



ST7500 Basic Service Manual


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European Union (EU) Waste of Electrical and Electronic Equipment (WEEE) directive



■ The European Union's WEEE directive requires that products sold into EU countries must have the crossed out trash bin label on the product (or the package in some cases).

As defined by the WEEE directive, this cross-out trash bin label means that customers and end-users in EU countries should not dispose of electronic and electrical equipment or accessories in household waste.

Customers or end-users in EU countries should contact their local equipment supplier representative or service centre for information about the waste collection system in their country.

Document History

The section records the changes that have been implemented in the various revisions of this manual.

Table 1: Document History

Edition	Description	Date
MN004528A01-AA	Initial edition	February 2018
MN004528A01-AB	Update manual for Global release.	August 2018
MN004528A01-AC	<ul style="list-style-type: none"> • Added supplier information for Leak Test Fixture in Vacuum Leak Test on page 90. • Updated the procedures in Performing Vacuum Leak Test on page 91. • Added part number for Leak Test Fixture in Service Aids on page 101. • Added SIM card test in Testing in DALT Mode on page 53. 	February 2019
MN004528A01-AD	Removed Motorola Solutions Propriety footer.	June 2019
MN004528A01-AE	Added information for Man Down calibration hotfix setup in Man Down Calibration Data chapter.	November 2019
MN004528A01-AF	Updated information for Man Down calibration hotfix in Man Down Calibration Data .	November 2019

Scope of this Manual

This manual contains information necessary to test and maintain the TETRA radio at the module level. It also contains information on radio assembling and disassembling.

Notations Used in This Manual

Throughout the text in this publication, you will notice the use of warning, caution, and notice notations. These notations are used to emphasize that safety hazards exist, and due care must be taken and observed.



WARNING: WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or injury.



CAUTION: CAUTION indicates a potentially hazardous situation which, if not avoided, might result in equipment damage.



NOTICE: NOTICE indicates an operational procedure, practice, or condition that is essential to emphasize.

Safety Information

This chapter is an extract of the multilingual safety booklet publication. For the latest safety information, refer to the separate safety booklet delivered with your radio.

RF Energy Exposure and Product Safety Guide

CAUTION: Before using this radio, read the guide enclosed with your radio which contains important operating instructions for safe usage and RF energy awareness and control for compliance with applicable standards and regulations.

Compliance with RF Exposure Standards

Your Motorola Solutions two-way radio is designed and tested to comply with various national and international standards and guidelines for human exposure to radio frequency electromagnetic energy.

Your Motorola Solutions two-way radio complies with the following RF energy exposure standards and guidelines:

- United States Federal Communications Commission (FCC), Code of Federal Regulations; 47 CFR et seq.
- FCC, OET Bulletin 65
- Institute of Electrical and Electronic Engineers (IEEE) C95.1
- International Commission on Non-Ionizing Radiation Protection (ICNIRP)
- Ministry of Health (Canada) Safety Code 6
- Industry Canada RSS-102
- Australian Communications Authority Radiocommunications Standard et seq.
- ANATEL ANNEX to Resolution No. 303 et seq.

This radio complies with the IEEE (FCC) and ICNIRP exposure limits for occupational/controlled RF exposure environments at operating duty factors of up to 50% talk-50% listen. The IEEE/ICNIRP authorizes this radio for occupational use only.



NOTICE: The approved batteries, supplied with the portable radio, are rated for a 5-5-90 duty cycle (5% talk–5% listen–90% standby), even though this radio complies with IEEE/ICNIRP occupational exposure limits at usage factors of up to 50% talk.

In terms of measuring RF energy for compliance with these exposure guidelines, your radio generates measurable RF energy only while it is transmitting (during talking), not when it is receiving (listening) or in standby mode.

Federal Communication Commission (FCC) Regulations

The FCC rules require manufacturers to comply with the FCC RF energy exposure limits for two-way radios before they can be marketed in the U.S.

When two-way radios are used as a consequence of employment, the FCC requires users to be fully aware of and able to control their exposure to meet occupational requirements. The use of a product label directing users to specific user awareness information can facilitate exposure awareness. Your Motorola Solutions two-way radio has Exposure Product Label. Do not remove this RF Exposure Label from the device. Also, your Motorola Solutions user manual, or separate safety booklet includes information and operating instructions required to control your RF exposure and to satisfy compliance requirements.

RF Energy Exposure Awareness, Control Information, and Operational Instructions for Occupational Use



NOTICE: This radio is intended for use in occupational/controlled conditions where users have full knowledge of their exposure and can exercise control over their exposure to meet the occupational limits in FCC/ICNIRP and International standards. This radio device is NOT authorized for general population consumer use.

This two-way radio uses electromagnetic energy in the radio frequency (RF) spectrum to provide communications between two or more users over a distance. It uses radio frequency (RF) energy or radio waves to send and receive calls. RF energy is one form of electromagnetic energy. Other forms include, but are not limited to, sunlight and x-rays. RF energy, however, should not be confused with these other forms of electromagnetic energy, which when used improperly, can cause biological damage. High levels of x-rays, for example, can damage tissues and genetic material.

Experts in science, engineering, medicine, health, and industry work with organizations to develop standards for safe exposure to RF energy. These standards provide recommended levels of RF exposure for both workers and the general public. These recommended RF exposure levels include substantial margins of protection.

All Motorola Solutions two-way radios are designed, manufactured, and tested to ensure that they meet government-established RF exposure levels. In addition, manufacturers also recommend specific operating instructions to users of two-way radios. These instructions are important because they inform users about RF energy exposure and provide simple procedures on how to control it.

Refer to the following websites for more information on what RF energy exposure is and how to control your exposure to assure compliance with established RF exposure limits:

<http://www.fcc.gov/oet/rfsafety/rf-faqs.html>

<http://www.osha.gov/SLTC/radiofrequencyradiation/index.html>

RF Exposure Compliance and Control Guidelines

Always adhere to the following procedures to control RF exposure to yourself and others and also to comply to the occupational/controlled environment exposure limits.

- Do not remove the RF Exposure Label from the device.
- User awareness instructions should accompany device when transferred to other users.
- Do not use this device if it does not meet the operational requirements.

Operating Instructions

- Transmit no more than the rated duty factor of 50% of the time. To transmit (talk), push the Push-To-Talk (PTT) button. To receive calls, release the PTT button. It is important to transmit 50% of the time or less, because this radio generates measurable RF energy exposure only when transmitting.
- Hold the radio in a vertical position in front of the face with the microphone (and other parts of the radio including the antenna) at least 2.5 cm (one inch) away from the nose or lips. Keep the antenna away from the eye. Keeping the radio at a proper distance is important as RF exposure decreases with increasing distance from the antenna.
- When worn on the body, always place the radio in a Motorola Solutions-approved clip, holder, holster, case, or body harness. The use of non-Motorola Solutions-approved accessories may result in exposure levels exceeding the IEEE/ICNIRP occupational/controlled environment RF exposure limits.

Approved Accessories

Use only Motorola Solutions-approved supplied or replacement antennas, batteries, and accessories. Use of non-Motorola Solutions-approved antennas, batteries, and accessories may exceed IEEE/ICNIRP RF exposure guidelines.

For a list of Motorola Solutions-approved antennas, batteries, and other accessories, contact your dealer or local Motorola Solutions contact. Your nearest dealer can be found at www.motorolasolutions.com.

Additional Information

For additional information on exposure requirements or other training information, visit <http://responsibility.motorolasolutions.com/index.php/downloads/dow07-rfexposureassessmentstand/>

Intrinsically Safe Radio Information

A radio that has been approved for intrinsic safety has the Intrinsically Safe Approval Label attached to the radio. This label specifies the hazardous Class/Division/Group along with the part number of the battery that must be used.

The Intrinsically Safe Approval unit refers to a product that has been approved as intrinsically safe by an approval agency (such as FM Approvals, CSA, UL, CENELEC, or ATEX). It certifies that a particular product meets the applicable intrinsic safety standards for specific types of hazardous classified locations of the agency.

Operational Cautions for Intrinsic Safe Equipment

Radios must be shipped from the Motorola Solutions manufacturing facility with the hazardous atmosphere capability and the intrinsic safety approval labeling (FM, UL, CSA, CENELEC, or ATEX). Radios will not be upgraded to this capability and labeled once they have been shipped to the field.

A modification changes the hardware of the unit from its original design configuration. Only the original product manufacturer can modify the hardware.



WARNING:

- Do not operate radio communications equipment in a hazardous atmosphere unless it is a type especially qualified (such as FM, UL, CSA, CENELEC, or ATEX approved). An explosion or fire may result.
- Do not operate a radio unit that has been approved as intrinsically safe product in a hazardous atmosphere if it has been physically damaged (for example, cracked housing). An explosion or fire may result.
- Do not replace or charge batteries in a hazardous atmosphere. Contact sparking may occur while installing or removing batteries and cause an explosion or fire.
- Do not replace or change accessories in a hazardous atmosphere. Contact sparking may occur while installing or removing accessories and cause an explosion or fire.
- Turn off the radio before removing or installing a battery or accessory.
- Do not disassemble an intrinsically safe product in any way that exposes the internal circuits of the unit.
- Failure to use an intrinsically safe approved battery or approved accessories for the radio unit may result in the dangerously unsafe condition of an unapproved radio combination being used in a hazardous location.
- Unauthorized or incorrect modification of the intrinsically safe approved product negates the approval rating of the product.
- Incorrect repair or relabeling of any intrinsically safe agency-approved radio could adversely affect the approval rating of the unit.
- Use of a radio that is not intrinsically safe in a hazardous atmosphere could result in serious injury or death.

Repair

A repair constitutes something done internally to the unit that would bring it back to its original condition.

Repairs for Motorola Solutions products with intrinsically safe approval are the responsibility of the user. Repairs to a Motorola Solutions FM approved radio product should only be done at a location that has been FM audited under the FM 3605 repairs and service standard. Contact Motorola Solutions for assistance regarding repairs and service of Motorola Solutions intrinsically safe equipment.

Items not considered as repairs are items in which an action is performed on a unit which does not require the outer casing of the unit to be opened in a manner which exposes the internal electrical circuits of the unit.

Do Not Substitute Options or Accessories

The Motorola Solutions communications equipment certified as intrinsically safe by the approving agency (FM, UL, CSA, CENELEC, or ATEX) is tested as a complete system which consists of the listed agency approved portable, approved battery, and approved accessories or options, or both. This approved portable and battery combination must be strictly observed. There must be no substitution of items, even if the substitute has been previously approved with a different Motorola Solutions communications equipment unit. The approving agency (FM, UL, CSA, CENELEC, or ATEX) lists all the approved configurations.

The Intrinsically Safe Approval Label affixed to the radio refers to the intrinsically safe classification of that radio product, and the approved batteries that can be used with that system.

The manual part number referenced on the Intrinsically Safe Approval Label identifies the approved accessories and/or options that can be used with that portable radio unit.

Using a non-Motorola Solutions intrinsically safe battery and/or accessory with the Motorola Solutions approved radio unit voids the intrinsically safe approval of that radio unit.

Electromagnetic Interference/Compatibility

If inadequately shielded, designed, or otherwise configured for electromagnetic compatibility, nearly every electronic device is susceptible to Electromagnetic Interference (EMI).

Facilities

To avoid electromagnetic interference and/or compatibility conflicts, turn off your radio in any facility where posted notices instruct you to do so. Hospitals or health care facilities may be using equipment that is sensitive to external RF energy.

Medical Devices

Pacemakers

The Advanced Medical Technology Association (AdvaMed) recommends that a minimum separation of 15 cm (6 in.) be maintained between a hand-held wireless radio and a pacemaker. These recommendations are consistent with those of the U.S. Food and Drug Administration. Persons with pacemakers should:

- ALWAYS keep the radio more than 15 cm from their pacemaker when the radio is turned ON.
- Not carry the radio in the breast pocket.
- Use the ear opposite the pacemaker to minimize the potential of interference.
- Turn the radio OFF immediately if you have any reason to suspect that interference is taking place.

Hearing Aids

Some digital wireless radios may interfere with some hearing aids. In the event of such interference, you may want to consult your hearing aid manufacturer to discuss alternatives.

Other Medical Devices

If you use any other personal medical device, consult the manufacturer of your device to determine if it is adequately shielded from RF energy. Your physician may be able to assist you in obtaining this information.

Aircraft

When instructed to do so, turn off your radio when on board an aircraft. Any use of a radio must be in accordance with applicable regulations per airline crew instructions.

European Union Directives Conformance Statement

This product is in conformance with the TETRA (TErrestrial Trunked RAdio) standard. This product is in conformance with the requirements of the applicable EU Council Directives.

Use of Communication Devices While Driving

Always obey the laws and regulations on the use of radios in the area where you drive.

- Give full attention to driving and to the road.
- Use hands-free operation, if available.
- Pull off the road and park before making or answering a call if driving conditions or regulations so require.

Operational Warnings



WARNING:

For vehicles with an air bag, refer to the manual of the vehicle manufacturer before installation of electronic equipment to avoid interference with air bag wiring.

Do not mount or place a radio in the area over an air bag or in the air bag deployment area. Air bags inflate with great force. If a radio is placed in the air bag deployment area and the air bag inflates, the radio may be propelled with great force and cause serious injury to occupants of the vehicle.

Potentially Explosive Atmospheres (explosive atmospheres refers to hazard classified locations that may contain hazardous gas, vapors, or dusts)

Turn off your radio before entering any area with a potentially explosive atmosphere, unless it is a radio type especially qualified for use in such areas as "Intrinsically Safe" (such as Factory Mutual, CSA, UL, CENELEC, or ATEX approved). Do not remove, install, or charge batteries in such areas. Sparks in a potentially explosive atmosphere can cause an explosion or fire resulting in bodily injury or even death.

The areas with potentially explosive atmospheres include fueling areas such as below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles, such as grain, dust, or metal powders. Areas with potentially explosive atmospheres are often but not always posted.

Blasting Caps And Blasting Areas

To avoid possible interference with blasting operations, turn off your radio when you are near electrical blasting caps, in a blasting area, or in areas posted: "Turn Off Two-way Radio". Obey all signs and instructions.

For radios installed in vehicles fueled by liquefied petroleum gas, refer to the (U.S.) National Fire Protection Association standard, NFPA 58, for storage, handling, and/or container information. For a copy of the liquefied petroleum standard, NFPA 58, contact the National Fire Protection Association, One Battery Park, Quincy, MA.

Operational Cautions



CAUTION:

Antennas

Do not use any portable radio that has a damaged antenna. If a damaged antenna comes into contact with your skin, a minor burn can result.

Batteries

If a conductive material such as jewelry, keys, or beaded chains touch exposed battery terminals, it can cause property damage and/or bodily injury such as burns. The conductive material may complete an electrical circuit (short circuit) and become hot. Exercise care in handling any charged battery, particularly when placing it inside a pocket, purse, or other container with metal objects.

Warranty and Service Support

Motorola Solutions offers long term support for its products. This support includes full exchange and/or repair of the product during the warranty period, and service/repair or spare parts support out of warranty.

Warranty Period and Return Instructions

The terms and conditions of warranty are defined fully in the Motorola Solutions Dealer or Distributor or Reseller contract. These conditions may change from time to time and the following notes are for guidance purposes only.

In instances where the product is covered under a "return for replacement" or "return for repair" warranty, a check of the product should be performed prior to shipping the unit back to Motorola Solutions. This is to ensure that the product has been correctly programmed or has not been subjected to damage outside the terms of the warranty.

Prior to shipping any radio back to the appropriate Motorola Solutions warranty depot, please contact Customer Resources or your Motorola Solutions dealer, distributor or reseller. All returns must be accompanied by a Warranty Claim Form, available from your Customer Service representative or Motorola Online (MOL) or your Motorola Solutions dealer, distributor or reseller. Products should be shipped back in the original packaging, or correctly packaged to ensure no damage occurs in transit.

After Warranty Period

After the Warranty period, Motorola Solutions continues to support its products.

- Motorola Solutions Regional Radio Support Centers offer a repair service to both end users and dealers at competitive prices.
- Dealers who are technically capable of performing fault analysis and repair can purchase individual parts and modules from the Radio Products and Solutions Organization (RPSO).

Related Publications

This section contains part numbers and titles of related publications.

Table 2: Quick Start Guides

Part Number	Language
MN004497A01	en-US
MN004499A01	zh-TW
MN004500A01	ja-JP
MN004501A01	ko-KR
MN004502A01	es-LA
MN004503A01	pt-BR
MN004505A01	ar-EG
MN004506A01	da-DK
MN004507A01	nl-NL
MN004508A01	fr-FR
MN004509A01	de-DE
MN004510A01	it-IT
MN004511A01	nb-NO
MN004512A01	pl-PL
MN004513A01	es-ES
MN004514A01	pt-PT
MN004515A01	sv-SE
MN004516A01	ru-RU
MN004517A01	uk-UA
MN004518A01	fi-FI
MN004978A01	ca-ES
MN005279A01	tr-TR

Table 3: User Manuals

Part Number	Description	Language
MN004519A01	ST7500 Feature User Guide	en-US
MN004520A01		en-US and zh-TW
MN004521A01		en-US and ja-JP
MN004523A01		en-US and ko-KR
MN004524A01		en-US and es-LA
MN004525A01		en-US and pt-BR

Part Number	Description	Language
MN004526A01		en-US and de-DE
MN004527A01	ST7500 Product Information Manual	en-US

Table 4: Other Related Manuals

Part Number	Description	Language
MN004530A01	ST7500 Detailed Service Manual	en-US

Chapter 1

Model Information

This manual applies to the following ST7500, Class 3L, TETRA Handportable Terminal model:

Table 5: ST7500 Sales Models

Sales Model No.	Short Description
AZH94PCL6TZ5AN	ST7500 380–430 MHz PTM412DER
MDH94PCL6TZ5AN	ST7500 380–430 MHz PTM412DER
MDH94PCL6TZ5ANB	ST7500 380–430 MHz BULK PTM412DER
AZH94PCL6TZ5ANB	ST7500 380–430 MHz PTM412DER – BULK

1.1

ST7500 Model Specifications



NOTICE: Specifications subject to change without notice.

The following are the model specifications for sales model as listed:

Sales Model No.:

AZH94PCL6TZ5AN

MDH94PCL6TZ5AN

MDH94PCL6TZ5ANB

Table 6: General Specifications for 380–430 MHz Sales Models

GENERAL	
ETSI:	
Humidity	ETSI 300 019-1-7 class 7.3E
Drop and Shock	ETSI 300-019 1-7 class 5M3 MIL-STD 810 /D/E/F/G
Type Number:	PTM412DER
Temperature Range for Transceiver:	
Operating	-30 °C to +60 °C
Storage	-40 °C to +85 °C
Battery Types:	
Standard	Removable 2300 mAH IMPRES 2™ Li-Ion
Battery Voltage:	
Minimum	3.2 Vdc
Nominal	3.8 Vdc
Portable Dimensions:	112x63x22 mm with standard battery

GENERAL	
(HxWxD in mm)	142x63x22 mm with 28 mm antenna 171x63x22 mm with 57 mm antenna
Weight:	
With standard battery and 28 mm antenna	199 g

Table 7: Receiver Specifications for 380–430 MHz Sales Models

RECEIVER	
Receiver Type:	Class A and B
Frequency Range:	380.0–430.0 MHz
Channel Spacing:	25 kHz
Sensitivity (3.5%) BER:	
Static	-116 dBm (guaranteed) -118 dBm (typical)
Dynamic	-107 dBm (guaranteed) -109 dBm (typical)
Intermodulation:	
Interfering Signal Level	(3.5%) BER -47 dBm
Selectivity Blocking: (50–100 kHz)	
Interfering Signal Level	(3.5%) BER -40 dBm
Spurious Rejection:	
Interfering Signal Level	(3.5%) BER -45 dBm
Frequency Stability:	
Locked to Base	+100 Hz
Unlocked to Base	+1000 Hz
Audio Rated	1 W
Distortion at Rated Audio:	15% Max.

