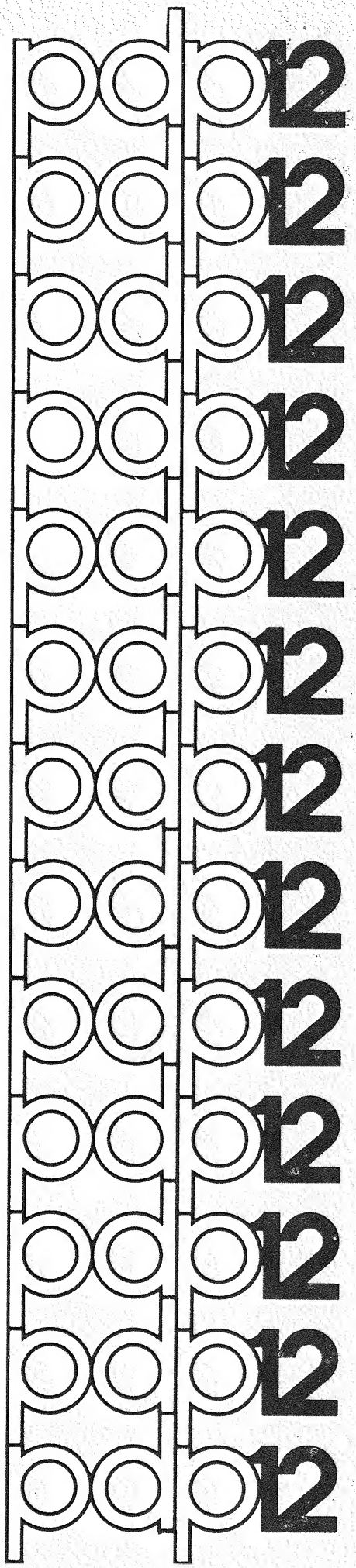
digital

CATACAL



CATACAI ADDENDUM
ASSEMBLING CATACAL
DEC-12-UW1A-DL
JULY, 1970

The CATACAL program is supplied to the user in both source and binary on the tape. To generate a new binary file if the source program is modified, use the following procedure.

1. Load a DIAL-MS tape on unit Ø. Load unit 1 with either a DIAL-V2 or DIAL-MS system tape. If another tape unit is available, mount the tape containing the CLEARSYM and CATACAL source programs there. If only two tape units are available, place the source programs on unit Ø (with PIP if necessary), in order to reduce the assembly time.

2. Type→ZE↵ to clear the binary Working Area of unit 1.

3. Type→AS↵CLEARSYM . CLEARSYM is a two word program which produces a clean symbol table.

   ØØØØ
   SAVSYM 1

4. Type→AS CAT2,Ø↵ . Error messages generated at this time should be ignored. Press the RETURN key to terminate the assembly after the errors have all been printed to suppress printing of the symbol table.

5. Type→ZE↵. This clears the binary Working Area on unit 1.

6. Type→LI CAT3,Ø↵. If no listing is desired, use the AS command. Any errors generated now are real and must be corrected.

7. Type→LI CAT2,Ø↵. Because the symbol table produced is the same as the one generated in step 6, printing may be suppressed with the RETURN key after it has started to be printed.

8. Type→SB CAT23,Ø↵. This saves the binary output from the two previous assemblies.

9. Type→ZE↵.

10. Two versions of the Floating Point Package are supplied. If the machine has the EAE option, CAT1E should be used in the following steps and CATACALE will be generated. If the machine does not have this option, CAT2 should be used to generate CATACAL.

11. Type→AB CAT1, Ø↵.

12. Type→AB CAT23,Ø↵.

13. Type→SB CATACAL,Ø↵ . A binary file of CATACAL (E) has now been generated and command→LO CATACAL,Ø↵ will cause load and execute.

DEC-12-UW1A-D
1st Printing May 1970

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CHAPTER 1
USING CATACAL

1.1 Introduction

CATACAL is a box-car averager for data acquisition at rates from 35 seconds/point to 250 microseconds point[1]. Any analytical instrument or experiment supplying data within those limits can be interpreted easily and quickly using CATACAL's many facilities.

Initially, CATACAL accepts analog data from the interfaced analytical instruments, averages the information, and displays the averaged data on the PDP-12 oscilloscope. The scientist can then interpret the data as required by his experiment in seconds using any of CATACAL's data handling commands. Thus, a sloping baseline can be aligned, a spectrum can be scaled, many integrations can be performed, and two spectra can be compared simultaneously, each operation requiring only a single command.

An X-Y recorder can be interfaced parallel to a scope channel of the computer if hard copy results are desired.

CATACAL is supplied in two versions -- CATACAL and CATACALE. The only difference between the two is that the latter version uses EAE (Extended Arithmetic Element) for greater calculating speed.

1.2 Hardware Requirements

The minimum configuration for using CATACAL is:

PDP-12A computer with 8K of core memory and KW12A clock

An X-Y Analog Recorder is recommended for hard copy.

The program does not require, but will support, a high speed reader/ punch.

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[1] If a faster sampling rate is required, the Signal Averager program, DEC-12-YZAA, can be used to collect the data and CATACAL can be used to interpret the supplied information. The TISA program, DEC-12-UW3A, accepts asynchronous data which also can be manipulated by CATACAL.

1.3 Initial Starting Procedure

Each time the PDP-12 computer is to be used to run CATACAL, the following procedure must be performed.

1. Mount the CATACAL tape on tape unit Ø. (Unit Ø is indicated by setting the tape channel indicator to 8). Mount a scratch or library tape on unit 1.
2. Set the switches on the tape units to REMOTE and WRITE ENABLE.
3. Set the mode switch to LINC mode and press the I/O PRESET key on the computer console.
4. Set the Left Switches to Ø7Ø1 and the Right Switches to 73ØØ.
5. Press the DO console switch.
6. When the tape has stopped moving, press the START 2Ø key.
7. Press LINE FEED, type

   ```
   LO CATACAL,Ø
   ```

   or

   ```
   LO CATACALE,Ø
   ```

   and press the RETURN key. Either program may be loaded. If only one program is to be used at all times, the other may be removed permanently from the tape.

Refer to the LAP6-DIAL Programmer's Reference Manual, DEC-12-SE2B-D, for additional information on operating procedures.

CATACAL indicates it has been successfully loaded into the computer by typing the message

```
CALACAL LIVES!
TITLE:
```

Commentary of any length may be typed in after TITLE. The information is not stored with the data on tape and is used only to supply a titled paper copy record of data operations performed. Type CTRL/A[1] to exit from the title phase. A command may now be issued (refer to Chapter 2).

[1] CTRL/A is typed by pressing down the CTRL (control) key and then the letter key (A in this case) in the same manner as a character requiring the SHIFT key is typed.

1.4 Inputting Data

Most calculations are performed with the Floating Point Package (refer to Floating Point System Manual, DEC-08-YQYB-D), but final array results are single precision (12 bit) integers, normally scaled to the range $\emptyset$-$1\emptyset\emptyset\emptyset_{1\emptyset}$. When a numeric value is requested, most conventional formats are acceptable. Thus, for example, the decimal value 1Ø may be entered as 1Ø.Ø, 1Ø, 1E1, or .1E+02, etc., as described in the above manual. After a numeric value has been typed in response to a command, any character except Ø to 9, E, or . will terminate input for that entry. A space is recommended as the terminator. (Pressing RETURN does not automatically generate a LINE FEED.) In response to questions, only Y or N are acceptable answers. Any other response generates a question mark on the Teletype and is ignored. No terminator is required after a Y or N response.

In all cases, striking RUBOUT before a terminator will delete all input up to the preceding terminator to allow the correct value to be entered. A RUBOUT during decimal input echoes as an exclamation mark and during octal input as a question mark on the Teletype.

If, during scope display, a command unacceptable to CATACAL is typed, a ? is printed on the Teletype and the program returns to the same scope display.

At all times when using CATACAL, it is strongly recommended that any data, both raw and interpreted, that may possibly be used at a later time be saved on tape (see TAPE I/O, section 2.5) to prevent accidental elimination from the display channel, because most commands replace the previous contents on the scope.

1.5 Stopping and Restarting CATACAL

If an operation must be halted immediately, press the console STOP switch. This should not be used haphazardly; if arrays were being modified the data will be lost. Routines requiring input parameters or initial dialogue can be halted during that stage and before the input is complete. To restart CATACAL after an emergency stop, set the MODE switch to 8 mode, set STOP switch to run position, and press I/O PRESET and then START 4ØØ key. A new CATACAL command can be issued when the display is restarted. If the START 2Ø key is pressed instead of START 4ØØ, the program starts at the beginning as described in Section 1.3.

CHAPTER 2
CATACAL COMMANDS

2.1 Introduction

After starting CATACAL (refer to Section 1.3), a scope channel should be designated to accommodate the incoming data which is loaded into the computer's memory area directly from an analog input channel, the Teletype[1] keyboard, the high-speed or Teletype reader, or storage on LINCtape. Any of CATACAL's commands can then be used to interpret the data. For example, the baseline can be linearized and the resulting spectrum integrated.

Each CATACAL command is described in this chapter. The values requested, acceptable ranges, formulas used and available options for each are included in the discussion. After each command is completed, the correct spectrum is displayed (except the MODIFY command). Another command may be issued at that time.

2.2 Scope Channel

The scope on the PDP-12 provides three viewing channels:

channel 1 - assigned by user
channel 2 - assigned by user
channel 3 - channels 1 & 2 simultaneously

Data supplied from the associated instrument or from LINCtape is assigned to channel 1 by typing the number 1 on the Teletype; similarly data is assigned to channel 2 by typing the number 2 on the Teletype. The choice of channels 1 or 2 determines which data will be used. If a number between 4 and 9 is typed, channel 1 is assumed. Typing Ø produces a response of question mark on the Teletype.

Each channel can accommodate up to 2ØØØ data points. A channel may be assigned to accommodate data when a new spectrum is being collected or when another CATACAL command has been completed by typing 1 or 2. The present contents of that channel are displayed on the scope. When new data is assigned to a channel which already contains data, it replaces the old data.

[1]Teletype is the registered trademark of the Teletype Corporation.

Channel 3 permits the user to view the data in channels 1 and 2 together. When channel 3 is being used, analog knobs Ø and 1 control the X and Y offset for channel 2 to allow comparison of data sets. It can be viewed at any time between commands, but should be followed by a 1 or 2 before calling a command. If left at channel 3, the next command assumes channel 2.

Most of the remaining CATACAL commands are called by typing at least the first two letters of its name and a colon after the termination of the preceding command. Refer to Appendix A for a summary of the commands.

2.3 AVERAGE

The AVERAGE command implements time averaged analog input from the associated instrument. The parameters of the scan are specified on the Teletype in response to AVERAGE's questions and then that operation is performed. The data collected is displayed on the channel specified before the AVERAGE command was initiated.

To collect data, proceed as follows.

1. Prepare the analog instrument for the experiment.
2. Specify a scope channel number (1 or 2) to accommodate the data.
3. Type AV: indicating an averaging operation is to be performed.
4. The Teletype asks

   CHANNEL=

   requesting the analog channel number (octal) to which the instrument is connected. Type in the analog channel number on the AD12 used by this experiment and press RETURN. Note that digits other than Ø-7 will serve as terminators.
5. The Teletype will respond with the message

   NO. POINTS=

   Type in the number of points to be collected in the scan where Ø<POINTS<2Ø48 and then press the SPACE bar.

6. The next question is

   SEC /SCAN=

   Type in a value for the length in seconds of each scan where SEC/SCAN= seconds/point x points/scan. Remember that a minimum of Ø.25 millisecond/point is required. Press the SPACE bar. If the resultant rate is too high [(SEC/SCAN/NO. POINTS) < Ø.25 msec], the routine restarts, asking for

   NO. POINTS=

7. The program now asks for the desired external sense line ($Ø\text{-}15_8$), and its state, which is to be used to trigger each scan. In response to

   SENSE:

   type the octal value of the desired sense line if the desired state is +3 volts. If the desired state is Ø volts, enter the sum of the sense line plus $2Ø_8$. Sense line 15 is used by the Teletype. All unconnected sense lines are held at +3 volts.

8. The next question is

   DELAY (SEC)=

   asking for the delay from receipt of the trigger pulse to the start of data acquisition for each scan. Values from Ø to 2Ø seconds are legal; resolution is 1Ø milliseconds. Press the SPACE bar after typing the value.

9. The message

   NO. OF SCANS=

   is asked last and the reply must be in the range 1≤SCANS≤2Ø48. Type in the value and press the SPACE bar. Input will begin with the arrival of the first trigger pulse.

10. Activate the instrument to begin the experiment. The AVERAGE command will now collect the data according to the specified parameters.

The AVERAGER implements two display routines of its own, totally separate from the main scope routine of CATACAL. (This was necessary because of internal timing and intermediate data structure peculiar to the AVERAGER.)

During data acquisition, the value for each point in the current scan is displayed as soon as it is available. Note that the X axis is not scaled to the number of points; thus, if less than 512 points were requested, the trace will wrap-around such that the 513th point will be displayed at the first location, the 514th at the second location, etc.

Bit Ø of the Right Switches can be set to 1 at any time during the run to interrupt the run when the current scan has been completed. The number of scans completed to that time is indicated by the message

NO. SCANS=

and the data are displayed on the scope. To diminish flicker, only one-fourth of the collected points are displayed. The Y axis can be doubled at this time by typing M; type D to halve the Y axis. By typing S, another message,

MORE SCANS?

is printed. Reply with Y if more scans are desired. Type N to terminate scanning with the specified parameters. This sequence of messages is repeated until the number of scans requested in step 9 have been performed or until bit Ø is set to Ø. If bit Ø = Ø, the collected data is displayed only after all the scans are collected.

2.4 TIME

The constant corresponding to the computer's memory cycle time used to determine timing accuracy for averaging during data acquisition may be reset. The AVERAGE routine may be calibrated as follows.

1. Call the MODIFY routine. Refer to section 2.24.

2. Place 74Ø2 in location 43Ø7 to stop when completed. This routine appears as follows on the Teletype. (The underlined data is typed in by the user.)

   MO:
   43Ø7=443Ø:74Ø2C
   R4ØØ

   The display is restored.

3. Call the AVERAGER by typing AV: then use the values CHANNEL Ø, 1ØØØ POINTS, 16 SEC/SCAN, 15 for SENSE to allow the keyboard to initiate (trigger) the run, Ø for DELAY, and 1Ø for NO. SCANS. Set bit Ø of Right Switches to Ø.

4. Time the program from when the keyboard is struck to when the computer halts, approximately 16Ø seconds later. Call this value T. The memory cycle time, MCT, is then determined by

$$MCT = T \times \frac{1.6 \times 10^{-6}}{16 \times 10} = T \times 1Ø^{-8} \text{ sec.}$$

1.6 microseconds is the value assumed by CATACAL. Restart the display by pressing the START 4ØØ switch as described in Section 1.5.

5. Enter the desired value by typing TI: and supplying the value of MCT after the message

   MCT(SEC)=

6. Call the MODIFY routine and replace the correct value in location 43Ø7. Once calibrated, the new value for MCT should be entered as in step 5 above each time CATACAL is loaded from the DIAL system, if the AVERAGER is to be used.

2.5 TAPE I/O

LINCtape provides the PDP-12 with large data storage capabilities, each tape block holding 256 single precision data points. When the system has been properly started, a LINCtape on any tape unit can be used to store any collected data, either when it is collected initially by AVERAGE or after it has been manipulated by any of the CATACAL commands. Similarly, any stored single precision (12 bit) data can be retrieved from LINCtape at any time. Both data storage and retrieval use the same command, as follows:

1. Type TA: to call the TAPE routine.
2. The Teletype responds with

   BLK1, U,M,(Ø=W):

   This statement requests the following information when data is to be retrieved from tape: the first tape block number (octal) where the data starts, the number of the tape unit (Ø-7) holding the tape, and the mode of operation. Type in the three requested parameters, separated by a comma or space. If a non-octal (not Ø-7) digit is supplied for block number, Ø is assumed; however, data can not be read or written on LINCtape block Ø. To request that block will merely repeat the question. Remember that each LINCtape contains 777_8 blocks. The mode for data retrieval is READ and is indicated by typing the number 1 for that parameter.

   If data is to be stored on tape, either immediately after collection via AVERAGE or after interpretation, the parameters requested are the same as above, except that the mode of operation is Ø for WRITE. When the tape WRITE operation is completed, the data is redisplayed. If the exact location of stored data or of empty blocks is not known, use the MAGSPY program to determine it. (Refer to DEC-12-UZSA-D). It is the user's responsibility to space the data files properly.

3. When the tape parameters have been accepted by the computer for a READ operation only,

   NO. POINTS=

   is printed on the Teletype. Type the number of points to be retained for this spectrum and press RETURN. Any number of points up to 2Ø47 can be read in (mode=1), not including those to be skipped.

4. The final message is

   PTS. TO SKIP=

   If some points are to be skipped before the desired portion of the spectrum, type that value now and press RETURN. Type Ø if no points are to be skipped. Up to 2Ø47 points can be skipped during a tape READ. operation. The tape READ operation is then performed after step 4. If a value greater than $2Ø47_{1Ø}$ is typed in step 3 or 4, 2Ø47 is assumed. If, during TAPE I/O, the program halts at location 3717, a checksum error has occurred due to a hardware malfunction or tape error. The program can be restarted by pressing the START 4ØØ switch as described in Section 1.5. The transfer can be retried, if desired.

2.6 PAPER TAPE

Data may be input to the computer from papertape via the high or low speed reader. The data[1] may have been punched directly by the analog instrument or may have been prepared by the CATACAL command OUTPUT. The procedure for inputting data from tape is as follows.

1. Type PA: to call the routine.
2. Answer the message

   NO. POINTS=

   with a value less than 2Ø48, not including skipped points.

3. The next request is for

   PTS TO SKIP=

   Type in the number of points to be skipped from the start of the tape before data is retained (less than 2Ø48) and press the SPACE bar.

---

[1] CATACAL will accept data in USA-ASCII format with and without spaces and/or non-numeric characters before a numeric value (each number must be properly terminated, as described in Section 1.4).

4. Two parameters are requested by

   YRANGE & MIN:

   The range on the Y axis should be at least as large as the difference between the largest and smallest values on the tape. Type the Y-range, a comma, and the minimum value, which should be no larger than the smallest Y value in the data. Press the SPACE bar.

5. The last question is

   TTY I/O?

   Answer Y if the data is coming from the low-speed reader. A reply of N will start the high-speed reader. Prepare the reader before replying because the tape will be read in immediately after the reply.

2.7 CALCULATE

Spectra can also be calculated from the Teletype keyboard. CATACAL requests information on the peaks, the number of points, and baseline. The spectrum resulting from this calculation is displayed on the presently active channel. The CALCULATE procedure is as follows:

1. Call the routine by typing CA:

2. After the Teletype has printed the message

   ABSORPTION 'DIPS'?

   reply with Y if the spectrum is to be generated with dips; reply with N if it is to be generated with peaks.

3. The next message is

   WIDTHS EQUAL?

   Type Y if all peak (or dip) widths are to be entered as equal; type N if unequal widths are to be entered (as specified in step 8 below).

4. Observe the Teletype for the message

   CUTOFF AT 8*WIDTH?

   If interaction from a peak that is more than eight times the halfwidth away from its position (or crest) is to be ignored, type Y. A considerable saving in time is gained for narrow width, multipeak spectrums if Y is typed. Note that all peak widths must be less than 1/4x(X RNG) (step 7) for this option. A response of N will include all interaction and impose no limits on widths.

Note that the messages in steps 2 through 4 are only asked for once each time CATACAL is loaded.

5. Respond to the next message

   NO. POINTS=

   with a number less than 2Ø48 and press the SPACE bar. Note that both channels 1 and 2 are affected by this value; thus, if the CALCULATE operation is using channel 1, only that number of points will be available for display of the data in channel 2.

6. After the message

   NO. PEAKS=

   type the desired number of peaks, in the range Ø<PEAKS≤42.

7. More data is requested by

   X RNG, X1, INT.MPLR, BASE, LOR. FR.(Ø-1) :

   The first three parameters allow the user to define any coordinate grid in which to contain the calculated data. These parameters scale the data to a 5ØØ x 1ØØØ point grid for compact integer storage. This does, however, impose a minimum on resolution, especially for peak position and width, defined as X RNG/5ØØ. Type in the parameters: X range, initial X location, multiplier which is the Y axis scaler, the location of the base line on the scaled Y axis, and the Lorentzian fraction where Ø is a 100% Gaussian fit and 1 is a complete Lorentzian fit. The fraction must be in the range Ø.Ø to 1.Ø. A value of 1 for INT.MPLR implies a range of Ø to 1ØØØ on the Y axis, a value of 1Ø implies a range of Ø to 1ØØ, etc. Base and peak heights should then fall within this scaled range. Peak positions should be in the range X1 to X1+X RNG. A negative X RNG is legal; e.g., for X1=5ØØ and X RNG= -5ØØ, the X axis runs from 5ØØ on the left to Ø on the right.

