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IM41-1085-00
SOFTWARE INSTRUCTION MANUAL
ND4410 X-RAY ANALYSIS OVERLAY PROGRAM

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INTRODUCTION

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1-2. The ND4410 X-Ray Analysis Overlay Program (41-1085) is written for use with the ND4410 Single Parameter Data Acquisition and Display System. The program is an overlay for the ND4410 Basic Physics Analyzer Program (41-1060) used in conjunction with the ND4410 Data Manipulation Overlay Program (41-1061). It enables performance of two general X-Ray functions: (1) setting and manipulation of the data contained in up to 32 user-specified areas, and (2) display of the principal K- and L-lines for any specified element. Each of these functions is performed by inter-active use of the teletype keyboard, the pushbuttons on the ND4410 Function Control Module and the oscilloscope display.

1-3. PROGRAM AREA

1-4. The program occupies memory core locations $\emptyset,42\emptyset\emptyset_8$ through $\emptyset,7666_8$.

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1-7. EQUIPMENT CONFIGURATION

1-8. MINIMUM EQUIPMENT

1-9. The minimum equipment required for proper operation of this program is:

a. An ADC.
b. The ND4410 Function Control Unit.
c. A 33ASR Teletype.

d. A display oscilloscope.
e. The 8K, ND812 Computer.

1-10. The program will operate with either an 8K, 12K or 16K ND812 memory configuration, providing maximum storage configuration of 2K, 4K or 6K (24 bits), respectively.

SECTION II
PROGRAM DESCRIPTION

(TO BE SUPPLIED)

SECTION III
OPERATIONAL PROCEDURE

3-1. INITIALIZATION PROCEDURE

3-2. The following is a step-by-step procedure for loading and initializing the ND4410 X-Ray Analysis Overlay Program (41-1085):

a. Depress the STOP key at the ND812 Computer.

b. Place the START/STOP/FREE switch at the teletype in the FREE position.

c. Load the ND4410 Basic Physics Analyzer Program (41-1060) Tape into the teletype reader with the leader (8-level punches) over the read head.

d. Set the START/STOP/FREE switch to START.

e. Simultaneously depress the LOAD AR and NEXT WORD keys at the ND812 Computer. The teletype will step through the leader and read the program into the ND812 memory. Upon completion of read-in, the reader will automatically stop. When the reader stops, check the J register for zero. If non-zero, reload.

NOTE

Refer to the ND812 Binary Paper Tape and Cassette Loader Program (41-0005) for loading procedures using a high speed paper tape reader or magnetic tape cassette. To avoid destruction of the loader program when 41-1085 is read in, 41-0005 should be loaded into field 1.

f. Repeat steps a through e to read-in the ND4410 Data Manipulation Overlay Program (41-1061).

g. Repeat steps a through e to read-in the ND4410 X-Ray Analysis Overlay Program (41-1085).

h. Set the SWITCH REGISTER switches at starting address ($Ø,Ø2ØØ_8$) and depress the LOAD AR key.

i. Depress the START key at the ND812 Computer. The program will cause the teletype to perform a carriage return and line feed, print ND4410, perform another carriage return and line feed, print PLOTTER? and then wait for entry of a Y or N to indicate whether or not an X-Y plotter is to be used.

j. If an X-Y plotter is not used, type N. When N is typed, the program causes the teletype to perform a carriage return and line feed and type an asterisk (*).

k. If an X-Y plotter is to be used, type Y. When Y is typed, the program will cause the teletype to print YES and supply a (Ø, Ø) calibration voltage to the X-Y plotter.

l. Adjust the plotter zero controls to place the pen at the desired (Ø, Ø) point.

m. Depress the SPACE bar at the teletype. This supplies a full scale X-Y calibration voltage to the X-Y plotter.

n. Adjust the plotter Vernier controls to place the pen at the desired full scale X-Y point.

o. Depress the SPACE bar at the teletype again. This returns the calibration voltage to the (Ø, Ø) point. Re-adjust the plotter zero controls to place the pen at the desired (Ø, Ø) point.

p. Depress the SPACE bar at the teletype again. This returns the calibration voltage to the full scale X-Y point. Re-adjust the plotter Vernier controls to place the pen at the desired full scale X-Y point.

q. Repeat steps o and p as often as necessary to attain satisfactory calibration. When satisfactory calibration is obtained, depress the RETURN key at the teletype. When the RETURN key is depressed, the program causes the teletype to perform a carriage return and line feed and type an asterisk (*).

r. When an asterisk (*) is typed either after step j or q, depress the GROUPS pushbutton and then call up the desired routine from the monitor mode by depressing the appropriate pushbutton at the ND4410 Function Control Module or by typing the appropriate single letter mnemonic at the teletype keyboard.

SECTION IV
OPERATOR OR USER CONTROL

4-1. GENERAL INFORMATION

4-2. The commands of the ND4410 X-Ray Analysis Overlay Program (41-1085) are executed by entering the appropriate single letter mnemonic at the teletype or by depressing the appropriate pushbutton at the ND4410 Function Control Module after the program causes an asterisk (*) to be typed, signifying the command mode. In the following description, the portion of the command to be typed at the teletype keyboard is underlined. All other information is provided by the program.

4-3. SET INTERVALS COMMAND

4-4. The Set Intervals command is the basic command for setting and altering the list of internally stored intervals. Up to 32 intervals can be specified in the list. Any one or all the specified intervals can be altered. It is possible to add on intervals or to modify one or more intervals without re-entering the entire list. Each interval may be set independently of the others. The intervals may overlap and they do not have to be in ascending order. The only requirement is that the starting point be less than or equal to the stopping point. The following operation is an example of the entries made the first time a list of intervals is specified. In this example, five intervals will be specified starting with interval one. Interval four will use the left and right markers as its starting and stopping points, respectively. Intervals one, two, three and five will use the digital values specified as their starting and stopping points.

```
* I SET INTERVAL NO.: A
  INTERVAL START STOP
       1:23(SPACE) :43(SPACE)
       2:648(SPACE):708(SPACE)
       3:94(SPACE) :162(SPACE)
       4:M         :M
       5:376(SPACE):476(SPACE)
       6:@
```

4-5. The following operation is an example of changing the last interval previously specified and adding one additional interval. In this example assume that interval number five was the last interval previously specified and interval number six is to be added.

```
* I SET INTERVAL NO.: 5 (SPACE)
      5:300(SPACE):500(SPACE)
      6:M          :M
      7:@
```

4-6. The following operation is an example of changing two consecutive intervals which were previously specified without changing any other intervals. In this example, assume that six intervals were previously specified and intervals four and five are to be changed.

```
* I SET INTERVAL NO.: 4 (SPACE)
      4:M          :M
      5:357(SPACE):505(RETURN PUSHBUTTON)
```

4-7. The Set Intervals Command is specified by typing I after an asterisk (*) is typed. When I is typed, the routine causes the teletype to print SET INTERVAL NO.: and then waits for entry of an A to specify all intervals, or a number (from 1 to 32) to specify a particular previously specified interval for modification. When A is typed, the routine causes the teletype to perform a carriage return and line feed, print the column headings: INTERVAL, START and STOP, perform another carriage return and line feed, type 1: and then waits for entry of the starting point of interval number one (1). When a number of a previously defined interval is typed, it must be terminated by depressing the SPACE bar at the teletype. When the SPACE bar is depressed, the routine causes the teletype to perform a carriage return and line feed, type the number of the interval specified and a colon (:), and then waits for entry of the starting point of the specified interval. When an interval number is typed in place of the letter A, printing of the column headings is suppressed.

4-8. After the interval number is typed, the starting point of the interval is entered. The starting point of the interval can be any digital channel number from 1 to the current group width, or M to specify the left marker channel of the current group. Entry of a digital channel number for the starting point must be terminated by depressing the SPACE bar at the teletype. When entry of the starting channel number is terminated by depressing the SPACE bar or when an M is typed to specify the left marker channel, the routine causes the teletype to print a colon (:) and then waits for entry of the stopping point of the interval. The stopping point can be any digital channel number equal to or greater than the starting channel number but less than or equal to the current group width, or M to specify the right marker channel of the current group. Entry of a digital channel number for the stopping point must be terminated by depressing the SPACE bar at the teletype. When entry of a stopping channel is terminated by depressing the SPACE bar or when an M is typed to specify the right marker channel, the routine causes the teletype to perform a carriage return and line feed, type the next consecutive interval number and a colon (:), and then waits for entry of the starting and stopping points for

the next consecutive interval number. The requirements for entry of the starting and stopping points for each succeeding interval are the same as the first. After entry of the stopping point for each succeeding interval is terminated, the routine causes the teletype to type the next consecutive interval number. The list can be terminated at any time by typing the character "@" in place of the starting point of an interval. When the character "@" is typed, the routine stores the interval entries made thus far and causes the teletype to perform a carriage return and line feed and then type an asterisk (*) signifying return to the command mode.

4-9. When the starting and stopping points of an interval are modified and the interval is not the last interval in the list, entry of the stopping point is terminated by depressing the RETURN pushbutton at the ND4410 Function Control Module in place of the SPACE bar at the teletype. This ensures that the end point of the interval list is not disturbed and all previously specified intervals, other than those being modified, will remain unaltered.

NOTE

The RETURN pushbutton can be depressed at any time during the Set Intervals Command without disturbing the end point of the interval list.

4-10. ENERGY CALIBRATE COMMAND

4-11. The Energy Calibrate Command permits entering the channel number of two known peaks and then the known energy in eV of the two known peaks. The routine then calculates the energy per channel (A) and the energy intercept (B). The following is an example of the entries made for the Energy Calibrate Command. In this example, assume a current group width of 1024 channels and the two known energy peaks of 320 eV and 6620 eV at channel locations 33 and 678, respectively.

```
* ENERGY CALIBRATE
  PCH1: 33(SPACE) E1: 320(SPACE)
  PCH2: 678(SPACE) E2: 6620(SPACE)
  A=     9EV/CH
  B=-    2EV
*
```

4-12. The Energy Calibrate Command is specified by typing E after an asterisk (*) is typed. When E is typed, the routine causes the teletype to print ENERGY CALIBRATE, perform a carriage return and line feed, and print PCH1: and then waits for entry of the channel number of the first known peak. The channel number entered can be any channel number from 1 to the current group width. Entry of the channel number must be terminated by depressing the SPACE bar at the teletype. When the SPACE bar is depressed, the routine causes the teletype to print E1: and then waits for entry of the energy of the first known peak. The energy value entered for E1 should be selected such that (E2 - E1)*

(Current group width) does not exceed 8,388,607. This will ensure that an overflow will not occur when the peak channel energy is calculated. If the energy values exceed these limitations, they should be scaled up accordingly. Entry of the energy must be terminated by depressing the SPACE bar at the teletype. When the SPACE bar is depressed, the routine causes the teletype to perform a carriage return and line feed and print PCH2: and then waits for entry of the channel number of the second known peak. The requirements for entry of the second peak channel are the same as the first. When the SPACE bar is depressed to terminate entry of the second peak channel, the routine causes the teletype to print E2: and then waits for entry of the energy of the second known peak. The requirements for entry of the second peak energy are the same as the first. When the SPACE bar is depressed to terminate entry of the second peak energy, the routine causes the teletype to perform a carriage return and line feed; print A=, the energy per channel and EV/CH; perform a carriage return and line feed, print B=, the energy intercept and EV; and perform a carriage return and line feed and type an asterisk (*), signifying return to the command mode.

4-13. PRINT REPORT COMMAND

4-14. The Print Report Command provides a printout of the information pertaining to a specified interval or all specified intervals in the list. Information included in the list is: the interval number, the starting and stopping channel numbers of the interval, the background counts in the interval, the net counts in the interval and the energy in eV for the peak channel in the interval. The number of counts in the background is determined by taking the area under a straight line drawn between the gross values in the end channel of each interval. The net count is determined by subtracting the background counts from the total counts in the interval. The energy of the peak channel in the interval is based upon the previously entered energy calibration obtained using the Energy Calibrate Command. The following operation is an example of the entries made and the printout for all intervals in the list. In this example assume the list contains six previously specified intervals and the Energy Calibrate Command was previously performed.

```
* PRINT INTERVAL NO.: A
```

INTERVAL	START	STOP	BKGND	NET	PEAK
1	23	43	3423	1386	271
2	684	708	7076	1813	6434
3	94	162	6417	276	1297
4	184	252	7245	1154	1951
5	357	505	4768	2201	3563
6	591	739	2086	12781	6434

4-15. The following operation is an example of the entries made and the printout for a previously specified interval number. In this example assume the specified interval is interval number four and the Energy Calibrate Command was previously performed.

* PRINT INTERVAL NO.: 4 (SPACE)

4	184	252	1245	1145	1951

4-16. The Print Report Command is specified by typing a P after an asterisk (*) is typed. When P is typed, the routine causes the teletype to print PRINT INTERVAL NO.: and then waits for entry of an A to specify all previously specified intervals or a number (from 1 to 32) to specify a particular previously defined interval for printout. When A is typed, the routine causes the teletype to perform a carriage return and line feed and print the column headings: INTERVAL, START, STOP, BKGND, NET and PEAK, and then performs the background, net counts and peak energy calculations and prints the interval number, starting channel, stopping channel, background counts, net counts, and peak channel energy for each previously specified interval in the list. When a particular interval number is specified for printout, it must be terminated by depressing the SPACE bar at the teletype. When the SPACE bar is depressed, the routine performs the background, net counts and peak energy calculations and prints the interval number, starting channel, the stopping channel, the background counts, net counts and peak channel energy for the specified interval. When a particular interval number is typed in place of the letter A, printing of the column heading is suppressed and the values are printed in a single line. Upon completion of printing the values for the last interval in the list (or a specific interval number), the routine causes the teletype to perform a carriage return and line feed and type an asterisk (*), signifying return to the command mode.

NOTE

The Print Report Command can be terminated at any time by depressing the RETURN pushbutton at the ND4410 Function Control Module.

4-17. MARKER PRINT REPORT COMMAND

4-18. The Marker Print Report Command provides a printout of the same information as the Print Report Command for the interval defined by the current markers. This command has no effect on the interval list. The following operation is an example of the entries made and the printout for the interval between the current markers. In this example, assume the left marker is at channel 591 and the right marker is at channel 739.

* M

Ø	591	739	3427	18348	6542

*

4-19. The Marker Print Report Command is specified by typing M after an asterisk (*) is typed. When M is typed, the routine causes the teletype to perform a carriage return and line feed, and then performs the background, net counts and peak energy calculation for the interval defined by the current markers and causes the teletype to print a zero for the interval number, the left marker channel, the right marker channel, the background

counts, the net counts and the peak channel energy in eV. Upon completion of printout of the peak channel energy, the routine causes the teletype to perform a carriage return and line feed and type an asterisk (*), signifying return to the command mode.

4-20. X-RAY STATUS DISPLAY COMMAND

4-21. The sequence of parameters displayed by depressing the STATUS pushbutton (41-1060) is modified by this program to include display of the following X-Ray parameters: current left and right marker channels and the net counts, background counts and the peak channel energy in eV of the last interval for which these values were calculated. The left and right marker channels do not necessarily pertain to the same interval as the background counts, net counts and peak channel energy. However, the intervals can be made the same by performing the Display Interval Command or by depressing the SPARE pushbutton on the ND4410 Function Control Module. The values displayed for the left and right marker channels are altered whenever the left and right markers are moved using the MARK POS and MARK SPAN pushbuttons. The values displayed for the background counts, net counts and peak channel energy are altered by the Print Report Command, Marker Print Report Command and the Auto Analyze Command (41-1061). The following is an example of X-Ray Status Parameters as they appear on the display. In this example, the left marker is at channel 591, the right marker is at channel 739, the background counts equals 3427, the net count is 18348 and the peak channel energy is 6542 eV.

```
591-739
3427/18348
6542
```

4-22. The status display of the Preset and Remaining Acquisition Time parameters (41-1060) is also modified by this program to include display of the total counts between the current markers and the count rate. During data acquisition, the display of the total count and count rate values is updated at one second intervals. The following is an example of these parameters as they appear on the display. In this example, the preset acquisition time is 1000 centiseconds, the remaining acquisition time is 731 centiseconds, the total counts between the markers as of the last update is 32582, and the count rate as of the last update is 1489.

```
1000/-731
32582/1489
```

4-23. DISPLAY INTERVAL COMMAND

4-24. The Display Interval Command permits display of starting and stopping channel, the background counts, net counts and peak channel energy for any specified interval. The starting and stopping channels are determined by resetting the left and right marker to the starting and stopping points of the specified interval and then updating the X-Ray Status display. This command is useful for visually checking the isolation of peaks or

other features in the various intervals stored by the system. The following is an example of the entries made for the Display interval command. In this example interval number three (3) is selected for display.