Table 8: Transmitter Specifications for 380–430 MHz Sales Models

TRANSMITTER	
Modulation Type:	$\pi/4$ DQPSK
RF Power:	1.8 W
Frequency Range:	
TMO	380.0–430.0 MHz
DMO	380.0–430.0 MHz
Frequency Stability:	
Locked to Base:	+100 Hz

TRANSMITTER	
Unlocked to Base:	+1000 Hz
Spurious Emissions:	
Conducted	
30 MHz–1 GHz:	-36 dBm
1 GHz–12.75 GHz:	-30 dBm
Radiated	
30 MHz–1 GHz:	-36 dBm
1 GHz–12.75 GHz:	-30 dBm
Adjacent Channel Power (at ±25 kHz):	
Class 4 (1 W)	55 dBc
Class 3L (1.8 W)	60 dBc


1.2

Sales Model Nomenclature

Table 9: Model Numbering Scheme

Typical Model Number	AZ	H	9	4	P	C	L	6	T	Z	5	A	N
Position	0	1	2	3	4	5	6	7	8	9	10	11	12

Table 10: Sales Models – Description of Positions

Position	Description	Value
0	Applicable Region	AZ = Asia/Latin America Central Region (APAC/LACR) AN = Australia & New Zealand (ANZ) MD = Europe, Middle East, and Africa (EMEA)
1	Type of Unit	H = Hand-Held Portable M = Mobile Product
2	Model Series	94 = Motorola Solutions ST7500 Family
3		
4	Frequency Band	P = 380–430 MHz  NOTICE: Values given represent range only; they are not absolute.
5	Power Level	A = 0–0.7 W B = 0.7–0.9 W C = 1.0–3.9 W D = 4.0–5.0 W E = 5.1–6.0 W

Position	Description	Value
		F = 6.1–10.0 W
6	Physical Packages	L = Limited Controls – Limited Display
7	Channel Spacing	1 = 5 kHz 2 = 6.25 kHz 3 = 10 kHz 4 = 12.5 kHz 5 = 15 kHz 6 = 25 kHz 7 = 30 kHz
8	Primary Operation	N = Digital Front Q = Low Profile – Basic Display R = Digital Multi-Service T = TDMA Digital Dual Mode
9	Primary System Type	Z = Dimetra
10	Feature Level	1 = Basic 2 = Limited Package 3 = Limited Plus 4 = Intermediate 5 = Standard Package 6 = Standard Plus 7 = Expanded Package 8 = Expanded Plus 9 = Full Feature/Programmable
11	Version	Version Letter (Alpha) – Major Change Version Letter (Beta) – Major Change
12	Unique Model Variations	N = Standard Package

Chapter 2

Overview

To achieve a high spectrum efficiency, the radio uses digital modulation technology and sophisticated voice-compression algorithm. The voice of the person speaking into the microphone is converted into a digital bit stream consisting of zeros (0) and ones (1).

This stream is then modulated into a radio frequency (RF) signal, which is transmitted over-the-air to another radio. The process is called digital modulation.

2.1

Digital Modulation Technology

The radio operates in dispatch and phone modes.

The radio also operates in Trunked Mode Operation (TMO) and Direct Mode Operation (DMO). It uses the $\pi/4$ DQPSK and Time Division Multiple Access (TDMA) digital technologies.

$\pi/4$ DQPSK is a modulation technique that transmits information by altering the phase of the signal. Data is converted into complex symbols, which alter the RF signal and transmit the information. When the signal is received, the change in phase is converted back into symbols and then into the original data.

The system can accommodate 4-voice channels in the standard 25 kHz channel as used in the two-way radio. TDMA is used to allocate portions of the RF signal by dividing time into four slots, one for each unit.

Time allocation enables each unit to transmit its data information without interference from other transmitting units. Transmission from a unit or base station is accommodated in time-slot lengths of 15 ms and frame lengths of 60 ms. The TDMA technique requires sophisticated algorithms and a Digital Signal Processor (DSP) to perform voice compressions/decompressions and RF modulation/demodulation.

2.2

Voice Compression Technology

Voice is converted into a digital bit stream by sampling the voice at high rate and converting the samples into numbers, which are represented by bits.

Voice compression reduces the number of bits per second while maintaining the voice at an acceptable quality level. The radio uses a coding technique called Algebraic Code Excited Linear Prediction (ACELP). The compressed voice-data bits modulate the RF signal.

2.3

Transceiver

All radio circuitry are contained in the Digital/RF board and the keypad board.

The Digital/RF board is divided into the following sections.

- Digital
- Transmitter
- Receiver
- Frequency Generating

2.3.1

Digital Section

The digital section is based on a Dual Core System On a Chip (SoC) processor, a low-power Applications processor with dual core architecture based on Advanced RISC Machine (ARM) application core and Digital Signal Processor (DSP) core with floating point.

The dual-core architecture of the Dual Core Processor SoC provides benefits of both DSP and Reduced Instruction Set Computing (RISC) technologies.

The DSP performs modulation and de-modulation functions for the radio. It also performs Forward Error Correction and other correction algorithms for overcoming channel errors and Algebraic Code Excited Linear Prediction (ACELP) speech coding. It carries out linear 16-bit analog to digital conversions, audio filtering, and level amplification for the microphone audio input and the received audio output.

The power and audio section is based on the Power Management IC and includes power supplies, audio routing, microphone, and earpiece amplifiers. An external audio power amplifier is used for the loudspeaker.

2.3.2

Transmitter Path

The transmitter circuitry includes a linear class AB Power Amplifier (PA) for the linear modulation of the terminal. It includes a Cartesian Loop to enhance its transmitter linearity and reduce splattering power into adjacent channels.

The transmitter path consists of a Cartesian Loop that contains forward and feedback paths. The forward path includes the following items.

- Tx Power Control Integrated Circuit
- Balanced-Unbalanced Converter (BALUN)
- Attenuator
- Power Amplifier
- Coupler
- Antenna Switch

The loop feedback path includes the following items.

- Tx Power Control Integrated Circuit
- BALUN
- Attenuator
- Directional Coupler

2.3.3

Receiver Path

The receiver section in the radio is based on the DCR (Direct Conversion) technology. The main concept of this technology is down converting of the RF signal directly into a base band signal, skipping the intermediate stage of IF signal.

The receiver path includes the following items.

- Duplexer
- Antenna Switch
- RF Switches

- Off Channel Detector and Inverting Schmitt Trigger
- Balanced-Unbalanced Converter (BALUN)
- Limiter
- 2-bit 6/12/18 dB Step Attenuator
- Discrete Front Filter
- Low Noise Amplifier (LNA) integrated with Step Attenuator and Automatic Gain Control (AGC) continuous attenuation
- 13 dB (350 MHz) or 12 dB (800 MHz) of Gain with LNA Bypass Option
- Discrete Post-Selector Filter (350 MHz) or SAW Post-Selector Filter (800 MHz)
- RFIC for mixing
- Baseband filtering and internal 55 dB AGC continuous attenuation (inclusive of the internal 10 dB step attenuator) which consists of all the baseband receive chain and mixer.

2.3.4

Frequency Generating Section

The frequency generating section includes the following components.

- Low Band VCO (380–430 MHz)
- RFIC Fractional-N Synthesizer
- Reference Oscillator
- Loop Filter
- Voltage Multiplier

2.4

Bluetooth Section

The Bluetooth (BT) section includes the following main components.

- BT Antenna
- RF Connector
- Bandpass Filter
- Switch
- TCXO
- BT IC

2.5

Global Navigation Satellite System Section

The Global Navigation Satellite System (GNSS) section includes the following main components.

- GNSS Antenna
- Front Filters
- GNSS IC

Chapter 3

Programming the Radio



NOTICE: For programming the radio, refer to *6802974C10 TETRA Customer Programming Software (CPS) Plus Start-up User Guide*.

Chapter 4

Test Setup and Testing

This chapter provides a general overview for testing Motorola Solutions radios.



CAUTION: Any level 3 repairs can deeply affect the performance of the terminal and may cause a new tuning procedure. Certain authorized Motorola Solutions depots, where the appropriate test and tune equipment is available, applies this tuning procedure. The appropriate test and tune equipment is a special automated test equipment which is only available at some Motorola Solutions factories and Motorola Solutions repair centers.



NOTICE: There may be some differences caused by the various software versions running on the testing equipment. Consult the user guides of the respective testing equipment for further details.

4.1

Typical Test Setup

Carry out the following instructions before testing:

- Check that you have a fully charged battery (not required when using Battery Eliminator and RF radio antenna adapter).
- To test the radio, a special Battery Eliminator (PS000241A01 for firmware MR16.5 and above) with RF Cable Kit (TL000100A01) and a SMA type RF Cable are required.
- Detach the antenna from the radio.
- Connect the RF Cable Kit at the rear side of your radio and fix it with the retainer by tightening the thumb screw.
- Connect the other side of the cable to the N-type RF Connector of the IFR using an N-type-to-SMA-adapter.
- Connect the power supply to the battery eliminator wires.

Figure 1: Battery Eliminator Overview

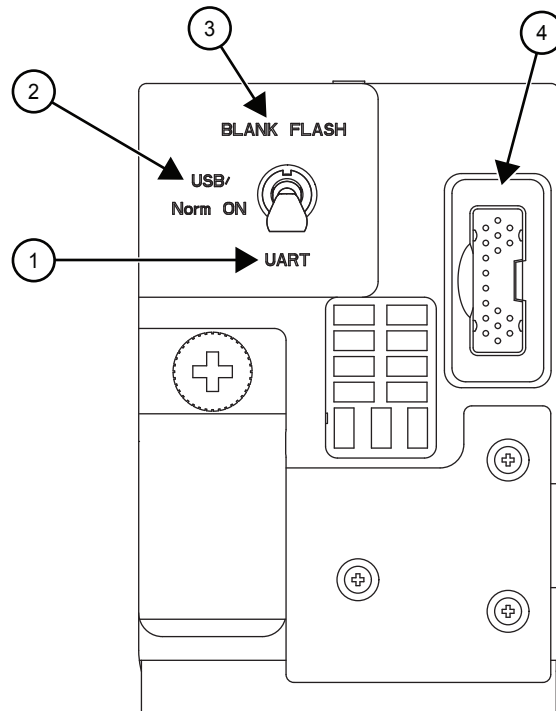


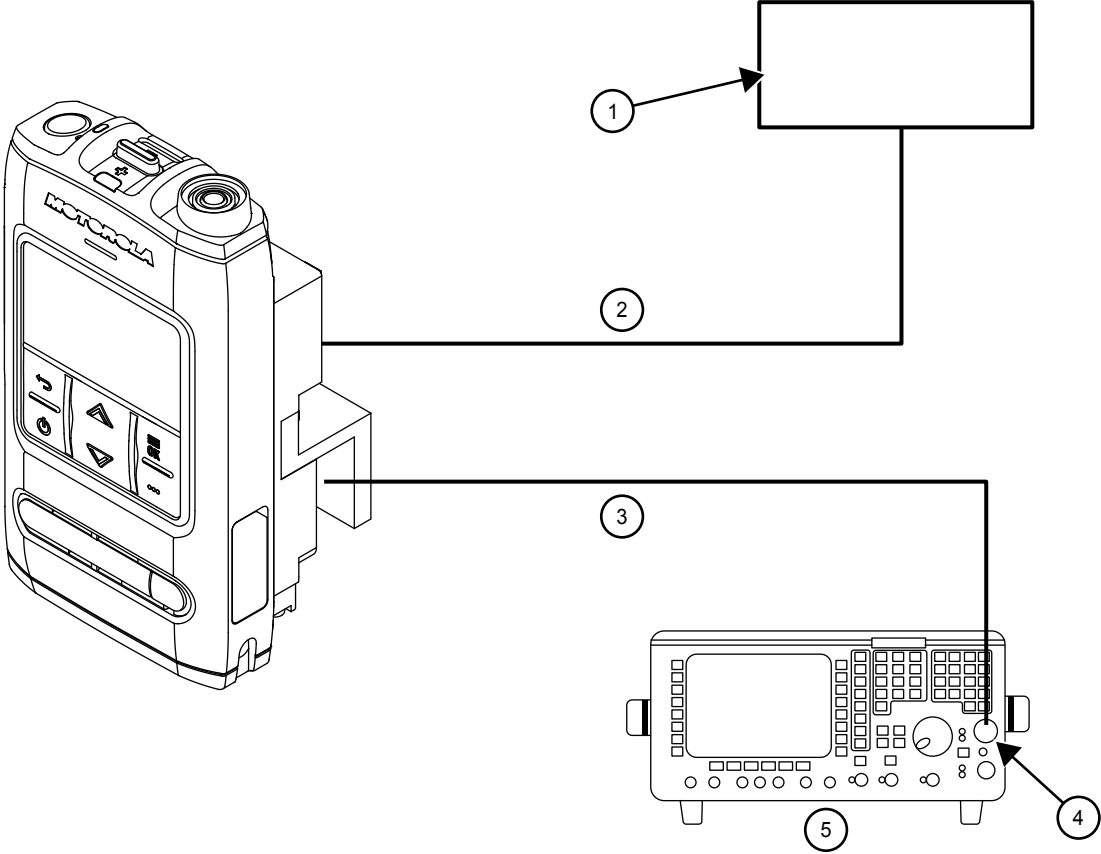
Table 11: Battery Eliminator Overview

No.	Description
1	UART Communication Mode
2	USB/Normal Power ON Mode
3	Blank Board Flashing Mode
4	UART Connector



CAUTION: Connect the red (+) and black (-) wires of the battery eliminator to the respective positive and negative points of the power supply, and use the correct voltage (3.8 VDC, maximum 4.2 VDC). Failing to properly connect the wires would damage your radio and/or the power supply.

Figure 2: Typical Test Setup



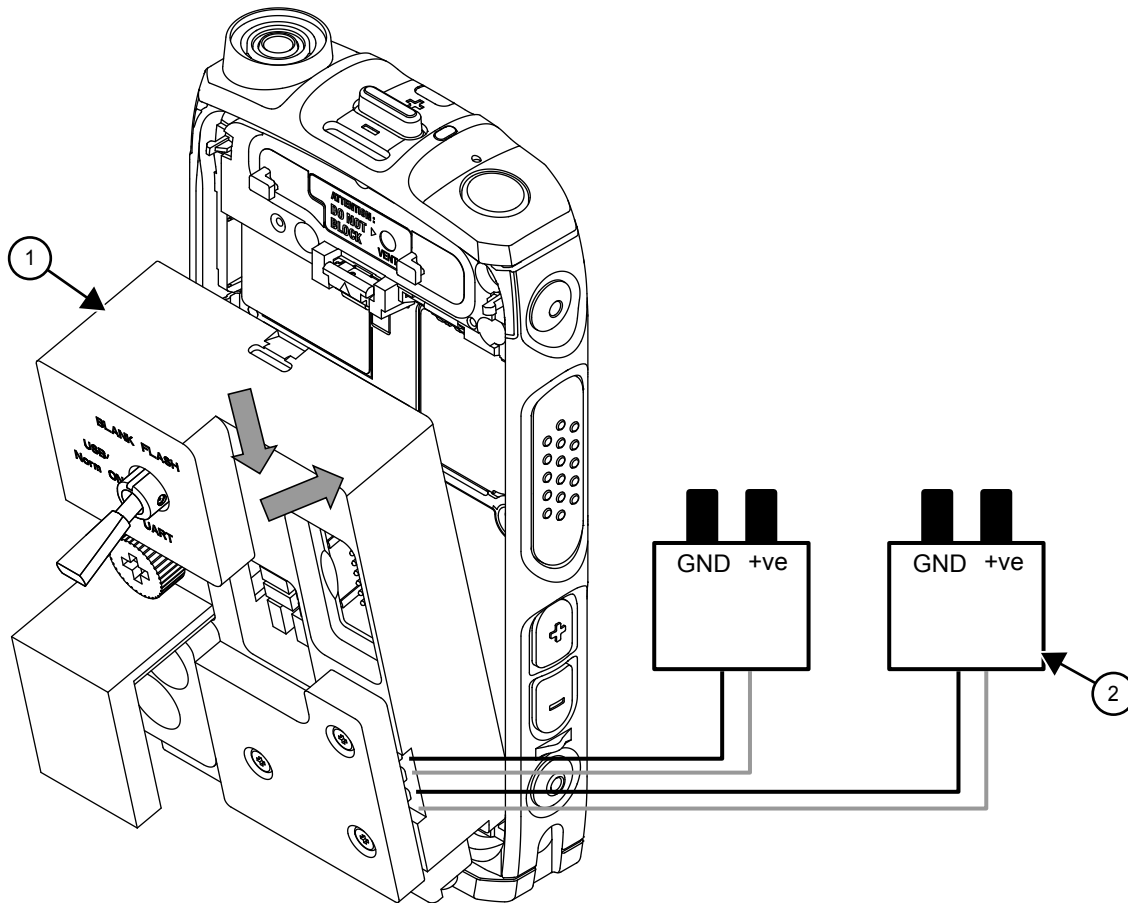
No.	Description
1	3.8 V Power Supply
2	Battery Eliminator connected to Power Supply
3	RF Cable
4	N-type RF Connector
5	IFR 39xx/IFR 2968

4.1.1
Assembly Procedures

Procedure:

- 1 Insert the bottom area of the battery eliminator into the compartment.

Figure 3: Battery Eliminator Insertion



No.	Description
1	Battery Eliminator
2	Banana Plug

- 2 Press down the top area of the battery eliminator into the compartment until it clicks.
- 3 Remove the retainer by loosening the thumb screw.



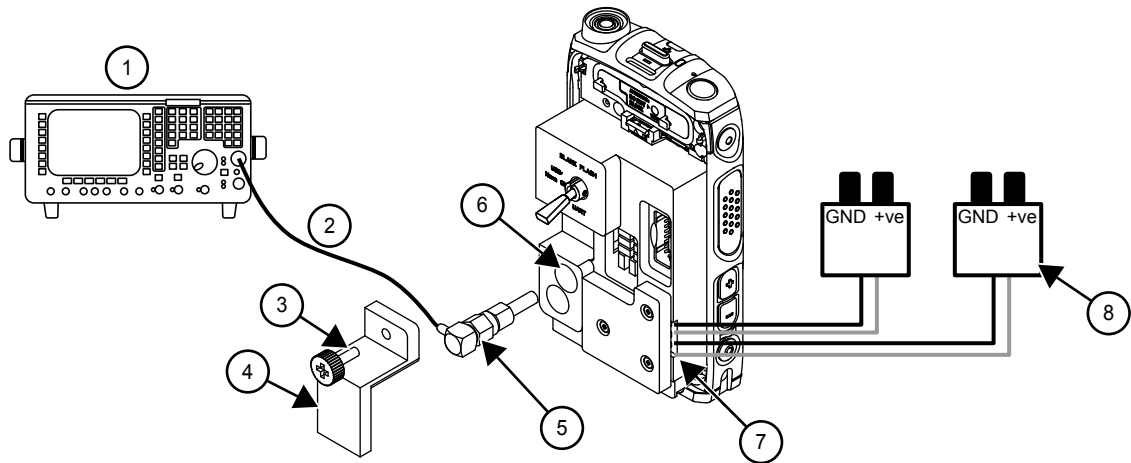
WARNING:

Use the right RF cable kit for testing, else it damages the RF connector.

- RF Cable Kit TL000100A01 for RF testing.
- RF Cable Kit TL000068A01 for GPS testing.

- 4 Align the RF Cable Kit into the RF slot.
- 5 Insert the RF Cable Kit into the RF slot. A slight friction is felt when the RF Cable Kit is connected to the RF switch located inside the radio.
- 6 Push the RF plug deeper into the slot until it reached maximum depth.
- 7 Reassemble the retainer and tighten the thumb screw.