8. The dimensions of each peak requested next by the message

   HGT,H-WIDTH,POS:

   are height, half width at half height, and position on the scaled X axis. Type in each value followed by a comma or space and then press RETURN after the parameters for each peak. Thus, a two peak spectrum may include the data:

   678,5,35
   789,4,5Ø

   If the equal widths option (step 3) is being used, enter a width for the first peak only. That value will be assumed for all other peaks.

9. After all the necessary data has been typed in, the computer indicates it is busy performing the calculation by the message

    COOL IT.

    on the Teletype. Do not type any key on the Teletype during the few seconds required for the computation; the keyboard is "dead". When calculated, the spectrum described by steps 2 through 8 is displayed on the scope.

After a display channel has been selected and data has been brought into the computer's memory, any of the following commands may be issued. Any number of them may be requested and in any order. After the data has been interpreted by any of the available commands, it can be stored on tape for later use.

2.8 ALTER

The parameters specified by the most recent CALCULATE command may be modified by an ALTER command. The command is implemented as follows:

1. Type AL: to call the ALTER routine.
2. The message

    PK,PA,VL:

    is printed on the Teletype, requesting the peak index number where the first peak typed in during CALCULATE is 1, the second is 2, etc., the parameter index where height is 1, half-width is 2, and position is 3, a comma or space, and the new value for that parameter. Type the peak number, a comma or space, the parameter index, and the new value. Press the SPACE bar. All parameters except X RNG and X1 may be altered. The equal widths option has no effect at this time; any width may be altered. Consider the following sequence:

    PK,PA,VL: 12,3,674

    This series will center the twelfth peak at location 674 on the scaled X axis.

Other spectral parameters may be modified by typing one of the sequences listed below and then the new value in response to the above message.

Sequence	Parameter to be Modified
Ø,1:	intensity multiplier
Ø,2:	baseline
Ø,3:	Lorentzian fraction
N,Ø:	print parameters for peak N
Ø,Ø:	print all parameters

The last two sequences exit to the display without recalculating the spectrum.

3. Type Ø,-1: when all alterations have been made and the resulting spectrum is to be calculated and then displayed.

4. The computer indicates it is recalculating the spectrum by printing the message

   COOL IT.

   on the Teletype. When it is completed, the new spectrum is displayed.

2.9 COPY

The contents of the currently displayed channel can be copied into another channel, leaving the two with identical data, by typing CO:. This is particularly useful if the manipulated data is to be compared with the original data.

2.10 XINVERT

The left to right X axis relationship of the displayed array can be inverted by typing XI:.

2.11 YINVERT

Each Y value of the displayed channel is subtracted from 1ØØØ and the differences stored in that channel, thus effectively inverting the Y axis by the command YI:.

2.12 SCALE

If, when data is displayed on the scope, the maximum and minimum points "wrap-around" because they are out of the scope's range or if

the range is smaller than desired, SCALE may be used to bring the Y data into the range $\emptyset \leq Y \leq 1\emptyset\emptyset\emptyset$. The scaling parameters used, original minimum value, original maximum value, and multiplier, are printed on the Teletype after the computation, as, for example:

```
MIN= -54
MAX= 75
MPY= 7.752
```

where

$$MPY = \frac{1\emptyset\emptyset\emptyset}{(MAX-MIN)} \quad \text{and} \quad Y_i = (Y_i - MIN) \times MPY$$

2.13 MULTIPLY

Data may be scaled to an arbitrary range other than the $\emptyset$ to $1\emptyset\emptyset\emptyset$ range assumed by the SCALE routine. The MULTIPLY routine is used mainly in spectrum stripping when a standard and/or background spectrum is to be subtracted from a raw data set after appropriate scaling.

The command is used as follows.

1. Type MU: to call the MULTIPLY routine.
2. The parameter

   MIN=

   is then requested. This value is to be subtracted from each data point before MPY is applied, as

   $Y_i = (Y_i - MIN)\ MPY$

   The final data should be in the range -2047 to 2047_{10}. Values outside of this range are truncated to these limits. Final values less than -5 or greater than 1019 will "wrap-around" when displayed.
3. When

   MPY=

   is printed, type in the desired multiplier.

2.14 SMOOTH

Collected data can be smoothed by an 11 point least squares curve fit routine via the SMOOTH command. The new spectrum is displayed on the

scope. The first and last five points are not altered. (This routine is a modification of DECUS 5/8-69.)

2.15 CURSORS

Typing CU: will display two movable bright dots, referred to as cursors, on the scope to be used to implement the INTEGRATE and STRIP commands[1] by delimiting the data points to be modified. The two cursors are controlled by four analog channel knobs as follows.

CURSOR	analog channel knob	direction of movement
	4	horizontal
left	5	vertical
	6	horizontal
right	7	vertical

When the two dots appear on the display initially, knobs 4 and 5 must always position one of them to the left of the other.

The decimal values of the location of the cursors are displayed at the top of the screen in the order 4,5,6,7. A grid of $5ØØ_{1Ø}$ x $1ØØØ_{1Ø}$ on the scope is assumed. The actual range extends slightly beyond, but the data points should be within that range.

Typing CU: a second time will remove the cursors from the scope.

Note that the cursors can be used to inspect peak amplitudes, valleys, widths, etc., by positioning them appropriately and noting the displayed values.

2.16 INTEGRATE

The INTEGRATE command provides two options:

1. Integrate the data between the cursors by using them to set a pivot or baseline, print out the area, and leave the data array unchanged.

---

[1] A very slight distortion may occur on the scope when the cursors are used to delimit a portion of the spectrum at the extrema of the Xaxis.

2. Integrate all data using the cursors (extrapolated) to define a pivot line and store a scaled running integral in the data array, then print out a scale down multiplier.

The data is defined as lying on a 5ØØ x 1ØØØ grid, independent of the total number of points in the array. The area at a given point, j, is expressed as

$$A_i = \sum_{i=s}^{j} (X_{i+1} - X_i) \left[(Y_{i+1} - P_{i+1}) + (Y_i - P_i) \right] / 2$$

where $X_Ø = Ø$, $X_n = 5ØØ$ and s is the starting point which is equal to the X value of the left cursor for option 1 or is equal to Ø for option 2. Similarly, j=x value of the right cursor and P_j is the value of the pivot line at that point.

An integration is performed as follows.

1. Type CU: and position the cursors as required for the desired option (refer to section 2.15).
2. Type IN: to call the routine.
3. The message

   SCAN INT'L?

   is printed. Type Y if a running integral (option 2) is desired; type N if a partial integral and area printout (option 1) are desired.

If, when the routine is first called, the message

BAD X POINTS!

is printed, the left-right relationship of the cursors has been inverted. The display is restarted to allow correct positioning. When corrected, type IN: to call the routine again.

2.17 STRIP

Three options are available for altering portions of the displayed spectrum.

1. Replace the data between the cursors with the best straight line.
2. Subtract a sloping baseline from all data points.

3. Subtract a straight line interpolated between the cursors from the data between the cursors.

The STRIP command is implemented as follows:

1. Type CU: and position the cursors as explained below.
2. Type ST: to call the STRIP program.[1]
3. The message

   STRIP PEAK?

   is printed on the Teletype and the two dots are displayed on the scope. If some of the data points are to be replaced by the best straight line, position the left dot at the first data point to be replaced, and the right dot at the last data point to be replaced. Then type Y and the delimited portion of the spectrum is replaced by a straight line. The STRIP program is exited. Continue with another CATACAL operation. If one of the other STRIP operations is desired, type a response of N.
4. A reply of N generates the message

   FULL BASE?

   If a (sloping) baseline is to be subtracted from all the data points, the two dots should have been positioned on the scope with the desired slope and amplitude. The dots need not be on the data curve nor on the X axis extrema because they are extrapolated. Type Y and the new display will appear. If a straight line is to be subtracted from some data points, i.e., partial baseline restoration is desired, type N.

If, when the STRIP routine is called, the message

BAD X POINTS!

is printed, it means that the left and right dots have been inverted. The original display with the cursors appears. Correct the dots by adjusting the knobs; then call the routine again.

2.18 DIFFERENTIATE

The derivative curve of a spectrum is computed by the DIFFERENTIATE command.[2] Derivatives to a depth of at least six can be calculated for some spectra with minimal distortion of the data. These are

---

[1] If STRIP is called without calling CURSORS first, stop and restart the program (refer to section 1.5) and call the CURSORS and then STRIP routines.

[2] Note that the DIFFERENTIATE function is called by typing DE:

produced, not by adjacent point differences, but by the following procedure.

$$Y = Y_{i+2} - Y_{i-2}$$

with

$$Y_1 \equiv Y_2 \equiv Y_3 \quad \text{and} \quad Y_{n-2} \equiv Y_{n-1} \equiv Y_n$$

If multi-depth derivatives are desired, scaling and smoothing are suggested before each level to reduce quantization error or "stairsteps" that result from integer arithmetic. It may also be necessary to strip out the first and last five points if they interfere with scaling (they are unaffected by smoothing).

2.19 PLOT

Any displayed spectrum can be plotted on an X-Y recorder interfaced to a scope channel for a hard copy of that spectrum using the PLOT command. The size and rate of the plot are controlled by the user; the pen is controlled by relay Ø.

To generate a plot of the presently displayed spectrum, proceed as follows:

1. Type PL: to call the plotting routine.
2. The first message printed on the Teletype is

   LINE PLOT?

   Type Y if a line plot is desired or type N if a point plot is preferred.
3. The plotting routine is now waiting for the user to calibrate an area on the X-Y recorder. A small dot appears on the scope and will make the same movements as the plotter pen. The speed for drawing the axes, as well as for the actual plotting, is controlled by knob 3 of the analog channel controls and may be adjusted at any time while using the PLOT command. Turning knob 3 clockwise increases the rate of plotting; turning it counterclockwise decreases the rate. The axes are calibrated by typing the following letters to perform the indicated operations.

Letter	Operation
X	locates maximum X co-ordinate
Y	locates maximum Y co-ordinate
O	returns pen to X-Y origin

The pen on the X-Y recorder should be set initially to the origin. Type X and then manually reposition the pen to the desired maximum X coordinate. After the $X_{max}Y_{\emptyset}$ position has been determined, type Y. Set the pen to the maximum Y coordinate ($X_{max}Y_{max}$) similarly. The axes have now been determined for the plot. Type O to move the pen automatically back to the origin ($X_{\emptyset}Y_{\emptyset}$).

4. The axes and quadrant markers of the graph may now be marked off on the plot if desired. Type M to mark off the frame and quadrants. Knob 3 controls the pen speed.

5. When the axes have been marked, the spectrum is ready to be plotted. Type G to initiate the plot. As before, analog channel knob 3 is used to adjust the plotting speed.

   Any characters other than X, Y, O, M or G during this sequence produce a question mark on the Teletype and are ignored.

6. When the spectrum has been plotted, the following message is printed.

   PLOTTER OFF?

   The plotter should be turned off or set to stand-by and then Y typed. If the plotter is not turned off, the pen will start to move wildly in its effort to follow the scope analog signals when the display starts.

2.20 SUBTRACT

Using the SUBTRACT command, data in the displayed channel will be subtracted from data in the other channel. The result will appear in the displayed channel. The spectrum in the displayed channel will be lost; therefore, the TAPE I/O command is suggested before using this command if that data is to be used later.

2.21 ADD

The two channels can be averaged and the result seen in the displayed channel by issuing an ADD command. As with SUBTRACT, the data in the displayed channel will be lost when the ADD command is executed.

2.22 SWAP

The data currently in channel 1 can be placed in channel 2 and the

data in channel 2 placed in channel 1 with the SWAP command. This facility is especially useful with ADD and SUBTRACT.

2.23 SQUEEZE

The SQUEEZE command compresses the data array by a factor of 2 by averaging adjacent data points. It is recommended that this command be used immediately after data input (TAPE I/O, COMPUTER or AVERAGE) because the number of points is halved for each issuance of this command. If the current channel was 1 or 2, only that channel is affected, but if both channels were being displayed (3 was typed during display), both are halved. The purpose of this command is to reduce the number of points in order to diminish flicker and allow faster smoothing, scaling, etc.

2.24 MODIFY

The CATACAL program itself can be modified by a routine that is similar to ODT-8 (DEC-8-COCO-D) to make changes in core locations. After calling the MODIFY routine, any of the following can be performed in a logical sequence. Each must begin at the left margin.

open location	Type the location (octal) and press the SPACE bar. The contents of that location are printed followed by a colon.
change contents	After the present contents of a location have been printed, type the new contents and the letter C to enter the correction and press the SPACE bar.
inspect next location	After pressing the SPACE bar, type N. The next location and its contents can be printed followed by a colon.
reinspect same	After pressing the SPACE bar, the contents of the last location opened can be printed again by typing S.
transfer control to any location	Type R and the location and press the SPACE bar. Execution of the program will continue from that location.

Pressing RUBOUT at any time will terminate the operation and restart the routine.

2.25 OUTPUT

Collected data can be listed and/or output on paper tape by using the OUTPUT command. After calling the routine, the question

TTY I/O?

is asked. A response of Y implies the Teletype punch, and a response of N implies the high-speed punch. Be sure the device is prepared before responding to the question. The format is 1Ø columns of four digit integers.

2.26 RESTART

The CATACAL program can be restarted from the beginning at any time. The message

CATACAL LIVES!

is printed. This command is equivalent to pressing the START 2Ø key as described in Section 1.5.

2.27 DIAL

An exit from CATACAL and a return to DIAL are performed by typing DI:. Any DIAL[1] commands can be issued at this time, including calling another program from the tape. Refer to the DIAL Manual, DEC-12-SE2B-D.

[1] DIAL refers to LAP6-DIAL.

CHAPTER 3

CATACAL EXAMPLE

The printout on the left side of the page is an actual CATACAL sequence. The commentary on the right was added to indicate the operation performed. Underlined information on the left is that typed in by the user.

LO CATACALE,Ø	LOAD CATACALE
CATACAL LIVES!	PROGRAM IS READY
TITLE:DEMO1	NAME THIS SEQUENCE "DEMO1"
OK, HIT ME!	READY FOR A COMMAND. CHANNEL 1 IS ASSUMED.
1CA: ABSORPTION 'DIPS'?N WIDTHS EQUAL?N CUTOFF AT 8*WIDTH?Y	CALCULATE SPECTRUM WITH PEAKS UNEQUAL WIDTHS CONSIDER INTERACTION
NO. POINTS=1ØØØ NO. PEAKS=5 X RNG, X1, INT.MPLR, BASE, LOR. FR.(Ø-1): 1ØØØ,Ø,1,Ø,Ø HGT, H-WIDTH,POS: 1ØØ,5,1ØØ 2ØØ,5,2ØØ 3ØØ,1Ø,3ØØ 4ØØ,15,4ØØ 5ØØ,15,5ØØ	1ØØØ POINTS 5 PEAKS PARAMETERS FOR SPECTRUM
COOL IT CO: 1AL: PK,PA,VL:1,1,5ØØ PK,PA,VL:2,2,1Ø PK,PA,VL:3,3,8ØØ PK,PA,VL:Ø,-1	SPECTRUM COMPUTED COPY DATA ONTO CHANNEL 2 ALTER SPECTRUM ON CHANNEL 1 ALTER HEIGHT OF FIRST PEAK TO 5ØØ CHANGE HALF WIDTH OF PEAK 2 TO 1Ø CENTER THIRD PEAK AT LOCATION 8ØØ ALL THE CHANGES REQUIRED
COOL IT 1TA: BLK1, U, M(Ø=W):2ØØ,1,Ø 2TA: BLK1, U, M(Ø=W):21Ø,1,Ø 1TA: BLK1, U, M(Ø=W):21Ø,1,1	SPECTRUM COMPUTED PUT CHANNEL 1 DATA ONTO LINCTAPE STARTING AT BLOCK 2ØØ UNIT 1 PUT CHANNEL 2 DATA ONTO LINCTAPE STARTING AT BLOCK 21Ø OF UNIT 1 GET DATA FROM LINCTAPE READ OFF UNIT 1 STARTING WITH BLOCK 21Ø
NO. POINTS= 1ØØØ PTS. TO SKIP=Ø2Ø 1SQ: 1CU: 1IN: SCAN INT'L?N AREA= Ø.11Ø3Ø9E+Ø6 SM:	READ 1ØØØ POINTS SKIP FIRST 2Ø POINTS HALVE DATA POINTS ON CHANNEL 1 DISPLAY CURSORS (POSITION CURSORS) INTEGRATE CHANNEL 1 PARTIAL INTEGRAL REQUESTED AREA UNDER CURVE SMOOTH DATA

```
CO:                                  COPY DATA INTO CHANNEL 2
CU:                                  DISPLAY CURSORS (POSITION CURSORS)
ST:                                  STRIP OUT A
STRIP PEAK?N
FULL BASE?Y                          (SLOPING) BASELINE
SC:                                  SCALE DATA

MIN=-     52                         PARAMETERS USED
MAX=    1029
MPY=   0.925
MU:                                  SCALE DATA TO ANOTHER RANGE

MIN=Ø                                WITH THIS MINIMUM AND THIS
MPY=.5                               MULTIPLIER (AXIS IS HALVED)
21AD:                                ADD DATA IN CHANNEL 2 TO CHANNEL 1
OU:                                  OUTPUT THIS DATA
TTY I/O?N                            ON HIGH-SPEED PUNCH
2AV:                                 ACQUIRE DATA IN DISPLAY CHANNEL 2
CHANNEL=1                            INPUT FROM CHANNEL 1:

NO. POINTS=1ØØØ                      1ØØØ POINTS,
SEC/SCAN =1Ø                         1Ø SECONDS/SCAN,
SENSE:15                             TRIGGER VIA TELETYPE, START WHEN
                                     KEY IS PRESSED,
DELAY(SEC)=1Ø                        1Ø SECOND DELAY,
NO. SCANS=3                          3 SCANS MAXIMUM.  TYPE A KEY.
                                     (BIT Ø SET)
NO. SCANS=1                          1 SCAN COMPLETED
                                     S IS TYPED BUT NOT ECHOED
MORE SCANS?N                         NO MORE SCANS DESIRED

3121MO:                              MODIFY THE PROGRAM
43Ø7=4Ø3Ø:74Ø2C                      LOCATION TO BE MODIFIED
R4ØØ                                 START PROGRAM AT LOCATION 4ØØ
AV:                                  CALL AVERAGER TO TIME MEMORY CYCLE
CHANNEL= Ø                           USE THESE PARAMETERS (BIT Ø=Ø)

NO. POINTS= 1ØØØ
SEC/SCAN= 16
SENSE=15
DELAY(SEC)=Ø
NO. SCANS=1Ø                         TIME THE PROGRAM FROM WHEN THE
                                     KEYBOARD IS STRUCK TO WHEN
                                     COMPUTER HALTS.
1TI:                                 CHANGE TIME OF THIS PROGRAM
MCT(SEC)=1.72E-6                     SET CONSTANT TO 1.72 MICROSECONDS

MO:                                  RESTORE ORIGINAL CONTENTS
43Ø7=74Ø2:443ØC                      TO MODIFIED LOCATION
R4ØØ                                 START PROGRAM AT LOCATION 4ØØ
12SW                                 VIEW AND THEN SWAP CHANNELS
SU:                                  SUBTRACT CHANNEL 2 FROM CHANNEL 1
1PL:                                 PLOT SPECTRUM ON X-Y RECORDER
LINE PLOT?Y                          LINE PLOT
OXYOM                                CALIBRATE AXES THEN MARK BOX
                                     AND QUADRANTS
G                                    PLOT
PLOTTER OFF?Y                        DONE PLOTTING

RE:                                  RESTART CATACALE

CATACAL LIVES!                       PROGRAM IS READY

TITLE:DEMO2                          NAME THIS SEQUENCE "DEMO2"

OK,HIT ME!                           READY FOR A COMMAND
```

PA:	READ IN FROM PAPERTAPE:
NO. POINTS= 6ØØ	6ØØ POINTS
PTS TO SKIP=Ø	START WITH FIRST POINT
YRANGE & MIN: 4ØØ,Ø	4ØØ POINTS ON Y AXIS WITH MIN. VALUE OF Ø
TTY I/O?N	VIA HIGH SPEED READER
XI:	INVERT LEFT-RIGHT RELATIONSHIP ON X AXIS
YI:	INVERT Y AXIS
DE:	CALCULATE FIRST DERIVATIVE OF DISPLAYED DATA
DI:	EXIT TO DIAL

APPENDIX A
COMMAND SUMMARY

At least the first two characters of a command must be typed before colon is typed.

