscillator grid current can be measured．To measure
the oscillator grid current，place a Simp son Model 260 he oschlitor grid current，place a simp son Model
Multimeter（or equivalent）on the 100 microamp scale across the 22 o lm resistor（R2）．See figure 4．A reading of io to 30 microamperes should
oscillator is functioning normally．

Both the oscillator and crystal detector can easily be checked by measuring the oscillator injection current．
Place a Simpson Model 260 Multimeter（or equivalent） on the 100 microamp scale across the 22 ohm resistor （R 10）at the terminal indicated in Figure $5 A$ or $5 B$
depending on the version of the tuner．A reading of 5 depending on the version of the tuner．A reading of 5
to 40 microampere should be obtained if both the oscillator and crystal are functioning normally．


Figure 4


Figure 5A Early Version


Figure 5
Later Version


Since UHF is a relatively new field，test equipment neces mary for RF and Oscillator Alignment is highly expensive
and not readily available on the market at the present hue．Therefore，a complete alignment procedure is no presented in this inanual．

The cascode Pre－1F Amplifier can easily be realigned i ecessary by connecting a 25 ic unmodulated signal to center tap of L6（see figure 7）or to the junction o
oil L－5 and Capacitor C－2（see figure 6），depending on the version of the tuner and a VTVM at the video IF Detector output of the receiver．Connect generator through aryan reading．
for any reason such as dial cord replacement coumonent replacement，etc．，the RI：cavities may be adjusted for peak performance．Before attempting adiustinent，note position of ribbons and mar the UHE drive gear，so that
original positions can be relocated if necessary．Loosen original positions can be relocated if necessary．Loosen
the pulley positioning screw（refer to figure 8）and rotate tate the pulleys for the sharpest and clearest picture．
CAUTION：DO not under any circumstances attemper ab justment of the tracking screws，oscillator trimmer scree or oscillator cavity．Precision test equipment is neces say for tue adjustinent．

sary for tue adjustinent.

CRYSTAL DETECTOR：If replacement of the CK－710 Crystal with the crystal cover（refer to figure 6）．The crystal is solder－
ed into place and should be carefully re soldered after replace ed into place and should be carefully resoldered after replace
mend．Overheating may damage the crystal．To dissipate the heat，grasp each crystal lead with a pliers when soldering


ALIGNMENT



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RECEIVER LOCATION .- Advise the owner as to the proper location for the television receiver. The fol
lowing may be used as a guide. 1. Choose an area in the home where sundight or light from lamps does not strike the face
and cause glare. and cause glare.
2. Remember the necessity of an electrical ourlet and
the location of the point at which the antenna leads enter the room.
31 The receiver should be placed a short distance from
the wall to allow adequate vencilation. the wall to allow adequate vencilation.
4. The receiver should be placed to pernit easy access
for all operation and comfortable viewing from all angles. ANTENNA .- This recei ver has been designed to use an antenna with a 300 ohm balanced transmission tine. This
line must be as short as possible because the longer line must be as short as possibe torer picking up elec-
the line the greater the chances are for trical disturbances. Stand-off insulation should be used to keep the line away from the mast, metal or walls.
Twist this line abour one curn per foot throughout the Twist this ine abour one curn
line to cancel out direct signal and/or noise pickup by
and the transmission line. It should also be securely anchored
in place so that a change in weather will not affect in place so
its position.

HIGH VOLTAGE WARNING
This television receiver contains high voltages which are dangerous to life. Never operate or ser
vice the receiver outside of the cabinet or with the vice the receiver outside of the cabinet or with the
covers removed until all the safery precautions
necessary for working with high volcage equipment
have been observed. have been observed.

## PICTURE TUBE HANDLING PRECAUTIONS

Shatcerproof goggles and heavy gloves must be warn by
individuals while handling the picture tube or installing the picture tube into the receiver.
The picture cube encloses a high vacuum and due to the Targe surface area, is subjected to very high air pres-
sure. Therefore, care should be taken not to bump or scratch the picture tube accidentally as it may cause the tube to implode resulting in damage to property or
TUNING PROCEDURE

1. To turn the celevision receiver on, turn the OFF-ON
VOLUME control clockwise uncil a click is heard. A1VOLUME control clock wise until a click is heard. Al-
low approximately 30 seconds for the tubes to warm up. Tun 2. Turn the STATION SELECTOR control to the desired . Tum the CONTRAST control clockwise until activity 3. Turn the CONTRAST control clock
or definite form is noted on the screen.
2. Adjust the FINE TUNING control for clearest pic4. Adjust the FINE TUNING control for clear
ture and the VOLUME control for desired vol ume.
3. To turn off the receiver, turn the OFF-ON VOLUME 5. To turn off the receiver, turn the OFF-ON
control counterclockwise until a click is heard.
4. TONE CONTROL -- When this control is turned clock. wise, the high notes will predominate and when turned counterclock wise, a deep bass effect will result.


Fig. 2. Front Panel Controls

## OCCASIONAL ADJUSTMENTS TO IMPROVE PICTURE RECEPTION

There are four controls at the front of the chassis which
are accessible when the hinged control panel is pulled are accessible when the hinged control panel is pulled
downward. See illustration. These controls are pre-set at the factory and may occasionally need adjustment due to aging of the components in the receiver and the fluctuating line voltages in different areas.

## CONTROLS AND FUNCTIONS

$\underset{\substack{\text { HORIzontal. } \\ \text { (diagonal bars.) }}}{\text { HOLD }}$-- Seops horizontal movement
(diagonal bars.)
TONE -- Adjusts for tonal quality ¿áss or creble.


FRONT OF CHASSIS
(Accessible After Opening Front Panel Control Horizontal hold .............................. R-9 Brightness ..................................... . . R- 25 Tone .............................................. . . R-72 Vertical Hold.

NON-OPERATING CONTROLS REAR OF CHASSIS

Horizontal Centering ........... , Centering Vertical Centering .............. $\}$ Device Ion Trap Magnet ...... .........ing Nut Adjustment Deflection Yoke ............................................. Width ............................................... L-15 Horizontal Linearity ........................................... Morizontal Drive ............................. R-89 Horizontal Frequency R- 89
L- 14 Vertical Linearity Height
 R. 54

Sync Stability
$\qquad$ ty ....
AGC Threshold

If any adjustments are necessary follow the instructions under "Controls and Functions."
MPORTANT -- Be sure that the FINE TUNING control has been set for the clearest picture before adjusting any controls.

BRIGHTNESS .- Adjusts for desired picture brilliance VERTICAL HOLD .- Stops upward or downward picture VERTICA
movement.

WARNING -- Before bandling the picture tube, it will be nacessary to remove the static charge. In receivers with, glass picture cubes, ground the anode lead to chast
sis. and insert an insulated wire from the well in the sis, and insert an insulated wire from the well in the
tube to chassis. In receivers with metal picture tubes, remove the static charge by grounding an insulated wire from the chassis to the metal portion of the tube

PICTURE TUBE REPLACEMENT -- To replace the picture rube it is necessary to remove the chassis from the
cabinet. This may be accomplished in the following cabiner.

1. Remore the front panel control knobs by pulling 2. Remove the cair
2. Disconnect the leads from the speaker, remove the antenna terminal board at the rear of the cabinet and then the five chassis mounting bolts. Pull chassis CARE-
3. Remove the picture tube as shown and outlined in the illustration. To install a new picture tube, reverse the procedure making sure that the picture tube fits
close against the picture tube cushion. If the picture cube sticks or fails to slip into place smoothly, investigate and remove the source of the theuble. Never force the tube. It is important that all the clips and shims ficulty may be encountered when horizontal or vertical centering is required.


Fig. 4 Adjustments Rear of Chassis

ION TRAP MAGNET ADJUSTMENT -- The ion trap magnet should be positioned close to the base of the
tube. From this position adjust the magnet by moving it cube. From this position adjust the magnet by moving
back and forth and at the same time rotating it slighly around the neck of the picture tube until the brightest raster is obtained on the picture screen. Reduce the bright ness control setting unt il the raster is slightly above aver
age brilliance. Readist the ion rrap magnet for maxage brinince. Readjust the ion trap magnet for max-
imum raster brilliance and best focus. MAXIMUM RASTER BRILLIANCE AND BEST FOCUS OCCUR AT THE The ion trap magnet adjustment is a very critical one especially with the electrostatic type zero focus pic ture tube. Consequenty, great care should be taken to
make sure that the ion trap magner is correctly adjusted. DEFLECTION YOKE ADJUSTMENT .- If the lines of DEFLECTION YOKE ADJUSTMENT .- If the lines of the
raster are not horizontal or squared with the picture raster are not horizontal or squared with the picture
mask, rotate the deflection yoke until this condition is
obtained. Tighten the yoke adjustmen obtained. Tighten the yoke adjustment wing screw.
CENTERING ADJUSTMENT -- If horizontal or vertical
centering is required, adjust each ring in the centering centering is required, adjust each ring in the centering
device until proper centering is obtained. If a clamp type centering device is used, rotate the device to the
left or right and turn the knob located at the top of the left or right and turn the knob located at the
device until the picture is centered correctly.
PICTURE ADJUSTMENT -. For further adjustments, ob PICTURE ADJUSTMENT .- For further adjustments, ob
tain a test patterion the receiver. Turn on receiver and
follow tuning procedure on tain a test patterin on the receiver. Turn on receiver and
follow euning procedure on page 3. When a test pautern
is obtained it may be necessary to slightly re-adjust is obtained it may be necessary to sli
the fine tuning concrol for clearest picture.

ADJUSTMENT OF AGC THRESHOLD CONTROL .- TUne the receiver to the strongest station in the area in which
the receiver will be used. While observing the picture the receiver will be used. While observing the picture
and listening to the sound, turn the control clockwise and listening to the sound, turn the control clockwise
until signs of overloading, (buzz in sound, washedout
picture) appear. Then turn the control a few degrees
 occurs. (The stronger the signal input, the more counter-
clockwise this seting will be.) In areas where the strong est si gnal does now exceed 10,000 uv the setting will
usualy be maximum clockwis. usually be maximum clockwise. With the control set
correctly correctly, the AGC will automatically adjust the bias
on the R.F. and I.F. amplifiers so that the best possible signal to noise ratio (Minimum snow) will be ob
tained for any signal tained for any signal input to the recerver
ADJUSTMENT OF SYNC STABILITY CONTROL -When receiving strong ( 500 MV or more) signals, set
hold controls up that the picture is locked in. Turn the sync control fully counterctockwise, then, while observing the picture, turm the connrel slowly clock wise
until a mini mum amount of bending occurs. If the control until a minimum amount of bending occurs. If the control and when switching from channel to channel the picture
will not lock in quickly. In weak signal areas the control should be set for maximum picture stability. In general the weaker the signal
the more clockwise the control should be turned. When the more clockwise the control should be turned. When
the sync stability control is correctly adjusted the receiver will hold sync without tearing or rolling under
even the most adverse noise

CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT -Tune in a station and adjust the horizontal hold con-
trol until the picture falls into sync. Momentarily remove the signal by switching off shannel and then back The picture should pull into sync over a range of $90^{\circ}$
rotation of the horizontal hold control. If in the abve check the receiver fails to hold sync or the pull-in range is at the extreme end of the control, it will be neces-
sary to make the following adj ustment.
HORIZONTAL FREQUENCY ADJUSTMENT --- With the
horizontal hold control set to the center of its range of rotation, adjust the horizontal frequency consrol range of until the pilcure pulls into sync. Recheck the "Hori-
zontal Oscillator Alignment." Her
HEIGHT AND VERTICAL LINEARITY ADJUSTMENT -Adjust the height control ( $R-54$ ) until the picture fills
the mask vertically. Adjust the vertical linearity control ( R -49) until the picture is symmerrical from conbottom. Adjust the picture centering device to align bottom. Adjust the picture centering device to align
picture with the mask. Adjustment of any control will
require a re-adjustment of the other control. WIDTH, DRIVE AND LINEARITY ADJUSTMENTS While receiving a signal trom a station (with picture
locked in sync)
turn contrast control fully counter-clockwise, turn the brightness control (R-25) up so that the picture appears washed our. Adjust width control (L-15)
until the picture fills the untive the picture fills the mask. Turn the horizontal
drive control ( R -89) clockwise until white bars appear in the left center portion of the raster, then turn counter-
clockwise until the clockwise until the white bars just disappear. This
adjustment will allow the horizontal system to operate at maximum efficiency. Adjust horizontal linearity control (L-16) for best linearity. If adjustment of the horizontal drive (R-89) or horizontal linearity (L-16) is re-
quired, it usually will be necessary to recheck the horizontal oscill ator alignment. If adjustment of the horizontal linearity control (L-16) is required, readju stment of
the horizontal drive control (R-80) will the horizontal drive control (R-89) will be necessary-
adjust the picture centering device to align the picture adiust the pic
with the mask.

CHECK OF R-F OSCILLATOR ADJUSTMENTS The oscillator is preset at the factory and normally quired, they can be made without removing the chassis from the cabinet. Remove the channel selector and fine suning knobs from the tuning shaft
TEST PROCEDURE:
to receive desired station 2. Set fine tuning control in center of its range.
3. Adjust oscillator slug, with bakelite type screw


Fig. 5 Tuner Oscillator Adjustments


Fig. 6 Bottom Socker Voltoges


NO RASTER ON PICTURE TUBE .- If raster cannot be obrained check below for the possible causes.
No +B voltage. Check $4 / 10$ ampere fuse. Replace if defectuve. If fuse continually bums out, ched
(A) Horizontal ourput tube V-17 (6BQ6-GT)
(B) Check damper tube V - 18 ( 6 W 4 -GT).
(C) Check horizontal oscillator tube V-16 (GSN7-GTA)
for proper operation.
(D) With an ohm meter, check for a short between erminal 1 of the horizonn (T-9) and the chassis.
(E) Check DC resistance of T-9

No high voltage. Check V-17, V-18 and V-19 tubes are operating as evidenced by the correct voltag ( 000 V ) measured on termi nal No. 1 of T-9, the trouble
can be isolared to the high voltage rectifier circuit. can be isolated to the high voitage rectifier circuil
Either the high voltage winding to the $6 \mathrm{BQ} 6-\mathrm{GT}$ Elare and 1 BZ plate is open, tube V-19 is defective, its filament circuit is open, R-99 and
4: Defective pic
HORIZONTAL DEFLECTION ONLY -- If only horizontal deflection is obtained as evidenced by a straight lin across the face
by the follo wing:
Verical oscillator and vertical oupput tube $V-8$
Verical oscillator and vertical
inoperative. Check socket voltages.
Vertical oscillator transformer ( $\mathrm{T}-4$ ) defective
3. Vertical output transformer ( $\mathbf{T}-5$ ) open or shorted
4. Yoke vertical coils open or shorted.

5: Vertical hold, height or linearity controls may be defecave.
POOR VERTICAL LINEARITY .- If adjustment of the height and linearity controls will not correct this con dition, any of the following may be the cause.
1: Check variable resistors $\mathrm{R}-49$ and $\mathrm{R}-54$.
2: Vertical output tran sformer ( $\mathrm{T}-5$ ) defective
3: Capacitors C-35A, C-39 or C-
5: Excess leakage or incorrect value of capacitor C-37,
6: Low plate voltages. Check rectifier tube and capacitors in + B supply circuits.
Capacitor C-36 defective.
8: Vertical deflection coils (L-12) defective.
POOR HORIZONTAL LINEARITY -. If adjustment of Horizontal drive and linearity controls does not correct this condition, check the following
1: Check or replace horizontal output tube V-17.
2: Check or replace damper cube $\mathrm{V}-18(6 \mathrm{~W} 4-\mathrm{GT})$
3: Check capacitors C-74, C-76, C-77 and horizontal 4. Horizontaldeflection coils(L-17) defective.

4: Horizontaldell TRAPEZOIDAL OR
WRINKLES ON LEFT SIDE OF RASTER -- This condition can be caused by:
1: Defective yoke due or $\mathrm{C}-75$ or R -98 (internal in yoke
assembly) being wrong value or open. These com-V-18 (6W4-GT) defective.

SMALL RASTER -- This condition can be caused by: 1: Low + B or line voltage. Check V-20 (5U4G).
2: Insufficient output from horizontal output tube V-17. Replace tube.
: In sufficient oupur from vertical oscillator and ver-
tical outpur tube $V-8$. Replace tube.
: Incorrect setting of horizontal drive control R-89. V-18(6W4-GT) defective
6: Incorrect setting of (L-15) width control.
RASTER; NO IMAGE, BUT ACCOMPANYING SOUND -This condition can be' caused by:
1: No signal on picture tube grid. Check V-5A (12AT7)
2: Bad contact to picture tube grid (lead to socke broken).
3: AGC rube (V-9) may be defective. Check tube and
SIGNAL APPEARS ON PICTURE TUBE GRID BUT IMPOSSIBLE TO SYNCHRONIZE THE PICTURE VER-
TICALLY AND HORIZONTALLY -- A condition of this
nature can be caused by:
1: Defective sync separator $V-7$ or phase splitter $V-5 B$.
2: If tubes are O.K. check voltages, and associated
: ${ }_{\text {circuits. }}$
3: AGC system in operative. Check V-9 (GAU6) AGC SIGNAL ON.PICTURE TUBE GRID AND HORIZONTA SIGNAL ON.P ICTURE TUBE GRID AND HORIZNT 1: Vertical integrating network capacitors C-31A, B \& C,
2: Vertical hold control (R-51) defective.
SIGNAL ON PICTURE TUBE GRID AND VERTICAL SYNC ONLY:
1: $V-15$ or $V-16$ defective.
2: Improper setting of (L-14) horizontal frequency con-
: seting of horizontal drive control and hori-
3: Check setting of horizo
4: Check $V-15$ and 16 socket voltages.
PICTURE STABLE BUT WITH POOR RESOLUTION If the picture resolution is not

1. Defective pix I-F tubes $\mathrm{V}-1,2 \& 3$, ( $6 C B 6$ 's).

2: Defective picture detector $\mathrm{V}-4 \mathrm{~A}$, ( 6 ALS ). or video outp ut V-6 (6AH6).
3: Defective picture tube.
4: Open video peaking coil. Check all peaking coils Open video peaking
$\mathrm{L}-5, \mathrm{~L}, \mathrm{~L}, \mathrm{~L}, \mathrm{~L}, \mathrm{~L}-9, \mathrm{~L}-10$ and $\mathrm{L}-11$ for continuity.
Note that $\mathrm{L}-5, \mathrm{~L}-9$ and $\mathrm{L}-10$ have shunting resistors.
5: Leakage in V-6 (6AH6) grid capacitor C-11. If the lowing:

1. Check all potential in video circuits

2: Check picture tube grid circuit for poor or dirty
3: Check and realign, if necessary, the picture l-F 3: Check and reali
and $R-F$ circuits.

PICTURE SMEAR:
1: A smear can be attributed to phase shift at the low o high frequency end of the video characteristic. This
can be caused by improper values of resistors and capacitors in the video circuits. Check for grid an rent on video output tube V-6 (6AH6), open or shorted peaking coils, video amplifier load resistors are of peaking coils, video
improper value (high).
2: This rooble can also originate at the transmitter.
Check reception fron another station.
Check reception fron another station.
3: Check and realign,-if necessary, the picture I-F and
$R-F$ circuits.
AN MADE NOISE IN SOUND (Ignition, etc)
: Check sound I-F tubes V-10, $11 \& 12$ and a ssociated
2: Check sound I-F alignment.
BENDING OR S-ING
1: Check sync stability control adjustment.
2: Check capacitors C-35B and C-79B
3: V -17 ( 6 BQQ -GT) defective or V - 16 (GSN 7-GTA) de-
 Check AGC threshold control

PICTURE NORMAL -- NO SOUND OR WEAK OR DIS: Check sound $1-F$ alignment
Check V-10 (6AUG) V-11 (6AUG) V-12 (6AL5) V-13
(6AVG) V-14(6AQS) and associated circuits.
POOR FOCUS
1: Improper setting of Ion Trap magnet.
2: Defective picture tube or picture tube socket.
PICTURE JITTER:
1: If regular sections at left of the picture are dis-
Verical institity
2: Vertical instabilitymay be due to loose connections
or noise received with the signal.
3: Horizontal instability may be due to unstable trans-
, Check receiv
Ceiver AGC system for proper operation
5: Check phase splitter V-5B, (12AT7) and sync sep
6: Check for improper setting of sync stability control. 7: Picture tube grid lead not held in position by support spring, ie: close proxi mity of grid lead to sync
and horizontal tubes will cause picture to jitter at high contrast setting
: Check AGC threshold control

## alignment PROCEDURE

TEST EQUIPMENT .. To service this receiver properly, it is recomm
be available:
R.F SWEEP GENERATOR .- meeting the following re quirements:
(a) Frequency ranges:

18 to $30 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
40 to $90 \mathrm{mc}, 10 \mathrm{mc} s$ weep width
170 to $225 \mathrm{mc}, 10 \mathrm{mc} s$ weep width
(b) Output adjustable with at least $\cdot 1$ volt maximum
(c) Output constant on all ranges.

CATHODE-RAY OSCILLOSCOPE .- preferably one with wide band vertical deflection and an input calibratin source.
SIGNAL GENERATOR -- To provide the following frequencies: (Output on the se ra
(a) Intermediate alignment frequencies.
23.1 mc first picture I-F coil.
24.1 mc third picture I-F coil.
24.1 mc third picture I-F coil.
25 mc second picture F - coil.
21.7 mc sound trap
21.7 mc sound rrap.
4.5 mc video trap
4.5 mc video trap \& sound 1 - F .
25.2 mc converter plate coil (Tuner).

HETERODYNE FREQUENCY METER with crystal cali-

ELECTRONIC VOLTMETER and a high voltage probe for use with
20 kilovolts.
SERVICE PRECAUTIONS - To service the receiver the knobe chassis from the cabinet. To do so, remove he knobsaker, remove the antenisconnect terminal board at rear cabinet, and then the 5 chassis mounting bolts. The provided the chassis is turned on its side with the power ransformer on the bottom. The weight of the chassis
will be supported will be support
CAUTION: Do not permit the kinescope second-a node cad to become shorted to the chassis. To do so will
cause a considerable overload on the high voltage filer resistor $\mathrm{R}-99$
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Fig. 8 Top Chassis Video and Audio I-F Adjustments
A. Uomodulated R-Figanal ine Conercere Grid by means tee in lead of 22 K ohms base


 line.


Fig. 10 VTVM Connections

## FREQUENCY

tuner for maximum de at pic
ture detector.
2. $\quad 23.9 \mathrm{MC} \quad \begin{aligned} & \text { lst picture } \\ & \text { maximum de at } \\ & \text { I-F }\end{aligned} \begin{aligned} & \text { coil } \\ & \text { picture }\end{aligned}$ (T-1) fotec-


5. $\quad 21.7 \mathrm{MC}$



Fig. 9 Bottom Chassis Video and Audio I-F Adjustments

The height of the 26.2 MC marker is controlled by
the 25.2 MC (Converter Plate Coil on tuner) and the the 25.2 MC (Converter P.
25.9 MC (2nd P.I.F.) coil s.
2. The uniformity of response (flatness across top and position of 23.5 MC marker is controled
most part by the 24.1 MC chird picture $\mathrm{I}-\mathrm{F}$ coils
The 23.0 MC marker position is controlled by the
first picture $1-\mathrm{F}$ ( 23.1 MC coil). However, it is NOT advisable to change the setting of the coil due to its effect on sound rejection. Its adjustment should
be avoided unless believed to be absolutely nec-
essary essary.

VIDEO
With 4.5 MC unmodulated signal from a high impedance source, ( 10,000 ohms in series with the generator) into plate of the picture detector tube (Pi in $7-6 \mathrm{ALS}$ ) and
VTVM on picture tube grid, tune 4.5 MC trap (L-7 Top VTVM on picture tube grid, tune 4.5 MC trap ( $\mathrm{LL}-\mathrm{Top}$ )
or minimum response. VTVM on 0.10 V AC scale. This
adjustment can also be made while observing a picture AUDIO I.F
1: With signal generator set 10 MC and dc VTVI With signal generator set to 4.5 MC and de VTVM
connected to junction of R-62 and C-46, adjust sound cake-off coil (L-13 Top) and sound I-F transformer
sol slugs (T-6 Top \& Bottom) for maximum
2: With VTVM connected to pin 7 of V-12 (6ALS) adjust the ratio detector primary ( $\mathrm{T}-7$ Botrom) for max
$\qquad$
3: With VTVM connected to junction of R-6G, R-69 and C-50, adjust ratio detector se condary ( T
cross over (zero voltage) ori lowest scal e. NOTE -- If no signal generator is available, the procedure above usi 4.5 MC beat between tion and using
sound carrier.


Fig. Il Oscilloscope Connections


Fig. 12 Overall Response Curve
B. RF AND CONVERTER ADJUSTMENT.

1. With channel selector on Channel 12, adjust iust $\mathrm{C}-206$ and C -209 for response as in Figure
2. Picture and sound markers ac $90 \%$ maximum re sponse.

Fig. 13 Top Turner Adjustments


TUNER ALIGNMENT
 Observe overall I-F response, which should be as
shown above: Alight touct--up may be required.
At no time should the trap coil be re-adjusted, nor At no time should the trap coil be re-adiusted, nor
should it be necessary to turn any of the picture
I-F coils more than $1 / 2$ tura of the slug. The fol-1-F coils more than $1 / 2$ turn of the
lowing comments are suggestions only:
B. I-F Sweep Generator into converter grid by means of
tube sthield insulated from base. Connect oscilloscope across , R-100 (in place of
VTVM). Apply $-4.5 V$ bias (DC) to AGC line (battery).
Tuner should be switched to dead channel so as not to cause interference.
2. Check response on all chamels. If markers are below $70 \%$ on any chanoels, readjust $\mathrm{C}-201$, C-
206 , and $\mathrm{C}-209$. Recheck all channels.


Fig. 14 Pix and Audio Markers


John F. Rider



## MODEL 2D1235E (Supplement to 2D1235D)

Model 2D1235E is identical to Model 2D1235D except for a change in the $V-18$ damper tube
from a $6 W 4$-GT to a 6 AX4-GT. A schematic diagram with this change incorporated is attached. Illustration on the next page shows the bottom socket voltage chart.

TUBE COMPLEMENT

| Symbol Type | Function |
| :---: | :---: |
| Tuner ......... 6J6 | R-F Osc, and Mixer |
| *Tuner ..........6BQ7 | R-F Amplifier |
| V-1 ..............6CB6 | 1st Pix I-F Amplifier |
| V-2 ...............6CB6 | 2nd Pix I-F Amplifier |
| V-3 ..............6CB6 | 3rd Pix I-F Amplifier |
| V-4 A\&B ...... 6AL5 | Pix Det. and DC Restorer |
| V-5 A\&B ........ 12AT7 | 1st Video Amp. and Phase Splitter |
| V-6 ................6AH6 | Video Output |
| V.7 .................6BE6 | Sync. Separator |


| V-8 ................6SN7-GTA | Vertical Osc. \& Vertical Output |
| :---: | :---: |
| V-9 ................ 6 AU6 | Automatic Gain Control |
| V. 10 ...............6AU6 | 1st Audio I-F |
| V-11 ...............6AU6 | 2nd Audio I-F |
| V-12 ..............6AL5 | Ratio Detector |
| V-13 ...............6AV6 | 1st Audio Amplifier |
| V-14 ..............6AQ5 | Audio Output |
| V-15 ............. 6AL5 | Phase Detector |
| V-16 ............. 6SN7-GTA | Horizontal Oscillator |
| V-17..............6BQ6-GT | Horizontal Output |
| V-18 ..............6AX4-GT | Damper |
| V-19 ............. 1B3-GT | High Voltage Rectifier |
| V-20 ............. 5U4-G | Low Voltage Rec tifier |
| V-21 ............. 17HP 4 | Picture Tube $17^{\prime \prime}$ Glass Rectangular (Electrostatic) |
| *For replocement purposes in ploce of o 6BQ7 tube. | - 6827 tube moy be used |







MODEL NO. 2D1331C


Model No. 2D1331D is identical to 2D1331C except for slight change in cabinet design and change in Pix Mast part number from 4X1230-2 to 4X1230-1

## ELECTRICAL SPECIFICATIONS

Power Supply ....................... 105-125 Volis AC

Power Consumption .............. 210 Watts


Tunin Rand VHF ........ Channols 2 thru 13 UHF ......... Channols 14 thru Antenna Input Imp. ............... 300 Ohms Balanced Intermediato Frequancies ....... Sicture ${ }^{\text {Sound }} 21.70 \mathrm{MC}$ I.F (UHF Position Only) ........ Picturo | Sound 126.125 |
| :---: |
| 15 | Intercarrior Sound Systom ....... 4.5 mC Loud Speaker .................... Soe Parts Lis Voice Coil Imp. ................... 3.2 Ohms 400 Cyeles



Fig. 1 .- Tube Layout.

## TUBE COMPLEMENT

Symbol Type
VHF Tuner 616 VHF Tuner..6BQ7* R-F Amplifier UHF Tunor..6AF4 R.FOsc. UHF Tuner. IN $_{\text {IN }}$ or Crystal Mixer
V.1........... 6CB6 1st Pix I-F Amplifior V-2 ............ 6CB6 2nd Pix I-F Amplifior V-3........... 6CB6 3rd Pix l-F Amplifier V-4 A\& B .. 6AL5 Pix Det. and DC Restorer V. 5 A \& B .. 12AT7 Iat Video Amp. and Phase V.6 ........... 6AH6 Video Output V-7 ........... 6BE6 Sync. Separator V-8........... 65N7-GTA Vertical Osc. \& Vertical Output V.9........... 6AU6 Automatic Gain Control V-10.......... 6AU6 1st Audio I-F V-11.......... 6AUG 2nd Audio I.F V.12..........6AL5 Ratio Detector V.13..........6AV6 1st Audio Amplifior V.14..........6AQ5 Audio Output V-15..........6AL5 Phaso Detector V.16.......... 65N7-GTA Horizontal Oscillator V.17.......... 6BQ6.GT Horizontal Output V-18..........6AX4-GT Damper V-19.......... 1B3-GT High Voltage Rectifior V-20)......... 5U4-G Low Voltage Rectifiers $\mathrm{V}-21 \ldots . . . . . . .21 \mathrm{YP4} \quad \begin{aligned} & \text { Pieture Tube 21,' Glass } \\ & \text { Rectangular (Electrostatic) }\end{aligned}$


Fig. 2 - Front Panel Controls


NO RASTER ON PICTURE TUBE .- If rastor cannot
abtained check belaw for the possible causes. abtained check below for the possible causes.

1. Ion trap magnot adiustment is incorract.
2. No tB voltage. Check $4 / 10$ ampere fuse. Replace if dofective. If ffuse continually burns aut, check.
(A) Horizontal outpu fube V-17 ( 6 B Q6-GT)
(B) Check da mper tube V. 18 (6AX4-GT)
(6tor tube V-16 (6SNT.GTA) (D) With on ohm moter, check for a short betweon terminal 1 of the horizontol output transformer
$(T-9)$ and the chassis. ) Check DC resistance. of T-9
3. No high voltage. Check V-17, V-18 and V-19 tubes
and circuits. If the horizontal doflection circuits are and circuits. If the hari zontal deflection circuits are
operating as evidencod by the correct voltage ( 600 V ) operating as evidenced by the corroct voltage ( 600 V )
measurod on terminal No. 1 of T-9, the trouble can be isolated to the high valtage rectifier circuit. Eith or
the high voltoge winding to the $68 Q 6-G T$ plate and the high voltage winding to the
$1 \mathrm{B3}$ plate is open, tube $\mathrm{V}-19 \mathrm{is}$ defoctive, its fillamont circuit is open, $R$ R. 99 and C .78 defective or pi
tube el
. Defoctive picture tube heater
circuit opon.
HORIZONTAL DEFLECTION ONLY .- If only horizontal deflection is obtained as evidenced by a straigh line across the face of the pleture tube, it con be cou sod by the following:
Vertical oscillator and vertical output rube $V .8 \mathrm{in}$ oporative. Chock socket voltages.
Vortical oscillator transformer (T-4) defectivo.
4. Vertical output transformer (T-5) open or shortiod
5. Yoke vertical colls open or shorted.
6. Vortical hold, hoight or linearity controls may be defectivo.
POOR VERTICAL LINEARITY -- If adjustment of the dition, ony of the following may be the couse.
7. Chock voriable resistors R-49 ond R-54.