Figure 4: RF cable kit insertion



No.	Description
1	IFR 39xx/IFR 2968
2	RF Cable
3	Thumb Screw
4	Retainer
5	RF Cable (Part Number TL000100A01)
6	RF Plug Slot
7	Battery Eliminator
8	Banana Plug

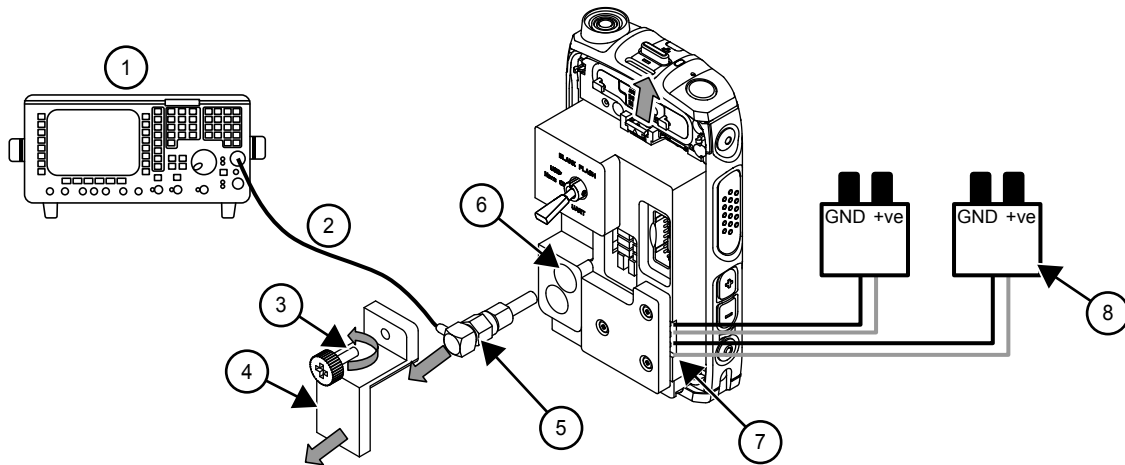
4.1.2

Disassembly Procedures

Procedure:

- 1 Loosen the thumb screw.
- 2 Remove the retainer horizontally backward.
- 3 Remove the RF plug horizontally backward. Ensure that the RF plug is fully removed.

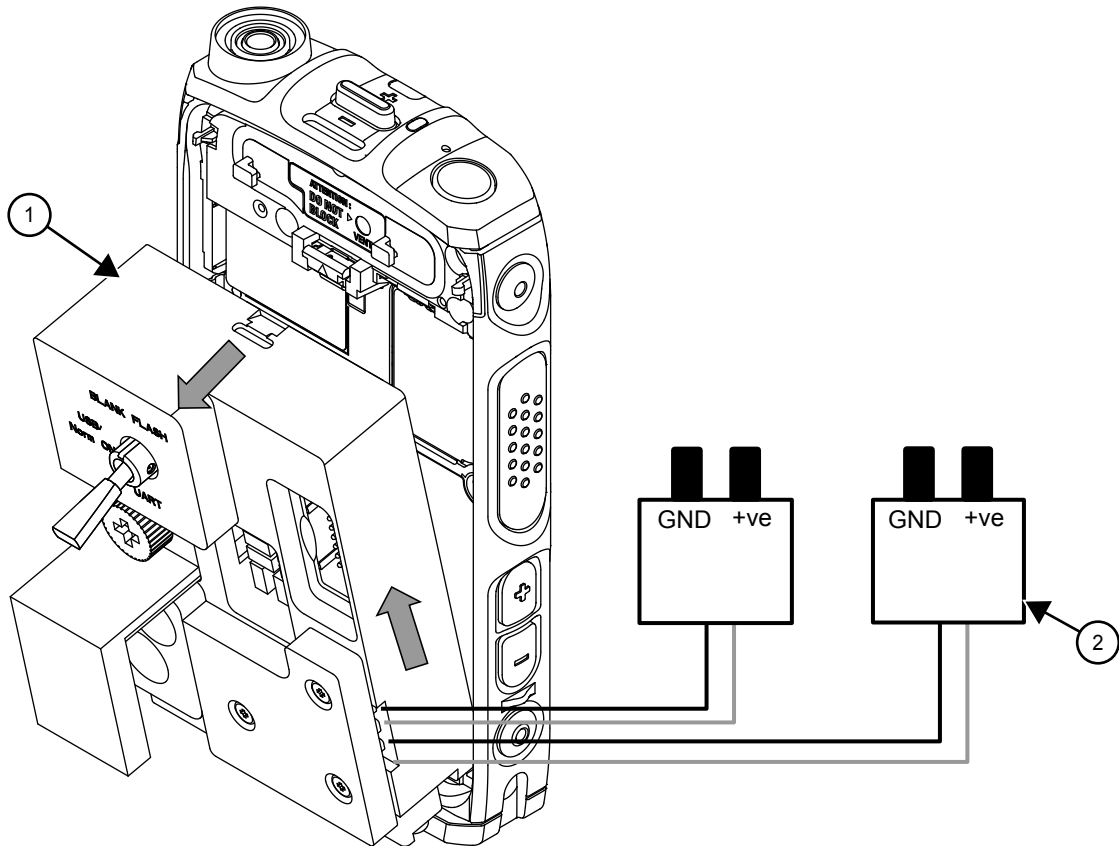
Figure 5: Removing RF Cable Kit



No.	Description
1	IFR 39xx/IFR 2968
2	RF Cable
3	Thumb Screw
4	Retainer
5	RF Cable (Part Number TL000100A01)
6	RF Plug Slot
7	Battery Eliminator
8	Banana Plug

- 4 Push up the battery latch. The battery eliminator is slightly ejected from the slot.
- 5 Pull the top part of the battery eliminator outward from the compartment.

Figure 6: Battery eliminator removal



No.	Description
1	Battery Eliminator
2	Banana Plug

- 6 Fully remove the battery eliminator from the compartment.

4.2

Flashing Mode

This section lists the applicable flashing mode for the radio and its procedures.

- Blank Flash Mode



NOTICE: Blank Board Flashing Mode is not supported and can only be performed at authorized Motorola Solutions Repair Center.

- Normal Mode
- UART Mode

4.2.1

Connecting the Radio in Blank Flash Mode

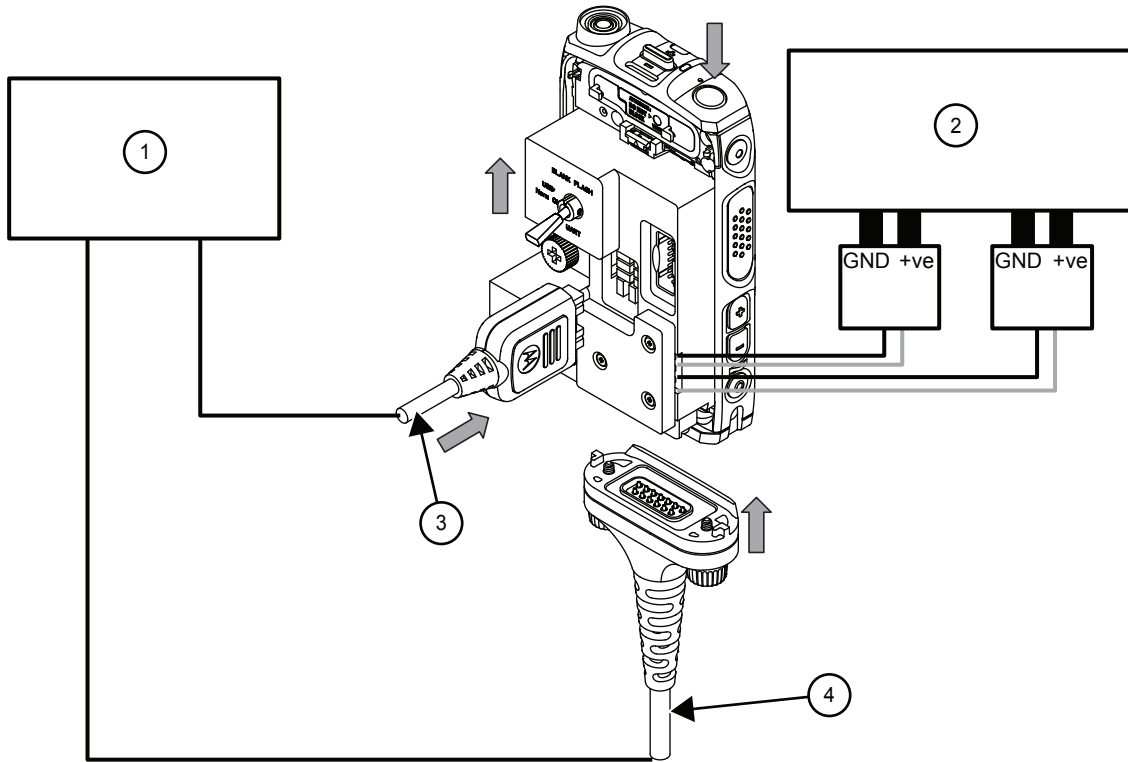
The function of this mode is for blank board flashing.

Procedure:

- 1 Flip up the battery eliminator switch.

- 2 Connect the serial data cable to the PC.
- 3 To enter Boot Me mode, press the **On/OFF** button or connect the programming cable to the PC.

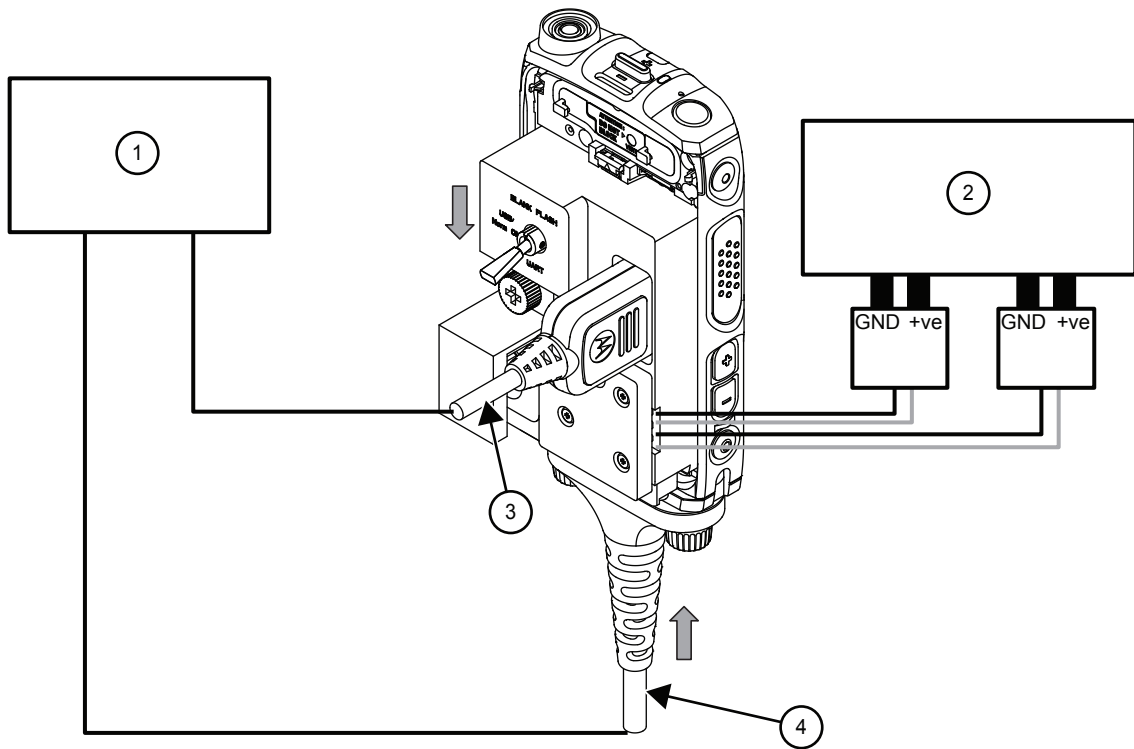
Figure 7: Connecting the Radio in Blank Flash Mode (1 of 2)



No.	Description
1	Personal Computer
2	Power Supply 3.8 V
3	Serial Data Cable
4	Programming Cable

- 4 Push the battery eliminator switch to the middle.
- 5 Ensure that the programming cable is connected to the radio and the PC.
- 6 Flash the software or firmware to the radio.

Figure 8: Connecting the Radio in Blank Flash Mode (2 of 2)



No.	Description
1	Personal Computer
2	Power Supply 3.8 V
3	Serial Data Cable
4	Programming Cable

4.2.2

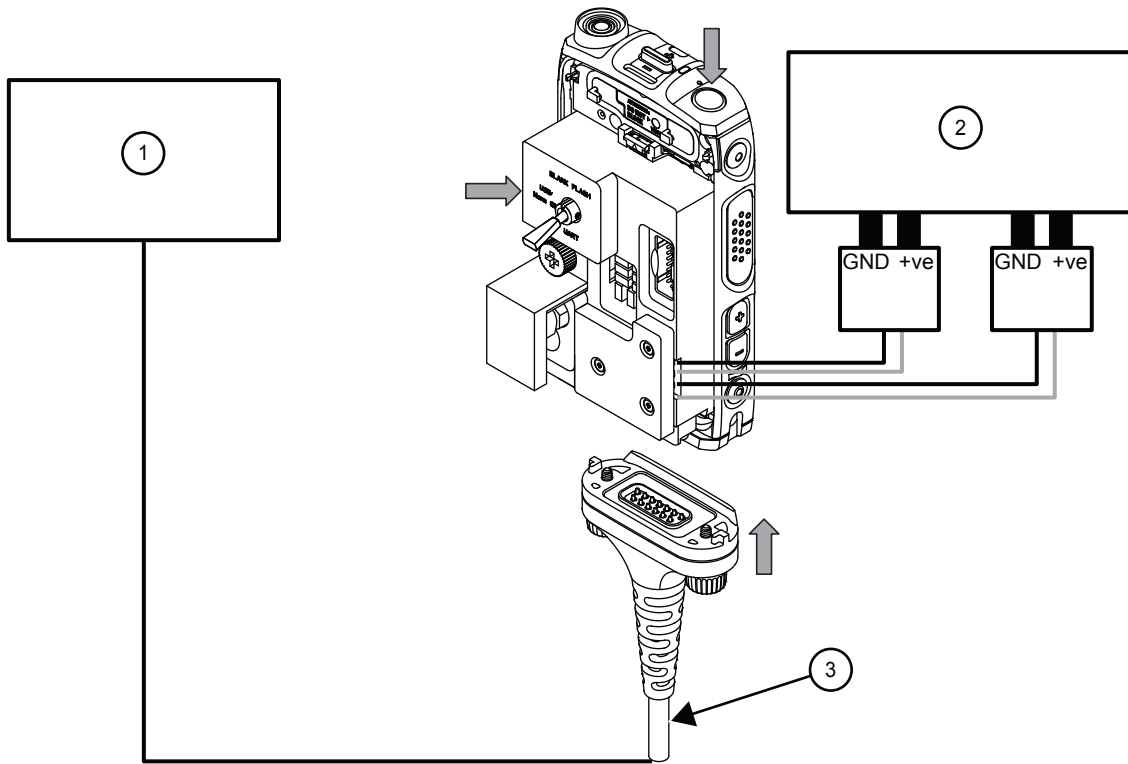
Connecting the Radio in Normal Mode

The function of this mode is for radio normal power-up and programming cable connection between the radio and the PC(TetraCom).

Procedure:

- 1 Push the switch to the middle.
- 2 Connect the radio and the PC with the programming cable.
- 3 Power on the radio.

Figure 9: Connecting the radio in Normal mode



No.	Description
1	Personal Computer
2	Power Supply 3.8 V
3	Programming Cable

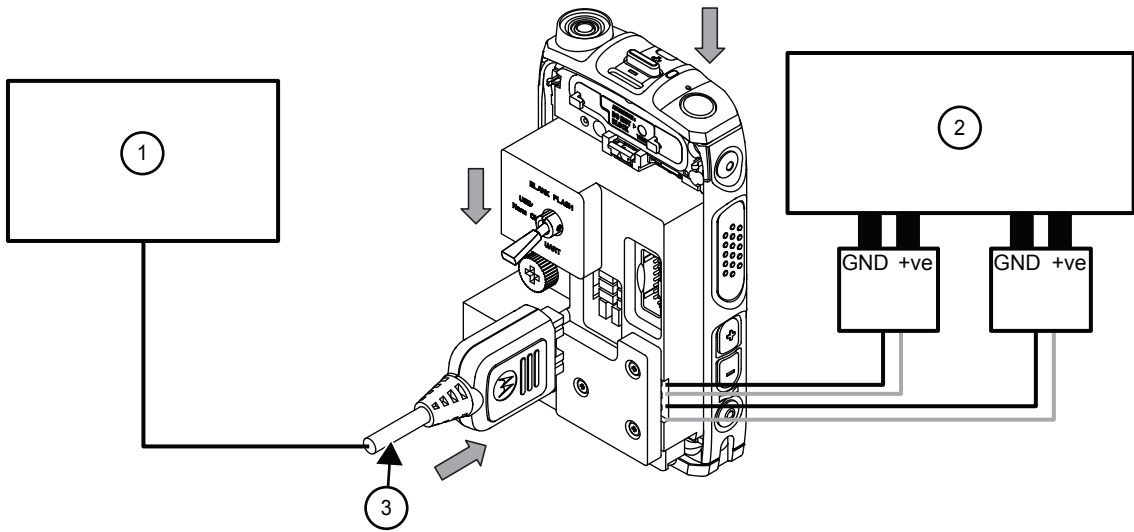
4.2.3

Connecting the Radio in UART Mode

Procedure:

- 1 Push down the switch.
- 2 Connect the radio and PC with the serial data cable.
- 3 Power on the radio.

Figure 10: Connecting the radio in UART mode



No.	Description
1	Personal Computer
2	Power Supply 3.8 V
3	Serial Data Cable

4.3

Test Check List

Table 12: Test Setup for 380–430 MHz Radio Models

The following table summarizes the required test setup for 380–430 MHz radio models.

Test Name	Test Setup	Radio Setup	Test Conditions	Limits
Base Station Registration	Control Channel	390.125 MHz	3605	TETRA 380+0MS
	Traffic Channel	390.125 MHz	3605	TETRA 380+0MS
	Time Slot	N/A	3	N/A
	Country Code	N/A	234	N/A
	Network Code	N/A	2392	N/A
	Base Color	N/A	1	N/A
	Location Area	N/A	22	N/A
	Min Rx Level	N/A	N/A	N/A
Max Tx Level	N/A	N/A	N/A	30.0 dBm (1 W radio) 32.5 dBm (1.8 W radio)

Test Name	Test Setup	Radio Setup	Test Conditions	Limits
	Access Parameter	N/A	-53 dBm	N/A
	Mobile Power	30.0 dBm (1 W radio) 32.5 dBm (1.8 W radio)	N/A	N/A
	Burst Type	N/A	Normal	N/A
Transmitter Burst Power	RF Gen Level Burst Power	N/A	-90 dBm	30.5–34.5 dBm (1.8 W radio)
	Timing Error	N/A	N/A	±0.25 Symbols
	Vector Error	N/A	N/A	Max 10% RMS, 30% Peak
	Frequency Error	N/A	N/A	±100 Hz
Call Processing Talk Back	1 kHz Test Signal Group Mode	N/A	-50 dBm	N/A
Call Processing Call to Mobile	Private	4-digit random number and Send	N/A	28.0–32.0 dBm (1 W radio) 30.5–34.5 dBm (1.8 W radio)
	RF Gen Level Burst Power	N/A	-90 dBm	28.0–32.0 dBm (1 W radio) 30.5–34.5 dBm (1.8 W radio)
	Timing Error	N/A	N/A	±0.25 Symbols
	Vector Error	N/A	N/A	Max 10% RMS, 30% Peak
	Frequency Error	N/A	N/A	±100 Hz

4.3.1

Transmitter Tests

- 1 Power Burst (Control Range)
- 2 Power Profiles
- 3 Tx Burst Timing Error
- 4 Vector Error RMS and Peak
- 5 Tx Frequency Error

4.3.2

Call Processing Tests

- 1 Talk Back
- 2 Call to Mobile

4.3.3

Duplex Test

Digital Duplex Test (Tx)

Measurement Capabilities:

- Bar charts (Tx Power, Frequency Error, Vector Error RMS)
- Spectrum Analyzer
- Power Analyzer
- Vector Analyzer
- Vector Diagrams

4.4

Configuring IFR 3901/IFR 3902/IFR 3920 Setup

Use these procedures to configure the IFR 3901/IFR 3902/IFR 3920 setup.

Procedure:

- 1 Turn ON the IFR.
- 2 Press **CONFIG** → **CONFIG**. Select **System** → **TETRA** → **MS**.
- 3 Press **CONFIG** → **CONFIG**. Select **Configure** → **Channel Plan**.
- 4 Press **SELECT** → **TETRA 380+0MS**.
- 5 Press **CONFIG**. Select **System ID & Access Params**.
- 6 Enter 234 for Mobile Country Code (MCC). Press **Enter**.
- 7 Enter 2392 for Mobile Network Code (MNC). Press **Enter**.
- 8 Enter 1 for Base Station Color Code (BCC). Press **Enter**.
- 9 Enter 22 for Location Area Code (LA). Press **Enter**.
- 10 Enter -110 for Min Rx Level For Access. Press **Enter**.
- 11 Enter 30 for Max Tx Level. Press **Enter**.
- 12 Enter -53 for Access Parameter. Press **Enter**.
- 13 Press **CONFIG**. Select **Base Services**.