INPUT-OUTPUT COMMANDS

TAPE:	Read or write LINCtape
AVERAGE:	Accept time averaged analog data
PAPERTAPE:	Input data from paper tape or keyboard
OUTPUT:	Print/punch paper tape
PLOT:	Plot data on X-Y analog recorder

PROCESSING COMMANDS

CALCULATE:	Calculate Lorentzian and/or Gaussian spectrum
ALTER:	Alter parameters input by previous CALCULATE command
COPY:	Copy CDC into NDC
XINVERT:	Invert X axis
YINVERT	Invert Y axis
SCALE:	Scale to range of Ø-1ØØØ
MULTIPLY:	Scale to arbitrary range
SMOOTH:	Apply eleven point digital filter
CURSORS:	Set up two cursors on scope
INTEGRATE:	Integrate between cursors or running integration (preceded by CURSOR command)
STRIP:	Strip out data or baseline (preceded by CURSOR command)
DERIVATIVE:	Form differences (derivatives)
SUBTRACT:	Subtract CDC from NDC; results in CDC
ADD:	Add NDC to CDC; results in CDC
SWAP:	Swap CDC and NDC
SQUEEZE:	Average adjacent points of displayed channels

SPECIAL COMMANDS

MODIFY:	ODT-like core modifier
TIME:	Set machine cycle time constant to calibrate AVERAGER
RESTART:	Restart program
DIAL:	Exit to DIAL Editor

CDC = currently displayed channel
NDC = non-displayed channel

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APPENDIX B

ASSEMBLING CATACAL

of error sheet inside front cover

The CATACAL program is supplied to the user in both source and binary on the tape. To generate a new binary file if the source program is modified, use the following procedure.

1. Load a DIAL-MS tape on unit Ø. Load unit 1 with either a DIAL-V2 or DIAL-MS system tape. If another tape unit is available, mount the tape containing the CLEARSYM and CATACAL source programs there. If only two tape units are available, place the source programs on unit Ø (with PIP if necessary), in order to reduce the assembly time.

2. Type →ZE↵ to clear the binary Working Area of unit 1.

3. Type →AS CLEARSYM↵. CLEARSYM is a two word program which produces a clean symbol table.

   ØØØØ
   SAVSYM 1

4. Type →AS CAT2,Ø↵. Error messages generated at this time should be ignored. Press the RETURN key to terminate the assembly after the errors have all been printed to suppress printing of the symbol code.

5. Type →ZE↵. This clears the binary Working Area on unit 1.

6. Type →LI CAT3,Ø↵. If no listing is desired, use the AS command. Any errors generated now are real and must be corrected.

7. Type →LI CAT2,Ø↵. Because the symbol table produced is the same as the one generated in step 6, printing may be suppressed with the RETURN key after it has started to be printed.

8. Type →SB CAT23,Ø↵. This saves the binary output from the two previous assemblies.

9. Type →ZE↵.

10. Two versions of the Floating Point Package are supplied. If the machine has the EAE option, CAT1E should be used in the following steps and CATACALE will be generated. If the machine does not have this option, CAT2 should be used to generate CATACAL.

11. Type →AB CAT1,Ø↵.

12. Type →AB CAT23,Ø↵.

13. Type →SB CATACAL,ØP↵. A binary file of CATACAL(E) has now been generated and the command →LO CATACAL,Ø↵ will cause load and execute.