* DISPLAY INTERVAL NO.: 3 (SPACE)
*

4-25. The Display Interval Command is specified by typing a D after an asterisk (*) is typed. When D is typed, the routine causes the teletype to print DISPLAY GROUP NO.: and then waits for entry of an interval number. Any previously assigned interval number from 1 to 32 may be specified. Entry of the interval number must be terminated by depressing the SPACE bar at the teletype. When the SPACE bar is depressed after entry of an interval number, the routine resets the left and right markers to the starting and stopping points of the specified interval, calculates the background counts, net counts and peak channel energy and updates the X-Ray Status Display (refer to paragraph 4-20). After the X-Ray Status Display has been updated, the routine causes the teletype to perform a carriage return and line feed and type an asterisk (*), signifying return to the command mode.

NOTE

The Energy Calibrate Command should be performed prior to the Display Interval Command in order to obtain a meaningful peak channel energy.

4-26. SPARE PUSHBUTTON COMMAND

4-27. Depressing the SPARE pushbutton updates the X-Ray Status Display of the Print Report so that interval of the Print Report corresponds to the current markers. Refer to the X-Ray Status Display Command (paragraph 4-20).

4-28. PRESET COUNTS COMMAND

4-29. The Preset Counts Command permits entering a preset maximum number of counts from 1 to 8,388,607 for determining analysis time. After analysis has been initiated by depressing the ACQUIRE pushbutton, it will automatically terminate when the total number of counts between the left and right markers of the current group as of the last status update exceeds the preset maximum number of counts. Entering Ø suppresses the preset count restriction, permitting analysis to continue until either manually terminated by depressing the ACQUIRE pushbutton or automatically terminated upon completion of the current preset analysis time. The following is an example of an entry for the Preset Counts Command. In this example, 100,000 is entered as the preset maximum number of counts. After analysis has been initiated by depressing the ACQUIRE pushbutton, it will automatically terminate when the total counts between the current markers exceed 100,000 counts.

```
* Q MAXIMUM COUNTS: 100000 (SPACE)
*
```

4-30. The Preset Counts Command is specified by typing a Q after an asterisk (*) is typed. When Q is typed, the routine causes the teletype to print MAXIMUM COUNTS: and then waits for entry of the preset maximum number of counts. The preset number can be any number from 1 to 8,388,607. Entering Ø suppresses the preset count restriction on analysis. Entry of the preset count must be terminated by depressing the SPACE bar at the teletype. When the SPACE bar is depressed, the routine causes the teletype to perform a carriage return and line feed and type an asterisk (*), signifying return to the Command mode.

4-31. ACQUIRE PUSHBUTTON COMMAND

4-32. The ACQUIRE Pushbutton Command (41-1060) is modified by this program to calculate the total counts between the current markers and the count rate, and then update the X-Ray Status Display with the calculated values at one second intervals. The display update occurs only during data acquisition. When not in acquire, the values resulting from the last calculation that occurred during acquire are displayed.

4-33. DISPLAY K/L LINES COMMAND

4-34. The Display K/L Lines Command permits display of a marker at the channel locations of the principal K or L lines for a specified atomic number from 1 to 100. The command also alters the X-Ray Status to display the specified atomic number and the principal K "beta" and K "alpha" values in eV or principal L "beta", L "gamma" and L "alpha" values in eV. If any of the K or L values is zero, it indicates that the system has no value for that particular parameter. The following is an example of the entries required and the X-Ray Status Display for the principal K lines. In this example, the atomic number is 27, the K "beta" is 7649 eV and the K "alpha" is 6925 eV. The zero indicates no other K values are available.

Entry	X-Ray Status Display
* T ATOMIC NO.: 27 K	7649 - Ø - 27 6925

4-35. The following is an example of the entries required and the X-Ray Status Display for the principal L lines. In this example, the atomic number is 27, the L "beta" is 790 eV and the L "alpha" is 775 eV. No L "gamma" is present.

Entry	X-Ray Status Display
* T ATOMIC NO.: 27 L	790 - Ø - 27 775

4-36. The Display K/L Lines Command is specified by typing T after an asterisk (*) is typed. When T is typed, the routine causes the teletype to print ATOMIC NO.: and then waits for entry of an atomic number. The atomic number can be any number from 1 to 100 (Refer to Appendix A for a table of atomic numbers). Entry of the atomic number must be followed by typing either a K to specify the K lines or an L to specify the L lines. When K is typed, the routine displays markers at the principle K lines and alters the X-Ray Status to display the principle K "beta" and K "alpha" in eV. When L is typed, the routine displays markers at the principal L lines and alters the X-Ray Status to display the principle L "beta", L "gamma" and L "alpha" in eV. If any of the K or L values displayed is zero, it indicates that the system has no values for that particular parameter. Display of the principal K or L lines is terminated by depressing the RETURN pushbutton at the ND4410 Function Control Unit. When the RETURN pushbutton is depressed, the markers and the X-Ray Status Display are restored to the value they were at prior to performing the Display K/L lines command and the program is returned to the command mode as signified by the teletype performing a carriage return and line feed and typing an asterisk (*).

4-37. AUTO ANALYZE COMMAND

4-38. The auto analyze sequence of the Auto Analyze Command (41-1061) is modified by this program to replace the totalize and print operations with printout of print report for each of the pre-assigned intervals in the list. The following is an example of the information printed by the Auto Analyze Command (41-1061) modified for X-Ray printout. In this example the auto analyze sequence is performed two times with an acquire time of 1000 centiseconds, and six intervals are assigned to the list.

NOTE

Analysis time during auto analyze can be controlled either on a preset clock time basis as selected by the Clock Set Command (41-1060) or on a preset maximum number of counts basis as selected by the Preset Counts Command (41-1086). However, when the Clock Set Command (41-1060) is used to control analysis time, the entry for the Preset Counts Command (41-1086) should be zero (Ø), or vice versa.

* AUTO ANALYZE: 2 (SPACE) TIMES

*

INTERVAL	START	STOP	BKGND	NET	PEAK
1	23	43	3339	1422	281
2	648	708	7259	1715	6610
3	94	162	6417	230	1414
4	184	252	8073	383	1931
5	357	505	5960	829	3719
6	591	739	2086	12637	6610

*

INTERVAL	START	STOP	BKGND	NET	PEAK
1	23	43	3507	1318	281
2	648	708	7198	1863	6542
3	94	162	6417	319	1355
4	184	252	6831	1474	2048
5	357	505	6109	903	3934
6	591	739	1490	13307	6542

*

SECTION V
ERROR DIAGNOSTICS

5-1. ERROR INDICATION

5-2. Execution of an illegal operation will result in an error message being typed at the teletype. Table 5-1 lists the error messages and their causes.

Table 5-1. Error Indication

Error Message	Cause
59XXXXX	Depressing an unassigned teletype key to call up a command or enter a command argument.
52XXXXX	Entering an atomic number other than 1 to 100 in the Atomic Number Command.

NOTE

The least significant digits indicated by X's in Table 5-1 for the ERROR message may change depending upon what illegal operation was performed. However, the two most significant digits will be the same for the same type of error.

SECTION VI
COMMAND SUMMARY

6-1. The following summarizes the commands described in Section IV.

1. I SET INTERVALS COMMAND. Permits assigning a list of up to 32 intervals of interest in the current display group. The command also permits adding or modifying one or more intervals without re-entering the entire list. Each interval is assigned by entering the starting and stopping channel of the desired area of interest. The starting channel can be any channel from 1 to the current group width or M for the left marker channel. The stopping channel can be any channel equal to or greater than the starting channel but less than or equal to the current group width or M for the right marker channel.

2. ENERGY CALIBRATE COMMAND. Permits energy calibration based upon entry of the known energy in eV for two peak channels. The routine calculates and prints the energy per channel and the energy intercept. These values are used to determine the peak channel energy for the print report.

3. PRINT REPORT COMMAND. Provides teletype printout of the print report for any specified interval number or all intervals in the previously assigned interval list. The print report lists the interval number, starting channel, stopping channel, background counts, net counts and peak channel energy for the specified interval or all intervals in the interval list.

4. MARKER PRINT REPORT COMMAND. Provides teletype printout and display of the print report for the interval between the left and right markers of the current display group. The print report lists the current left and right marker channels, the background counts, net counts and peak channel energy for the interval defined by current markers.

5. X-RAY STATUS COMMAND. Modifies the status display sequence (41-1060) to include display of the print report. The print report lists the interval number, the current left and right marker channel numbers, the background counts, net counts and peak channel energy in eV for the last interval for which these values were calculated. Note, that the current markers may not be set at the limits of interval to which the values correspond. However, they

can be set to correspond by depressing the SPARE pushbutton or by performing the Display Interval Command. The Status display of the preset and remaining acquisition time (41-1060) is also modified to include display of the total counts between the current markers and the count rate. During data acquisition these values are updated at one second intervals.

6. DISPLAY INTERVAL COMMAND. Sets the left and right markers to the limits of any specified interval number and displays the print report for that interval. The print report lists the interval number, the starting point (left marker channel), the stopping point (right marker channel), background counts, net counts and peak channel energy for the specified interval number.

7. SPARE PUSHBUTTON. Sets the interval of X-Ray Status Display to correspond to the current markers.

8. Q PRESET COUNTS COMMAND. Permits entry of a preset maximum number of counts from 1 to 8,388,607 for control of analysis time. Entering Ø suppresses the preset count restriction on analysis.

9. ACQUIRE PUSHBUTTON. Modifies acquire operation (41-1060) to calculate the total counts between the current markers and the count rate and then updates the status display at one second intervals.

10. T DISPLAY K/L LINES COMMAND. Sets the markers at the principle K or L lines and alters the X-Ray Status to display the K "beta" and K "alpha" values in eV or the L "beta", L "gamma" and L "alpha" values in eV for a specified atomic number. Refer to Appendix A for a listing of atomic numbers.

11. AUTO ANALYZE COMMAND. Modifies the auto analyze sequence (41-1061) to replace the totalize and print operations with the teletype printout of the print report for each interval assigned to the interval list.

SECTION VII
FLOW CHARTS

(TO BE SUPPLIED)