2 Vertical output tron sform or (T-5) defective.
3. Cop acifors C- $35 \mathrm{~A}, \mathrm{C}-39$ or C-70
4. V. 8 defective, check voltoges.
5. Excess loakage or incorroct value of capocitor C.37,
or open or incorroct volue of resistors R-55 \& R-56.
6. Low plate voltogos. Check rectifior tube aid capac
7. itors in +B supply eircuits.
8. Vartical daflection coils (L-12) defective.

FOOR HORIZONTAL LINEARITY .- If adjustment of the Horizontal drive and linearity controls
correct this condition, check the following: 1. Check ar roplace hori zontal output tube $\mathrm{V}-17$.
2. Check or replace dampor tube V-18 (6AXA-GT).
3. Check copacitors $\mathrm{C}-74, \mathrm{C}-76, \mathrm{C}-77$ and horizontal
3. Check copaciiors C-7, C-76,
lineority control (L-16) for dofects.
4. Horizontal defloction coils (L-17) dofective.

TRAPEZOIDAL OR NONSYMMETRICAL RASTER

1. Defective yoke.
WRINKLES ON LEFT SIDE OF RASTER - This condifion can be caused by: C - 75 or R-98 (internal in yoke assembly) being wrong value or open. Thase compononis ore mountod in rear of yoke assombly.
2. $\mathrm{V}-18$ ( $6 \mathrm{AX} 4-\mathrm{GT}$ ) defective.
SMALL RASTER .. This condition can be caused by: . Low +B or line voltage. Check V-20 \& V-22 (5U4G). 2. Insufficient output from horizontal output tube V-17. Roplace tube.
Insufficiont output from vartical oscillator and verti-
3. Incourrect sutting of herizontal drive control R-89.
4. $\mathrm{V}-18$ ( 6 AX4-GT) defoctive.
5. Incorrect setting of (L-15) width control.

RASTER; NO IMAGE, BUT ACCOMPANYING SOUND i. Na signal on picture tobe grid. Cheek V-5A (12AT7) 2 and V-6 (6AH6) tubes and associotod circuits. 2 Bad contact to plicture tube grid (lead to socket
3. AGC tube (V-9) may be defective. Check tube and 3. its associatod circult.

SIGNAL APPEARS ON PICTURE TUBE GRID BUT IMPOSSIBLE TO SYNCHRONIZE THE PICTURE
VERTICALLY AND HORIZONTALLY of this nature con be caused by:

1. Dofoctive sync soparator $V-7$ or phase splitter V-5B. 1. Dofoctive syne separator V-7 or phase splitter V-5B.
2. If tubess are 0 . K. chock voltogos, ond associated 2. circults. arb 0 . K. chock voltoges, and associated 3. AGC systom inoperative. Check V-9 (6AU6) AGC
tube and associated circuits. SIGNAL ON PICTURE TUBE GRID AND HORIZONTAL SYNC ONLY -- If this condition is encountered, check:
3. Vortical intograting notwork capacitors C-31A, B 2. Vortical hold control (R-5i) defoctive.
signal on picture tube grid and vertical SYNC ONLY
4. V. 15 or $V .16$ defective.
5. V. 15 or V. 16 defoctivo.
6. Improper setting of ( $L \cdot 14$ ) horizontal frequency con-
7. Improper setting of (L.14) horizontal frequency con3. Check setting of horizontal drive control and hori4. Check V-15 and V-16 socket voltages.

PICTURE STABLE BUT WITH POOR RESOLUTION -
If the picture resolution is not up to standard, it may be
caused by ony of the following:

1. Defoctive pix $\mid-F$ tubes $V \cdot 1,2,\left(6 C B 66^{\prime} s\right)$.
 2. plifier V. 5 Pi or vidoo output $V=6$ ( 6 AH6).
2. Dofoctive pictura tubo.
3. Opan video poaking coil. Check all peoking colls
$\mathrm{L-5}, \mathrm{~L} .6$, L-8, L-9, $\mathrm{L}-10$ and L .11 for continity.
$\mathrm{L}-5, \mathrm{~L}-6, \mathrm{~L}-8, \mathrm{~L}-9, \mathrm{~L}, 10$ and $\mathrm{L}-11$ for contimuity.
Noto that $\mathrm{L}-5, \mathrm{~L}-9$ and $\mathrm{L}-10$ have shunting resistors.
 copacitor is not found to be defective, check the
following: ollowing:
4. Chack all potentials in video circuits.
5. Check picture tube grid circuit for poor ar dirty
6. Chock and realign, if necessary, the picture I-F
ond R-F circuits. and R-F circulis.
PICTURE SMEAR
7. A smear can be otributod to phase shift of the low Th hish frequoncy ond of the vidoo characteristic. ands can be caused by impropar volues of resistors
and capacitors in the video circults. Check for grid current on video output tube V-6 (6AH6), open or ore of peaking coils, video amplifier load resistors
8. This trouble col ue (high).

Chock rocaption from another station.
3. Check and roalign, if neces sary, the picture I-F and R-F circols.
MAN MADE NOISE IN SOUND (Ignition, otc.)

1. Chock sound $1-F$ tubea $V-10$, 11 a 12 ond $) ~$
2. Chock sound I-F tubes V-10, 11 \& 12 and associated
3. Check sound I-F alignment.

BENDING OR S-ING

1. Check sync stability control adjustment.
2. Chack capocitors C-35B and C-79B. (6SN7-GTA) do-
fective.
Chock sync soparator tube V-7 (6BE6) ond phase 5. Check AGC threshold control.

## SERVICE SUGGESTIONS .. (continued)

PICTURE NORMAL - NO SOUND OR WEAK OR
DISTORTED SOUNDD
DISTORTED SOUND

1. Check sound I-F alignment.
2. Check V-10 (6AU6) V-11 (6AU6) V-12 (6AL5) V-13
(6AV6) V-14 (6AQ5) and assocloted circuits.

RASTER ON TUBE BUT NO PICTURE OR SOUND This condition con be coused by,

1. Defective pix I.F Amplifier tubee V-1, V-2 or V-3.
2. Defective plx dotector tube $V-4 A$ (6AL5). Check tube and its associated circuit.
3. Defective R-F Amplifier or oscillator mixer tubes
in the tuner.
4. UHF-VHF awitch defective.

## POOR FOCUS

1. Improper setting of Ion Trap magnat.
2. Defective picture tube or picture tube socket.

## PICTURE JITTER:

1. If regular sections of left of the picture are dis-
placed, roploce the horizontal oscillator tube $\mathrm{V}-16$.
2. Vortical instability may be due to loose connec-
tions or noise received with the signal.
3. Horizontal instability may be due to unstable transmittod sync.
4. Check recoiver AGC system for proper aperation.
5. Check phase splitter V-5B, (12AT7) and sync
separator V.7 (6BE6).
6. Check for improper sotting of syme stability control.
7. Picture tube grid lead nat held in position by support spring, io; ciose proximity of grid load to sync and horizontal tubses will cause pleture to littor at high contrast sotting.
B. Check AGC threshold control

NO PICTURE OR SOUND OR WEAK PICTURE OR
SOUND (UHF Position) If this condition is oncounsered:

1. Check to soe whether or not a UHF stotion is operating in the vicinity.
2. The 6AF4 oscillator tube or the 1 N 72 (or 1N82) crystal may be defective.
3. Pre-selector in UHF tuner defective.
4. Low pass filter defoctive.
5. The UHF position antenna and oscillator strips in the VHF funer defective.
6. Dafective Switch on UHF funer.

## ALIGNMENT PROCEDURE

TEST EQUIPMENT -. To service this receiver properly, it is recommended that the following test equipment be available:

R-F SWEEP GENERATOR mooting the following re-
(a) Frequency ranges:

18 to $30 \mathrm{mc}, 10 \mathrm{mc}$ swoop width
40 to $90 \mathrm{mc}, 10 \mathrm{mc}$ sweep widt
120 to $90 \mathrm{mc}, 10 \mathrm{mc}$ swoop width

470 to $890 \mathrm{mc}, 10 \mathrm{mc}$ sweop width
(b) Output adiustable with at leost 1 volt maximum
(c) Output constant on oll ranges.
(d) Flot output in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE proforably one with a wide band vartical deflection and an Input calibrating

SIGNAL GENERATOR to provide the following frequencies: (Output on these ranges should be adiustable (I) volt maximum.)
(a) intermodiate alignment frequencies.
23.1 me first pieture l-F coil.
24.1 mc third picture l-F coil.
24.1 mc third picture l-F coil.
25.9 mc socond picture 1 -F coil.
25.9 mc socond pictur
21.7 mc sound top.
4.7 mc sound trop. me vidoo trap 8. sound I-F.
25.2 me converter
25.2 me converter plate coil (Tunor).

HETERODYNE FREQUENCY METER with crystal calibrator if the signal generator is not crystal controlled. ELECTRONIC VOLTMETER and a high voltage probe for use with this metor to permit measurements up to 20 CAUTION: Do not pormit the kinescope second-anode cause a considerable overload on the high so will couse a conside
filter resistor R-99.

## PIX I－F



Fig． 8 －Top Chossis Video and Audio i－F Adjustments

A．Unmodulated R－F signal into Converter Grid by moons in lead of 22 K ohmz and 5000 mmf Connectod fo piltor det．Lood resistor，（R－100） 4700 ohms，in sorios with peaking coil（L．6）from Pin 7 of 6ALS．Input signal
lovel should be such that output is loss than 2 volts DC．Apply $-4.5 V$ battery bias on AGC line．

## FREQUENCY

ADJUST

| 25.2 MC | Converter plate coil on top of tuner for maximum de at picture detector． |
| :---: | :---: |
| 23.1 MC | lst picture I－F coil（T－1）for maximum de at picture detector． |
| 25.9 MC | 2nd picture l－F coil（T－2）for maximum de ot picture detector． |
| 24．1 MC | 3rd picture I．F coil（T－3 below chassis）for maximum de at pic－ ture detector． |
| 21.7 MC | 3rd picture l．F trap（ T .3 in can above chossis）for minimum de at picture detector． |

1．F Sweep Generator into converter grid by means of rube shield insulated from base．
Connect oscilloscope across R－100（in place of VTVM）， Apply－4．5V bias（DC）to AGC line（battery）．
Tuner should be switched to dead channel so as not Toberv interference．
Observe overall I－F response，which should be as
shown above：A slight touch－up may be required．At shown above：A slight touch－up may be required．At
no time should the trap coil be pe－diusted，nor shauld it be necessary to turn any of the picture I－F coils more than $1 / 2$ turn of the slug．The following com－
ments are suggestions only：


Fig． 9 ．．Bottom Chassis Video and Audio I－F Adjustments


Fig． 12 －Overall Response Curve
1．The hoight of the 26.2 MC morker is controlled by the 25.2 MC （Converter Plate Coil on tuner）and
the 25.9 MC （2nd P．1F）coils． the 25.9 MC（2nd P．I．F．）coils．
2．The uniformity of response（flatness across top and position of 23.5 MC ）marker is controlled for
the most part by the 24.1 MC third picture l．F coil．
3．The 23.0 MC marker position is controlled by the

ALIGNMENT PROCEDURE（Continued）
advisable to change the setting of the coil，due to
its offect on sound reiection．lits adiustment should be avoided unless believod to be absolutely neces． sary．

## VIDEO

With 4．5 MC unmodulated signal from a high impedance source，（ 10,000 othm in series with the generator）into VTVM on pleture tube gridd tune 4.5 MC trap（L． 7 Top） for minimum response．VTVM on $0-10 \vee$ AC scale．This
adjustment can also bo made while observing a picture adjust ment can also be made while observing a picture
from a station．Tune trap for least 4.5 MC beat in pic．

## AUDIO I．F

1．With signal generator set to 4.5 MC and de VTVM con nected to iunction of R－62 and C．46，adjust sound ake－off coll slugs（T．O Top \＆Botam）for maximum．
2．With YTVM connected to pin 7 of $\mathrm{V}-12$（6ALS）adjust
．The rario detector primary（ $T .7$ Bottom）for maximum．
With VTVM connacted to inction of R．66，R－69 and cross over（zero valtage）on lowest scole．
NOTE－－If no signal generator is available，the pro． cedure above may be followed by tuning in a station and using the 4.5 MC beat between picture and sound

## TUNER ALIGNMENT

A．Swoop generator with bolanced 300 ohm output to antenna terminais．Marker generator output to antenno an tuner．Connect $1 / 2 \mathrm{~V}$ bios to AGC line at iunction
of R .33 and C .20 on the


Fig． 13 ．．Top Tuner Adiustments
B．RF AND CONVERTER AD JUSTMENT．
1．With channol selector on Channal 12，adjust C－201 slightly favoring the Pix carrier，then odiust C－20 and C －209 for response as in Figure 14．Pictur
2．Check response on all channels．If markers are be low 70\％on any channels，readlust
and $\mathrm{C}-209$ ．Recheck oll dhannels．


C．OSCILLATOR ADJUSTMENT
1．Apply -4.5 volts on I－F AGC line at function of
$R \cdot 1$ and $C-21$ ．

2．Connect oscilloscope to output of video detector． Place fine tuning in center of range．Chock res． ponse on all channels．Sound marker should be in
3．It markers are off，individual oscillator coil slugs will require adjustment．Ad iust each channal slugs accessible through hole in front of chassis with of non－metallic screwdriteer to bring sound marker to correct position．
4．To adjust ascillator on UHF position，faed the and markers at 121.75 and 126.25 into the input the low pass filter（autput of UHF funer）．Adius $o s c i l l o f o r ~ s t u g ~ i n ~ t h e ~ V H F ~ f u n e r ~ s o ~ t h e i ~ t h e ~$
pix carrier marker is at $50 \%$ and that 126.25 marker pix carrier marker is at $50 \%$ and that 126.25 marker available，a single frequency generator set to 126.25 MC and VTVM may be used．Connect VTVM to the pix detector lood resistor R－100．Fied generator inta the low poss filter．Adjust oscillator slug in
the VHF tue so that the 126.25 morker is in the the VHF tuen so that the 126.25 morker is in the
sound noter of the I－F cure．
5．If the 6AF4 oscillator tube in the UHF tuner is reploced，it moy be necessary to adiust the oscil．
lator trimmer C． lator trimmer C－ 309 on the UHF tuner located under－
neath the chersis．（See Figure 15 ）．Adiust this neath the charris．（ 5 ee Figure 15）．Adiuat this
trimmer until the funer will cover a range of below 470 MC to above 890 MC．


MODELS 2D1331C，D


OJohn F. Rider

## OSCILLOSCOPE WAVEFORM PATTERNS

The waveforms on this page were taken with the receiver tuned to a normal picture. The numbers on the waveforms correspond to the numbers on the schematic diagram The voltages shown test point.
mate peak to peak amplitudes. The frm are the approxi-

No. 3-Pix Tube Grid
$20-100 \mathrm{~V}$ P.P 60 c.p.S.



No. $10-65 N 7$. GTA $\begin{aligned} & \text { Vert. Output Grid } \\ & 150 \mathrm{~V}\end{aligned}$


No. 6-12ATV Phose Splititer Cothode
No. ${ }^{11}$-Vort. Dof. Coil
100 V P.P 60 C.p.S.
No. 17-6BQ6
120 V P.p
15,750
c.p.S.


No. 6-12AT7 Phase Splititer Coihode
18V P.p
15,750 C.P.S.
No. ${ }^{12-6 A U 6}$ A.G.C.
$450 V$ p.p 15,750 C.p.S.
No. 12-6AX4-GT Do.mper Plate
120V P.P 15,750 C.P.S.
d
dicates the repetition rate of the waveform, not the sweep rate of the oscilloscope. If the waveforms are observed
on the oscilloscope with a poor high frequency response, on the oscilloscope with a poor high frequency response,
the corners of the pulses will tend to be more rounded the corners of the pulses will rend to be more rounded frequency pulse will tend to be less.


No. 5-6BE6 Syce Sep. Plato
 ssov p.p 1 S.ss

REPLACEMENT PARTS LIST .- Con't.

## CAPACITORS

LIST
PRICE

|  | $80 \times 1$ | 1000 mmf |  | Coramic |
| :---: | :---: | :---: | :---: | :---: |
| $\left.\begin{array}{l} \mathrm{C}-2 \mathrm{~A} \\ \mathrm{C}-2 \mathrm{~B} \\ \mathrm{C}-21 \mathrm{~A} \end{array}\right\}$ | $80 \times 3$ | 1000 mmf |  | Dual Coromic |
| C-6 | $47 \times 603$ | 47 mmf | 500 V | Caramic |
| c. 7 | Part of T.3 |  |  |  |
| c. 8 | $47 \times 562$ | 5 mmf | 500 V | Coramic |
| c. 9 | $47 \times 584$ | 1.5 mmf |  | Composition |
| C.10 ${ }_{\text {C. } 67}$ | $47 \times 568$ | 360 mmf | 500 V | Molded Mico |
| $\left.\begin{array}{l} C_{11} \\ c_{27} \\ C_{58} \\ C_{72} \\ C_{-77} \end{array}\right\}$ | RCP 10m473m | . 047 mf | 400 V | Tubular |
| C.12 $\substack{\text { C.66 } \\ \text { c.74 } \\ \text { c }}$ | RCP 10M4104M | . 1 mf | 400 V | Tubula |
| C. 13 C 37 | RCPIOM6473M | . 047 mf | 600 V | Tubular |
| C. 14 | RCPIOM6153M | . 015 mf | 600 V | Tubular |
| C-15 | RCPIOM2IOMM | .1 mf | 200 V | Tubular |
| $\left.\begin{array}{l} c_{2} 20 \\ c_{-23} \end{array}\right)$ | RCP10m2224M | . 22 mf | 200 V | Tubular |
| $\left.\begin{array}{l} \mathrm{C}-25 \\ \mathrm{C}-56 \\ \mathrm{C}-60 \end{array}\right\}$ | RCPIOMA103m | . 01 mf | 400 V | Tubular |
| $\begin{aligned} & \text { C.30A) } \begin{array}{l} (-30 \mathrm{~B} \\ \mathrm{C} 30 \mathrm{C}) \end{array} \end{aligned}$ | $45 \times 392$ | $\begin{aligned} & 20 \mathrm{mf} \\ & 40 \\ & 10 \mathrm{mf} \\ & \mathrm{mf} \end{aligned}$ | $\begin{aligned} & 400 \mathrm{~V} \\ & 500 \\ & 400 \mathrm{v} \end{aligned}$ | Dry Electroistic |
|  | Port of $76 \times 7$ | (Saes Miscel | Ilaneous | us) |
| C-32 ${ }_{\text {c-65 }}$ ( | $47 \times 543$ | 4700 mmf | 500 V | Molded Mleo |
|  | RCPIOM472m | . 0067 mf | 400 V | Tubulor |
|  | 47x604 | 100 mmf | 500 V | Cerame |
| c. 354 C-35B S | $45 \times 391$ | $100 \mathrm{~mm}$ | $\begin{array}{r} 50 \mathrm{~V} \\ 400 \mathrm{~V} \end{array}$ | Diy Electrolytic |
| c.36 C-39 - | RCPIOm6Iorm | . 1 mf | 600 V | Tubulor |
| c. 38 | RCP10M6103m | . 01 mf | 600 V | Tubular |
| c-1 | $45 \times 361$ | 4 mf | 100 V | Dry Eloctrolyic |
| C-12 | Port of L. 13 |  |  |  |
| $\left.\begin{array}{c} C-43 \\ c-4 \end{array}\right)$ | Part of T-6 |  |  |  |
|  | $47 \times 507$ | 5000 mmf |  | Coromic |
| C-48 | Port of T . 7 |  |  |  |
| C.51 | 45×378 | 5 mf | 25 V | Dey Eloctrolytie |
| C. 52 | RCPIOM2AT3M | . 047 mf | 200 V | Twuler |
| C. 53 | 47X52 | 470 mmf | 500 V | Molded Mica |

CAPACITORS .. Cantinue
PRICE C. 57 Port of $76 \times 5$ (Seo Miscellaneous) $\begin{array}{llll}\text { C. } 59 & \text { RCP } 10 M 6472 M & .0047 \mathrm{mf} & 600 \mathrm{~V} \text { Tubulor } \\ \text { C. } 62 & \text { RCM20A271K } & 270 \mathrm{mmf} & 500 \mathrm{~V} \text { Molded Mlec }\end{array}$
 c. 75 Part of Daflection Yoke Aizembly $\begin{array}{ll}\text { C. } 75 & \text { Port of Defloction Yoke Assombly } \\ \text { C. } 76 & \text { RCP10ma } 154 M \quad .15 \mathrm{mf} 400 \mathrm{~V} \text { Tubular }\end{array}$
 $\begin{array}{lll}\text { C. } 79 \mathrm{~A}) & 4 \times 390 & 60 \mathrm{mf} \\ \mathrm{C} .90 \mathrm{~B} & 400 \mathrm{~V} & \text { Dra Electrolytic }\end{array}$ .3
. 20 RESISTORS
 $\begin{array}{llllll}.20 & \left.\begin{array}{llll}R-2 \\ R .5\end{array}\right\} & 88347047 & 0.5 & \text { Cabbon }\end{array}$


$\begin{array}{lllll}\text { R-8 B8181 } & 180 & 0.5 & \text { Corbon }\end{array}$
. 35 R.9) B84 152 R $1.5 \mathrm{~K} \quad 0.5$ Corbon
. 30 R. 10 Part of L. 5

.45 $\begin{array}{lllll}\text { R.13) } \\ \text { R.19) } & \text { B\& } 105 & 1.0 \text { meg. } & 0.5 & \text { Corbon }\end{array}$
$\begin{array}{lllll} \\ .25 & \begin{array}{lll}\text { R-14) } \\ \text { R-60) } \\ \text { R.15 }\end{array} & \text { B8t101 } 100 & 0.5 & \text { Carton of L.10 }\end{array}$ $\begin{array}{ll}\text { R.15 } & \text { Port of L. } 10 \\ \text { R.16 } & \text { C83472 } 4.7 \mathrm{~K}\end{array}$
$\begin{array}{lllll}\text { R.16 } & \text { C83472 } & 4.7 \mathrm{~K} & 1.0 & \text { Carbon } \\ \text { R.188) } & \text { B85104 } & 100 \mathrm{~K} & 0.5 & \text { Cosbon }\end{array}$
$\mathrm{R}-20$ )
R .63 ) B84333 $33 \mathrm{~K} \quad 0.5$ Corbon $\begin{array}{lll}\mathrm{R}-22)^{2} & 78 \times 12 & 1.5 \mathrm{~K} \\ \mathrm{R} .71 & 7.2\end{array}$


$3.70 \begin{aligned} & \text { R.26) } \mathrm{R} .74 \text { ) B85473 } 47 \mathrm{~K}\end{aligned}$
$.5\left(\begin{array}{c}\text { R.28) } \\ \text { R. } 24 \\ \text { R.78 } \\ \hline\end{array}\right)$ Be4104 100 K

$\left(\begin{array}{llll}R-29) \\ R-30) & 885151 & 150 & 0.5 \\ R & \text { Corbon }\end{array}\right]$
$\begin{array}{llllll}\text { R.31 } & \text { B84275 } & 2.7 \text { meg. } 0.5 & \text { Corbon } \\ \text { R } 32 & \text { B83334 } & 330 \mathrm{~K} & 0.5 & \text { Carbor }\end{array}$



.30 R.37 BL2274 $270 \mathrm{~K} \quad 0.5$ Cerben

LIST

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## ELECTRICAL SPECIFICATIONS



MODEL NO. 2DI336A


Fig. 1 .. Tube Loyout.
Power Supply ...................... $105-125$ Volts AC
60 Cycles Only

## TUBE COMPLEMENT

| ymbol Type | Function |
| :---: | :---: |
| VHF Tuner. $6 \mathrm{J6}$ | R-F Osc. and Mixer |
| VHF Tuner..6BQ7* | R-F Amplifier |
| UHF Tuner..6AF4 | R-F Osc. |
| UHF Tuner.. ${ }_{1}$ N 822 or | Crystal Mixer |
| V-1.......... 6CB6 | 1st Pix l-F Amplifier |
| V-2.......... 6CB6 | 2nd Pix l-F Amplifier |
| V-3........... 6CB6 | 3rd Pix I-F Amplifier |
| V-4A \& B .. 6ALS | Pix Det. and DC Restorer |
| V-5 A \& B .. 12AT7 | 1st Video Amp. and Phase Splitter |
| V.6 ........... 6AH6 | Video Output |
| V-7 ........... 6BE6 | Sync. Separator |
| V-8.......... 65N7-GTA | Vertical Osc. \& Vertical O |
| V.9 ........... 6AU6 | Automatic Gain Control |
| V.10 .......... 6AU6 | 1st Audio I.F |
| V.11..........6AU6 | 2nd Audio i-F |
| V.12.......... 6ALS | Ratio Detector |
| V.13.......... 6AV6 | 1st Audio Amplifier |
| V.14......... 6AQS | Audio Output |
| V.15......... 6AL5 | Phase Detector |
| V-16 .......... 65N7-GTA | Horizontal Oscillator |
| V.17 ..........6BQ6-GT | Horizontal Output |
| V-18..........6AX4-GT | Damper |
| V-19.......... 183-GT | High Voltage Rectifior |
| $\begin{aligned} & \text { V-20)......... 5U4-G } \\ & \text { V-22)... } \end{aligned}$ | Low Voltage Rectifiers |
| v-21 .......... 17HP4 | Picture Tube 17" Glass Rectangular (Electrostatic) |


Fig. 2 .. Frant Panel Contrals

## TUNING PROCEDURE

1. To turn the television receiver on, furn the OFFON VOLUME control clockwise until a click is heard. worm up.
2 Turn the STATION SELECTOR control to the do sired channel. This control may be turned in either direction.
2. Turn the CONTRAST control clockwise until activ,
3. Adiust the FINE TUNING control for clearest pic
OCCASIONAL ADJUSTMENTS TO IMPROVE PICTURE RECEPTION

There are four controls of the front of the chassis which are accessible whon the hinged control panal is pulled downword. Soe illustration above. These controls
dre pre-sot of the factory and moy occasionally need are preseot of the factory and moy occasionally noed
adjustment due to aging of the components in the readjustment due to aging of the components in the re-
ceiver and coliver
aroos.
5. To turn off the recoiver, turn the OFFON VOLUME

6. TONE CONTROL .- When this control is turnod clockwise, the high notos will prodominate and whion iturnd
result.
7. In localities where UHF programs are available, turn the STATION SELECTOR controi to the UHF position and tune in the desired station with the UHF Tuning Control. The dial scale is calibratod in channel numbers and eovers the entire UHF range of
channels 14 through 83 .

| HORIZONTAL <br> (diagonal bars.) | BOLD .. Stops horizontol movement |
| :--- | :--- |
| TONE -- Adiusts for tonal quality bass or troble. | VERTICAL <br> movement. |

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When the sync stability control is correctly adjusted The recoiver will hold sync withour learing or rolling
under even the most adverse noise conditions. CHECK OF HORIZONTAL OSCILLATOR ALIGNMENT - Tune in a station and adiust the horizontal hold con tral until the picture falls into sync. Momentarily ro The picture should pull into sync over a renge of $90^{\circ}$ atation of the horizontal hold control. If in the above chack the receiver fails to hold sync or the pull-in range s ar the extreme and on heces. sary to make the following adiustment. HORIZONTAL FREQUENCY ADJUSTMENT .- With the horizontal hold control set to the center of its range
ootation, adjust the horizontal frequency control (L-14) until the picture pulls into symc. Recheck the "Horl zontal Oscillator Alignment.'
HEIGHT AND VERTICAL LINEARITY ADJUSTMENT fills Adiust the mask vertically. Adiust the vertical linearity control ( $R$-49) until the picture is symmetrical from top - bottom. Adjust the picture centering device to align picture with the mask. Adjustment of any control WIDTH, DRIVE AND LINEARITY ADJUSTMENTS While receiving a signal from a stotion (with picture clockwise, turn the brightriess control ( $R$ - 25 ) up so hat the picture appears washed out. Adiust width con rol (L-15) until the picture fills the mask. Turn the
horizontal drive control (R-89) clockwise until white bars oppear in the left center portion of the raster, then turn counter-clockwise until the white bars just disoppeor. This adustment iffoliow ho horizonsi systom to operate at maximum officiency. Adiust
zontal linearity contral (L-16) for best adjustment of the horizontal drive (R-89) or horizonta linearity (L-16) is required, it usually will be neces. sory to rechack the horizontal oscillator alignment.
If adiustment of the horizontal linearity control (L-16) is required, readiustment of the horizontal drive conis required, readiustment. (R-89) will be necossary. Adiust the picture center-
ing device to align the picture with the mask.

ADJUSTMENT OF AGC THRESHOLD CONTROL Tune the receiver to the strongest station in the area in which the receiver will bused. While observing the picture ack until signs of overloading (buz $z$ in
trol sound, washed-out picture) appear. Then turn the control a fow degrees counter-clockwise from the point at which overlooding occurs. (The stronger the signal in-
put, the more counter-clockwise this setting will bo.) put, the more counter-clockwise this setting will be.)
In areas where the strongest signal does not excoed 10,000 uv the setting will usually be maximum clock.
wise. With the control set correctly, the $A G C$ will wise. With the control set correctly, the AGC will
outomatically adjust the bias on the R.F. and I.F. auplifiers so that the best possible signal to noise ratio (Minimum snow) will be obtained for any signal
input to the receiver.
ADJUSTMENT OF SYNC STABILITY CONTROL When receiving strong (500 MV or more) signols, sot hold controls so that the pieture is locked in. Turn the
sync control fully counter-clockwise, then, while observing the picture, turn the control slowly clockwise until o minimum omount of bending occurs. If the control is sot incorrectly bending, tearing, otc., will be present and when switching from chome will not lock in quickly.
In weak signal areas the control should be set for maxithe more clockwise the control should be turned.


Fig. 4 . Adjustments Rear of Chossis


Fig S Tuncer Oscillator Adustments

CHECK OF R.F OSCILLATOR ADJUSTMENTS
The oscillator is pre-sot ar the factory and normally needs no odiustment. However, if adiustments ore re from the cobinat. Remove the channel selectar and fine tuning knobs from the tuning shoft.
TEST PRODEDURE:

1. Sot chonnel selector to receive desired station.
${ }_{2}$ Set fine funing control in conter of its range.
${ }^{3}$ Adiust oseillotor slug, with bokelite type scre
2. Repeot stops 1,2 and 3 on all chonnels used.

CAUTION -- These adiustments are only intended for
VHF Chonnels. For information regarding UHF olignment, see poragroph "otuner Alignment" on page 11



Fig. 6 - Botrom Socket Voltoge:

## SERVICE SUGGESTIONS

NO RASTER ON PICTURE TUBE .- If rastor cannot be obtained check bolow for the possible caus

1. Ton trap magnet adjustment is incorrect. 2. No tr voltage. Check $4 / 10$ ampere fuse. Roplace if defective. If fuse continually burns out, check
(A) Horizontal output tube $V .17$ ( $6 \mathrm{BQ} 6-\mathrm{GT}$ )
(B) Check da mpor tube V -18 ( $6 \mathrm{AX} 4-\mathrm{GT}$ ).
(C) Check horizontal oscillator tube V. 16 (6SN7-GTA)
(D) for proper operation.
(D) With an ohm notor, chock (B) Corminal 1 of the check for a short betweon
it -9 ) orizontal output transformex Iominal of the h
(T.9) and the chassis.
Check DC
(E) Chock DC resistance of T-9

No high voltage. Check V-17, V-18 and V-19 tubes
and circuits. if the horizontal deflection circuits operating as evidenced by the correct voltage ( 600 V oparating as ovidencod by the corract voltage (600 isolared to the high valtage rectifier circuit. Either
the high voltage winding to the $68 Q 6$-GT plate and the high voltage winding to the $68 \mathrm{BQ6}-\mathrm{GT}$ plate and
iB3 plate is open, tube $V-19$ is defective, its fila ment circuit is opon, R-99 and C. 78 defoctive or pix tubb elements shorted internally.
Defective picture tube heater open or cathode return circuit open.