INDEX

```
                        /CATACAL1
                        /THE COMPUTER OF AVERAGE TRANSIENTS AND
                        /CALCULATOR OF LORENTZIAN AND/OR GAUSSIAN
                        /SPECTRA FOR COMPARISON. THE PROGRAM USES PDP-8
                        /CODE ALMOST EXCLUSIVELY EXCEPT FOR THAT NECESSARY
                        /TO IMPLEMENT THE PDP-12 HARDWARE.

                        /WRITTEN BY G.W. DULANEY, DIG.EQ.CORP., FEB., 1970,
                        /USING MANY OF THE CONCEPTS AND CODE AS WAS IN
                        /LORCAP-MADCAP PACKAGES (DECUS #8-237).

                        FIXMRI CALL=4400        /USED TO CALL SUBR'S INDIRECTLY
                        FIXMRI FADD=1000
                        FIXMRI FSUB=2000
                        FIXMRI FMPY=3000
                        FIXMRI FDIV=4000
                        FIXMRI FGET=5000
                        FIXMRI FPUT=6000
                        FIXMRI FLOT=7000
          0000          FEXT=0000

          6201          CDF=6201
          6131          CLSK=6131
          6132          CLLR=6132
          6133          CLAB=6133
          6134          CLEN=6134
          6135          CLSA=6135
          6136          CLBA=6136
          6137          CLCA=6137
          0014          ATR=0014
          0015          RTA=0015
          0100          SAM=0100
          0140          DIS=0140
          1740          DSC=1740
          0002          PDP=0002
          6141          LINC=6141
          0516          RSW=0516
          0517          LSW=0517
          0500          IOB=0500
          0600          LIF=0600
          0640          LDF=0640
          0416          STD=0416
          0453          IBZ=0453
          0440          SNS=0440
          0005          QAC=0005
          0340          SCR=0340
          0400          SXL=0400
          0300          ROR=0300
          0240          ROL=0240
          1600          BSE=1600
          0455          QLZ=0455
```

```
                                
                                
                                
1100            ADA=1100
1000            ADD=1000
1000            LDA=1000
4000            STC=4000
0702            RDE=0702
0701            RCG=0701
0700            RDC=0700
0706            WRI=0706
0704            WRC=0704
0705            WCG=0705
0707            CHK=0707
0703            MTB=0703
0004            ESF=0004
0003            TAC=0003
0023            TMA=0023
0001            AXO=0001
0006            DJR=0006
0024            SFA=0024
                
                FIXTAB
                
                /SHORT HAND SUBR, CALLS
4424            FIXT=   JMS I FIXER
4423            FLOAT=  JMS I FLOTER
4430            INITAR= JMS I INIT
4433            HEDIT1= JMS I HEADR1
4434            HEDIT2= JMS I HEADR2
4407            ENTR=   JMS I 7
4425            GETNO=  JMS I READXY
4427            RDTTY=  JMS I TELRED
4435            ASK=    JMS I QUERY
4432            CRLFD=  JMS I CRTLFD
5467            DISPLAY=        JMP I DISM2     /COMMON EXIT TO DISPLAY
                
                /THE FOLLOWING ARE USED TO CALL CERTAIN
                /OPERATIONS WHILE IN INTERPRETER MODE.
                
0001            SQUARE= 1
0002            SQROOT= 2
0003            NEGATE= 3       /NEGATE FL. PT. AC
0004            READ=   4       /READ FP#, IGNORE NON-NUMERICS
0005            OUTPUT= 5       /PRINT FAC, IN E FORMAT
0006            HEDIT=  6       /PRINT HEADING WITH 'HEDER2'
0007            FNOR=   7       /NORMALIZE C(FAC)
0010            EXPON=  10      /FORM EXP(FAC); RESULT IN FAC
```

```
                        /THESE DEFINE X-Y DAC RANGE AND PLOTTER
                        /LIMITS AS USED BY THIS PRGM.

          0764          AXR=764           /X RANGE=500(10)
          0764          AYR=764           /Y RANGE=500(10)
          0006          AXL=6             /LOWER X LIMIT=6
          7406          AYL=7406          /LOWER Y LIMIT=-250(10)

                        /THESE ARE USED BY 'MARKER' TO SET
                        /UP QUADRANT COORDINATES NEEDED.

          0203          AX1=AXL+175       /1ST X QUAD.,=131(10)
          0400          AX2=AXL+372       /2ND  "  =256(10)
          0575          AX3=AXL+567       /3RD  "  =381(10)
          7603          AY1=AYL+175       /1ST Y QUAD.,=-125(10)
          0000          AY2=AYL+372       /2ND  "  =0
          0175          AY3=AYL+567       /3RD  "  =125(10)


          0000          BUF1=0            /STARTING ADDR.-1 OF FIRST BUFFER
          4000          DLBUF=4000        /ARRAY SIZE OR OFFSET
          7600          PTABST=DIALOG     /START OF PARA ARRAY

          0000          FIELD 0
          0005          *5
0005      0000  XDIS,    0          /CURRENT X COORDINATE FOR DISPLAY
0006      7200            7200     /START OUTPUT CONTROLLER
0007      5600            5600     /START INTERPRETER

0010      0000  XIND,    0          /AUTO-INDEX REGISTERS
0011      0000  YIND,    0
0012      0000  ZIND,    0
0013      0000  AUTO,    0          /USED FOR TEMPORARY WORK.

          0020          *20
0020      0002            PDP      /IN CASE DUM-DUM STARTS IN LINC MODE
0021      5422            JMP I .+1
0022      0403            START
                                   /SUBROUTINE TABLE
0023      0556  FLOTER,  FLOATR    /FLOAT C(AC) INTO FAC
0024      0524  FIXER,   FIXR      /FIX C(FAC) INTO AC AND LOC'N 45
0025      0600  READXY,  READER    /INPUT A FP #
0026      1103  HOLD,    STALL     /RC CLOCK DELAY SUBR.
0027      0356  TELRED,  MODTTI    /GET & PRINT CHAR. ON ASR
0030      3756  INIT,    INITIZ    /INITIALIZE STORAGE POINTERS
0031      0607  OUT,     SELECT    /OUTPUT CHAR TO ASR OR HSP
0032      0366  CRTLFD,  MODCR     /ISSUE CR-LF
0033      1730  HEADR1,  HEDER1    /OUTPUT STRIPPED ASCII;ADDR. AFTER JMS
0034      1740  HEADR2,  HEDER2    /DITTO; NO ADDRESS
0035      1066  QUERY,   ASKER     /ACCEPT Y OR N IN ANSWER TO QUESTION
0036      1144  PENUP,   UPPEN     /CLOSE RELAY ONE TO LIFT PEN
0037      1154  PENDN,   DNPEN     /OPEN  "    TO DROP PEN
```

```
                0063            *63     /MORE SUBR'S AND OPERATIONAL CONTROLS
0063  1134      DISMOV, RESET   /RESET DAC OUTPUT TO NEW COORD'S
0064  1435      IOASK,  ASKIO   /ASK WHICH I/O DEVICE TO USE
0065  1124      ADCON,  ADCONV  /ADC SUBR. FOR GENERAL USE
0066  1213      XSET,   XSETUP  /COMPUTE X AXIS INCREMENT FOR DISPLAY
0067  0421      DISM2,  BEGDIS  /BEGIN OF SCOPE DISPLAY ROUTINE
0070  1717      PPSET,  SETPP   /INITIALIZE CALC'N PARA POINTERS
0071  1557      ADINX,  ADDMX   /SET UP X DISPLAY COORD'S
0072  1171      MPYR,   MPYRI   /SCALE FACTOR FOR CALC'N OF Y INTEN. VALUES
0073  1166      XMPY,   XMPYI   /SIMILARLY FOR X
0074  0000      NPTS,   0       /NUMBER OF POINTS
0075  7600      PARPTR, PTABST  /START OF PARA STORAGE TABLE
0076  1163      HUNDRD, HNDRD   /FLOATING 100(10)
0077  1174      FLORF,  FLLORF  /LORENTZIAN FRACTION
0100  1775      FGASF,  FLGASF  /GAUSSIAN "
0101  2751      X1,     X1I     /LEFT X VALUE FOR CALC'N
0102  0000      LORFR,  0       /LOR. PERCENT
0103  0000      GASFR,  0       /GAUSS "
0104  0006      XLIM,   AXL     /MIN. X FOR DISPLAY
0105  7406      YLIM,   AYL     /SAME FOR Y
0106  0764      XRNG,   AXR     /X DISPLAY RANGE
0107  0764      YRNG,   AYR     / " FOR Y
0110  0000      YONE,   BUF1    /STARTING INDEX-1 FOR Y ARRAY
0111  4000      OFFSET, DLBUF   /ARRAY OFFSET
0112  0000      YDIS,   0       /CURRENT DISPLAY COORD. FOR Y

                        /XNC AND TXSM HAVE ASSUMED DECIMAL
                        /POINT AFTER BIT 11 OF HI ORDER WORD.
0113  0000      XNC,    0       /DOUBLE PRECISION VALUE FOR X
0114  0000              0       /INCREMENT FOR DISPLAY
0115  0000      TXSM,   0       /IS CURRENT DOUBLE PREC.
0116  0000              0       /VALUE FOR X DISPLAY.

                        /THESE 4 LOC'NS ARE USED BY AVERAGER
0117  0000      RUN,    0       /NO. OF SCANS
0120  0000      MCHAN,  0       /MULTIPLEXOR CHANNEL
0121  0000      AVSUM,  0       /NO. OF SAMPLES PER PT. (2'S COMP.)
0122  0000      EXPFC,  0       /EXPONENT FACTOR REDUCES ADC SUM
```

```
197
198                                 /TABLE OF CONSTANTS, COUNTERS, & TEMP, LOC'NS.
199     0123  0000    HALF,   0     /THIS IS USED TO AVOID TRUNCATION
200     0124  2000            2000  /WHEN FIXING THE FAC TO AN INTEGER,
201     0125  0000            0
202     0126  7774    NEG4,   -4
203     0127  0077    RM77,   77
204     0130  1000    K1000,  1000
205     0131  0000    PCTR,   0
206     0132  0000    CNTR,   0
207     0133  0000    LNCTR,  0
208     0134  0000    MCTR,   0
209     0135  0000    TEMP,   0
210     0136  0000    TEMP1,  0
211     0137  0000    TEM2,   0
212     0140  0000    TEM3,   0
213     0141  0000    MIN,    0
214     0142  0000    MAX,    0
215     0143  0000    MODE,   0
216     0144  0000    BLOCK,  0
217     0145  0000    PKS,    0
218     0146  0000    PAR1,   0
219     0147  0000    PIND1,  0
220     0150  0000    PIND2,  0
221     0151  0000    PIND3,  0
222                   FTEM1,
223     0152  0000    CLTM,   0
224     0153  0000    DLATM,  0
225     0154  0000            0
226                   FTEM2,
227     0155  0000    LOORD,  0
228     0156  0000    TMXP,   0
229     0157  0000    TMCTR,  0
230     0160  0000    TEMFP,  0
231     0161  0000            0
232     0162  0000            0
233     0163  0000    XMIN,   0
234     0164  0000            0
235     0165  0000            0
236     0166  0000    YMIN,   0
237     0167  0000            0
238     0170  0000            0
239     0171  0000    XSCLFC, 0
240     0172  0000            0
241     0173  0000            0
242     0174  0000    YSCLFC, 0
243     0175  0000            0
244     0176  0000            0
```

```
                        /PAGE ONE: MAIN CALLING ROUTINE AND
                        /DISPLAY LOOP PLUS SMALL SUBR'S.

          0400          *400
0400      0002          PDP
0401      3056          DCA IOSWT
0402      5220          JMP BEGDIS-1      /SA=400 TO RE-ENTER DISPLAY
0403      7300  START,  CLA CLL
0404      3056          DCA IOSWT         /CLR I/O SWITCH FOR LOW SPD
0405      4433          HEDIT1            /CATACAL LIVES!'TITLE:
0406      5107          HD1
0407      4427          RDTTY             /READ IN TEXT UNTIL CTRL/A
0410      1323          TAD MALT          /IS ENTERED, THEN GO ON TO INPUT
0411      7640          SZA CLA
0412      5207          JMP .-3
0413      3144          DCA BLOCK         /CLEAR FOR BLOCK ONE
0414      3143          DCA MODE          /NO CURSORS
0415      7001          IAC
0416      3074          DCA NPTS          /SET # PTS TO ONE FOR INITIAL COMMAND
0417      4434          HEDIT2            /OK, HIT ME!
0420      4436          CALL PENUP        /BE SURE PLOTTER PEN IS UP

0421      6201  BEGDIS, CDF 0             /NORMAL EXIT POINT FROM ROUTINES
0422      4466          CALL XSET
0423      3062          DCA 62            /CLEAR FOR EXP, FORMATTED OUTPUT
0424      4432          CRLFD
0425      6032          KCC               /KNOCK DOWN TTY FLAG
0426      1143  SCPINT, TAD MODE
0427      7640          SZA CLA           /WANT CURSORS?
0430      4721          CALL DSPTS        /YES
0431      3135          DCA TEMP          /IS A SWITCH USED TO SWAP BLOCKS
0432      3136          DCA TEMP1         /IS Y AXIS OFFSET IF BLOCK=2
0433      1144          TAD BLOCK
0434      7640          SZA CLA           /BLOCK=1(I.E., WANT BUFFER 2)?
0435      7130          STL RAR           /YES, SET BIT 0 FOR CHANNEL 2
0436      3005          DCA XDIS
0437      1144          TAD BLOCK
0440      7640          SZA CLA           /BLOCK 1?
0441      1111  STYN,   TAD OFFSET        /YES, ADD ARRAY OFFSET
0442      1110          TAD YONE
0443      3011          DCA YIND
0444      1074          TAD NPTS
0445      7041          CIA
0446      3132          DCA CNTR
0447      3116          DCA TXSM+1
0450      6031          KSF               /GET CHAR. FROM TTY?
0451      7410          SKP
0452      5722          JMP I INTRP       /YES, GO GET REST AND DECODE.
0453      6211          CDF 10
```

```
295
296   0454  1411   SCPLOP, TAD I YIND      /GET Y VALUE (0-1000)
297   0455  7110           CLL RAR         /DIVIDE FOR DISPLAY
298   0456  1105           TAD YLIM        /ADD LOWER LIMIT
299   0457  1136           TAD TEMP1
300   0460  6141           LINC
301   0461  0145           DIS xDIS
302   0462  0002           PDP
303   0463  7300           CLA CLL
304   0464  1114           TAD XNC+1       /INCR. X DISPLAY SUM
305   0465  1116           TAD TXSM+1
306   0466  3116           DCA TXSM+1
307   0467  7004           RAL
308   0470  1005           TAD XDIS
309   0471  1113           TAD XNC
310   0472  3005           DCA XDIS
311   0473  2132           ISZ CNTR        /MORE PTS?
312   0474  5254           JMP SCPLOP      /YES
313   0475  6201           CDF 0
314   0476  7240           STA
315   0477  1144           TAD BLOCK
316   0500  7750           SPA SNA CLA     /BLOCK #=2?
317   0501  5226           JMP SCPINT      /NO, CONTINUE WITH CDA
318   0502  2135           ISZ TEMP        /IS SWITCH SET FOR BUFFER 1?
319   0503  5307           JMP .+4         /NO
320   0504  3005           DCA XDIS        /YES CLEAR X AND Y OFFSET
321   0505  3136           DCA TEMP1
322   0506  5242           JMP STYN+1      /AND RETURN
323   0507  7240           STA             /SET SWITCH TO SKIP
324   0510  3135           DCA TEMP
325   0511  7001           IAC
326   0512  4465           CALL ADCON      /GET A NEW Y OFFSET
327   0513  7010           RAR             /DIVIDE BY 2
328   0514  3136           DCA TEMP1
329   0515  4465           CALL ADCON      /GET NEW X OFFSET
330   0516  7130           STL RAR         /DIVIDE BY 2, LEAVE BIT 0 SET
331   0517  3005           DCA XDIS
332   0520  5241           JMP STYN        /AND RETURN TO GET ARRAY OFFSET
333   0521  3324   DSPTS,  DISPTS
334   0522  2000   INTRP,  SERVIS  /DECODE KBD CHAR'S AND ACT
335   0523  7577   MALT,   -201    /-CTRL/A
```

```
0524  0000  FIXR,   0        /THIS SUBR, TRUNCATES FAC TO INTEGER
0525  7200          CLA      /AND LEAVES IT IN THE AC & LOC'N 45,
0526  1044          TAD 44
0527  7750          SPA SNA CLA      /EXPO.<1?
0530  5351          JMP DONE-1       /YES; TRUNCATE TO ZERO
0531  1044          TAD 44
0532  1354          TAD M13
0533  7450          SNA              /EXPO=13?
0534  5352          JMP DONE         /YES; C(45) ARE INTEGER PART
0535  7500          SMA              /EXPO.<13?
0536  5344          JMP LRG          /NO, IS TOO LARGE
0537  3356          DCA FLOATR       /USE FLOATR AS TEMP REG,
0540  4755          CALL DIV1        /IS FAC ROTATE RIGHT; LEAVE
0541  2356          ISZ FLOATR       /FRACTION AS C(46)
0542  5340          JMP .-2
0543  5352          JMP DONE
0544  7300  LRG,    CLA CLL
0545  1045          TAD 45
0546  7710          SPA CLA          /WAS IT NEG.?
0547  7046          CMA RTL          /YES; SET AC=7775
0550  7050          CMA RAR          /IF *,=3777; IF -,=4001
0551  3045          DCA 45
0552  1045  DONE,   TAD 45
0553  5724          JMP I FIXR
0554  7765  M13,    -13
0555  6200  DIV1,   6200

0556  0000  FLOATR, 0        /CONVERTS INTEGER IN AC TO F.P.#
0557  3045          DCA 45   /AND LEAVES IT IN FAC
0560  1366          TAD P13
0561  3044          DCA 44
0562  3046          DCA 46
0563  4765          CALL FPNORM
0564  5756          JMP I FLOATR
0565  6600  FPNORM, 6600
0566  0013  P13,    13

0567  1040  INTFLT, TAD 40          /USED TO GET FLOAT THRU INTERPRETER
0570  4423          FLOAT
0571  5772          JMP I .+1
0572  5601          5601
```

```
                        /THIS IS A SHORT DEBUG AND CORE MODIFIER ROUTINE
                        /THE RETURN LOCATION IS SPECIFIED BY
                        /TYPING 'R' THEN RETURN LOC'N.
                        /TYPE 'N' TO OPEN NEXT LOCATION; TYPE 'C'
                        /AFTER A CORRECTION TO ENTER IT;
                        /AND TYPE 'S' TO REOPEN LAST LOCATION USED.
                        /'RUBOUT' WILL TERMINATE ANY OPERATION
                        /THEN RESTART ROUTINE.

     0200               *200                /NOTE: OUT OF SEQUENCE.
0200 4366    STRTIT,    JMS MODCR
0201 4272               JMS OCTIN           /GET A LOCATION TO OPEN
0202 5200               JMP .-2
0203 7440               SZA                 /GET A NUMBER>0?
0204 5231               JMP GOTIT           /YES
0205 1353               TAD LSCHR           /IS LAST CHARACTER READ
0206 1346               TAD MEN
0207 7450               SNA                 /WAS IT 'N'?
0210 5225               JMP NLOC            /YES
0211 1347               TAD MES
0212 7450               SNA                 /WAS IT 'S'?
0213 5226               JMP NLOC+1          /YES
0214 7001               IAC
0215 7640               SZA CLA             /WAS IT 'R'?
0216 5200               JMP STRTIT          /NO, IGNORE IT
0217 4272               JMS OCTIN           /YES; GET EXIT LOC'N
0220 5200               JMP STRTIT          /IF ERROR, RESTART
0221 7650               SNA CLA             /MUST BE NONZERO ADDR.
0222 5200               JMP STRTIT
0223 4366               JMS MODCR           /WAS OK
0224 5754               JMP I VALU          /EXIT TO THERE.

0225 2352    NLOC,      ISZ LSLOC
0226 1352               TAD LSLOC
0227 4252               JMS OCTOUT
0230 7410               SKP
0231 3352    GOTIT,     DCA LSLOC
0232 1343               TAD EQUAL
0233 4431               CALL OUT
0234 1752               TAD I LSLOC         /GET CONTENTS OF OPEN LOC'N
0235 4252               JMS OCTOUT          /PRINT IT
0236 1344               TAD COLON
0237 4431               CALL OUT
0240 4272               JMS OCTIN           /GET CORRECTION
0241 5200               JMP STRTIT
0242 7200               CLA
0243 1353               TAD LSCHR
0244 1336               TAD MSEE
0245 7640               SZA CLA             /WAS LAST CHAR, A 'C'?
0246 5200               JMP STRTIT          /NO, RESTART.
0247 1354               TAD VALU            /YES
0250 3752               DCA I LSLOC         /STORE CORRECTION
0251 5200               JMP STRTIT
```

```
0252  0000  OCTOUT, 0
0253  7104        CLL RAL          /CAME WITH OCTAL # IN AC;
0254  3355        DCA DTEM         /ROTATE 1ST DIGIT INTO LINK
0255  1126        TAD NEG4
0256  3351        DCA NCNTR
0257  1355  SETIT, TAD DTEM
0260  7006        RTL
0261  7004        RAL
0262  3355        DCA DTEM
0263  1355        TAD DTEM
0264  0345        AND MS7          /MASK RIGHTMOST 3 BITS
0265  1337        TAD AS260
0266  4431        CALL OUT
0267  2351        ISZ NCNTR        /PRINTED 4 DIGITS?
0270  5257        JMP SETIT        /NO
0271  5652        JMP I OCTOUT     /YES, WE'RE DONE,

0272  0000  OCTIN, 0
0273  7200        CLA              /OCTAL INPUT ROUTINE
0274  3354        DCA VALU         /ANY NON OCTAL CHAR TERMINATES
0275  3351        DCA NCNTR        />4 DIGITS OR RUBOUT GENERATE ERROR RETURN
0276  4356  GTCHR, JMS MODTTI      /GET A CHARACTER
0277  3353        DCA LSCHR
0300  1353        TAD LSCHR
0301  1341        TAD MN7
0302  7540        SMA SZA          /<OR= ASCII '7'?
0303  5323        JMP FNISH        /NO, IS NOT DIGIT
0304  1342        TAD P7M0
0305  7510        SPA              /> ASCII '0'?
0306  5323        JMP FNISH        /NO, DEFINITELY NOT DIGIT,
0307  3355        DCA DTEM         /IS DIGIT, KEEP IT,
0310  1354        TAD VALU         /IS CURRENTLY ASSEMBLED LOC'N
0311  7106        CLL RTL
0312  7004        RAL
0313  1355        TAD DTEM         /ADD NEW DIGIT
0314  3354        DCA VALU
0315  2351        ISZ NCNTR
0316  1351        TAD NCNTR        /HAVE MORE THAN 4 CHAR'S?
0317  1126        TAD NEG4
0320  7740        SZA SMA CLA
0321  5333        JMP BAD          /YES, ERROR
0322  5276        JMP GTCHR        /NO, GET ANOTHER
0323  7200  FNISH, CLA            /EXIT HERE WITH OPEN LOC'N IN AC
0324  1353        TAD LSCHR
0325  1340        TAD MRBT
0326  7650        SNA CLA          /WAS LAST CHAR A RUBOUT?
0327  5333        JMP .+4          /YES, ERROR!
0330  2272        ISZ OCTIN        /INDEX RETURN IF NO ERROR
0331  1354        TAD VALU         /AND LEAVE RESULT IN AC
0332  5672        JMP I OCTIN
0333  1350  BAD,   TAD QUEST
0334  4431        CALL OUT
0335  5672        JMP I OCTIN
```

```
                                
0336  7475  MSEE,   -303
0337  0260  AS260,  260
0340  7401  MRBT,   -377
0341  7511  MN7,    -267
0342  0007  P7M0,   267-260
0343  0275  EQUAL,  275
0344  0272  COLON,  272
0345  0007  MS7,    7
0346  7462  MEN,    -316
0347  7773  MES,    316-323
0350  0277  QUEST,  277
0351  0000  NCNTR,  0
0352  0000  LSLOC,  0
0353  0000  LSCHR,  0
0354  0000  VALU,   0
0355  0000  DTEM,   0
                                
0356  0000  MODTTI, 0
0357  6031        KSF
0360  5357        JMP .-1
0361  6036        KRB
0362  6046        TLS
0363  6041        TSF
0364  5363        JMP .-1
0365  5756        JMP I MODTTI
                                
0366  0000  MODCR,  0
0367  7200        CLA
0370  1375        TAD MDCR
0371  4431        CALL OUT
0372  1376        TAD MDLF
0373  4431        CALL OUT
0374  5766        JMP I MODCR
0375  0215  MDCR,   215
0376  0212  MDLF,   212
```

```
                0600            *600
                                /FP INPUT SUBR. TO IGNORE NON-NUMERICS.
0600  0000  READER, 0
0601  4606          CALL FLIN         /GET CONVERSION
0602  1060          TAD 60
0603  7650          SNA CLA           /NUMERIC INPUT?
0604  5201          JMP .-3           /NO, TRY AGAIN
0605  5600          JMP I READER      /YES, EXIT.
0606  7400  FLIN,   7400

0607  0000  SELECT, 0       /OUTPUT SELECTOR ACCORDING TO IOSWT
0610  3227          DCA OUTCHR        /KEEP CHAR.