NOTICE: You are entering base services setup. The displayed value are factory defaults and should not be changed.

```
Power On Registration: Required
Power Off De-registration: Required
Priority Cell: Yes
Minimum Mode Service: May Be Used
Migration: Supported
System Wide Services: Normal Mode
TETRA Voice Service: Supported
Circuit Mode Data Service: Supported
(Reserved): Available
TETRA Packet Data Service: Available
Air Interface Encryption: Not Available
Advanced Link: Not Supported
```

- 14 Press **CONFIG**. Select **Neighbor Cell Info**.
- 15 Verify that the following NEIGHBOUR CELL INFO values are displayed:



NOTICE: The displayed values are factory defaults and should not be changed.

```
BROADCAST: Not Supported
BROADCAST INTERVAL: 5 s
NEIGHBOUR CELL CHANNEL: 3500
NEIGHBOUR CELL LOCATION AREA: 0017
NEIGHBOUR CELL IDENTIFIER: 01
SLOW RE-SELECT THRESHOLD ABOVE FAST: 10 dB
FAST RE-SELECT THRESHOLD: 10 dB
SLOW RE-SELECT HYSTERESIS: 10 dB
FAST RE-SELECT HYSTERESIS: 10 dB
```

- 16 Press **CONFIG**. Select **Call Timers & Trunking**.
- 17 Select **Transmission** for Trunking Type.
- 18 Select **Continuous** for Test Set Transmit Mode.

4.5

Configuring IFR 2968 Setup

Use these procedures to configure the IFR 2968 setup.

Procedure:

- 1 Turn ON the IFR.
- 2 Press **Systems Mode Key** and wait until the digital system is initialized.
- 3 Press **Tetra Mobile** → **Setup**. Enter the System Parameters Screen.
- 4 Press **Channel Plan**.
- 5 Press **Traffic Channel** → **Traffic Channel**. Check that the marker goes to Timeslot.
- 6 To change to Timeslot 3, press **3** → **Traffic Channel**.
- 7 Press **Country Code**. Enter 234 and press **Country Code**.
- 8 Press **Network Code**. Enter 2392 and press **Network Code**.
- 9 Press **Base Color**. Enter 1 and press **Base Color**.
- 10 Press **More**.
- 11 Press **Location Area**. Enter 22 and press **Location Area**.
- 12 Press **More**.
- 13 Press **Min Rx Level**. Enter -110 dBm and press **Min Rx Level**.
- 14 Press **Max Tx Level**. Enter 30 dBm and press **Max Tx Level**.
- 15 Press **Access Parameter**. Enter -53 dBm and press **Access Parameter**.
- 16 Press **Test Mode** → **Enable**.
- 17 Press **Base Service**.



NOTICE: You are entering base services setup. The displayed value are factory defaults and should not be changed.

```
Power On Registration: Required
Power Off De-registration: Required
Priority Cell: Yes
Minimum Mode Service: May Be Used
Migration: Supported
System Wide Services: Normal Mode
```

18 Press More.

```
TETRA Voice Service: Supported
Circuit Mode Data Service: Supported
(Reserved): Available
SNDCP Service: Available
Air Interface Encryption: Not Available
Advanced Link: Not Supported
```

19 Press Return. Select Neighbor Cell.

20 Verify that the following NEIGHBOUR CELL INFO values are displayed:



NOTICE: The displayed values are factory defaults and should not be changed.

```
BROADCAST: Not Required
BROADCAST INTERVAL: 5 s
NEIGHBOUR CELL CHANNEL: 3500
NEIGHBOUR CELL LOCATION AREA: 00017
NEIGHBOUR CELL IDENTIFIER: 01
SLOW RE-SELECT THRESHOLD ABOVE FAST: 10 dB
```

21 Press More.

```
FAST RE-SELECT THRESHOLD: 10 dB
SLOW RE-SELECT HYSTERESIS: 10 dB
FAST RE-SELECT HYSTERESIS: 10 dB
```

22 Press Return.

23 Press Trunk Type → message Trunked (Transmission).

24 Press More.



NOTICE: The displayed values are factory defaults and should not be changed. It is not required to configure Call Types, Call Aerial, and Messages.

25 Press More.

4.6

Configuring IFR 3901/IFR 3902/IFR 3920 Manual Screen Test

Use these procedures to configure the IFR 3901/IFR 3902/IFR 3920 manual screen test.

Procedure:

- 1 Press **TEST** → **TAB**.
- 2 Enter 3600 for Control Channel.
- 3 Enter 3700 for Traffic Channel.
- 4 Enter 3 for Slot.
- 5 Enter -75 for RF Gen Level.
- 6 Select **Expected** → **30.0 dBm/1 W** for Mobile Power.
- 7 To select Tx Measurements, press **TAB**.
- 8 Press **Normal** for Burst.

The test equipment configuration setup is completed.




NOTICE: The System Setup Configuration Data is saved even after the power is turned off. However, the Manual Test Setup is not saved.

4.7

Configuring IFR 2968 Manual Screen Test

Use these procedures to configure the IFR 2968 manual screen test.

Procedure:

- 1 Press **Manual** to enter the Manual Test screen.
- 2 Press **Control Channel**. Enter 3605 and press **Control Channel**.
(IFR 3605 = Rx 390.125000 MHz)
- 3 Press **Traffic Channel**. Enter 3605 and press **Traffic Channel**.
The marker goes to Timeslot.
- 4 Enter 3 and press **Traffic Channel**.
 **NOTICE:** The Traffic Channel number changes automatically after entering the Control Channel number.
- 5 Press **RF Gen Level**. Enter -75 and press **dBm** → **RF Gen Level**.
- 6 Press **Mobile Power**. Enter 30 dBm/1 W.
- 7 Press **Burst Type** → **Normal**.

The test equipment configuration setup is completed.



NOTICE: The System Setup Configuration Data is saved even after the power is turned off. However, the Manual Test Setup is not saved.

4.8

RF Tests

This section lists the applicable RF Tests and its procedures for the radio.

4.8.1

Testing Receiver using IFR 3901/IFR 3902/IFR 3920

Prerequisites: This test requires programming the radio. Refer to TETRA Customer Programming Software (CPS) User Guide.

Procedure:

- 1 Turn ON the radio.
- 2 Do one of the following to enter the radio test page:
 - Use CPS.
 - Press **Menu/OK** → **Up** → **Down** → **Back**.
- 3 Check that registration and ITSI ---/---: xxxx is displayed on the IFR Operations/Status screen.

GROUP: XXXXXXXX SELECTED

4.8.2

Testing Receiver using IFR 2968

Prerequisites: This test requires programming the radio. Refer to TETRA Customer Programming Software (CPS) User Guide.

Procedure:


- 1 Turn ON the radio.
The screen is Idle.
- 2 Do one of the following to enter the radio test page:
 - Use CPS.
 - Press **Menu/OK** → **Up** → **Down** → **Back**.
- 3 Check that registration and ITSI ---/---: xxxx is displayed on the IFR Manual Test screen.

```
STATUS: REGISTRATION (ITSI ATTCHED)
GSSI: XXXXXXXX SELECTED
```

4.8.3

Testing Transmitter using IFR 3901/IFR 3902/IFR 3920

Procedure:

- 1 To select RF Settings, press **TAB**.
 - 2 Enter -90 for RF Gen level.
 - 3 Switch ON the RF Gen.
 - 4 Switch OFF the Pre Amp.
 - 5 Press **PTT**.
-  **NOTICE:** Press and hold the **PTT** to read the results.

Monitor the **Tx Measurement** window which displays the Power Profile, Burst Timing, Vector Peak, Vector RMS, Freq Error, and Residual Carrier.

```
Burst Power Required Results: 28.0-32.0 dBm (Class 4) or 30.5-34.5 dBm
(Class 3L)
Power Profile: Passed
Burst Timing: ± 0.25 Symbols
Vector Error: Max 10% RMS, Max 30% Peak, Max 5% residual
Frequency Error: ± 100 Hz
```

- 6 Press **TAB** to select Operations/Status.
- 7 Press **Call Mobile** → **Group Call** → **Cleardown**.

4.8.4

Testing Transmitter using IFR 2968

Procedure:

- 1 Press **RF Gen Level**. Enter -90 dBm and press **RF Gen Level**.
- 2 Press **PTT**.



NOTICE: Press and hold the **PTT** to read the results.

Monitor the IFR Manual Test screen which displays the Power Profile, Burst Timing, Vector Peak, Vector RMS, Freq Error, and Residual Carrier.

Burst Power Required Results: 28.0–32.0 dBm (Class 4) or 30.5–34.5 dBm (Class 3L)

Power Profile: Passed

Burst Timing: ± 0.25 Symbols

Vector Error: Max 10% RMS, Max 30% Peak, Max 5% residual

Frequency Error: ± 100 Hz

- 3 Press **Clear Down** to proceed with other tests.

4.9

Call Processing Tests

This section list the applicable Call Processing Tests and its procedures.

4.9.1

Talk Back using IFR 3901/IFR 3902/IFR 3920

Prerequisites: Ensure that the handset and test equipment are configured the same as given in the Transmitter Test before you start this test.

Procedure:

- 1 Press **Call Mobile** → **Group Call**.
- 2 Press **TALKBACK**.
- 3 Press **PTT** and speak into the microphone of the radio.
The last 3 sec of the speech frames is heard after **PTT** is released.
- 4 Press **Test Sound** to provide the 1 kHz signal to the radio speaker.
A 1 kHz tone is heard from the radio speaker for about 3 sec.
- 5 Press the **Silence** to mute the 1 kHz Audio Signal of the speaker.
- 6 Press **Clear Down**.

4.9.2

Talk Back using IFR 2968

Prerequisites: Ensure that handset and test equipment are configured the same as given in the Transmitter Test before you start this test.

Procedure:

- 1 Press **PTT** and speak into the microphone of the radio.
The last 3 sec of the speech frames is heard after **PTT** is released.
- 2 Press **Test Sound** to provide the 1 kHz signal to the radio speaker.
A 1 kHz tone from the radio speaker is heard for about 3 sec.
- 3 Press the **Silence** to mute the 1 kHz Audio Signal of the speaker.
- 4 Press **Clear Down**. Check that the `Cleardown Complete` status appears on the IFR Manual Test screen.

4.9.3

Call to Mobile

Procedure:

- 1 Press **Call Mobile** on the IFR.
- 2 Press **Private**.



NOTICE: Select the type of call.

The handset beeps.

- 3 Press **Abort Call**.
- 4 Repeat [step 1](#) through [step 3](#) for Phone and Emergency calls.

4.10

Digital Duplex Test (Tx) using IFR 3901/IFR 3902/IFR 3920

Procedure:

- 1 On the radio, press **Menu** → **Contact** → **Contact 1** → **Send**.

The following results are displayed on the **Tx Measurements** window.

```
Burst Power Required Results: 28.0-32.0 dBm (Class 4) or 30.5-34.5 dBm
(Class 3L)
Power Profile: Passed
Burst Timing: ± 0.25 Symbols
Vector Error: Max 10% RMS, Max 30% Peak, Max 5% residual
Frequency Error: ± 100 Hz
```

- 2 Press **Call Mobile** → **Group Call** → **TALKBACK**.
- 3 Speak into the microphone of the handset.
You hear your speech (after a short delay) from the internal earpiece of the handset.
- 4 If you need more details, select ▼ at the Rx Measurement Window.

For...	Then...
Power Analyzer Graph	<ol style="list-style-type: none"> a Select Power → Profile Full. b To view the detail of Profile Full, select <input type="checkbox"/> and press Select. c To minimize the window, press Select. d To view the rest of the power analyzer graphs, select any item under Power drop-down list.
Vector Analyzer Diagram	<ol style="list-style-type: none"> a Select Mod Accuracy → Vector Error. b To view the detail of Vector Error, select <input type="checkbox"/>, and press Select. c To minimize the window, press Select. d To view the rest of the vector analyzer graphs, select any item under Mod Accuracy drop-down list.

- 5 Press **End** on the handset.

4.11

Digital Duplex Test (Tx) using IFR 2968

Procedure:

- 1 On the radio, press **Menu** → **Contact** → **Contact 1** → **Send**.

The following results are displayed on IFR Manual Test Screen.

```
Burst Power Required Results: 28.0-32.0 dBm (Class 4) or 30.5-34.5 dBm  
(Class 3L)  
Power Profile: Passed  
Burst Timing: ± 0.25 Symbols  
Vector Error: Max 10% RMS, Max 30% Peak, Max 5% residual  
Frequency Error: ± 100 Hz
```

- 2 Speak into the microphone of the handset.

You hear your speech (after a short delay) from the internal earpiece of the handset.



NOTICE: If you need more details, press **Duplex Test**.

- 3 Press **Duplex Test (Tx)**.

The Digital Duplex test results are displayed on the IFR screen providing you with the following bar charts measurement capabilities:

- Power
- Vector RMS
- Frequency Error

- 4 Perform one of the following actions:

For...	Then...
Power Analyzer Graph	a Press power ana . b Check that the power frame falls within the limits.
Spectrum Analyzer Diagram	a Press spec ana . b Monitor the Tx frequency.
Vector Analyzer Diagram	a Press vector ana . b Monitor the constellation diagram. c Press vector diagram . d Monitor the vector diagram. e To zoom in on the constellation, press rotated vector .

- 5 Press **End** on the handset.

4.12

Manual Mode Testing

When and where to use: Use these procedures to set up radio for DALT Mode testing.

Procedure:

- 1 Verify that the radio is turned OFF.
- 2 Press and hold **P2 Programmable** button and **PTT** simultaneously and press the **Power** button for more than 5 seconds to enter DALT mode.

4.12.1

Testing in DALT Mode



NOTICE: Any key pressed causes the test to advance from one step to the next. You are to respond accordingly to the instructions on the screen.

Prerequisites:

- Ensure that SD card is inserted to perform the SD Card Test.
- Ensure that SIM card is inserted to perform the SIM Card Test.
- Prepare a Remote Speaker Microphone (RSM) and a Personal Hands-Free (PHF) accessories for Accessory Connect Test.
- Prepare supported Bluetooth accessories for Bluetooth Test.

Procedure:

Display Test

- 1 The display shows:

```
Display Test
Press Any key
To Continue
```

- 2 Do the following:

Action	The display shows:
Press any key consecutively.	Vertical black lines become thicker with every key press, until it becomes fully black.
Press any key.	Four rectangles.
Press any key consecutively.	Horizontal black lines become thicker with every key press, until it becomes fully black.
Press any key.	White screen.
Press any key.	Black screen.
Press any key.	END LCD test!!!

- 3 Press the corresponding key to proceed to the next test.

Battery Test

- 4 The display shows:

```
Battery
Interface Test
Press Any key
To Continue
```

5 Do the following:

Action	The display shows:
Press any key.	<ul style="list-style-type: none"> If passed, the display shows: Battery Interface Test PASSED If failed, the display shows: Battery Interface Test FAILED

6 Press the corresponding key to proceed to the next test.

SD Card Test

7 The display shows:

```
SD card
Press Any key
To Continue
WARNING! This will
wipe your card!
```

8 Do the following:

Action	Result
Press any key.	<ul style="list-style-type: none"> If SD card is detected in SD slot, the display shows: SD card PASSED Press Any key To Continue If SD card is not detected in SD slot, the display shows: SD card No card detected! FAILED Press Any key To Continue

9 Press the corresponding key to proceed to the next test.

SIM Card Test

10 The display shows:

```
SIM card test
Press any key to continue
```



NOTICE: Check SIM card presence for the SIM card version of radio.

11 Do the following:

Action	Result
Press any key.	<ul style="list-style-type: none"> If SIM card presence is detected in SIM slot, the display shows: SIM card PASSED

12 Press the corresponding key to proceed to the next test.

Vibrator Test

13 The display shows:

Vibrator
Test

14 Do the following:

Action	Result
Press any key.	The display shows: Vibrator On The radio vibrates.

15 Press the corresponding key to proceed to the next test.

LEDs Test

16 The display shows:

LEDs
Test

17 Do the following:

Action	Result
Press any key.	The display shows: Red LED on LED Coverage Indicator lights up in red.
Press any key.	The display shows: Green LED on LED Coverage Indicator lights up in green.
Press any key.	The display shows: Amber LED on LED Coverage Indicator lights up in amber.
Press any key.	The display shows: CHRG Red LED on LED Power Indicator lights up in red.
Press any key.	The display shows: CHRG Green LED on LED Power Indicator lights up in green.
Press any key.	The display shows: CHRG Amber LED on LED Power Indicator lights up in amber.

18 Press the corresponding key to proceed to the next test.

Keypad Test

19 The display shows:

Keypad
Backlight Test

20 Do the following:

Action	Result
Press any key.	The display shows: Up LED on The Up button lights up.
Press any key.	The display shows: Down LED on The Down button lights up.
Press any key.	The display shows: Back LED on The Back button lights up.
Press any key.	The display shows: OK LED on The Menu/OK button lights up.
Press any key.	The display shows: POWER LED on The Power button lights up.
Press any key.	The display shows: PROG 3 LED on The P3 Programmable Button button lights up.
Press any key.	The display shows: ALL LED on All the buttons on the keypad light up.

21 Press the corresponding key to proceed to the next test.

MACE Test

22 The display shows:

```
MACE
Press Any key
To Continue
```

23 Do the following:

Action	Result
Press any key.	<ul style="list-style-type: none"> If CRYPTR card is detected in SD slot, the display shows: MACE ping test PASSED Press Any key To Continue If CRYPTR card is not detected in SD slot, the display shows: MACE ping test FAILED CRYPTR CARD NOT INSERTED Press Any key To Continue

24 Press the corresponding key to proceed to the next test.

VBUS 5 V Output Test

25 The display shows:

```
VBUS 5V Output
Test
WAIT!!!
```

26 Do the following:

Action	Result
Wait for response	<ul style="list-style-type: none"> If passed, the display shows: VBUS 5V Output Test PASSED If failed, the display shows: VBUS 5V Output Test FAILED

27 Press the corresponding key to proceed to the next test.

Accessory Connect Test


28 The display shows:

```
Accessory Connect
Test
```

29 Do the following:

Action	Result
Press any key.	The display shows: Connect accessory: 1. Core Accy 2. PHF to the radio and press any key
Attach Core accessory to the Bottom connector.	The display shows: WAIT!!! ----ACCY---- IMPRESS RSM connected Press any key to continue
Press the corresponding key to continue.	Depending on the instructions, the display shows: RSM Accessory Ptt Pressed OR/AND RSM Accessory Emergency Pressed
Press any key to continue.	The display shows:

Action	Result
	Connect/Disconnect SAD Not Connected Press any key To Continue
Attach the PHF to the RSM.	The display shows: Connect/Disconnect SAD Connected Press any key To Continue

 **NOTICE:** Press the **P1 Programmable Button** to proceed. Otherwise, the Accessory Connect Test restarts.

30 Press the corresponding key to proceed to the next test.

Tones Test

31 The display shows:

Tones
Test

32 Do the following:

Action	Result
Press any key.	The display shows: Internal Speaker Tone Test The speaker plays a continuous tone.
Press any key.	The display shows: Internal Earpiece Tone Test The internal earpiece plays a continuous tone.
Press any key.	The display shows: Connect RSM accessory to the radio
Attach RSM accessory to the radio.	The display shows: RSM Tone Test The RSM earpiece plays a continuous tone.

33 Press the corresponding key to proceed to the next test.

Loopback Test

34 The display shows:

Loopback
Test

35 Do the following:

Action	Result
Press any key.	The display shows:

Action	Result
	INT MIC to INT EAR Loopback Test
Speak into the internal microphone.	You hear your voice from the internal earpiece.
Press any key to continue.	The display shows: Connect RSM accessory to the radio
Attach RSM accessory to the radio. Press any key to continue.	The display shows: TOP MIC 1 to RSM Loopback Test
Speak into the top microphone.	You hear your voice from the RSM earpiece.
Press any key to continue.	The display shows: Connect RSM accessory to the radio
Attach RSM accessory to the radio.	The display shows: RSM MIC to INT EAR Loopback Test
Speak into the RSM microphone.	You hear your voice from the internal earpiece.