SECTION VIII
PROGRAM LISTING

8-1. A listing of the ND4410 X-Ray Analysis Overlay Program (41-1085) as produced by Pass 3 of the ND812 BASC-12 General Assembler Program (41-0001) is provided on the following pages.

```
/ND41-1085-00
/X-RAY FUNCTIONS        SA=N.A.
/OVERLAY FOR 4410(1060,1061)- VERSION A

/RM/DB
/9(36) 8/14/72
/LOADER MUST BE IN FIELD 1

/SYMBOLS DEFINED IN 41-1060-00(EDIT 52)

             AQEXIT      = 2061
             AQOFF       = 2025
             CHARX       = 2320
             CLOCK1      = 2100
             CNTR        = 2230
             DECODE      = 0227
             DUBINT      = 2441
             ECHOF       = 2106
             ERROR       = UNUSED = 2120
             FCHAR       = 0245
             GROUPW      = 1664
             GROUPZ      = 0156
             GSC         = 1640
             HORD        = 2506
             II1         = 1656
             INEC        = 2140
             IN2         = 1642
             IN2000      = 1644
             IRTRN       = 2105
             LDF         = 2252
             LDLIST      = 0632
             LORD        = 2505
             LOREAD      = 0264
             MGCCP       = 1515
             MGCC        = 1525
             MGCLP       = 1513
             MGCL        = 1266
             MGCRP       = 1514
             MGCR        = 1270
             OLYEXT      = 2074
             RETRN       = 0362
             STATX       = 1041
             TABLE       = 2336
             TAB1        = 2304
             TIME        = 2076
             TTY         = 0003
             UNPACK      = 2403

/SYMBOLS DEFINED IN 41-1061-00(EDIT 23)
```

```
            AQR         = 3061

/INTEGER PACKAGE DEFINITIONS

            IEXT        =  0000         /EXIT
            IOUT        =  3400         /OUTPUT
            ISUB        =  4000         /SUBTRACTION
            IADD        =  4400         /ADDITION
            ILOD        =  5000         /LOAD
            ISTR        =  5400         /STORE
            INEG        =  6000         /NEGATE INTEGER AC
            IDIV        =  6400         /DIVISION
            IMUL        =  7000         /MULTIPLICATION
            INOP        =  7400         /NO OPERATION
            IM =  DUBINT        /INTEGER PACKAGE ENTRY
```

```
            [FIELD 0

            *IN2000
 0 1644  4000            4000     /DATA STARTS AT 0000 IN FIELD 1
 0 1645  0000            0000

            *AQOFF-0004             /MODIFICATION TO CLOCK SERVICE
 0 2021  1442            SKIP

            *AQOFF-0002             /MOD TO CLOCK SERVICE
 0 2023  0600            TWJMP
 0 2024  5173            CDTR

            *OLYEXT                 /LINK INTO ACQ ON/OFF
 0 2074  5117            SRCT

            *TAB1+0005
 0 2311  0111            0111     /SET INTERVALS
 0 2312  0115            0115     /PRINT REPORT FOR CURRENT MARKERS
 0 2313  0120            0120     /PRINT REPORT FOR SPECIFIED PAIR
 0 2314  0105            0105     /ENERGY CALIBRATION
 0 2315  0104            0104     /DISPLAY SPECIFIED PAIR
 0 2316  0124            0124     /DISPLAY K- OR L-LINES

            *CHARX+0006
 0 2326  4247            SLIM
 0 2327  4664            PRCM
 0 2330  4740            MPRR
 0 2331  5011            ECOF
 0 2332  5131            DLMP
 0 2333  5350            DENR

            *CHARX+0015
 0 2335  5103            PSCN             /CHECK FOR PRESET COUNTS

            *TABLE+0014
 0 2352  5324            RMDP     /RESTORE ORIGINAL MARKERS ON "RETURN"

            *TABLE+0017             /SPECIAL X-RAY PUSHBUTTON
 0 2355  5000            MSTD

            *LDF+0003
 0 2255  5545            XCLK-1   /REVISE CLOCK STATUS DISPLAY
 0 2256  5533            XSTS-1   /ADD X-RAY STATUS DISPLAY

            *AQR
 0 3061  0640            TWJPS    /LINK INTO AUTO-ACQUIRE
 0 3062  4366            PRPT

/E1747
```

```
            *4047
 0 4047  1400           IDLE    /MODIFY MEMORY SIZE CALCULATION
                            /TO ACCOMODATE SMALLER DATA AREA

            *4000
            LMTB        =.      /BEGINNING OF LIMIT PAIR BUFFER

            *LMTB+0200 /NUMBER OF WORDS=MAX. NO. OF PAIRS*4
                            /MINIMUM NO. OF WORDS=0164 TO ACCOMMODATE
                            /41-1060 INITIALIZATION
            LMTE        =.

/GET LEGAL PAIR NUMBER AND INITIATE POINTERS TO
/MARKER BUFFER
/ENTER WITH "LLMA" SET TO POINT TO LAST WORD+1 OF
/LAST PAIR ENTERED
/IF CALL+1 CONTAINS AN <IDLE>, ROUTINE WILL NOT ALLOW
/SPECIFICATION OF LAST ENTERED PAIR NUMBER+1
/IF IT CONTAINS <SET 0>, IT WILL ALLOW SPECIFICATION
/OF LAST ENTERED PAIR+1
/RETURN WITH "LMPR"=SPECIFIED PAIR IF "ALL" WERE
/SPECIFIED AND "LMPP" POINTED TO APPROPRAITE
/WORD IN LIMIT PAIR BUFFER
/RETURN TO CALL+2 IF PAIR NO. IS SPECIFIED
/RETURN TO CALL+3 IF "A" IS ENTERED SPECIFYING ALL PAIRS

 0 4200  0000  IPSP,   0
 0 4201  7047          XCT  X25          /<JPS UNPACK>
 0 4202  5667          GLMP
 0 4203  7062          XCT  X21          /<JPS INEC>GET LIMIT PAIR NO.
 0 4204  4355  LMPRI,  LMPR
 0 4205  0500  X05,    TWLDJ
 0 4206  2320          CHARX
 0 4207  2431          SMJ  C101         /A?
 0 4210  6032          JMP  IPSP1        /YES- SET UP FOR MODIFICATION STARTING
 0 4211  5305          LDJ@ LMPRI        /NO
 0 4212  2301          SUBL 01           /SUBTRACT "1" FROM SPECIFIED PAIR NO.
 0 4213  1142          SFTZ 02 J         /MULTIPLY PAIR NUMBER BY 4
 0 4214  1502          SIP  J            /FORM POINTER TO SPECIFIED PAIR
 0 4215  6624          JPS@ ERRORI       /PAIR NUMBER TOO LARGE
 0 4216  1450          CLR  0            /NEW POINTER MUST BE BETWEEN BEGINNING
 0 4217  0440          TWADJ             /OF TABLE AND LAST SPECIFICATION
 0 4220  4354  BLMTI,  BLMT
 0 4221  1455          SIZ  CLR 0
 0 4222  6617          JPS@ ERRORI       /PAST END OF FIELD
 0 4223  0400          TWSBJ             /GREATER THAN LAST SPECIFICATION?
 0 4224  4357  LLMAI,  LLMA
 0 4225  1501          SNZ  J            /LAST PAIR ENTERED+1 SPECIFIED?
 0 4226  7326          XCT@ IPSP         /YES- EXECUTE CALL+1 TO SEE IF ITS AN E
 0 4227  1451          SNZ  CLR 0        /NO- LEGAL PAIR NO.?
```

```
 0 4230   6611            JPS@ ERRORI      /YES
 0 4231   4705            ADJ@ LLMAI       /NO- RESTORE J
 0 4232   5472  IPSP2,    STJ  LMPP
 0 4233   1510            CLR  J
 0 4234   0540            TWSTJ
 0 4235   4356            LMPR+1
 0 4236   3536            ISZ  IPSP        /RETURN TO CALL+2 OR 3
 0 4237   6337  IRETURN   IPSP

 0 4240   0101  C101,     0101
 0 4241   2120  ERRORI,   ERROR

 0 4242   3542  IPSP1,    ISZ  IPSP
 0 4243   1514            CLR  INC J
 0 4244   5740            STJ@ LMPRI
 0 4245   5325            LDJ@ BLMTI
 0 4246   6114            JMP  IPSP2

/SET LIMITS LIST VIA KEYBOARD

 0 4247   0000  SLIM,     0
 0 4250   7057  X25,      XCT  X07         /<JPS UNPACK>
 0 4251   5567            LIMS
 0 4252   6552            JPS  IPSP        /GET LEGAL PAIR NO.
 0 4253   1470            SET  0           /MAY SPECIFY LAST PAIR NO. ENTERED+1
 0 4254   6005            JMP  SLIM3
 0 4255   7052            XCT  X07         /<JPS UNPACK>
 0 4256   5575            HDNG
 0 4257   7050            XCT  X07         /<JPS UNPACK>
 0 4260   5627            CRLF
 0 4261   7046  SLIM3,    XCT  X07         /<JPS UNPACK>
 0 4262   5627            CRLF
 0 4263   0340            TWISZ            /<ISZ ECHOF>SET FLAG FOR PRINT ONLY
 0 4264   2106            ECHOF
 0 4265   7035  X21,      XCT  X06         /<JPS INEC>PRINT PAIR NO.
 0 4266   4355            LMPR
 0 4267   5071            LDJ  MGCLI       /INITIALIZE MARKER BUFFER POINTER
 0 4270   5471            STJ  MKBP
 0 4271   6430            JPS  GLIM        /GET LOWER LIMIT
 0 4272   7165  X23,      XCT  X05         /<LDJ CHARX>
 0 4273   2425            SMJ  C100        /0?
 0 4274   6020            JMP  SLIM1       /YES- LAST PAIR IN LIST
 0 4275   7004            XCT  X08         /<JPS IM>SAVE IN "ITMP"
 0 4276   5464            ISTR ITMP
 0 4277   0000            IEXT
 0 4300   6421            JPS  GLIM        /GET UPPER LIMIT
 0 4301   0640  X08,      TWJPS            /<JPS IM>NO-CHECK UPPER LIMIT AGAINST
 0 4302   2441            IM               /LOWER LIMIT
 0 4303   4057            ISUB ITMP
 0 4304   0000            IEXT             /RETURNS WITH JK=IAC
```

```
0 4305  1602            SIP   K           /UPPER LIMIT <OR= LOWER LIMIT?
0 4306  6745            JPS@  ERRORI      /YES
0 4307  3446            ISZ   LMPR        /NO= INCREMENT PAIR NUMBER
0 4310  5014            LDJ   LMPP        /INCREMENT PAIR POINTER BY 2
0 4311  2406            SMJ   ELMT        /END OF TABLE?
0 4312  6002            JMP   SLIM1       /YES
0 4313  6132            JMP   SLIM3       /NO

0 4314  5010  SLIM1,    LDJ   LMPP        /SAVE POINTER TO LAST PAIR+1
0 4315  5442            STJ   LLMA
0 4316  6347  [RETURN   SLIM

0 4317  4200  ELMT,     LMTE
0 4320  0100  C100,     0100

0 4321  0000  GLIM,     0
0 4322  0640  X06,      TWJPS
0 4323  2140            INEC
0 4324  0000  LMPP,     0
0 4325  0340            TWISZ             /FILL FIELD OUT WITH SPACES
0 4326  2230  CNTRI,    CNTR

          GLIM4         .

0 4327  7047  X07,      XCT   X02         /<JPS UNPACK>PRINT ONE SPACE
0 4330  5566            SPCS
0 4331  3303            DSZ@  CNTRI       /LAST SPACE?
0 4332  6103            JMP   GLIM4       /NO
0 4333  7141            XCT   X23         /<LDJ CHARX>YES
0 4334  2430            SMJ   C115        /TERMINATING CHARACTER=M?
0 4335  6010            JMP   GLIM1       /YES= USE MARKER VALUE POINTED TO BY "M
0 4336  2516            SMJ   C100        /TERMINATOR?
0 4337  6316  [RETURN   GLIM              /YES= SKIP PAIR POINTER INCREMENTATION
0 4340  3514            ISZ   LMPP        /NO= VALUE ENTERED
0 4341  3420            ISZ   MKBP        /INCREMENT BUFFER POINTERS
0 4342  3516  GLIM2,    ISZ   LMPP
0 4343  3416            ISZ   MKBP
0 4344  6323  [RETURN   GLIM

0 4345  5214  GLIM1,    LDJ@  MKBP
0 4346  5722            STJ@  LMPP
0 4347  3412            ISZ   MKBP
0 4350  3524            ISZ   LMPP
0 4351  5210            LDJ@  MKBP
0 4352  5726            STJ@  LMPP
0 4353  6111            JMP   GLIM2


0 4354  4000  BLMT,     LMTB    /POINTER TO BEGINNING OF LIMIT
                        /PAIR TABLE
```

```
 0 4355   0001   LMPR,    0001     /LIMIT PAIR NO.
 0 4356   0000             0000     /HIGH ORDER MUST BE=0
 0 4357   4000   LLMA,    LMTB     /ADDRESS+1 OF LAST LIMIT PAIR
                               /"LLMA" IS RESET UPON SPECIAL
                               /CHARACTER TERMINATION IN "SLIM"
                               /OF LIMIT SET COMMAND
 0 4360   1266   MGCLI,   MGCL
 0 4361   0000   MKBP,    0        /MOVING POINTER TO MARKER BUFFER
 0 4362   0000   ITMP,    0        /TEMPORARY DOUBLE PRECISION INTEGER STORAGE
 0 4363   0000             0
 0 4364   0115   C115,    0115
 0 4365   0140   C140,    0140

/E3679
```

```
/PRINT AUTO-ANALYZER REPORT

 0 4366   0000  PRPT,    0
 0 4367   0500           TWLDJ              /FORM <TWLDJ> POINTER TO BEGINNING
 0 4370   0157           GROUPZ+1           /WORD OF ACQUISITION GROUP
 0 4371   4504           ADJ  C140          /"GROUPZ" CONTAINS A <TWISZ FX>
 0 4372   5425           STJ  SPNT+1        /INSTRUCTION
 0 4373   0500           TWLDJ
 0 4374   0156           GROUPZ
 0 4375   5421           STJ  SPNT
 0 4376   0640  X02,     TWJPS              /PRINT HEADING
 0 4377   2403           UNPACK
 0 4400   5575           HDNG
 0 4401   7103           XCT  X02           /<JPS UNPACK>
 0 4402   5613           SHDG
 0 4403   1514           CLR  INC J         /SET LIMIT PAIR NUMBER=1
 0 4404   5527           STJ  LMPR
 0 4405   1510           CLR  J
 0 4406   5530           STJ  LMPR+1
 0 4407   5130           LDJ  LLMA
 0 4410   0540           TWSTJ
 0 4411   4655           LAPR
 0 4412   5136           LDJ  BLMT          /INITIATE POINTER TO LIMIT PAIR
 0 4413   6414           JPS  POPR
 0 4414   6326  [RETURN  PRPT

 0 4415   1642  IN2I,    IN2
 0 4416   0000  SPNT,    0          /DOUBLE PRECISION <TWLDJ> POINTER TO
 0 4417   0000           0          /STARTING ADDRESS OF ACQUISITION GROUP

/PRINT DOUBLE PRECISION INTEGER POINTED TO
/BY "LMTP" AND ADVANCE "LMTP" TO NEXT DOUBLE
/PRECISION INTEGER

 0 4420   0000  PLNO,    0
 0 4421   7015           XCT  X01           /<ISZ ECHOF>SET FLAG FOR PRINT ONLY
 0 4422   7016           XCT  X03           /<JPS INEC>
 0 4423   0000  LMTP,    0
 0 4424   3501           ISZ  LMTP          /ADVANCE POINTER TO NEXT VALUE
 0 4425   3502           ISZ  LMTP
 0 4426   6306  [RETURN  PLNO

/ENTER WITH J=POINTER TO FIRST PAIR TO BE LISTED
/AND "LAPR" INITIALIZED WITH POINTER TO END OF PAIR
/BUFFER TO BE LISTED+1; "LMPR" SET TO NUMBER OF FIRST
/PAIR TO BE LISTED; AND "SPNT" INITIALIZED TO ADDRESS
/OF BEGINNING OF GROUP

 0 4427   0000  POPR,    0
 0 4430   5505           STJ  LMTP
```

```
 0 4431   0500  POPR1,  TWLDJ            /LAST PAIR ENTERED+1?
 0 4432   4423          LMTP
 0 4433   0240          TWSMJ
 0 4434   4655          LAPR
 0 4435   6306  [RETURN POPR             /YES
 0 4436   0340  X01,    TWISZ            /PRINT LIMIT PAIR NO.
 0 4437   2106          ECHOF
 0 4440   0640  X03,    TWJPS
 0 4441   2140          INEC
 0 4442   4355          LMPR
 0 4443   6523          JPS   PLNO       /PRINT INTERVAL START CHANNEL
 0 4444   6524          JPS   PLNO       /PRINT INTERVAL STOP CHANNEL
 0 4445   5122          LDJ   LMTP       /RESTORE "LMTP"
 0 4446   2304          SUBL  04
 0 4447   5524          STJ   LMTP
 0 4450   6420          JPS   CALC       /PERFORM CALCULATIONS FOR ONE PAIR
 0 4451   7113          XCT   X01        /<ISZ ECHOF>"INEC" PRINT ONLY
 0 4452   7112          XCT   X03        /<JPS INEC>PRINT BACKGROUND
 0 4453   4661          BGND
 0 4454   7116          XCT   X01        /<ISZ ECHOF>PRINT ONLY
 0 4455   7115          XCT   X03        /<JPS INEC>PRINT NET COUNTS
 0 4456   4653          NTOT
 0 4457   7121          XCT   X01        /<ISZ ECHOF>
 0 4460   7120          XCT   X03        /<JPS INEC>PRINT PEAK ENERGY
 0 4461   4656          PADD
 0 4462   0640          TWJPS
 0 4463   2403          UNPACK
 0 4464   5627          CRLF
 0 4465   0340          TWISZ            /ADVANCE LIMIT PAIR NUMBER
 0 4466   4355          LMPR
 0 4467   6136          JMP   POPR1      /NO

/E1680
```

```
/CALCULATE REPORT VALUES
/ENTER WITH "LMTP" POINTING TO TWO DOUBLE PRECISION
/INTEGER CHANNELS
/EXIT WITH "SUML,SUMH"=GROSS COUNTS UNDER PEAK IN
/SPECIFIED INTERVAL; "HPTL,HPTH"=ADDRESS OF HIGHEST
/CHANNEL CONTAINING THE HIGHEST POINT
/IN SPECIFIED INTERVAL; AND "PADD"= ENERGY OF HIGHEST
/POINT AS CALCULATED FROM CALIBRATION COEFFICIENTS "A" AND "B"

 0 4470   0000  CALC,   0
 0 4471   0640  X04,    TWJPS           /CONVERT STARTING CHANNEL INTO
 0 4472   2441          IM              /ADDRESS POINTER
 0 4473   5350          ILOD@ LMTP      /GET STARTING LIMIT
 0 4474   5447          ISTR FPNT       /SAVE STARTING LIMIT
 0 4475   7360          IMUL@ IN2I
 0 4476   4361          ISUB@ IN2I
 0 4477   4561          IADD SPNT
 0 4500   0000          IEXT            /RETURNS WITH JK=IAC
 0 4501   5446          STJ  DATP+1     /TRANSFER POINTER FROM IAC TO "DATP"
 0 4502   0540          TWSTJ           /INITIALIZE HIGHEST POINT ADDRESS
 0 4503   4657          PADD+1
 0 4504   1374          EXJK
 0 4505   5441          STJ  DATP
 0 4506   0540          TWSTJ
 0 4507   4656          PADD
 0 4510   3565          ISZ  LMTP       /INCREMENT LIMIT BUFFER POINTER
 0 4511   3566          ISZ  LMTP
 0 4512   7121          XCT  X04        /<JPS IM>AND CALCULATE CHANNEL COUNTER
 0 4513   5370          ILOD@ LMTP      /GET STOPPING LIMIT
 0 4514   4027          ISUB FPNT       /SUBTRACT STARTING LIMIT
 0 4515   0000          IEXT            /RETURNS WITH JK=IAC=NO. OF CHANNELS
 0 4516   3573          ISZ  LMTP       /INCREMENT LIMIT BUFFER POINTER
 0 4517  <3574          ISZ  LMTP
 0 4520   1504          INC  J          /(STOP-START)+1
 0 4521   5424          STJ  DCNT       /SET INTERVAL COUNTER
 0 4522   0540          TWSTJ           /SAVE INTERVAL WIDTH
 0 4523   4651          IWID
 0 4524   7022          XCT  DATP       /<TWLDJ FX "DATP+1">
 0 4525   5416          STJ  FPNT       /SAVE VALUE OF FIRST POINT OF INTERVAL
 0 4526   7034          XCT  X22        /<STJ SUML>AND INITIALIZE TOTAL
 0 4527   5646          STJ@ HPTLI      /AND INITIALIZE HIGHEST POINT
 0 4530   3417          ISZ  DATP+1     /CHANNEL CANNOT CROSS MEMORY FIELDS
 0 4531   7015          XCT  DATP       /<LDJ FX "DATP+1">
 0 4532   5412          STJ  FPNT+1
 0 4533   7035          XCT  X24        /<STJ SUMH>
 0 4534   7050          XCT  X13        /<STJ HPTH>
 0 4535   3412          ISZ  DATP+1     /LAST CHANNEL IN FIELD?
 0 4536   1442          SKIP            /NO
 0 4537   3407          ISZ  DATP       /YES- INCREMENT MEMORY FIELD
 0 4540   3005  PRPT4,  DSZ  DCNT       /LAST CHANNEL?
```

```
0 4541  6005          JMP  POPR2       /NO
0 4542  6052          JMP  PRPT3       /YES

0 4543  0000  FPNT,   0        /COUNTS IN FIRST CHANNEL IN INTERVAL
0 4544  0000          0        /USED ALSO FOR TEMPORARY STORAGE
0 4545  0000  DCNT,   0        /INTERVAL COUNTER

          POPR2       *.
0 4546  0504  DATP,   TWLDJ F0
0 4547  0000          0
0 4550  1204          LKFJ             /LOW ORDER TO K
0 4551  3502          ISZ  DATP+1
0 4552  7104          XCT  DATP        /<LDJ FX "DATP+1">HIGH ORDER IN J
0 4553  1301          LRSFJK
0 4554  3505          ISZ  DATP+1
0 4555  1442          SKIP
0 4556  3510          ISZ  DATP
0 4557  1374          EXJK
0 4560  1450          CLR  0           /ADD TO "SUM"
0 4561  4602          ADJ@ SUMLI
0 4562  0540  X22,    TWSTJ
0 4563  4645  SUMLI,  SUML
0 4564  1455          SIZ  CLR 0
0 4565  1604          INC  K
0 4566  1374          EXJK
0 4567  4602          ADJ@ SUMHI
0 4570  0540  X24,    TWSTJ
0 4571  4646  SUMHI,  SUMH
0 4572  1302          LJKFRS           /HIGHEST POINT?- RESTORE JK
0 4573  1450          CLR  0           /(J=HIGH ORDER,K= LOW)
0 4574  0410          TWSBK
0 4575  4647  HPTLI,  HPTL
0 4576  1455          SIZ  CLR 0
0 4577  2301          SUBL 01
0 4600  4050          SBJ  HPTH
0 4601  1455          SIZ  CLR 0       /POSITIVE RESULT?
0 4602  6142          JMP  PRPT4       /NO- DO NEXT POINT
0 4603  1302          LJKFRS           /YES- REPLACE OLD VALUE WITH NEW
0 4604  5444  X13,    STJ  HPTH
0 4605  0550          TWSTK
0 4606  4647          HPTL
0 4607  5140          LDJ  DATP+1      /AND UPDATE ADDRESS
0 4610  5446          STJ  PADD
0 4611  5143          LDJ  DATP
0 4612  5445          STJ  PADD+1
0 4613  6153          JMP  PRPT4       /DO NEXT POINT

0 4614  1302  PRPT3,  LJKFRS           /RESTORE JK
0 4615  0550          TWSTK            /AND STORE IN TAC
0 4616  2505          LORD
```

```
 0 4617   0540            TWSTJ
 0 4620   2506            HORD
 0 4621   0640   X28,     TWJPS            /CALCULATE BACKGROUND
 0 4622   2441            IM
 0 4623   4560            IADD FPNT
 0 4624   6637            IDIV@ IN2I1
 0 4625   7024            IMUL IWID
 0 4626   5433            ISTR BGND        /STORE BACKGROUND
 0 4627   5016            ILOD SUML        /GET GROSS COUNTS
 0 4630   4031            ISUB BGND        /AND CALCULATE NET
 0 4631   5422            ISTR NTOT        /STORE NET COUNTS
 0 4632   5024            ILOD PADD        /CONVERT ADDRESS OF HIGHEST
 0 4633   4225            ISUB@ SPNTI      /POINT TO CHANNEL NUMBER
 0 4634   6627            IDIV@ IN2I1
 0 4635   5421            ISTR PADD
 0 4636   0000            IEXT
 0 4637   0640            TWJPS            /CONVERT CHANNEL NUMBER TO ENERGY
 0 4640   4723            PECA
 0 4641   4656            PADD
 0 4642   0620
 0 4643   4470   [RETURN  CALC

 0 4644   1656   II1I,    II1      /POINTER TO DOUBLE PRECISION CONSTANT IN 41-106
 0 4645   0000   SUML,    0        /GROSS TOTAL UNDER PEAK
 0 4646   0000   SUMH,    0
 0 4647   0000   HPTL,    0        /VALUE OF HIGHEST POINT ON INTERVAL
 0 4650   0000   HPTH,    0
 0 4651   0000   IWID,    0        /WIDTH OF INTERVAL
 0 4652   0000            0000     /HIGH ORDER MUST BE=0
 0 4653   0000   NTOT,    0        /NET TOTAL UNDER PEAK(GROSS-BACKGROUND)
 0 4654   0000            0
 0 4655   4000   LAPR,    LMTB     /MOVING POINTER TO LAST PAIR TO BE PRINTED
 0 4656   0000   PADD,    0        /ADDRESS OF HIGHEST POINT IN INTERVAL
 0 4657   0000            0        /CONVERTED TO ENERGY BEFORE PRINTING
 0 4660   4416   SPNTI,   SPNT
 0 4661   0000   BGND,    0        /BACKGROUND COUNTS IN INTERVAL
 0 4662   0000            0

/E3123
```

```
 0 4663  1642  IN2I1,  IN2

/PRINT REPORT FOR CURRENT MARKERS ONLY

 0 4664  0000  PRCM,   0
 0 4665  0640  X26,    TWJPS
 0 4666  2403          UNPACK
 0 4667  5627          CRLF
 0 4670  6417          JPS  SSTC        /INITIALIZE "SPNT"
 0 4671  1510          CLR  J           /SET PAIR NUMBER=0 TO INDICATE
 0 4672  0540          TWSTJ            /MARKERS
 0 4673  4355          LMPR
 0 4674  0500  X27,    TWLDJ
 0 4675  4360          MGCLI
 0 4676  2204          ADDL 04          /INITIALIZE END POINTER TO
 0 4677  0540          TWSTJ            /END OF CURRENT MARKERS BUFFER
 0 4700  4655          LAPR             /AS USED IN 41+1060
 0 4701  2304          SUBL 04          /RESTORE J
 0 4702  0640  X20,    TWJPS            /PERFORM CALCULATIONS AND PRINT REPORT
 0 4703  4427          POPR
 0 4704  6320  [RETURN PRCM

 0 4705  1640  GSCI,   GSC
 0 4706  0504  CTWLD,  TWLDJ F0

/INITIALIZE  "SPNT" WITH STARTING ADDRESS OF BEGINNING
/OF CURRENTLY DISPLAYED GROUP

 0 4707  0000  SSTC,   0
 0 4710  7167  X29,    XCT  X28         /<JPS IM>
 0 4711  5304          ILOD@ GSCI
 0 4712  7327          IMUL@ IN2I1
 0 4713  0000          IEXT
 0 4714  0450          TWADK
 0 4715  4706          CTWLD
 0 4716  0550          TWSTK
 0 4717  4417          SPNT+1
 0 4720  0540          TWSTJ
 0 4721  4416          SPNT
 0 4722  6313  [RETURN SSTC

/CALCULATE ENERGY FROM CALIBRATION COEFFICIENTS: "BN,BD" AND "ACON"
/WHICH ARE SET UP BY "ECOF."
/REPLACES CHANNEL NO. (DOUBLE PRECISION INTEGER) POINTED
/TO BY CALL+1 WITH ENERGY
/RETURNS TO CALL+2

 0 4723  0000  PECA,   0
 0 4724  5301          LDJ@ PECA
 0 4725  3502          ISZ  PECA
```

```
 0 4726  5411           STJ  PNTR1
 0 4727  7117           XCT  X29          /<JPS IM>
 0 4730  5207           ILOD@ PNTR1
 0 4731  7037           IMUL BN
 0 4732  6440           IDIV BD
 0 4733  4433           IADD ACON
 0 4734  5603           ISTR@ PNTR1
 0 4735  0000           IEXT
 0 4736  6313  [RETURN  PECA

 0 4737  0000  PNTR1,   0

/MANUAL PRINT REPORT

 0 4740  0000  MPRR,    0
 0 4741  7154           XCT  X26          /<JPS UNPACK>
 0 4742  5572           PRMM
 0 4743  6534           JPS  SSTC         /INITIALIZE "SPNT"
 0 4744  0640           TWJPS             /GET LIMIT PAIR NO.
 0 4745  4200           IPSP
 0 4746  1400           IDLE              /LAST PAIR ENTERED IS LARGEST LEGAL PAI
 0 4747  6025           JMP  MPRR1
 0 4750  7163           XCT  X26          /<JPS UNPACK>
 0 4751  5575           HDNG
 0 4752  7165  X32,     XCT  X26          /<JPS UNPACK>
 0 4753  5613           SHDG
 0 4754  0500           TWLDJ
 0 4755  4357           LLMA
 0 4756  0540  MPRR2,   TWSTJ
 0 4757  4655           LAPR
 0 4760  7106           XCT  X32          /<JPS UNPACK>
 0 4761  5627           CRLF
 0 4762  0500           TWLDJ
 0 4763  4324           LMPP
 0 4764  7162           XCT  X20          /<JPS POPR>
 0 4765  6325  [RETURN  MPRR

 0 4766  0000  ACON,    0        /CALIBRATION CONSTANT
 0 4767  0000           0
 0 4770  0000  BN,      0        /CALIBRATION COEFFICIENT NUMERATOR
 0 4771  0000           0
 0 4772  0000  BD,      0        /CALIBRATION COEFFICIENT DENOMINATOR
 0 4773  0000           0

 0 4774  0500  MPRR1,   TWLDJ
 0 4775  4324           LMPP
 0 4776  2204           ADDL 04
 0 4777  6121           JMP  MPRR2

/UPDATE STATUS DISPLAY OF PEAK PARAMETERS BETWEEN
```

```
/CURRENT MARKERS

 0 5000  0000  MSTD,   0
 0 5001  6572          JPS  SSTC
 0 5002  0500  X12,    TWLDJ
 0 5003  4360          MGCLI
 0 5004  0540          TWSTJ
 0 5005  4423          LMTP
 0 5006  0640          TWJPS
 0 5007  4470          CALC
 0 5010  6310  [RETURN MSTD

/CALCULATE ENERGY CALIBRATION COEFFICIENTS

 0 5011  0000  ECOF,   0
 0 5012  7140          XCT  X32        /<JPS UNPACK>
 0 5013  5630          ENCF
 0 5014  0640  X31,    TWJPS           /GET "X1"
 0 5015  2140          INEC
 0 5016  5073          X1
 0 5017  7145          XCT  X32        /<JPS UNPACK>
 0 5020  5643          EM1