0611  1056          TAD IOSWT
0612  7650          SNA CLA           /WAS IT >0?
0613  5221          JMP TTOUT         /NO, USE TELETYPE
0614  1227          TAD OUTCHR
0615  6026          PLS
0616  6021          PSF
0617  5216          JMP .-1
0620  5225          JMP .+5
0621  1227  TTOUT,  TAD OUTCHR
0622  6046          TLS
0623  6041          TSF
0624  5223          JMP .-1
0625  7200          CLA
0626  5607          JMP I SELECT
0627  0000  OUTCHR, 0

0630  0000  MARKER, 0       /TABLE DRIVEN AXIS MARKER ROUTINE
0631  1261          TAD CORTAB        /INITIALIZE COORD. TABLE POINTER
0632  3013          DCA AUTO
0633  1413  LOKIN,  TAD I AUTO       /GET STATUS WORD
0634  3135          DCA TEMP
0635  1135          TAD TEMP
0636  7001          IAC
0637  7650          SNA CLA           /END OF TABLE?
0640  5630          JMP I MARKER      /YES
0641  1135          TAD TEMP
0642  7700          SMA CLA           /NEED X COORD.?
0643  5246          JMP .+3           /NO
0644  1413          TAD I AUTO
0645  3005          DCA XDIS
0646  1135          TAD TEMP
0647  7004          RAL
0650  7700          SMA CLA           /NEED Y COORD.?
0651  5254          JMP .+3           /NO
0652  1413          TAD I AUTO
0653  3112          DCA YDIS
0654  7201          CLA IAC           /IF BIT 11=1, MOVE TO COORD'S
0655  0135          AND TEMP          /THEN PUT PEN DOWN; IF =0,
0656  4660          CALL PLTMV        /INCREMENT TO COORD'S W/PEN DOWN.
0657  5233          JMP LOKIN         /CONTINUE SCANNING TABLE
0660  1600  PLTMV,  PLTINC
```

```
574
575                             /THE FOLLOWING TABLE OF COORD'S IS STRUCTURED
576                             /THUSLY: 1ST WORD=STATUS, BIT 0=1 MEANS
577                             /X COORD. FOLLOWS, BIT 1=1 Y COORD. FOLLOWS,
578                             /BOTH SET MEANS X THEN Y COORD'S FOLLOW.
579                             /BIT 11 DESCRIBES PEN STATUS: =0
580                             /LEAVE PEN AS IS, AND =1 RAISE PEN.
581
582          4000               PX=4000;PY=2000;PU=1
583          2000
584          0001
585
586    0661  0661    CORTAB, .
587
588                             /THESE DRAW A BOX STARTING FROM AXES ORIGIN
589    0662  6001               PX+PY+PU          /GO TO AXES ORIGIN
590    0663  0001               AXL=5
591    0664  7401               AYL=5
592    0665  4000               PX        /GO TO RIGHT
593    0666  0777               AXL+AXR+5
594    0667  2000               PY        /GO TO TOP
595    0670  0377               AYL+AYR+5
596    0671  4000               PX        /GO TO LEFT TOP
597    0672  0001               AXL=5
598    0673  2000               PY        /GO TO AXES ORIGIN
599    0674  7401               AYL=5
600
601                             /THESE DRAW TICS ON X AXIS
602    0675  4001               PX+PU
603    0676  0006               AXL
604    0677  2000               PY
605    0700  7404               AYL=2
606    0701  6001               PX+PY+PU
607    0702  0203               AX1
608    0703  7401               AYL=5
609    0704  2000               PY
610    0705  7404               AYL=2
611    0706  6001               PX+PY+PU
612    0707  0400               AX2
613    0710  7401               AYL=5
614    0711  2000               PY
615    0712  7404               AYL=2
616    0713  6001               PX+PY+PU
617    0714  0575               AX3
618    0715  7401               AYL=5
619    0716  2000               PY
620    0717  7404               AYL=2
621    0720  6001               PX+PY+PU
622    0721  0772               AXR+AXL
623    0722  7401               AYL=5
624    0723  2000               PY
625    0724  7404               AYL=2
```

```
                                /TICS ON Y AXIS
0725  6001                      PX+PY+PU
0726  0001                      AXL=5
0727  7406                      AYL
0730  4000                      PX
0731  0004                      AXL=2
0732  6001                      PX+PY+PU
0733  0001                      AXL=5
0734  7603                      AY1
0735  4000                      PX
0736  0004                      AXL=2
0737  6001                      PX+PY+PU
0740  0001                      AXL=5
0741  0000                      AY2
0742  4000                      PX
0743  0004                      AXL=2
0744  6001                      PX+PY+PU
0745  0001                      AXL=5
0746  0175                      AY3
0747  4000                      PX
0750  0004                      AXL=2
0751  6001                      PX+PY+PU
0752  0001                      AXL=5
0753  0372                      AYR+AYL
0754  4000                      PX
0755  0004                      AXL=2
0756  6001                      PX+PY+PU
0757  0006                      AXL
0760  7406                      AYL
0761  7777    MIN1,   -1        /END OF TABLE.

0762  0000    NORMAT, 0                 /SCALE HGT VALUE IN FAC
0763  4407              ENTR
0764  3472              FMPY I MPYR
0765  1123              FADD HALF
0766  0000              FEXT
0767  4424              FIXT            /LEAVE RESULT IN AC
0770  5762              JMP I NORMAT

0771  0000    HIGHT,  0                 /GET AND SCALE HGT VALUE
0772  4425              GETNO
0773  4362              JMS NORMAT
0774  3547              DCA I PIND1
0775  5771              JMP I HIGHT
```

```
             1000                *1000
       1000  4433    CALBRT, HEDIT1            /CALIBRATE!*LINE PLOT?
       1001  5151            HD3
       1002  4435            ASK
       1003  3663            DCA I PTPLT       /=0 FOR LINE PLOT;=1 FOR POINT
       1004  4432    CLSTRT, CRLFD
       1005  4436            CALL PENUP
       1006  5250            JMP ORGN          /START PEN AT ORIGIN OF DATA
       1007  4463    INSTRK, CALL DISMOV       /BEGIN INTERROGATION
       1010  6031            KSF
       1011  5207            JMP .-2           /MUST REFRESH DISPLAY
       1012  6036            KRB
       1013  6046            TLS
       1014  1256            TAD YES           /LEGAL CHARACTERS ARE
       1015  7450            SNA               /X,Y,O,M, OR G
       1016  5244            JMP YMAX          /WAS Y, GO TO YMAX
       1017  7001            IAC               /WAS IT X?
       1020  7450            SNA
       1021  5240            JMP XMAX          /YES, GO TO XMAX,
       1022  1260            TAD MGEE          /WAS IT G?
       1023  7450            SNA
       1024  5665            JMP I PLTXIT      /YES, EXIT,
       1025  1261            TAD MEM           /WAS IT M?
       1026  7440            SZA
       1027  5232            JMP .+3           /NO
       1030  4664            CALL MARKR        /YES, MARK COORDINATE AXES,
       1031  5204            JMP CLSTRT
       1032  1262            TAD MOH           /WAS IT O?
       1033  7650            SNA CLA
       1034  5250            JMP ORGN          /YES, GO TO DATA MINIMA,
       1035  1255            TAD QUES          /NO, FOUND INVALID CHARACTER
       1036  4431            CALL OUT
       1037  5207            JMP INSTRK

       1040  1104    XMAX,   TAD XLIM
       1041  1106            TAD XRNG
       1042  3005            DCA XDIS
       1043  5207            JMP INSTRK

       1044  1105    YMAX,   TAD YLIM
       1045  1107            TAD YRNG
       1046  3112            DCA YDIS
       1047  5207            JMP INSTRK

       1050  1104    ORGN,   TAD XLIM
       1051  3005            DCA XDIS
       1052  1105            TAD YLIM
       1053  3112            DCA YDIS
       1054  5207            JMP INSTRK
```

```

1055 0277  QUES,   277      /?
1056 7447  YES,    -331     /-Y
1057 0013  NO,     331-316 /Y-N
1060 0021  MGEE,   330-307 /X-G
1061 7772  MEM,    307-315 /G-M
1062 7776  MOH,    315-317 /M-O
1063 1364  PTPLT,  PNTPLT
1064 0630  MARKR,  MARKER
1065 1335  PLTXIT, PLTINT

                            /SUBR. ACCEPTS ONLY 'Y' OR 'N' FROM
1066 0000  ASKER,  0        /ASR, GIVES '?' IF NOT, SETS AC=1
1067 4427          RDTTY            /FOR 'N' ANSWER, AC=0 FOR 'Y'
1070 1256          TAD YES
1071 7450          SNA
1072 5666          JMP I ASKER      /=0 FOR YES
1073 1257          TAD NO
1074 7640          SZA CLA
1075 5300          JMP .+3
1076 7001          IAC              /=1 FOR NO
1077 5666          JMP I ASKER
1100 1255          TAD QUES
1101 4431          CALL OUT
1102 5267          JMP ASKER+1

1103 0000  STALL,  0
1104 7300          CLA CLL
1105 1322          TAD SET
1106 7650          SNA CLA          /WANT FAST CLOCK?
1107 1130          TAD K1000        /NO SET FOR 1KC
1110 1323          TAD K3100        /IF SKIPPED SET FOR 10KC
1111 3317          DCA CCLDR
1112 7125          STL IAC RAL
1113 4465          CALL ADCON       /GET VARIABLE COUNT FROM CHAN 3
1114 1130          TAD K1000
1115 7106          CLL RTL          /TIMES 4
1116 4721          CALL CLKSET      /INSERT DELAY TIME
1117 0000  CCLDR,  0
1120 5703          JMP I STALL
1121 4343  CLKSET, SETCLK
1122 0000  SET,    0
1123 3100  K3100,  3100

1124 0000  ADCONV, 0
1125 1333          TAD CSAM         /FORM SAM N; CHANNEL IN AC
1126 3330          DCA .+2
1127 6141          LINC
1130 0000          0
1131 0002          PDP              /LEAVE RESULT IN AC
1132 5724          JMP I ADCONV
1133 0100  CSAM,   SAM
```

```
774
775  1134  0000  RESET, 0                /RESET DISPLAY COORD'S
776  1135  7200        CLA
777  1136  1112        TAD YDIS
778  1137  6141        LINC
779  1140  0145        DIS XDIS
780  1141  0002        PDP
781  1142  7200        CLA
782  1143  5734        JMP I RESET
783
784                    /THESE TWO SUBR'S OPEN AND CLOSE RELAY 1
785  1144  0000  UPPEN, 0
786  1145  4426        CALL HOLD
787  1146  7001        IAC
788  1147  6141        LINC
789  1150  0014        ATR
790  1151  0002        PDP
791  1152  4426        CALL HOLD
792  1153  5744        JMP I UPPEN
793
794  1154  0000  DNPEN, 0
795  1155  4426        CALL HOLD
796  1156  6141        LINC
797  1157  0014        ATR
798  1160  0002        PDP
799  1161  4426        CALL HOLD
800  1162  5754        JMP I DNPEN
801
802  1163  0007  HNDRD, FLTG 100,0
     1164  3100
     1165  0000
803  1166  0000  XMPYI, 0;0;0
     1167  0000
     1170  0000
804  1171  0000  MPYRI, 0;0;0
     1172  0000
     1173  0000
805  1174  0000  FLLORF, 0;0;0
     1175  0000
     1176  0000
```

```
            1200            *1200
     1200   0000    LEADER, 0       /OUTPUT 10 INCHES OF LDR-TRLR.
     1201   4432            CRLFD
     1202   1211            TAD LNUM
     1203   3131            DCA PCTR
     1204   1212            TAD C200
     1205   4431            CALL OUT
     1206   2131            ISZ PCTR
     1207   5204            JMP .-3
     1210   5600            JMP I LEADER
     1211   7634    LNUM,   -144
     1212   0200    C200,   200

     1213   0000    XSETUP, 0
     1214   7240            STA                 /FOLLOWING ROUTINE COMPUTES
     1215   1074            TAD NPTS            /X DISPLAY INCREMENT SCALED
     1216   4423            FLOAT               /TO THE NO. OF PTS., NPTS.
     1217   4407            ENTR
     1220   6171            FPUT XSCLFC
     1221   7106            FLOT XRNG
     1222   4171            FDIV XSCLFC         /LEAVES X UNITS/PT IN FAC
     1223   6171            FPUT XSCLFC         /AND XSCLFC.
     1224   0000            FEXT
     1225   1044            TAD 44
     1226   7740            SZA SMA CLA         /WAS FAC<1?
     1227   5237            JMP GTZR            /NO
     1230   3113            DCA XNC             /YES, CLEAR INTEGER PART
     1231   1045            TAD 45              /ASSUMES FACTOR IS ALWAYS
     1232   7104            CLL RAL             /0.25 OR GREATER;RAL FOR SIGN BIT
     1233   2044            ISZ 44              /WAS C(44)=-1?
     1234   7410            SKP                 /NO, WAS 0
     1235   7110            CLL RAR             /YES, DIVIDE BY 2
     1236   5242            JMP .+4
     1237   4424    GTZR,   FIXT
     1240   3113            DCA XNC
     1241   1046            TAD 46
     1242   3114            DCA XNC+1
     1243   5613            JMP I XSETUP
```

```
845   1244  4307   ISDIG,  JMS DATYP
846   1245  4434           HEDIT2          /PTS. TO SKIP:
847   1246  4425           GETNO
848   1247  4424           FIXT
849   1250  7040           CMA             /KEEP AS ONE'S COMP.
850   1251  3131           DCA PCTR
851   1252  4433           HEDIT1          /Y RANGE AND MIN.:
852   1253  5352           DIHD1
853   1254  4425           GETNO
854   1255  4324           JMS YSVAL
855   1256  4407           ENTR
856   1257  0004           READ            /READ MINIMUM Y
857   1260  6166           FPUT YMIN
858   1261  0000           FEXT
859   1262  4464           CALL IOASK      /LOW SPEED I/O?
860   1263  6014           RFC
861   1264  4430           INITAR
862   1265  4407   XYSCAL, ENTR            /READ A Y VALUE
863   1266  0004           READ
864   1267  2166           FSUB YMIN
865   1270  3174           FMPY YSCLFC
866   1271  1123           FADD HALF
867   1272  0000           FEXT
868   1273  4424           FIXT
869   1274  6211           CDF 10
870   1275  3411           DCA I YIND
871   1276  6201           CDF 0
872   1277  2131           ISZ PCTR        /KEEPING THIS POINT?
873   1300  5264           JMP XYSCAL-1    /NO, RE-INIT. TO IGNORE PTS.
874   1301  7240           STA             /AFTER FIRST SKIP, ALWAYS SKIP
875   1302  3131           DCA PCTR
876   1303  2132           ISZ CNTR
877   1304  5265           JMP XYSCAL
878   1305  3056           DCA IOSWT       /CLEAR I/O SWITCH
879   1306  5467           DISPLAY         /EXIT FOR DISPLAY
880
881   1307  0000   DATYP,  0
882   1310  4433           HEDIT1
883   1311  5133           HD2             /NO. PTS=
884   1312  4425           GETNO
885   1313  4424           FIXT
886   1314  7041           CIA
887   1315  1111           TAD OFFSET
888   1316  7710           SPA CLA         /LESS THAN ARRAY SIZE?
889   1317  5310           JMP DATYP+1     /NO. TRY AGAIN
890   1320  1045           TAD 45
891   1321  3074           DCA NPTS
892   1322  4466           CALL XSET       /SET X DISPLAY INCREMENT
893   1323  5707           JMP I DATYP
```

```
894
895   1324  0000   YSVAL, 0
896   1325  4407          ENTR
897   1326  3123          FMPY HALF       /DATA RANGE IN FAC ON ENTRY
898   1327  6174          FPUT YSCLFC
899   1330  7107          FLOT YRNG       /FIND YRNG/D,R,=YSCLFC
900   1331  4174          FDIV YSCLFC     / AND LEAVE FACTOR IN FAC
901   1332  6174          FPUT YSCLFC
902   1333  0000          FEXT
903   1334  5724          JMP I YSVAL
904
905   1335  4430   PLTINT, INITAR         /INCREMENTAL X-Y ANALOG PLOTTING ROUTINE
906   1336  4436          CALL PENUP      /RAISE PEN
907   1337  4466          CALL XSET
908   1340  7001          IAC             /SET SWITCH FOR 1 ST PT ONLY
909   1341  3133          DCA LNCTR
910   1342  6211   PLTLOP, CDF 10         /SET UP Y VALUE
911   1343  1411          TAD I YIND
912   1344  6201          CDF 0
913   1345  7110          CLL RAR
914   1346  1105          TAD YLIM
915   1347  3112          DCA YDIS
916   1350  1364          TAD PNTPLT      /=0 FOR LINE PLOT, =1 FOR POINT
917   1351  1133          TAD LNCTR
918   1352  4765          CALL PLTMOV     /MOVE PEN
919   1353  3133          DCA LNCTR       /CLEAR 1 ST PT SWITCH
920   1354  4471          CALL ADINX      /INCR. X DISPLAY SUM
921   1355  2132          ISZ CNTR        /MORE PTS?
922   1356  5342          JMP PLTLOP      /YES
923   1357  4436          CALL PENUP      /LIFT PEN + EXIT
924   1360  4433          HEDIT1          /DONE. IS PLOTTER OFF?
925   1361  5170          HD6
926   1362  4435          ASK             /IGNORE RESPONSE
927   1363  5467          DISPLAY
928   1364  0000   PNTPLT, 0
929   1365  1600   PLTMOV, PLTINC
930
931   1366  4430   YFLIP,  INITAR         /INVERT Y AXIS
932   1367  6211          CDF 10          /Y(I)=2*YRNG-Y(I)
933   1370  1411   FLY,    TAD I YIND
934   1371  7041          CIA
935   1372  1107          TAD YRNG
936   1373  1107          TAD YRNG
937   1374  3412          DCA I YIND
938   1375  2132          ISZ CNTR
939   1376  5370          JMP FLY
940   1377  5467          DISPLAY
```

```
941
942
943
944
945          1400              *1400
946                                    /SUBR. PRINTS DEC. NOS. IN 10 COLUMNS
947     1400 4464     FPOUT,   CALL IOASK       /OF UP TO 4 DIGIT INTEGERS,
948     1401 4634              CALL LEDER
949     1402 4430              INITAR
950     1403 3055              DCA 55            /CLEARS CR-LF SWITCH IN FPP.
951     1404 1231              TAD NDIG
952     1405 3062              DCA 62            /NO. OF DIGITS TO OUTPUT
953     1406 1232     NULINE,  TAD NLIN
954     1407 3134              DCA MCTR
955     1410 6211     LOOP6,   CDF 10
956     1411 1411              TAD I YIND
957     1412 6201              CDF 0
958     1413 4423              FLOAT
959     1414 1233              TAD SPAACE
960     1415 4431              CALL OUT
961     1416 4406              CALL 6
962     1417 2132              ISZ CNTR
963     1420 7410              SKP
964     1421 5226              JMP DNE
965     1422 2134              ISZ MCTR
966     1423 5210              JMP LOOP6
967     1424 4432              CRLFD
968     1425 5206              JMP NULINE
969     1426 4634     DNE,     CALL LEDER
970     1427 3056              DCA IOSWT         /CLEAR I/O SWITCH
971     1430 5467              DISPLAY
972     1431 0004     NDIG,    4        /ALSO USED BY 'SCALY'
973     1432 7766     NLIN,    -12
974     1433 0240     SPAACE,  240
975     1434 1200     LEDER,   LEADER
976
977                            /CHECK WHICH I/O DEVICES TO USE
978     1435 0000     ASKIO,   0
979     1436 4433              HEDIT%
980     1437 1446              HDIO
981     1440 4435              ASK
982     1441 7110              CLL RAR           /KEEP ANSWER IN LINK
983     1442 4432              CRLFD             /MUST HAVE LOW I/O FOR CR-LF
984     1443 7004              RAL               /NOW SET UP SWITCH
985     1444 3056              DCA IOSWT         /=1,HIGH;=0,LOW
986     1445 5635              JMP I ASKIO
987     1446 2424     HDIO,    TEXT \TTY I/O?\
        1447 3140
        1450 1157
        1451 1777
        1452 0000
988
```

```
 989
 990
 991   1453  4430  SCALY,  INITAR
 992   1454  2132          ISZ CNTR        /UPDATE BY ONE
 993   1455  6211          CDF 10
 994   1456  1411          TAD I YIND
 995   1457  3141          DCA MIN
 996   1460  1141          TAD MIN
 997   1461  3142          DCA MAX
 998   1462  1411  LOOP4,  TAD I YIND      /FIND YMAX AND YMIN IN DATA
 999   1463  3135          DCA TEMP
1000   1464  1135          TAD TEMP        /SUB Y FROM MIN
1001   1465  7041          CIA
1002   1466  1141          TAD MIN
1003   1467  7700          SMA CLA         /MIN<Y?
1004   1470  5277          JMP LOW         /NO, SET MIN=Y
1005   1471  1135          TAD TEMP        /YES,SUB Y FROM MAX
1006   1472  7041          CIA
1007   1473  1142          TAD MAX
1008   1474  7710          SPA CLA         /MAX>Y?
1009   1475  5302          JMP HIGH        /NO, SET MAX=Y
1010   1476  5304          JMP INCR
1011   1477  1135  LOW,    TAD TEMP
1012   1500  3141          DCA MIN
1013   1501  5304          JMP INCR
1014   1502  1135  HIGH,   TAD TEMP
1015   1503  3142          DCA MAX
1016   1504  2132  INCR,   ISZ CNTR
1017   1505  5262          JMP LOOP4
1018   1506  6201          CDF 0
1019   1507  1141          TAD MIN
1020   1510  7041          CIA
1021   1511  1142          TAD MAX
1022   1512  4423          FLOAT
1023   1513  4756          CALL YSCVAL
1024   1514  4433          HEDIT1          /'MIN=
1025   1515  5157          HD5
1026   1516  1231          TAD NDIG        /SET C(62) FOR 'NDIG' DIGITS
1027   1517  3062          DCA 62
1028   1520  1141          TAD MIN
1029   1521  4423          FLOAT
1030   1522  4406          CALL 6          /OUTPUT 'NDIG' DIGIT INTEGER
1031   1523  4434          HEDIT2          /MAX=
1032   1524  1142          TAD MAX
1033   1525  4423          FLOAT
1034   1526  4406          CALL 6
1035   1527  4407          ENTR
1036   1530  0006          HEDIT           /MPY=
1037   1531  5174          FGET YSCLFC
1038   1532  0000          FEXT
1039   1533  7125          STL IAC RAL     /SET 3 IN AC FOR 3 DEC, PLACES
1040   1534  4406          CALL 6          /'NDIG' DIGITS WITH 3 "   "
```

```
1041    1535  4430            INITAR
1042    1536  1141    SKL,    TAD MIN         /SCALE DATA AFTER SUB'G MIN Y.
1043    1537  7041            CIA
1044    1540  6211            CDF 10
1045    1541  1411            TAD I YIND
1046    1542  6201            CDF 0
1047    1543  4423            FLOAT
1048    1544  4407            ENTR
1049    1545  3174            FMPY YSCLFC
1050    1546  1123            FADD HALF       /CORRECT FOR TRUNCATION.
1051    1547  0000            FEXT
1052    1550  4424            FIXT
1053    1551  6211            CDF 10
1054    1552  3412            DCA I ZIND
1055    1553  2132            ISZ CNTR
1056    1554  5336            JMP SKL
1057    1555  5467            DISPLAY
1058    1556  1324    YSCVAL, YSVAL
1059
1060                          /LOADS CURRENT XDIS AND READYS NEXT.
1061    1557  0000    ADDMX,  0
1062    1560  7300            CLA CLL
1063    1561  1116            TAD TXSM+1      /GET LOW ORDER
1064    1562  7104            CLL RAL         /PUT BIT 0 IN 11 FOR ROUNDOFF
1065    1563  7204            CLA RAL
1066    1564  1115            TAD TXSM        /GET HIGH ORDER
1067    1565  1104            TAD XLIM
1068    1566  3005            DCA XDIS        /IS CURRENT X DISPLAY VALUE.
1069    1567  1116            TAD TXSM+1      /FOR NEXT TIME: GET FRACTIONS