36 Press the corresponding key to proceed to the next test.

B Test

37 The display shows:

Button
Test

38 Do the following:

Action	Result
Press any key.	The display shows: Back to EXIT VOL UP TG UP VOL DW EMER UP TG DW Ptt DOWN
Press the corresponding key to continue.	The respective display disappears every time you press a key. Continue until display is empty.

39 Press the corresponding key to proceed to the next test.

Front Button Test

40 The display shows:

Front Button
Test

41 Do the following:

Action	Result
Press any key.	The display shows: BACK UP OK PWR DOWN PROG3
Press the corresponding key to continue.	The respective display disappears every time you press a key. Continue until display is empty.

42 Press the corresponding key to proceed to the next test.

Gyro Sensor Test

43 The display shows:

```
Gyro Sensor
Test
```

44 Do the following:

Action	Result
Press any key.	The display shows: 45 Degree Angle Angle Detection Mandown Test
Place the radio on a flat surface.	A beep sounds after 10 seconds. Mandown angle detection feature is funtional.
Press any key to continue.	The display shows: No-Movement Mandown Test
Place the radio in a stable position.	A beep sounds after 10 seconds. Mandown angle detection feature is funtional.

45 Press the corresponding key to proceed to the next test.

Bluetooth Test

46 The display shows:

```
Bluetooth
Test
```

47 Do the following:

Action	Result
Press any key.	The display shows: Bluetooth Enable WAIT !!! bt enable completed BT test - pairing WAIT !!!
Wait for result.	The display shows pairing test result.
Press any key to continue.	The display shows pairing connection test result.
Press any key to continue.	The display shows:

Action	Result
	BT test - SPEAKER SPEAKER STARTED
Speak into the internal microphone.	You will hear yourself in the paired Bluetooth audio speaker.

48 Press the corresponding key to proceed to the next test.


The display shows:

```
The test is
completed.
Press any key
to turn the
radio OFF.
Test is completed. Press any key to turn the radio OFF.
```

4.12.2

Testing Charger Recognition

Procedure:

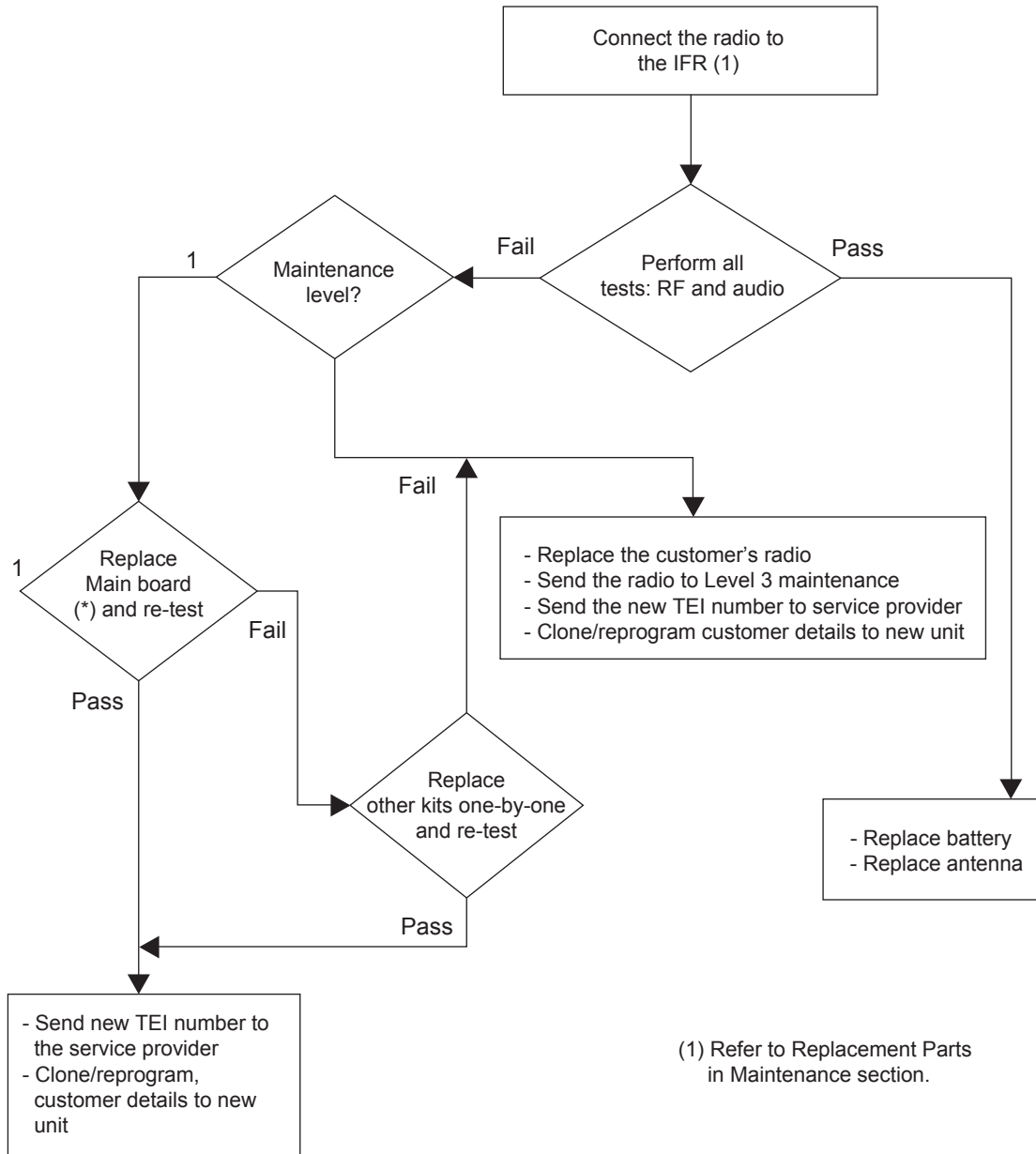
- 1 Turn the radio ON.
- 2 Connect the Rapid Travel Charger accessory connector to the handset. Check the following:
 - LCD display shows `charger connected`.
 - A beep is heard.
 - Keypad back-light is turned ON.
 - Charging icon is shown.
- 3 Connect the handset to the USB Charger. Check the following:
 - PMOLED display shows `charger connected`.
 - Three beeps are heard.
 - Keypad back-light is turned ON.
 - Charging icon is shown.
- 4 Connect the handset to the MUC Charger. Check the following:
 - PMOLED display shows `charger connected`.
 - A beep is heard.
 - Keypad back-light is turned ON.
 - Charging icon is shown.
- 5 Verify that the battery charger is in progress.
 -  **NOTICE:** The process advance is indicated on the Battery Strength icon.
- 6 Press the **Power ON/OFF**.
The radio turns OFF.

4.13

Service Flowchart

The service flowchart shows the expected results and their next required actions for the testing procedure of the radio.

Figure 11: Service Flowchart



(1) Refer to Replacement Parts in Maintenance section.

4.14

Man Down Calibration Data

To operate the Man Down feature, the radio must contain Man Down calibration data. If the radio does not contain this data, a hotfix must be applied to the radio. This hotfix contains the default Man Down calibration data.

The hotfix is only available at the Motorola Solutions Service Center or Depot. To enable the Man Down feature, you must bring your radio to the center to have it serviced for calibration data setup.

4.14.1

Testing for Man Down Calibration Data



Prerequisites:

Activate the Man Down selling license on the radio.

Procedure:

- 1 Turn off the radio.
- 2 Set the radio to flashing mode and connect it to the Customer Programming Software (CPS).
- 3 Enable Man Down angle detection by configuring the following codeplug fields:
 - Enable **Codeplug** → **Man-Down** → **Man Down Radio Enable**.
 - Enable **Codeplug** → **Man-Down** → **Angle Feature Enable**.
- 4 Turn off the radio and disconnect it from the CPS.
- 5 Turn on the radio.
- 6 Verify that the radio contains Man Down calibration data by checking the Man Down icon on the display.

Table 13: Man Down Icon Display

Display	Man Down Icon	Description
	Man Down Active	The radio contains Man Down calibration data.
	Man Down Failure	The radio does not contain Man Down calibration data. An error tone sounds.

- 7 Perform one of the following actions:

If...	Then...
If the radio displays the Man Down Active icon,	no further action is required to set up the calibration data.
If the radio displays the Man Down Failure icon,	perform the following actions:

If...	Then...
	<ul style="list-style-type: none">a Turn off the radio.b Contact the nearest Motorola Solutions Service Center or Depot to set up the calibration data.

Chapter 5

Maintenance

This chapter provides information about the care and maintenance of this radioRSM.

5.1

Preventive Maintenance

Periodic visual inspection and cleaning are recommended.



IMPORTANT: To avoid compromising the ingress protection of IP67, do not remove the seal label at the side of the radio.



NOTICE: To ensure optimum ingress protection of IP65 and IP67, you are recommended to change the battery cover after two years of usage.

The radio is submersible (compliant with the IP67 standard) – but only with the battery and the antenna attached.

To clean your radio and ensure that it is dust-free, use a moistened or antistatic/lint-free cloth to clean the battery cover seal and housing sealing surface.

Inspection

Check that the external surfaces of your radio are clean, and that all external controls and switches are functional. It is not recommended to inspect the interior electronic circuitry.

Cleaning Procedures

The following procedures describe the recommended cleaning agents and the methods to clean the external and internal surfaces of your radio.

External surfaces include the front cover, housing assembly, battery cover, and battery. These surfaces should be cleaned whenever a periodic visual inspection reveals the presence of smudges, grease, and/or grime.



CAUTION: Use all chemicals as prescribed by the manufacturer. Follow all safety precautions as defined on the label or material safety data sheet.

The effects of certain chemicals and their vapors can have harmful results on certain plastics. Avoid using aerosol sprays, tuner cleaners, and other chemicals.



NOTICE:

Only clean internal surfaces when your radio is disassembled for service or repair.

Before any programming procedure and to ensure optimum performance of the bottom connectors, use a lint-free cloth applied with isopropyl alcohol (100% by volume) to clean the contact pads.

Cleaning External Plastic Surfaces



IMPORTANT: The only recommended agent for cleaning the external radio surfaces is a 0.5% solution of a mild dish-washing detergent in water.

Apply the 0.5% detergent-water solution sparingly with a stiff, non-metallic, short-bristled brush to work all loose dirt away from your radio. Use a soft, absorbent, lint-less cloth, or tissue to remove the

solution and dry your radio. Make sure that no water remains entrapped near the connectors, cracks, or crevices.

Cleaning Internal Circuit Boards and Components



IMPORTANT:

The only factory recommended liquid for cleaning the printed circuit boards and their components is isopropyl alcohol (100% by volume).

Always use fresh supply of alcohol and a clean container to prevent contamination by dissolved material (from previous usage).

Apply Isopropyl alcohol (100%) with a stiff, non-metallic, short-bristled brush to dislodge embedded or caked materials located in hard-to-reach areas. The brush stroke should direct the dislodged material out and away from the inside of your radio. Make sure that controls or tunable components are not soaked with alcohol. Do not use high-pressure air to hasten the drying process since it can cause the liquid to collect in unwanted places. After completing of the cleaning process, use a soft, absorbent, lint-less cloth to dry the area. Do not brush or apply any isopropyl alcohol to the frame, front cover, or back cover.

Cleaning Bottom Connector Contacts



IMPORTANT:

The contact material technologies used in the radio are engineered to provide a reliable interconnection. For reliable performance, it is important to ensure that the electrical contact interface remains clean and free of foreign material. To maintain optimal performance of the contact interface, Motorola Solutions recommends inspecting and cleaning the contacts every six months or before Radio programming.

There are two options to clean the bottom connector contacts:

- 1 Using a lint-free swab applied with isopropyl alcohol (100% by volume), wipe/remove any dirt or foreign material from the contact pads.
- 2 To maintain optimal performance of the contact interface, clean and protect the contacts with a DeoxIT®GOLD cleaner/lubricant pen (Supplier CAIG Labs, P/N G100P)¹. The pen-based package is recommended as it provides better cleaning action and access to the contacts. Prior to applying the lubricant/cleaner, wipe the contacts with lint-free swabs to remove any dirt or foreign material. Per the manufacturer's instructions, shake the pen, and depress the pen tip until fluid begins to flow and saturates the felt tip. Apply the lubricant/cleaner to the contacts with short wiping strokes.

Vent Port Handling Precaution

The portable device has a vent port that allows for pressure equalization in the device. The pressure equalization vent is located at the rear housing plastic surface. Never touch the equalization vent. Ensure that no oily substances come in contact with this vent. Never poke this vent with any objects, such as needles, tweezers, or screwdrivers. This create a leak path into the device and lost the submersibility of the device.

¹ DeoxIT®GOLD cleaner/lubricant is available at numerous electronics suppliers and directly from the manufacturer.

5.2

Safe Handling of CMOS and LDMOS Devices

Complementary Metal Oxide Semiconductor (CMOS) and Laterally Diffused Metal Oxide Semiconductor (LDMOS) devices are used in this family of radios, and are susceptible to damage by electrostatic or high-voltage charges.

Damage can be latent, resulting in failures occurring weeks or months later. Therefore, special precautions must be taken to prevent device damage during disassembly, troubleshooting, and repair.

Handling precautions are mandatory for CMOS/LDMOS circuits and are especially important in low humidity conditions. Do not attempt to disassemble your radio without referring to the following caution statement.



CAUTION:

This radio contains static-sensitive devices. Do not open your radio unless you are properly grounded. Take the following precautions when working on this unit:

- Store and transport all CMOS/LDMOS devices in conductive material so that all exposed leads are shorted together. Do not insert CMOS/LDMOS devices into conventional plastic "snow" trays used for storage and transportation of other semiconductor devices.
- Ground the working surface of the service bench to protect the CMOS/LDMOS device. It is recommended that you use a wrist strap, two ground cords, a table mat, a floor mat, electrostatic discharge (ESD) shoes, and an ESD chair.
- Wear a conductive wrist strap in series with a 100k resistor to ground. Replacement wrist straps that connect to the bench top covering are Motorola Solutions part number 4280385A59.
- Do not wear nylon clothing while handling CMOS/LDMOS devices.
- Do not insert or remove CMOS/LDMOS devices with power applied. Check all power supplies used for testing CMOS/LDMOS devices to be certain that there are no voltage transients present.
- When straightening CMOS/LDMOS pins, provide ground straps for the apparatus used.
- When soldering, use a grounded soldering iron.
- Handle CMOS/LDMOS devices by the package and not by the leads. Before touching the unit, touch an electrical ground to remove any static charge that you may have accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.



NOTICE: The radio has a vent port that allows pressure equalization in the device. The pressure equalization vent is located at the battery compartment. Do not touch the equalization vent.

Ensure no oily substance comes in contact with the vent. Do not poke the vent with any objects such as needles, tweezers, or screwdrivers. This could create a leak path into the device and lose the submergibility of the device.

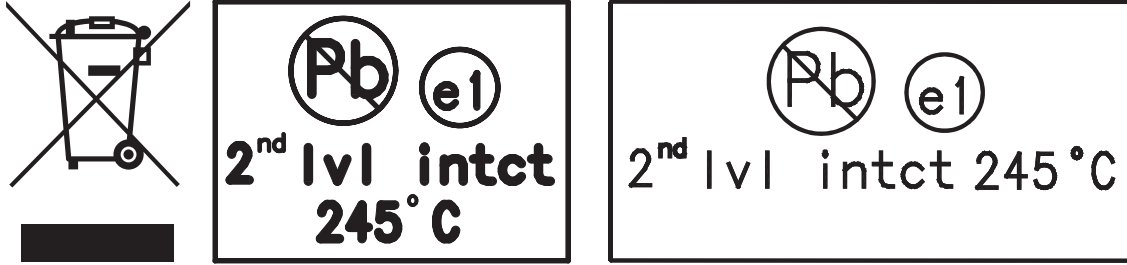
5.3

General Repair Procedures and Techniques

Environmentally Preferred Products (EPP) were developed and assembled using environmentally preferred components and solder assembly techniques to comply with the European Union's Restriction of Hazardous Substances (ROHS 2) Directive 2011/65/EU and Waste Electrical and Electronic Equipment (WEEE) Directive 2012/19/EU. To maintain product compliance and reliability, use only the Motorola Solutions specified parts in this manual.

For the identification of lead (Pb) free assemblies, all EPP products carry the EPP Marking, shown in the following examples, on the Printed Circuit Board (PCB). This marking provides information to those

performing assembly, servicing, and recycling operation on this product, adhering to the JEDEC Standard No. 97. The EPP Marking takes the form of a label or marking on the PCB.



Any rework or repair on Environmentally Preferred Products must be done using the appropriate lead-free solder wire and lead-free solder paste as stated in the following tables:

Table 14: Lead Free Solder Wire Part Number List

Motorola Solutions Part Number	Alloy	Flux Type	Flux Content by Weight	Melting Point	Supplier Part number	Diame-ter	Weight
1088929Y01	95.5Sn/3.8Ag/0.7Cu	RMA Version	2.7–3.2%	217 °C	52171	0.015 in.	1 lb spool

Table 15: Lead Free Solder Paste Part Number List

Motorola Solutions Part Number	Manufacturer Part Number	Viscosity	Type	Composition and Percent Metal	Liquid Tem-perature
1085674C03	NC-SMQ230	900–1000KCPs Brookfield (5 rpm)	Type 3 (-325/+500)	(95.5%Sn-3.8%A g-0.7%Cu) 89.3%	217 °C

Parts Replacement and Substitution

When damaged parts are replaced, identical parts must be used. If the identical replacement part is not locally available, check the parts list for the proper Motorola Solutions part number and order the part.

Rigid Circuit Boards

This family of radios use bonded, multi-layer, printed circuit boards. Since the inner layers are not accessible, some special considerations are required when soldering and unsoldering components. The plated-through holes may interconnect multiple layers of the printed circuit. Therefore, exercise care to avoid pulling the plated circuit out of the hole.

When soldering near a connector:

- Avoid accidentally getting solder in the connector.
- Be careful not to form solder bridges between the connector pins.
- Examine your work closely for shorts due to solder bridges.

For soldering components with Hot-Air or infra red solder systems, check the user guide of your solder system to get information on solder temperature and time for the different housings of the integrated circuits and other components.

Care After Submersion

The radio (device with antenna and battery assembled) is IP67 compliant. It is fully protected from dust, can withstand being submerged in one meter of static water for up to 30 minutes.

If the device has been submerged in water, shake the device to remove any water that is trapped inside the speaker grille and microphone port. Otherwise, the water will decrease the audio quality of the device.

If any accessory or the Universal Connector Dust Cover is covering the Universal Connector and Bottom Connector, check the interface to ensure no water has penetrated the seal. Water left in this interface can degrade the performance of the accessories.

5.4

Pre-baking of Integrated Circuits

Electronic components are generally coated with plastic material which has the nature of not being waterproof. If kept unsealed, the components can absorb humidity.

When soldered to the board (especially with reflow techniques) the sudden change in temperature can cause fissures or cracks that can result in malfunction or damage.

To avoid this problem, these Moisture Sensitive (MS) components must be stored and shipped in a sealed wrapping (dry pack). Processing must take place only with dry components when uninterrupted dry storage can be guaranteed, otherwise the components must be pre-baked.

If a reflow procedure takes place close to MS components, the whole board must be pre-baked.

Table 16: Moisture Sensitivity Levels (MSL)

Part Number	MSL	Description
5166554A01	3	ADDAG
5186988J77	3	JAVELIN
5185956E43	2A	FLASH 16 MB
5185963A85	3	ABACUS AD9874
5166541A01	3	Patriot ROM3
5189233U61	3	PSRAM 4 MB
5199434A01	2	Serial SPI EEPROM

Part Number	Moisture Sensitivity Level (MSL) ²	Description
51009877001 ³	3	RFIC, U200_W
5186988J77	3	Tx Power Control IC, U600_Y
5108683Y44	3	TETRA PA, U702_Y, U703_Y, U704_Y
IC000326A01	3	Power Management IC 4.1, U6010_B

² Out of dry package MSL:

- 1 – No dry pack required
- 2 – One year
- 3 – 168 hours

³ New parts replacement. Use older parts until depletion.

Part Number	Moisture Sensitivity Level (MSL) ²	Description
51012475004	3	Dual Core Processor 2.3, U4020_A
51016003001	3	mDDR RAM, U4050_A
MM000157A01	3	FLASH, U4000_A

5.5

Level 1 and Level 2 Maintenance

This manual covers Level 1 and Level 2 Maintenance.