HORIZONTAL DEFLECTION ONLY - If only horizontal deffection is obtained as ovidenced by a straight coused by the following:

1. Vertical oscillator and vertical output tube $V .8 \mathrm{in}$ -
2. Opertitive. Check sockes voltagos.
3. Vortical output transformer (T-5) open or shortad.
4. Vortical output transformer (T-S) open or shorted.
5. Yoke vertical coils open or shorted.
6. Vertical hold, height or linearity controls may be
7. Vertical hold, height or linearity controls may be dofective

POOR VERTICAL LINEARITY-I If adiustment of the
height and linearity controls will not correct this conhoight and linearity controls will nat correct this
dition, any of the following may be the cause.

1. Check yariable
2. Chock variable resistors R-49 and R-54.
3. Vartical output transformer ( $\mathrm{T}-5$ ) dafoctivo
4. Capacitors C-35A, C-39 or C-70 dofective.
5. V-8 dofective, ehock voltrages.
6. Excess look age or incorrect value of capocitor C-37,
or open or incorrect value of resistors R-55 \& R-56.
7. Low plate voltages. Check rectifior tube and capac7. Cors in +B supply circuits.
8. Capacitor C-36 defective.
9. Vortical deflection coils (L-12) defective

POOR HORIZONTAL LINEARITY .- If adiustment of the Horizontal drive and linearity controls does not 1. Check or roplace horizontal output tube V - 1 1. Check or replace damper tube V-18 (6AX4GT).
3.
3. Check eapacitors C-74, C-76, C-77 and horizontal
4. Horizontal deflection coils (L-17). defective.

TRAPEZOIDAL OR NONSYMMETRICAL RASTER
WRINKLES ON LEFT SIDE OF RASTER - This con dition can be caused by: 1. Defective yoke due to C. 75 or R-98 (internal in yoke assembiy) abeing wrong value or open. Thase 2. $V$ - 18 ( $6 A X A-G T$ ) dofective.

SHLLL RASTER - Thls condition con be cauzed by:

1. Low +B or line voltago. Check $V-20$ \& $V-22$ ( $5 U 4 \mathrm{G}$ ) 1. Low +B or line voltage. Check $\mathrm{V}-20$ \& $\mathrm{V}-22$ (5U4G).
2 Insufficient output from horizontal output tube $\mathrm{V}-17$. Roplace tuba.
2. Insufficient output from vertical oscillator and verti4. cal output fube V-8. Roplace tube.
3. $\mathrm{V}-18$ ( $6 \mathrm{AX} 4-\mathrm{GT}$ ) defective) drive control R-89.
4. Incorroct setting of (L-15) widh control.
5. 

RASTER; NO IMAGE, BUT ACCOMPANYING SOUND 1. This condition can be caused by

1. No signal on picture tube grid. Check V-5A (12AT7) 2. Bad contact to picture tubsociated circuits.
2. AGC tube (V-9) may be defective. Check tube and
its associatod circult. circu
SIGNAL APPEARS ON PICTURE TUBE GRID BUT IMPOSSIBLE TO SYNCHRONIZE TUBE GRID BUT
VERTICALLY AND HORIONTICTHRE of this nature can be causod by:
3. Defoctive sync soparator V-7 or phase splitter V-5B.
chock voltages,
4. AGC system inoperative. Chock V-9 (6AU6) AGC tube and associoted circuits.
SIGNAL ON PICTURE TUBE GRID AND HORIZONTAL SYNC ONLY .. If this condition is encountored, chock

Vertical hold control (R-51) defoctive.
SIGNAL ON PICTURE TUBE GRID AND VERTICAL 1. V. 15 of V. 16 defective.
5. V. 15 or V. 16 defective.
6. Improper sotting of (L. 14 ) horizontal frequency an
7. Improper setting of (L-14) horizontal frequency con-
trol.
theck setting of horizontal drive control ond horizontal linearity control.
V. 15 and V - 16 sock at voltages.

PICTURE STABLE BUT WITH POOR RESOLUTION f the picture resolution is not up to standard, it may be caused by ony of the following:

1. Dofective pix $1-F$ fobes $V \cdot l,{ }^{2}, ~(6 C B 6 ' s)$.
 plifier V-5A or video output V-6'(6AH6).
2. Opect video peaking coil. Check all peaking coils

3. Loote that L-5, L-9, L-10, L-11 have shunting rosistors.

Leak age in V.- ( 6 ANG ) grid copacitor C-11. If the copacitor
following:

1. Chock all potentials in video circuits.
2. Check picture tube grid circuit for poor or dirty
3. Check ond reolion, if necessary, the picture I-F
ond R-F circulits.

ICTURE SMEAR:
. A smear can be attributed to phase shift at the low or high frequency ond of the vidoo cheactoristic. This can be caused by 1 mprop ar valuas of rossistor.
and capacitors in the video circuits. Check for grid and capacitors in the video circuits. Check for grid
current on video output tube V. 6 (6AH6), open or shortod peoking coils, video amplifior load resistors are of improper value (high).
This trouble can also originate at the transmittor.
3. Check ond realion, if nocessary, the picture I-F and

MAN mADE NOISE IN SOUND (Ignition, etc.)
Chack sound $1-F$ tubes $V-10,11 \& 12$ and associated circuits.

BENDING OR S-ING
. Check sync stability control adjustment.
2. Check copacitors $\mathrm{C}-35 \mathrm{~B}$ and C - 79 B .
3. V - 17 ( $6 \mathrm{BQ6}-\mathrm{GT}$ ) defective or $\mathrm{V}-16$ ( 6 SN7-GTA) de
3. V - 17 ( $6 \mathrm{BQQ6-GT}$ ) dofective or $\mathrm{V}-16$ (6SN7-GTA) de-
foctive.
4. Chock syme separator tube V-7 (6BE6) and phase
splitior $V$. $5 B$ (12AT7) and $V-5 A(12 A T 7)$ video
amplifior Chplor.

PICTURE NORMAL - NO SOUND OR WEAK OR
DISTORTED SOUND

1. Check sound I-F alignment.
2. Check V-10 (6AU6) V-11 (6AU6) V-12 (6AL5) V. 13
$(6 A V 6)$ V- 14 (6AQ5) and as cociated cirevits

RASTER ON TUBE BUT NO PICTURE OR SOUND This condition can be caused by,

1. Defective plx I-F Amplifier tubes $\mathrm{V}-1, \mathrm{~V}-2$ or $\mathrm{V}-3$.
2. Defoctive pix dotector tube $V-4 A$ ( $6 A L 5$ ). Check
tube and its associated circuit.
3. Dofoctive R-F Amplifior or oscillator mixor tuben
in the funor. UHF-VH

POOR FOCUS
. Improper setting of lon Trap magnot.
2. Defective picture tube or picture tube socket.

## PICTURE JITTER

. If regular soctions of laft of the picture ore dis
placed, replace the horizontal oscillator tube $V-16$.
2. Yertical instability may be due to loose connec-

## ALIGNMENT PROCEDURE

TEST EQUIPMENT .. To service this receiver properly, it is recommonded that the following test equipment be available:

R-F SWEEP GENERATOR mooting the following re
Frequency rangas
18 to $30 \mathrm{mc}, 10 \mathrm{mc}$ swoop width
40 to $90 \mathrm{mc}, 10 \mathrm{mc}$ sweop width

(b) Output adiustable with at least . 1 volt maximum.
(c) Output constont on all ronges.
(d) Flat output in all atrenuator positions.

CATHODE-RAY OSCILLOSCOPE proferably one with o wide band vertical deflection and an input calibrating

SIGMAL GENERATOR to provide the following fro quancies: (Output on these ranges should be adiustable and at least 1 volt maximum.)
a) intermediate alignment frequencies
23.1 mc first picture $1-\mathrm{Fc}$ coil.
24.1 me third pieture $1-\mathrm{F}$ coil.
24.1 mc third picture l-F coil.
25.9 me second picture I-F coil.
25.9 mc second picture l-F coil.
21.7 me sound $\pi$ op.
21.7 me sound top.
25.2 mc vidoo trap alate coil (Tuner).
3. Horizontal instability may be due to unstable trane
4. Check recoiver AGC systam for proper aporation.
5. Check phase eplittor V-5B, (12AT7) and sync
6. Check for improper setting af sync stability control
7. Picture tube grid lead not held in pasition by sup port spring, ie; close proximity of grid lead to syn
ond horizontal tubes will cause pleture to litter a and horizontal tubes will cause pleture to littor a high contrast sotting.
8. Check AGC threshold control

NO PICTURE OR SOUND OR WEAK PICTURE OR SOUND (UHF Position)
If this condition is encauntered

1. Check to see whother or not a UHF station is oper ating in the vieinity.
2. The 6AF4 oscillator tube or the $1 N 72$ (or IN82)
crystal may be defective.
3. Praselector in UHF tuner defective.
4. Low pass filter dafective.
5. The UHF position antenna and oscillator strips in tive Switch on UHF

HETERODYNE FREQUENCY METER with crysial caliHeTER it the ir

ELECTRONIC VOLTMETER and a high voltage probe for wse with this moter to permit measurements up to 20 kilovolts.

SERVICE PRECAUTIONS .- To service the recoiver re nove the cha ssis from the cabinet. To do so, remove the
knobs, the cabinet bock, disconnect the leods from the spoaker, remove the antenna terminal board at rear of cabinet, ond then the 5 chassis mounting bolts. The
chassis may be serviced with the picture tube in place provided the chassis is turned on its side with in place transformer on the bottom. The weight of the chassis will be supported against the power tanaformer and pix tube

CAUTION: Do not permit the kinescope second-anode cad to become shorted to the chassis. To do so will cause a considerable overload on the high voltage filtor resistor R- 99.
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## OSCILLOSCOPE WAVEFORM PATTERNS

The waveforms on this page were taken with the receiver tuned to a normal picture. The numbers on the waveforms which identifies each test point The voltages shown on each wave mate peak to peak amplitudes. The frequencies shown in
cates the repetition rate of the waveform, not the swee rate of the oscilloscope. If the waveforms are observed on the oscilloscope with a poor high frequency response, than those shown below and the amplitudes of any high frequency pulse will tend to be less.
fequency pulse will tend to be less.

$\begin{array}{lll}\text { No. } 1-\text { - AAL5 Pix } \\ \text { 3.5V P.P } & \text { Dot. Plote } \\ \text { C.P.S. }\end{array}$

$\begin{array}{lll}\text { No. } & \\ 3512-12 A T 7 & \text { Plote } \\ 350 \\ \text { P.p } & 60 & \text { c.p.s. }\end{array}$


No. 7-12AT7 Phase Spliter Plate
45V P.P 60 C.P.S.


No. 13-6AL5 Phase Det.
18V P.P 15,750 C.P.S.


No. 3-Pix Tube Grid
No. 9 -6SNT.GTA Vert. Osc. Grid
130 Y P.P 60 c.p.S.
No. ${ }^{15-65 N 7}$ Hor. Ose. Grid
48 V p.
15,750 C.P.S.


No. 16-6SN7 Hor. Osc. Plo


No. $17-6896$ Grid
120 V P.p 15,750 C.P.S.


No. ${ }^{12-6 A U 6}$ A.G.C.
450 Y P. P 15.750 C.P.
1


NOTE , There cre two different ratio detector transformers used in these recelvers, Part numbers 9 A2269 and 9A2295. The T - 7 circuit shown in this schematic diagram covers the 9 A 2269
ratio detector. Recalvers using the 9 A 2295 rotio detector can be identified by the following changes:

${ }^{2}-68$ ) bocome B83 103 loK ohm $0.5 W$ earbon resistors.


ELECTRICAL SPECIFICATIONS Power Supply .............. 10 5-125 Volts AC


Power Output .............. $\begin{aligned} & \text { 2.4 Watts (Max.) } \\ & 1.8 \text { watts ( } 10 \% \text { Distortion) }\end{aligned}$
Tuning Ronges ............ TV-12 Channel
Intermedi ote Freq. (Tel.) Picture-26.20 MC $\begin{gathered}\text { Sound-21.70 MC }\end{gathered}$
Intermediate Freq.
(Rodio) ............
Selectivity (Radio) ........AM-45 KC Broad at 1000 Times

Tel. Antenna Input Imp. . 300 Ohms Balanced
Loud Speaker .............. 8"' PM Dynamic
Voice Coil Impodance ... 3.2 Ohms 400 Cycles

TUBE COMPLEMENT
TV CHASSIS



Fig. 1 .- Tube Layour.

This television receiver contains high voltages which are out side of the cabinet or with the or service the receiver the safety precautions necessary fors working until al voltage equipment have been observed. working with hig
veraution necessary for
PICTURE TUBE

HANDLING PRECAUTIONS antenna with a 300 ohm balanced transmission line. This Shat terproof gogles and heavy gloves must be worn by
line must be as short as possible because the longer the individuals while handling the picture tube or installing line must be as short as possible because the longer the
line the greater the chances are for picking up electrical disturbances. Stand-off insulation should be used to keep
the line away from the mast, meal or walls. Twist this
line about one turn per foot throughout the line to cancel out direct signal and/or noise pickup by the transmission line. It should also be securely anchored in place so that
a change in weather will not affect its position.



Fig. 2. .- Front Panel Controls

## TUNING PROCEDURE

- To wum the television recei ver on, turn the OFF-ON VOLUME control on the radio panel clock wise until
a click is heard. Allow approximately 30 seconds for the tubes to wam up.
Turn BAND SWITCH control on the radio panel to the
TV position. TV position.

3. Turn the STATION SELECTOR control to the dee
sired channel. This control may be turned in either sired channel. This control may be turned in either
direction.
4. Tum the CONTRAST control clockwise until activ-
ity or definite form is noted on the screen.
5. Adjust the FINE TUNING control for clearest pic-
ture and the VOLUME contol for desired volume. To turn of the receiver, tum only the OFF-ON VOL UME control counteclockwise until a click is heard OCCASIONAL ADJUSTMENTS TO IMPROVE PICTURE RECEPTION
There are three controls at the front of the chassis which
are accessible when the hinged contuol panel is pulled are accessible when the hinged control panel is pulled
down ward See illustration on this page. These controls are pre-set at the factory and may oc casionally need ad-
justment due to aging of the components in the receiver justment due to aging of the components in the receiver
and the fluctuating line voltages in different areas. If any adjustments are necessary, follow the instructions
under "Controls and Functions." IMPORTANT -- Be sure that the FINE TUNING control has been set for the clearest picture before adjusting
any controls.

CONTROLS AND FUNCTIONS
HORIZONTAL HOLD -- Stops horizontal movement (diag BRIGHTNESS -- Adjusts for desired picture brilliance VERTICAL HOLD .- Stops upward or downward picture

> PICTURE TUBE SAFETY GLASS It will be necessary to clean this glass and the face of the picture tube occasionally. Remove the safery glass ined in the llustration.
CAUTION-UPON REMOVAL OF THE LAST SCREW SUPPORT THE GL THE GL WITS ONE WL FALL FORWARD. IT GENTLY FROM THE CABINET. Clean the safery cloth dampened the the picture tube with a soft lint-free


Fig. 3 -- Remaval of Picture Tube
WARNING - Before handling the picture tube, it will be necessary to remove the static charge. In receivers with glass picture tubes, ground the anode lead to chassis, and
insert an insulated wire from the well in the tube to chasinsert In receivers with metal picture tubes, remove the sis. In receivers with metal picture cubes, remove the
static charge by prounding an insulated wire from the chassis to the metal portion of the tube.
PICTURE TUBE REPL ACEMENT - To replace the picture tube it is necessary to remove the chassis from the ner:

1. Remove the front panel control knobs by pulling them straight from their shafts 2. Remove the cabinet back
2. Disconnect the leads from the speaker and radio chassis, remove the antenna terminal board at the rear of the cabinet and then the five chassis mounting
bolts. Pull chassis CAREFULLY out of the cabinet.
3. Remove the picture tube as shown and outlined in the 4. Remove the picture tube as shown and outined in the the procedire making sure that the picture tube fits close against the picture tube cusbion. If the picture
tube sticks or fails to slip into place smoothly, intube stacks or fails to slip into place smoothly, ip-
vestigate and remove the source of the trouble. Never force the tube. It is important hat all the clips and shims used in mounting the tube be replaced. other-
wise difficulty may be encountered when horizontal wise difficulty may be encounte
or vertical rentaing is required.
FRONT OF CHASSIS
(Accessible After Opening Front Panel Control Cover) Horizontal Hold ....................................................................................................................................................
Brightness
Vertical Hold

NON-OPERATING CONTROLS REAR OF CHASSIS


Fig. 4 .- Adiustments Rear of Chassis

ION TRAP MAGNET ADJUSTMENT .. The ion trap magFrom this position adjust the magnet by me of the mbe. and forth and at the same time rotating it slightly around
the neck of the picture tube until the neck of the picture tube until the brightest raster is
obtained on the picture screen. Reduce the brightess control setting until the raster is slightly above average brilliance. Readjust the ion trap magnet for maximum
raster brilliance and best focus. raster briliance and be st focus. MAXIMUM RASTER
BRILIANCE AND BEST FOCUS OCCUR AT THE SAMF BRILLIANCE AND BEST FOCUS OCCUR AT THE SAME
POINT. Do not sacrifice brilliance for best focus. The on trap magnet adjustment in a very critical one especially
with the electrostatic type zero focus picture sequently, great care should be taken to make tube. Consequently, great care should be taken to
the ion trap magnet is correctly adjusted.
DEFLECTION YOKE ADJUSTMENT -- If the lines of the maske are not horizontal or squared with the picture mask, rotate the deflection yoke until this condition is
obtained. Tightep the yoke adjustment wing screw. CENTERING ADJUSTMENT .- If horizontal or vert centering is required, adjust each ring in the centering de vice until proper centering is obtained. If a clamp type centering device is used, rotate the device to the left or
right and turn the knob located at the top of the device until picture is centered correctly.
PICTURE ADJUSTMENT -- For further adjustments, ob-
tain a test pattern on the receiver. Turn on receiver and rain a test pattern on the receiver. Turn on receiver and
follow tuning procedure on page 4. When a test pattern is obtained it may be necessary to slightly re-adjust the fine tuning control for clearest picture.
ADJUSTMENT OF SYNC STABILITY CONTROL When controls so that the picture is more) signals, set
hold col in. Turn the sync control fully counter-clockwise, then, while observing the picture, turn the control' slowly clockwise
until a minimun amount of bending occurs. If the control
is set minection until a minimum amount of bending occurs. If the control
is set ncorrectly bending, tearing, etc., will be present
and when switclin. from channel to channel the picture and when switchin, from channel to channel the picture
aill not lock in quickly. will not lock in quickly.
In weak signal areas the control should be set for max-
imum picture stability. In general the weaker the signal imum picture stability. In general the weaker the signal
the more clockwise the control should be turned. When the sync stability control is correctly adjusted the receiver will hold sync without tearing or rolling under
even the most adverse noise conditions. CHECK OF HORIZONTAL OSCILLATOR - Tune in a station and adjust the horizontal hold cont trol until the picture falls into sync. Momentarily remove
the signal by switching off channel and then bat the signal by switching off channel and then back. The
ficture should pull into sync over a range of 90 rotation of the horizontal hold control. If in the above check
the receiver fails to held sync or the pullein rang is at the receiver fails to hold sync or the pull-in range is at
the extreme end of the control, it will be necessary to mak the extree end of the con
the following adjustment.
HORIZONTAL FREQUENCY ADJUSTMENT .- With the horizontal hold control set to the center of its range of rotation, adjust the horizontal frequency control (L-14)
until the pitcure pulls into sync. Recheck the "Horiuntil the picture pulls into,
zontal Oscillator Alignment."
HEIGHT AND VERTICAL LINEARITY ADJUSTMENT - Adjust the height control ( K -54) until the picture fills (R-49) until the picture is symmetrical from top to bot tom.
adjust the picture centering device to align picture with the mask. Adjustment of any control will sequire a re-
adjustment of the other control adjustment of the other control.
WIDTH, DRIVE AND LINEARITY ADJUSTMENTS --
While receiving a signal from a station with picture locked in sync) curn contrast control fully counter-clock wise, turn the brighness control (R-25) up so that the picture appears washed out. Adjust widch control (L-15) until the
picture fills the mask. Turn the horizontal drive control (R-89) clock wise until white bars appear in the left center portion of the raster, then turn counterclockwist
uniil the white bars just disappear. This adjustment
will allow the horizontal until the white bars anst disappear. This adjustment
will allow the horizontal system to operate at maximum
efficiency. Adjust horizontal line best linearity. If adjustment of the horizontal drive ( $(\mathrm{R}-89$ ) or hecesary to recheck the horizontal oscillator align-
be necesser ment. If adjustment of the horizontal linearity control
(L-16) is required, readjustment of the horizontal drive
control ( R -89) will be necessary. Adjust the picture CHECK OF R-F OSCILLATOR ADJUSTMENTS The oscillator is preset at the factory and normally needs no adjustment. However, if adjustments are required,
they can be made without removing the chassis from the they can be made without removing the chassis from the
cabinet. Remove the channel selector and fine tuning cabinet. Remove the channe
knobs from the tuning shaft.

> TEST PROCEDURE:

1. Set channel selector to receive desired station
2. Set fine tuning control in center of its range.
3. Adjust oscillator slug, with bakelite type screwdriver,
for best picture resolution. 4. Repeat steps, 1,2 and 3 on all channels used.


Fig. 5 -- Tuner Oscill ator Adjustment

## SERVICE SUGGESTIONS

NO RASTER ON PICTURE TUBE.- If raster cannot be
obtained check below for the possible causes
1: Ion trap ma gnet adjustment is incorrect.
2: $\begin{aligned} & \text { No }+ \text { +B voltage. Check } 4 / 10 \text { ampere fuse. Replace if } \\ & \text { defective. If fuse continually burns out, check }\end{aligned}$ (A) Horizontal output tube $\mathrm{V}-17$ ( $6 \mathrm{BQ} G-\mathrm{GT}$ )
(B) Check damper tube V - 18 ( $6 / \mathrm{W} 4-\mathrm{GT}$ )
(C) for proper operation.
(D) With an ohm meter, check for a short between terminal of the horizontal output transformer (E) Check DC resistance of T-9.

3: No high voltage. Check V-17, V-18 and V-19 tubes operating as evidenced by the correct voltage ( 600 V ) measured on terminal No. 1 of T-9, the trouble can
be isolated to the high voltage rectifier circuits. Eithe the high voltage winding to the $6 B Q 6-G T$ plate and 183 plate is open, tube $V-19$ is defective, its filament circuit is open, $\mathrm{R}-99$ and $\mathrm{C}-78$ defective or pix
tube elements shorted internally.
4: Defective picture tube heater open or cathode return
circuit open. -

HORIZONTAL DEFLECTION ONLY -- If only hori2ontal deflection is obsained as evidenced by a straight
line across the face of the picture tube, it can be caused by the following:
1: Vertical oscillator and vertical output tube V-8 (6BL7)
2: Vertical oscillator transformer ( $T-4$ ) defective
3: Vertical output transformer ( $\mathrm{T}-5$ ) open or shorted.
4. Yoke vertical coils open or shorted.

5: Vertical hold, height or linearity controls may be de-




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SIGNAL ON PICTURE TUBE GRID AND VERTICAL
1: V-15 or V-16 defective.
2: Improper seting of (L-14) horizontal frequency con-
trol.
3: Check setting of horizontal drive control and horizon-
4: Check $\mathrm{V}-15$ and $\mathrm{V}-16$ socket voltages.
5: If R-90 (see schematic) is connected as shown with
PICTURE STABLE BUT WITH POOR RESOLUTION --
If the picture resolution is not up to standard, it may
1: Defective pix I-F tubes $\mathrm{V}-1,2$ \& 3 , ( $6 \mathrm{CB} 6^{\prime} \mathrm{s}$ ).
2: Defective picture detector $V-4 \mathrm{~A},(6 \mathrm{AL} 5)$ or video am-
3: Defective picture tube.
4: Open video, peaking coil. Check all peaking coils Open video, peaking
$\mathrm{L}-5, \mathrm{~L}-6, \mathrm{~L}-8, \mathrm{~L}-9, \mathrm{~L}-10$ and $\mathrm{L}-11$ for continuity.
Note that $\mathrm{L}-5, \mathrm{~L}-9$ and $\mathrm{L}-10$ have shunting resistors.
5: Leakage in V -6 (GAHG) grid capacitor C-11. If the
capacitor is not found to be defective, check the folcapaci to
lowing:
1: Check all potentials in video circuits.
2: Check picture tube grid circuit for poor or dirty con-
3: Check and realign, if necessary, the picture I-F and R-F circuits.

PICTURE SMEAR:
1: A smear can be attributed to phase shift at the low This can fe caused by improper values of resistors This can be caused by improper values of resistors
and cap acitors in the video circuits. Check for grid and cap acitors in the video circuits. Check for grid
current on video output ube $V=6(6 A H)$ open or current on video output tube V-6 (GAHG, open or
shorted peaking coils, video amplifier load resistors are of improper value (high).
2: This trouble can also originate at the transmitter.
Check reception from another station.
3: Check and realign, if necessary, the picture I-F and
$\mathrm{R}-\mathrm{F}$ circuits.
MAN MADE NOISE IN SOUND (Ignition, etc.)
1: Check sound I-F rubes V-10, $11 \& 12$ and associated circuits.
2: Check sound $\mathrm{F} F$ alignment.
BENDING OR S-ING
1: Check sync stability control adjustment.
2: Check capacitors $\mathrm{C}-35 \mathrm{~B}$ and $\mathrm{C}-79 \mathrm{~B}$.
3: V -17 ( $6 \mathrm{BQ} 6-\mathrm{GT}$ ) defective or $\mathrm{V}-16$ (GSN7-GTA) de-
fective.
4: Check sync separator tube $V-7$ (6BE6) and phase
splitter $V-5 B(12 A T 7)$ and $V-5 A(12 A T 7)$ video amplifier.
PICTURE NORMAL-NO SOUND OR WEAK OR DISTORTED SOUND
1: Check sound I-F alignmenc.
2: Check $v-10$ (GAUG) V-11 (GAUG) V-12 (6AL5) V-13

## POOR FOCUS

1: Improper setting of Ion Trap magner.
2: Defective picture tube or picture tube socket.

PICTURE JITTER:
1: If regular sections at 1 eft of the picture are displaced, replace the horizontal oscillator tube V -16.
Vertical instability may be due to loose connections
or noise received with the si gnal.
Horizontal instabilicy may be due
mitted sync.
4: Check receiver AGC system for proper operation.
5: Check phase splitter V-5B, (12AT7) and sync separa Check phase sp
to 7 ( 6 BE 6 ).
6: Check for improper setting of sync stability control. : Picture tube grid lead not held in position by support spring, ie: close proximity of grid lead to sync and
horizontal tubes will causc picture to fitter at hid contrast setting.

## ALIGNMENT PROCEDURE

TEST EQUIPMENT .- To service this receiver properly it is recon
available.
R-F SWEEP GENERATOR meeting the following requirements:
(a) Frequency ranges:

18 to 30 mc , No. mc sweep width
40 to 90 mc , No. mc sweep width
40 to $90 \mathrm{mc}, \mathrm{No}$. me sweep width
170 to $225 \mathrm{mc}, 10 \mathrm{mc}$ sweep width
(b) Output adjustable with at least .1 volt maximum.
(c) Output constant on all ranges.
(d) Flat oupput in all attenuator positions.

CATHODE-RAY OSCILLOSCOPE preferably one with a wide band vertical deflection and an input calibrating

SIGNAL GENERATOR to provide the following frequen cies: (Output on these r.
least. 1 volt maximum.)
(a) Intermediate alignment frequencies.
23.1 mc first picture I-F coil.
24.1 mc third picture I-F coil.
24.1 mc second picture I-F coil
21.7 mc sound trap.
21.7 mc sound trap.
4.5 mc video trap
4.5 mc video trap \& sound I-F.
25.2 mc converter plate coil (Tuner).

HETERODYNE FRE QUENCY METER with crystal cali-
brator if the signal generator is not crystal controlled ELECTRONIC VOLTMETER and a high voltage probe for use with this meter to permit measurements up to 20 SERVICE PRECAUTIONS
-. To service the receiver remove the chassis from the cabinet. To do so, remove
the knobs, the cabinet back, disconnect the leads from the speaker, remove the antenna teminal board at rea of cabinet, and then the 5 chassis mounting bolts, The
chassis may be serviced with the picture tube in place chassis may be serviced with the picture tube in place
provided the chassis is umed on its side with the po we ransformer on the bottom. The weight of the chassis will be supported against the high voltage housing.
CAUTION: Do not permit the kinescope second-anode cause a considerable overload on the high voltage filter resistor R-99.

ALIGNMENT PROCEDURE (Continued)

| FREQUENCY |  |
| :--- | :--- |
| 25.2 MC | ADJUST |


$\square^{257}$
Fig. 11 - Oscilloscope Connection
B. I-F Sweep Generator into conv
tube shield in sulated from base.

Connect oscilloscope across R-100 (in place of VTVM). Apply -4.5 V (DC) bias to AGC line (battery).
Tuner should be switched to dead channel so as not to cause interference.


Fig. 12 .. Overall Response Curve

Observe overall I-F response, which should be as Observe overall 1-F response, which should be as shown
above. A stight touch hep may be required At no time
should the trap coil be re-adiusted, not should it te necessary to turn any of the picture $1-\mathrm{F}$ coils more than $1 / 2$
tumn of the slug. The following comments are suggestions tum of
only:

RF AND CONVERTER ADJUSTMENT

1. With channel selector on Channel 12, adjust C-201 slightly favoring the Pix carrier, then adjust C-206
and $\mathrm{C}-200$ for response as in and C -20n for response as in Figure 14. Picture
and sound markers at $90 \%$ maximum response.
2. Check response on all channels. If markers are
below $70 \%$ an any channels, readjust $\mathrm{C}-201, \mathrm{C}-206$,

The' height of the 26.2 MC marker is controlled by the 25.2 MC (Converter Plate Coil on tuner) and the 25.9
MC
(2nd P.I.F.) coils.
2. Thee uniformity of response (flatness across top and
position of 23.5 MC ) marker is controlled for the most position of 23.5 MC matre 24.1 MC third picture $1-\mathrm{F}$ coil.
3. The 23.0 MC marker position is controlled by the first picture 1-1F (23.1 NC coil). However, it is NOT ad
visable to change the setting of the coil due visable to change the setting of the coil due to its
effect on sound rejection. Its adjustment should be effect on sound rejection. tits adjustment should be
avoided unless believed to be absolutely necessary. VIDEO
ith 45 NC With 4.5 MC unmodulated signal from a high impedance
source, ( 10,000 ohms in series with the generator) into plate of the picture detector tube (Fin $7-6 A L$ ) and VTVM
on picture tube grid, tune 4.5 MC trap (L-7 Top) for minon picture tube grid, tune 4.5 MC trap ( $\mathrm{L}-7$ Top) for min
imum tesponse, VTVM on ( $1-10 \mathrm{VAC}$ scale. This adjustment ran al so, be made while observing a picture from
meation. Tune trap for least 4.5 NiC beat in picture. station. Tune trap for least 4.5
AUDIO 1-F
: With signal generator set to 4.5 MC and dc VTV. connected to junction of $\mathrm{R}-62$, and
take-off coil (L-13 Top) and sound I-F transformer take-off coil (L-13 Top) and sound I-F transformer
slugs (T-6 Top \& Bottom) for maximum. With VTVM connected to pin 7 of V-12 (GALS) adjust
the ratio detector primary ( $\mathrm{T}-7$ Bottom) for maximum. With VTVM connected to junction of $\mathrm{R}-66, \mathrm{R}-69$ \& $\mathrm{C}-50$ adjust ratio detector secondary ( $\mathrm{T}-7 \mathrm{TOP}$ ) for cross (zero voltage) on lowest scale.
NOTE -- If no signal generator is available, the pro-
edure above may- be followed by tuning in a station cedure above may-be toat between picture and sound catries.