1070    1570  1114            TAD XNC+1
1071    1571  3116            DCA TXSM+1
1072    1572  7004            RAL             /PUT OVERFLOW IN BIT 11
1073    1573  1115            TAD TXSM        /GET INTEGER PARTS
1074    1574  1113            TAD XNC
1075    1575  3115            DCA TXSM
1076    1576  5757            JMP I ADDMX
1077
```

```
1078          1600            *1600
1079                          /ENTER WITH CONTROL VALUE IN AC:
1080                          /NEG=SCOPE,0=INCREMENT, & POS=FIRST
1081                          /POINT (FOR PLOTTING ONLY, NOT SCOPE)
1082                          /OR MAKE A POINT PLOT.
1083
1084    1600  0000    PLTINC, 0
1085    1601  7500            SMA             /IS AC NEG?
1086    1602  5205            JMP .+3         /NO
1087    1603  4463            CALL DISMOV     /YES, USE FAST JUMP
1088    1604  5307            JMP PLEXT
1089    1605  7650            SNA CLA         /WAS AC>0?
1090    1606  5215            JMP GSCAN       /NO, USE INCREMENTER
1091    1607  4436            CALL PENUP      /YES; GO TO COORD'S AND WAIT
1092    1610  4463            CALL DISMOV
1093    1611  4436            CALL PENUP
1094    1612  4436            CALL PENUP
1095    1613  4437            CALL PENDN      /THEN PUT PEN DOWN
1096    1614  5307            JMP PLEXT
1097
1098    1615  1315    GSCAN,  TAD OLDX        /IS OLD X
1099    1616  7041            CIA
1100    1617  1005            TAD XDIS
1101    1620  3131            DCA PCTR        /IS DELTA X
1102    1621  1316            TAD OLDY        /IS OLD Y
1103    1622  7041            CIA
1104    1623  1112            TAD YDIS
1105    1624  3136            DCA TEMP1       /IS DELTA Y
1106    1625  1131            TAD PCTR
1107    1626  7510            SPA
1108    1627  7041            CIA
1109    1630  3134            DCA MCTR        /IS ABS. VALUE OF DX
1110    1631  1136            TAD TEMP1
1111    1632  7510            SPA
1112    1633  7041            CIA             /NOW HAVE ABS(DY)
1113    1634  1134            TAD MCTR        /ADD ABS(DX)
1114    1635  3134            DCA MCTR        /ABS(DX)+ABS(DY)=# OF MOVES=MCTR
1115    1636  1134            TAD MCTR
1116    1637  7450            SNA             /IS MCTR>0?
1117    1640  5307            JMP PLEXT       /NO, NO MOVES TO MAKE, EXIT.
1118    1641  7041            CIA
1119    1642  3133            DCA LNCTR
```

```
1120   1643  4407            ENTR
1121   1644  7134            FLOT MCTR       /# MOVES
1122   1645  6160            FPUT TEMFP
1123   1646  7315            FLOT OLDX
1124   1647  6163            FPUT XMIN
1125   1650  7316            FLOT OLDY
1126   1651  6166            FPUT YMIN
1127   1652  7131            FLOT PCTR       /DELTA X
1128   1653  4160            FDIV TEMFP
1129   1654  6171            FPUT XSCLFC     /X UNITS/MOVE
1130   1655  7136            FLOT TEMP1      /DELTA Y
1131   1656  4160            FDIV TEMFP
1132   1657  6174            FPUT YSCLFC     /Y UNITS/MOVE
1133   1660  0000            FEXT
1134   1661  2714            ISZ I CSET      /USE FAST CLOCK CYCLE
1135   1662  4407  SCANIT,   ENTR
1136   1663  5163            FGET XMIN
1137   1664  1171            FADD XSCLFC
1138   1665  6163            FPUT XMIN
1139   1666  1123            FADD HALF
1140   1667  0000            FEXT
1141   1670  4424            FIXT            /TRUNCATE XPOS TO NEAREST INTEGER
1142   1671  3005            DCA XDIS
1143   1672  4407            ENTR
1144   1673  5166            FGET YMIN
1145   1674  1174            FADD YSCLFC
1146   1675  6166            FPUT YMIN
1147   1676  1123            FADD HALF
1148   1677  0000            FEXT
1149   1700  4424            FIXT            /DO SAME FOR Y,
1150   1701  3112            DCA YDIS
1151   1702  4463            CALL DISMOV     /MOVE PEN TO NEW COORD'S
1152   1703  4426            CALL HOLD       /WAIT FOR FAST CLOCK CYCLE
1153   1704  2133            ISZ LNCTR       /MORE MOVES?
1154   1705  5262            JMP SCANIT      /YES,
1155   1706  3714            DCA I CSET      /RESTORE FOR SLOW CLOCK
1156   1707  1005  PLEXT,    TAD XDIS
1157   1710  3315            DCA OLDX
1158   1711  1112            TAD YDIS
1159   1712  3316            DCA OLDY
1160   1713  5600            JMP I PLTINC
1161   1714  1122  CSET,     SET
1162   1715  0000  OLDX,     0
1163   1716  0000  OLDY,     0
1164
1165   1717  0000  SETPP,    0               /SET UP PARA TABLE POINTERS
1166   1720  3147            DCA PIND1       /VALUE FOR PIND1 IS IN AC
1167   1721  1147            TAD PIND1
1168   1722  7001            IAC
1169   1723  3150            DCA PIND2
1170   1724  1150            TAD PIND2
1171   1725  7001            IAC
1172   1726  3151            DCA PIND3
1173   1727  5717            JMP I SETPP
```

```
1174                            /ENTER HEDER1 WITH MESSAGE ADDRESS IN
1175                            /LOCATION FOLLOWING THE JMS (HEDER1),
1176                            /ENTER HEDER2 TO CONTINUE ON WITH A
1177                            /BROKEN STRING (E.G., SEE 'HD1' BELOW)
1178                            /AND DO NOT SUPPLY ADDRESS AFTER THE JMS.
1179    1730  0000    HEDER1, 0               /THESE SUBR'S OUTPUT PACKED ASCII
1180    1731  7301            CLA CLL IAC     /AS GENERATED BY MACRO-8 ASSEMBLER,
1181    1732  1330            TAD HEDER1      /A SINGLE CODE,UP ARROW,=CR+LF
1182    1733  3340            DCA HEDER2      /ALWAYS RETURN THRU HEDER2
1183    1734  7240            STA
1184    1735  1730            TAD I HEDER1    /GET MESSAGE ADDRESS-1
1185    1736  3330            DCA HEDER1      /USE HEDER1 AS TEMP REG
1186    1737  7410            SKP
1187    1740  0000    HEDER2, 0               /ENTER HERE IF NO ADDRESS GIVEN
1188    1741  4432            CRLFD           /BEGIN ALL MESSAGES WITH THIS
1189    1742  2330    NPR,    ISZ HEDER1
1190    1743  1730            TAD I HEDER1
1191    1744  7012            RTR
1192    1745  7012            RTR
1193    1746  7012            RTR             /SWAP HALVES
1194    1747  4353            JMS TYPCH       /SET UP & TYPE ORIGINAL LEFT HALF
1195    1750  1730            TAD I HEDER1
1196    1751  4353            JMS TYPCH       /       "       RIGHT HALF
1197    1752  5342            JMP NPR
1198
1199    1753  0000    TYPCH,  0
1200    1754  0127            AND RM77        /DELETE CURRENT LEFT HALF
1201    1755  7450            SNA             /ZERO IN EITHER HALF SIGNIFIES
1202    1756  5740            JMP I HEDER2    /END OF STRING; RETURN
1203    1757  1374            TAD M36
1204    1760  7510            SPA             /CODE 300 SERIES?
1205    1761  5367            JMP PRTT        /YES
1206    1762  7440            SZA             /SPECIAL CODE?
1207    1763  5366            JMP .+3
1208    1764  4432            CRLFD           /YES, CODE 36! CARR,RET,+LN,FEED
1209    1765  5753            JMP I TYPCH
1210    1766  1373            TAD P236
1211    1767  1372    PRTT,   TAD P336
1212    1770  4431            CALL OUT
1213    1771  5753            JMP I TYPCH
1214    1772  0336    P336,   336
1215    1773  7700    P236,   236-336
1216    1774  7742    M36,    -36
1217
1218    1775  0000    FLGASF, 0:0:0
        1776  0000
        1777  0000
```

```
1219           2000              *2000
1220     2000  6036    SERVIS,   KRB             /DISPLAY INTERRUPT SERVICE ROUTINE
1221     2001  6046              TLS             /PRINT LAST CHAR,
1222     2002  6041              TSF
1223     2003  5202              JMP .-1
1224     2004  1267              TAD M300
1225     2005  7550              SPA SNA         /WAS IT A LETTER?
1226     2006  5255              JMP NMCHK       /NO, MAY BE NEW BLOCK #
1227     2007  7106              CLL RTL
1228     2010  7006              RTL
1229     2011  7006              RTL
1230     2012  3135              DCA TEMP
1231     2013  4427              RDTTY           /GET NEXT CHAR
1232     2014  1267              TAD M300
1233     2015  7550              SPA SNA         /LETTER?
1234     2016  5234              JMP INVAL       /NO, ERROR
1235     2017  1135              TAD TEMP
1236     2020  7041              CIA
1237     2021  3135              DCA TEMP        /KEEP 6-BIT PR AS 2'S COMP,
1238     2022  3136              DCA TEMP1
1239     2023  1274              TAD CHTAB       /SET UP SEARCH TABLE
1240     2024  3013              DCA AUTO
1241     2025  4427    MRRED,    RDTTY           /GET MORE INPUT
1242     2026  1271              TAD M272
1243     2027  7450              SNA             /WAS IT A COLON?
1244     2030  5240              JMP CHLOP       /YES, LOOKUP JUMP ADDR,
1245     2031  1272              TAD RUBIT
1246     2032  7640              SZA CLA         /RUBOUT?
1247     2033  5225              JMP MRRED       /NO, GET MORE
1248     2034  7200    INVAL,    CLA
1249     2035  1266              TAD ERRQ        /OUTPUT '?'
1250     2036  4431              CALL OUT
1251     2037  5467              DISPLAY         /AND EXIT TO DISPLAY
1252     2040  2136    CHLOP,    ISZ TEMP1
1253     2041  1413              TAD I AUTO      /GET 6 BIT PAIR
1254     2042  7450              SNA             /END OF TABLE?
1255     2043  5234              JMP INVAL       /YES, INVALID COMMAND
1256     2044  1135              TAD TEMP
1257     2045  7640              SZA CLA         /GET A MATCH?
1258     2046  5240              JMP CHLOP       /NO, TRY NEXT ENTRY
1259     2047  1136              TAD TEMP1       /YES, GET TABLE POINTER
1260     2050  1275              TAD JUMPTB      /FORM JUMP ADDR,
1261     2051  3135              DCA TEMP
1262     2052  1535              TAD I TEMP
1263     2053  3135              DCA TEMP
1264     2054  5535              JMP I TEMP      /AND GO THERE
```

```
1265
1266                                /SET UP BLOCK PARAMETER, 0=BUFFER 1, 1=BUFFER 2
1267   2055  1270   NMCHK,  TAD M261        /AND 2= BOTH BUFFERS W/OFFSETS FOR 2
1268   2056  7510           SPA             /<261?
1269   2057  5234           JMP INVAL       /YES
1270   2060  3144           DCA BLOCK       /KEEP IT TEMPORARILY
1271   2061  7344           STA CLL RAL
1272   2062  1144           TAD BLOCK
1273   2063  7740           SMA SZA CLA     />2?
1274   2064  3144           DCA BLOCK       /YES, SET TO 0
1275   2065  5673           JMP I CDISPL    /EXIT TO DISPLAY W/O CR-LF
1276   2066  0277   ERRQ,   277
1277   2067  7500   M300,   -300
1278   2070  0017   M261,   300-261
1279   2071  7506   M272,   -272
1280   2072  7673   RUBIT,  272-377
1281   2073  0425   CDISPL, SCPINT-1
1282   2074  2126   CHTAB,  DCTAB-1
1283   2075  2075   JUMPTB, JMPTB-1
1284
1285                                /JUMP ADDR, TABLE FOR 'SERVIS':
1286   2076  3254   JMPTB,  STRIPR
1287   2077  3025           SMOT11
1288   2100  3400           INTEG
1289   2101  2243           CALPRT
1290   2102  2200           LORCL4
1291   2103  2361           SUBTRT
1292   2104  1400           FPOUT
1293   2105  1000           CALBRT
1294   2106  1453           SCALY
1295   2107  3000           SWAPBL
1296   2110  0403           START
1297   2111  1244           ISDIG
1298   2112  3613           TAPHAN
1299   2113  4003           ANINPT
1300   2114  4153           CALSET
1301   2115  0200           STRTIT
1302   2116  4663           SQEEZE
1303   2117  3156           ADDTWO
1304   2120  4600           DERIV
1305   2121  4011           DILST
1306   2122  4726           XFLIP
1307   2123  1366           YFLIP
1308   2124  4752           COPY
1309   2125  3170           CURSR
1310   2126  4761           MULP
```

```
1311
1312  2127  2324  DCTAB,  2324    /ST-RIP
1313  2130  2315         2315    /SM-OOTH
1314  2131  1116         1116    /IN-TEGRATE
1315  2132  0114         0114    /AL-TER
1316  2133  0301         0301    /CA-LCULATE
1317  2134  2325         2325    /SU-BTRACT CDA FROM OTHER
1318  2135  1725         1725    /OU-TPUT
1319  2136  2014         2014    /PL-OT
1320  2137  2303         2303    /SC-ALE
1321  2140  2327         2327    /SW-AP
1322  2141  2205         2205    /RE-START
1323  2142  2001         2001    /PA-PER TAPE INPUT
1324  2143  2401         2401    /TA-PE I/O
1325  2144  0126         0126    /AV-ERAGER INPUT
1326  2145  2411         2411    /TI-ME CALIBRATION
1327  2146  1517         1517    /MO-DIFIER ROUTINE
1328  2147  2321         2321    /SQ-UEEZE DATA DENSITY
1329  2150  0104         0104    /AD-D OTHER TO CDA
1330  2151  0405         0405    /DE-RIVATIVE FORMATION
1331  2152  0411         0411    /DI-AL EXIT
1332  2153  3011         3011    /XI-NVERT
1333  2154  3111         3111    /YI-NVERT
1334  2155  0317         0317    /CO-PY CDA INTO OTHER
1335  2156  0325         0325    /CU-RSORS
1336  2157  1525         1525    /MU-LTIPLY (SCALE) CDA
1337  2160  0000         0              /END TABLE
1338
1339  2161  0000  RECALC, 0              /USED TO RESCALE HGTS FOR NEW INT, MPYR,
1340  2162  4470         CALL PPSET
1341  2163  4407         ENTR
1342  2164  7547         FLOT I PIND1
1343  2165  4160         FDIV TEMFP     /HAS OLD MPYR
1344  2166  0000         FEXT
1345  2167  4776         CALL NEWMP     /MULT BY NEW MPYR
1346  2170  3547         DCA I PIND1
1347  2171  7001         IAC
1348  2172  1151         TAD PIND3
1349  2173  2135         ISZ TEMP       /MORE PEAKS?
1350  2174  5362         JMP RECALC+1   /YES
1351  2175  5761         JMP I RECALC
1352  2176  0762  NEWMP,  NORMAT
```

```
1353
1354
1355          2200              *2200
1356    2200  4601    LORCL4,   CALL .+1          /CALL INITIAL DIALOG
1357    2201  7600              DIALOG
1358    2202  4637              CALL GETVAR       /GET SCALING VARIABLES, ETC,
1359    2203  4434              HEDIT2            /'HGT, HALF-WIDTH, POSITION:'
1360    2204  7001              IAC
1361    2205  3140              DCA TEM3          /IS SWITCH FOR FIRST PEAK
1362    2206  1145              TAD PKS
1363    2207  3137              DCA TEM2
1364    2210  1075              TAD PARPTR
1365    2211  4470    NUPEEK,   CALL PPSET
1366    2212  4756              CALL HGT
1367    2213  1235              TAD WIDSWT
1368    2214  1140              TAD TEM3
1369    2215  7650              SNA CLA           /FIRST PEAK OR UNEQUAL WIDTHS?
1370    2216  5221              JMP .+3           /NO
1371    2217  4757              CALL WID
1372    2220  5223              JMP .+3
1373    2221  1636              TAD I WIDONE      /GET FIRST WIDTH AND PUT INTO
1374    2222  3550              DCA I PIND2       /OTHER PEAKS
1375    2223  3140              DCA TEM3          /CLEAR SWITCH AFTER FIRST PEAK
1376    2224  4760              CALL POS
1377    2225  4432              CRLFD
1378    2226  1151              TAD PIND3
1379    2227  7001              IAC
1380    2230  2137              ISZ TEM2
1381    2231  5211              JMP NUPEEK
1382    2232  4634    GCAL,     CALL CLARR        /CLEAR ARRAY STORAGE
1383    2233  5640              JMP I CALCY
1384    2234  3535    CLARR,    CLRR
1385    2235  0000    WIDSWT,   0                 /IS SET BY INITIAL DIALOG ROUTINE
1386    2236  7601    WIDONE,   PTABST+1          /ADDRESS FOR FIRST WIDTH
1387    2237  2715    GETVAR,   VARGET
1388    2240  2400    CALCY,    YCALC
1389    2241  2520    DUMPIT,   PARDMP
1390    2242  2544    PKDMP,    PEKDMP
```

```
1391
1392
1393  2243  4433  CALPRT, HEDIT1          /PEAK, PARA, VALUE!
1394  2244  5315         HD21
1395  2245  4425         GETNO
1396  2246  4424         FIXT
1397  2247  7510         SPA              /PEAK #<0?
1398  2250  5243         JMP CALPRT       /YES, NO GOOD
1399  2251  7104         CLL RAL
1400  2252  1045         TAD 45
1401  2253  1351         TAD MIN3
1402  2254  3136         DCA TEMP1        /3*PKS-3=PK INDEX #
1403  2255  1145         TAD PKS
1404  2256  1045         TAD 45
1405  2257  7740         SMA SZA CLA      /PK NO, > NO, PKS?
1406  2260  5243         JMP CALPRT       /YES, IGNORE
1407  2261  1045         TAD 45
1408  2262  3135         DCA TEMP
1409  2263  4425         GETNO
1410  2264  4424         FIXT
1411  2265  7510         SPA              /PARA #<0?
1412  2266  5232         JMP GCAL         /YES, EXIT TO CALC SPECTRUM
1413  2267  1135         TAD TEMP
1414  2270  7650         SNA CLA          /BOTH ENTRIES = 0?
1415  2271  5641         JMP I DUMPIT     /YES, SIGNALS ALL PARA DUMP
1416  2272  1045         TAD 45
1417  2273  7450         SNA              /PARA #=0?
1418  2274  5642         JMP I PKDMP      /YES, SIGNALS PEAK PARA DUMP
1419  2275  1351         TAD MIN3
1420  2276  7740         SMA SZA CLA      /PARA #>3?
1421  2277  5243         JMP CALPRT       /YES, ILLEGAL TRY AGAIN
1422  2300  1136         TAD TEMP1
1423  2301  7510         SPA              /PK #>0?
1424  2302  5314         JMP P123         /NO, GET MPYR, BASE, OR LOR FR
1425  2303  1075         TAD PARPTR       /=POINTER TO HGT PARA
1426  2304  4470         CALL PRSET
1427  2305  1045         TAD 45
1428  2306  1355         TAD PSTAB        /NOW, GET SUBR FOR INPUT
1429  2307  3135         DCA TEMP
1430  2310  1535         TAD I TEMP
1431  2311  3135         DCA TEMP
1432  2312  4535         CALL TEMP
1433  2313  5243         JMP CALPRT
```

```
1434  2314  7240  P123,   STA
1435  2315  1045          TAD 45
1436  2316  7640          SZA CLA          /WANT MPYR?
1437  2317  5337          JMP GTP2         /NO, GET BASE OR LOR FR
1438  2320  4407          ENTR
1439  2321  5472          FGET I MPYR      /KEEP OLD VALUE
1440  2322  6160          FPUT TEMFP
1441  2323  0004          READ             /GET NEW
1442  2324  6472          FPUT I MPYR
1443  2325  0000          FEXT             /UPDATE OLD HGT'S & BASE!
1444  2326  1145          TAD PKS
1445  2327  3135          DCA TEMP
1446  2330  1075          TAD PARPTR
1447  2331  4754          CALL NUCALC      /RESCALE HGTS
1448  2332  4407          ENTR
1449  2333  7146          FLOT PAR1
1450  2334  4160          FDIV TEMFP
1451  2335  0000          FEXT
1452  2336  5346          JMP PRIT
1453  2337  1045  GTP2,   TAD 45
1454  2340  1351          TAD MIN3
1455  2341  7640          SZA CLA          /WANT NEW BASE?
1456  2342  5345          JMP .+3          /YES
1457  2343  4752          CALL LGFRAC      /NO, GET NEW LOR, FR,
1458  2344  5243          JMP CALPRT
1459  2345  4425          GETNO
1460  2346  4753  PRIT,   CALL NUMP        /SCALE IT.
1461  2347  3146          DCA PAR1
1462  2350  5243          JMP CALPRT
1463  2351  7775  MIN3,   -3
1464  2352  2754  LGFRAC, GLFRAC
1465  2353  0762  NUMP,   NORMAT
1466  2354  2161  NUCALC, RECALC
1467  2355  2355  PSTAB,  .
1468  2356  0771  HGT,    HIGHT
1469  2357  4532  WID,    WIDTH
1470  2360  4714  POS,    POSTN
1471
1472  2361  4773  SUBTRT, CALL INTSP       /SUBTRACT CDA FROM OTHER BUFFER
1473  2362  1105          TAD YLIM         /USE -2*YLIM FOR OFFSET
1474  2363  7104          CLL RAL
1475  2364  1411          TAD I YIND       /GET CDA
1476  2365  7041          CIA
1477  2366  1413          TAD I AUTO       /SUBTRACT FROM OTHER
1478  2367  3412          DCA I YIND       /RESTORE IN CDA
1479  2370  2132          ISZ CNTR         /MORE POINTS?
1480  2371  5362          JMP SUBTRT+1     /YES
1481  2372  5467          DISPLAY          /EXIT TO DISPLAY
1482  2373  3014  INTSP,  SPINIT
```

```
1483
1484          2400                *2400
1485                              /COMPUTES LORENTZIAN AND/OR GAUSSIAN 'DIPS'
1486    2400  4433    YCALC,      HEDIT1          /'COOL IT'
1487    2401  5322                HD23
1488    2402  4430                INITAR
1489    2403  4466                CALL XSET       /GET XSCLFC (X DIS, UNITS/PT)
1490    2404  3155                DCA FTEM2       /USED AS TEMP REGS
1491    2405  3156                DCA FTEM2+1
1492    2406  3157                DCA FTEM2+2
1493    2407  1145    NUPNT,      TAD PKS
1494    2410  3137                DCA TEM2
1495    2411  3174                DCA YSCLFC
1496    2412  3175                DCA YSCLFC+1
1497    2413  3176                DCA YSCLFC+2
1498    2414  4716                CALL LOADX
1499    2415  1075                TAD PARPTR
1500    2416  4470    YCLC,       CALL PPSET
1501    2417  1550                TAD I PIND2     /CHECK FOR PEAK IN RANGE OF X
1502    2420  7510                SPA             /WAS RANGE NEG?
1503    2421  7041                CIA             /YES, MAKE WIDTH POS
1504    2422  7106                CLL RTL
1505    2423  7004                RAL
1506    2424  3135                DCA TEMP        /IS 8 * WIDTH
1507    2425  1135                TAD TEMP
1508    2426  7041                CIA
1509    2427  1551                TAD I PIND3     /GET POSITION - 8 * W
1510    2430  7041                CIA
1511    2431  1115                TAD TXSM        /SUBTRACT FROM CURRENT X
1512    2432  7710                SPA CLA         /IS POS -8*W<X
1513    2433  5300                JMP NXPK        /YES, INGORE THS PEAK
1514    2434  1135                TAD TEMP        /GET P+8*W
1515    2435  1551                TAD I PIND3
1516    2436  7041                CIA
1517    2437  1115                TAD TXSM
1518    2440  7700                SMA CLA         /IS P+8*W>X
1519    2441  5300                JMP NXPK        /YES, IGNORE THIS PK
1520    2442  4717    STRCL,      CALL CALBEG     /GET W**2 AND (P-X)**2
1521    2443  1102                TAD LORFR
1522    2444  7650                SNA CLA         /ANY LOR, CONTRIBUTION?
1523    2445  5263                JMP ALLGS       /NO
1524    2446  4407                ENTR            /YES, COMPUTE IT
1525    2447  1160                FADD TEMFP      /GET (P-X)**2+W**2
1526    2450  6152                FPUT FTEM1      /TEMP STORE
1527    2451  7547                FLOT I PIND1    /GET HGT
1528    2452  3163                FMPY XMIN       /GET H*W**2
1529    2453  4152                FDIV FTEM1      /GET H*W**2/((P-X)**2+W**2)