At Level 1 maintenance, you replace the terminal and/or accessories and send the faulty unified chassis and/or accessories to a higher level of maintenance. At Level 2 maintenance, a faulty kit is replaced.

5.6

Replacement Parts

Damaged parts must be replaced with identical replacement parts.

For complete information on ordering required parts and kits, contact your local customer service representative. The first column of the radio replacement parts list provides you with the call out number of the components as marked in.

5.6.1

Radio Replacement Parts List

The radio replacement parts list identifies all the serviceable components and part/kit numbers of the radio.

The [Table 17: Radio Replacement Parts List on page 71](#) table provides the part/kit numbers of the components shown in the following exploded view.

² Out of dry package MSL:

- 1 – No dry pack required
- 2 – One year
- 3 – 168 hours

Figure 12: Exploded View

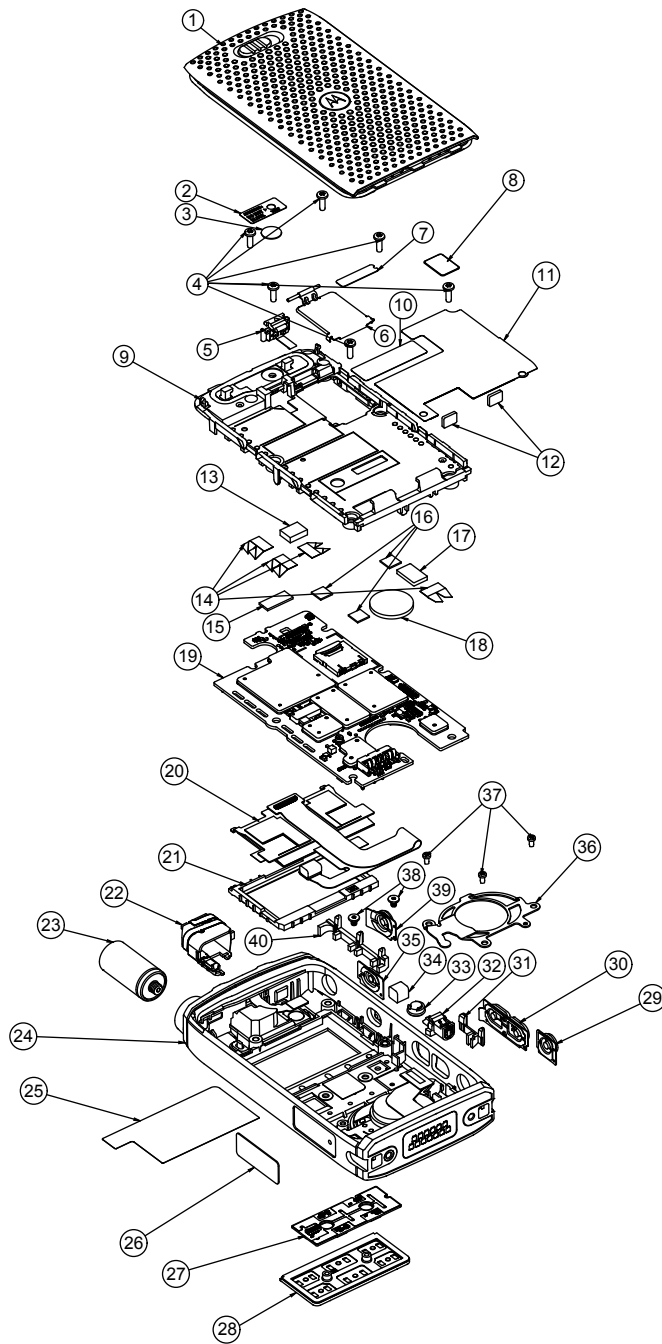


Table 17: Radio Replacement Parts List

No. from Exploded View	Part/Kit Number	Description
1	PMHN4389_	Battery Door Kit
2	LB001049A01	Vent Label
3	3286058L01	Gore Port Membrane
4	FN000147A04	Machined Screw, M2 x 0.4 x 5.3 (mm)

No. from Exploded View	Part/Kit Number	Description
5	HW001058A01	Battery Latch
6	0104077J56	Sim Door Assembly
7	33012021018	Model Label
8	54012164001	Tamper Label
9	PMHN4387_	Rear Housing Kit
10	LB000755A01	Test Point Label
11	LB001045A01	Battery Floor Cosmetic Label
12	HW001102A01	Battery Pad
13	HW001593A01	20-pin Board-to-Board Connector Pad
14	3980667Z06	Grounding Contact Spring
15	HW001186A01	Thermal Pad
16	HW000555A01	Grounding Pad
17	HW001613A01	30-pin Board-to-Board Connector Pad
18	HW001591A01	Extended Back Loud Speaker Pad
19	PMUE5331_Z	PCB
20	PMHN4392_	OLED Display Assembly
21	SL000394A01	OLED Jacket
22	0104077J58	Internal Antenna Module (UHF)
23	AN000169A01	28 mm Stubby Antenna (380–430 MHz)
	AN000262A01	57 mm Stubby Antenna (380–430 MHz)
24	PMHN4393_ ⁴	Front Housing Kit (comes with keypad installed)
25	LB001044A01	Lens Liner
26	HW001615A01	Side Escutcheon
27	PA002004A01	Keypad Assembly PCB
28	KP000141A01	Front Keypad
29	KP000145A01	P2 Programmable Button
30	KP000144A01	Volume Button
31	HW001619A01	Side Keypad Support
32	0104077J55	Vibrator Assembly
33	SL000393A01	Microphone Boot
34	HW001614A01	Grounding Pad (Keypad Metal)
35	KP000142A01	PTT Button
36	BR000330A01	Speaker Retainer
37	0378212A01	Retainer Speaker Self Threading Screw

⁴ Adhesive, OLED Flex is required when servicing PMHN4393_. Use part number HW001773A01.

No. from Exploded View	Part/Kit Number	Description
38	FN000361A01	Keypad Machine Screw
39	KP000143A01	P1 Programmable Button
40	HW001618A01	Side Keypad Support

5.6.2

Accessories Replacement Parts List

Choose from a variety of accessories designed, tested, and certified to optimize the performance of this radio.

Table 18: Antennas

Part Number	Description
AN000169A01	Stubby 28 mm (380–430 MHz)
AN000262A01	Stubby 57 mm (380–430 MHz)

Table 19: Antenna Rings

Part Number	Description
PMLN7636_	Antenna ID Band (Grey-pack of 10 pieces)
PMLN7637_	Antenna ID Band (Yellow-pack of 10 pieces)
PMLN7638_	Antenna ID Band (Red-pack of 10 pieces)
PMLN7639_	Antenna ID Band (Blue-pack of 10 pieces)
PMLN7640_	Antenna ID Band (Purple-pack of 10 pieces)

Table 20: Audio Accessories

Part Number	Description
PMLN6900_	1-Wire Receive-only Earpiece with Translucent Tube, Black
PMLN7181_	Flexible-fit Swivel Earpiece with Boom Microphone
PMLN7203_	Flexible-fit Swivel Earpiece with Boom Microphone (requires NNTN8191)
PMLN7844_	3.5 mm Receive-only Earpiece with Translucent Tube
PMMN4550_	3.5 mm Jack IMPRES Small Remote Speaker Microphone

Table 21: Operations Critical Wireless Accessories

Part Number	Description
NNTN8191_	Operations Critical Wireless Push-To-Talk Pod. Power supply for charging this pod must be ordered separately.
NNTN8294_	Wireless Bluetooth Ear-bud with 11.5 inch Cable. Requires NNTN8191 Operations Critical Wireless Push-To-Talk Pod.
NNTN8295_	Wireless Bluetooth Ear-bud with 45 inch Cable.

Part Number	Description
	Requires NNTN8191 Operations Critical Wireless Push-To-Talk Pod.
NNTN8433_	Completely Discreet Wireless Surveillance Kit. Includes Wireless Neck Loop Y-Adapter and Retention Hook, Completely Discreet Earpiece Kit and Wireless Push-to-Talk Pod.
NTN2572_	Operations Critical Wireless Earpiece with 12 inch Cable. Requires NNTN8191 Operations Critical Wireless Push-To-Talk Pod.
PMLN6463_	Bluetooth Kit with a Receive-only Earpiece and Bluetooth Pod

Table 22: Batteries and Chargers

Part Number	Description
AS000111A01	Tri-Unit Charger Pocket for Battery Only
PMNN4510_	IMPRES 2, 2300 mAh Li-Ion Slim Battery
PMPN4370_	IMPRES 2, 1-Display Battery Only Multi-Unit Charger with 100–240 VAC Power Supply
PMPN4373_	IMPRES 2, 1-Display Battery Only Multi-Unit Charger with 100–240 VAC Power Supply (UK/HK)
PMPN4444_	IMPRES 2, Battery Only Single-Unit Charger with 100–240 VAC Power Supply
PMPN4447_	IMPRES 2, Battery Only Single-Unit Charger with 100–240 VAC Power Supply (UK/HK)
PS000277A03	USB Type-A Wall Charger, UK/HK Plug

Table 23: Carry Accessories

Part Number	Description
PMLN7841_	Carry Holster with Swivel Clip
PMLN7842_	Carry Holster with Peter Jones (ILG) Klick Fast Clip

Table 24: Power Cords

Part Number	Description
3087791G01	Power Cord, US/NA

Table 25: Power Supply

Part Number	Description
PS000242A01	100–240 VAC Power Supply

Table 26: Programming Cable

Part Number	Description
PMKN4024_	ST7500 to Si700 Cable
PMKN4203_	Programming Cable

Table 27: Miscellaneous

Part Number	Description
HN001402A01	Dust Cover
LB000967A01	Battery Packed with Equipment Label
LB001044A01	Lens Liner
PMHN4389_	Battery Cover
PMLN7867_	Cosmetic Label
PS000241A01	Battery Eliminator
TL000100A01	RF Cable Assembly
TL000068A01	RF Adapter

5.7

Radio Disassembly and Reassembly

Mechanical checks and self-tests should be performed on the unit at the basic level of service.



NOTICE: Read each procedure thoroughly before performing the actual task.

5.7.1

Torque Specification Chart

Use the recommended torque value in this chart when fastening different parts of the radio.

Table 28: Torque Specification Chart

Description	Part/Kit	Quantity	Torque
Keypad Screw	FN000361A01	2	2.7±0.1 lb-in
Speaker Retainer Screw	0378212A01	3	1.4±0.1 lb-in
Housing Screw	FN000147A04	6	3.5±0.1 lb-in

5.7.2

Disassembling the Radio

Only Motorola Solutions Service Centers or Authorized Motorola Solutions Service Dealers can disassemble the radio for repair or maintenance.

Prerequisites: Prepare a torque screwdriver with 5 IP and 6 IP TORX Plus® bits, Black Stick, and ST7500 Front Keypad Service Removal Fixture.

Purchase the ST7500 Front Keypad Removal Fixture from the following supplier:

Supplier

ACCESS HITECH AUTOMATION SDN BHD (592024-U)

Website

www.accesshitech.com

Contact Details

Steven Boey

Office: +604-6261700

Mobile: +6012-5808783

Fax: +604-6261708

Email: stevenboey@accesshitech.com / hq@accesshitech.com

MSI Part Number

TL000111A01

Supplier Part Number

MT062/17

5.7.2.1

Removing the Antenna

Procedure:

Unscrew the antenna counterclockwise until it is detached from the radio. The antenna must be removed each time the back housing is removed.

Figure 13: Removing the Antenna



5.7.2.2

Removing the Battery Cover

Procedure:

- 1 Slide the latch to the right to unlock the battery cover.

Figure 14: Unlocking the Battery Cover



- 2 Lift up the battery cover.

Figure 15: Removing the Battery Cover



5.7.2.3

Removing the Battery

Procedure:

Push the battery release button upward to release the battery from the radio.

Figure 16: Removing the Battery



5.7.2.4

Removing the Back Cover

Procedure:

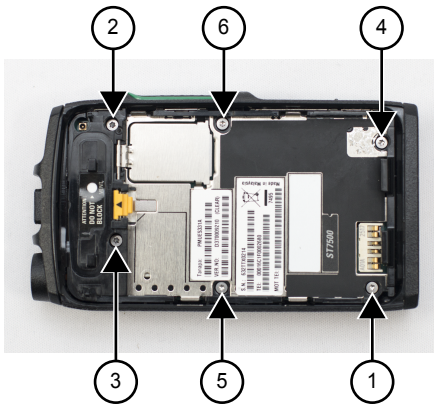
- 1 Remove the tamper label.

Figure 17: Removing the Tamper Label



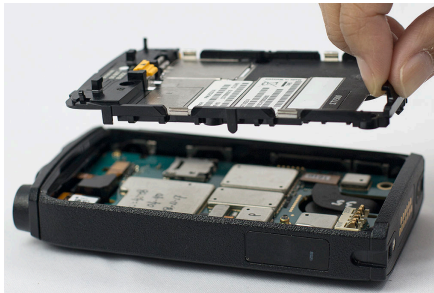
- 2 Follow the sequence in [Figure 18: Removing the Main Screws on page 78](#) to remove the screws. Use a torque screwdriver with 6 IP Torx Plus bit and unscrew in a counterclockwise direction.

Figure 18: Removing the Main Screws



- 3 Lift the back cover upward.

Figure 19: Removing the Back Cover



5.7.2.5

Removing the Main Board

Procedure:

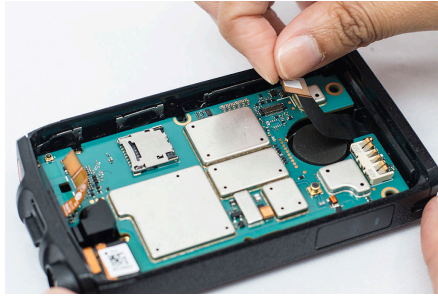
- 1 Detach the top flex connector.

Figure 20: Detaching the Top Flex Connector



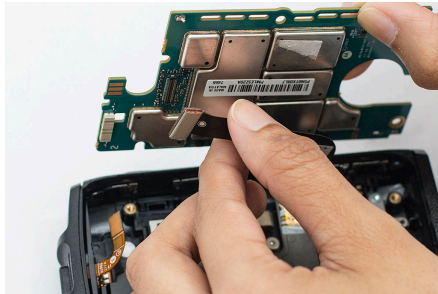
- 2 Detach the bottom connector flex connector.

Figure 21: Detaching the Bottom Connector Flex Connector



- 3 Flip over the main board and detach the OLED flex connector to remove the main board.

Figure 22: Removing the Main Board



5.7.2.6

Removing the Internal Antenna Module Assembly

Procedure:

Detach the internal antenna module assembly.

Figure 23: Detaching the Internal Antenna Module Assembly



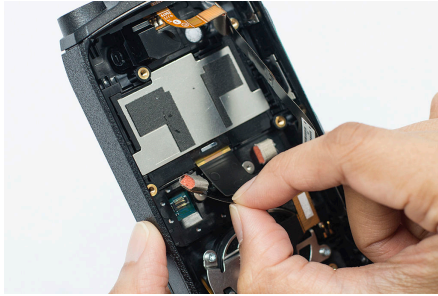
5.7.2.7

Removing the OLED Display Module Assembly

Procedure:

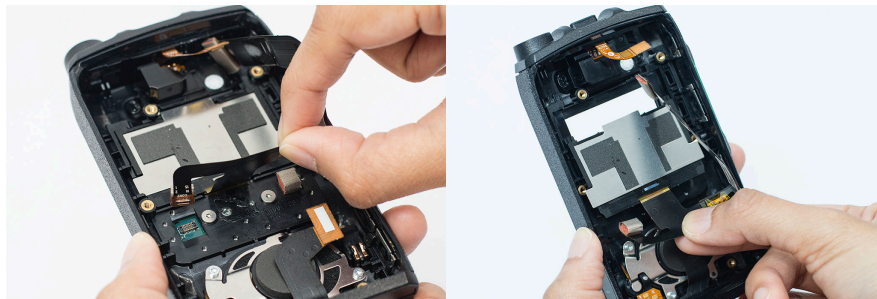
- 1 Detach the front keypad board connector.

Figure 24: Detaching the Front Keypad Board Connector



- 2 Flip upward the OLED flex adhesive gently and pull downward the OLED Display Module to remove the OLED Display Module.

Figure 25: Removing the OLED Display Module Assembly



5.7.2.8

Removing the Vibrator

Procedure:

Use the Black Stick to open and remove the vibrator from the slot.

Figure 26: Removing the Vibrator



5.7.2.9

Removing the Front Keypad

Prerequisites:

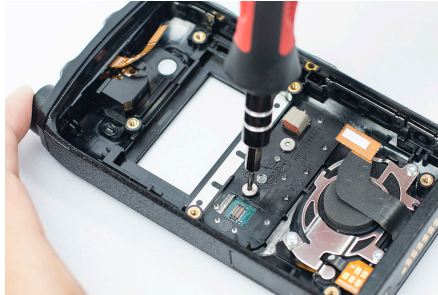
These procedures are applicable only for radios with the Front Keypad (part number: KP000141A01). Skip this section if your radio uses the Front Housing Kit (part number: PMHN4393_).

The ST7500 Front Keypad Service Removal Fixture is required to perform the Front Keypad removal. Purchase the ST7500 Front Keypad Service Removal Fixture from the supplier listed in [Disassembling the Radio on page 75](#).

Procedure:

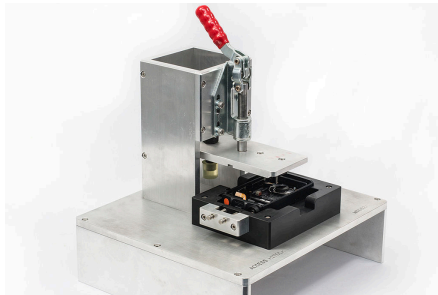
- 1 Use a torque screwdriver with 5 IP Torx Plus bit to unscrew front keypad screw in a counterclockwise direction.

Figure 27: Removing the Front Keypad Screw



- 2 Insert the front housing kit into the ST7500 Front Keypad Service Removal Fixture.

Figure 28: Inserting the Front Housing Kit Into the ST7500 Front Keypad Service Removal Fixture



- 3 Press down the fixture toggle to detach the front keypad.

Figure 29: Detaching the Front Keypad



- 4 Remove the front keypad.

Figure 30: Removing the Front Keypad



- 5 Remove and clean the adhesive for the front keypad.

5.7.3

Reassembling the Radio

Only Motorola Solutions Service Centers or Authorized Motorola Solutions Service Dealers can disassemble the radio for repair or maintenance.

Prerequisites: Prepare a torque screwdriver with 5 IP and 6 IP TORX Plus® bits, Black Stick, and ST7500 Front Keypad Service Assembly Fixture.

Purchase the ST7500 Front Keypad Assembly Fixture from the following supplier:

Supplier

ACCESS HITECH AUTOMATION SDN BHD (592024-U)

Website

www.accesshitech.com

Contact Details

Steven Boey

Office: +604-6261700

Mobile: +6012-5808783

Fax: +604-6261708

Email: stevenboey@accesshitech.com / hq@accesshitech.com

MSI Part Number

TL000112A01

Supplier Part Number

MT003/18

5.7.3.1

Installing the Front Keypad

Prerequisites:

These procedures are applicable only for radios with the Front Keypad (part number: KP000141A01). Skip this section if your radio uses the Front Housing Kit (part number: PMHN4393_).

The ST7500 Front Keypad Service Assembly Fixture is required to perform the Front Keypad removal. Purchase the ST7500 Front Keypad Service Assembly Fixture from the supplier listed in [Reassembling the Radio on page 82](#).

Procedure:

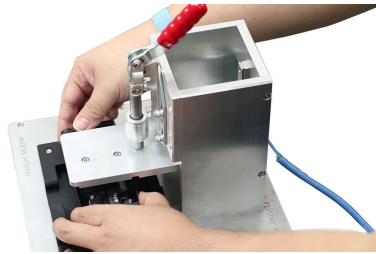
- 1 Insert a new front keypad into the front housing.

Figure 31: Inserting the Front Keypad



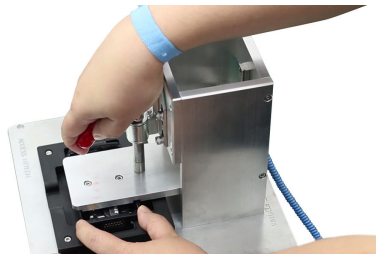
- 2 Insert the front housing kit into the ST7500 Front Keypad Service Insertion Fixture.