 0 5021  7105          XCT  X31        /<JPS INEC>GET "Y1"
 0 5022  5077          Y1
 0 5023  7151          XCT  X32        /<JPS UNPACK>
 0 5024  5647          PM1
 0 5025  7111          XCT  X31        /<JPS INEC>GET "X2"
 0 5026  5075          X2
 0 5027  7155          XCT  X32        /<JPS UNPACK>
 0 5030  5652          EM2
 0 5031  7115          XCT  X31        /<JPS INEC>GET "Y2"
 0 5032  5101          Y2
 0 5033  7161  X11,    XCT  X32        /<JPS UNPACK>
 0 5034  5656          OUT1
 0 5035  0640  X09,    TWJPS
 0 5036  2441          IM
 0 5037  5036          ILOD X2         /CALCULATE DENOMINATOR OF CALIBRA-
 0 5040  4033          ISUB X1         /TION COEFFICIENT
 0 5041  5547          ISTR BD
 0 5042  5037          ILOD Y2         /CALCULATE NUMERATOR OF CALIBRA-
 0 5043  4034          ISUB Y1         /TION COEFFICIENT
 0 5044  5554          ISTR BN
 0 5045  6553          IDIV BD         /PRINT CALIBRATION COEFFICIENT(SLOPE)
 0 5046  3400          IOUT            /(A IN ENERGY=A*CHANNEL+B)
 0 5047  0000          IEXT
 0 5050  7115          XCT  X11        /<JPS UNPACK>
 0 5051  0003          TTY
 0 5052  7115          XCT  X09        /<JPS IM>
 0 5053  5163          ILOD BN
 0 5054  7017          IMUL X1
```

```
 0 5055   6563            IDIV BD
 0 5056   6000            INEG                /CALCULATE CALIBRATION CONSTANT
 0 5057   4420            IADD Y1
 0 5060   5572            ISTR ACON
 0 5061   0000            IEXT
 0 5062   7127            XCT  X11            /<JPS UNPACK>
 0 5063   5660            OUT2
 0 5064   0340            TWISZ
 0 5065   2106            ECHOF
 0 5066   7152            XCT  X31            /<JPS INEC>
 0 5067   2505            LORD
 0 5070   7135            XCT  X11            /<JPS UNPACK>
 0 5071   5665            OUT3
 0 5072   6361   [RETURN  ECOF

 0 5073   0000   X1,      0          /FIRST CHANNEL VALUE
 0 5074   0000            0
 0 5075   0000   X2,      0          /SECOND CHANNEL VALUE
 0 5076   0000            0
 0 5077   0000   Y1,      0          /FIRST ENERGY VALUE(TO CORRESPOND TO
 0 5100   0000            0          /CHANNEL VALUE "X1")
 0 5101   0000   Y2,      0          /SECOND CHANNEL VALUE(TO CORRESPOND TO
 0 5102   0000            0          /CHANNEL VALUE "X2")

/E2707
```

```
/CHECK FOR PRESET COUNTS

 0 5103  0000  PSCN,    0
 0 5104  0500           TWLDJ            /LAST CHAR
 0 5105  2320           CHARX
 0 5106  2410           SMJ  P121        /Q ?
 0 5107  1442           SKIP
 0 5110  7030           XCT  X33         /NO =ERROR
 0 5111  7156           XCT  X11         /<JPS UNPACK>
 0 5112  5707           SPCM
 0 5113 <7177           XCT  X31         /<JPS INEC>
 0 5114  5317           PSCL
 0 5115  6312  [RETURN PSCN

 0 5116  0121  P121,    121

/INITIATE "RCNT"(MODIFICATION OF "ACQUIRE" COMMAND)

 0 5117  5050  SRCT,    LDJ  C144
 0 5120  5446           STJ  RCNT
 0 5121  0500           TWLDJ            /SAVE CURRENT MARKER LOCATIONS
 0 5122  1266  MGCLI1,  MGCL
 0 5123  5437           STJ  LMKR
 0 5124  0500           TWLDJ
 0 5125  1270  MGCRI,   MGCR
 0 5126  5435           STJ  RMKR
 0 5127  0600           TWJMP
 0 5130  2062           AQEXIT+1

/DISPLAY LIMIT PAIR (SET MARKERS= LIMIT PAIR)

 0 5131  0000  DLMP,    0
 0 5132 <7177           XCT  X11         /<JPS UNPACK>
 0 5133  5675           DMES
 0 5134  0640           TWJPS            /GET PAIR NO.
 0 5135  4200           IPSP
 0 5136  1400           IDLE             /DO NOT ALLOW LAST PAIR+1
 0 5137  6003           JMP  DLMP1
 0 5140  0640  X33,     TWJPS            /"ALL" SPECIFICATION NOT ALLOWED
 0 5141  2120           ERROR

 0 5142  5120  DLMP1,   LDJ MGCLI1       /SET UP POINTER TO BEGINNING
 0 5143  5407           STJ  PNTR2       /OF MARKER BUFFER
 0 5144  1510           CLR  J
 0 5145  2204           ADDL 04
 0 5146  5417           STJ CNTR2
 0 5147  0520  DLMP2,   TWLDJ@
 0 5150  4324  LMPPI,   LMPP
 0 5151  0540           TWSTJ
 0 5152  0000  PNTR2,   0
```

```
0 5153   3501            ISZ   PNTR2
0 5154   3704            ISZ@  LMPPI
0 5155   3010            DSZ   CNTR2
0 5156   6107            JMP   DLMP2
0 5157   0640            TWJPS                 /UPDATE STATUS FOR NEW MARKER VALUES
0 5160   5000            MSTD
0 5161   6330  [RETURN   DLMP
```

```
/RATE CALCULATION -PART OF BACKGROUND DISPLAY DURING ACQ

 0 5162   0000  LMKR,    0                    /MARKER LOC AT START OF ACQ
 0 5163   0000  RMKR,    0
 0 5164   0000  CNTR1,   0
 0 5165   0000  CNTR2,   0
 0 5166   0000  RCNT,    0          /CLOCK COUNTER FOR RATE DETERMINATION
 0 5167   0144  C144,    0144
 0 5170   0140  CX140,   140
 0 5171   0362  RTRNI,   RETRN
 0 5172   2025  AQOFFI,  AQOFF

/CALCULATE RATE OF ACQUISITION FOR 1-SECOND INTERVALS
/(MODIFICATION OF CLOCK SERVICE)

 0 5173   0340  CDTR,    TWISZ                /INCREMENT CLOCK COUNTER
 0 5174   2100            CLOCK1
 0 5175   6012            JMP  CDTR2
 0 5176   0340            TWISZ
 0 5177   2101            CLOCK1+1
 0 5200   6007            JMP  CDTR2
 0 5201   0500            TWLDJ                /CLOCK EXPIRED -DID USER SET A TIME?
 0 5202   2076            TIME
 0 5203   0510            TWLDK
 0 5204   2077            TIME+1
 0 5205   1705            SIZ  JK
 0 5206   6314            JMP@ AQOFFI          /YES- CLOCK EXPIRED- STOP ACQUISITION
 0 5207   3121  CDTR2,   DSZ  RCNT            /NO SET TIME- 10 SECONDS ELAPSED?
 0 5210   6317  X14,     JMP@ RTRNI           /NO
 0 5211   5122            LDJ  C144            /YES- RE-INITIALIZE COUNTER
 0 5212   5524            STJ  RCNT
 0 5213   5131            LDJ  LMKR            /SET-UP POINTERS
 0 5214   1610            CLR  K
 0 5215   2301            SUBL 01
 0 5216   1341            SFTZ 01 JK
 0 5217   0440            TWADJ
 0 5220   0156            GROUPZ
 0 5221   5422            STJ  RPNT+1
 0 5222   1374            EXJK
 0 5223   0440            TWADJ
 0 5224   0157            GROUPZ+1
 0 5225   4535            ADJ  CX140
 0 5226   5414            STJ  RPNT
 0 5227   5144            LDJ  RMKR            /CALCULATE POINT COUNTER
 0 5230   4146            SBJ  LMKR
 0 5231   2201            ADDL 01
 0 5232   5546            STJ  CNTR1
 0 5233   5060            LDJ  TSML            /SAVE LAST TOTAL
 0 5234   5461            STJ  OSML
 0 5235   5057            LDJ  TSMH
```

```
0 5236   5460            STJ   OSMH
0 5237   1510            CLR   J
0 5240   5453            STJ   TSML          /CLEAR SUM
0 5241   5453            STJ   TSMH
            CDTR1        =.
0 5242   0505  RPNT,     TWLDJ F1
0 5243   0000            0
0 5244   1450            CLR   0
0 5245   4446            ADJ   TSML
0 5246   5445            STJ   TSML
0 5247   3504            ISZ   RPNT+1
0 5250   7106            XCT   RPNT          /<LDJ FX "RPNT+1">
0 5251   1455            SIZ   CLR 0
0 5252   1504            INC   J
0 5253   4441            ADJ   TSMH
0 5254   5440            STJ   TSMH
0 5255   3512            ISZ   RPNT+1
0 5256   1442            SKIP
0 5257   3515            ISZ   RPNT
0 5260  <3174            DSZ   CNTR1         /LAST POINT IN INTERVAL?
0 5261   6117            JMP   CDTR1         /NO
0 5262   1450            CLR   0             /CALCULATE DIFFERENCE BETWEEN
0 5263   5030            LDJ   TSML          /LAST AND LATEST TOTALS WHICH IS
0 5264   4031            SBJ   OSML          /=RATE PER SECOND
0 5265   5430            STJ   OSML
0 5266   5026            LDJ   TSMH
0 5267   1455            SIZ   CLR 0
0 5270   2301            SUBL  01
0 5271   4025            SBJ   OSMH
0 5272   5424            STJ   OSMH
0 5273   5024            LDJ   PSCL          /PRESET COUNT ?
0 5274   0510            TWLDK
0 5275   5320            PSCH
0 5276   1705            SIZ   JK
0 5277   6002            JMP   CDTR4         /YES
0 5300   7170            XCT   X14           /<JMP RETRN>

0 5301   4012  CDTR4,    SBJ   TSML          /PRESET COUNT EXCEEDED ?
0 5302   1374            EXJK
0 5303   1455            SIZ   CLR 0
0 5304   2301            SUBL  01
0 5305   4007            SBJ   TSMH
0 5306   1455            SIZ   CLR 0
0 5307   6203            JMP@  AQOFI         /YES
0 5310   0600            TWJMP               /NO
0 5311   0362            RETRN

0 5312   2025  AQOFI,    AQOFF
0 5313   0000  TSML,     0                   /TOTAL BETWEEN MARKERS
0 5314   0000  TSMH,     0
```

```
 0 5315  0000  OSML,   0
 0 5316  0000  OSMH,   0
 0 5317  0000  PSCL,   0                  /PRESET COUNTS
 0 5320  0000  PSCH,   0
 0 5321  5533  XSTSI,  XSTS-1
 0 5322  5555  XATNI,  XATN-1
 0 5323  0145  CX145,  0145

 0 5324  0000  RMDP,   0                  /RESTORE NORMAL MARKER DISPLAY
 0 5325  5104          LDJ  XSTSI         /RESTORE X-RAY STATUS DISPLAY
 0 5326  5625          STJ@ LDF4I
 0 5327  5626          STJ@ STATXI
 0 5330  0500          TWLDJ
 0 5331  4360          MGCLI
 0 5332  5661          STJ@ MGCLPI
 0 5333  0500          TWLDJ
 0 5334  5125          MGCRI
 0 5335  5661          STJ@ MGCRPI
 0 5336  5004          LDJ  MGCCI
 0 5337  5662          STJ@ MGCCPI
 0 5340  0600          TWJMP
 0 5341  0230          DECODE+1

/E2763
```

```
 0 5342   1525  MGCCI,   MGCC
 0 5343   0113  C113,    0113
 0 5344   0114  C114,    0114
 0 5345   2120  ERRI1,   ERROR
 0 5346   0000  ATNO,    0
 0 5347   0000            0

/DISPLAY PRINCIPAL ENERGY MARKERS

 0 5350   0000  DENR,    0
 0 5351   5127            LDJ  XATNI       /RESET X-RAY STATUS DISPLAY
 0 5352   0540            TWSTJ            /FOR ATOMIC NUMBER
 0 5353   2256  LDF4I,   LDF+4
 0 5354   0540            TWSTJ
 0 5355   1041  STATXI,  STATX
 0 5356   0640            TWJPS
 0 5357   2403            UNPACK
 0 5360   5701            ATNM
 0 5361   0640            TWJPS            /GET ATOMIC NO.
 0 5362   2140            INEC
 0 5363   5346            ATNO
 0 5364   5116            LDJ  ATNO
 0 5365   1501            SNZ  J           /ZERO?
 0 5366   6721            JPS@ ERRI1       /YES
 0 5367   1450            CLR  0           /NO- GREATER THAN 100(10) ?
 0 5370   4145            SBJ  CX145
 0 5371   1451            SNZ  CLR 0
 0 5372   6725            JPS@ ERRI1       /YES
 0 5373   4550            ADJ  CX145       /NO RESTORE J
 0 5374   5472            STJ  CNTR3
 0 5375   0500  DENR5,   TWLDJ            /INPUT TERMINATED WITH "K" OR "L"?
 0 5376   2320            CHARX
 0 5377   2534            SMJ  C113
 0 5400  >6076            JMP  DENR6       /YES- "K"
 0 5401   2535            SMJ  C114
 0 5402   6004            JMP  DENR7       /YES- "L"
 0 5403   0640            TWJPS            /NO- WAIT FOR CHARACTER FROM KEYBOARD
 0 5404   0245            FCHAR
 0 5405   6110            JMP  DENR5       /GO CHECK IT
 0 5406   5066  DENR7,   LDJ  BLTB
 0 5407   6414            JPS  GMKR
 0 5410   0003            0003
 0 5411   5064  DENR4,   LDJ  MKR1I       /REDIRECT MARKER DISPLAY
 0 5412   0540            TWSTJ
 0 5413   1513  MGCLPI,  MGCLP
 0 5414   2202            ADDL 02
 0 5415   0540            TWSTJ
 0 5416   1514  MGCRPI,  MGCRP
 0 5417   2202            ADDL 02
 0 5420   0540            TWSTJ
```

```
 0 5421   1515  MGCCPI, MGCCP
 0 5422   6352  [RETURN DENR


/GET MARKERS LOCATIONS FROM TABLE
/ENTER WITH POINTER TO BEGINNING OF TABLE IN "J" AND
/NUMBER OF MARKER LOCATIONS TO BE RETREIVED IN CALL+1
/RETURN TO CALL+2

 0 5423   0000  GMKR,   0
 0 5424   5464          STJ  ETLP
 0 5425   5050          LDJ  MKR1I       /SET UP POINTER TO MARKER DISPLAY
 0 5426   5437          STJ  PNTR9       /BUFFER
 0 5427   5062          LDJ  ENR1I       /AND ENERGY BUFFER
 0 5430   5434          STJ  PNTR8
 0 5431   5306          LDJ@ GMKR        /SET UP MARKER COUNTER
 0 5432   5455          STJ  CNTR4
 0 5433   3510          ISZ  GMKR
 0 5434   3032  GMKR1,  DSZ  CNTR3
 0 5435   6032          JMP  GMKR2
 0 5436   5252  GMKR9,  LDJ@ ETLP        /TRANSFER TO DISPLAY AREA
 0 5437   3451          ISZ  ETLP
 0 5440   5455          STJ  ITMP1
 0 5441   5247          LDJ@ ETLP
 0 5442   3446          ISZ  ETLP
 0 5443   5453          STJ  ITMP1+1
 0 5444   0640          TWJPS            /CALCULATE CHANNEL
 0 5445   2441          IM
 0 5446   5047          ILOD ITMP1
 0 5447   5615          ISTR@ PNTR8
 0 5450   4242          ISUB@ ACONI
 0 5451   7243          IMUL@ BDI
 0 5452   6641          IDIV@ BNI
 0 5453   5612          ISTR@ PNTR9
 0 5454   0000          IEXT
 0 5455   3410          ISZ  PNTR9
 0 5456   3407          ISZ  PNTR9
 0 5457   3405          ISZ  PNTR8
 0 5460   3404          ISZ  PNTR8
 0 5461   3026          DSZ  CNTR4       /LAST ONE?
 0 5462   6124          JMP  GMKR9       /NO
 0 5463   6340  [RETURN GMKR             /YES

 0 5464   0000  PNTR8,  0
 0 5465   0000  PNTR9,  0
 0 5466   0000  CNTR3,  0

 0 5467   5021  GMKR2,  LDJ  ETLP        /ADVANCE TABLE POINTER
 0 5470   4417          ADJ  CNTR4
 0 5471   4416          ADJ  CNTR4
```

```
 0 5472  5416           STJ   ETLP
 0 5473  6137           JMP   GMKR1

 0 5474  6537  BLTB,    LTBB
 0 5475  5520  MKR1I,   MKR1

 0 5476  5021  DENR6,   LDJ   BKTB
 0 5477  6554           JPS   GMKR        /GET TWO MARKERS
 0 5500  0002           0002
 0 5501  1510           CLR   J           /CLEAR THIRD MARKER
 0 5502  5422           STJ   MKR3
 0 5503  5422           STJ   MKR3+1
 0 5504  5426           STJ   ENR1+4
 0 5505  5426           STJ   ENR1+5
 0 5506 <6175           JMP   DENR4

 0 5507  0000  CNTR4,   0
 0 5510  0000  ETLP,    0
 0 5511  5526  ENR1I,   ENR1
 0 5512  4766  ACONI,   ACON
 0 5513  4770  BNI,     BN
 0 5514  4772  BDI,     BD
 0 5515  0000  ITMP1,   0
 0 5516  0000           0
 0 5517  5717  BKTB,    KTBB

 0 5520  0000  MKR1,    0        /THESE THREE DOUBLE PRECISION INTEGERS
 0 5521  0000           0        /MUST BE STORED SEQUENTIALLY
 0 5522  0000  MKR2,    0
 0 5523  0000           0
 0 5524  0000  MKR3,    0
 0 5525  0000           0

 0 5526  0000  ENR1,    0
 0 5527  0000           0
 0 5530  0000           0
 0 5531  0000           0
 0 5532  0000           0
 0 5533  0000           0

/E1984
```

```
/STATUS DISPLAY LISTS

/ITEMS ARE DISPLAYED FROM RIGHT TO LEFT
/BETWEEN CRLF'S

 0 5534  1271  XSTS,   MGCR+1   /RIGHT MARKER
 0 5535  0075          0075     /DASH
 0 5536  1267          MGCL+1   /LEFT MARKER
 0 5537  0057          0057     /CRLF
 0 5540  4662          BGND+1   /TOTAL BACKGROUND
 0 5541  0077          0077     /SLASH
 0 5542  4654          NTOT+1   /NET TOTAL ON MARKER INTERVAL
 0 5543  0057          0057     /CRLF
 0 5544  4657          PADD+1   /PEAK ENERGY
 0 5545  7760          7760     /TERMINATOR

 0 5546  2101  XCLK,   CLOCK1+1         /TIME REMAINING
 0 5547  0077          0077     /SLASH
 0 5550  2077          TIME+1   /SET TIME
 0 5551  0057          0057     /CRLF
 0 5552  5316          OSMH     /COUNTS/SECOND
 0 5553  0077          0077     /SLASH
 0 5554  5314          TSMH     /TOTAL COUNTS
 0 5555  7760          7760     /TERMINATOR

 0 5556  5347  XATN,   ATNO+1   /ATOMIC NUMBER
 0 5557  0075          0075     /DASH
 0 5560  5533          ENR1+5   /FIRST ENERGY
 0 5561  0075          0075     /DASH
 0 5562  5531          ENR1+3   /SECOND ENERGY
 0 5563  0057          0057     /CRLF
 0 5564  5527          ENR1+1   /THIRD ENERGY
 0 5565  7760          7760     /TERMINATOR

/MESSAGE STRINGS

 0 5566  0075  SPCS,   0075

 0 5567  0063  LIMS,   0063     / SET
 0 5570  4564          4564
 0 5571  0075          0075

 0 5572  6251  PRMM,   6251     /RINT
 0 5573  5664          5664
 0 5574  0075          0075

 0 5575  7777  HDNG,   7777
 0 5576  5156          5156     /INTERVAL   START    STOP
 0 5577  6445          6445
 0 5600  6266          6266
```

```
0 5601   4154            4154
0 5602   0000            0000
0 5603   0063            0063
0 5604   6441            6441
0 5605   6264            6264
0 5606   0000            0000
0 5607   0000            0000
0 5610   6364            6364
0 5611   5760            5760
0 5612   7575            7575

0 5613   0000   SHDG,    0000     /   BKGND      NET     PEAK
0 5614   0042            0042
0 5615   5347            5347
0 5616   5644            5644
0 5617   0000            0000
0 5620   0000            0000
0 5621   0056            0056
0 5622   4564            4564
0 5623   0000            0000
0 5624   0000            0000
0 5625   6045            6045
0 5626   4153            4153
0 5627   7775   CRLF,    7775

0 5630   5645   ENCF,    5645     /NERGY CALIBRATE,CRLF
0 5631   6247            6247     /PCH1
0 5632   7100            7100
0 5633   4341            4341
0 5634   5451            5451
0 5635   4262            4262
0 5636   4164            4164
0 5637   4577            4577
0 5640   6043            6043
0 5641   5021            5021
0 5642   7575            7575

0 5643   0000   EM1,     0000     /     E1
0 5644   0000            0000
0 5645   4521            4521
0 5646   7575            7575

0 5647   7760   PM1,     7760     /CRLF,PCH2
0 5650   4350            4350
0 5651   2275            2275

0 5652   0000   EM2,     0000     /     E2
0 5653   0000            0000
0 5654   4522            4522
0 5655   7575            7575
```

```
 0 5656   7741   OUT1,    7741     /CRLF,A=
 0 5657   3575             3575

 0 5660   0045   OUT2,    0045     / EV/CH,CRLF
 0 5661   6617             6617     /B=
 0 5662   4350             4350
 0 5663   7742             7742
 0 5664   3575             3575

 0 5665   0045   OUT3,    0045     / EV
 0 5666   6675             6675

 0 5667   5156   GLMP,    5156     /INTERVAL NO.
 0 5670   6445             6445
 0 5671   6266             6266
 0 5672   4154             4154
 0 5673   0056             0056
 0 5674   5775             5775

 0 5675   5163   DMES,    5163     /IS
 0 5676   6054             6054     /PL
 0 5677   4171             4171     /AY
 0 5700   0075             0075     / -

 0 5701   0041   ATNM,    0041     / A
 0 5702   6457             6457     /TO
 0 5703   5551             5551     /MI
 0 5704   4300             4300     /C
 0 5705   5657             5657     /NO
 0 5706   1675             1675     /.=

 0 5707   0055   SPCM,    0055     /MAXIMUM COUNTS
 0 5710   4170             4170
 0 5711   5155             5155
 0 5712   6555             6555
 0 5713   0043             0043
 0 5714   5765             5765
 0 5715   5664             5664
 0 5716   6375             6375

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 0 5724   0000            0000     / 2        0
 0 5725   0000            0000     / 2        0
 0 5726   0000            0000     / 2        0
 0 5727   0064            0064     / 3       54
 0 5730   0000            0000     / 3       54
 0 5731   0000            0000     / 3        0
 0 5732   0000            0000     / 3        0
 0 5733   0155            0155     / 4      109
 0 5734   0000            0000     / 4      109
 0 5735   0000            0000     / 4        0
 0 5736   0000            0000     / 4        0
 0 5737   0270            0270     / 5      184
 0 5740   0000            0000     / 5      184
 0 5741   0000            0000     / 5        0
 0 5742   0000            0000     / 5        0
 0 5743   0427            0427     / 6      279
 0 5744   0000            0000     / 6      279
 0 5745   0000            0000     / 6        0
 0 5746   0000            0000     / 6        0
 0 5747   0611            0611     / 7      393
 0 5750   0000            0000     / 7      393
 0 5751   0000            0000     / 7        0
 0 5752   0000            0000     / 7        0
 0 5753   1014            1014     / 8      524
 0 5754   0000            0000     / 8      524
 0 5755   0000            0000     / 8        0
 0 5756   0000            0000     / 8        0
 0 5757   1243            1243     / 9      675
 0 5760   0000            0000     / 9      675
 0 5761   0000            0000     / 9        0
 0 5762   0000            0000     / 9        0
 0 5763   1521            1521     /10      849
 0 5764   0000            0000     /10      849
 0 5765   0000            0000     /10        0
 0 5766   0000            0000     /10        0
 0 5767   2021            2021     /11     1041
 0 5770   0000            0000     /11     1041
 0 5771   0000            0000     /11        0
 0 5772   0000            0000     /11        0
 0 5773   2347            2347     /12     1255
 0 5774   0000            0000     /12     1255
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0 5776  0000          0000     /12        0
0 5777  2717          2717     /13     1487
0 6000  0000          0000     /13     1487
0 6001  0000          0000     /13        0
0 6002  0000          0000     /13        0
0 6003  3313          3313     /14     1739
0 6004  0000          0000     /14     1739
0 6005  3456          3456     /14     1838
0 6006  0000          0000     /14     1838
0 6007  3736          3736     /15     2014
0 6010  0000          0000     /15     2014
0 6011  4136          4136     /15     2142
0 6012  0000          0000     /15     2142
0 6013  4403          4403     /16     2307
0 6014  0000          0000     /16     2307
0 6015  4644          4644     /16     2468
0 6016  0000          0000     /16     2468
0 6017  5076          5076     /17     2622
0 6020  0000          0000     /17     2622
0 6021  5401          5401     /17     2817
0 6022  0000          0000     /17     2817
0 6023  5615          5615     /18     2957
0 6024  0000          0000     /18     2957
0 6025  6167          6167     /18     3191
0 6026  0000          0000     /18     3191
0 6027  6360          6360     /19     3312
0 6030  0000          0000     /19     3312
0 6031  7005          7005     /19     3589
0 6032  0000          0000     /19     3589
0 6033  7152          7152     /20     3690
0 6034  0000          0000     /20     3690
0 6035  7654          7654     /20     4012
0 6036  0000          0000     /20     4012
0 6037  7770          7770     /21     4088
0 6040  0000          0000     /21     4088
0 6041  0553          0553     /21     4459
0 6042  0001          0001     /21     4459
0 6043  0634          0634     /22     4508
0 6044  0001          0001     /22     4508
0 6045  1503          1503     /22     4931
0 6046  0001          0001     /22     4931
0 6047  1525          1525     /23     4949
0 6050  0001          0001     /23     4949
0 6051  2463          2463     /23     5427
0 6052  0001          0001     /23     5427
0 6053  2443          2443     /24     5411
0 6054  0001          0001     /24     5411
0 6055  3473          3473     /24     5947
0 6056  0001          0001     /24     5947
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0 6060   0001          0001     /25     5895
0 6061   4534          4534     /25     6492
0 6062   0001          0001     /25     6492
0 6063   4400          4400     /26     6400
0 6064   0001          0001     /26     6400
0 6065   5623          5623     /26     7059
0 6066   0001          0001     /26     7059
0 6067   5415          5415     /27     6925
0 6070   0001          0001     /27     6925
0 6071   6741          6741     /27     7649
0 6072   0001          0001     /27     7649
0 6073   6460          6460     /28     7472
0 6074   0001          0001     /28     7472
0 6075   0111          0111     /28     8265
0 6076   0002          0002     /28     8265
0 6077   7551          7551     /29     8041
0 6100   0001          0001     /29     8041
0 6101   1313          1313     /29     8907
0 6102   0002          0002     /29     8907
0 6103   0667          0667     /30     8631
0 6104   0002          0002     /30     8631
0 6105   2544          2544     /30     9572
0 6106   0002          0002     /30     9572
0 6107   2033          2033     /31     9243
0 6110   0002          0002     /31     9243
0 6111   4027          4027     /31    10263
0 6112   0002          0002     /31    10263
0 6113   3224          3224     /32     9876
0 6114   0002          0002     /32     9876
0 6115   5350          5350     /32    10984
0 6116   0002          0002     /32    10984
0 6117   4444          4444     /33    10532
0 6120   0002          0002     /33    10532
0 6121   6721          6721     /33    11729
0 6122   0002          0002     /33    11729
0 6123   5712          5712     /34    11210
0 6124   0002          0002     /34    11210
0 6125   0325          0325     /34    12501
0 6126   0003          0003     /34    12501
0 6127   7203          7203     /35    11907
0 6130   0002          0002     /35    11907
0 6131   1760          1760     /35    13296
0 6132   0003          0003     /35    13296
0 6133   0526          0526     /36    12630
0 6134   0003          0003     /36    12630