1530    2454  3477                FMPY I FLORF    /SCALE BY LOR. FR.
1531    2455  1174                FADD YSCLFC     /ADD TO CURRENT SUM FOR THIS PT
1532    2456  6174                FPUT YSCLFC
1533    2457  0000                FEXT
1534    2460  1103                TAD GASFR
1535    2461  7650                SNA CLA         /ANY GAUSS, CONTRIBUTION?
1536    2462  5300                JMP NXPK        /NO
1537          5242    SPCJ=JMP STRCL  /DEFINE IT FOR INIT. DIALOG
```

```
1538
1539   2463  4407   ALLGS,  ENTR
1540   2464  5160           FGET TEMFP
1541   2465  4163           FDIV XMIN
1542   2466  3123           FMPY HALF
1543   2467  0003           NEGATE          /GET -(X-P)**2/(2*W**2)=Z
1544   2470  0010           EXPON           /GET EXP(-Z)
1545   2471  6160           FPUT TEMFP
1546   2472  7547           FLOT I PIND1
1547   2473  3160           FMPY TEMFP      /GET H*EXP(-Z)
1548   2474  3500           FMPY I FGASF    /SCALE BY GAUSS, FRACTION
1549   2475  1174           FADD YSCLFC     /ADD TO SUM
1550   2476  6174           FPUT YSCLFC
1551   2477  0000           FEXT
1552   2500  1151   NXPK,   TAD PIND3       /RESET PARA PTRS,
1553   2501  7001           IAC
1554   2502  2137           ISZ TEM2        /ANOTHER PEAK?
1555   2503  5216           JMP YCLC        /YES
1556   2504  4424           FIXT            /NO, FORM INTEGER FROM SUM
1557   2505  7041   BSCHNG, CIA             /SUBTRACT FROM BASELINE; CHANGE
1558   2506  1146           TAD PAR1        /TO 'NOP' FOR PEAK SPECTRA,
1559   2507  6211           CDF 10
1560   2510  3411           DCA I YIND      /STORE INTEGER RESULT
1561   2511  6201           CDF 0
1562   2512  4471           CALL ADINX      /INCREMENT TXSM
1563   2513  2132           ISZ CNTR        /MORE POINTS?
1564   2514  5207           JMP NUPNT       /YES
1565   2515  5467           DISPLAY         /EXIT
1566   2516  2705   LOADX,  XLOAD
1567   2517  3600   CALBEG, BEGCAL
1568
1569   2520  4433   PARDMP, HEDIT1          /X RANGE, X1, INT,MPYR,BASE,LOR FR;
1570   2521  5256           HD20B
1571   2522  4407           ENTR
1572   2523  7106           FLOT XRNG
1573   2524  4473           FDIV I XMPY
1574   2525  0005           OUTPUT
1575   2526  5501           FGET I X1
1576   2527  0005           OUTPUT
1577   2530  5472           FGET I MPYR
1578   2531  0005           OUTPUT
1579   2532  7146           FLOT PAR1
1580   2533  4472           FDIV I MPYR
1581   2534  0005           OUTPUT
1582   2535  5477           FGET I FLORF
1583   2536  0005           OUTPUT
1584   2537  0000           FEXT
1585   2540  4434           HEDIT2          /HGT, H-WIDTH,POS;
1586   2541  1145           TAD PKS
1587   2542  3131           DCA PCTR        /SET TO PRINT ALL PEAKS
1588   2543  5350           JMP PKPRNT      /STARTING FROM FIRST PEAK
```

```
1589
1590
1591    2544  7240    PEKDMP, STA
1592    2545  3131            DCA PCTR        /SET TO PRINT ONLY ONE PEAK
1593    2546  4432            CRLFD
1594    2547  1136            TAD TEMP1       /GET PEAK INDEX
1595    2550  1075    PKPRNT, TAD PARPTR      /OUTPUT CURRENT PARA'S IN INPUT UNITS
1596    2551  4470            CALL PPSET
1597    2552  4407            ENTR
1598    2553  7547            FLOT I PIND1
1599    2554  4472            FDIV I MPYR
1600    2555  0005            OUTPUT
1601    2556  7550            FLOT I PIND2
1602    2557  4473            FDIV I XMPY
1603    2560  0005            OUTPUT
1604    2561  7551            FLOT I PIND3
1605    2562  4473            FDIV I XMPY
1606    2563  1501            FADD I X1
1607    2564  0005            OUTPUT
1608    2565  0000            FEXT
1609    2566  4432            CRLFD
1610    2567  7001            IAC
1611    2570  1151            TAD PIND3
1612    2571  2131            ISZ PCTR        /MORE PEAKS?
1613    2572  5351            JMP PKPRNT+1    /YES
1614    2573  5467            DISPLAY
```

```
1615
1616
1617          2600              *2600
1618                            /THIS IS AN EXPONENTIATION ROUTINE
1619                            /IDENTICAL TO THAT USED BY FLOATING
1620                            /POINT PKG WITH EXTENDED FUNCTIONS.
1621                            /THE ONLY DIFFERENCES ARE IN THE USE
1622                            /OF TEMPORARY STORAGE AND THE 'FIX'
1623                            /AND 'FLOAT' OPERATIONS.
1624
1625    2600  0000    FLEXPO, 0
1626    2601  1045              TAD 45
1627    2602  7700              SMA CLA           /NEG. EXPO?
1628    2603  5206              JMP .+3           /NO
1629    2604  4660              CALL NEGIT        /YES
1630    2605  7240              STA
1631    2606  3261              DCA SINE          /KEEP SIGN OF EXPO
1632    2607  4407              ENTR
1633    2610  3277              FMPY LG2E
1634    2611  6163              FPUT XMIN
1635    2612  0000              FEXT
1636    2613  4424              FIXT
1637    2614  3262              DCA FLAG2
1638    2615  4407              ENTR
1639    2616  7045              FLOT 45
1640    2617  6166              FPUT YMIN
1641    2620  5163              FGET XMIN
1642    2621  2166              FSUB YMIN
1643    2622  6163              FPUT XMIN
1644    2623  3163              FMPY XMIN
1645    2624  6166              FPUT YMIN
1646    2625  1274              FADD D
1647    2626  6160              FPUT TEMFP
1648    2627  5271              FGET C
1649    2630  4160              FDIV TEMFP
1650    2631  2163              FSUB XMIN
1651    2632  1263              FADD A
1652    2633  6160              FPUT TEMFP
1653    2634  5266              FGET B
1654    2635  3166              FMPY YMIN
1655    2636  1160              FADD TEMFP
1656    2637  6160              FPUT TEMFP
1657    2640  5163              FGET XMIN
1658    2641  4160              FDIV TEMFP
1659    2642  1044              FADD 44
1660    2643  1302              FADD ONE
1661    2644  0000              FEXT
1662    2645  1262              TAD FLAG2
1663    2646  1044              TAD 44
1664    2647  3044              DCA 44
```

```
1665
1666
1667    2650  2261          ISZ SINE
1668    2651  5600          JMP I FLEXPO
1669    2652  4407          ENTR            /HAD NEG, EXPO
1670    2653  6163          FPUT XMIN
1671    2654  5302          FGET ONE
1672    2655  4163          FDIV XMIN
1673    2656  0000          FEXT
1674    2657  5600          JMP I FLEXPO
1675
1676    2660  6000  NEGIT,  6000
1677    2661  0000  SINE,    0
1678    2662  0000  FLAG2,   0
1679    2663  0004  A,       0004
1680    2664  2372          2372
1681    2665  1402          1402
1682    2666  7774  B,       7774
1683    2667  2157          2157
1684    2670  5157          5157
1685    2671  0012  C,       0012
1686    2672  5454          5454
1687    2673  0343          0343
1688    2674  0007  D,       0007
1689    2675  2566          2566
1690    2676  5341          5341
1691    2677  0001  LG2E,    0001
1692    2700  2705          2705
1693    2701  2435          2435
1694    2702  0001  ONE,     0001
1695    2703  2000          2000
1696    2704  0000          0000
1697
1698    2705  0000  XLOAD,   0               /UPDATE CURRENT X FOR 'YCALC'
1699    2706  4407          ENTR
1700    2707  5155          FGET FTEM2
1701    2710  1171          FADD XSCLFC
1702    2711  6155          FPUT LOORD
1703    2712  0000          FEXT
1704    2713  3044          DCA 44
1705    2714  5705          JMP I XLOAD
```

```
1706
1707   2715  0000   VARGET, 0                /CALLED BY LORCL4 TO GET VARIABLES
1708   2716  4750           CALL GETPTS      /GET # PTS
1709   2717  4433           HEDIT1           /'NO. OF PEAKS='
1710   2720  5250           HD20A
1711   2721  4425           GETNO
1712   2722  4424           FIXT
1713   2723  7041           CIA
1714   2724  3145           DCA PKS          /KEEP AS 2'S COMP
1715   2725  4434           HEDIT2           /XRNG,X1,INT,MPYR,,BASE,LOR,FR,!
1716   2726  4407           ENTR
1717   2727  0004           READ
1718   2730  6171           FPUT XSCLFC
1719   2731  7106           FLOT XRNG
1720   2732  4171           FDIV XSCLFC
1721   2733  6473           FPUT I XMPY
1722   2734  0004           READ
1723   2735  6501           FPUT I X1
1724   2736  0004           READ             /GET INT, MULTIPLIER
1725   2737  6472           FPUT I MPYR
1726   2740  0004           READ             /GET BASELINE
1727   2741  3472           FMPY I MPYR      /SCALE IT
1728   2742  1123           FADD HALF
1729   2743  0000           FEXT
1730   2744  4424           FIXT
1731   2745  3146           DCA PAR1         /PAR1=BASELINE
1732   2746  4354           JMS GLFRAC       /GET LOR. FRACTION; SET G,F, AND PERCENTS
1733   2747  5715           JMP I VARGET
1734   2750  1307   GETPTS, DATYP
1735   2751  0000   X11,    0;0;0
       2752  0000
       2753  0000
1736
1737   2754  0000   GLFRAC, 0
1738   2755  4407           ENTR
1739   2756  0004           READ             /GET LORENTZION FRACTION
1740   2757  6477           FPUT I FLORF
1741   2760  0003           NEGATE
1742   2761  1302           FADD ONE
1743   2762  6500           FPUT I FGASF     /FIND GAUSSIAN FRACTION
1744   2763  3476           FMPY I HUNDRD
1745   2764  0000           FEXT
1746   2765  4424           FIXT
1747   2766  3103           DCA GASFR        /SET GAUSS PERCENT
1748   2767  1103           TAD GASFR
1749   2770  7041           CIA
1750   2771  1374           TAD PK100
1751   2772  3102           DCA LORFR        /AND LOR. PERCENT
1752   2773  5754           JMP I GLFRAC
1753   2774  0144   PK100,  144
```

```
1754
1755            3000            *3000
1756    3000    4214    SWAPBL, JMS SPINIT      /SWAP THE TWO BUFFERS
1757    3001    1013            TAD AUTO
1758    3002    3010            DCA XIND
1759    3003    1410    SWLOOP, TAD I XIND
1760    3004    3135            DCA TEMP
1761    3005    1412            TAD I ZIND
1762    3006    3413            DCA I AUTO
1763    3007    1135            TAD TEMP
1764    3010    3411            DCA I YIND
1765    3011    2132            ISZ CNTR        /MORE POINTS?
1766    3012    5203            JMP SWLOOP      /YES
1767    3013    5467            DISPLAY         /NO, EXIT
1768
1769    3014    0000    SPINIT, 0               /SPECIAL INIT. ROUTINE
1770    3015    4430            INITAR
1771    3016    1144            TAD BLOCK
1772    3017    7650            SNA CLA
1773    3020    1111            TAD OFFSET
1774    3021    1110            TAD YONE
1775    3022    3013            DCA AUTO
1776    3023    6211            CDF 10
1777    3024    5614            JMP I SPINIT
1778
1779                            /MODIFIED DECUS 5/8-69 (LESQ11)
1780    3025    4430    SMOT11, INITAR          /11 POINT SMOOTHER
1781    3026    1011            TAD YIND
1782    3027    1333            TAD PL13
1783    3030    3137            DCA TEM2
1784    3031    7040            CMA
1785    3032    1132            TAD CNTR
1786    3033    1333            TAD PL13
1787    3034    3132            DCA CNTR
1788    3035    1336    NEWY,   TAD MIN5
1789    3036    3135            DCA TEMP
1790    3037    1324            TAD COTAG
1791    3040    3136            DCA TEMP1
1792    3041    4423            FLOAT
1793    3042    4407            ENTR
1794    3043    6163            FPUT XMIN
1795    3044    6166            FPUT YMIN
1796    3045    0000            FEXT
```

```
1797
1798    3046  6211  LOOP9,  CDF 10
1799    3047  1411          TAD I YIND
1800    3050  1537          TAD I TEM2
1801    3051  6201          CDF 0
1802    3052  4423          FLOAT
1803    3053  4407          ENTR
1804    3054  6160          FPUT TEMFP
1805    3055  1163          FADD XMIN
1806    3056  6163          FPUT XMIN
1807    3057  5160          FGET TEMFP
1808    3060  3536          FMPY I TEMP1
1809    3061  1166          FADD YMIN
1810    3062  6166          FPUT YMIN
1811    3063  0000          FEXT
1812    3064  7125          STL IAC RAL
1813    3065  1136          TAD TEMP1
1814    3066  3136          DCA TEMP1
1815    3067  7040          CMA
1816    3070  1137          TAD TEM2
1817    3071  3137          DCA TEM2
1818    3072  2135          ISZ TEMP
1819    3073  5246          JMP LOOP9
1820    3074  6211          CDF 10
1821    3075  1537          TAD I TEM2
1822    3076  6201          CDF 0
1823    3077  4423          FLOAT
1824    3100  4407          ENTR
1825    3101  1163          FADD XMIN
1826    3102  3325          FMPY F125
1827    3103  2166          FSUB YMIN
1828    3104  4330          FDIV F161
1829    3105  1123          FADD HALF
1830    3106  0000          FEXT
1831    3107  4424          FIXT
1832    3110  6211          CDF 10
1833    3111  3537          DCA I TEM2
1834    3112  6201          CDF 0
1835    3113  1011          TAD YIND
1836    3114  1126          TAD NEG4
1837    3115  3011          DCA YIND
1838    3116  1137          TAD TEM2
1839    3117  1334          TAD P6
1840    3120  3137          DCA TEM2
1841    3121  2132          ISZ CNTR
1842    3122  5235          JMP NEWY
1843    3123  5467          DISPLAY
```

```
1844
1845    3124  3137    COTAG,  TAGCO
1846    3125  0005    F125,   0005
1847    3126  2163            2163
1848    3127  1463            1463
1849    3130  0007    F161,   0007
1850    3131  2534            2534
1851    3132  6314            6314
1852    3133  0013    PL13,   13
1853    3134  0006    P6,     6
1854    3135  7764    M12,    -14
1855    3136  7773    MIN5,   -5
1856    3137  0005    TAGCO,  5
1857    3140  3100            3100
1858    3141  0000            0
1859    3142  0005            5
1860    3143  2000            2000
1861    3144  0000            0
1862    3145  0004            4
1863    3146  2200            2200
1864    3147  0000            0
1865    3150  0003            3
1866    3151  2000            2000
1867    3152  0000            0
1868    3153  0001            1
1869    3154  2000            2000
1870    3155  0000            0
1871
1872    3156  4214    ADDTWO, JMS SPINIT      /ADD DISP. CHAN TO OTHER
1873    3157  1411            TAD I YIND
1874    3160  1413            TAD I AUTO
1875    3161  7110            CLL RAR
1876    3162  7430            SZL
1877    3163  7001            IAC
1878    3164  3412            DCA I ZIND      /RESULTS IN DISP. CHAN.
1879    3165  2132            ISZ CNTR
1880    3166  5357            JMP ADDTWO+1
1881    3167  5467            DISPLAY
1882
1883    3170  1143    CURSR,  TAD MODE
1884    3171  7700            SMA CLA         /CURSORS ON SCOPE?
1885    3172  7240            STA             /NO, PUT THEM UP
1886    3173  3143            DCA MODE
1887    3174  5467            DISPLAY
```

```
1888
1889            3200            *3200
1890    3200    0000    SETSTR, 0
1891    3201    4430            INITAR
1892    3202    1306            TAD TPNT+1      /GET LEFT Y
1893    3203    7041            CIA
1894    3204    1310            TAD TPNT+3      /RIGHT Y
1895    3205    3310            DCA TPNT+3      /KEEP DELTA Y
1896    3206    1305            TAD TPNT        /GET LEFT X
1897    3207    7041            CIA
1898    3210    1307            TAD TPNT+2      /RIGHT X
1899    3211    7550            SPA SNA         /RIGHT>LEFT?
1900    3212    5251            JMP ERRD        /NO, ARE INVERTED
1901    3213    3307            DCA TPNT+2      /KEEP DELTA X
1902    3214    4466            CALL XSET       /GET X INCREMENT
1903    3215    4407            ENTR
1904    3216    7306            FLOT TPNT+1     /GET LEFT Y
1905    3217    6166            FPUT YMIN
1906    3220    7307            FLOT TPNT+2     /GET DELTA X
1907    3221    4171            FDIV XSCLFC     /SCALE IT
1908    3222    6163            FPUT XMIN       /IS # OF PTS
1909    3223    1123            FADD HALF
1910    3224    0000            FEXT
1911    3225    4424            FIXT
1912    3226    7550            SPA SNA         /INSURE CNTR<0!
1913    3227    7201            CLA IAC
1914    3230    7041            CIA
1915    3231    3132            DCA CNTR        /IS # PTS IN RANGE
1916    3232    4407            ENTR
1917    3233    7310            FLOT TPNT+3     /GET DELTA  Y
1918    3234    4163            FDIV XMIN
1919    3235    6174            FPUT YSCLFC     /=Y DIS UNITS   /PT
1920    3236    7305            FLOT TPNT       /LEFT X
1921    3237    4171            FDIV XSCLFC
1922    3240    1123            FADD HALF
1923    3241    0000            FEXT            /FAC=#PTS TO LEFT X
1924    3242    4424            FIXT
1925    3243    1011            TAD YIND
1926    3244    3011            DCA YIND        /SETS INDEX
1927    3245    1011            TAD YIND
1928    3246    3012            DCA ZIND
1929    3247    3143            DCA MODE
1930    3250    5600            JMP I SETSTR
1931            *
1932    3251    4433    ERRD,   HEDIT1          /BAD X PTS!
1933    3252    5343            HD26
1934    3253    5467            DISPLAY
```

```
1935
1936    3254  4200    STRIPR, JMS SETSTR
1937    3255  4433            HEDIT1          /STRIP PEAK?
1938    3256  5327            HD25
1939    3257  4435            ASK
1940    3260  7640            SZA CLA
1941    3261  5267            JMP STRBS
1942    3262  4311    STRPK,  JMS YSTEP       /GET NEW Y
1943    3263  3411            DCA I YIND
1944    3264  2132            ISZ CNTR
1945    3265  5262            JMP STRPK
1946    3266  5467            DISPLAY
1947    3267  4434    STRBS,  HEDIT2          /FULL BASE STRIP?
1948    3270  4435            ASK
1949    3271  7640            SZA CLA
1950    3272  5275            JMP .+3         /NO
1951    3273  4430            INITAR
1952    3274  4704            CALL EXTRP
1953    3275  4311    REMOV,  JMS YSTEP
1954    3276  7041            CIA
1955    3277  1411            TAD I YIND      /SUB. FROM Y
1956    3300  3412            DCA I YIND
1957    3301  2132            ISZ CNTR
1958    3302  5275            JMP REMOV
1959    3303  5467            DISPLAY
1960    3304  5074    EXTRP,  EXTRAP
1961
1962    3305  0000    TPNT,   0       /TABLE OF LAST ADC COORD'S
1963    3306  0000            0
1964    3307  0000            0
1965    3310  0000            0
1966
1967    3311  0000    YSTEP,  0               /COMPUTE Y VALUE
1968    3312  6201            CDF 0
1969    3313  4407            ENTR
1970    3314  5166            FGET YMIN
1971    3315  1174            FADD YSCLFC
1972    3316  6166            FPUT YMIN
1973    3317  1123            FADD HALF
1974    3320  0000            FEXT
1975    3321  4424            FIXT
1976    3322  6211            CDF 10
1977    3323  5711            JMP I YSTEP
```

```
1978
1979
1980    3324  0000    DISPTS, 0
1981    3325  7344            STA CLL RAL     /-2
1982    3326  3140            DCA TEM3
1983    3327  1376            TAD DPTR        /SET UP STORAGE TABLE
1984    3330  3013            DCA AUTO
1985    3331  7107            CLL IAC RTL     /SET 4 AS FIRST CHANNEL
1986    3332  3137            DCA TEM2
1987    3333  1137    NXPT,   TAD TEM2
1988    3334  4465            CALL ADCON      /MAKE ADC ON CHAN'S 4 THEN 6
1989    3335  1130            TAD K1000       /ADD 512 TO GET +RESULT
1990    3336  7110            CLL RAR
1991    3337  3005            DCA XDIS
1992    3340  1104            TAD XLIM        /SUBTRACT XLIM
1993    3341  7041            CIA
1994    3342  1005            TAD XDIS
1995    3343  1377            TAD FUDGE       /CORRECT FOR HARDWARE HYSTERESIS
1996    3344  7510            SPA             /RESULT<0?
1997    3345  7200            CLA             /YES, SET IT=0
1998    3346  3413            DCA I AUTO      /KEEP RESULT
1999    3347  2137            ISZ TEM2        /INCR. CHAN
2000    3350  1137            TAD TEM2
2001    3351  4465            CALL ADCON      /ADC ON CHAN'S 5 THEN 7
2002    3352  7110            CLL RAR
2003    3353  3112            DCA YDIS
2004    3354  1105            TAD YLIM        /SUB. YLIM
2005    3355  7041            CIA
2006    3356  1112            TAD YDIS
2007    3357  7104            CLL RAL
2008    3360  1377            TAD FUDGE       /FOR HYSTERESIS
2009    3361  3413            DCA I AUTO      /KEEP IT
2010    3362  2137            ISZ TEM2
2011    3363  1375            TAD DCT         /SET DELAY COUNTER
2012    3364  3134            DCA MCTR
2013    3365  4463            CALL DISMOV     /REFRESH DISPLAY
2014    3366  2134            ISZ MCTR
2015    3367  5365            JMP .-2
2016    3370  2140            ISZ TEM3        /NEED 2ND PT THIS TIME?
2017    3371  5333            JMP NXPT        /YES
2018    3372  4774            CALL DISCUR     /DISPLAY CURSOR VALUES IN DECIMAL
2019    3373  5724            JMP I DISPTS    /GOT IT; EXIT
2020    3374  5000    DISCUR, CRDIS
2021    3375  7700    DCT,    -100
2022    3376  3304    DPTR,   TPNT-1          /STORAGE ADDR.
2023    3377  0004    FUDGE,  4
```

```
2024          3400              *3400
2025    3400  4323    INTEG,    JMS RDY
2026    3401  4707              CALL CURSET
2027    3402  7240              STA
2028    3403  1171              TAD XSCLFC
2029    3404  3171              DCA XSCLFC
2030    3405  4433              HEDIT1          /SCAN INT'L?
2031    3406  5237              HD15
2032    3407  4435              ASK
2033    3410  7640              SZA CLA
2034    3411  5311              JMP PTINT       /NO, BETWEEN CURSORS
2035    3412  4710              CALL SETLY
2036    3413  4407              ENTR
2037    3414  5201              FGET INTEG+1    /GET A LARGE NEG # TO START
2038    3415  6152              FPUT FTEM1
2039    3416  5271              FGET CMPINT+3   /GET LRG POS. #
2040    3417  6155              FPUT FTEM2
2041    3420  0000              FEXT
2042    3421  4323              JMS RDY         /PREPARE TO SCAN DATA
2043