Figure 32: Inserting the Front Housing Kit Into the ST7500 Front Keypad Service Assembly Fixture



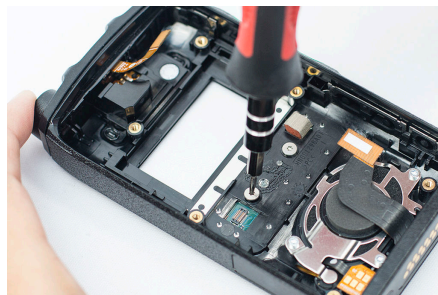
- 3 Press down the fixture toggle to attach the front keypad.

Figure 33: Installing the Front Keypad



- 4 Use a torque screwdriver with 5 IP Torx Plus bit to fasten the front keypad screws in a clockwise direction.

Figure 34: Attaching the Front Keypad Screw



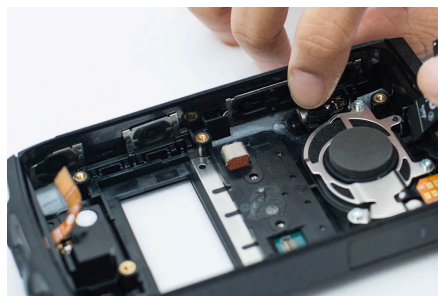
5.7.3.2

Installing the Vibrator

Procedure:

Insert the vibrator into the vibrator slot.

Figure 35: Installing the Vibrator



5.7.3.3

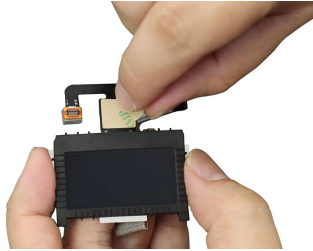
Installing the OLED Display Module Assembly

Prerequisites: Clean the residue on the OLED flex surface and on the housing surface before replacing a new OLED flex adhesive.

Procedure:

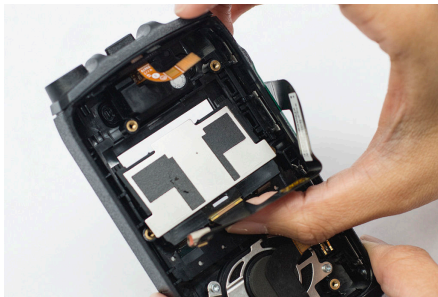
- 1 Replace the OLED flex adhesive with a new adhesive.

Figure 36: Replacing the OLED Flex Adhesive



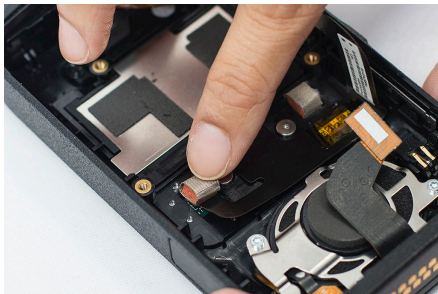
- 2 Slot in and press down the OLED Display Jacket.

Figure 37: Inserting the OLED Display Jacket



- 3 Attach the front keypad board connector.

Figure 38: Attaching the Front Keypad Board Connector



5.7.3.4

Installing the Internal Antenna Module Assembly

Procedure:

Insert the internal antenna module assembly and press it down firmly until it snaps in place.

Figure 39: Installing the Internal Antenna Module Assembly



5.7.3.5

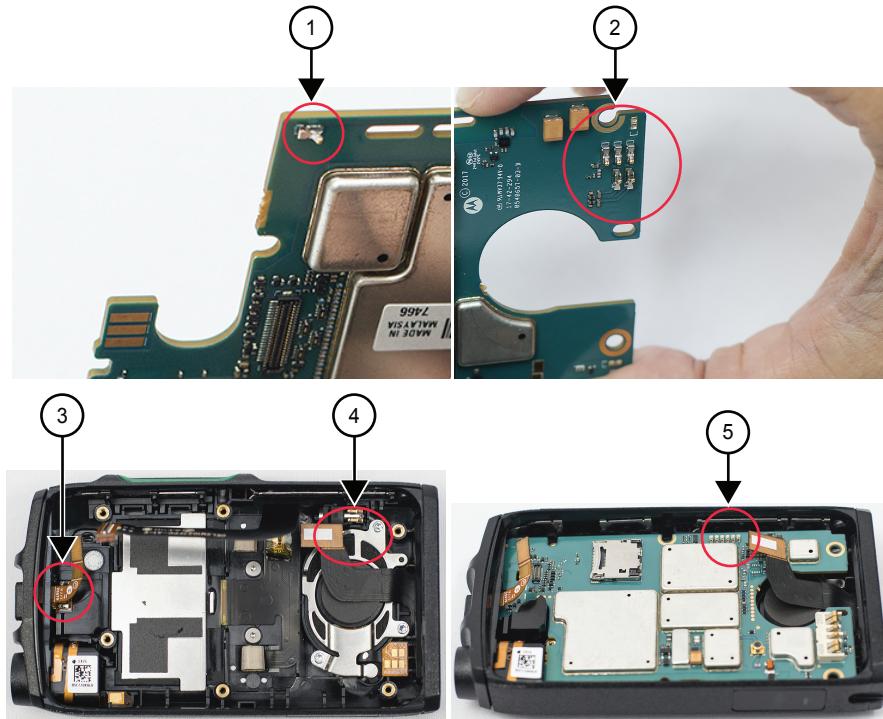
Installing the Main Board

Prerequisites:



CAUTION: Check and ensure there is no damage to the vibrator spring, internal antenna spring, speaker/bottom mic spring, earpiece flex spring, PTT and side buttons spring. If there is damage, replace the parts.

Figure 40: Checking the Vibrator Spring, Internal Antenna Spring, Speaker/Bottom Mic Spring, Earpiece Flex Spring, PTT and Side Buttons Spring



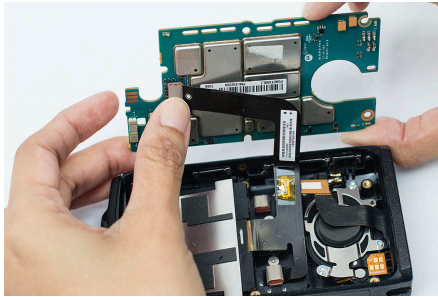
No.	Description
1	Internal antenna spring
2	Speaker/bottom mic spring
3	Earpiece spring

No.	Description
4	Vibrator spring
5	PTT and side buttons spring

Procedure:

- 1 Insert OLED Flex connector to the main board.

Figure 41: Inserting the OLED Flex Connector

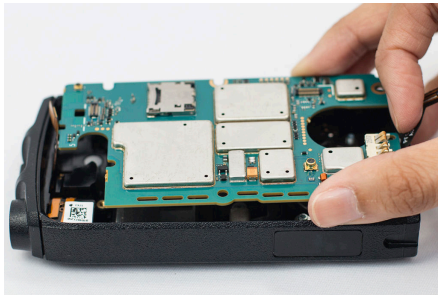


- 2 Insert the main board into the front housing.



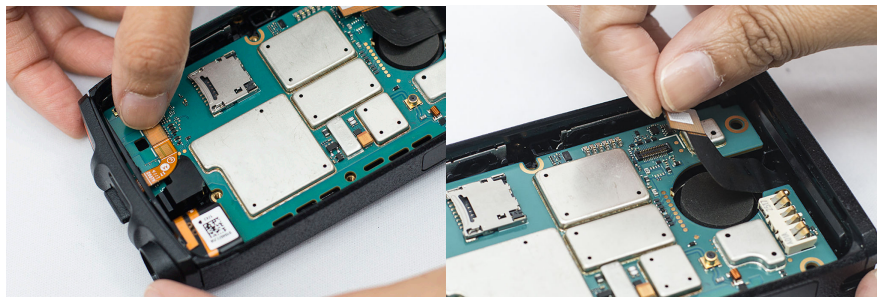
NOTICE: Ensure the top flex and bottom connector flex are on top of the main board.

Figure 42: Insert the Main Board



- 3 Insert the top flex and the bottom connector flex connector to the main board.

Figure 43: Inserting the Top Flex and the Bottom Connector Flex Connector



5.7.3.6

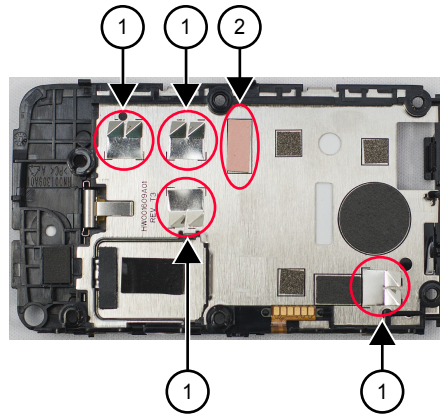
Installing the Back Cover

Prerequisites:



CAUTION: Check and ensure there is no damage to the thermal pad and butterfly clips. If there is damage, replace the parts.

Figure 44: Checking the Thermal Pad and Butterfly Clips



No.	Description
1	Butterfly clip
2	Thermal pad

Procedure:

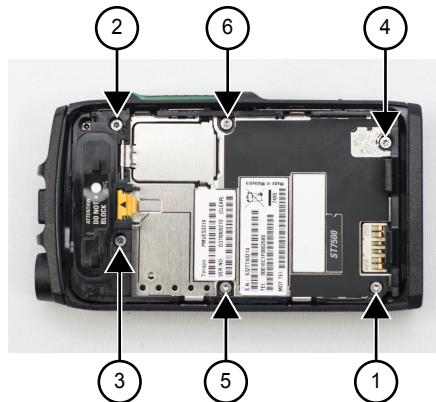
- 1 Slide in the back housing into the front housing slot from the top and then press down on the bottom area of the back housing.

Figure 45: Installing the Back Housing



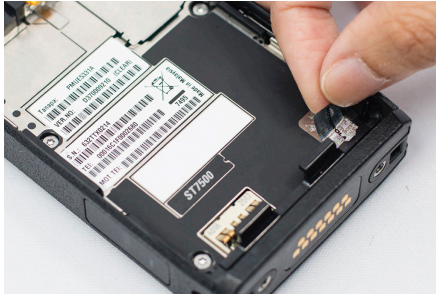
- 2 Follow the sequence in [Figure 46: Attaching the Main Screws on page 87](#) to fasten the screws.

Figure 46: Attaching the Main Screws



- 3 Place a new tamper label into its designated slot.

Figure 47: Placing a New Tamper Label



5.7.3.7

Inserting the Battery

Procedure:

- 1 Insert the battery into the battery compartment until the contacts align and the battery hooks in place.

Figure 48: Inserting the Battery



- 2 Press the battery downward until it clicks.

5.7.3.8

Attaching the Battery Cover

Prerequisites: Ensure the battery cover latch is at the unlock state before attaching the battery cover.

Figure 49: Unlock State



Check the cleanliness of the battery cover seal . Refer to [Cleaning Procedures on page 65](#) if you need to clean the battery cover seal.

Procedure:

- 1 Insert the bottom tabs of the battery cover into the slot and press down the top part, followed by the middle part of the battery cover.

Figure 50: Attaching the Battery Cover



- 2 Slide the latch to the left to lock the battery cover.

Figure 51: Locking the Battery Cover



5.7.3.9

Installing the Antenna

Procedure:

- 1 Insert the screw-in base of the antenna into the antenna terminal at the top of the radio.
- 2 Turn clockwise until tight.

Figure 52: Installing the Antenna



5.8

Radio Leak Test

This section discusses radio immersibility concerns, tests, and disassembly and reassembly of the radios.

5.8.1

Vacuum Leak Test

The vacuum leak test is performed to ensure that the radio is IPx7 compliant. Perform this test after servicing the radio and before returning the radio to the customer.

The following parts are required to perform a vacuum leak test:

Vacuum Leak Tester

The Vacuum Leak Tester comes with a gauge and a vacuum hose. Purchase the Vacuum Leak Tester from the following supplier:

Supplier:

Horizon Land Malaysia Sdn. Bhd.

Website:

www.horizon-land.com

Contact:

+604-6463636

Model Description:

Horizon Land Delta Version TC-2000

Other items required for the test include:

Table 29: Other Vacuum Leak Test Parts

Part Number	Description
HW001772A01	Leak Test Spacer
LB001049A01	Ventilation Label
3286058L01	GORE® Membrane

Leak Test Fixture

A Leak Test Fixture is also required for the vacuum leak test. Purchase the Leak Test Fixture from the following supplier:

Supplier:

Access Hitech Automation Sdn. Bhd.

Website:

www.accesshitech.com

Contact:

Steven Boey

Mobile: +6012-5808783

Email: stevenboey@accesshitech.com or hq@accesshitech.com

Office: +604-6261700

Fax: +604-6261708

Motorola Solutions Part Number:
TL000116A01

Supplier Part Number:
MT057#17

5.8.1.1

Performing Vacuum Leak Test

This test is performed to determine if the radio is properly sealed.

Prerequisites:

- Remove the antenna, side escutcheon, and battery cover from the radio.
- Remove the ventilation label and GORE membrane.
- Cover the vent hole with the leak test spacer, ensuring no air leak through the spacer seal.
- Reassemble the battery cover.

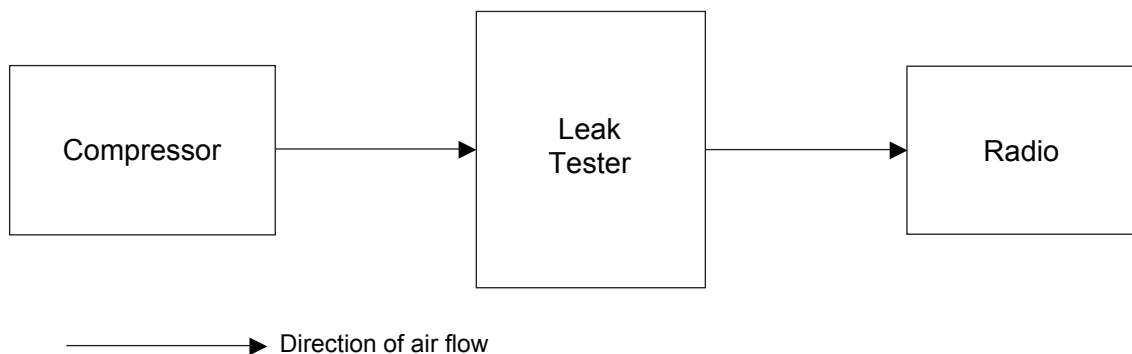
Procedure:

- 1 Attach the vacuum hose to the vacuum leak tester.
- 2 To verify that the leak tester is functioning, check the leak tester and the hose for leaks by blocking off the open end of the hose and operating the leak tester a few times.
- 3 Ensure that the difference between the maximum and minimum fluctuation readings of the gauge pointer remains within 0.05 inHg.



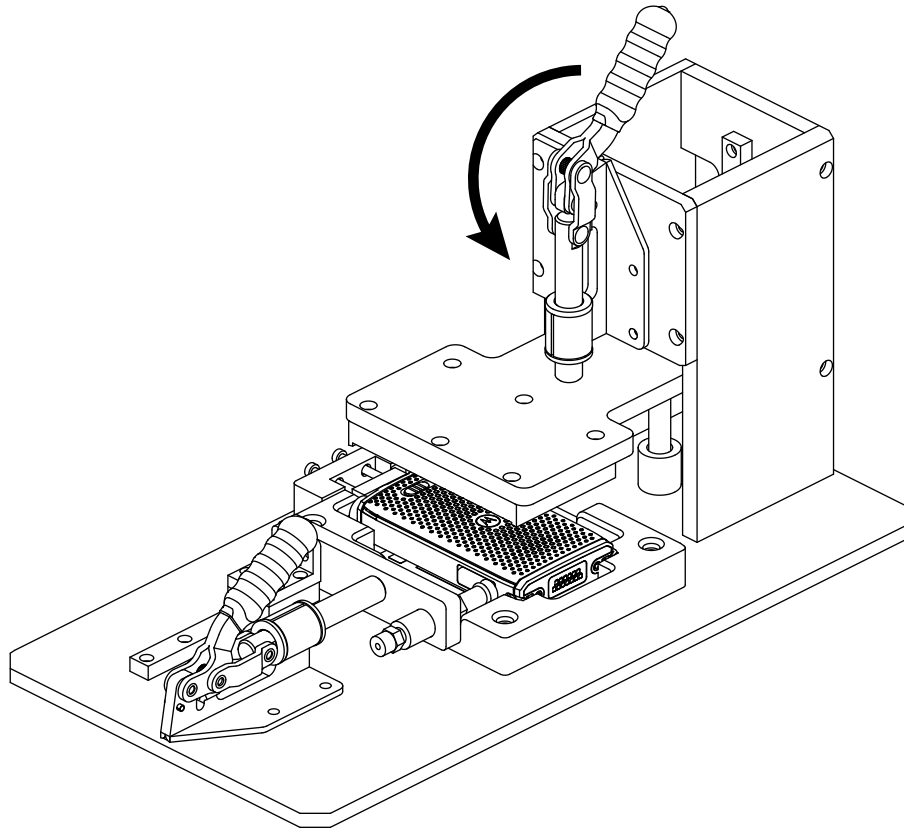
NOTICE: The actual reading of the gauge pointer at this point is not important.

Figure 53: Vacuum Leak Test Setup



- 4 Block the open end of the hose and adjust the leak tester so that the gauge shows 3.30 inHg.
- 5 Attach the open end of the hose to the leak text fixture.
- 6 Ensure that the suction cup on the radio leak test fixture is in good condition (no damage or dust).
- 7 Place the radio in the leak test fixture with the battery cover facing upwards.
- 8 Push down the handle of the fixture plate.

Figure 54: Radio in Leak Test Fixture



- 9 Start the vacuum leak test and observe the gauge for 20 seconds while the vacuum leak tester is running.



NOTICE: Maximum allowable pressure drop after 20 seconds is 0.10 inHg.

- 10 Perform one of the following actions:

If...	Then...
If the radio passes the vacuum leak test,	perform the following actions: a Remove the leak test spacer. b Assemble a new GORE membrane, ventilation label, and side escutcheon.
If the radio fails the vacuum leak test,	continue with Performing Leak Area Troubleshooting on page 92 with the leak test spacer still attached.

5.8.2

Performing Leak Area Troubleshooting

If the radio fails the vacuum leak test, the leak area must be identified and serviced or replaced.

Prerequisites: Label the original components or kits with a marker or sticker to avoid confusion.

Procedure:

Preparing a set of golden sample for troubleshooting reference.

- 1 On the front housing kit, remove the side escutcheon.
- 2 On the rear housing kit, remove the ventilation label and the GORE membrane.
- 3 Place the leak test spacer on the GORE membrane recess.
- 4 Prepare a golden sample for the front housing kit.



IMPORTANT: Golden sample kit must pass the vacuum leak test.

- 5 Prepare a golden sample for the battery cover kit.



IMPORTANT: Golden sample kit must pass the vacuum leak test.

Verifying the golden sample with assemble to the existing radio.

- 6 Perform the vacuum leak test with radio assemble on golden sample battery cover with existing front housing kit.
- 7 Perform one of the following actions:

If...	Then...
Pass	Front housing kit is good for reuse.
Fail	Proceed with Performing Front Housing Kit Troubleshooting on page 93 .

- 8 Perform vacuum leak test with radio assemble on golden sample front housing kit with existing battery cover kit.
- 9 Perform one of the following actions:

If...	Then...
Pass	Battery cover kit is good for reuse.
Fail	Proceed with Performing Battery Cover Kit Troubleshooting on page 94 .

Postrequisites: After completing the troubleshooting steps, perform actions:

- On the rear housing kit, remove the leak test spacer and replace with a new GORE membrane and ventilation label.
- On the front housing kit, replace the side escutcheon.

5.8.2.1

Performing Front Housing Kit Troubleshooting

Procedure:

- 1 Inspect the sealing path of the front housing kit.
- 2 Use IPA to clean the sealing path of the front housing kit from contamination.
- 3 If there are damages or scratches, replace the front housing kit.
- 4 Perform the vacuum leak test with the golden sample battery cover kit. See [Performing Vacuum Leak Test on page 91](#).
- 5 Perform one of the following actions:

If...	Then...
Pass	Front housing kit is good for reuse. Proceed to Performing Miscellaneous Troubleshooting on page 94 .
Fail	Replace the front housing kit.