0 6135   3450          3450     /36    14120
0 6136   0003          0003     /36    14120
0 6137   2077          2077     /37    13375
0 6140   0003          0003     /37    13375
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0 6141  5173          5173     /37   14971
0 6142  0003          0003     /37   14971
0 6143  3476          3476     /38   14142
0 6144  0003          0003     /38   14142
0 6145  6751          6751     /38   15849
0 6146  0003          0003     /38   15849
0 6147  5125          5125     /39   14933
0 6150  0003          0003     /39   14933
0 6151  0562          0562     /39   16754
0 6152  0004          0004     /39   16754
0 6153  6602          6602     /40   15746
0 6154  0003          0003     /40   15746
0 6155  2402          2402     /40   17666
0 6156  0004          0004     /40   17666
0 6157  0310          0310     /41   16584
0 6160  0004          0004     /41   16584
0 6161  4275          4275     /41   18621
0 6162  0004          0004     /41   18621
0 6163  2043          2043     /42   17443
0 6164  0004          0004     /42   17443
0 6165  6227          6227     /42   19607
0 6166  0004          0004     /42   19607
0 6167  3627          3627     /43   18327
0 6170  0004          0004     /43   18327
0 6171  0151          0151     /43   20585
0 6172  0005          0005     /43   20585
0 6173  5443          5443     /44   19235
0 6174  0004          0004     /44   19235
0 6175  2227          2227     /44   21655
0 6176  0005          0005     /44   21655
0 6177  7307          7307     /45   20167
0 6200  0004          0004     /45   20167
0 6201  4301          4301     /45   22721
0 6202  0005          0005     /45   22721
0 6203  1203          1203     /46   21123
0 6204  0005          0005     /46   21123
0 6205  6410          6410     /46   23816
0 6206  0005          0005     /46   23816
0 6207  3130          3130     /47   22104
0 6210  0005          0005     /47   22104
0 6211  0556          0556     /47   24942
0 6212  0006          0006     /47   24942
0 6213  5105          5105     /48   23109
0 6214  0005          0005     /48   23109
0 6215  2755          2755     /48   26093
0 6216  0006          0006     /48   26093
0 6217  7113          7113     /49   24139
0 6220  0005          0005     /49   24139
0 6221  5212          5212     /49   27274
0 6222  0006          0006     /49   27274
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 0 6223  1266            1266     /50    25270
 0 6224  0006            0006     /50    25270
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 0 6226  0006            0006     /50    28483

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 0 6232  0007          0007     /51   29723
 0 6233  5517          5517     /52   27471
 0 6234  0006          0006     /52   27471
 0 6235  4421          4421     /52   30993
 0 6236  0007          0007     /52   30993
 0 6237  7702          7702     /53   28610
 0 6240  0006          0006     /53   28610
 0 6241  7044          7044     /53   32292
 0 6242  0007          0007     /53   32292
 0 6243  2152          2152     /54   29802
 0 6244  0007          0007     /54   29802
 0 6245  1554          1554     /54   33644
 0 6246  0010          0010     /54   33644
 0 6247  4372          4372     /55   30970
 0 6250  0007          0007     /55   30970
 0 6251  4250          4250     /55   34984
 0 6252  0010          0010     /55   34984
 0 6253  6677          6677     /56   32191
 0 6254  0007          0007     /56   32191
 0 6255  7030          7030     /56   36376
 0 6256  0010          0010     /56   36376
 0 6257  1240          1240     /57   33440
 0 6260  0010          0010     /57   33440
 0 6261  1647          1647     /57   37799
 0 6262  0011          0011     /57   37799
 0 6263  3635          3635     /58   34717
 0 6264  0010          0010     /58   34717
 0 6265  4527          4527     /58   39255
 0 6266  0011          0011     /58   39255
 0 6267  6267          6267     /59   36023
 0 6270  0010          0010     /59   36023
 0 6271  7452          7452     /59   40746
 0 6272  0011          0011     /59   40746
 0 6273  0757          0757     /60   37359
 0 6274  0011          0011     /60   37359
 0 6275  2435          2435     /60   42269
 0 6276  0012          0012     /60   42269
 0 6277  3371          3371     /61   38649
 0 6300  0011          0011     /61   38649
 0 6301  5651          5651     /61   43945
 0 6302  0012          0012     /61   43945
 0 6303  6274          6274     /62   40124
 0 6304  0011          0011     /62   40124
 0 6305  0530          0530     /62   45400
 0 6306  0013          0013     /62   45400
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0 6310   0012          0012     /63    41529
0 6311   3663          3663     /63    47027
0 6312   0013          0013     /63    47027
0 6313   3747          3747     /64    42983
0 6314   0012          0012     /64    42983
0 6315   7116          7116     /64    48718
0 6316   0013          0013     /64    48718
0 6317   6666          6666     /65    44470
0 6320   0012          0012     /65    44470
0 6321   2327          2327     /65    50391
0 6322   0014          0014     /65    50391
0 6323   1641          1641     /66    45985
0 6324   0013          0013     /66    45985
0 6325   5722          5722     /66    52178
0 6326   0014          0014     /66    52178
0 6327   4650          4650     /67    47528
0 6330   0013          0013     /67    47528
0 6331   1256          1256     /67    53934
0 6332   0015          0015     /67    53934
0 6333   7713          7713     /68    49099
0 6334   0013          0013     /68    49099
0 6335   4612          4612     /68    55690
0 6336   0015          0015     /68    55690
0 6337   3052          3052     /69    50730
0 6340   0014          0014     /69    50730
0 6341   0350          0350     /69    57576
0 6342   0016          0016     /69    57576
0 6343   6210          6210     /70    52360
0 6344   0014          0014     /70    52360
0 6345   3730          3730     /70    59352
0 6346   0016          0016     /70    59352
0 6347   1457          1457     /71    54063
0 6350   0015          0015     /71    54063
0 6351   7542          7542     /71    61282
0 6352   0016          0016     /71    61282
0 6353   4715          4715     /72    55757
0 6354   0015          0015     /72    55757
0 6355   3351          3351     /72    63209
0 6356   0017          0017     /72    63209
0 6357   0264          0264     /73    57524
0 6360   0016          0016     /73    57524
0 6361   7272          7272     /73    65210
0 6362   0017          0017     /73    65210
0 6363   3656          3656     /74    59310
0 6364   0016          0016     /74    59310
0 6365   3241          3241     /74    67233
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0 6370   0016          0016     /75    61131
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0 6371  7262          7262    /75   69298
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0 6373  3017          3017    /76   62991
0 6374  0017          0017    /76   62991
0 6375  3354          3354    /76   71404
0 6376  0021          0021    /76   71404
0 6377  6566          6566    /77   64886
0 6400  0017          0017    /77   64886
0 6401  7515          7515    /77   73549
0 6402  0021          0021    /77   73549
0 6403  2404          2404    /78   65820
0 6404  0020          0020    /78   66820
0 6405  3730          3730    /78   75736
0 6406  0022          0022    /78   75736
0 6407  6272          6272    /79   68794
0 6410  0020          0020    /79   68794
0 6411  0220          0220    /79   77968
0 6412  0023          0023    /79   77968
0 6413  2245          2245    /80   70821
0 6414  0021          0021    /80   70821
0 6415  4602          4602    /80   80258
0 6416  0023          0023    /80   80258
0 6417  6234          6234    /81   72860
0 6420  0021          0021    /81   72860
0 6421  1176          1176    /81   82558
0 6422  0024          0024    /81   82558
0 6423  2315          2315    /82   74957
0 6424  0022          0022    /82   74957
0 6425  5672          5672    /82   84922
0 6426  0024          0024    /82   84922
0 6427  6451          6451    /83   77097
0 6430  0022          0022    /83   77097
0 6431  2447          2447    /83   87335
0 6432  0025          0025    /83   87335
0 6433  2700          2700    /84   79296
0 6434  0023          0023    /84   79296
0 6435  7321          7321    /84   89809
0 6436  0025          0025    /84   89809
0 6437  7165          7165    /85   81525
0 6440  0023          0023    /85   81525
0 6441  4237          4237    /85   92319
0 6442  0026          0026    /85   92319
0 6443  3530          3530    /86   83800
0 6444  0024          0024    /86   83800
0 6445  1235          1235    /86   94877
0 6446  0027          0027    /86   94877
0 6447  0147          0147    /87   86119
0 6450  0025          0025    /87   86119
0 6451  6313          6313    /87   97483
0 6452  0027          0027    /87   97483
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0 6454  0025          0025     /88    88485
0 6455  3450          3450     /88   100136
0 6456  0030          0030     /88   100136
0 6457  1416          1416     /89    90894
0 6460  0026          0026     /89    90894
0 6461  0676          0676     /89   102846
0 6462  0031          0031     /89   102846
0 6463  6226          6226     /90    93334
0 6464  0026          0026     /90    93334
0 6465  6170          6170     /90   105592
0 6466  0031          0031     /90   105592
0 6467  3153          3153     /91    95851
0 6470  0027          0027     /91    95851
0 6471  3570          3570     /91   108408
0 6472  0032          0032     /91   108408
0 6473  0174          0174     /92    98428
0 6474  0030          0030     /92    98428
0 6475  1271          1271     /92   111289
0 6476  0033          0033     /92   111289
0 6477  5215          5215     /93   101005
0 6500  0030          0030     /93   101005
0 6501  7005          7005     /93   114181
0 6502  0033          0033     /93   114181
0 6503  2345          2345     /94   103653
0 6504  0031          0031     /94   103653
0 6505  4632          4632     /94   117146
0 6506  0034          0034     /94   117146
0 6507  7557          7557     /95   106351
0 6510  0031          0031     /95   106351
0 6511  2543          2543     /95   120163
0 6512  0035          0035     /95   120163
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0 6514  0032          0032     /96   109098
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0 6517  2430          2430     /97   111896
0 6520  0033          0033     /97   111896
0 6521  6632          6632     /97   126362
0 6522  0036          0036     /97   126362
0 6523  0071          0071     /98   114745
0 6524  0034          0034     /98   114745
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0 6526  0037          0037     /98   129544
0 6527  5616          5616     /99   117646
0 6530  0034          0034     /99   117646
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/E3633
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 0 6552   0000            0000     / 2
 0 6553   0000            0000     / 3
 0 6554   0000            0000     / 3
 0 6555   0000            0000     / 3
 0 6556   0000            0000     / 3
 0 6557   0000            0000     / 3
 0 6560   0000            0000     / 3
 0 6561   0000            0000     / 4
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 0 6566   0000            0000     / 4
 0 6567   0000            0000     / 5
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 0 6574   0000            0000     / 5
 0 6575   0000            0000     / 6
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 0 6614   0000            0000     / 8
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0 6717  0000            0000     /19
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0 6722  0000            0000     /20 341
0 6723  0530            0530     /20 344
0 6724  0000            0000     /20 344
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0 6730  0000            0000     /21 395
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0 6734  0000            0000     /21 390
0 6735  0704            0704     /22 452
0 6736  0000            0000     /22 452
0 6737  0712            0712     /22 458
0 6740  0000            0000     /22 458
0 6741  0000            0000     /22 450
0 6742  0000            0000     /22 450
0 6743  0776            0776     /23 510
0 6744  0000            0000     /23 510
0 6745  1007            1007     /23 519
0 6746  0000            0000     /23 519
0 6747  0000            0000     /23 510
0 6750  0000            0000     /23 510
0 6751  1073            1073     /24 571
0 6752  0000            0000     /24 571
0 6753  1105            1105     /24 581
0 6754  0000            0000     /24 581
0 6755  0000            0000     /24 580
0 6756  0000            0000     /24 580
0 6757  1174            1174     /25 636
0 6760  0000            0000     /25 636
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0 6761  1207            1207     /25 647
0 6762  0000            0000     /25 647
0 6763  0000            0000     /25 640
0 6764  0000            0000     /25 640
0 6765  1300            1300     /26 704
0 6766  0000            0000     /26 704
0 6767  1315            1315     /26 717
0 6770  0000            0000     /26 717
0 6771  0000            0000     /26 710
0 6772  0000            0000     /26 710
0 6773  1407            1407     /27 775
0 6774  0000            0000     /27 775
0 6775  1426            1426     /27 790
0 6776  0000            0000     /27 790
0 6777  0000            0000     /27 790
0 7000  0000            0000     /27 790
0 7001  1521            1521     /28 849
0 7002  0000            0000     /28 849
0 7003  1542            1542     /28 866
0 7004  0000            0000     /28 866
0 7005  0000            0000     /28 860
0 7006  0000            0000     /28 860
0 7007  1640            1640     /29 928
0 7010  0000            0000     /29 928
0 7011  1664            1664     /29 948
0 7012  0000            0000     /29 948
0 7013  0000            0000     /29 940
0 7014  0000            0000     /29 940

/E2037
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0 7020  0000          0000    /30    1032
0 7021  0000          0000    /30    1030
0 7022  0000          0000    /30    1030
0 7023  2110          2110    /31    1096
0 7024  0000          0000    /31    1096
0 7025  2142          2142    /31    1122
0 7026  0000          0000    /31    1122
0 7027  0000          0000    /31    1120
0 7030  0000          0000    /31    1120
0 7031  2242          2242    /32    1186
0 7032  0000          0000    /32    1186
0 7033  2300          2300    /32    1216
0 7034  0000          0000    /32    1216
0 7035  0000          0000    /32    1210
0 7036  0000          0000    /32    1210
0 7037  2402          2402    /33    1282
0 7040  0000          0000    /33    1282
0 7041  2445          2445    /33    1317
0 7042  0000          0000    /33    1317
0 7043  0000          0000    /33    1310
0 7044  0000          0000    /33    1310
0 7045  2543          2543    /34    1379
0 7046  0000          0000    /34    1379
0 7047  2613          2613    /34    1419
0 7050  0000          0000    /34    1419
0 7051  0000          0000    /34    1410
0 7052  0000          0000    /34    1410
0 7053  2710          2710    /35    1480
0 7054  0000          0000    /35    1480
0 7055  2766          2766    /35    1526
0 7056  0000          0000    /35    1526
0 7057  0000          0000    /35    1520
0 7060  0000          0000    /35    1520
0 7061  3063          3063    /36    1587
0 7062  0000          0000    /36    1587
0 7063  3146          3146    /36    1638
0 7064  0000          0000    /36    1638
0 7065  0000          0000    /36    1630
0 7066  0000          0000    /36    1630
0 7067  3236          3236    /37    1694
0 7070  0000          0000    /37    1694
0 7071  3330          3330    /37    1752
0 7072  0000          0000    /37    1752
0 7073  0000          0000    /37    1750
0 7074  0000          0000    /37    1750
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0 7075  3416          3416     /38     1806
0 7076  0000          0000     /38     1806
0 7077  3520          3520     /38     1872
0 7100  0000          0000     /38     1872
0 7101  0000          0000     /38     1870
0 7102  0000          0000     /38     1870
0 7103  3602          3602     /39     1922
0 7104  0000          0000     /39     1922
0 7105  4114          4114     /39     2124
0 7106  0000          0000     /39     2124
0 7107  0000          0000     /39     2120
0 7110  0000          0000     /39     2120
0 7111  3772          3772     /40     2042
0 7112  0000          0000     /40     2042
0 7113  4114          4114     /40     2124
0 7114  0000          0000     /40     2124
0 7115  4376          4376     /40     2302
0 7116  0000          0000     /40     2302
0 7117  4166          4166     /41     2166
0 7120  0000          0000     /41     2166
0 7121  4321          4321     /41     2257
0 7122  0000          0000     /41     2257
0 7123  4636          4636     /41     2462
0 7124  0000          0000     /41     2462
0 7125  4365          4365     /42     2293
0 7126  0000          0000     /42     2293
0 7127  4533          4533     /42     2395
0 7130  0000          0000     /42     2395
0 7131  5077          5077     /42     2623
0 7132  0000          0000     /42     2623
0 7133  4570          4570     /43     2424
0 7134  0000          0000     /43     2424
0 7135  4752          4752     /43     2538
0 7136  0000          0000     /43     2538
0 7137  5350          5350     /43     2792
0 7140  0000          0000     /43     2792
0 7141  4776          4776     /44     2558
0 7142  0000          0000     /44     2558
0 7143  5173          5173     /44     2683
0 7144  0000          0000     /44     2683
0 7145  5624          5624     /44     2964
0 7146  0000          0000     /44     2964
0 7147  5210          5210     /45     2696
0 7150  0000          0000     /45     2696
0 7151  5422          5422     /45     2834
0 7152  0000          0000     /45     2834
0 7153  6110          6110     /45     3144
0 7154  0000          0000     /45     3144
0 7155  5426          5426     /46     2838
0 7156  0000          0000     /46     2838
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0 7157  5656          5656    /46    2990
0 7160  0000          0000    /46    2990
0 7161  6400          6400    /46    3328
0 7162  0000          0000    /46    3328
0 7163  5650          5650    /47    2984
0 7164  0000          0000    /47    2984
0 7165  6117          6117    /47    3151
0 7166  0000          0000    /47    3151
0 7167  6677          6677    /47    3519
0 7170  0000          0000    /47    3519
0 7171  6075          6075    /48    3133
0 7172  0000          0000    /48    3133
0 7173  6364          6364    /48    3316
0 7174  0000          0000    /48    3316
0 7175  7204          7204    /48    3716
0 7176  0000          0000    /48    3716
0 7177  6327          6327    /49    3287
0 7200  0000          0000    /49    3287
0 7201  6637          6637    /49    3487
0 7202  0000          0000    /49    3487
0 7203  7520          7520    /49    3920
0 7204  0000          0000    /49    3920
0 7205  6564          6564    /50    3444
0 7206  0000          0000    /50    3444
0 7207  7116          7116    /50    3662
0 7210  0000          0000    /50    3662
0 7211  0043          0043    /50    4131
0 7212  0001          0001    /50    4131
0 7213  7025          7025    /51    3605
0 7214  0000          0000    /51    3605
0 7215  7403          7403    /51    3843
0 7216  0000          0000    /51    3843
0 7217  0373          0373    /51    4347
0 7220  0001          0001    /51    4347
0 7221  7271          7271    /52    3769
0 7222  0000          0000    /52    3769
0 7223  7675          7675    /52    4029
0 7224  0000          0000    /52    4029
0 7225  0732          0732    /52    4570
0 7226  0001          0001    /52    4570

/E2517
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0 7232  0001            0001    /53     4220
0 7233  1300            1300    /53     4800
0 7234  0001            0001    /53     4800
0 7235  0017            0017    /54     4111
0 7236  0001            0001    /54     4111
0 7237  0506            0506    /54     4422
0 7240  0001            0001    /54     4422
0 7241  1654            1654    /54     5036
0 7242  0001            0001    /54     5036
0 7243  0276            0276    /55     4286
0 7244  0001            0001    /55     4286
0 7245  1014            1014    /55     4620
0 7246  0001            0001    /55     4620
0 7247  2240            2240    /55     5280
0 7250  0001            0001    /55     5280
0 7251  0563            0563    /56     4467
0 7252  0001            0001    /56     4467
0 7253  1334            1334    /56     4828
0 7254  0001            0001    /56     4828
0 7255  2633            2633    /56     5531
0 7256  0001            0001    /56     5531
0 7257  1053            1053    /57     4651
0 7260  0001            0001    /57     4651
0 7261  1663            1663    /57     5043
0 7262  0001            0001    /57     5043
0 7263  3235            3235    /57     5789
0 7264  0001            0001    /57     5789
0 7265  1350            1350    /58     4840
0 7266  0001            0001    /58     4840
0 7267  2216            2216    /58     5262
0 7270  0001            0001    /58     5262
0 7271  3644            3644    /58     6052
0 7272  0001            0001    /58     6052
0 7273  1652            1652    /59     5034
0 7274  0001            0001    /59     5034
0 7275  2561            2561    /59     5489
0 7276  0001            0001    /59     5489
0 7277  4262            4262    /59     6322
0 7300  0001            0001    /59     6322
0 7301  2156            2156    /60     5230
0 7302  0001            0001    /60     5230
0 7303  3132            3132    /60     5722
0 7304  0001            0001    /60     5722
0 7305  4712            4712    /60     6602
0 7306  0001            0001    /60     6602
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0 7307  2467          2467     /61     5431
0 7310  0001          0001     /61     5431
0 7311  3504          3504     /61     5956
0 7312  0001          0001     /61     5956
0 7313  5353          5353     /61     6891
0 7314  0001          0001     /61     6891
0 7315  3004          3004     /62     5636
0 7316  0001          0001     /62     5636
0 7317  4076          4076     /62     6206
0 7320  0001          0001     /62     6206
0 7321  6014          6014     /62     7180
0 7322  0001          0001     /62     7180
0 7323  3326          3326     /63     5846
0 7324  0001          0001     /63     5846
0 7325  4470          4470     /63     6456
0 7326  0001          0001     /63     6456
0 7327  6466          6466     /63     7478
0 7330  0001          0001     /63     7478
0 7331  3653          3653     /64     6059
0 7332  0001          0001     /64     6059
0 7333  5072          5072     /64     6714
0 7334  0001          0001     /64     6714
0 7335  7154          7154     /64     7788
0 7336  0001          0001     /64     7788
0 7337  4203          4203     /65     6275
0 7340  0001          0001     /65     6275
0 7341  5503          5503     /65     6979
0 7342  0001          0001     /65     6979
0 7343  7650          7650     /65     8104
0 7344  0001          0001     /65     8104
0 7345  4537          4537     /66     6495
0 7346  0001          0001     /66     6495
0 7347  6121          6121     /66     7249
0 7350  0001          0001     /66     7249
0 7351  0342          0342     /66     8418
0 7352  0002          0002     /66     8418
0 7353  5100          5100     /67     6720
0 7354  0001          0001     /67     6720
0 7355  6550          6550     /67     7528
0 7356  0001          0001     /67     7528
0 7357  1054          1054     /67     8748
0 7360  0002          0002     /67     8748
0 7361  5444          5444     /68     6948
0 7362  0001          0001     /68     6948
0 7363  7202          7202     /68     7810
0 7364  0001          0001     /68     7810
0 7365  1601          1601     /68     9089
0 7366  0002          0002     /68     9089
0 7367  6015          6015     /69     7181
0 7370  0001          0001     /69     7181
```