TUNER ALIGNMENT
A. Sweep generator with balanced 300 ohm output to antenna terminals. Narker generator output to an
tena terminals. Osilloscope to "test point", (Figure
th) 133 on tunet. Connect $11 / \mathrm{V}$ bias to AGC line at junc
tion of $1 \mathrm{k}-33$ and $\mathrm{C}-20$ on the receiver.
tion


Fig. 13-- Top Tuner Adiustment
C. OSCILI ATOR ADJUSTMENT.
 Apply -4.5 .
R-1 and $\mathrm{C}-21$.
Connect oscilloscope to output of video detector. Place fine waning in center of range. Check response on all channel s. Sound marker should be
in notch and picture marker at $50 \%$. (See Figure 12).

If markers are off, individual oscillator coil slugs accessible adrough hole in in front each chas chan el slugg, accessible through hole in front of chassis with a
non-metallic. scre wdriver to bring sound marker to orrect position.


Fig. 14 -. Pix \& Audio Markers


Fig. 15 .. 'Q'" Tuner Pictorial

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RADIO INFORMATION
ALIGNMENT PROCEDURE
RADIO

The following is required for aligning：
An all Wave Signal Generator Which will Provide An accurately Calibrated Signal at the Test Fire－ quencies as Listed．
Output Indicating Merer，Non－Metallic Screwdriver， Outpur Indicating，Meter，Non－Metalic Screwdriver，
Dummy Antennas，$-1 . \mathrm{mf}$ ，and 50 mmf ．

| SIGNAL GENERATOR |  |  |  | $\begin{aligned} & \text { GANG } \\ & \text { CONDENSER } \\ & \text { SETTING } \end{aligned}$ | ADJUST | $\begin{aligned} & \text { ADJUST } \\ & \text { FOR } \\ & \hline \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| FREQUENCY SETTING | $\begin{aligned} & \text { CONNECT } \\ & \text { GENERATOR } \\ & \text { OUTPUT TO } \end{aligned}$ | THROUGH DUMmY ANTENNA | $\begin{array}{\|c\|} \hline \text { CONNECT } \\ \text { GROUND } \\ \text { TO } \end{array}$ |  |  |  |
| 455 KC | Control Grid I－F6BA6 Pin No． 1 | ． 1 mf | $\begin{gathered} \text { Chassis } \\ \text { Base } \end{gathered}$ | Rotor Fully Open | $\begin{gathered} \text { 2nd I-F. Pri. (1) } \\ \text { and Sec. (2) } \\ \hline \end{gathered}$ | $\begin{gathered} \text { Maximum } \\ \text { Output } \\ \hline \end{gathered}$ |
| 455 KC | Control Grid 6BE6 Pin No． 7 1st Det． | ． 1 mf | Chassis Bose | Rotor Fully Open | $\begin{aligned} & 1 \text { st I.F. Pri. (4) } \\ & \text { and Sec. (3) } \end{aligned}$ | $\begin{aligned} & \text { Maximum } \\ & \text { Output } \end{aligned}$ |
| 455 KC | Control Grid 6BE6 Pin No． 7 | ． 1 mf | $\begin{gathered} \text { Chassis } \\ \text { Base } \end{gathered}$ | Rotor Fully Open | $\begin{gathered} \text { 2nd I.F. Pri. (1) } \\ \text { and Sec. (2) } \end{gathered}$ | $\begin{gathered} \text { Maximum } \\ \text { Output } \end{gathered}$ |
| 1620 KC | $\begin{array}{\|c\|} \hline \text { Control Grid } \\ \text { R-F 6BA6 Pin NO. } 1 \\ \hline \end{array}$ | ． 1 mf | $\begin{gathered} \text { Chassis } \\ \text { Base } \end{gathered}$ | Rotor Fully Open | Oscillator C．8 | $\begin{gathered} \text { Maximum } \\ \text { Ciutput } \\ \hline \end{gathered}$ |
| 1400 KC | $\begin{aligned} & \text { Control Grid } \\ & \text { R-F 6BA6 Pin No. } 1 \end{aligned}$ | ． 1 mf | $\begin{gathered} \text { Chassis } \\ \text { Base } \end{gathered}$ | Turn Rotor to Max Output Set Pointer to 1400 KC See Note A | $\begin{gathered} \text { Interstage C-6 } \\ \text { See Note B } \end{gathered}$ | $\begin{aligned} & \text { Maximum } \\ & \text { Output } \end{aligned}$ |
| 1400 KC | External Antenna Terminal | 50 mmf | Chassis Base | Turn Rotor to Max．Output． Set Pointer to 1400 KC See Note A | Antenna C－2 <br> See Note 8 | Moximum |
| NOTE A－If the pointer is not at 1400 KC on the dial，reset pointer to the 1400 KC mark on the dial scale． <br> NOTE B－－Turn the rotor back and forth and adjust the trimmer until the peak of greate st intensity is obtained． |  |  |  |  |  |  |



DRIVE CORD REPLACEMENT dial pointer cord Use a new S－10X 77 drive cord assembly or a new length
of cord 48 inches long for the installation．Install the cord as shown in the illustration，winding three turns
cord
counterclockwise around the drive shaft with the terns counterclockwise around the drive shaft with the turns
progressing away from the chassis．After completing progressing away from the chassis．After completing
the installation rotate the drive shaft a few turns to
take up the slack in the cord．
No． $\begin{gathered}18 \\ 120 \mathrm{~V} \\ \text { P．}\end{gathered}$
Volumie Control Naximum all Adjustments． Connect Kadio Chassis to Ground Post of Signa Generator with a Short Heavy Lead Allow Chassis and Signal Generator to＂Heat

$\begin{array}{lllll}\text { No．} & 15 & \ldots & 65 N 7 & \text { Hor．} \\ 48 \mathrm{~V} \text { s．e．} & \text { Grid } \\ & 15,750 & \text { C．P．S．}\end{array}$




 No． 4 A． 63 E6 Sync Sep．
Grid No． 1.2 V P．P 60 C．P．s．

|  |
| :---: |
|  |  |

 35V P．P 60 C．P．S． No． $2 \cdots$ Grat 8 V RP $60 \mathrm{C} . \mathrm{P} . \mathrm{S}$.


教

## 






No． 11 －Vert．Def．Coil
100 V P．P 60 C．P．S．



## Pand <br> No． $7-12$ AT7 Phase Splitter Plate 45 V P．P $60 \mathrm{C.P.S}$.

No． 13 ®－ 6 AL 5 Phase Det．
18 V P－P 15,750 C．P．S．
Tate peak shown on each waveform are the approxi－ dicates the repetition rate of the wave form，nor the swe ep
rate of the oscilloscope．If the wavefoms are observed on the oscilloscope with a poor high frequency response，
the corners of the pulses will tend to be more rounded the corners of the pulses will tend to be more rounde
than those shown below and the amplitudes．of any high than those shown below and the amp！itudes of any high
frequency pulse will tend to be less． correspond to the numbers on the schematic diagram
which identifies each test

##  <br> 

ISNI
$\begin{array}{lll}\text { No．} & 3 \\ 20-100 \mathrm{~V} & \text { Pix } & \text { Tube Grid } \\ 60 & \text { C．P．S．}\end{array}$


No． 5 －$\quad \begin{array}{lll}6 B E 6 & \text { Sync Sep．Plate } \\ 20 \vee P-P & 60 \text { C．P．S．}\end{array}$


No． 6 ．．12AT7 Phase Splitter
18V C．P $\quad 60$ C．P．S．


No． 6 ．－ $12 A T T$ Phase Splitter



## Alddns Oln＊NXヨISヨM 29－カ1 39Vd＾1



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MODELS 2D1344A, B, Ch. 221MS36C-25A2-256

| RESISTORS (Continued) |  |  |  |  | TRANSFORMERS AND COILS |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{array}{\|l} \text { Ref. No. } \\ \text { R-29) } \\ R-30) \end{array}$ | Part No. |  | Description |  | Ref.Lo.L-1)$\mathrm{L}-2)$ | Part No.9A2033 | Description <br> R. F. Heater Choke $\qquad$ |
|  | B85 151 | 150 | 0.5 | Carbon |  |  |  |
| R-31 | B83395 | 3.9 Meg |  | Carbon | L-3) |  |  |
| R-32 | B8 3334 |  | K 0.5 | CarbonCarbon | L-4) | 9A19793610 | Peaking Coil ( $36 \mathrm{Mu} . \mathrm{h}$ ) $\qquad$ <br> Peaking Coil ( $60 \mathrm{Mu} . \mathrm{h}$ ) |
| $\left(\begin{array}{l} R-33) \\ R-93) \end{array}\right.$ | B84474 |  | 0.50.5 |  | L-8) |  |  |
|  |  |  |  |  | L-S |  |  |
| R-35) | B84473 | 47 | 0.5 | Carbon ............... | L-6 | 36A11 | Peaking Coil ( $500 \mathrm{Mu} . \mathrm{h}$ ) ............. |
| R-90) |  |  |  |  | L-7 | 9 A2074 | 4.5. MC Trap |
| R-36) | B84103 | 10 | 0.5 | Carbon ............. | L-9 | 36 A16 | Peaking Coil ( $80 \mathrm{Mu} . \mathrm{h}$ ) |
|  |  |  |  |  | L-10 | $36 \wedge 12$ | Peaking Coil ( $160 \mathrm{Mu} . \mathrm{h}$ ) |
| R-37 | B84274 | 270 | K 0.5 | Carbon ............... | L-11 | 36A2 | Peaking Coil ( $190 \mathrm{Mu} . \mathrm{h}$ ) .. |
| $\left(\begin{array}{l} R-38) \\ R-50) \end{array}\right.$ | B84155 | 1.5 Meg 0.5 |  | Carbon ................ | $\begin{aligned} & \mathrm{L}-12) \\ & \mathrm{L}-17 \mathrm{O} \end{aligned}$ | Part of Deflection Yoke Assembly |  |
| R-39 | 40X363 | 7.5 M | Meg | Sync Stability Control | L-13 | 9A2168 | 4.5 MC Sound Take-Off Coil .......... |
| R-40) |  |  |  |  | L-14 | 9A2096 | Horizontal Hold Control ................ |
| R-69) | B84683 |  | K 0.5 | Carbon ............... | L-15 | 9 A 2183 | Width Control . |
| R-41 | B84824 | 820 | K 0.5 | Carbon | L-16 | 9A2262 | Horizontal Linearity Control |
| R-43 | B84332 | 3.3 | K 0.5 | Carbon | L-18 | $52 \times 90$ | Filter Choke |
| R-45 | C84102 |  | K 1.0 | Carbon ................ | ${ }_{\text {T-1) }}^{\text {T-2) }}$ | 9A2230 | 1st and 2nd P. I. F. Tra |
| $\left(\begin{array}{l} \mathrm{R}-46 \mathrm{~A}) \\ \mathrm{R}-46 \mathrm{~B}) \\ \mathrm{R}-46 \mathrm{C}) \end{array}\right.$ | Part of 76X7 (See Miscellaneous) |  |  |  |  | 9 92226 | 3rd P.I.F. Tr |
|  |  |  |  |  | T-4 | $54 \mathrm{X8}$ | Vertical Osc. Trans. |
| $\begin{aligned} & R-47) \\ & R-81) \end{aligned}$ | B85474 | 470 | K 0.5 | Carbon | T-5 | $51 \mathrm{X159}$ | Vertical Output Trans. |
| R-49 | 40X368 |  | K | Vertical Linearity - | T-6 | 9A2170 | Sound I.F. Trans. |
| R-51 | $40 \times 334$ | 1.0 M | Meg | Vertical Hold ....... | T-7 | 9A2269 | Sound Ratio Detector Trans |
| R-52 | B84184 | 180 | K P. 5 | Carbon ................ | T-9 | $53 \times 324$ | Output Tra |
| R-53 | B84225 | 2.2 Meg 0.5 |  | Carbon ................ | T-10 |  | Power Trans. ......................... |
| R-54 | 40X364 | 2.5 Meg |  | Height Control ...... |  |  |  |
| R-5s | B84125 | 1.2 Meg 0.5 |  | Carbon ................ | MISCELLANEOUS |  |  |
| $\binom{R-58}{R-107}$ | B8456) | 560 | 0.5 | Carbon ............... |  |  |  |
| R-59 | D84332 | 3.3 | K 2.0 | Carbon ................ | $9 \mathrm{~A} 2274$ |  | ection Yoke Assembly .................... |
| R-62 | B84563 |  | K 0.5 | Carbon | 76x7 |  | iple Resistor-Capacitor .................. |
| R-66 | B84271 | 270 | 0.5 | Carbon ................ | $\begin{aligned} & \text { 2A407 } \\ & \text { 2A426 } \end{aligned}$ | Ion Trap Magnet ............................... |  |
| R-79 | B85475 | 4.7 Meg 0.5 |  |  |  |  | rering Device ............................... |
| R-82 | B84273 |  | 0.5 | Carbon ............... | 3 A303 | Tube Socket (SU4) ......................................... |  |
| $\begin{aligned} & R-83) \\ & R-84) \end{aligned}$ | C84682 | 6.8 | 1.0 | Carbon ............... | 3A427 | Tube Socket (6AL5) (6AV6) (6AH6) (6BE6) |  |
| R-87 | C83562 | $\begin{aligned} & 5.6 \\ & 220 \end{aligned}$ | K 1.0 | Carbon ................ | 31445 | Tube Socket Octal ............................. |  |
| R-88 | B83224 |  | K 0.5 | Carbon ............... | 3A458 | Tuoe Socket (6AU6) (6CB6) (6AL5) ......... |  |
| R-89 | 40×331 | 150 |  | Horizontal Drive.... | 31463 | Tube Socket (12AT7) .......................... |  |
| R-91 | B83154 | 150 |  | Carbon .................... | $3 \wedge 464$3 4470 | Tube Socket Octal - Top Mounting ............ <br> Tube Socket Octal |  |
| R-92 | B84562 | 5.650 | K 0.5 |  |  |  |  |  |
| R-94 | 40×361 |  | K | Horizontal Hold .... | 31466 | Tube Socket (183) ............................. |  |
| R-95 | D84101 | 100 | 2.0 | Carbon ................ | $13 \times 817$ |  | Tube Socket ............................... |
| R-96 | $43 \times 276$ | 12 | 5.0 | Wirewound $\qquad$ | $32 \times 403$ | Tube Shield (3A458 Socket) ................- |  |
| R-97 | $43 \times 239$ |  |  |  | $32 \times 405$ | Tube Shield (3A463 Socket).................. |  |
| R-99 | C85105 |  | .1 1.0 Meg 1.0 | $\qquad$ <br> Carbon $\qquad$ | S-34X19 | Tube Mtg. Strap Assembly .................... |  |
| R-100 | B83472 | 4.7 K 0.5 |  |  | S-25 $\times 85$ |  |  |  |
| R-101 | $43 \times 272$ | 10 | 5.0 | Wirewound $\qquad$ | 25A1095 | Tuner R.F. Assembly ............................Anode Connector and Lead Assembly ...... |  |
| R-102 | $43 \times 277$ | 2 | 15.010.0 |  | S-6A1 |  |  |  |
| R-103 | $43 \times 273$ | 330 |  | Wirewound $\qquad$ <br> Wirewound $\qquad$ | $6 \times 67$ | Rubber Grommer ................................ |  |
| R-104 | Part of L-9 |  |  |  | $\begin{aligned} & 6 \times 73 \\ & 20 \times 1652 \end{aligned}$ | Rubber Grommet (6BQ6 Plate Lead) .......... <br> Wing Screw |  |
| R-105 |  |  |  |  |  |  |  |  |  |  |  |
| R-106 | $43 \times 274$ | 7.5 | K 10.0 | Wirewound | $\begin{aligned} & 4 \wedge 408 \\ & 28 \times 599 \end{aligned}$ | Antenna Terminal Strap <br> Ground Spring |  |
|  |  |  |  |  |  |  |  |  |

## O John F. Rider



MODEL NO. 2DI353A


## HORIZONTAL OSCILLATOR ADJUSTMENTS

NOTI: These adiustments are very critical and should only be performed by a qualified servicoman. Failure to comply with this caution may result in serious malperformance of the receiver If adjustment of the "Horizontal Hold" control as explained in step 3 under the section entitled "Control Adjusiment Procedure" fails to lock the picture horizontally, it will be necessary to make the following adjustments

1. Set the "Harizontal Hold" contral to the center of its ronge.
2. Adjust the "Horizontal Blocking Oscillatar Slug" until picture remains stationary and does nat lase horizantol sync when operating "Chonnel Selectar" knob. See Fig. 15 for location of slug.
3. If the proceding step fails to proceed os follows:
a. Set the "Horizontal Blocking Oscillator Slug" to a position which is approximataly in the center of its range.
b. Remove snap button cover of "Horizontal Range" control and ad. Wust this control until picture locks in horizontally and does no
lose sync when operating "Channel Selector" knob, see fig 15 form location af contral. Then repeat step 2 for a greater degroe of horizantol stability.
4. If it still bocomes impassible to abtain proper harizontal sync, it will be necessary to odjust the "Horizantal Sine Wove Ossillotor Slug"

## SPECIFICATIONS

DIMENSIONS $\begin{array}{lll}\text { Height } & \text { Width } & \text { Depth } \\ 377 / 8^{\circ} & 24 / 2^{\prime \prime} & 231 / 8^{\prime \prime}\end{array}$

WEIGHT (Packed) 122 lbs.
POWER REQUIREMENTS 117 volts 60 cycles 220 watts
PICTURE SIZE
21" Rectangular
ANTENNA INPUT IMPEDANCE 300 Ohms--balanced to ground

BUILT-IN ANTENNA Broad band dipole
R.F. TUNER
V.H.F.--Turret Type
U. H.F.-.Continuous tuning type

SPEAKER
$\begin{array}{lll}\text { Type } & \text { Size } & \text { V.C. Impedance }\end{array}$
INTERMEDIATE FREQUENCIES Sound Carrier--41.25 Mc. Picture Carrier-r45.7S Mc.
I.F. SYSTCM

Three stages--overcoupled--for composite signal One additional stage for sound channel.

## DETECTOR

Sound--Ratio type Picture--Germanium crystal type
U.H.F. Mixer--Germanium crystal typ
RETRACELINE SUPPRESSOR
Eliminates retrace lines thruout the range of picture brightness and contrast.

| DEFLECTION | V19 | $6 J 6$ | V.H.F. Mixer-Oscillator--U.H.F. I.F. <br> Magnetic |
| :--- | :---: | :---: | :--- |
| Amplifer |  |  |  |

Electrostatic
HORIZONTAL SYCHRONIZATION
Automatic frequency control provides excellent picture stability.
HIGH VOLTAGE POWER SUPPLY
"Fly-back" typa. Completely enclosed in a shieldad compartment.

TUBE COMPLEMENT
TUBE TUBE
NO
v1 6CB6
6CB6
6CB6 3rd. I.F. Amplifier
$12 \mathrm{BY7}$ Video Amplifier
6 AU6 Kayer--A.G.C.
6BE6 Gated Sync. Separator
$12 A U 7$ Sync Amplifier.-Vertical Blocking Oscillator
6SNTGT Horizontal A.F.C.--Horizontal Blocking Oscillator

6BQ6GT Horizontal Scanning Output
1B3GT High Voltage Rectifier
6AX4GT Horizontal Damping
5U4G Rectifier
6 AU6 Sound I.F. Amplifier--Sound Limiter
678 Sound Discriminator--Sound Amplifier
6AQ5 Sound Output
6AHAGT Vertical Scanning Output
21MP4 Picture Tube
6BQ7 or
6BQ7A or
V.H.F. R.F. Amplifier--U.H.F. I.F. Amplifier Amplifier
U.H.F. Oscillator


The tuning mochanism of this receiver comprites two R.F. funing unity-a
 tinuous type U.H.F. tuner which covers all of the U.H.F. television channels.
When is is necessary to remove the tuning units for sorvicc, it can be ac When it is necesary to remove the tuning units for sorvice, it ean be ac-
complished by following the procedure given in the following paragraphs. For simplicity, there is a separate removal procedure for each of the tuners.
Instructions for replacing the U.H.E. tuning belt and the dial drive cord are also given below.

REMOVING U.H.F. TUNER
(Numbers which appear aftor parts mentioned in
toxt rofer to parts shown in illustration abovo.)

1. Disconnect loads marked $S, R$ ond $T$ on "Botrom View of Chassis Show-
 Remove Brackot and Triangular Shaped Guard (7) shielding U.H.F. Tuning Gear (5). 3. Turn fine tuning knob until U.H.F. tuner shaft is fully countor-dockwise,
then loosen two sat scrows and slide U.H.F. Dial Drive Pulley ( 6 ) off Then lion (To avoid the necossity of restringing U.H.F. dial drive cord hold Drive Pulley ( (6) to that cord doess not slip off and clamp cord tightly around pulloy by wrapping "scotch" tape around the two
strands of cord as noar as possible to the pulloy. Also clamp cord around Dial Pulloy and Shaft (12) in this mannor.)
2. Remove the two U.H.F. Tuner Mounting Scrows (2) and a third scrow (not shown in illustration) located underneath chasis on Mounting
Bracket (1).
3. Loosen the

Coosen the two set screws on U.H.F. Tuning Gear (5) and froe tuner
from mounting by pulling away from botiom of chasis. Tuner may trom mounting by pulling away from bottom of chasis. Tuner may
now be complotely removed by sliding it toward rear of chousis, thus rer is returned to
If funner is returned ta factory for ropair it must be shipped with all parth

## REMOVING V.H.F. TUNER

Numbers which appear after parts montloned in

1. Remove U.H.F. tuner as described above.
2. Disconnect leads marked $\mathrm{M}, \mathrm{N}, \mathrm{P}, \mathrm{Q}$ and U on "Bottom View of Chas sis Showing Connections of R.F. Tuners." Also disconnect the two
white and yellow leads from the tuner to the V.H.F. Selector Switch white and yollow loads from
(17); at terminals $S B$ and $S 17$.
3. Rotate Channol Solector knob until V.A.F. Solector Switch Actuotor Com is complotely disengaged from Switch (17) and remove the two switch mounting scrows.
Remove channol Soloctor knob, Fine Tuning knob and U.H.F. Dia
from their shafts by pulling them forward.
4. Remove Fiber Brackot (11) which supports tunor oporating shaft. Also remove fiber dial lite shiold which is fastoned by one of the fiber brackot mounting screws.
o. Remove the four
(16) from chasis. and slide shaft and pult rotoins U.H.F. Dial
and slide shaft and pulloy off of inner shoft.
. Loosen two set scrows and rem pulioys.
5. Remove U.H.F. Tuning Pulley and Bracket Assembly (10)
6. Reve Frot Mous Bratet (3) and Resombly (Y)
7. Loosen set screw and remove V.A.F. Solector Switch Actuator ftuner is on rear of turret shaft. must be shippod with all parts removed as indicated above.

## REINSTALLING TUNERS

The reinstallation of the tuner can be made in the reverse or
the removal procedure, observing the following procautions.
back on chassis as possible.
2. Position coaxial coble load so that it completely dears the V.H.F.
3. When roinstalling U.H.F. Dial

Whon roinstaling U.H.F. Diel Drive Pulloy (6), furn U.H.r. funing (6) until the opening in its rim is as shown in lower illustration bufore tightoning pulley set scrows.
When removing "scotch" tape from U.H.F. dial drive cord, hold drive
pulloys to that cord is sufficiently tout to prevent it from sliding off pularys 80.
of pulloys.
5. Before replacing U.H.F. dial, be sure that "Fine Tuning" shaft is in fully counter-clockwise position or until U.H.F. dial shaft is is in top conter position.
full cheren

## REPLACING U.H.F. DIAL DRIVE CORD

As it is necossary to remove drive cord when replacing U.H.F. Tuning Belt As it is nocessary to remove drive cord when roplacing u.H.F. Tuning
(9), the bolt should be reploced at this time it it is worr. The method
accomplishing this is oiven in a soperate procedure outlined below. accomplishing this is given in a soparate procedure ou

1. Remove Bracket and Triangular Shaped Guard (7).
2. Turn U.H.F. tunar thatf fully coounter-clockwise and if necessary bosen 2 zet scrows and turn Drive Pulloys (6) and (1i)
in their rims are located as shown in lower illustration.
3. String drive cord by placing ring at end of cord over tongue of Drive
Pulloy (6) and winding cord around pulloys as show in tration. $B$. 4. Replace U.H.F. dial by following pro
soction entitlod "Roinstalling Tuners."

REPLACING U.H.F. TUNING BELT

1. Follow steps 2 and 3 in procedure ontitiled "Romoving U.H.F. Tuner"
2. Remove old Tuning Belt (9) by pulling it over Drive Pulloys (6) and
3. (12) and through shaft opening on front of chassis,
4. Install now belt by using revarse of procedure given in stop 2 obove.
5. Reploce Drive Pulloy (6) fallowing procedure given in paragraphs 3 ,


DIAL DRIVE CORD ARRANGEMENT

## SYNCROGUIDE TRANSFORMER ALIGNMENT <br> Chassis that do not inc'ude series "E" change)

Alignment of the Syncroguide transformer, circuir diogram \#1 128 , which
is used in the Horizontal Ocillotor circuit on tho include the leter "E" in the series designotion ot the rear of the chossis can be occomplished by utilizing the procedure outlined below. To per One that has a 2 megocycle response and o o ow ow ispillotcopes, proferobly ond that has a 2 . megocyclo
under 100 mm dd to ground.

Set the "Top Slug" ond "Bottom Slug" of the Syncroguide trans
Short together terminals $C$ and $D$ of the Syncroguide transformer
Set "Horizontol Range" control, locoted on rear of chassis pan, to
its maximum clockwise position.
Sot "Horizontal Hold", control, located at front of chassis to it
on receiver and None in ony locol TV channel
6. Adiust "Top Slug" clockwise until picture just locks in horizontally. Remove short from terminals C and D . If picture does not hold sync
when short is removed, adiust "Botom Slug" clockwise when sho
8. Connect 'scope to terminal C of Syncroguide transformer and adjust Twoep "Bote of 'scope until two cycles of oscillogram remain stationory. Turn "Bottom Slug" clockwise until wave form peaks are equal in
height os shown in Fig. height os shown in fig.

MPORTANT: The first peak of the wave form should never be higher poak by more thon 3\%. Also when adiusting the "Borthon the second picture must be in sync, therefore it may be necessary to turn the "Horizontol Hold" control clockewise when performing this step. the "Hori-
adjustment has beon completed, disconnect scopose from recciver.
9. Sel "Horizontal Hold" control countor-clockwise and adjust "Top
Slug" until picture is locked in and dows not
 counter-clockwise until piefure is just ready to lose sync as shown in rig.
0. Horizontal holding action of receiver should now be as follows: o. When "Horizontal Hold" control is at its maximum counter-clock- wise position ond "Channal Selector" knob is switched, picture may appear os shown in fig. 4 or be out of sync.
b. When "Horizontal Hold" control is at its maximum clockwise posithe tise sync when swisting "Chorel Selector" c. When "Horizontal Hold" control is in the conter or near the
conter of its ronge, picture remains sable when switching "Channel Solector" knob.

1. If the foregoing steps foil to correct for loss of horizontal holding action under normal roceiver operation, be sure that condenser 130
$(.01 \mathrm{mfd}$ ) connected ocross terminals C and D of the Syncroguide .
iransformer is Suewort Worner part 512311 , fubular, .01 mfd ., 400 V .
Do not use a substitute part.


## incorrec

## SYNCROGUIDE TRANSFORMER ALIGNMENT

## Series "E" type chassis)

Alignment of the Syncroguide transformer, circuit diagrom \#128, which ing the procedure outlined below. To perform this alignment, it will be necessary to use on oscilloscope, preferably one that has a 2 megocycle Set the "Top Slug" ond "Bottom Slug" of the Syneroguide trans. UM counorclockwise positions.
2. Short together terminals $C$ and $D$ of the Syncroguide transformer.
3. Adiust "Horizontal Drive" control, located on rear of chassis pan, ximum clockwise position
Sot "Horizontal Hold" control, located of front of chassis, to its
5. Turn on receiver and tune in any local TV channel
6. Adiust "Top Slug" clockwise until picture iust locks in horizontally. Remove short from terminals $C$ and $D$. If picture does not hold sync
when short is removed, adiust "Bottom Slug" clockwise until picture locks in.
8. Connect 'scope to terminal C of Syncroguide tramformer and adiust
nionory. Turn "Bottom Slug" clockwise until wave form peaks are
IMPORTANT: The first peak of the wave form should never be higher than the second peak nor should the first peak be lower than the second eak by more than $3 \%$. Also, when adiusting the "Bottom Slug," the Herizontal Holdi" connrol counter-cleckekwey when peasorming thisn thep.
After this adiustment has been completed, disconnect scoope from roceiver.
9. Set "Horizontal Hold" control countor-clockwise and adiust "Top Slug", until picture is locked in and does not lose sync when swithe
ing "Channel Seloctor" knob. Then, turn "Top Slug" slowly counter. ing "Channel Selector" knob. Then, turn "Top Slug" slowly countier-
clockwise until picture is just ready to lose sync as shown in Fig. 4.
10. Horizontal Holding action of receiver should now be as follows: a. When "Horizontal Hold"" control is at its maximum counter.
clockwise position ond "Channol Selector" picture may appear as shown in fig. 4 or be out of sync.
b. When "Horizontol Hold" control is ot its maximum clockwise posilion, picture may lose syne when swithhing "Channel Selector"
knob.
When "Horizontal Hold" control is in the conter or near the
center of iss range, picture remains stable when switching "Chan-
nel Selector" knob.

## ALIGNMENT PROCEDURE

The receiver chassis must be removed from the cabinet in order to a
complish alignment of all funed circuits complish alignment of all tuned circuits.
Alignment of all RF and IF funed circuits in this receiver may be ac These procedures should preferably be opplied in the order in which the are presented. Alignient of Sound Channel or IF Channel may be ac complished individually if desired.
The RF Amplifier and Mixer alignment ma; olso be accomplished inde pendent of Sound or If Channel alignment, but oseillator calibration can
only be done ofter. IF Channel has been correctly aligned. CAUTION
The picture tube is highly evacuated and
if broken fragments will be violently ex-
pelled. Handle with care. Avoid contact
with metal shell of picture tube as this is part of the high voltage circuit.
Nources and outhe following instruments will be required as signal sources ond output indicators during the clignment. Since accurate
alignment of a television receiver is heovily dependent upan the perform alignment of a television receiver is heavily dependent upon the perform-
ance of your instruments, it is imperative that they meet the essentiol pecifications described her

STANDARD SIGNAL GENERATOR to provide unmodulated (pure angies should be of leost il rolt with provision for outtenuation as desired. This instrument must have good frequency stability ond be accurotely colibroted
4.5 Mc. Sound Channel
b. RF Frequencies:

54 to 88 Mc .
No frequencies are listed for the UHF RF Channels. If it ever becomes necessary 10 align the UHF RF Channels, the UH
Uner, part 521170 , cordonce with the remuval instructions, listed in actsubsequent section
cedure."
2. Vacuum tube voltmeter. The lowest voltage ronge of this in. trument should proferably permit a 1.0 volt readin
an not less shan one third of full scole defection.
3. RF SWEEP GENERATOR to provide frequency modulated signal for abserving the over-all bandposs chorocteristic and RF Channel alignint at the following frequencies:
40 to 50 Mc . with 10 Mc . sweep width.
54 to 88 Mc . with 10 Mc . sweep width.
54 to 88 Mc. with 10 Mc. sweep width.
174 to 216 Mc . with 10 Mc . swoop width.
No frequencies are listed for the UHF RF Channels. If it ever Secomes nocessary to align the UUF RF Channels, the UHF
Tuner, part 521170 , must be returned to the factory in accordonce with the removal instructions, listed in ocs subsequent
section under the heading. "VHFFUHF Tuner Servicing Pro. section,""
cedure."
4. CATHODE RAY Oscilloscope, preferably a unit with vertical amplifier hoving wide ronge frequency responas and low cepracity
pick-up probe. This instrument is used for observing the overall band.