5.8.2.2

Performing Battery Cover Kit Troubleshooting

Procedure:

- 1 Inspect the sealing path of the battery cover kit.
- 2 Use IPA to clean the sealing path of the battery cover kit from contamination.
- 3 If there are damages or tearing, replace the battery cover kit.
- 4 Perform the vacuum leak test with the golden sample front housing kit. See [Performing Vacuum Leak Test on page 91](#).
- 5 Perform one of the following actions:

If...	Then...
If Pass	Battery cover kit is good for reuse. Proceed to Performing Miscellaneous Troubleshooting on page 94 .
If Fail	Replace the battery cover kit.

5.8.2.3

Performing Miscellaneous Troubleshooting

Procedure:

- 1 Reassemble the whole radio.
Leakage may be due to improper assembly.
- 2 Repeat [Performing Leak Area Troubleshooting on page 92](#) with a second golden sample set.

Appendix A

Service Information

Service for the radio is based on the substitution method; whereby a working part replaces a faulty one, providing quicker service to the customer. For example, if the controller board is faulty, it is replaced.

If the radio requires complete testing or servicing than that is available at field level, it is sent to the European Radio Service Center where it is serviced and returned to the Regional Service Center.

If the radio requires complete testing or servicing than that is available at field level, it is sent to the Motorola Solutions Service Center where it is serviced, and returned to the Regional Service Center.

Level 1 and Level 2 Maintenance

This manual covers Level 1 and Level 2 Maintenance.

Level 1 Maintenance

You replace the radio and/or accessories and send the faulty radio and/or accessories to a higher level of maintenance.

Level 2 Maintenance

A radio board is replaced.

The radios are programmed at the factory. They cannot be tuned at the field service level.

Level 3 Maintenance

Level 3 maintenance can only be done at the Motorola Solutions Service Center/Depot. To find out more about Motorola Solutions Service Center, visit <https://www.motorolasolutions.com/>.

Replacement Parts

Damaged parts are replaced with identical replacement parts. For complete information on ordering required parts and kits, contact your local customer service representative.

A.1

Service Information

EMEA Technical Support Operations (TSO)

The EMEA Technical Support Operations (TSO) provides a remote Technical Support Service to help customers resolve technical issues and quickly restore networks and systems. This team of highly skilled professionals is available to customers with current service agreements in place that include the Technical Support Service. The TSO technical experts may be accessed through the Service Desk either electronically or using the listed telephone numbers. If you are unsure whether your current service agreement entitles you to benefit from this service, or if you would like more information about the Technical Support Service, contact your local customer support or account manager for further information.

Contact Details

Technical Requests: techsupport.emea@motorolasolutions.com

Repair Support: repair.emea@motorolasolutions.com

Contact Us: https://www.motorolasolutions.com/en_xu/support.html

Parts Identification and Ordering

If you need help in identifying non-referenced spare parts, direct a request to the Customer Care Organization of a local area Motorola Solutions representative. Orders for replacement parts, kits, and assemblies should be placed directly at the local distribution organization of Motorola Solutions or through the Extranet site Motorola Online at <https://emeaonline.motorolasolutions.com>.

However, you cannot order export-controlled products or spare parts such as TEA-related boards through Motorola Online. Send an order form with actual end-customer details by e-mail to your customer care team.

Your Input

Send questions and comments regarding user documentation to documentation@motorolasolutions.com.

A.2

Service Information – APAC

This topic contains contact details to service centers in Asia and Pacific region.

Technical Support

Technical support is available to assist the dealer/distributor in resolving any malfunction which may be encountered. Initial contact should be by telephone wherever possible. When contacting Motorola Solutions Technical Support, be prepared to provide the product model number and the serial number.

Further Assistance from Motorola Solutions

You can also contact the Customer Help Desk through the website: http://www.motorolasolutions.com/en_xp/products. If a unit requires further complete testing, knowledge and/or details of component level troubleshooting or service than is customarily performed at the basic level, send the radio to a Motorola Solutions Service Center as listed in the following table:

Table 30: Service Information – Telephone Numbers and Addresses of the Asia and Pacific Motorola Solutions Centers

Country	Telephone Number	Address
Singapore	+65-6352-6383	Motorola Solutions Singapore Pte. Ltd, c/o Azure Engineering, 49 Jalan Pemimpin, #03-11 APS Industrial Building, Singapore 577203 Contact: Mareen Phua E-mail: mareen@azure.com.sg Enquiry: Goe Engkiet E-mail: eng-kiet.goe@motorolasolutions.com
Malaysia	+603-7809-0000	Motorola Solutions Sdn. Bhd. Level 14, Persoft Tower, No. 68, Pesiaran Tropicana, 47410 Petaling Jaya, Selangor Darul Ehsan, Malaysia Contact: Koh Tiong Eng

Country	Telephone Number	Address
		E-mail: A21001@motorolasolutions.com
Indonesia	+62-21-3043-5239	PT. Motorola Solutions Indonesia 30th Floor, Gedung BRI II, Suite 3001, Jl. Jend. Sudirman Kav. 44-46, Jakarta 10210, Indonesia Contact: Eko Haryanto E-mail: Eko.Haryanto@motorolasolutions.com
Thailand	Tel: +662-653-220 Fax: +668-254-5922	Motorola Solutions (Thailand) Ltd. 142 Two Pacific Place Suite 2201, 3220 Sukhumvit Road, Klongtoey, Bangkok 10110 Contact: Nitas Vatanasupapon E-mail: Nitas@motorolasolutions.com
India	+91-9844218850	Motorola Solutions India Pvt. Ltd. C/o Communication Test Design India Private Limited, #4, 5 Maruthi Industrial Estate, Rajapalya, Hoodi Village, Bangalore - 560048, India Contact: K. Umamaheswari E-mail: umamaheshwari@motorolasolutions.com
China	+86-10-8473-5128	Motorola Solutions (China) Co. Ltd. No. 1 Wang Jing East Road, Chao Yang District, Beijing, 100102, P.R. China Contact: Sophy Wang E-mail: C18170@motorolasolutions.com
Hong Kong	852-2966-4823	Motorola Solutions Asia Pacific Ltd. Unit 1807-1812, 18/F, Two Harbourfront, 22 Tak Fung Street, Hung Hom, Kowloon, Hong Kong Contact: Judy Leung E-mail: Judy.Leung@motorolasolutions.com
Philippines	Tel: +632 858-7500 Fax: +632 841-0681	Motorola Communications Philippines, Inc. Unit 2102, One Global Place Building, 5th Ave., Bonifacio Global City, Taguig, Philippines 1634. Contact: Arthur Nieves E-mail: Arthur.Nieves@motorolasolutions.com
Korea	+822-3497-3649	Motorola Solutions Korea, Inc.

Country	Telephone Number	Address
		9th Floor, Hibrand Building, 215, Yangjae-Dong, Seocho-Gu, Seoul, 137-924, Korea. Contact: KS Kwak E-mail: r45321@motorolasolutions.com
Taiwan	+886-2-8729 8000	Motorola Solutions Taiwan, Ltd. 8F, No. 9, Songgao Rd., Taipei 110, Taiwan (R.O.C.) Contact: Michael Chou E-mail: ftpe239@motorolasolutions.com
Australia	+613-9847-7725	Motorola Solutions Australia Pty. Ltd. 10 Wesley Court, Tally Ho Business Park, East Burwood Victoria 3151, Australia. E-mail: servicecentre.au@motorolasolutions.com

Piece Parts

Some replacement parts, spare parts, and/or product information can be ordered directly. If a complete Motorola Solutions part number is assigned to the part, it is available from Motorola Solutions Service Organization. If no part number is assigned, the part is not normally available from Motorola Solutions. If a list of parts is not included, that means that no user-serviceable parts are available for that kit or assembly.

Customer Programming Software has no capability to tune the radio. Tuning the radio can only be performed at the factory or at the appropriate Motorola Solutions Repair Center. Component replacement can affect the radio tuning and must only be performed by the appropriate Motorola Solutions Repair Center.

All orders for parts/information should include the complete Motorola Solutions identification number. All part orders should be directed to your local Motorola Solutions Service Organization. See your latest price pages.

Parts Identification and Ordering

Request for help in identification of non-referenced spare parts should be directed to the Customer Care Organization of Motorola Solutions local area representation. Orders for replacement parts, kits, and assemblies should be placed directly on a Motorola Solutions local distribution organization or from the Motorola Solutions Online (Extranet).

A.3

Recommended Programming Equipment

Table 31: Recommended Programming Equipment

Name	Part Number
Customer CPS User Guide	6802974C10

Name	Part Number
Programming cable	PMKN4203_

A.4

Service Replacement Kit Matrix

The following kits consist of complete radio but exclude any accessories, battery, and antenna.

Service Replacement Kit Matrix

Table 32: Service Replacement Kit Matrix (for APAC)

Service Tanapa	Description
PMUE5331_	ST7500 380–430 MHz CLR
PMUE5389_	ST7500 380–430 MHz TEA3
PMUE5390_	ST7500 380–430 MHz TEA3 AES128

Table 33: Service Replacement Kit Matrix (for EMEA)

Service Tanapa	Description
PMUE5331_S	ST7500 380-430MHz CLR
PMUE5434_S	ST7500 380-430MHz TEA1
GMUE0004_S	ST7500 380-430MHz TEA2 (for Alsdorf DC)
PMUE5389_S	ST7500 380-430MHz TEA3
PMUE5435_S	ST7500 380-430MHz CLR SIM
GMUE0005_S	ST7500 380-430MHz TEA2 BSI (for Alsdorf DC)
PMUE5436_S	ST7500 380-430MHz CLR AES128
PMUE5437_S	ST7500 380-430MHz TEA1 AES128
GMUE0006_S	ST7500 380-430MHz TEA2 AES128 (for Alsdorf DC)
PMUE5390_S	ST7500 380-430MHz TEA3 AES128
PMUE5438_S	ST7500 380-430MHz CLR AES256
PMUE5439_S	ST7500 380-430MHz TEA1 AES256
GMUE0007_S	ST7500 380-430MHz TEA2 AES256 (for Alsdorf DC)
PMUE5440_S	ST7500 380-430MHz TEA3 AES256

Service Replacement Kit Matrix for Mainboard

Table 34: Service Replacement Kit Matrix for Mainboard (for APAC)

Service Main Board Kit	Description
PMUE5331_Z	ST7500 380–430 MHz CLR Mainboard PEN

Table 35: Service Replacement Kit Matrix for Mainboard (for EMEA)

Service Main Board Kit	Description
PMUE5331_Z ^{5,6}	ST7500 380-430MHz CLR Mainboard PEN
PMUE5435_Z ⁵	ST7500 380-430MHz CLR SIM Mainboard PEN
PMUE5331_W	ST7500 380-430MHz CLR Mainboard
PMUE5434_W	ST7500 380-430MHz TEA1 Mainboard
GMUE0004_W	ST7500 380-430MHz TEA2 Mainboard (for Alsdorf DC)
PMUE5389_W	ST7500 380-430MHz TEA3 Mainboard
PMUE5435_W	ST7500 380-430MHz CLR SIM Mainboard
GMUE0005_W	ST7500 380-430MHz TEA2 BSI Mainboard (for Alsdorf DC)
PMUE5436_W	ST7500 380-430MHz CLR AES128 Mainboard
PMUE5437_W	ST7500 380-430MHz TEA1 AES128 Mainboard
GMUE0006_W	ST7500 380-430MHz TEA2 AES128 Mainboard (for Alsdorf DC)
PMUE5390_W	ST7500 380-430MHz TEA3 AES128 Mainboard
PMUE5438_W	ST7500 380-430MHz CLR AES256 Mainboard
PMUE5439_W	ST7500 380-430MHz TEA1 AES256 Mainboard
GMUE0007_W	ST7500 380-430MHz TEA2 AES256 Mainboard (for Alsdorf DC)
PMUE5440_W	ST7500 380-430MHz TEA3 AES256 Mainboard

⁵ Internal Motorola Solutions ordering only.

⁶ PMUE5331_Z can also be used to service PMUE5436_ or PMUE5438_ by flashing in the correct software.

Appendix B

Service Aids

This section lists the test equipments required to service the radio.

Table 36: Service Aids List

Name	Part Number
Anritsu Digital Signal Generator ¹³	MG3660A
Battery Eliminator ⁷	PS000230A01 ⁸ PS000241A01 ⁹
Programming Cable	PMKN4203A
Front Keypad Assembly Fixture ¹⁰	TL000112A01
Front Keypad Removal Fixture ¹¹	TL000111A01
Leak Test Fixture ¹²	TL000116A01
IFR System ¹³	2968/3901/3902/3920
Multi-channel GPS simulator ¹³	Spirent STR4500
Power Meter ¹³	HP437B
Power Supply ¹³	HP6032A
R&S Audio Analyzer ¹³	UPL16
RF Adapter	TL000068A01
RF Antenna Adapter	PMLN5891_
RF Cable	TL000100A01
RF Probe ¹³	HP85024A
Spectrum Analyzer ¹³	HP8560E
Universal Multimeter ¹³	HP3457A

⁷  **DANGER:** Do not use these service tools in a potentially explosive environment.

⁸ Version 1 for MR16 and above.

⁹ Version 2 for MR16.5 and above. Replaces PS000230A01 when it is obsolete.

¹⁰ The supplier for this equipment is listed in [Reassembling the Radio on page 82](#).

¹¹ The supplier for this equipment is listed in [Disassembling the Radio on page 75](#).

¹² The supplier for this equipment is listed in [Vacuum Leak Test on page 90](#).

¹³ This test equipment is not provided by Motorola Solutions. Customers are required to obtain the equipment from external vendors.

Glossary

Advanced RISC Machine (ARM) A processor architecture based on a 32-bit reduced instruction set (RISC) computer.

Air Interface Encryption (AIE) Provides confidentiality on the radio link over the air.

Algebraic Code Excited Linear Prediction A speech (or other audio signals) encoding algorithm where a limited set of pulses is distributed as excitation to linear prediction filter.

| **Abbreviation:** ACELP

Analog Refers to a continuously variable signal or a circuit or device designed to handle such signals.

Analog-to-Digital Converter A device that converts analog signals into digital data. Also known as codec.

| **Abbreviation:** ADC

Automatic Gain Control (AGC) A process or means by which gain is automatically adjusted in a specified manner as a function of a specified parameter, such as received signal level.

BALUN Balanced-unbalanced converter.

Band Frequencies allowed for a specific purpose.

Bluetooth (BT) A wireless protocol utilizing short-range communications over short distances.

CMOS Complementary Metal-Oxide Semiconductor

Co-uP Co-Processor

Customer Programming Software (CPS) Software with a graphical user interface containing the feature set of a radio.

Default A pre-defined set of parameters.

Differential Quadrature Phase Shift Keying (DQPSK) A sub-class of the QPSK methods of transmitting data. Rather than using the absolute value of phase (as in QPSK), only the difference between the current value of phase and the previous value of phase are used. By using phase differences, the implementation is simpler (since an absolute reference source is not required).

Digital Refers to data that is stored or transmitted as a sequence of discrete symbols from a finite set; most commonly this means binary data represented using electronic or electromagnetic signals.

Digital-to-Analog Converter A device that converts a digital value to a corresponding dc voltage value.

| **Abbreviation:** DAC

Digital Signal Processor (DSP) A special-purpose microprocessor that can perform math calculations very rapidly.

Electrically Erasable Programmable Read-Only Memory (EEPROM) Integrated circuit used to store data, which can be erased by electrical methods.

Federal Communications Commission (FCC) Regulates interstate and international communications by radio, television, wire, satellite and cable in all 50 states, the District of Columbia, and U.S. territories. It was established by the Communications Act of 1934 and operates as an independent U.S. government agency overseen by Congress. The commission is committed to being a responsive, efficient and effective agency capable of facing the technological and economic opportunities of the new millennium.

Frequency Number of times a complete electromagnetic-wave cycle occurs in a fixed unit of time (usually one second).

General-Purpose Input/Output (GPIO)
Pins whose function is programmable.

Global Core Accessory Interface
Motorola Solutions proprietary accessory port for use with Motorola Solutions approved cables. USB and RS232 styles supported.

| **Abbreviation:** GCAI

Global Navigation Satellite System A standard generic term for satellites orbiting the Earth to determine the geographical location. GNSS uses satellites from the GPS, GLONASS, Galileo, and BeiDou systems.

| **Abbreviation:** GNSS

Global Positioning System (GPS) System of 24 satellites that identify earth locations, launched by the U.S. Department of Defense. By triangulating signals from three of the satellites, a GPS receiving unit can pinpoint its current location anywhere on earth to within a few meters.

Input Output For computers, bi-directional input/output (I/O) ports couple the micro-controller to external devices. This interface can operate in parallel or serial form and is usually digital (0 to +5Vdc) logic. Parallel interfaces allow I/O data transfer of eight bits at a time to parallel ports on the micro-controller. The technology is typically used to transfer data between the micro-controller and the external logic it controls. Screen reader support enabled.

| **Abbreviation:** I/O

Integrated Circuit (IC) An assembly of interconnected components on a small semiconductor chip, usually made of silicon. One chip can contain millions of microscopic components and perform many functions.

integrated Terminal Management
integrated Terminal Management in Motorola Solutions Dimetra radio systems.

| **Abbreviation:** iTM

Intermediate Frequency A range of frequent audio and radio frequencies.

| **Abbreviation:** IF

Joint Test Action Group Same as IEEE std 1149.1a, which defines signals and behavior for serial testing.

| **Abbreviation:** JTAG

kilohertz (kHz) One thousand cycles per second. Used especially as a radio-frequency unit.

LDMOS Laterally Diffused Metal Oxide Semiconductor

Light Emitting Diode (LED) An electronic device that lights up when electricity is passed through it.

Local Oscillator A tunable oscillator used in a radio or TV receiver to select a particular channel for reception.

| **Abbreviation:** LO

Low Noise Amplifier (LNA) The main amplifying unit in the receiver.

Low-Pass Filter A filter that passes only frequency components lower than a certain frequency.

| **Abbreviation:** LPF

Man Machine Interface (MMI) An interface that enables information to be passed between a human user and hardware or software components of a computer system.

Megahertz (MHz) One million cycles per second. Used especially as a radio-frequency unit.

Phase-locked Loop (PLL) A circuit in which an oscillator is kept in phase with a reference, usually after passing through a frequency divider.

Printed Circuit Board (PC Board) A circuit manufactured so that many or all of the components are attached to a non-conductive

circuit board with copper strips on one or both sides to replace wires.

Programming Cable A cable that allows the computer to communicate directly with certain radios using USB.

Radio Frequency (RF) The portion of the electromagnetic spectrum between audio sound and infrared light (approximately 10 kHz to 10 GHz).

Radio Frequency Power Amplifier
Amplifier having one or more active devices to amplify radio signals.

| **Abbreviation:** RFPA

Receiver Electronic device that amplifies RF signals. A receiver separates the audio signal from the RF carrier, amplifies it, and converts it back to the original sound waves.

Request-To-Send In General Packet Radio Service (GPRS), a handshaking signal used with some communication links to indicate that data is ready for transmission.

| **Abbreviation:** RTS

RESET Reset line; an input to the microcontroller that restarts execution.

Signal An electrically transmitted electromagnetic wave.

SLIM Slim Connector

Spectrum Frequency range within which radiation has specific characteristics.

Static Random Access Memory Static-RAM chip used for volatile, program/data memory.

| **Abbreviation:** SRAM

Subscriber Identity Module A smart card that holds subscriber information (including the authentication key) and is inserted into the radio to grant its personality.

| **Abbreviation:** SIM

System-On-a-Chip An integrated circuit with all the required circuitry and components of an electronic system on a single chip.

| **Abbreviation:** SoC

Time Division Multiple Access (TDMA)

A channel access method to allow several users to share the same frequency channel by dividing the signal into different time slots

Transceiver Transmitter-receiver: A device that both transmits and receives analog or digital signals.

| **Abbreviation:** XCVR

Transmitter Electronic equipment that generates and amplifies an RF carrier signal, modulates the signal, and then radiates it into space.

Universal Serial Bus (USB) An external bus standard that supports data transfer rates of 12 Mbps.

Voltage Controlled Oscillator (VCO)
An oscillator whereby the frequency of oscillation can be varied by changing a control voltage.