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0 7371   7647          7647     /69     8103
0 7372   0001          0001     /69     8103
0 7373   2320          2320     /69     9424
0 7374   0002          0002     /69     9424
0 7375   6366          6366     /70     7414
0 7376   0001          0001     /70     7414
0 7377   0321          0321     /70     8401
0 7400   0002          0002     /70     8401
0 7401   3063          3063     /70     9779
0 7402   0002          0002     /70     9779
0 7403   6746          6746     /71     7654
0 7404   0001          0001     /71     7654
0 7405   1004          1004     /71     8708
0 7406   0002          0002     /71     8708
0 7407   3636          3636     /71    10142
0 7410   0002          0002     /71    10142
0 7411   7332          7332     /72     7898
0 7412   0001          0001     /72     7898
0 7413   1475          1475     /72     9021
0 7414   0002          0002     /72     9021
0 7415   4422          4422     /72    10514
0 7416   0002          0002     /72    10514
0 7417   7721          7721     /73     8145
0 7420   0001          0001     /73     8145
0 7421   2175          2175     /73     9341
0 7422   0002          0002     /73     9341
0 7423   5214          5214     /73    10892
0 7424   0002          0002     /73    10892
0 7425   0314          0314     /74     8396
0 7426   0002          0002     /74     8396
0 7427   2706          2706     /74     9670
0 7430   0002          0002     /74     9670
0 7431   6023          6023     /74    11283
0 7432   0002          0002     /74    11283
0 7433   0713          0713     /75     8651
0 7434   0002          0002     /75     8651
0 7435   3430          3430     /75    10008
0 7436   0002          0002     /75    10008
0 7437   6644          6644     /75    11684
0 7440   0002          0002     /75    11684
0 7441   1316          1316     /76     8910
0 7442   0002          0002     /76     8910
0 7443   4162          4162     /76    10354
0 7444   0002          0002     /76    10354
0 7445   7476          7476     /76    12094
0 7446   0002          0002     /76    12094
0 7447   1725          1725     /77     9173
0 7450   0002          0002     /77     9173
0 7451   4722          4722     /77    10706
0 7452   0002          0002     /77    10706
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 0 7453   0335          0335     /77    12509
 0 7454   0003          0003     /77    12509
 0 7455   2341          2341     /78     9441
 0 7456   0002          0002     /78     9441
 0 7457   5475          5475     /78    11069
 0 7460   0002          0002     /78    11069
 0 7461   1213          1213     /78    12939
 0 7462   0003          0003     /78    12939
 0 7463   2757          2757     /79     9711
 0 7464   0002          0002     /79     9711
 0 7465   6257          6257     /79    11439
 0 7466   0002          0002     /79    11439
 0 7467   2103          2103     /79    13379
 0 7470   0003          0003     /79    13379
 0 7471   3403          3403     /80     9987
 0 7472   0002          0002     /80     9987
 0 7473   7057          7057     /80    11823
 0 7474   0002          0002     /80    11823
 0 7475   3004          3004     /80    13828
 0 7476   0003          0003     /80    13828
 0 7477   4032          4032     /81    10266
 0 7500   0002          0002     /81    10266
 0 7501   7662          7662     /81    12210
 0 7502   0002          0002     /81    12210
 0 7503   3720          3720     /81    14288
 0 7504   0003          0003     /81    14288
 0 7505   4465          4465     /82    10549
 0 7506   0002          0002     /82    10549
 0 7507   0503          0503     /82    12611
 0 7510   0003          0003     /82    12611
 0 7511   4652          4652     /82    14762
 0 7512   0003          0003     /82    14762
 0 7513   5124          5124     /83    10836
 0 7514   0002          0002     /83    10836
 0 7515   1335          1335     /83    13021
 0 7516   0003          0003     /83    13021
 0 7517   5614          5614     /83    15244
 0 7520   0003          0003     /83    15244