SOUND CHANNEL ALIGNMENT PROCEDURE

1. Short antenna terminals together with a jumper wire.
2. Set reesiver Channel Selector to any inactive tolevision channel ond
Contrast contral to its maximum counter-lockwise position; other controls may be lett at any desired setting.
3. A small screwdriver (preferably non-metallic) can be used for alignment of Sound IF. The blade of this tool will fit the slot in the core of the transformer.

| STANDARD SIGNAL GENERATOR |  | $\xrightarrow[\text { VTVM }]{\text { CONNECTIONS }}$ | miscellaneous INSTRUCTIONS | TRIMMER OR SLUG | TYPE OF ADJUSTMENT AND OUTPUT INDICATION |
| :---: | :---: | :---: | :---: | :---: | :---: |
| CONNECTIONS | frequency |  |  |  |  |
| Connect as as shawn in fig. |  | Connect ${ }_{\text {Fig. }}$ as. ${ }_{\text {2 }}$ Shown in | 1. Set Contrast control. to it it maximum counter-clockwise position. 2. A special deteetior must be urilized when aligning the 4.5 Mc. Sound Trop Coil. <br>  <br>  a high frequency. A.C. probe is avail. place a fig 2 <br> 3. During this odiustment only, remave iUbes (V1, v2 or V3). This will prevent noise int the ea stages from offecting the voltoge reoding while odiusting the sound trap. |  |  |
| Same as | Same asabove. | Connect figs. Shown in | A "swishing" sound may be heord in the speaker during Sound Channe! Alignment zontal sweep voltoge being picked up in he oudio system thru stray coupling of os it will have no effect on alignment of the sound channel. | \#2 <br> Discriminator Secondary (See Fig. 10) | Adiust for maximum reading |
|  |  |  |  | $\begin{gathered} \# 3 \\ \text { Discriminotor } \\ \text { Primary } \\ \text { (See Fig. 8) } \\ \hline \end{gathered}$ |  |
|  |  |  |  | \#4 <br> Sound IF Tronsformer (See Fig. 10 | Adiust for moximum reading |
| Same as as above. | Same as as above. | Connect ors fig. shown in | To obtcin zero balance of the discriminator circuit two 68,000 ohm resistors will be so tha, theer respective resistances do not difer by mare than io the critcol. Connect the two resistars in series from Cof the otion tube to shos sis ground Pin 2 of the oir as shown in Fig. 5 . | \#2 <br> Discriminatar Secandary (See Fig. 10) | Note that as slug $\# 2$ is ratated a paint will be found where the ly from o positive to a legative reading or vice verso. The cor rect setting of slug $\#$ \# is obtained when the meter reads pher point the slug is moved thru this point |
| Replace the type 6CB6 tube previously removed in the above procedure and iurn set on. Tune in to a local channel and should there be an unusual amount of "Intercarrier Buzz" refer to procedure on adjoining page to remove this aforementioned fault. |  |  |  |  |  |

INSTRUMENT CONNECTIONS FOR SOUND CHANNEL A!.IGNMENT




FIG. 5
VTVM Connections
for Sound Discriminator
Alignment

## REDUCTION OF INTERCARRIER BUZZ

Under actual reception conditions slight "dynamic" unbalance of the dis Criminator secondary can emphasize intercarrier buzz due to incomplete an accurate setting of the discriminotor secondary ity important to obtoin ditions.
Disconnect all instruments (ke sure that I.F. fube removed for the adjust ment of Sound Trap has been replaced) and then connect an antenna to the receiver to obtain program reception from a local station. If inter canier buzz is prominent, a slight readiustment of the discriminato
secondary slug $(\# 2)$ should be made to obtain the "dip" buzzing sound. Note that program sound will be clear and free from distortion at this point. Buzz should now be at an acceptable minimum
if station transmission is not at fault.


## VHF RF CHANNEL ALIGNMENT PROCEDURE

NSTRUMENT CONNECTIONS FOR R.F. CHANNEL ALIGNMENT

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## PRODUCTION CHANGES


 incorporate only that chango indicated, by letiter at

The circuit shown on this page applie
to "SERIES ABCDEFGHJK" chassis


\section*{| DETTER |
| :--- |
| DESIGNATION | <br> DESIGNATION}

DESCRIPTION OF CHANGE

## NITIAL PRODUCTION

| UNCODED | INITIAL PRODUCTION |
| :---: | :---: |
| " ${ }^{\text {" }}$ |  Components do those olements ware changed. The circuit for tubey vil |



PRODUCTION CHANGES - Continued

| LETTER DESIGNATION | discription of change |
| :---: | :---: |
| "E" |  <br>  <br>  <br>  <br>  <br>  <br> 5. Remove roisisor 133 (10,000 Ohmi) in grid circult of tivbe V9. (Horizontol <br>  <br> 7. 820,000 Ohmis 10 10.5 Meg. 10,000 Ohm 10 , 4700 Ohms and add roistor 105 ( 4700 Ohms) in 3 orios with rosisitor 108 and plate of tuba V7A. V7A-12AU7 while condennen 107 (100 Mmfd.) is reconnected to the <br>  in the service detata section of the manual. |
| $\begin{gathered} \text { "E" } E \text { " } \\ \text { (cont.) } \end{gathered}$ | The following changes were incorporated to improve the blanking during horizontal ratrace interval. 1. Add resistor 213 ( 150,000 Ohms), belween cathode of tube Vg (Horlzontal <br> 1. Scanning Outpul) and the grid circult of tube vil (Prieture Tube). <br> 2. Add rosistor 211 (1) Meo.) betworen pin of the horizontal output trans- <br> 3. Formmer and grid circuit of tube V17 (Picture Tube) <br> 4. Add condianser 216 ( 100 Mmfd .) from the iunction of resistors 213 and 214 <br> 4. Add condenser 216 ( 100 Mmid.) from the <br> The following change was incorporated to. reduce illumination of picture tube <br> with minimum setting of the Brightness Control. <br> Ohms. |
| "F" | The following change was incorporated to minimize frequency drift in the syncroguide circuir. <br> Change condensor 130 from a .01 Mfd . to a .01 Mfd . (Spectal charac teristic) part 512311 only. |
| "G" | The following changes wero incorporated to improve the the contrast control. <br> 1. Change connoection of Brightnoss contro 67 associaled circuit from to grid of the same tube. The Brightness circuit for chassis that do not incorporate the lettur " $G$ " is shown at the rights <br> 2. Add resistor 219 ( 470,000 Ohms) Mfd.) locoted in cathode circuit <br> of tube V17 (Picture tuba). <br> 3. Change resistor 70 in plate circuit <br>  <br>  and resistor 191 ( 8200 Ohms ). |
| "H" | The following changoses were incorporatod to improve the video response. 1. Chango 1. Chango peaking coil 5 . <br> 2. Chanos resithor 52 in parallel with peaking coil 51 from 15,000 Ohms <br> 3. ${ }^{\text {Co }} \mathrm{Chan}, 1200$ Ohms. <br> 3. Chango. poakking coil 53 in plate circuit of tube V4 (Video Amp.) from <br> 4. Chenge rosistor 54 in plate circuit of tube VA (Viddeo Amp.) from 3900 <br> 5. Chmongo to 22000 Ohms. <br> 5. Change Ohms ofo 1800 Ohisor 55 in plate circuil of iube VA (Video Amp.) from 1500 |
| "J" | The following change was incorporaticd to maintain proper focus for the normal range of the brightness control. <br> 1. Change resistor 68 in brighness circuit from 100,000 Ohms to 220,000 Ohms. |
| "K" | The following change was incorporated to permit the use of the I.F. system <br> in various ype chassis <br> 1. Add condensoer 240 (sfor Mmfd.) botwoen the grid of tube VI (1st I.F. <br> Amp.) and 1. F. Iransformer 9. |

Type ................................................ Po
RECEIVER ANTENNA INPUT MPFEDANCE 300 ohms balanced or 72 ohms unbalanced
TUBE COMPLEMENT


High voltage rectifier Low voltage rectifiers .... Horizontal AFC Sound I-F amplifier Sync separator
Keyed AGC Horizontal damper Audio output
Horizontal outpur RF amplifier I-F amplifiers Vertical multivibrator

1 6X8

| 12 AT 7 |
| :--- |
|  |

1 12AU7
$\begin{array}{ll}1 & 12 \mathrm{BH} 7 \\ 1 & 12 \mathrm{BY} 7\end{array}$
$\begin{array}{ll}1 & 12 \mathrm{BY} 7 \\ 1 & 21 \mathrm{YP} 4\end{array}$

VIDEO RESPONSE:
SOUND CARRIER 4.5 mc .

FOCUS:
Electrostatic
SWFEP DEFLECTION:
. Magnetic
SCANNING:
Interlaced 525 line
HORIZONTAL SCANNING FREQUENCY:
15,750 CPS
VERTICAL SCANNING FREQUENCY: .... 60 CPS
FRAME FREQUENCY:
(picture repetition rate)

## HIGH VOLTAGE WARNING

The danger accompanying shock is always present when the receiver is operated outside the cabinet or when the rear cover is removed from the cabinet. Only a person familiar with the precautions to be observed when working with high-voltage equipment should service this receiver.

## CATHODE RAY TUBE HANDLING PRECAUTIONS

Shatterproof goggles and heavy gloves should be worn at all times when handling a cathode ray tube. The tube should not be handled in the vicinity of any person not so equipped. When handling the tube, always keep it away from the body.
Due to the large surface area of the tube and the high vacuum contained within, more than ordinary care is required to prevent shattering the tube. The large end of the bulb, particuiarly the rim of the viewing surface, must not be struck, scratched, or subjected to more than moderate pressure. If the tube binds during removal or replacement, determine the cause of the trouble - DO NOT FORCE THE TUBE.
An additional precaution is required when handling o cathode ray tube that has an aquadag coating on the outside of the tube. The outside aquadag coating forms one plate of a capacitor, and the inside coating to which the high voltage is applied serves as the other plate. The high voltage charge may be retained in this capacitor for a long time ofter the high voltage lead is disconnected, Since the charge could produce a shock that would startle the handler into dropping the tube, the charge should be dissipated before any handling of the tube is attempted. To dissipate the charge, place a iumper from the outside aquadag coating to the high voltage button on the tube. Due to the relatively high resistance of the aquadog, the iumper should be held in place for some time to insure complete discharge.

1. SPECIFICATION CHANGES. CIO0, .005 mfd . and C101, . 005 mfd . are replaced with a dual .005 mfd . capacitor designated C100. C206, . 005 mfd . and C208, .005 mfd. are replaced with a dual capacitor designated C206.
2. ALTERNATE HORIZONTAL OUTPUT TUBE. A 6BQ6G can be substituted for the 6BQ6GT horizontal output tube.
3. IMPROVED UHF RECEPTION. The gain of the pentode section of the 6X8 tube, when operating as an IF amplifier stage for the UHF tuner, has been increased. The 220 ohm cathode resistor, previously out of the circuit during UHF operation, is now grounded by soldering a plece of $\$ 22$ bus wire from the junction of the 220 ohm resistor and wafer switch
minal of wafer switch 2 A .
4. TWEET SUPPRESSION. To eliminate tweet interference in the picture which might otherwise occur under certain conditions, a resistor, R223, is inserted between C211 and the junction of R203, C210 and R204. At the same time a filament choke, LSOS, is added in series with filament (pin 3) of the 6BN6 FM detector.
5. INCREASED SOUND ATTENUATION. C302 has been changed from 1.5 mmf to 2.2 mmf . This change into a point where any 4.5 mc . tweet, that might appear in the picture, is suppressed. C 301 is now unnecessary and has been removed.
6. SOUND HASH ELIMINATION. To avoid hash in the sound which occurred in some sets due to pick-up of sceased to 02 mfd
7. IMPROVED PICTURE QUALITY. To reduce ringing in the video amplifier plate circuit, R314 has been changed to 6800 ohms.
8. REDUCTION OF HORIZONTAL DRIVE. To prevent overdrive of the horizontal output stage R435 is increased to 12,000 ohms.
9. IMPROVED AGC PERFORMANCE. To improve the action of the AGC circuit under strong signal con-
ditions and to provide a wider range of AGC control setditions and to provide a wider range of AGC control settings, R326 is increased to 390,000 ohms and R327, the AGC control is changed to 750,000 ohms.
10. DECREASED PLATE DISSIPATION TO REDUCE 6BQ6 TUBE FAILURE. The output voltage of the low voltage power supply has been reduced from 290VDC to 278 VDC . To compensate for this change in other circuits, R442, 68,000 ohms and R456, 100,000 ohms have been removed. R444 is decreased to 1800 ohms, the audio decoupling resistor R211 is changed to 560 ohms and a 27,000 ohm resistor has been added in parallel with R454. This resistor is designated R464. The power transformer is changed to part no. V-11544-3N.
11. IMPROVED SYNC. The gain of the GAUG sync separator tube is increased by reducing the cathode resistor (R405) from 2,700 ohms to 1,200 ohms.
12. SPECIFICATION CHANGE. C209 and C210 have been replace
13. UHF TUNER DRIVE BELT. To prevent slippage, the UHF tuner drive belt has been changed to part number V-11338-4.

INSTALLATION AND SERVICE ADJUSTMENTS
THE INDIVIDUAL CHANNEL OSCILLATOR AD JUSTMENTS OF EVERY RF.CEIVFR SHOULD BE CHECKED AT THE TIME OF INSTALLATION AND WHENEVER SERVICING IS NECESSARY.

If these adjustments are made correctly, the re ceiver can be switched from channel to channel by merely turning the channel selector. With proper adjust ment, the best picture detail and sound quality will be found when the fine tuning control is in the center of its range.

Individual channel oscillator adjustments can be made on an "air signal". It is not necessary to remove the chassis from its cabinet.

Proceed as follows:

1. Allow 5 min. for receiver warm-up.
2. Set the channel selector for the channel to be adjusted. Set the other cperating controls for a normal picture and sound.
3. Remove the channel selector knob and fine tuning knob.
4. Set the fine tuning control to the center of its range by rotating the fine tuning shaft until the flat side faces up.
5. Insert a non-metallic alignment tool (see Fig. 3 ) through the opening in the cabinet and into the small
hole provided in the tuner. The oscillator slug for the channel being adjusted will be in position to receive the alignment tool. Adjust the slug for best picture detail and sound quality. In most instances, only a slight rotation of the slug is necessary. Always adjust the slug by turning it co untrectockwise first. Turning the slug too far clockwise will cause it to pass its retaining spring. If this occurs, it will be necessary to remove the coil strip and reset the stug in its retaining spring.

guide - nonmetallic sleeve
FIG. 4 - OSCILLATOR ADJUISTMENT TOOL

## ALIGNMENT CHARTS

## COMMON I-F SECTION

Rotate the channel selector to channel 13.
Connect the oscilloscope to the video test terminal, point " $B$ " on . 5, through the decoupling network shown in Fig. 2.
Connect a 9 volt bias battery to the AGC line, point "A" on Fig. 8. Couple the marker generator output to the sweep generator output. In the steps that follow, use the marker to check the response curve at the frequencies indicated on Fig. 6.

| Step | Alignment Signal | Remarks | Adjust - |
| :---: | :---: | :---: | :---: |
| 1. | Remove the 6BZ7 RF amplifier tube. |  |  |
| 2. | 44 mc . sweep to 3rd IF grid | Connect detuning clips to 1 st \& 2 nd IF plates | Pri. of T302 for max. response and sec. of T302 for symmetrical curve shown in Fig. 6A |
| 3. | 47.25 mc , amplitude modulated to 1st IF grid | Use sufficient signal to produce sine wave response on oscilloscope | L302 for min. response |
| 4. | 44 mc . sweep to 2nd IF grid | Connect detuning clip to Ist IF plate | Pri, of T 301 for max. response and sec. of T301 for syminetrical curve shown in Fig. 6B |
| 5. | $\begin{aligned} & 44 \mathrm{mc} \text {. sweep to } \\ & 1 \mathrm{st} \mathrm{IF} \text { grid } \end{aligned}$ | Detune L 103 before adjusting T300 | Pri. of T 300 for max. response andsec. of T300 for symmetrical curve |
| 6. | 44 mc . sweep to 1 st IF grid |  | L103 for "suck-out" at 44 mc . (center of curve). See Fig. 6C |
| 7. | Replace the 6B77 RF amplifier tube |  |  |
| 8. | 213 mc , sweep to antenna terminals through | Fine tuning set to midrange | L300 for symmetrical curve and 1.301 for min. 41.25 mc , marker amplitudc. See Fig. 6D |

47,25Mc 45.0Mc 43.0Mc 41.25Mc


- RESPONSE CURVES

RIOUS STAGES OF
ALIGNMENT

Connect the signal generator to the video test terminal (point "B'' on Fig. 5) through a . 001 mfd capacitor.

| Step | Signal Gen. <br> Frequency | VTVM Connections | Remarks | Adjust - |
| :---: | :---: | :---: | :---: | :---: |
| 1. | 4.5 mc. <br> unmodulated | RF probe co point "C'" (see <br> Fig. 8) and common lead to <br> chassis. | Use strong signal from gen- <br> erator | L303 for minimum voltage |

Using a weak signal, adjust L200 and L201 for maximum response to a 4.5 mc . FM signal. Using a strong signal, adjust L 202 for maximum response on a 4.5 mc . FM signal. Using a weak signal, adjust the quieting control for minimum AM noise.

# Model H-793KU21 is the same as Model H-793K21 except that 

it contains a built-in all- channel UHF tuner. For service
information on the UHF tuner, refer to the H-804 service notes.
MODELS H-786KU21 AND H-787KU21 are the same as
Models H-786K21 and H-787K21 except that they contain a built-in all-channel UHF tuner. For service
information on the UHF tuner, refer to the H-804

For service information on the V-2243-1 and V-2243-2 chassis, refer to the H-770T21, H-771T21, H-772K21, H-773K21, H-774K21. H-775K21, and H-776T21 service notes and supplementary information thereto.

- John F. Rider

1. Refer to AND MIXER ALIGNMENT
the H -770T21, H-77TH51, H-772K24, H-773K21, the H - 77775 H 21 , H - 7112 H , $\mathrm{H}-776 \mathrm{~T} 21$ for test equipment tails and general information.
2. Disconect the tuner $A G C$
lead (white wire) from the junction of C324, R327 and R326. Apply -2 volts bias to the tuner.
-2 volts bias to the tuner.
3. Connect the output of the sweep generator to the receiver antenna terminals. Be sure the proper impedance matching network is used.
4. Loosely couple the marker generator to the sweep output cable at antenna terminals.
5. Connect the oscilloscope, through a 10,000 ohm isolating resistor, to the "VHF test point" on the tuner. (See Fig, 1)
6. Turn on the receiver and test equipment and allow 5 min . warm-up.
7. Set the receiver channel selector to channel 12 and adjust the sweep generator to sweep channel 12 frequencies. Sweep width of 12 mc . is desirable so that the skirts of the response curve will fall to zero.
8. Set the marker generator to 207 mc . and adjust the outpur level so that the marker pip is barely visible. Excessive marker injection will distort the response curve.
9. Using 205.25 mc . and 209.75 mc . settings of the marker generator as reference, adjust in sequence the antenna ( RF ) trimmer, C 117 ; the RF plate circuit trimmer, $\mathrm{Cl19}$; and the mixer grid trimmer, C120 to produce a response curve similar to that shown in Fig. 4. The response curve should be symmetrical and the depth of the valley between peaks should noc exceed $30 \%$ of the overall amplitude. Tolerances in amplitude of $30 \%$ at or between carrier frequencies are permissable. Avoid "stagger tuning" these circuits by tuning each for maximum pattern height at the point midway between the two markers.

The adjustment should result in maximum amplitude of the response curve, proper positioning of the sound and picture carriers and the closest approach to equal amplitude of the two humps with minimum valley between. Fig. 4 is the RF and mixer response curve and should not be confused with the overall RF-IF response curve of the tuner.
10. Without disturbing the settings of C117 C 119 and C 120 , check the response curve on the other TV channels by changing the frequency of the sweep generator and the marker generator to correspond with the channel being checked. (See Fig. 7) The response curves should be substantially the same on all channels and
the marker frequencies should fall in the same positions the marker frequencies should fall in the same positions
on the response curve. A slight amount of "tilt" inon the response curve. A slight amount of "tilt" in-
dicated by the relative amplitude of the two humps can be tolerated but should not exceed $30 \%$ of the overall amplitude of the response curve. The ideal response curve has a flat top.


FIG. 3 - Alignment Tool


FIG. 4 - RF-Mixer Response Curve


FIG. 5 - Decoupling Network


FIG. 6 - Overall Response Curve

## OSCILLATOR ALIGNMENT

Under the INSTALLATION AND SERVICE ADJUST MENTS section of this note, adjustment of the individual oscillator circuits using "air signals" was outlined. The following procedure covers shop alignment of the oscillator circuits and does not. require "air IF circuits must be properly aligned for pass band char IF circuits must be pepre acteris note).

1. With the exception of the oscilloscope, the tes equipment hook-up is the same as that used when align ing the RF and mixer stages. Connect the vertical input of the oscilloscope to the video test point " $B$ " (See Fig. 10 schematic diagram) through the decoupling network shown in Fig. 5.
2. Set the fine tuning control to center frequency by turning the fine tuning shaft until the flat section faces up. Using the sweep and marker generator frequen cies in the chart, (See Fig. 7) adjust he oscillatis slug so that the Fig gh Fig. 6)

| Channel | SWEEP GENERATOR CENTER FREQUENCY 12 MC. SWEEP | MARKER GENERATOR frequency |  |
| :---: | :---: | :---: | :---: |
|  |  | PIX | SOUND |
| 2 | 57 Mc | 55.25 | 59.75 |
| 3 | 63 " | 61.25 | 65.75 |
| 4 | 69 " | 67.25 | 71.75 |
| 5 | 79 " | 77.25 | 81.75 |
| 6 | 85 " | 83.25 | 87.75 |
| 7 | 177 " | 175.25 | 179.75 |
| 8 | 183 " | 181.25 | 185.75 |
| 9 | 189 | 187.25 | 191.75 |
| 10 | 195 | 193.25 | 197.95 |
| 11 | 201 n | 199.25 | 203.75 |
| 12 | 207 " | 205.25 | 209.75 |
| 13 | 213 n | 211.25 | 215.75 |

FIG. 7 - Alignment Frequencies


FIG. 8 - Antenna Switch

V-12400-1 - Tuner UHF Adjustments


FIG. 9 - UHF Dipole Lengths

## CHASSIS ASSEMBLY V.2243.4

In addition to the V-2243-1 and V-2243-3 chassis assemblies, the V-2243-4 chassis assembly is also used in production of some of the models covered by this service note. The V-2243-4 chassis uses a new tuner, part $V-12400-1$, otherwise it is identical to chassis V-2243-1.

## V.12400-1 TUNER ASSEMBLY

The V-12400-1 tuner is basically the same as the V -11794-1 tuner, which is used in the 2243-1 chassis, with the exception that the UHF input circuit has been modified to provide link-coupling for an all-channel UHF continuous tuner. (See circuit schematic Fig. 12). Refer to the Model $\mathrm{H}-804$ service notes for specific information covering all-channel UHF continuous tuners.

Model H-802 plug-in receptors can also be used for UHF reception in the V-2243-4 chassis. Both sections in frequency. 300 ohm tubular transmission line is acceptable.

Where two or more antennas are used for receivers containing a single antenna inpur, an antenna switching or isolating device may be required. A low capacity, manually operated switch can be attached to the back of the receiver. (See Fig. 8) A variety of antenna isolating devices are now available. The ir installation is simple and their operation is automatic. Some are designed for installation on the antenna mast, thus avoiding the need for additional transmission lines.
of the dual UHF input circuit of the V-12400-1 VHF tuner are adjustable to provide optimum coupling between the UHF receptors and the VHF tuner.

Referring to Figs. 10 and 11 , L100 is the coupling adjustment for the receptor installed in the outboard UHF socket; L104 is the coupling adjustment for the receptor installed in the inboard UHF socket. To make the adjust-
ment, set the channel selector to the proper UHF poment, set the channel selector to the proper unf po-
sition, tune the receiver in the normal manner and ad ust the slug (L100 or L104) for best picture quality.

NOTE: The series resonant trap, L106-C118 is normally set for maximum capacity but should be adjusted in the field if local interference on channel 2 is en. countered.

## UHF ANTENNA INFORMATION

Antenna requirements for satisfactory UHF television reception are determined by the signal conditions in the particular locality.

Some of the possibilities are as follows:

1. In areas where signals are very strong and reflections are not troublesome, satisfactory reception can be obtained by using a single broad-band VHF-UHF antenna.
2. In medium signal areas, a separate UHF antenna may be required. A simple resonant dipole usually pro vides satisfactory UHF reception. The chart, Fig. 9, gives the total length of a half-wave dipole element for any frequency in the UHF spectrum.
3. Where signals are weak or reflections are troublesome, a high gain, directive UHF antenna system should be used. Typical of this type are the Corner Reflector the Conical and the Yagi.

Transmission lines should be of an approved low loss type. The use of 300 ohm ribbon type transmission line for UHF installations is not recommended as it attenuat ion factor, when wet, rises sharply with increase


BOTTOM VIEW OF CHASSIS







# MODELS H-786K21 <br> (MAHOGANY) AND H-787K21 (BLOND) <br> CHASSIS ASSEMBLY <br> V-2243-I 

## MODELS H-786KU21 AND H-787KU21

These models are the same as Models H-786K21 and H-787K21 except that they contain a built-in all-channel UHF tuner. For service information on the UHF tuner, refer to the $\mathrm{H}-804$ service notes.

## SERVICE NOTES

For service information on the V-2243-1 chassis, refer to the H-770T21, H-771T21, H-772K21, H-773K21, H-774K21, H-775K21 and H-776T21 service notes and any supplementary information thereto.

## H-786K21 AND H-787K21 MODEL PARTS

The following parts are used in Models $\mathrm{H}-786 \mathrm{~K} 21$ and $\mathrm{H}-787 \mathrm{~K} 21$ in lieu of the MODEL PARTS listed in the $\mathrm{H}-770 \mathrm{~T} 21, \mathrm{H}-771 \mathrm{~T} 21, \mathrm{H}-772 \mathrm{~K} 21, \mathrm{H}-773 \mathrm{~K} 21, \mathrm{H}-774 \mathrm{~K} 21, \mathrm{H}-775 \mathrm{~K} 21$ and $\mathrm{H}-776 \mathrm{~T} 21$ service notes:

| Part No. |  | Descriptio | List Price Each |  |
| :---: | :---: | :---: | :---: | :---: |
| + V-1320-1 | Cabinet, H-786K21 |  | \$ | ** |
| + V-1320-2 | Cabinet, $\mathrm{H}-787 \mathrm{~K} 21$ |  |  | * |
| V-11856-1 | Caster, swivel |  |  | . 50 |
| V-5522 | Cord, AC power |  |  | 1.25 |
| V-11987-2 | Cover Assembly, ba |  |  | 3.60 |
| + V-8639 | Doors, matched pair | (H-786K21) |  | - |

Doors, matched pair

## Description

Grille Cloth (H-786K21)
Grille Cloth (H-787K21)
Gasket, dust seal
Hinge, upper LH and lower RH (H-786K21) Hinge, upper RH and lower LH (H-786K21) Hinge, upper LH and lower RH (H-787K21) Hinge, upper RH and lower LH (H-787K21)
Knob, channel selector (H-786KU21)
Knob Assy., channel selector (H-786K21) Knob, channel selector (H-787KU21) Knob Assy., channel selector (H-787K21) Knob, fine tuning
Kit (H-786K21)
Knob, off-on-volume (H-787K21)
Knob, picture
Knob, dial, UHF (H-786KU21, H-787KU21)
Mask, picture, spherical
Panel Assy., controls (H-786K21)
Panel Assy., controls (H-787K21)
Plate, glass
Pull, door (H-786K21)
Pull, door (H-787K21)
Speaker, 10 " PM

- New part number listed for the first time in Westinghouse radio or television service information
* Price includes Federal Excise Tax.
- Price furnisbed on request.

NOTE: All prices are subject to change without notice.


## H-766T17



The V-2260-14 chassis is the same as the V-2260-12 chassis with the exception that a V-12415 RF tuner is used. For service and alignment information on the V-12415 tuner, refer to Supplement 1 of the $\mathrm{H}-765 \mathrm{~T} 17$ and $\mathrm{H}-766 \mathrm{~T} 17$ service notes.

For alignment, adjustments, and other service information refer to the H-765T17 and H-766T17 service notes.

## MODELS H-798TUI7 AND H-799TUI7 USING A V. 2270 CHASSIS

The $\mathrm{V}-2270$ chassis is identical to the $\mathrm{V}-2260$ chassis with the exception that an all-channel UHF has been factory installed to provide reception of the UHF television channels ( 14 through 83). For service information on the UHF tuner, refer to the Model H-804 service note and any supplementary information thereto.

Several different combinations of VHF and UHF tuners are used in the V-2270 chassis. The following chart will identify these combinations.

| Cbassis assembly | VHF tuner | Positions | UHF tuner |
| :--- | :---: | :---: | :---: |
| V-2270-122 | V-12400-1 | 16 | V-12390-1 |
| V-2270-124 | V-12400-1 | 16 | V-11972-1 |



FIG 1 BOTTOM VIEW OF V.2260.12 AND V.2260.14 CHASSIS


FIG. 2 TOP VIEW OF V-2260-12 AND V.2260-14 ChiASSIS


Fig． 2 V－12415－1 Tuner－Schematic Diagram

Production Changes Affecting Chassis V－2240．1

In production，any or all of the following changes may be incorporated in $\mathrm{V}-2240-1$ chassis． See Fig．10，V－2240－1 Schematic Revised．

1．R450 is changed from 6.8 K to 12 K to pre－ vent horizontal overdrive．

2．A condenser $C 447,47 \mathrm{mmf}$ ．is added be－ tween the plate（pin 5）of the 6AU6 sync separator and ground．C447 provides additional video modu－ lation filtering to prevent bending of the picture at the top．

3．R316 is increased to 270 K and R 332 to 120 K to prevent picture streaking at high bright－ ness．

4．C100，． 005 mfd ．，and C101，． 005 mfd ．ar replaced with a dual .005 mfd ．capacitor．The new capacitor is designated C100

5．C206， 005 mfd ．，and C208，． 005 mfd ．are replaced with a dual .005 mfd ．capacitor．The new capacitor is designated C206．

6．Filament choke L505 part \＃V－4886－2 has been added in series with the filament（pin 3）of the 6BNG．A 12 K resistor has been inserted be－ tween R203， 470 ohms and C211，． 02 mfd ．These
changes were made to reduce tweet in Fivtre caused by harmonics generated in the 6BN6．

7．C419 is changed from 100 mmf ，to 150 mmf ． to improve the locking range of the hor zoatal hold control．

8．C302， 1.5 mmf ．has been changed to 2.2 mmf ．to increase sound attenuation．With this change C $301,3.3 \mathrm{mmf}$ ．，is unnecessary and has been removed．

9．To increase the gain of the pentode section of the 6 X 8 when working as an IF stage for the UHF tuner，the 220 ohm cathode resistor is con－ nected to ground．This is done by soldering a piece of \＃22 wire from the junction of the 220 K resistor and wafer switch section 1 B to the ground terminal of wafer switch section 2 A ．
10．Ion trap magnet，part V－9784－5，has been replaced with，ion trap magnet，part V－9784－4 to mprove ion trap action

11．The two outside connections to R 400 have been reversed，decreasing the $B+$ to the picture control，thus stabilizing the picture brightness at various settings of the picture control．

12．To prevent slippage the UHF tuner drive belt has been replaced with part $V-11338-4$ ．

## R. F. AND MIXER ALIGNMENT

1. Refer to page 5 of the basic service notes on the $\mathrm{H}-765 \mathrm{~T} 17$ and the $\mathrm{H}-766 \mathrm{~T} 17$ for test equip. ment details and general information.
2. Disconnect the tuner AGC lead (white wire) from the junction of C324, R327 and R326. Apply -2 volts bias to the tuner.
3. Connect the output of the sweep generator to the receiver antenna terminals. Be sure the proper impedance matching network is used.
4. Loosely couple the marker generator to the sweep output cable at antenna terminals.
5. Connect the oscilloscope, through a 10,000 ohm isolating resistor, to the "VHF test point" on the tuner. (See Fig. 1).
6. Turn on the receiver and test equipment and allow 5 min . warm-up.
7. Set the receiver channel selector to channel 12 and adjust the sweep generator to sweep channel 12 frequencies. Sweep width of 12 mc . is desirable so that the skirts of the response curve will fall to zero.
8. Set the marker generator to 207 mc . and adjust the output level so that the marker pip is barely visible. Excessive marker injection will distort the response curve.
9. Using 205.25 mc . and 209.75 mc . settings of the marker generator as reference, adjust in sequence the antenna (RF) trimmer, C117; the RF plate circuit trimmer, C 119 ; and the mixer grid trimmer, C120 to produce a response curve similar to that shown in Fig. 4. The response curve should be symmetrical and the depth of the valley between peaks should not exceed $30 \%$ of the overall amplitude. Tolerances in amplitude of $30 \%$ at or between carrier frequencies are permissable. Avoid "stagger tuning" these circuits by tuning each for maximum pattern height at the point midway between the two markers.