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0 7524  0003          0003    /84   13441
0 7525  6574          6574    /84   15740
0 7526  0003          0003    /84   15740
0 7527  6240          6240    /85   11424
0 7530  0002          0002    /85   11424
0 7531  3061          3061    /85   13873
0 7532  0003          0003    /85   13873
0 7533  7570          7570    /85   16248
0 7534  0003          0003    /85   16248
0 7535  6714          6714    /86   11724
0 7536  0002          0002    /86   11724
0 7537  3754          3754    /86   14316
0 7540  0003          0003    /86   14316
0 7541  0600          0600    /86   16768
0 7542  0004          0004    /86   16768
0 7543  7375          7375    /87   12029
0 7544  0002          0002    /87   12029
0 7545  4662          4662    /87   14770
0 7546  0003          0003    /87   14770
0 7547  1625          1625    /87   17301
0 7550  0004          0004    /87   17301
0 7551  0062          0062    /88   12338
0 7552  0003          0003    /88   12338
0 7553  5567          5567    /88   15223
0 7554  0003          0003    /88   15223
0 7555  2665          2665    /88   17845
0 7556  0004          0004    /88   17845
0 7557  0552          0552    /89   12650
0 7560  0003          0003    /89   12650
0 7561  6540          6540    /89   15712
0 7562  0003          0003    /89   15712
0 7563  3175          3175    /89   18045
0 7564  0004          0004    /89   18045
0 7565  1246          1246    /90   12966
0 7566  0003          0003    /90   12966
0 7567  7510          7510    /90   16200
0 7570  0003          0003    /90   16200
0 7571  5041          5041    /90   18977
0 7572  0004          0004    /90   18977
0 7573  1753          1753    /91   13291
0 7574  0003          0003    /91   13291
0 7575  0474          0474    /91   16700
0 7576  0004          0004    /91   16700
0 7577  6147          6147    /91   19559
0 7600  0004          0004    /91   19559
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0 7601  2455        2455    /92   13613
0 7602  0003        0003    /92   13613
0 7603  1502        1502    /92   17218
0 7604  0004        0004    /92   17218
0 7605  7303        7303    /92   20163
0 7606  0004        0004    /92   20163
0 7607  3171        3171    /93   13945
0 7610  0003        0003    /93   13945
0 7611  2514        2514    /93   17740
0 7612  0004        0004    /93   17740
0 7613  0446        0446    /93   20774
0 7614  0005        0005    /93   20774
0 7615  3707        3707    /94   14279
0 7616  0003        0003    /94   14279
0 7617  3546        3546    /94   18278
0 7620  0004        0004    /94   18278
0 7621  1631        1631    /94   21401
0 7622  0005        0005    /94   21401
0 7623  4432        4432    /95   14618
0 7624  0003        0003    /95   14618
0 7625  4615        4615    /95   18829
0 7626  0004        0004    /95   18829
0 7627  3032        3032    /95   22042
0 7630  0005        0005    /95   22042
0 7631  5161        5161    /96   14961
0 7632  0003        0003    /96   14961
0 7633  5701        5701    /96   19393
0 7634  0004        0004    /96   19393
0 7635  4253        4253    /96   22699
0 7636  0005        0005    /96   22699
0 7637  5715        5715    /97   15309
0 7640  0003        0003    /97   15309
0 7641  7003        7003    /97   19971
0 7642  0004        0004    /97   19971
0 7643  5512        5512    /97   23370
0 7644  0005        0005    /97   23370
0 7645  6455        6455    /98   15661
0 7646  0003        0003    /98   15661
0 7647  0122        0122    /98   20562
0 7650  0005        0005    /98   20562
0 7651  6770        6770    /98   24056
0 7652  0005        0005    /98   24056
0 7653  7222        7222    /99   16018
0 7654  0003        0003    /99   16018
0 7655  1256        1256    /99   21166
0 7656  0005        0005    /99   21166
0 7657  0266        0266    /99   24758
0 7660  0006        0006    /99   24758
0 7661  7773        7773    /100  16379
0 7662  0003        0003    /100  16379
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 0 7663  2431          2431    /100  21785
 0 7664  0005          0005    /100  21785
 0 7665  1603          1603    /100  25475
 0 7666  0006          0006    /100  25475