The adjustment should result in maximum amplitude of the response curve, proper positioning of the sound and picture carriers and the closest approach to equal amplitude of the two humps with minimum valley between. Fig. 4 is the RF and mixer response curve and should not be confused with the overall RF-IF response curve of the tuner.
10. Without disturbing the settings of C 117 , C119 and C120, check the response curve on the other TV channe is by changing the frequency of the sweep generator and the marker generator to correspond with the channel being checked. (See Fig. 7) The response curves should be substantially the same on all channels and the marker ally the same on all channels and the marker
frequencies should fall in the same positions on the response curve. A slight amount of "tilt" in dicated by the relative amplitude of the two humps can be tolerated but should not exceed $30 \%$ of the overall amplitude of the response curve. The ideal response curve has a flat top.

NOTE: The series resonant trap, L106-C118 is normally set for maximum capacity but should be adjusted in the field if local interference on channel 2 is encountered.


Fig. 4 RF Mixer Response Curve


Fig. 5 Decoupling Network


## OSCILLATOR ALIGNMEN

Under the INSTALLATION AND SERVICE ADJUSTMENTS section of this note, adjustment of the individual oscillator circuits using "air sig. nals" was outlined. The following procedure covers shop alignment of the oscillator circuits and does not require "air signals". Before undertaking oscillator alignment, all IF circuits must be properly aligned for band pass characteristics and trap settings. (Refer to basic service note)

1. With the exception of the oscilloscope, the test equipinent hoop-up is the same as that used when aligning the RF and mixer stages. Connect the vertical input of the oscilloscope to the video test point " $B$ " (See Fig. 10 schematic diagram) through the decoupling network shown in Fig. 5 .
2. Set the fine tuning control to center frequency by turning the fine tuning shaft until the flat section faces up. Using the sweep and marker generator frequencies in the chart, (See Fig. 7) adjust the oscillator slug so that the video carrier marker is at half amplitude on the high frequency slope of the IF response curve. (See Fig. 6)

|  | Sweep Generator Center Frequency | Marker Generator Frequency |  |
| :---: | :---: | :---: | :---: |
| Channel | 12 mc . Sweep | Pix | Sound |
| 2 | 57 mc . | 55.25 | 59.75 |
| 3 | 63 mc . | 61.25 | 65.75 |
| 4 | 69 mc . | 67.25 | 71.75 |
| 5 | 79 mc . | 77.25 | 81.75 |
| 6 | 85 mc . | 83.25 | 87.75 |
| 7 | 177 mc . | 175.25 | 179.75 |
| 8 | 183 mc . | 181.25 | 185.75 |
| 9 | 189 mc . | 187.25 | 191.75 |
| 10 | 195 mc . | 193.25 | 197.75 |
| 11 | 201 mc . | 199.25 | 203.75 |
| 12 | 207 mc . | 205.25 | 209.75 |
| 13 | 213 mc . | 211.25 | 215.75 |

Fig. 7 Alignment Frequencies


Fig. 8 VHF-UHF Antenna Switch


Fig. 9 UHF Dipole Antenna Length

## UHF ANTENNA INFORMATION

Antenna requirements for satisfact/ry UHF relevision reception are determined by the signal conditions in the particular locality.

Some of the possibilities are as follows:

1. In areas where signals are ve v strorg and reflections are not troublesome, fansfactory re ception can be obtained by using a single broadband VHF-UHF antenna.
2. In medium signal areas, a separate UHF antenna may be required. A simple resonant dipole provides satisfactory UHF reception. The chart Fig. 9 gives the total length of a half-wave dipole element for any frequency in the UHF spectrum.
3. Where signals are weak or reflections are troublesome, a high gain, directive UHF antenna system should be used. Typical of this type are the Corner Reflector, the Conical and the Yagi.

Transmission lines should be of an approved low loss type. The use of 300 ohm ribbon type transmission line for UHF installations is not recommended as its attenuation factor, when wet, rises sharply with increase in frequency. 300 ohm tubular transmission line is acceptable.

Where two or more antennas are used for re ceivers containing a single antenna input, an antenna switching or isolating device may be requir ed. A low capacity, manually operated $s$ witch can be attached to the back of the receiver. (See Fig. 8) A variety of antenna isolating devices are now available. Their installation is simple and their operation is automatic. Some are designed for in stallation on the antenna mast, thus avoiding the need for additional transmission lines.

OJohn F. Rider

## ADDITIONS AND CHANGES TO THE MODEL

H-765TI7 AND H-766Tl7 PARTS LIST
When ordering parts, specify model number of set in addition to part number and description of part.
ADDITIONAL PARTS USED IN V-2240-3 CHASSIS AND FOR PRODUCTION CHANGES IN Y.2240.1 CHASSIS
Ref. No.
C100
C206
C210
C419
C447
L505
R223
R316
R322
R450
R457
T200
+T302
+
+

| Port No. |
| :--- |
| V-9044-1 |
| V-9044-1 |
| R2CC63Y5Y202M |
| RCM20B15KK |
| RCM20B470K |
| V-4886-2 |
| RC20AE123K |
| RC20AE274K |
| RC20AE124K |
| RL20AE123K |
| V-9927-7 |
| V-9238-2 |
| V-9880-2 |
| V-9784-4 |
| V-11338-4 |


| Description | Function |
| :---: | :---: |
| Capacitor, dual .005, . 005 mfd . | Fil \& B-Bypass |
| Capacitor, dual .005, . 005 mfd . | Cath. -Screen Bypass |
| Capacitor, 002 mfd .600 V | Tone Compensation |
| Capacitor, 150 mmf . | A.F.C. Coupling |
| Capacitor, 47 mmf . | Sync Sep. Circuit |
| Reactor, 1.1 microhemps | Heater Isolation |
| Resistor, 12,000 Ohms, $1 / 2 \mathrm{~W}$ | Grid Cir. Hor. Amp. |
| Resistor, 270,000 Ohms, $1 / 2 \mathrm{~W}$ | $\checkmark$ ideo Output Cir . |
| Resistor, 120,000 Ohms, $1 / 2 \mathrm{~W}$ | Brightness Control Cir. |
| Resistor, 12,000 Ohms, $1 / 2 \mathrm{~W}$ | Hor. Pulse Shaping |
| Resistor, 330,000 Ohms iw | Hi Voltage Filter |
| Transformer | Audio Output |
| Transformer | 3RD IF |
| Magnet, lon Trap |  |


| List Price |
| :---: |
| Each |

.39
.39
. .25
.20
. .22
.38
.05
.06
.10
.05
.10
1.90
1.50
.85

## V-2240-3 CHASSIS ONLY

V-10970-1
V-12026-1
V.12249-1
V. $11338-3$
V. $11338-3$
$\mathrm{~V}-12118-1$

V-12118-2
RF Tuner Assembly
Knob Assy. Channel Selector, 12 Pos. (H-766T17) Knob Assy. Channel Selector, 12 Pos. (H-765T 17)

Socket 5 prong, UHF
Sleeve Assy., Dial
Ring, Sleeve Retaine
Belt, Dial Drive
Selector (H766T17)

## H-765T17 AND H.766T17 MODEL PARTS

ELECTRICAL PARTS V.12415-1 TUNER ASSEMBLY

| Ref. No. | Part No. | Description | List Price Each |
| :---: | :---: | :---: | :---: |
| +C105 | V-8659 | 3 mmf . NPO | * |
| +C106 | V-8659 | 3 mmf . NPO | * |
| +C107 | V-8660 | 120 mmf . | * |
| +C108 | V-8661 | 47 mmf . N 1400 | * |
| +C109 | V-8662 | 1000 mmf . GMV | * |
| $+\mathrm{C} 110$ | $V-8663$ | 6.8 mmf . NPO | * |
| +C111 | V-8664 | 5 mmf . N750 | * |
| +C112 | V-8665 | 10 mmf . NPO | * |
| +C113 | V. 8682 | 1000 mmf . GMV | * |
| ${ }_{+}^{+} 114$ | V-8666 | 150 mmf . | * |
| +C115 | V-8662 | 1000 mmf . GMV | * |
| +C116 | V-8662 | 1000 mmf . GMV | * |
| +C117 | V-8667 | 3.9 mmf . Trimmer |  |
| +C118 | V-8667 | 3.9 mmf . Trimmer |  |
| +C119 | V-8668 | .5-3 mmf. Trimmer | * |
| +C120 | V-8668 | . 5 -3 mmf. Trimmer |  |
| +L103 | V-8669 | IF Output Coil | * |
| +L 104-C 103 | V-8670 | Trap, ANT |  |
| +L 105-C104 | V-8671 | Trap, ANT |  |
| $\dagger$ L106 | V-8676 | Coil | * |
| R 100 | RC20AE 153K | Resistor 15K $\pm 10 \%$ (IRC $T_{\text {ype }} \mathrm{BTS}$ ) | . 05 |
| R 102 | RC20AE473K | Resistor $47 \mathrm{~K} \pm 10 \%$ | . 05 |
| R 103 | RC20AE334K | Resistor $330 \mathrm{~K} \pm 10 \%$ | . 05 |
| R104 | RC20AE224K | Resis tor $220 \mathrm{~K} \pm 10 \%$ | . 05 |
| R 105 | RC20AE471K | Resis tor 470 Ohms $\pm 10 \%$ | . 05 |
| R 106 | RC20AE153K | Resistor $15 \mathrm{~K} \pm 10 \%$ | . 05 |
| R 107 | RC20AE224K | Resistor $220 \mathrm{~K} \pm 10 \%$ | . 05 |
| R 108 | RC20AE 103 K | Resistor 10K $\pm 10 \%$ | . 05 |
| R109 | RC20AE153K | Resistor 15K $\pm 10 \%$ | . 05 |
|  | RC20AE472K | Resistor 4.7K $\pm 10 \%$ | $05$ |
|  | MECHANICAL PARTS FOR V-12415.1 TUNER |  |  |
| Ref. No. <br> On Illus. | Part No. | Description | List Price Each |
| $\dagger 1$ | V-8672 | Fine Tuning Shatt and Rator | * |
| $\dagger \quad 2$ | V. 8673 | Drum Assy. Without Coils | * |
| $\dagger 38$ | V-8674 | Spring, Fine Tuning Ground | * |
| + + + | V-8675 | Spring, Shaft Retaining Front and Rear | * |
| $\pm 6$ | V. 8677 | Spring, Detent | * |
| 1 | V-8678 | Roller, Detent | * |
| $\dagger 8$ | V - 8679 | Spring, Slug Retaining | * |
| + 9 | V-8680 | Slug, Osc. Tuning | * |
| +10 +11 | V-8681 | Contact Bracket Assy. | * |
| + 11 | V-12484-(2 through 83 | ANT-RF Coil Strip | * |
| + 12 | V-12485.(2 through 83) | Mixer-Osc. Coil Strip | * |

> The part number for channel 48 ANT.RF baic part numbers for cail strips indicates the charinel numbers. 1 e; The part number for chonnel 48 ANT.RF coil strip would be V.12484-48.
> $\dagger$ New part number listed for first time in Westinghouse Radio or Television service information.
> *Price furnished on request.

All prices are subiect to change without notice.

| POWER CONSUMPTION: ..................... 225 watts | 1 12RH7 ...... Vert. output and vert. discharge <br> 1 17LPa or 17VP4 ............. Cathode ray tube |
| :---: | :---: |
| AUDIO POWER OUTPUT: |  |
| Undistorted ..................................... 2.8 watts | VIDEO CARRIER INTERMEDIATE FREQUENCY: |
| Maximum ........................................... 3.2 watts | 45.75 mc . |
| LOUDSPEAKER: VIDEO |  |
| Type $\qquad$ 51/" P.M. <br> Voice Coil Impedance .. 3.2 ohms at 400 cycles |  |
|  | SOUND CARRIER INTERMEDIATE FREQUENCY: |
| RECEIVER ANTENNA INPUT IMPEDANCE: <br> ...... 300 ohms balanced or 72 ohms unbalanced |  |
| TUBE COMPLEMENT: | FOCLS: ........................................ Electrostatic |
| 1 1B3GT .................... High voltage rectifier |  |
| 1 SU4G ...................... Low voltage rectifier | SWEEP DEFLECTION: ......................... Magnetic |
| 1 GAL5 .............................. Horizontal AFC | SWEEP DEFLECTION: ........................ Magnetic |
| 1 6AS4GT or 6AX4GT ...... Horizontal damper | SCANNING: ............................ Interlaced 525 line |
| 1 6B27A or 6BZ.7 ..................... RF amplifier |  |
| 1 6BK5 .............................. Video amplifier | HIORIZONTAL SCANNING FREQUENCY: |
| 1 6BK5 ..................................... Audio output | .................................................. 15,750 CPS |
| 1 6BNG .................................... FM detector |  |
| 1 6BQ6GT ........................ Horizontal output | VERTICAL SCANNING FREQUENCY: .... 60 CPS |
| 1 6X8 ............................. HF osc. and mixer |  |
| 1 12AU7 ......... Keyed AGC and noise clipper | FRAME FREQUENCY: |
| 1 12AU7 ................... Horizontal multivibrator | (picture repetition rate): ...................... 30 CPS |



FIG. 1 - CRT ADJUSTMENTS


FIG. 2 - OSCILLOSCOPE CONNECTIONS

guice - nonmetallic sleeve
FIG. 4 - OSCILLATOR ADJUSTMENT TOOL

1. Set the fine tuning control to the middle of its range by rotating it until the middle hole nea the edge of the fine tuning drive wheel is straight up, and keep it in this position during the follow g adjustments.
2. Set the channel selector to the highest of he low band (channels 2 through 6) stations oper ating in your vicinity.
3. Peak the low band adjustment slug (L102) for the best picture detail.
4. Set the channel selector to the highest of he high band (channels 7 through 13) stations operating in your vicinity.
5. Peak the high band adjustment slug (L101) the best picture detail.
6. Check the previously made low band adjustment, and if the tuning has changed repeat steps 2 and 3


FIG. 5 - TOP VIEW OF CHASSIS

## COMMON I-F SECTION

Rotate the channel selector to channel 13.
Connect the oscilloscope to the video test terminal, point " $B$ " on Fig. 8, through the decoupling network shown in Fig. 2.

Connect a 9 volt bias battery to the AGC line, point " $A$ " on Fig. 8.

Couple the marker generator outpur to the sweep generator output. In the steps that follow, use the marker to check the response curve at the frequencies indicated on Fig. 6.

| Step | Alignment Signal | Remarks | Adjust - |
| :---: | :---: | :---: | :---: |
| 1. | Remove the 6BZ7 R-F amplifier tube |  |  |
| 2. | $44 \mathrm{mc} . \mathrm{sweep}$ to 3rd I-E grid | Connect detuning clips to 1 st \& 2nd I-F plates | Pri. of T302 for max. response and sec. of T302 for symmetrical curve shown in Fig. 6A |
| 3. | 47.25 mc . amplitude modulated to lst I-F grid | Use sufficient signal to produce sine wave response on oscilloscope | L302 for min. response |
| 4. | 44 mc . sweep to 2nd I-F grid | Connect detuning clip to 1st I-F plate | Pri. of T301 for max. response and sec. of T301 for symmetrical curve shown in Fig. 6B |
| 5. | 44 mc . sweep to 1 st I-F grid | Detune L103 before adjusting T300 | Pri. of T300 for max. response and sec. of T300 for symmetrical curve |
| 6. | 44 mc . sweep to 1st I-F grid |  | L103 for "suck -out" at 44 mc . (center of curve). See Fig. 6C |
| 7. | Replace the 6BZ7 R-F amplifier tube |  |  |
| 8. | 213 mc. sweep to antenna terminals through network | Fine tuning set to midrange | L300 for symmetrical curve and L301 for min. 41.25 mc . marker amplitude. See Fig. 6D |

4.5 MC. TRAP

Connect the signal generator to pin \#3 or \#7 of the 6 BK 5 video amplifier (point "B" on Fig. 8) through a .001 mfd capacitor.

| Step | Signal Gen. <br> Frequency | VTVM Connections | Remarks | Adjust - |
| :---: | :---: | :---: | :---: | :---: |
| 1. | 4.5 mc. <br> unmodulated | R-F probe to point "C' (see <br> Fig. 8) and common lead to <br> chassis | Use strong signal from gen- <br> erator | L303 for minimum voltage |

## SOUND SECTION

Refer to SOUND ALIGNMENT PROCEDURE on page 7. Using a weak signal, adjust L200 for maximum response to a 4.5 mc . FM signal. Using a strong signal, adjust $L 202$ for marimum response on a 4.5 mc . FM signal. Using a weak signal, adjust the quieting control for minimum AM noise.

FIG. 6 - RESPONSE CURVES at various stages of ALIGNMENT



OJohn F. Rider


CHASSIS NO. V-2260-12

PARTS LIST FOR MODELS H-765TI7 AND H-766TI7


| $\begin{aligned} & \text { Ref. } \\ & \text { No. } \end{aligned}$ | Pate No. | Description | Function | $\begin{gathered} \text { List Price } \\ \text { Each } \end{gathered}$ | $\begin{aligned} & \text { Ref. } \\ & \text { No. } \end{aligned}$ | Part No. | Description | Function | $\begin{gathered} \text { List Price } \\ \text { Each } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ${ }^{4} 411$ | $\mathrm{RCP}_{10 \mathrm{M}} \mathbf{2 0 2 \mathrm { M }}$ | Capacitor, . 002 mfd 600 v . | Pulse shaping | 3. 19 | $\mathrm{R}_{422}$ | RC20AE104K | Resistor, 100;000 ohms $1 / 2 \mathrm{~m}$. | Verrical grid | 3.05 |
| ${ }_{4} 413$ | ${ }_{\text {RCP }}^{\text {RCP 10M6 }}$ 1020 102 M | Capacitox, 11 mfd 600 v . | Bypass ${ }_{\text {couling VMV to vertical }}$ |  | R423 |  | Resistor, 10 megohms $1 / 2 \mathrm{w}$. | Verrical discharge grid Height | . 75 |
|  | RCP $10 \mathrm{M6}$ 104M |  |  | 35 | R425 | RC20AE225K | Resistor, 2.2 me gohms $1 / 2 \mathrm{w}$. | Height limiting | . 05 |
| C414 | RCP 10M10102M |  | Coupling | . 17 | R426 | RC20AE335K | Resistor, 3.3 megohms $1 / 2 \mathrm{w}$. | Height limiting | . 09 |
| C415 | RCP 10M6203K | Capacitor, 02 mfd 600 v . | Retrace suppression | . 25 | ${ }^{\mathrm{R} 427}$ | RC20AE473K | Resistor, 47,000 ohms $1 / 2 \mathrm{~m}$. | VMV grid | . 05 |
| -64178 | v -10306-1 | Capacitor, 150 mfd 50 v . elec. (assy. consists of C213B, C417B, C418B) | Cathode bypass | . 25 | ${ }^{\mathrm{R} 428}$ | $\mathrm{RCO}^{\text {20AEISSK}}$ | Resistor, 1.5 megohms $1 / 2 \mathrm{w}$. | Grid recturn | . 05 |
|  |  |  |  | 3.25 * | $\begin{aligned} & \text { R429 } \\ & \text { R430 } \end{aligned}$ | $\begin{aligned} & \text { RC20AE101K } \\ & \text { V-6463 } \end{aligned}$ | Resistor, 100 ohms $1 / 2 \mathrm{w}$. | Suppre ssor | $.05$ |
| C418B | V-10306-1 |  | Cathode bypass | 3.25 - | R431 |  |  | Cathode biasRetrace supression |  |
|  |  | Capacitor, 30 mfd 450 v.elec. (assy. consists of C213B, C417B, C418B) |  |  | R432 | $\mathrm{RC} 20 \mathrm{AE} 183 \mathrm{~J}$ |  |  | . 15 |
| ${ }_{\text {C420 }}$ | ${ }_{\text {RCM20B101K }}$ |  | ${ }_{\text {Coupling }}^{\text {AFC cathode }}$ | . 22 | R433 | $\mathrm{RC} 20 \wedge \mathrm{AE} 562 \mathrm{~K}$RC 40 AE 103 K | Resistor, 86000 ohms $1 / 1 / \mathrm{w}$. | Pulse shapingDecoupling | . 18 |
|  |  |  |  | . 22 | R434 |  |  |  |  |
| ${ }_{4} 421$ | RCM20B681K | Capacitor, 100 mmf | Plate bypassPlate coupling | . 23 | R435 |  |  | Decoupling | . 18 |
| ${ }^{\text {c } 422}$ | RCMM20B3311RCP10M6103M |  |  |  | R436 | $\mathrm{RCC20AE} 33 \mathrm{~K}$RC 20 AEEOSK |  |  | . 20 |
| ${ }^{4} 423$ |  | Capacitor, 390 mmf Capacitor, 0101 mfd 600 om | ${ }_{\text {AFC delay }}$ | . 21 | ${ }^{\text {R437 }}$ |  | Resistor, 33,000 ohms $1 / 2 \mathrm{~m}$. Resistor, 1 megohm $1 / 2 \mathrm{w}$. | Boost decoupling AFC bleeder | . 05 |
| ${ }_{4}{ }_{4} 24$ |  |  | ${ }_{\text {MV grid }}^{\text {coupling }}$ | . 21 | ${ }^{\text {R438 }}$ |  |  | AFC bleeder | .05.05.05 |
| ${ }^{4} 425$ | RCP 10 M6 502 M RCM20B101K |  |  | . 20 | R439 | ${ }^{\text {RCO }}$ R $20 A \mathrm{AE} 224 \mathrm{~K}$ |  | ${ }_{\text {AF }} \mathrm{AFC}$ b fileerer |  |
| ${ }^{C} 426$ |  | Capacitor, .005 mfd 600 v . Capacitor, 100 mmf | Plate bypass | .221.17 | R440 |  | Resistor, 220,000 ohms $1 / 2 \mathrm{~m}$. |  | . 05 |
| ${ }^{4} 427$ | RCM20B101K RCM30C392K | Capacitor, 3900 mmf | MV plate tank |  | $\mathrm{R}_{441}$ | RC20AE183K <br> RC20AE273K |  | ${ }_{\text {AFC take off }}$ | . 05 |
| ${ }^{4} 428$ | RCM 30 C 392 K RCP10W404M |  | Plate decoupling | -22 | ${ }^{\text {R442 }}$ |  | Resistor, 18,000 ohms $1 / 2 \mathrm{w}$. Resistor, 27,000 ohms $1 / 2$ w. |  | $.05$ |
| C429 | RCM20B101K |  | HMV plate | . 35 | R443 | RC20AE 223 K | Resistor, 22,000 ohms $1 / 2 \mathrm{w}$. |  | . 06 |
| C430 | - ${ }_{\text {V}-11228-2}^{\text {RCP 10W4104M }}$ | ${ }_{\text {Capacitor }} 5$-80 mmf |  |  | ${ }_{\text {R444 }}$ | ${ }_{\text {RCO }}$ | Resistor, 10,000 ohms $1 / 2 \mathrm{w}$. | Coil shunt | . 05 |
| ${ }_{4} 432$ | RCP 10w RCM2003 R |  | Pulse shaping |  | ${ }_{\text {R446 }}^{\text {R44 }}$ | ${ }_{\text {RC20AE821K }}$ | Resistor, 820 ohms $1 / 2 \mathrm{w}$. <br> Resistor, 270,000 ohms $1 / 2 \mathrm{w}$. | Ceathode bias HMY grid | . 15 |
| ${ }_{\text {c }} 433$ |  |  | Decoupling | . 35 | R447 | V-11538-3 ${ }^{\text {R }}$ | Resistor, $67,0000 \mathrm{ohms} 1 / 2 \mathrm{~m}$. | HMY grid |  |
| C434 |  |  | Coupling | . 21 | R448 |  |  | Horizontal hold Decoupling | . 80 |
| C435 |  | Capacior, 11 mfd 400 v . | Cathode bypass | . 25 | R449 |  |  | Decoupling Plate load | . 05 |
| C436 | ${ }_{\text {RCP } 10 W 4104 M}$ |  | Screen bypas s | . 25 | R450 | RC20AE682K |  | Puls se shapingSupre sor | . 05 |
| C437 | RCP10W4254M RCP 10 W 4104 M |  | ${ }^{1} \mathrm{ACC}$ filter | . 35 | ${ }^{\text {R451 }}$ | RC20AE151MRC20AE474K |  |  | .06 |
| ${ }^{\text {C438 }}$ |  | V-5596-1 $\quad$ Capacitor, 005 mfd m . |  |  | . 25 |  |  | ${ }_{\text {R452 }}$ |  | Suppre ssor |
| ${ }_{C}$ C439 |  |  |  | ${ }_{\text {B plus bypass }}^{\text {Bhasing network }}$ |  | ( ${ }_{\text {R453 }}$ | V-11328-2 | Resistor, 470,000 ohms Resistor, 33 ohms 1 w . | Cathode bias | .11 |
| C441 | $\underset{\text { V-9901-3 }}{\text { RCP 10M4 }}$ | Capacitor, 04 mfd 400 v. Capacitor, 500 mmf | High oilcage filterPhasPing network | 1.70 | R455 | RC40AE.22RC20AE102KR |  | Bleeder Dropoing | . 90 |
| ${ }^{\text {c } 442}$ |  | Capacitor, 500 mmf <br> Capacitor, 06 mfd 400 v . |  | $\begin{aligned} & .25 \\ & .35 \\ & .25 \end{aligned}$ | ${ }^{\text {R456 }}$ |  | Resistor, 2200 ohms 2 w. <br> Resistor, 1000 ohms $1 / 2 \mathrm{w}$. <br> Resistor, 330,000 ohms 1 w. | ${ }_{\text {Dropping }}^{\text {AGC filter }}$ |  |
| ${ }_{\substack{\text { c443 } \\ \text { c44 }}}$ | $\begin{aligned} & \text { RCP10M4254M } \\ & \text { V }-9792-10510 \mathrm{~J} \\ & \mathrm{~V}=9891-1 \end{aligned}$ | Capacitor, 25 mfd $4000^{\text {. }}$ <br> Capacitor, 51 mmf 1000 v consists of C216A, C445A, C502A. C503A) | Hor. yoke returnDeflection yoke |  | (R457 | ${ }^{\mathrm{V} \text { - } 92927-1}$ |  | High volt age filter | -11 |
| -C449 ${ }^{\text {c }}$ |  |  |  |  | R458 R 459 | $\mathrm{RCO}^{\mathrm{RC} 2015391 \mathrm{~K}}$ | Resistor, 390 ohms $1 / 2 \mathrm{w}$. | Transient damping | .08 |
|  |  |  |  |  | ${ }_{\text {R } 460}$ | ${ }_{\text {RC20AE } 561 \mathrm{~K}}$ |  | Transient damping | . 05 |
|  |  |  | I-F decoupling | 4.35 * | ${ }_{\text {R461 }}$ | RC20AE473K | Resistor, 47,000 ohms $1 / 2$ | ${ }_{\text {HMV grid }}$ Tranient damping | . 05 |
| $\mathrm{C}_{446}$ | V-9044-1 | Capacitor, dual .005-.005 mfd | Inte grator net work | . 39 | Sw400 | V. 5406 |  | Local-distant | . 34 |
| L400 | V-6764 | Coil | Ringing | 1.45 | T 400 | V-10909-2 | Transformer | Vertical output | 3.90 |
| L401 | V -11789-1 | Reactor | Horizontal linearity | 1.30 | $\mathrm{T}^{101}$ | V -11548-3 | Tran sformer | Horizontal output | 13.50 |
| ${ }^{\text {L } 402}$ | V-11791-1 | Reactor | Width control | 1.40 | 2401 | v-12218-1 | Yoke assembly | Deflection | 13.50 |
| R $\begin{gathered}\text { R400 } \\ \text { R401 }\end{gathered}$ |  | Resistor, 3000 ohms Resistor, 4700 ohms $1 / 2 \mathrm{~m}$ | ${ }^{\text {Voltage divider }}$ | .80 |  |  |  |  |  |
| ${ }_{\text {R402 }}$ | ${ }_{\text {RCO2AE104K }}$ | Resistor, 100,000 ohms $1 / 2 \mathrm{~m}$. | Dividet | . 05 |  |  | SECtion 5 - power |  |  |
| \% $\begin{gathered}\text { R } 403 \\ \text { R404 }\end{gathered}$ | $\mathrm{RCO}^{\mathrm{RC} 20 \mathrm{AE}} 184 \mathrm{~K}$ | Resistor, 180,000 ohms $1 / 2 \mathrm{~m}$. | ${ }^{\text {Divider }}$ Cathode bias | . 05 | C500 | V.5040-15 | Capacitor, 01 mfd 600 v . | Line filter | . 35 |
| R404 | ${ }_{\text {RCP }}^{\text {RC20AE823J }}$ | Resistor, 82,000 ohms $1 / 2 \mathrm{~m}$. | Cathode bias AGC cathode | . 05 | ${ }_{-}^{\text {C C501 }}$ | $\underset{\substack{\text { v-5040-15 } \\ \mathrm{v}-98901-1}}{ }$ |  | Line filter | . 35 |
| $\stackrel{\text { R406 }}{ }$ | RC20AE473] | Resistor, 47,000 ohms $1 / 2 \mathrm{w}$. | AGC cathode | . 15 |  |  | Capacitor, 40 mfd 450 v . elec. (assy. (2024 |  |  |
| R407 R408 |  |  | ${ }_{\text {Load }}^{\text {Loading limiter }}$ | . 05 |  |  | C503A) | Input filter | 4.35* |
| ${ }_{\text {R409 }}$ | ${ }_{\text {RC20AE }} \mathbf{R C S K}$ | Resistor, $470,000 \mathrm{ohms} 1 / 2 \mathrm{~m}$. | Syoucling separator grid | .05 | -C503A | v-9891-1 | Capacitor, 40 mfd 450 v . elec (assyy. |  |  |
| R410 | RC20AE122K | Resistor, 1,200 ohms $1 / 2 \mathrm{w}$. | Cathode bias | . 25 |  |  | ${ }_{\text {cosis }}^{\text {consists }}$ |  |  |
| ${ }^{\text {R411 }}$ | $\mathrm{RCO}^{20} \mathrm{AE224K}$ | Resistor, 220,000 ohms $1 / 2 \mathrm{~m}$. | Bypass |  | C504 | $\mathrm{v}-9863-1$ | Capacitor, 800 mmf | Heater bypass | . 20 |
| ${ }_{\text {R413 }}^{\text {R412 }}$ |  |  | ${ }_{\text {Draping }}^{\text {Diate load }}$ | .06 | C505 | $\mathrm{V}=9863$-1 | Capacitor, 800 mmf | Heater bypass | . 20 |
| R414 | RC20AE183K | Resistor, 18,000 ohms $1 / 2 \mathrm{w}$. | DC divider | . 05 | 1500 | V. V -4877-3 | Reactor ${ }_{\text {Reater }}$ Reactor, 1 microhenries | Low rolage filter | $\begin{array}{r}2.45 \\ \hline\end{array}$ |
| ${ }^{\text {R415 }}$ | RC20AE223K | Resistor, 22,000 ohms $1 / 2 \mathrm{w}$. | Signal divider | . 06 | L502 | v -4886-2 | Reactor, 1.1 microhenries | Filament choke | . 38 |
| R416 | RC20AE822K | Resistor, 8,200 ohms $1 / 2 \mathrm{w}$. | Vertical integrator | . 05 | ${ }_{\text {L503 }}$ | V -4886-2 | Reactor, 1.1 microhenries | Filament choke | . 38 |
| ${ }^{\text {R417 }}$ | $\mathrm{RCO}^{\text {20AESP22K }}$ | Resistor, 8,200 ohms $1 / 2 \mathrm{w}$. | Verical integrator | . 05 | R500 | RC30AE224M | Resistor, 220,000 ohms 1 m . | Protection | - 10 |
| R418 R419 |  |  | - Divider ${ }_{\text {Vertical }}$ | . 80 | - ${ }_{\text {R } 501}$ | V-11328-8 | Resistor, 50 olms 10 w . | Current limiter | . 75 |
| R420 | RC30AE823K | Resistor, 82,000 ohhs | Divider | . 09 |  |  |  |  |  |
| R421 | RC20AE474K | Resistior, 470,000 ohms $1 / 2 \mathrm{~m}$. | Delay network | . 05 | T500 | V-11544-4 | Transformer | Power | $\begin{array}{r} 2.65^{\circ} \\ 19.50 \end{array}$ |
|  | New part number Sold only as comp Price includes Fed All prices are sub | for the first time in Westinghouse radi assembly. Price shown covers complete Excise Tax. est. <br> o change without notice. | or television service inform assembly. |  | v-10030-1 | Speaker, 5\%" PM |  | $\cdots{ }^{(1 . . . . . . . . . . . . . . . . . . . . . . . . . . ~}$ | 3.90 * |

## DESCRIPTION

Model H-802 UHF Receptors are designed for use with Westinghouse television receivers that contain specific provisions for the ir use. Receivers that cont ain Receptors, on one UHF television channel. If only one UHF station is active in a particular locality, only one UHF Receptor is required. If two UHF stations transmit in the locality, they can both be received by installing two UHF Recepo tors. The UHF reception provided by these receptors is in addition to the standard VHF reception provided by the VHF tuner in the television receiver.