/E1873
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SE 3034
ACON     = 4766
ACONI    = 5512
AQEXIT   = 2061
AQOFF    = 2025
AQOFFI   = 5172
AQOFI    = 5312
AQR      = 3061
ATNM     = 5701
ATNO     = 5346
BD       = 4772
BDI      = 5514
BGND     = 4661
BKTB     = 5517
BLMT     = 4354
BLMTI    = 4220
BLTB     = 5474
BN       = 4770
BNI      = 5513
C100     = 4320
C101     = 4240
C113     = 5343
C114     = 5344
C115     = 4364
C140     = 4365
C144     = 5167
CALC     = 4470
CDTR     = 5173
CDTR1    = 5242
CDTR2    = 5207
CDTR4    = 5301
CHARX    = 2320
CLOCK1   = 2100
CNTR     = 2230
CNTR1    = 5164
CNTR2    = 5165
CNTR3    = 5466
CNTR4    = 5507
CNTRI    = 4326
CRLF     = 5627
CTWLD    = 4706
CX140    = 5170
CX145    = 5323
DATP     = 4546
DCNT     = 4545
DECODE   = 0227
DENR     = 5350
DENR4    = 5411
DENR5    = 5375
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DENR6    = 5476
DENR7    = 5406
DLMP     = 5131
DLMP1    = 5142
DLMP2    = 5147
DMES     = 5675
DUBINT   = 2441
ECHOF    = 2106
ECOF     = 5011
ELMT     = 4317
EM1      = 5643
EM2      = 5652
ENCF     = 5630
ENR1     = 5526
ENR1I    = 5511
ERRI1    = 5345
ERROR    = UNUSED
ERRORI   = 4241
ETLP     = 5510
FCHAR    = 0245
FPNT     = 4543
GLIM     = 4321
GLIM1    = 4345
GLIM2    = 4342
GLIM4    = 4327
GLMP     = 5667
GMKR     = 5423
GMKR1    = 5434
GMKR2    = 5467
GMKR9    = 5436
GROUPW   = 1664
GROUPZ   = 0156
GSC      = 1640
GSCI     = 4705
HDNG     = 5575
HORD     = 2506
HPTH     = 4650
HPTL     = 4647
HPTLI    = 4575
IADD     = 4400
IDIV     = 6400
IEXT     = 0000
II1      = 1656
II1I     = 4644
ILOD     = 5000
IM       = 2441
IMUL     = 7000
IN2      = 1642
IN2000   = 1644
IN2I     = 4415
```

```
IN2I1    = 4663
INEC     = 2140
INEG     = 6000
INOP     = 7400
IOUT     = 3400
IPSP     = 4200
IPSP1    = 4242
IPSP2    = 4232
IRTRN    = 2105
ISTR     = 5400
ISUB     = 4000
ITMP     = 4362
ITMP1    = 5515
IWID     = 4651
KTBB     = 5717
LAPR     = 4655
LDF      = 2252
LDF4I    = 5353
LDLIST   = 0632
LIMS     = 5567
LLMA     = 4357
LLMAI    = 4224
LMKR     = 5162
LMPP     = 4324
LMPPI    = 5150
LMPR     = 4355
LMPRI    = 4204
LMTB     = 4000
LMTE     = 4200
LMTP     = 4423
LORD     = 2505
LOREAD   = 0264
LTBB     = 6537
MGCC     = 1525
MGCCI    = 5342
MGCCP    = 1515
MGCCPI   = 5421
MGCL     = 1266
MGCLI    = 4360
MGCLI1   = 5122
MGCLP    = 1513
MGCLPI   = 5413
MGCR     = 1270
MGCRI    = 5125
MGCRP    = 1514
MGCRPI   = 5416
MKBP     = 4361
MKR1     = 5520
MKR1I    = 5475
MKR2     = 5522
```

```
MKR3     = 5524
MPRR     = 4740
MPRR1    = 4774
MPRR2    = 4756
MSTD     = 5000
NTOT     = 4653
OLYEXT   = 2074
OSMH     = 5316
OSML     = 5315
OUT1     = 5656
OUT2     = 5660
OUT3     = 5665
P121     = 5116
PADD     = 4656
PECA     = 4723
PLNO     = 4420
PM1      = 5647
PNTR1    = 4737
PNTR2    = 5152
PNTR8    = 5464
PNTR9    = 5465
POPR     = 4427
POPR1    = 4431
POPR2    = 4546
PRCM     = 4664
PRMM     = 5572
PRPT     = 4366
PRPT3    = 4614
PRPT4    = 4540
PSCH     = 5320
PSCL     = 5317
PSCN     = 5103
RCNT     = 5166
RETRN    = 0362
RMDP     = 5324
RMKR     = 5163
RPNT     = 5242
RTRNI    = 5171
SHDG     = 5613
SLIM     = 4247
SLIM1    = 4314
SLIM3    = 4261
SPCM     = 5707
SPCS     = 5566
SPNT     = 4416
SPNTI    = 4660
SRCT     = 5117
SSTC     = 4707
STATX    = 1041
STATXI   = 5355
```

```
SUMH     = 4646
SUMHI    = 4571
SUML     = 4645
SUMLI    = 4563
TAB1     = 2304
TABLE    = 2336
TIME     = 2076
TSMH     = 5314
TSML     = 5313
TTY      = 0003
UNPACK   = 2403
UNUSED   = 2120
X01      = 4436
X02      = 4376
X03      = 4440
X04      = 4471
X05      = 4205
X06      = 4322
X07      = 4327
X08      = 4301
X09      = 5035
X1       = 5073
X11      = 5033
X12      = 5002
X13      = 4604
X14      = 5210
X2       = 5075
X20      = 4702
X21      = 4265
X22      = 4562
X23      = 4272
X24      = 4570
X25      = 4250
X26      = 4665
X27      = 4674
X28      = 4621
X29      = 4710
X31      = 5014
X32      = 4752
X33      = 5140
XATN     = 5556
XATNI    = 5322
XCLK     = 5546
XSTS     = 5534
XSTSI    = 5321
Y1       = 5077
Y2       = 5101
ER 0000
```

APPENDIX A
PRINCIPAL K AND L LINES BY ATOMIC NUMBER

Atomic Number	Element	Energy (eV)				
		K "alpha"	K "beta"	L "alpha"	L "beta"	L "gamma"
1	H	Ø	Ø	Ø	Ø	Ø
2	He	Ø	Ø	Ø	Ø	Ø
3	Li	54	Ø	Ø	Ø	Ø
4	Be	1Ø9	Ø	Ø	Ø	Ø
5	B	184	Ø	Ø	Ø	Ø
6	C	279	Ø	Ø	Ø	Ø
7	N	393	Ø	Ø	Ø	Ø
8	O	524	Ø	Ø	Ø	Ø
9	F	675	Ø	Ø	Ø	Ø
10	Ne	849	Ø	Ø	Ø	Ø
11	Na	1Ø41	Ø	Ø	Ø	Ø
12	Mg	1255	Ø	Ø	Ø	Ø
13	Al	1487	Ø	Ø	Ø	Ø
14	Si	1739	1838	Ø	Ø	Ø
15	P	2Ø14	2142	Ø	Ø	Ø
16	S	23Ø7	2468	Ø	Ø	Ø
17	Cl	2622	2817	Ø	Ø	Ø
18	Ar	2957	3191	Ø	Ø	Ø
19	K	3312	3589	Ø	Ø	Ø
20	Ca	369Ø	4Ø12	341	344	34Ø
21	Sc	4Ø88	4459	395	399	39Ø
22	Ti	45Ø8	4931	452	458	45Ø
23	V	4949	5427	51Ø	519	51Ø
24	Cr	5411	5947	571	581	58Ø
25	Mn	5895	6492	636	647	64Ø
26	Fe	64ØØ	7Ø59	7Ø4	717	71Ø
27	Co	6925	7649	775	79Ø	79Ø
28	Ni	7472	8265	849	866	86Ø
29	Cu	8Ø41	89Ø7	928	948	94Ø
30	Zn	8631	9572	1ØØ9	1Ø32	1Ø3Ø

Atomic Number	Element	Energy (eV)				
		K "alpha"	K "beta"	L "alpha"	L "beta"	L "gamma"
31	Ga	9243	1Ø263	1Ø96	1122	112Ø
32	Ge	9876	1Ø984	1186	1216	121Ø
33	As	1Ø532	11729	1282	1317	131Ø
34	Se	1121Ø	125Ø1	1379	1419	141Ø
35	Br	119Ø7	13296	148Ø	1526	152Ø
36	Kr	1263Ø	1412Ø	1587	1638	163Ø
37	Rb	13375	14971	1694	1752	175Ø
38	Sr	14142	15849	18Ø6	1872	187Ø
39	Y	14933	16754	1922	2124	212Ø
40	Zr	15746	17666	2Ø42	2124	23Ø2
41	Nb	16584	18621	2166	2257	2462
42	Mo	17443	19607	2293	2395	2623
43	Tc	18327	20585	2424	2538	2792
44	Ru	19235	21655	2558	2683	2964
45	Rh	20167	22721	2696	2834	3144
46	Pd	21123	23816	2838	299Ø	3328
47	Ag	221Ø4	24942	2984	3151	5519
48	Cd	231Ø9	26Ø93	3133	3316	3716
49	In	24139	27274	3287	3487	392Ø
5Ø	Sn	2527Ø	28483	3444	3662	4131
51	Sb	26357	29723	36Ø5	3843	4347
52	Te	27471	3Ø993	3769	4Ø29	457Ø
53	I	2861Ø	32292	3937	422Ø	48ØØ
54	Xe	298Ø2	33644	4111	4422	5Ø36
55	Cs	3Ø97Ø	34984	4286	462Ø	528Ø
56	Ba	32191	36376	4467	4828	5531
57	La	3344Ø	37799	4651	5Ø43	5789
58	Ce	34717	39255	484Ø	5262	6Ø52
59	Pr	36Ø23	4Ø746	5Ø34	5489	6322
60	Nd	37359	42269	523Ø	5722	66Ø2
61	Pm	38649	43945	5431	5956	6891
62	Sm	4Ø124	454ØØ	5636	62Ø6	718Ø
63	Eu	41529	47Ø27	5846	6456	7478
64	Gd	42983	48718	6Ø59	6714	7788
65	Tb	4447Ø	5Ø391	6275	6979	81Ø4
66	Dy	45985	52178	6495	7249	8418
67	Ho	47528	53934	672Ø	7528	8748
68	Er	49Ø99	5569Ø	6948	781Ø	9Ø89
69	Tm	5Ø73Ø	57576	7181	81Ø3	9424
70	Yb	5236Ø	59352	7414	84Ø1	9779
71	Lu	54Ø63	61282	7654	87Ø8	1Ø142
72	Hf	55757	632Ø9	7898	9Ø21	1Ø514
73	Ta	57524	6521Ø	8145	9341	1Ø892

Atomic Number	Element	Energy (eV)				
		K "alpha"	K "beta"	L "alpha"	L "beta"	L "gamma"
74	W	5931Ø	67233	8396	967Ø	11283
75	Re	61131	69298	8651	1ØØØ8	11684
76	Os	62991	714Ø4	891Ø	1Ø354	12Ø94
77	Ir	64886	73549	9173	1Ø7Ø6	125Ø9
78	Pt	6682Ø	75736	9441	11Ø69	12939
79	Au	68794	77968	9711	11439	13379
80	Hg	7Ø821	8Ø258	9987	11823	13828
81	Ti	7286Ø	82558	1Ø266	1221Ø	14288
82	Pb	74957	84922	1Ø549	12611	14762
83	Bi	77Ø97	87335	1Ø836	13Ø21	15244
84	Po	79296	898Ø9	11128	13441	1574Ø
85	At	81525	92319	11424	13873	16248
86	Rn	838ØØ	94877	11724	14316	16768
87	Fr	86119	97483	12Ø29	1477Ø	173Ø1
88	Ra	88485	1ØØ136	12338	15223	17845
89	Ac	9Ø894	1Ø2846	1265Ø	15712	18Ø45
90	Th	93334	1Ø5592	12966	162ØØ	18977
91	Pa	95851	1Ø84Ø8	13291	167ØØ	19559
92	U	98428	111289	13613	17218	2Ø163
93	Np	1Ø1ØØ5	114181	13945	1774Ø	2Ø774
94	Pu	1Ø3653	117146	14279	18278	214Ø1
95	Am	1Ø6351	12Ø163	14618	18829	22Ø42
96	Cm	1Ø9Ø98	123235	14961	19393	22699
97	Bk	111896	126362	153Ø9	19971	2337Ø
98	Cf	114745	129544	15661	2Ø562	24Ø56
99	Es	117646	132781	16Ø18	21166	24758
100	Fm	12Ø598	136Ø75	16379	21785	25475