Each receptor contains a local oscillator which employs a 6AF4 tube and operates 45.75 mc . bigher than the video carrier frequency of the received UHF signal. The oscillator frequency is initially adjusted by the oscillator trimmer, C10, and fine tuning is provided by the fine tuning capacitof which is mechanically coupled to the fine tuning control on the television receiver. Suitable band-pass circuits tuned to the frequency of
the received signal by the $\mathrm{R}-\mathrm{F}$ trimmers (C1 and C 2 ) the received signal by the $\mathrm{R}-\mathrm{F}$ trimmers ( Cl and C 2 )
serve as the antenna inpur circuit in each receptor. serve as the antenna input circuit in each receptor. The incoming UHF signal mixes and the resultant I-F output (center frequency is 44 mc .) is fed to the R-F amplifier in the television receiver. When the channel selector on the television receiver is set to either of the UHF positions, the R-F amplifier and mixer circuits in the television receiver serve as I-F amplifiers at 44 mc., and the VHF oscillator is disabled. Thus, the 44 mc. output of the UHF Receptor is amplified in these circuits and fed into the I-F strip in the receiver.

## IDENTIFICATION

Model H-802 Receptors are shipped pre-adjusted to receive a particular UHF channel. The channel to which the receptor is tuned is marked on the label which is attached to the unit.

In addition, the receptors are divided into categories depending on the frequency range covered by each. The identifying markings which are stamped on
the receptors and the corresponding frequency coverages are as follows:

Receptors Marked -
V-11900-1
V-11900-2
V-11900-3
V-11900-5
V-11900-5

Can Be Tuned To Channels 14 through 29 Channels 28 through 43 Channels 43 through 58 Channels 58 through 73 Channels 73 through 83

V-11213 (early production) Special ranges



FIG. 1 - MODEL H-802 UHF RECEPTOR

## INSTALLATION

To install a UHF Receptor:

1. Remove the rear of the television receiver.
2. Plug the receptor into either of the two UHF sockets located on the rear of the VHF tuner mounting plate in the television receiver. If the receptor is plugged position socket nearer the side of the chassis, the activated. If the receptor is plugged into the socket nearer the center of the chassis, the UHF position next to channel 2 on the channel selector is activated. The receptor should be seated firmly in the socket with the slots in the top of the receptor engaging the top of the VHF tuner bracket. If the center tongue of the tuner bracket is bent too far toward the back of the cabinet, it will catch the top of the receptor and prevent proper insertion. In this event, bend the center tongue toward the front of the cabinet just enough to allow insertion of the receptor. The sharp bend in the center tongue must bear on the top of the receptor when the receptor is fully seated. The fine tuning. wheel on the receptor the two sockets. If the two wheels are not correcty aligned, undue pressure will be required to mesh the wheels, and the drive torque will be excessive. In this event, loosen the set screw in the metal drive wheel and slide the wheel to the correct position on the shaft
3. Connect the ribbon-type antenna lead from the receptor to the UHF antenna terminals on the back cover of the receiver. To prevent impaired reception which zhassis, the lead should be passed trough receiver clip that supports the VHF antena lead but do allow the two antenna leads to run close together for any appreciable distance.
4. Replace the rear cover of the television receiver
5. Make appropriate antenna arrangements (se ANTENNA INFORMATION), and check the operation


FIG. 2 - UHF dipole antenna length

## ANTENNA INFORMATION

Antenna requirements for satisfactory UHF television reception are determined by the signal conditions in the particular locality. Some of the possibilities
are as follows:

1. In areas where signals are strong and reflections are not troublesome, satisfactory reception may be obexternal) for borh VHF and UHF. This can be done by connecting two jumper wires from the UHF antenna terminals to the STD antenna terminals so as to connect the two sets of terminals in parallel. If this method is used, make certain that it does not adversely affect reception on the standard VHF channels.

If an external antenna is used for VHF reception, satisfactory UHF reception may be obtained by connecting
the built-in VHF antenna to the UHF antenna terminals.
2. If the above methods are not satisfactory, a simple, resonant dipole antenna may provide satisfactory reception in medium-signal areas. The chart, Fig. 2, gives the total length of a dipole elem
quency in the UHF television spectrum
3. Where signals are weak or reflections are troublesome, a high gain, directive antenna system should be used. Typical of this type of antenna are the corner reflector, the rhombic, and the Yagi.

## ADJUSTMENTS

It is desirable to check for best adjustment each time a receptor is installed. This is accomplished as follows:

1. Rotate the fine tuning wheel on the receptor to its center frequency position. The fine tuning capacitor is centered when the midd'c hile in the rim of the
2. Rotate the channel selector on the receiver the appropriate UHF position (see step 2 under INSTALLATION).
3. Rotate the oscillator trimmer ( C 10 ) to the position that provides best picture detail. NOTE: Since the units are pre-adjusted for a particular frequency, only a slight re-adjustment at most should be needed certain the antenna facilities are adequate before move ing the oscillator trimmer far from its original setting.
4. Rotate the R-F trimmers ( C 1 and C 2 ) to the positions that provide best picture detail. NOTE: If the R-F trimmers are rotated too far counterclockwise, they under SERVICE when replacing the screus.
5. Rotate the I-F trimmer (L6) for best picture detail. This trimmer has a broad tuning characteristic and is effective mostly in weak signal are as.

## SERVICE

Troubleshooting inside the UHF Receptor is not recommended.

There are critical adjustments inside. One critical adjustment consists of two shield vanes located be$t$ ween the R-F coils (L2 and L3) which determine the coupling between the coils. Since special equipment and techniques are required to make the adhe original factory placement of wires and components.

The R-F trimmers (C1 and C2) will detach from the unit if they are roxaced con damaging the ceramic part of the trimmer when replacing the screw:

1. With the screw removed from the unit and the inetal locking device placed on the screw, rotate the ocking dev
2. Insert the screw in place and rotate it clockise several full turns.

Thile keeping the screw from turning, rotate the locking device clockwise until it is moderately tight against the outside of the receptor.


FIG. 1 - V-11390-1 TUNER


FIG. 2 - V-11390-2 AND V-11390-3 TUNERS

V-11390.1, -2, AND . 3 CIRCUIT DESCRIPTIONS
As indicated in Figs. 1 and 2, the incoming UHF signal is coupled into the tuner through a 300 ohm the desired RF bandpass. Operaule tuned to provide than the video carrier frequency of the received signal, the oscillator tuning is ganged with that of the bandpass circuit. A portion of the oscillator voltage is coupled into the bandpass circuit where it mixes with the incoming UHF signal. The difference frequency (center IF is 44 mc .) is extracted in the mixer circuit and fed through a shielded cable to the UHF socket on the television receiver. In the $V-11390-1$ runer, a germanium crystal serves as the mixer, while the $\mathrm{V}-11390-2$ grid mixer circuit. Otherwise, the three tuners are basically alike.

## V-11613-1 CIRCUIT DESCRIPTION

The bandpass circuit in the V-11613-1 tuner conists of $t$ wo tuned sections as indicated on Fig. 3. Each d loops L3 and L4. Coupling of the UHF signal into the the circuit is effected through the antenna input coupling loops, L1 and L2, and the signal is fed from the bandpass circuit to the mixer through L6.

Also fed to the mixer (through L7) is a locally generated signal which is 45.75 mc . higher than the video carrier frequency of the received signal. This signal is not the fundamental ourput frequency of the oscillator, however. Instead, the oscillator operates at one-hal frequency and its second harmonic is utilized. The second harmonic content of the oscillator output is increased by the action of the harmonic generating crystal and coupled which is capacitor-tuned 45.75 mc . above the video carrier of the received signal, the oscillator double section selects the second harmonic of the oscillato and discriminates against the fundamental.

In the crystal mixer circuit, the difference fre In (center IF is 44 mc .) is derived from the UHF signal and the locally generated signal. A shielded cable carries the IF signal to the UHF socket on the elevision receiver.

## INSTALLATION

1. Remove the back cover, and remove the chassis om the cabinet.

2. Remove the wheel trom the back end of the UH drive shaft, and install the $13 / 16^{n}$ pulley on the drive shaft.
3. Mount the tuner support bracket to the tuner and mount ing plate assembly as shown in Fig. 4. The bracket grommets in the two large mounting holes, insertin metal spacers inside the grommets, and using $1 / 2^{n}$ selftapping screws.
4. On models that have the on-off-volume and pic ure control mounted above the channel selector, loosen the $3 / 8$ palnut which holds the control to the chassis.
5. Make certain the dial background bracket is itted into the correct slots in the mounting plate used for all $17^{n}$ receivers and the " $B$ ", slots are use for all $21^{n}$ receivers
6. Place the tuner assembly as shown in Fig. 4 The slots in the mounting plate assembly must be placed over the tongues at the top of the UHF bracke and pressed down until firmly locked in place.
7. On models that have the on-cff-volume and pic ure control mounted above the channel selector, the lot in the front lip of the mounting plate assembly between the palnut and the vertical section of chassis, and then tighten the palnut.
8. On models that have the on-off-volume and pic ture controls located other than above the channel selector, use a $6-32$ screw, $6-32$ nut and $\# 6$ lockwasher to secure the front lip of the mounting plate assembly to the vertical section of chassis. Insert the screw through the slor located near the center of the mounting enter of the chassis vertical section and near the lockwasher and nut. 9. Insert a $1 / /^{T \prime}$ self-tapping screw into the hole located to the right of the palnut mentioned in step 7
or the screw mentioned in step 8, and tighten the screw or the screw mentioned in step 8 , and tighten the scre 10 ated in front of the mounting plate assembly slot which engage the tongues of the UHF bracket, and tighten the screw.
9. With the large pulley rotated to its maximum counterclockwise position, install the $19^{n}$ drive string and spring as shown in Fig. 5 .
10. Insert the UHF plug into the UHF socket far thest from the side of the chassis as indicated in Fig 4. This socket corresponds to the UHF position next to
channel 2 on the channel selector. The the side of the chassis is left arocup
11. With the large pulley rotated fully counterclock wise, see that the dial pointer is positioned as in-


FIG. 3 - V-11613-1 TUNER
dicated in the lower left corner of Fig. 4.
14. Remove the plastic plate from the picture mask inside the cabinet by removing the clips which hold it in place.
15. Install the calibrated UHF dial in place of the plastic plate which was removed in step 14 , and replace he clips.
16. Replace the chassis in the cabinet
17. Connect a suitable antenna to the UHF antenna ead (SEE ANTENNA INFORMATION), and check the operation. If the dial pointer does not indicate the correct channel, turn off the receiver, reach in along he left side of the cabinet, and slide the pointer to he correct position.
18. Route the ribbon type antenna lead from the UHF tuner through the opening above the UHF antenna
terminals on the back cover, and attached the lead to he UHF antenna terminals.
19. Replace the back cover

## REPLACING V.11390-1, V.11390-2, OR V.11390-3 TUNER USED WITH MODELS H-803-1; H-803-2,

1. Remove the two drive strings and springs from the large pulley.
2. Remove the tuner support.
3. Remove the UHF plug from its socket.
4. Unsolder the ground strap from the tuner.
5. Release the tuner from the mounting plate assembly by removing the two self-tapping screws used to shock-mount the tuner.
6. Loosen the two small set screws in the hub of the large pulley, and remove the pulley.
7. With the tuning shaft of the replacement tuner otated completely counterclockwise, place the large pulley on the shaft so that the opening in the rim of the pulley is as indicated in Fig. 5. Tighten the set screws in the hub of the pulley.
8. Place the tuner in position, and install the shock-mount screws.
9. Solder the ground strap to the tuner, and install the tuner support.
10. String the two dial drive cords, and see hat the ial pointer is positioned as shown in Fig. 4 with the large pulley rotated completely counterclockwise.
11. Insert the UHF plug into the UHF socket farthest from the side of the chassis.
12. Check the dial calibration using an air signal. If the dial pointer does not indicate the correct channel, turn off the receiver, reach in along the left side of the cabinet, and slide the pointer to the correct position.

## REPLACING V. 11613 -1 TUNER USED WITH MODELS

## H-803-4, H-803-5 AND H-803-6

1. Remove the UHF plug from its socket.
2. Remove the two drive strings and springs from the large pulley.
3. Remove the self-tapping screw which secures the front lip of the mounting plate to the vertical section of chassis.
4. Loosen the off-on-volume and picture control planut or remove the $6-32$ screw (whichever is used to secure the front lip of the mounting plate).
5. Remove the selftappingscrew which secures the the mounting plate to the UHF bracket.
6. Remove the two self-tapping screws that secure the tuner support to the receiver chassis.
7. Release the mounting plate assembly from the UHF bracket by pulling straight up.
8. Remove the tuner by removing the three screws from the side of the tuner.
9. Mount the replacement tuner by replacing the three screws in the side.


Fig. 4 - installation details
10. Mount the assembly to the chassis by replac 11. Check the dial calibration using air signal If the dial pointer does not indicate the correct chan tel, turn off the receiver, reach in along the left side of the cabinet, and slide the pointer to the correc position.

FIG. 5 -
DIAL
STRINGING


## ANTENNA INFORMATION

Antenna requirements for satisfactory UHF teleAntenna requirements for satisfactory UHF tele-
in the part
as follows

1. In areas where signals are strong and reflection are not troublesome, satisfactory reception may be obained by using the existing VHF antenna (built-in or external) for both VHF and UHF. This can be done by connecting two jumper wires from the UHF antenna terminals to the SID antenna terminals so as to connect the two sets of terminals in parallel. If this method is used, make certain that it does not adversely affec reception on the standard VHF channels.

If an external antenna is used for VHF reception satisfactory UHF reception may be obtained by con necting the built-in VHF antenna to the UHF antenna
2. A simple, resonant dipole antenna may provide 2. A simple, resonan in medium-signal areas The chart, Fig. 6, gives the roral lengrh of a half-wave element for any frequency in the UHF television speceleme
trum.
3. Where signals are weak or reflections are roublesome, a high-gain, directive antenna system orner reflecto Typical of this type of antenna are th corner reflector, the rhombic, and the Yagi.

## ADJUSTMENTS

Model H-803 All-Channel UHF Television Tuner shipped pre-adjusted to receive UHF channels 14 hrough 83, and additional adjustments are not normally
required. In some cases, however, it may be desirable to adjust the IF trimmer, L5, located as shown in Fig.
4 for best picture detail and sound.

## SERVICE

A high degree of precision is used in the manufacture of UHF television tuners. Critical factors include lead lengths, lead and component dress, anc: component sizes. In servicing UHF tuners, problems arise which are not encountered in ordinary service not r. Therefore, troubleshooting inside the tuner is through a Westinghouse distributor.


FIG. 6 - UHF Dipole antenna length

PARTS LIST FOR MODEL H-803
Part No.

## Description

+ V-11431-1 Background, dial
+ V-11424-1 Cable Assembly(V-11390tuners)
V-3219S Cord, dial drive ( 100 ' spool)
+ V-11430-1 Dial, UHF 21" (H-803-1, H-803-4)
+ V-11580-1 Dial, UHF $17^{\prime \prime}$ (H-803-2, H-803-5)
$\not \subset$ V-11581-1 Dial, UHF $17^{\text {n P Plastic (H-803-3, }}$ H-803-6
- V-11426-2 Point

V-11428-1 Pulley Assembly, large (V-11390 Pulley, UH
V-10076-1 Spring, dial drive string
+V -i 1390-3 Tuner Assembly (H-803-1, -2, -3)

+ V-11613-1 Tuner Assembly (H-803-4, -5, -6)
6 New part number listed for the first time in Westing bouse radio or television service information.
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## IDENTIFICATION

In production two basic UHF tuner types are used． They are designated V－11972－1 and V－12325－1．Tuner assemblies packed for field installation will be iden－ tified by a number following the basic model number （ $\mathrm{H}-804$ ）marked on the outside of the carton．

| Model No．on <br> Outside of <br> Carton | UHF <br> Tuner Type | For Use in Re－ <br> ceivers containing <br> VHF Tuner Type |
| :---: | :---: | :---: |
| $\mathrm{H}-804-1$ | $\mathrm{~V}-12325-1$ | $\mathrm{~V}-11794-1$ |
| $\mathrm{H}-804-2$ | $\mathrm{~V}-11972-1$ | $\mathrm{~V}-12100-1 . \mathrm{V}-12400-1$ |

## V－12325－1 CIRCUIT DESCRIPTION

See schmeatic Fig． 1 In this tuner the incoming UHF signal is inductively coupled to the preselector stage of the tuner through a 300 ohm balanced input circuit．The preselector stage is double tuned to provide the desired RF bandpass．The ultraudion oscillator circuit uses a type 6AF4／6T4 tube and operates at a frequency 45.75 mc ．higher than the video carrier of the received signal． A portion of the oscillator voltage is link－coupled to the preselector stage．The difference frequency is extracted by a crystal mixer stage（center IF is 44 mc ．）and is capacitively coupled to the VHF tuner via a shielded． cable．

## V－11972－1 CIRCUIT DESCRIPTION

See Schematic Fig．2．This tuner employs four tuned sections．Three are modified end－tuned quarter－
wave coaxial lines and are used in the preselector and oscillator doubler circuits．The fundamental oscil－ lator uses a 6 J 6 dual triode in a capacitor tuned cur－ cuit，operating at one－half the frequency required to mix with the incoming signal．The capacitor tuning plates for the four sections are mounted on a common tuning shaft．

Considering the first two sections comprising the preselector，the input signal is inductively coupled to the first tuning section．The coupling loops L1 and L2 present a 300 ohm impedence to the antenna trans－ mission line．The 1 st and 2 nd sections of the preselector ate over－coupled by means of the coupling loops L3 and L4．

The oscillator doubler section selects the second harmonic of the fundamental via a harmonic generating crystal．This second harmonic frequency is 45.75 mc higher than the video carrier of the incoming signal．

A crystal mixer taps into the 2 nd RF and the os－ cillator doubler sections，receiving energy from both cillator doubler sections，receiving energy from both
to produce the IF signal．（center IF is 44 mc ．）The out－ put of the UHF tuner is link－coupled to the VHF tuner via a shielded cable．

## INSTALLATION

The following procedure is recommended for installing the H -804 tuner.

1. Remove the back cover from the cabinet. Installation can be made without removing the receiver chassis from the cabinet.
2. The drive shaft for the UHF tuner is mounted directly above the VHF tuner. It is already coupled to the fine tuning shaft of the VHF tuner and to the fiber shaft on which the UHF channel indicating dial will be installed. (See Fig. \#3)
3. Remove and discard the split pulley wheel which is found on the rear of the UHF drive shaft, Also remove the button plug bearing from the rear support bracket for the UHF drive shaft. This part is no longer needed as the rear of the UHF drive shaft will be supported by the UHF tuner shaft. (See Fig. \#3)
4. Turn the VHF fine tuning control until the flat section of the UHF drive shaft is in the proper position to slide into the flexible coupling on the UHF tuner shaft.

NOTE: The flexible coupling may be a press fit or secured by set screws. Set screws should be properly tightened.
S. Insert the plug on the connecting cable from the UHF tuner into the UHF socket located on left top of the VHF tuner mounting bracket when viewed from rear. Some receivers will have the UHF socket mounted vertically on the left side of the VHF tuner mounting bracket.
6. Slide the UHF tuner assembly into position so that the bottom of the UHF tuner mounting bracket is securely the bottom of the UHF tuner mounting bracket is securely
locked under the protruding lip found on the VHF mountlocked under the protruding lip found on the VhF mount-
ing bracket. While doing this, guide the UHF drive shaft into the flexible coupling on the UHF tuner. Two $1 / 4$ selftapping screws are supplied to secure the rear of the UHF mounting hracket firmly to the VHF tuner mounting bracket. (See Fig. \#3)
7. Remove the VHF channel selector knob and calibrated dial from the front of the cabinet. Remove the tape stamped U [iF from the inside of the VHF calibrated dial to uncover the window between channel numbers 2 and 13.
8. Rotate the VHF fine tuning knob counter-clockwise until the fiber tuning shaft stops turning.
9. Remove the VHF fine tuning khob.
10. Without disturbing the position of the fiber tuning shaft press the calibrated UHF dial onto the fiber tuning shaft so that channel 14 is barely visible on the left when viewed through the window in the cabinet.
11. Discard both the fiber washer and the felt washer found on the VHF fine tuning knob. Place the felt washer supplied with the kit on the outside shoulder of the calibrated UHF dial and replace the VHF fine tuning knob and the channel selector knob.
12. Route the ribbon type antenna lead from the UHF 12. Route the ribbon through the opening provided above the UHF antenna terminals on the back cover and attach.
13. Replace the back cover.

## ADJUSTMENTS

Model H-804 All-Channel UHF Television Tuner is shipped pre-adjusted to receive UHF channels 14 through 83. Additional adjustments are not normally required In some cases, however, it may be desirable to adjust the IF trimmers, LS and L100 (See Fig. \#3) for best picture detail and soind. Refer to alignment information for procedure.

## OPERATION

1. See the channel selector to the position which allows the UHF channel numbers to be visible through the window in the selector knoh.
2. Rotate the VHF fine tuning knob until the cali brated I'HF dial is in the approximate position for the desired channel. Since the UHF stations operating in any
particular locality are widely separated over the entire UHF tuning range it is not necessary to indicate their exact location on the UHF dial.
3. Adjust the VHF fine tuning knob until the desired program is received with the best picture detail and sound quality.
4. The other controls on the receiver have the same function and are operated in the same manner as they would be when receiving a standard VHF program.

## ALIGNMENT INFORMATION

When a H -840 tuner is installed in a fringe area or as a replacement it may be necessary to make minor alignment adjustments. When the channel selector of the VHF tuner is turned to the THF position the VHF tuner hecomes a two stage IF amplifier. It amplifies the signals from the UHF tuner and applies them to theIF stages of the receiver. It is therefore necessary that the combination of the output circuit of the U!!F tuner and the input circuit of the VHF tuner have the required bandpass to maintain the desired ratio between sound carrier and picture carrier amplification.

## TEST EOUIPMENT

1. UHF Sweep Generato

Range $470-890 \mathrm{mc}$.
Sweep width 10 mc .
2. High Gain Oscilloscope
3. Calibrated Marker Generator capable of pror ducing an accurate 43 mc . marker signal.
4. Resistor network to match sweep generator output to 300 ohm impedance of UHF tuner input. (See Fig. 7)
5. Detector Probe (See Fig. 5)
6. 9 Volt bias battery.


1. Refer to block diagram Fig. \#6 for test equip ment hookup.
2. Connect a 9 volt bias battery hetween the te ceiver A.G.C. line and ground. Negative to A.G.C. line. Positive grounded to receiver chassis.
3. Connect the input lead of the detector probe (Fig. 5) to the VHF factory test point on the VHF tuner Connect the output of the detector probe to the vertical input of the oscilloscope. Use shielded cable for all leads. Cable shields should be grounded as close as possible to the point at which the "hot" lead is
connected.
4. If the sweep generator has built-in provisions to produce a synchronized horizontal sweep in the oscillscope, connect a sheilded cahle from the horizontal input of the oscilloscope to the corresponding terminals on the sweep penerator, (I'sually marked 'Scope Horiz',
5. Connect a shielded lead from the UHF Sweep Generator ouput terminals through the impedance matminals.
6. Set the receiver channel selector in the UHF position and rotate the VHF fine tuning knob until channel $\psi^{2} 8$ is viewed through the channel selector window.
7. Set the sweep generator to 677 mc . (cente frequency of channel 48) and the sweep width to 10 mc with all equipment on and the oscilloscope controls properly adjusted, adjust the VHF fine tuning control until the response curve appears on the oscilloscope.
8. Set the marker generator to 43 mc . (accuracy is importart) Loosely couple the outpur to the VHF tuner factory test point. Adjust marker signal output so that
the pip is barely visible on the scope. Fxcessive marker injection will distort the response curve.
9. Simultaneously adjust LS LHF IF Trimer and L100 located on the VHF Tuner (see Fig. 1, 2 and 3) until the response curve is symmetrical and 43 mc . marke ip appears in the center of the response curve. (See Fig.

## Replacing V-12325-1

 and V-11972-1 UHF Tuner1. Remove back cover from receiver.
2. R:move the plug on the UHF tuner connecting cable from its socket on the VHF tuner bracket.
3. Insolder the antenna lead from the UHF tuner antenna terminals.
4. The coupling device hetween the VHF tuner and the UHF tuner drive shaft is either a press fit or seured by set screws. If set screws are used they must of UHF television precision is used in the manufacture e loosened to release the coupling device from the UHF lengths, lead and compons. Critical factors include lead uner drive shaft.
5. Remove the two $1 / 4$ self-tanping screws that secure the tear of the LHF tuner mounting brachet to the VHF tuner mounting bracket. Pull the tuner assembly toward the rear of the receiver chassis to release the front of the fistribe some, a high-gain, directive UHF antenna system should be used. Typical of this type of antenna are corner re flector, the conical, and Yagi.

Transmission lines should be of an approved low loss type. The use of rubular 300 ohm line is preferred over ribton type 300 ohm line

## service

 engths, lead and component dress, and component sizes. in servicing thF tuners, problems arise which are not countered in ordinary service work. Therefore, troublehooring inside the tuner is not recommended. Deributerers should be returned through a Wesringhouse distributor.HF tuner mounting bracket from the VHF tuner mounting
6. Unsolder the connecting cable from the old tune and install on the replacement.
7. Remove coupler and install on replacement tuner.
8. Remove LHF mounting bracket from old tuner and install on the replacement.

The V-12325-1 tuner is shock mounted to the bracket by four $1 / 4$ self-tapping screws located on the top four corner of the tuner. It is grounded by a honding strap located on the top front of the tuner. It is important that this strap is soldered to -
h. The V-11972-1 tuner is mounted to the bracket by three 8-32 screws located on the side.
9. Follow the procedure used when installing a $\mathrm{H}-804$ uner assembly, starting with step ${ }^{*} 4$

## ANTENNA INFORMATION

Antenna requirements for satisfactory UHF tele vision rec eption are determined by the signal condition in the particular locality

1. In areas where signals are strong and refle ctions are not troublesome, satisfactory reception may be obtained by using the existing VHF antenna (Built in or external) for both VHF and (HF. This can be done by connecting two jumper wires trom the UHF antenna terminals to the STD antenna terminals so as to connect the two sets of terminals in parallel. If this ared make certain that it does not adversely If reception on the standard VHF channels.
I an external antenna is used for VHF reception, ang thactory Unf reception may be obtained by connect2. A simple, resonant dipole antenna may provide satisfactory reception in medium-signal areas, where quency in the CHF television spectrum.
2. Where signals are weak or reflections are trouble -


Fig. I V-12390-1 Tuner


A third UHF tuner assembly is being lised in the production of the Manei H-804 all-channel UHF tuner kit. This tuner is designated V-12390-1 and will be used in the H-804-3 kit. The V -12390-1 UHF tuner is basically the same as the V-12325-1 UHF tuner (see basic H-804 service note) except that its IF out put is designed for link-coupling to the VHF tuner.
Refer to the following chart for identification:

| Model No. on <br> Outside of <br> Carton | UHF <br> Tuner Type | For Use in Receivers contain- <br> ing VHF Tuner Type |
| :--- | :--- | :--- |
| $\mathrm{H}-804-1$ | $\mathrm{~V}-12325-1$ | $\mathrm{~V}-11974-1$ |
| $\mathrm{H}-804-2$ | $\mathrm{~V}-11972-1$ | $\mathrm{~V}-12100-1$ or V -1 2400-1 |
| $\mathrm{H}-804-3$ | $\mathrm{~V}-12390-1$ | $\mathrm{~V}-12100$-1 or V-12400-1 |

## PARTS LIST FOR MODEL H-804

Part No.
Description
V -12325-1 Tuner UHF (H-804-1) V-1 1972-1 Tuner UHF (H-804-2) -12330-2 Coup er, flexible (H-804-1) Includes one compression ing) Coump for $\mathrm{H}-804-1$ coupler. Coupler, fiexible (H-804)
(Includes two compression ings) Cable Assy., includes UHF Knob, dial UHF (Includes comiression ring
Washer, Felt (ThF dial
© John F. Rider


## GENERAL DESCRIPTION

The Model $\mathrm{H}-805$ single channel UHF coil strips pro－ vide reception of the UHF television channels（14 through 83）．They are used with Westinghouse television re－ are installed in place of unused VHF coil strips and Model H－805 is a single section assembly comprised of the RF preselector mixer and local oscillator harmonic generator circuirs．Because of size limitations a max generator circuits．Because of size limitations a max－ installed adjacent to each other．Fig． 1 is the schematic diagram and also shows the physical layout of the com－ ponents．All Model H－80s strips are factory alipned and ponents．All Model $\mathbf{H} 80 \mathrm{strips}$ are factory aligned and
with the exception of the oscillator coil slug，do not re－ quire adjustment when installed．THE OSCILLATOR SLUG MUST BE ADJUSTED AT THE TIME OF IN－ STALLATION．

## CIRCUIT DESCRIPTION

Refer to schematic diagram Fig． 1 and block diagram Fig．2．The received signal is coupled to the double cuned preselector circuit by the 300 balanced antenna in－ put coupling coil．The output of the preselector is ap－ plied to the mixer crystal by means of a tap on the sec－
ond preselector coil． ond preselector coil．

The frequency required to beat with the incoming signal to produce the IF carrier frequency is obtained by operating the local oscillator at a sub－harmonic and ap－ operating the local oscillator at a sub－harmonic and ap－ plying its output to the crystal harmonic generator．
to receive channel $30,(567.25 \mathrm{mc}$ ．），using a 45.75 mc ． video carrier IF frequency，the local oscillator would operate at 204.33 mc ．and be tripled in the harmonic gen－ inc．）

As shown in Fig．1，the output of the local oscillato is fed to the harmonic generator crystal through the 100 K resistor and 4.7 mmf capacitor network．This network biases the crystal so that it operates over a non－linear portion of its characteristic curve．The third harmonic of the local uscillator is developed across the harmonic se lector circuit and applied to the mixer transformer by means of a coupling loop．The sound and video IF sig nals appear across the primary of the mixer transformer which serves as an IF transformer to couple the IF sig nals to the grid of the 6BK7 or 6BK7A cascode amplifier． This stage and one section of the 6 J 6 dual triode（nor－ mally operated as the tuner mixer）function as IF amp－ lifiers．

## INSTALLATION INSTRUCTIONS

Extreme care must be exercised when handling UHF coil strips．Component parts positioning and lead dress are important factors in the construction of these strips． Careless handling can easily impair their performance．

To install UHF coil strips，proceed as follows：
1．Remove the receiver chassis from the cabinet．
2．Remove the VHF tuner bottom cover．It is secured by four hex head self tapping screws．

3．Remove unused VHF coil strips and replace with the desired UHF coil strips．

4．Replace bottom cover，turn on the receiver and allow 5 min ．warm－up time．Set the channel selector to the channel corresponding to the UHF coil strip，set the fine tuning control in the center of its range（flat of shaft facing down and tilted approximately $10 \%$ counterclock－ wise）and adjust the oscillator slug for best picture de－ tail and sound quality．A non－metallic alignment tool should be used．Always adjust the slug in a counter－ clockwise direction first．If it is turned too far clock－ wise，it will pass its retaining spring and slide into the coil form．

5．Replace the chassis in the cabinet and recheck the oscillator setting．

## SERYICE

A high degree of precision is used in the manufacture of UHF coil strips，and therefore，component parts re－ placement or preselector and mixer alignment is not re placement or presen ．Wher oring replacement UHF coil strips commended．When ordering replacement UHF coil strips， number following the basic part number indicates the channel number，i．e．，V－12550－28 is the part number for a channel 28 coil strip．



FIG．2．H－805－Block Diagram


## GENERAL DESCRIPTION

The model H-806 single channel UHF coil strips provide reception of UHF television channels 14 through 83. They are used with Westinghouse television receivers 83. They are used wish westinghouse television receivers stalled in place of unused VHF coil strips. The model H-806 is a dual section coil strip. One section contains the RF preselector, local oscillator harmonic selector and the mixer circuit for the first conversion. The other section contains the oscillator coil and the mixer circuit for the second conversion. Because of size limitations, a maximum of six sets of UHF strips can be installed. They cannot be installed adjacent to each other. Fig. 1 is the schematic diagram and shows the physical layout of the components. All Model $\mathrm{H}-806$ coil strips are factory aligned, and with the exception of the oscillator coil slug, do not require adjustment when installed. THE OSCILLATOR COIL SLUG MUST BE ADJUSTED AT
THE TIME OF INSTALLATION.

## CIRCUIT DESCRIPTION

Refer to schematic diagram Fig. 1 and block diagram Fig. 2. These UHF strips operate by double conversion of the received signal, using a harmonic of the local oscillator frequency for the first conversion and the funda-
mental frequency for the second conversion. The received mental frequency for the second conversion. The received
signal is coupled to the double tuned preselector by the 300 ohm balanced antenna input coupling coil. The first mixer circuit (UHF crystal) receives energy from both the preselector and the oscillator harmonic selector to produce the first conversion. This first conversion frequency
is amplified by the tuner RF amplifier tube, fed to the second mixer circuit where it beats with the furdameatal frequency of the local oscillator to produce the receiver IF frequency.

## INSTALLING MODEL H806 COIL STRIPS

Extreme care must be exercised when handling UHF coil strips. Component parts positioning and lead dress are important factors in the construction of these strips. Careless handling can easily impair their performance.

To install UHF coil strips, proceed as follows:

1. Remove the chassis from its cabinet.
2. Remove the bottom cover of the tuner by pulling he front end away from the tuner chassis and unhooking the rear end
3. Remove unused VHF coil strips and replace with the desired UHF coil strips. Be sure that the pin connector on the long section makes firm contact with the antenna section. DO NOT BEND THE PIN.
4. Replace bottom cover, turn on the receiver and allow 5 min. warm up. Set the channel selector to the channel corresponding to the UHF coil strip, set the fine tuning control in the center of its range (flat of shaft facing down) and adjust the oscillator slug for best picture detail and sound quality. A non-metallic alignment tool should be used. Always adjust the slug in a counter-clockwise direction first. If it is turned too far clockwise it will pass its retaining spring and slide into the coil form.
5. Replace chassis in the cabinet and recheck the oscillator setting.

## SERVICE

A high degree of precision is used in the manufacture of UHF coil strips, and therefore, component parts reof UHF coil strips, and therefore, component parts reing replacement coil strips, order by service part nos.
V -12384-(14-83) for the antenna section, and V-12485( $14-83$ ) for the oscillator section. The dash number fol lowing the basic part number indicates the channel num ber, i.e., V-12484-28 is the antenna section for channel
28 .


FIG. 1 - Schematic Diagram


FIG. 2 - H-806 Block Diagram

|  |  |  |  |
| :---: | :---: | :---: | :---: |
|  |  |  |  |
|  |  |  |  |
| R1800E \& R | Table | 17LP4 | 19R20 |
| R1800EZ \& RZ | Table | 17LP4 | 19M20 |
| R1812E \& R | Table | 17LP4A | 19R20 |
| R1812EZ \& RZ | Table | 17LP4A | 19M20 |
| R2229E \& R | Table | 21YP4A | 19R21 |
| R2229EZ \& RZ | Table | 21YP4A | 19M21 |
| R2230E \& R | Table | 21YP4A | 19R21 |
| R2230EZ \& RZ | Table | 21YP4A | 19M21 |
| R2249E \& R | Console | 21YP4A | 19R21 |
| R2249EZ \& RZ | Console | 21YP4A | 19M21 |
| R2250E \& R | Console | 21YP4A | 19R21 |
| R2250EZ \& RZ | Console | 21YP4A | 19M21 |
| R2253M | Console | 21YP4A | 19R21 |
| R2257E \& R | Console | 21 YP 4 A | 19R22 |
| R2258E \& R | Console | 21YP4A | 19R21 |
| R2258EZ \& RZ | Console | 21 YP 4 A | 19M21 |
| R2337E \& R | Table | 212P4B | 22R20 |
| R2359E \& R | Console | 217P4B | 22R20 |
| R2360R | Console | 21 ZP 4 B | 22R20 |
| R2368R | Console | $21 \mathrm{ZP4B}$ | 22R20 |
| R2367E \& Y | Console | 212P4B | 22R20 |
| R2387R | Combination | 217P4B | 22R20/10L20 |
| R2391E | Combination | 212P4B | 22R20/10L20 |
| R2671E \& R | Console | 24CP4A | 22R21 |
| R2975R | Console | 27EP4 | 22R21 |
| R2976E | Console | 27EP4 | 22R21 |
| R2979E | Console | 27EP4 | 22R21 |
| R2994EU | Combination | 27EP4 | 22R21/12R21 |
| R2994HU | Combination | 27EP4 | 22R21/12R21 |
| SUFFIX "U" FOLLOWING ANY MODEL NUMBER INDICATES A |  |  |  |
| RECEIVER EQUIPPED WITH THE ZENITH CONTINUOUS TUNER |  |  |  |
| TV AUDIO OUTPUT | ANTEN | A IMPEDANCE | FINISH |
| 19R SERIES |  | 00 Ohms |  |
| 1.5W. Undistorted |  | ER SUPPLY | E - Blond |
| 1.8W. Maximum | 110 Vo | - 60 Cycles AC | H - Cherry |
| 22R SERIES | 19R S | ies 185 Watts | M - Maple |
| 6W. Undistorted | 22R20 | 265 Watts | R - Mahogany |
| aW. Maximum | 22R2 | 300 Watts | Y - Ebony |

## INTRODUCTION

The 19R20, 19R21, 22R20 and 22R21 chassis described in this manual are similar in design. Alignment and adjustment procedures are identical. The 22R series is similar to the basic 19R series except for the horizontal output tube, an additional 5U4G rectifier, higher second anode voltage and high fidelity sound. In addition, receivers using the 22 R chassis are equipped with a phono connector, push pull audio and top tuning with the switch and volume control mounted in the upper left corner of the cabinet, the channel selector at the right and the fine tuning at the rear adjacen to the turret tuner. The main differences between various chassis are in the type of tuner, audio system and picture tube size (see chart).


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CHASSIS 19M20,21,19R20,21,22,22R20,21

TUBE COMPLEMENT
19R20-19R21 Chassis

| SYMBOL | L TUBE | FUNCTION |
| :---: | :---: | :---: |
| V1 | 6BK7A | RF Amplifier <br> V2A Mixer <br> V2B RF Oscillator <br> 1st IF Amplifier <br> 2nd IF Amplifier <br> 3rd IF Amplifier <br> Video Amplifier <br> Sound Limiter <br> Audio Detector <br> Sound Output <br> V10A AGC Amplifier <br> V10B Vertical Osc. <br> Sync Clipper <br> Vertical Output <br> V13A Horiz. Phase Det <br> V13B Horiz. Control <br> V14A Horiz. Osc. <br> Vi4B Horiz. Discharge <br> Horiz. Output <br> High Voltage Rect. <br> Damper <br> Low Voltage Rect. <br> 19R20 Chassis <br> 19R21 Chassis |
| V2 | 6U8 |  |
| v3 | 6 CB 6 |  |
| V4 | 6CB6 |  |
| v5 | 6CB6 |  |
| V6 | 12BY7 |  |
| V7 | 6AU6 |  |
| V8 | 6BN6 |  |
| V9 | 6AQ5 |  |
| V10 | $12 \mathrm{AX7}$ |  |
| V11 | 6BE6 |  |
| V12 | 12B4 |  |
| V13 | 6AQ7GT |  |
| 4 | 6SN7GT |  |
| V15 6 | 6BQ6GT/6BQ6GA |  |
| V16 | 1B3GT |  |
| V17 | 6AX4GT |  |
| V18 | 5U4G/5U4GA |  |
| V19 | 17LP4/17LP4A |  |
| V19 | 21YP4/21YP4A |  |

## TUBE COMPLEMENT

22R20 Chassis

| SYMBOL | TUBE | FUNCTION |
| :---: | :---: | :---: |
| V1 | 6BK7A | RF Amplifier |
| V2 | 6 U 8 | V2A Mixer V2B RF Osc |
| V3 | 6CB6 | 1st IF Amplifier |
| V4 | 6CB6 | 2nd IF Amplifier |
| V5 | 6CB6 | 3rd IF Amplifier |
| V6 | 12BY7 | Video Amplifier |
| V7 | 6AU6 | Sound Limiter |
| v8 | 6BN6 | Audio Detector |
| V9 | 12AX7 | V9A Sound Amplifier |
| V10 | 6AQ5 | Sound Output |
| V11 | 6AQ5 | Sound Output |
| V12 | 12AX7 | VI2A AGC Amplifier |
| V13 | 6BEb | Sync Clipper |
| V14 | $6 \mathrm{BX7GT}$ | Vertical Output |
| V15 | 6AQ7GT | V15A Horiz. Phase Det. V15B Horiz Control |
| V16 | 6SN7GT | V16A Horiz. Osc. |
|  |  | V16B Horiz. Discharge |
| V17 | 6CD6G | Horizontal Output |
| V18 | 1B3GT | High Voltage Rectifier |
| V19 | 6AX4GT | Damper |
| V20 | 5U4G | Low Voltage Rectifier |
| V21 | 5U4G | Low Voltage Rectifier |
| V22 | 21ZP4B | Picture Tube |

## TUBE COMPLEMENT

| SYMBOL | TUBE | FUNCTION |
| :---: | :---: | :---: |
| V1 | 6BK7A | RF Amplifier |
| v2 | 6U8 | V2A Mixer |
| v3 | $6 \mathrm{CB6}$ | 1st IF Amplifier |
| V4 | 6CB6 | 2nd IF Amplifier |
| V5 | 6CB6 | 3rd IF Amplifier |
| V6 | 12BY7 | Video Amplifier |
| V7 | 6AU6 | Sound Limiter |
| v8 | 6BN6 | Audio Detector |
| V9 | 12AX7 | V9A Sound Amplifier V9B Phase Inverter |
| V10 | 6AQ5 | Sound Output |
| V11 | 6AQ5 | Sound Output |
| V12 | 12AX7 | Vi2A AGC Amplifier |
| V13 | 6BE6 | Sync Clipper |
| V14 | 6 AV 5 | Vertical Output |
| V15 | 6AQ7GT | V15A Horiz. Phase Det. V15B Horiz. Control |
| V16 | 6SN7GT | V16A Horiz. Osc. |
| V17 | 6CD6G | Horizontal Output |
| V18 | 1B3GT | High Voltage Rectifier |
| V19 | 6 V 3 | Damper |
| V20 | 5U4G | Low Voltage Rectifier |
| V21 | 5U4G | Low Voltage Rectifier |
| v22 | 24CP4A/27EP4 | Picture Tube |



Fig. 9 Adjustments on Neck of Picture Tube 22R21 Chassis


Fig. 10 Rear View of R23--Series Receiver

## ADJUSTMENTS

## REMOVABLE PICTURE TUBE

 PROTECTIVE CUPWith the exception of a few models, a removable cup is provided to allow easy access to the adjustments on the neck of the picture tube.
To remove cup turn it counterclockwise a few degrees at a time and depress each of the three catches with a screwdriver until the cup is unlocked

To install cup match the cup flanges (different widths) with the cabinet slots and turn clockwise until cup is locked in place.


BULLS EYE TUNER ADJUSTMENTS
To adjust the receiver for bulls-eye tuning, set the ine tuning control to its approximate center position the fine tuning control insert a 68-21 alignment wrench into the tuner (See Fig. 11) and adjust each operating channel to resonance. It will be noted that tuning to one side of resonance results in a faded, washed-out picture with the spacing between the wedge lines fogged and tuning in the opposite direction causes the spaces between the lines to clear up. However, going beyond this point causes the picture into the picture. Correct adjustment is obtained by uning to the "wormy" picture and then backing the control off slightly until the picture clears up.

## CENTERING ADJUSTMENT

In the 19R series, the centering assembly is built into the yoke housing. This assembly is made up of two magnetic rings which can be rotated by means of tabs. Centering is accomplished by gradually ro-
tating the tabs with respect to each other then rotating both tabs simultaneously until the picture is centered.

In the 22 R series, PM focusing and centering is utilized. The top screwdriver adjustment on the centering assembly is used to move the picture up or down and the bottom adjustment for side to side movement. The center adjustment is for focusing.

In some 22 R 20 and 22R21 receivers, a single centering lever is used for both vertical and horizontal center ing. The up-down movement of this lever moves the moves the picture vertically. A screwdriver adjustment is provided for focusing

## AFC ADJUSTMENT

The AFC is adjusted by setting the horizontal hold control L21 to a position where it is virtually imposs ble to "throw" the receiver out of horizontal sync when switching from channel to channel.

## CORRECTOR MAGNET ADJUSTMENT

Two corrector magnets are used (not required in the 19R series) to obtain straight, sharply focused sweep ines across the face of the picture tube. In the 22 R 21 chassis, the corrector magnets are mounted op and bottom. The magnets are mounted on the in and out or up and down by bending the flexible arms which support them. Adjustment has been made at the factory and should not require re-adjustment unless accidentally bent out of position. If this occurs, proceed as follows

1. With the vertical and horizontal size controls, reduce the size of the picture to a point where the four corners and sides of the picture are visible.
(In some receivers it may not be possible to reduce (In some receivers it may not be possible to reduce in this case it may be necessary to shift the picture with the centering control to view one side at a time.)
2. Bend the corrector magnet arms until the corners become right angles and the top of the raster is with the right side. After the left side is paralle hould be restored to normal size:

NOTE: Mis-adjustment of the corrector magnets nay cause pincushioning, barreling, keystoning, poo linearity, etc.

## THE FRINGE LOCK CIRCUIT

The fringe lock circuit utilizes a 6BE6 heptode, which an be adjusted to assure sync stability over the wide erent areas. In this circuit the encountered in difdetector, approximately -3 volts peak of the crystal to grid \#1 (pin 1) of the 6BE6. The same signal after it has been inverted and amplified to approximately 40 volts peak to peak by the first video amplifier, is applied to grid \#3 (pin 7) which in this circuit is the signal grid. The fringe lock control is used to pre-set
he bias on grid \#l so that the normal 3 volt signal allows proper sync clipping action, i.e. the sync pulses, which have been stripped from the composite late. If a noise pulse drives plate. If a noise pulse drives grid \#l beyond the 3 volt cannot get through to falsely trigger the sweep oscillators. On rare occasions, a strong noise pulse may occur at the time of the sync pulse and the tube likewise may cut off, however, the flywheel action of the weep oscillators will maintain sync during this brie eriod. The entire fringe lock system is based on the o be preferred loss of an occasional sync pulse is to be preferred over having a noise p
to falsely trigger the sweep oscillator

## FRINGE LOCK ADJUSTMENT

. Turn the fringe lock control fully clockwise and then back it off approximately $1 / 4$ turn. Adjust the vertical and horizontal hold controls and check operation of the receiver to see that it syncs normal-
ly when the turret is switched from channel to channel.
2. If the picture jitters or shows evidence of delay, tearing, split phase, etc., back down the fringe lock control further, a few degrees at a time, each time channel to channel until normal sync action is obtained. It will be found that under normal signal conditions, the correct adjustmeat will be near the counter-clockwise position of the control.
3. In fringe and noisy areas, the best adjustment will be found at or near the maximum clockwise position of the control, however, do not automatically turn the fringe lock fully clockwise in fringe areas as has been done on previous models. Follow the procedure outlined. In areas where both local and fringe signals are received, a compromise se

## DOUBLE DELAYED GATED AGC

In order to obtain the best possible performance in fringe and weak signal areas, it is important that the application of AGC voltage to the 6BK7A RF tube be delayed until the signal level reaches The noise figure of the tuner will be antenna input. under this condition of no AGC voltage To ace plish this, the cathode of the 6CB6 Ist IF tube is approximately 8 volts positive by virtue of the drop through the cathode resistor of the 6CB6 3rd IF. This voltage plus the voltage which results from current flow through the tube makes the grid of the 6CB6 1st IF approximately 8.6 volts negative with respect to its cathode. It should be noted here that the 120 ohm portion of the cathode resistor The voltage at the junction of the two resistors varies from 8 volts with no signal to 4 volts with strong signals. The 2nd IF tube is in series with the lst if tube and any changes in the plate current of the Ist IF tube will also change the 2nd IF tube thus the 2nd IF tube is also controlled indirectly by the AGC

Under weak signal conditions, the output of the AGC tube at point " E " is approximately 6.8 volts positive. This positive voltage however, does not reach the grid of the 6BK7A because of the 2.2 megohm resistor Actually the grid of this tube is slightly negative of the high resistance in its grid circuit ( 2 a result The 6.8 volts positive voltage however, is applied to the grid of the 6CB6 Ist IF but because the cathode is 8.6 volts positive the grid is actually 1.8 volts negative espect to its cathode and AGC control of the results under weak signal conditions.

When the receiver is used with normal signals, the signal voltage applied to the grid of the AGC tube will increase and as a result the output of the AGC ube will become 4 to 5 volts negative. This negativ megohm resistor thed to the 6BK7A through the 2.2 then be controlled by the AGC

With the application of a negative AGC voltage to the 6BK7A tube under normal signal conditions, the nois figure of the tuner will not be optimized as unde weak signal conditions, however, this is not a consideration with normal signal levels.

## AGC ADJUSTMENTS

IMPORTANT: THE AGC CONTROL CANNOT BE USED IN ANY WAY TO IMPROVE THE RECEIVE SENSITIVITY. The sole function of this control is tube so that the output of this tube is approximately 100 volts peak ( $100 \%$ modulated video signal) for application to the picture tube cathode
The adjustment can also be made by connecting a cali brated oscilloscope through a 10 K isolation resistor the strongest TV signal adjust the AGC delay contro for 2.75 volts peak output.

Satisfactory adjustment can also be made by observir the picture and slowly turning the AGC delay contro from its maximum clockwise position, counterclockwise until a point is reached where the picture distorts and buzz is heard in the sound. The control point comfortably below this level of intercarrie buzz, picture distortion and improper sync.

CAUTION: Misadjustment of the AGC delay contro can result in a washed-out picture, distorted picture buzz in sound OR COMPLETE LOSS OF PICTURE AND SOUND.

## REMOVING TURRET TUNER FROM THE CHASSIS

. Pull out the power connector, IF connector and disconnect the antenna transmission line. On some models it is also necessary to pull out the UHF IF connector and unsolder the pilot light and the osciltator B+lead.


Fig. 12 Removing Fine Tuner Shaft. 2. On those models with the fine tuning control on the ront panel it is also necessary to remove the fine tuning shaft from the tuner. This is done by pulling out the fine tuning shaft retaining clip (See Fig. 12) and completely removing the keye sher rear of the cabinet it is unnecessary to take out the shaft before removing the tuner.
3. To insure proper indexing, note the channel to which the receiver is tuned so that if the turret drum is rotated while the tuner is out of its case it can be turned back to the original channel.
. Remove the tift ine nuts and one machine screw NOTE: When installing the tuner
in reverse. The tuner fine tuning can only be inserted one way

## REMOVING CHANNEL STRIPS

1. Rotate the turret drum until the strip to be re moved is readily accessible.
2. Insert a small screwdriver in the slot (See Fig. 13). Push in the direction of arrow until the channel strip clears the drum slot then lift straigh out in direction of screwdriver shaft. Some strip tool is used in place of the screwdriver

CAUTION: TO A VOID DAMAGE TO CHANNEL STRIPS, DO NOT USE PRYING ACTION IN RE MOVING STRIPS.

## S21845 UHF

AND VHF TUNER ASSEMBLY
This unit combines the S21700 Turret Tuner and the S21864 Continuous Tuner. The turret tuner section is conventional except that on UHF a pair of 40 Mc IF
coils are switched into position making the 6 BK 7 A and the 6 U8 tube IF amplifiers. The 6 AF4 high frequency oscillator mixes with the incoming UHF signal and produces a 40 Mc IF which is applied to the turre tuner section through terminal ' $F$ see Fig. 33. The turret tuner in this unit is designed for VHF only UHF strips cannot be used.

## UHF-VHF CHANGEOVER SWITCH

The low loss UHF-VHF changeover switch is part of the S21845 UHF-VHF tuner package. The switch performs 3 functions
. Is used to switch the antenna between tuners. 2. Switches the oscillator $B+$ between tuners. 3. Actuates the UHF pilot light

The switch is actuated by a lever (see Fig. 12) which is mounted on the turret tuner shaft. When the VHF uner is in the UHF position, the lever, if proper
gned, will actuate the changeover switch

## REMOVING THE S21700 CONTINUOUS

 TUNER FROM THE CHASSISAlthough it may be more convenient to first take out the VHF tuner before removing the UHF tuner it is not necessity. The UHF tuner can be removed as


Fig. 13 Removing Channel Strips.
Loosen the screws and hex nuts which hold the VHF tuner in place (See Fig 15). This step is necessary so that the VHF tuner case can be moved slightly to obtain clearance for removal of the UHF tuner. This step is not required in those models in which the tuner is secured to the top of the cabinet
2. Remove the UHF heater and B+ connections (See Fig. 15).
3. Loosen the set screw and remove the UHF tuner drive pulley.
4. Loosen or remove the UHF tuner locking screw and lift out the tuner. It may be necessary to bear slightly against the VHF tuner case to obtain sufficien clearance for removing the UHF tuner.

When the tuner is reinstalled, reverse this procedure Do not tighten the UHF tuner drive pulley until th tuner and the indicator dial are in synchronism on channels 14, 54 and 83.

## METAL WRAPPED RESISTORS

In servicing the TV receiver, the serviceman will find several circuits in which metal wrapped resistors ar used. The metal wrapping dissipates much of the resistor heat and doubles the wattage rating. I replacing a resistor care should be used to mount it as the original. If the metal mounting clamp is dis carded, the resistor wattage must be doubled.

## ALIGNMENT

 suitable VHF and UHF sweep generator in conunction with an accurate marker must be used for lignment work. It is very important to have the weep generator output cable properly terminated nd to check whe her or not is alt the is reactive mproperly terminated, correct alionment cannot be made since the degree of attenuation then may change the shape as well as the amplitude of the response curve. The position of the attenuator should only vary the amplitude and not the shape of the response curve.

## CALIBRATING THE OSCILLOSCOPE

When aligning the RF and IF stages of the receiver, is necessary to measure detector peak output.
his may be done with a voltage calibrator used in conjunction with an oscilloscope. If a calibrator is not a vailable, the oscilloscope can be calibrated with a known DC voltage. To make the calibration, the negative side of a 3 volt battery supply. Turn the horizontal gain control fully counterclockwise With the "hot" lead, make a momentary contact to the positive connection on the battery and observe the instantaneous spot deflection on the screen. Discharge the scope input capacitor by shorting out the leads and repeat the procedure, each time readjusting the scope vertical gain until the spot dethen represents 1 volt peak. The position of the vertical gain control should be marked for future reference

## SOUND ALIGNMENT

proper alignment of ALI Mc intercarrier soun hannel can only be obtained if the signal to the rethe limiting point of the 6BN6 Gated Beam Detector This level can be easily identified by the "hiss" whic
then accompanies the sound.
Various methods may be used to reduce the signa evel, however, it is recommended that a step attenatisfactory results. (See Fig. 25) used .(See Fig. 25)
Connect the step attenuator between the antenna nd the receiver antenna terminals
2. Tune in a tone modulated TV signal and adjust the tep attenuator until the signal is reduced to a level where "hiss" is heard with the sound.
3. Adjust the sound take-off coil L17 (top and bottom slugs), intercarrier coil L19, quadrature coil L20 and buzz control R32 for the cleanest sound and these adjustments may cause the "hiss" to disappear and further reduction of the signal will be necessary so that the "hiss" does not disappear during alignment.
If intercarrier buzz is in evidence, after all normal sound adjustments have been made, the cause may be attributed to one or more of the following:

1. Improper adjustment of the AGC delay control.
2. Defective 6AU6 sound limiter
3. Extremely high signal levels which require atten uation in the antenna circuit.
4. Transmitter over modulation.

## VIDEO IF ALIGNMENT

1. Slowly turn the channel selector until the turret is made to rest between two channels. Connect the negtive lead of a 2 volt battery supply to terminal "E " (Fig. 27) and the positive lead to chassis. The bias upply should be made variable so that il can be the supply leads shor
2. Connect the calibrated oscilloscope through a $10,000 \mathrm{ohm}$ isolation resistor between terminal " $D$ " and chassis. The sweep generator input to the receiver should be adjusted for 3 volts peak to peak detector output. Do not exceed during any of the adjustments.
3. Feed the output from the sweep generator through the special termination unit shown in Fig. 14 to point until a pattern similar to Fig. 16 is obtained.


Fig. 16 4th IF Response
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> 4. Set the Marker Generator to 45.75 Mc and alternately adjust the top and bottom slugs of the 4th IF transformer for maximum gain and symmertry with the 45.75 Mc markers positioned as shown in Fig. 16 The 39.75 Mc marker can be within 10.5 Mc of the specified frequency. If the correct response curve cannot be obtained in this step, check the position of the two slugs to see that they are entering their respective coils from the opposite ends of the coil form. The position of the slugs near the center of the coils may change the coefficient of coupling, making correct alignment difficult if not impossible. 5. Connect the sweep generator cable to terminal "A" (Mixer Grid). In this step it may be necessary to temporarily reduce the bias to zero or even to go to a slightly positive voltage in order to see the highly attenuated trap slots with the oscilloscope vertical gain near maximum.
6. Adjust the $47.25 \mathrm{Mc}, 41.25 \mathrm{Mc}$ (Top slug of 1 st marker amplitude, See Fig. 17. It can be seen that maximum oscilloscope gain has been used and as result the top of the response curve has been 'run off" the oscilloscope screen in order to see a "blow-
up" of the trap slots.

7. Readjust the bias to -2 volts and set the oscilloscope vertical gain to the calibrated position. Adjus the sweep generator for a 3 volt peak to peak output from the video detector.

8. With the test equipment set up as in Step 7, alter nately adjust the 2nd IF, 3rd IF, 1st IF and the conver er plate coil until an overall response curve similar to Fig. 18 is obtained. Do not adjust the 4th IF in this side $(42.75 \mathrm{Mc})$ and the 3 rd IF the high side of the response curv


## Fig. 18 Overall IF Respons

## TURRET TUNER ALIGNMENT

The RF chassis adjustments have been made at the actory and normally do not require readjustment in the field unless tampered with. If adjustment becomes necessary check the overall IF response and procee as follows:
. Temporarily ground the turret AGC by connectin jumper between the AGC bus (yellow lead) and chassis. (II sufficient output from the signal genera tor is available moderately


15 Front and Rear views of S21845 VHF-UHF Tuners Used in "U'" Models
2. Connect the calibrated oscilloscope to the feed through terminal " H " (Fig. 4) through a 10 K isolation resistor. This terminal is the screen of the 6U8 mixer
3. Use a 50 to 300 ohm matching transformer (Fig. 14) and feed the output from the sweep gen4. Turn the channel selector to Channel 4 and adjus the sweep generator until a response curve somewhat similar to Fig. 19 is obtained.


Fig. 19 Channel 4 RF Response
5. Study Fig. 4 and adjust the converter grid capaci tor (C9), the RF plate capacitor (C8) and the RF grid capacitor (C5) until a response curve similar to Fig. 19 is obtained.
6. Turn the channel selector to Channel 11 and adjust ihe sweep generator until a response somewhat similar to Fig. 20 is obtained. Adjust L5 and L6 to obtain symmetry. If the band pass is too great or too narrow also


Fig. 20 Channel 11 RF Response.
7. Repeat steps 5 and 6 until the best overall sym metry is obtained. REMOVE AGC JUMPER. MASTER OSCILLATOR ALIGNMENT

The master oscillator adjustment is to be made onl if resonance cannot be obtained with the strip oscilla tor adjustment wrench with the fine tuning control in its center position, and after it has been determine that the channel strip itself is not at fault.

If channels 2 through 6 can be made to resonate with the bull's-eye adjustment at the rear of the turret and the high channels do not resonate, a slight readjustment of the oscillator inductance Ll0 (See Fig. 4 ) may be n

## S 21700 UHF

## TUNER ALIGNMENT PROCEDURE

The Zenith continuous tuner has been aligned at the factory with precision test equipment. Adjustment test equipment is available. It must be remembered that any attempt to peak any one particular channe will usually cause serious degradation of the other channels. If alignment becomes necessary, use a



[^0]:    *May be part of couplate, part number 63c6-10. Replace with exact part or individual components
    May be part of couplate, part number 63c6-5. Replace with exact part or individual components.

[^1]:    ©John F. Rider

[^2]:    © John F. Rider

[^3]:    By raster we mean the illuminated scanning lines.

[^4]:    - Sound Carrier Marker
    *Picture Corrier Marke

[^5]:    signals.
    NOTE: All of the above four antennas will operate over all 70 UHF channels.

[^6]:    

[^7]:    note: tube locations, test points, and adjustMENTS ON THE 2040 AND 1840 Chassis are iden. tical except `that the 1840 does not use tubes
    V- 2 AND V-16.

[^8]:    The schematic is shown in the latest
    Condition at the time of printing
    condition at the et ite of printing the latest
    All resistance value in ohms. K
    All capacitance values less than 1 in MF
    and bove 1 in MMF unless otherwise
    noted.

[^9]:    Figure 3-Yoke and Focus Magnet Adiustment

[^10]:    Figure 18-KRK22C or KRK29A R-F Response

[^11]:    © John F. Rider

[^12]:    V PAGE $14-164$ RADIO CORPORATION OF AMERICA

[^13]:    Figure 24-Horizontal Ossillator Waveforms

[^14]:    World Rediohistory

[^15]:    OJohn F. Rider

[^16]:    © John F. Rider

[^17]:    $d \wedge 1$

[^18]:    Type Volto
    Tubular
    Disc Ceramic
    109
    100
    450