2044                            /THIS LOOP COMPUTES TOTAL INTEGRAL (SUM)
2045                            /TO FIND A SCALE DOWN FACTOR,
2046    3422  4345    FNTOT,    JMS SCASM       /STRIP BASELINE AND ADD ADJ. Y'S
2047    3423  1045              TAD 45
2048    3424  7700              SMA CLA         /IS CURRENT SUM<CURRENT MIN?
2049    3425  5232              JMP PT1         /NO
2050    3426  4407              ENTR            /YES, SO KEEP IT AS MIN.
2051    3427  5160              FGET TEMFP
2052    3430  6155              FPUT FTEM2
2053    3431  0000              FEXT
2054    3432  4407    PT1,      ENTR            /CHECK MAX VALUE
2055    3433  5160              FGET TEMFP
2056    3434  2152              FSUB FTEM1
2057    3435  0000              FEXT
2058    3436  1045              TAD 45
2059    3437  7710              SPA CLA         /IS CURRENT SUM>CURRENT MAX?
2060    3440  5245              JMP PT2         /NO
2061    3441  4407              ENTR
2062    3442  5160              FGET TEMFP
2063    3443  6152              FPUT FTEM1
2064    3444  0000              FEXT
2065    3445  2132    PT2,      ISZ CNTR        /MORE POINTS?
2066    3446  5222              JMP FNTOT       /YES
```

```
2067  3447  4407          ENTR
2068  3450  5152          FGET FTEM1      /FIND INTEGRAL RANGE.
2069  3451  2155          FSUB FTEM2
2070  3452  3123          FMPY HALF       /DIV BY 2 SINCE DATA RNG=2*DISP RNG
2071  3453  6152          FPUT FTEM1
2072  3454  7107          FLOT YRNG       /COMPUTE SCALE-DOWN FACTOR
2073  3455  4152          FDIV FTEM1
2074  3456  6152          FPUT FTEM1
2075  3457  3155          FMPY FTEM2      /SCALE MIN VALUE
2076  3460  6155          FPUT FTEM2
2077  3461  5152          FGET FTEM1
2078  3462  3171          FMPY XSCLFC     /GET NEW MULT'R INCLUDING SCL-DN
2079  3463  6171          FPUT XSCLFC
2080  3464  0000          FEXT
2081  3465  4323          JMS RDY
2082
2083                      /THIS LOOP COMPUTES AND STORES
2084                      /SCALED DOWN INTEGRAL VALUE AT EACH POINT,
2085  3466  4345  CMPINT, JMS SCASM       /GET INTEGRAL-BASELINE
2086  3467  4424          FIXT
2087  3470  6211          CDF 10
2088  3471  3412          DCA I ZIND
2089  3472  2132          ISZ CNTR        /MORE POINTS?
2090  3473  5266          JMP CMPINT      /YES
2091  3474  1045          TAD 45          /PUT N-1 VALUE INTO NTH
2092  3475  3412          DCA I ZIND
2093  3476  6201          CDF 0
2094  3477  4433          HEDIT1          /Y MULT'D BY!
2095  3500  5165          HD5+6
2096  3501  4407          ENTR
2097  3502  5171          FGET XSCLFC
2098  3503  4123          FDIV HALF
2099  3504  0005          OUTPUT
2100  3505  0000          FEXT
2101  3506  5467          DISPLAY         /RETURN TO DISPLAY
2102  3507  3200  CURSET, SETSTR
2103  3510  5074  SETLY,  EXTRAP
2104
2105  3511  4345  PTINT,  JMS SCASM       /INTEGRATES BETWEEN CURSORS
2106  3512  2132          ISZ CNTR        /AND PRINTS AREA; NO CHANGE
2107  3513  5311          JMP .-2         /IN DATA ARRAY
2108  3514  4434          HEDIT2          /AREA=
2109  3515  4407          ENTR
2110  3516  5160          FGET TEMFP
2111  3517  0005          OUTPUT
2112  3520  0000          FEXT
2113  3521  5467          DISPLAY
2114  3522  3306  LEFY,   TPNT+1
```

```
2115
2116    3523  0000    RDY,    0
2117    3524  4430            INITAR
2118    3525  2132            ISZ CNTR
2119    3526  4423            FLOAT
2120    3527  4407            ENTR
2121    3530  6160            FPUT TEMFP      /CLEAR TEMFP
2122    3531  7141            FLOT MIN        /SET LEFT Y
2123    3532  6166            FPUT YMIN
2124    3533  0000            FEXT
2125    3534  5723            JMP I RDY
2126
2127    3535  0000    CLRR,   0               /CLEAR Y ARRAY
2128    3536  4430            INITAR
2129    3537  6211            CDF 10
2130    3540  3411            DCA I YIND
2131    3541  2132            ISZ CNTR
2132    3542  5340            JMP .-2
2133    3543  6201            CDF 0
2134    3544  5735            JMP I CLRR
2135
2136    3545  0000    SCASM,  0
2137    3546  6211            CDF 10
2138    3547  1411            TAD I YIND
2139    3550  1411            TAD I YIND
2140    3551  6201            CDF 0
2141    3552  4423            FLOAT
2142    3553  4407            ENTR
2143    3554  2166            FSUB YMIN       /SUBTRACT PIVOT VALUE
2144    3555  6163            FPUT XMIN       /KEEP THIS
2145    3556  3174            FGET YSCLFC     /INCR. PIVOT VALUE
2146    3557  1166            FADD YMIN
2147    3560  6166            FPUT YMIN       /KEEP FOR NEXT POINT
2148    3561  0003            NEGATE          /SUBTRACT FROM PT SUM
2149    3562  1163            FADD XMIN       /FAC=Y(I+1)+Y(I)-P(I+1)-P(I)
2150    3563  3171            FMPY XSCLFC     /SCALE DOWN
2151    3564  1160            FADD TEMFP
2152    3565  6160            FPUT TEMFP
2153    3566  2155            FSUB FTEM2      /SUBTRACT MIN VALUE
2154    3567  0000            FEXT
2155    3570  7040            CMA             /RESET Y POINTER
2156    3571  1011            TAD YIND
2157    3572  3011            DCA YIND
2158    3573  5745            JMP I SCASM
```

```
2159          3600              *3600
2160    3600  0000    BEGCAL,   0                 /CALLED BY YCALC
2161    3601  4407              ENTR
2162    3602  7551              FLOT I PIND3
2163    3603  2155              FSUB FTEM2        /POS -X
2164    3604  0001              SQUARE
2165    3605  6160              FPUT TEMFP        /(P-X)**2
2166    3606  7550              FLOT I PIND2      /WIDTH
2167    3607  0001              SQUARE
2168    3610  6163              FPUT XMIN         /W**2
2169    3611  0000              FEXT
2170    3612  5600              JMP I BEGCAL
2171
2172    3613  4433    TAPHAN,   HEDIT1            /BLK 1, UNIT, & MODE:
2173    3614  5367              THD1
2174    3615  4746              CALL INOCT        /OCTAL INPUT ROUTINE
2175    3616  5215              JMP .-1           /ERROR RETURN
2176    3617  7450              SNA               /BLOCK 0 NOT ALLOWED
2177    3620  5213              JMP .-5
2178    3621  3312              DCA STBLK
2179    3622  4425              GETNO             /UNIT
2180    3623  4424              FIXT
2181    3624  0351              AND MK7
2182    3625  7110              CLL RAR           /PUT BIT 11 IN LINK
2183    3626  1350              TAD CXOB          /ADD HIGH BITS TO SET XOB
2184    3627  3307              DCA XOBL
2185    3630  7006              RTL               /GET UNIT BIT INTO BIT 8
2186    3631  7006              RTL
2187    3632  3140              DCA TEM3          /SAVE AS U*10
2188    3633  4425              GETNO             /MODE
2189    3634  4424              FIXT
2190    3635  7640              SZA CLA           /WRITE?
2191    3636  1355              TAD CRDC          /NO, IS READ
2192    3637  1354              TAD CWRC
2193    3640  1140              TAD TEM3          /ADD IN UNIT BIT*10
2194    3641  3311              DCA WRTP          /SET INSTRUCTION
2195    3642  4430              INITAR
2196    3643  1045              TAD 45            /CHECK MODE AGAIN
2197    3644  7650              SNA CLA
2198    3645  5261              JMP TAP1          /WAS 'WRITE'
2199    3646  4747              CALL GTNPT        /GET # PTS
2200    3647  4434              HEDIT2            /# TO SKIP
2201    3650  4425              GETNO
2202    3651  4424              FIXT
2203    3652  1353              TAD M256
2204    3653  7510              SPA               />256 WORDS TO SKIP?
2205    3654  5261              JMP TAP1                  /NO, PROCEED
2206    3655  2312              ISZ STBLK         /YES, BUMP START BLK
2207    3656  3045              DCA 45
2208    3657  1045              TAD 45
2209    3660  5252              JMP .-6           /AND CHECK AGAIN
2210    3661  7201    TAP1,     CLA IAC           /FIND CORE ADDRESS
2211    3662  1011              TAD YIND
2212    3663  3135              DCA TEMP
```

```
2213  3664  6211            CDF 10
2214  3665  7240            STA
2215  3666  3137            DCA TEM2
2216  3667  1045            TAD 45
2217  3670  1074            TAD NPTS
2218  3671  1353  SBPTB,    TAD M256
2219  3672  7510            SPA                 /ANOTHER BLK?
2220  3673  5302            JMP BLKIO           /NO, PROCEED
2221  3674  3140            DCA TEM3            /YES
2222  3675  7240            STA
2223  3676  1137            TAD TEM2            /DECR. BLK CNTR
2224  3677  3137            DCA TEM2
2225  3700  1140            TAD TEM3
2226  3701  5271            JMP SBPTB
2227  3702  7200  BLKIO,    CLA
2228  3703  1135            TAD TEMP            /SET TAPE REGISTERS
2229  3704  6141            LINC
2230  3705  0023            TMA
2231  3706  1020            LDA 20
2232  3707  1020  XOBL,     1020
2233  3710  0001            AXO
2234  3711  0000  WRTP,     0                   /WILL CONTAIN INSTRUCTION
2235  3712  0000  STBLK,    0                   /IS CURRENT TAPE BLOCK
2236  3713  0003            TAC
2237  3714  0002            PDP
2238  3715  7101            IAC CLL
2239  3716  7440            SZA                 /TRANSFER OK?
2240  3717  7402            HLT                 /NO
2241  3720  2312            ISZ STBLK           /INCR. TAPE BLOCK
2242  3721  1045            TAD 45              /CHECK MODE OR # TO SKIP
2243  3722  7450            SNA                 /HAD PTS TO SKIP?
2244  3723  5337            JMP MRBKS           /NO, WAS WRITE, OR HAD NO PTS TO SKIP
2245  3724  1353            TAD M256            /SET UP SHIFT COUNTER
2246  3725  3136            DCA TEMP1
2247  3726  1045            TAD 45              /GET # TO SKIP
2248  3727  1011            TAD YIND
2249  3730  3011            DCA YIND            /RESET POINTER
2250  3731  1411            TAD I YIND          /SHIFT BUFFER DOWN
2251  3732  3412            DCA I YIND
2252  3733  2136            ISZ TEMP1
2253  3734  5331            JMP .-3
2254  3735  1045            TAD 45              /RESET CORE ADDRESS
2255  3736  7041            CIA
2256  3737  1352  MRBKS,    TAD P256
2257  3740  1135            TAD TEMP
2258  3741  3135            DCA TEMP
2259  3742  3045            DCA 45
2260  3743  2137            ISZ TEM2            /MORE BLOCKS?
2261  3744  5302            JMP BLKIO           /YES
2262  3745  5467            DISPLAY
```

```
2263
2264
2265    3746  0272    INOCT,  OCTIN
2266    3747  1307    GTNPT,  DATYP
2267    3750  1020    CXOB,   1020
2268    3751  0007    MK7,    7
2269    3752  0400    P256,   400
2270    3753  7400    M256,   -400
2271    3754  0704    CWRC,   WRC
2272    3755  7774    CRDC,   RDC-WRC
2273
2274    3756  0000    INITIZ, 0       /SETS UP A COUNTER=-NPTS, INITIALIZES
2275    3757  7300            CLA CLL /X,Y, & Z ARRAY STARTING LOC'NS,
2276    3760  1074            TAD NPTS
2277    3761  7041            CIA
2278    3762  3132            DCA CNTR
2279    3763  1144            TAD BLOCK
2280    3764  7640            SZA CLA         /BUFFER 1?
2281    3765  1111            TAD OFFSET      /NO, ADD ARRAY OFFSET
2282    3766  1110            TAD YONE
2283    3767  3011            DCA YIND
2284    3770  1074            TAD NPTS        /X ARRAY BEGINS AFTER Y'S
2285    3771  1011            TAD YIND
2286    3772  3010            DCA XIND
2287    3773  1011            TAD YIND
2288    3774  3012            DCA ZIND        /AUXILIARY AUTO REG, FOR Y ARRAY
2289    3775  3115            DCA TXSM        /CLEAR X DISPLAY SUM
2290    3776  3116            DCA TXSM+1
2291    3777  5756            JMP I INITIZ
```

```
2292          4000          *4000    /THIS IS THE AVERAGER INPUT ROUTINE
2293    4000  0000          0                /DUMMY CELL FOR LINC JUMP IN ROUTINE AVGMR
2294    4001  0000          0                /BETA REG'S FOR CHRDIS
2295    4002  0000          0
2296    4003  4433  ANINPT, HEDIT1           /CHANNEL=
2297    4004  5177          HD7
2298    4005  4751          CALL GETOCT      /OCTAL INPUT
2299    4006  5205          JMP .-1
2300    4007  3120          DCA MCHAN
2301    4010  5220          JMP AGO
2302    4011  6141  DILST,  LINC     /SUPER KLUDGE TO BOOTSTRAP DIAL INTO CORE!
2303    4012  1020          LDA 20
2304    4013  0020          20
2305    4014  0004          ESF              /I/O PRESET
2306    4015  0643          LDF 3
2307    4016  0701          RCG
2308    4017  7300          7300     /MUST BE AT LOC'N 4017!!
2309    4020  4433  AGO,    HEDIT1           /NO. POINTS=
2310    4021  5133          HD2
2311    4022  4425          GETNO
2312    4023  4424          FIXT
2313    4024  3140          DCA TEM3
2314    4025  1140          TAD TEM3
2315    4026  7112          CLL RTR
2316    4027  3074          DCA NPTS         /TEMP'LY SET TO # PTS/4
2317    4030  4466          CALL XSET        /GET 4*X DISP. INCREMENT
2318    4031  1140          TAD TEM3
2319    4032  3074          DCA NPTS
2320    4033  4433          HEDIT1           /SEC/SCAN=
2321    4034  5204          HD8
2322    4035  4407          ENTR
2323    4036  7074          FLOT NPTS
2324    4037  6163          FPUT XMIN
2325    4040  0004          READ
2326    4041  4163          FDIV XMIN
2327    4042  6163          FPUT XMIN        /=TIME PER POINT (SEC)
2328    4043  0000          FEXT
2329    4044  1346          TAD PK14
2330    4045  1044          TAD 44
2331    4046  7550          SPA SNA
2332    4047  5220          JMP AGO
2333    4050  3044          DCA 44
2334    4051  7133          STL IAC RTR
2335    4052  3045          DCA 45
2336    4053  4424          FIXT
2337    4054  3121          DCA AVSUM
2338    4055  1121          TAD AVSUM
2339    4056  4423          FLOAT
2340    4057  1044          TAD 44
2341    4060  3122          DCA EXPFC
```

```
2342
2343
2344    4061  4407          ENTR
2345    4062  6166          FPUT YMIN       /-# SAMPLES PER PT
2346    4063  5163          FGET XMIN       /# SECS PER PT
2347    4064  4367          FDIV CYCTM      /FAC=TOTAL # CY'S NEEDED PER PT/3
2348    4065  2375          FSUB NCY        /OVERHEAD CY'S PER PT/3
2349    4066  4166          FDIV YMIN       /DIV BY -# SAMPLES/PT=-#CY'S/SAMPLE
2350    4067  1372          FADD FUGCY      /OVERHEAD CY'S PER SAMPLE/3 IN LOOP 'ADDUP'
2351    4070  3123          FMPY HALF
2352    4071  0000          FEXT            /FAC=-# DELAY CY'S NEEDED PER SAMPLE/6
2353    4072  4424          FIXT
2354    4073  7500          SMA             /RESULT MUST BE NEG.
2355    4074  5220          JMP AGO         /TOO FAST!!
2356    4075  7104          CLL RAL
2357    4076  3152          DCA CLTM
2358    4077  1046          TAD 46          /ROUNDOFF!
2359    4100  7710          SPA CLA
2360    4101  2152          ISZ CLTM
2361    4102  4434          HEDIT2          /SENSE!
2362    4103  4751          CALL GETOCT
2363    4104  5303          JMP .-1
2364    4105  1350          TAD ISXL        /FORM INSTRUCTION
2365    4106  3747          DCA I CSXL
2366    4107  4434          HEDIT2          /DELAY TIME(SEC)=
2367    4110  4407          ENTR
2368    4111  0004          READ
2369    4112  3476          FMPY I HUNDRD
2370    4113  0000          FEXT
2371    4114  4424          FIXT
2372    4115  7041          CIA
2373    4116  7500          SMA
2374    4117  7200          CLA
2375    4120  3153          DCA DLATM       /IS -100*SEC AS ENTERED
2376    4121  4434          HEDIT2          /NO. SCANS=
2377    4122  4425          GETNO
2378    4123  4424          FIXT
2379    4124  7041          CIA
2380    4125  3131          DCA PCTR
2381    4126  3117          DCA RUN
2382    4127  4432          CRLFD
2383    4130  4430          INITAR
2384    4131  1074          TAD NPTS
2385    4132  7144          CLL CMA RAL
2386    4133  3135          DCA TEMP
2387    4134  6211          CDF 10
2388    4135  3411          DCA I YIND
2389    4136  2135          ISZ TEMP        /CLEAR THAT ARRAY,
2390    4137  5335          JMP .-2
2391    4140  6201          CDF 0
2392    4141  1213          TAD DILST+2     /EXECUTE I/O PRESET
2393    4142  6141          LINC
2394    4143  0004          ESF
2395    4144  0002          PDP
2396    4145  5752          JMP I ESRNMR
```

```
2397   4146  0014   PK14,   14
2398   4147  4212   CSXL,   AVLOP+3
2399   4150  0400   ISXL,   SXL
2400   4151  0272   GETOCT, OCTIN
2401   4152  4200   ESRNMR, AVGMR
2402
2403                                    /SPECIAL ROUTINE TO RESET
2404   4153  4433   CALSET, HEDIT1     /MACHINE CYCLE TIME FOR
2405   4154  5362           HDSP       /ACCURATE CALIBRATION,
2406   4155  4407           ENTR
2407   4156  0004           READ
2408   4157  3364           FMPY FK3
2409   4160  6367           FPUT CYCTM  /3*CYCLE TIME
2410   4161  0000           FEXT
2411   4162  4432           CRLFD
2412   4163  5467           DISPLAY     /EXIT
2413   4164  0002   FK3,    FLTG 3,0
       4165  3000
       4166  0000
2414
2415                           /NEXT 3 CONSTANTS SET TIMING FOR AVERAGER
2416   4167  7757   CYCTM,  FLTG 4,8E-6 /IS 3* MACHINE CYCLE TIME
       4170  2410
       4171  3730
2417   4172  0004   FUGCY,  FLTG 12,333 /IS # CYCLES IN LOOP 'ADDUP'/3
       4173  3052
       4174  4774
2418   4175  0005   NCY,    FLTG 16,450 /IS # OVERHEAD CYCLES PER PT/3
       4176  2034
       4177  6315
```

```
2419          4200              *4200
2420    4200  7300    AVGMR,    CLA CLL
2421    4201  1122              TAD EXPFC
2422    4202  1337              TAD ISCR
2423    4203  3254              DCA HIORD+1
2424    4204  1341              TAD KSAM
2425    4205  1120              TAD MCHAN
2426    4206  3232              DCA GTAD
2427    4207  4430    AVLOP,    INITAR
2428    4210  6141              LINC
2429    4211  4001              STC 1
2430    4212  0400              SXL 0             /SKIP IF EXT. LEVEL 0 IS +3V
2431    4213  6212              6000 .-1          /LINC JMP .-1
2432    4214  0002              PDP
2433    4215  1153              TAD DLATM
2434    4216  7450              SNA
2435    4217  5222              JMP .+3
2436    4220  4343              JMS SETCLK
2437    4221  5100              5100
2438    4222  6211              CDF 10
2439    4223  1121    GOSUM,    TAD AVSUM         /THIS ROUTINE TAKES ADC
2440    4224  3133              DCA LNCTR         /SAMPLES, -AVSUM IN #, IN A TIME
2441    4225  3253              DCA HIORD         /PER SAMPLE VARIED BY CLTM
2442    4226  3155              DCA LOORD         /BASE TIME PER SAMPLE=58 USEC.
2443    4227  1152    ADDUP,    TAD CLTM          /OVERHEAD/PT=77.8-80.2 USEC
2444    4230  3157              DCA TMCTR
2445    4231  6141              LINC
2446    4232  0100    GTAD,     SAM
2447    4233  0002              PDP
2448    4234  1130              TAD K1000         /MAKE ALL RESULTS POS.
2449    4235  7100              CLL
2450    4236  1155              TAD LOORD         /STORED AS DOUBLE PREC. INTEGER
2451    4237  3155              DCA LOORD
2452    4240  7004              RAL               /LOORD OVERFLOW SETS LINK
2453    4241  1253              TAD HIORD
2454    4242  3253              DCA HIORD
2455    4243  2157              ISZ TMCTR         /ADD SOME TIME BETWEEN SAMPLES
2456    4244  5243              JMP .-1
2457    4245  2133              ISZ LNCTR
2458    4246  5227              JMP ADDUP
2459    4247  1155              TAD LOORD
2460    4250  6141              LINC              /DIVIDE BY NO. SAMPLES
2461    4251  0354              SCR 14
2462    4252  1020              LDA 20
2463    4253  0000    HIORD,    0
2464    4254  0000              0
```

```
2465   4255  0005            QAC
2466   4256  1120            ADA 20
2467   4257  7400            -400
2468   4260  0161            DIS 20 1
2469   4261  0005            QAC
2470   4262  0241            ROL 1              /GET 12 BITS FROM MQ
2471   4263  0475            QLZ 20
2472   4264  6267            6000 ,+3
2473   4265  1620            BSE 20
2474   4266  0001            1
2475   4267  0002            PDP
2476   4270  7100            CLL
2477   4271  1411            TAD I YIND
2478   4272  3412            DCA I ZIND
2479   4273  7004            RAL
2480   4274  1411            TAD I YIND
2481   4275  3412            DCA I ZIND
2482   4276  2132            ISZ CNTR
2483   4277  5223            JMP GOSUM
2484   4300  6201            CDF 0
2485   4301  2117            ISZ RUN            /IS NO OF SCANS TAKEN
2486   4302  7604            LAS                /CHECK BIT 0
2487   4303  7710            SPA CLA            /WANT TO INTERRUPT?
2488   4304  4740            CALL LOOK          /YES, CALL DISPLAY ROUTINES
2489   4305  2131            ISZ PCTR           /INCR. COUNTER; MORE SCANS?
2490   4306  5207            JMP AVLOP          /YES.
2491   4307  4430            INITAR             /NO, WE'RE FINISHED.
2492   4310  4407            ENTR               /PREPARE TO NORMALIZE THE 24
2493   4311  7117            FLOT RUN           /BIT Y STORAGE DOWN TO 12 BITS
2494   4312  6160            FPUT TEMFP         /BY DIVIDING BY NO. OF SCANS
2495   4313  0000            FEXT
2496   4314  6211  DIVD,     CDF 10
2497   4315  1411            TAD I YIND         /GET LOW ORDER BITS OF 1ST WORD
2498   4316  3046            DCA 46
2499   4317  1411            TAD I YIND
2500   4320  3045            DCA 45
2501   4321  6201            CDF 0
2502   4322  1342            TAD P27
2503   4323  3044            DCA 44
2504   4324  4407            ENTR
2505   4325  0007            FNOR
2506   4326  4160            FDIV TEMFP
2507   4327  1123            FADD HALF
2508   4330  0000            FEXT
2509   4331  4424            FIXT
2510   4332  6211            CDF 10
2511   4333  3412            DCA I ZIND
2512   4334  2132            ISZ CNTR
2513   4335  5314            JMP DIVD
2514   4336  5467            DISPLAY
2515   4337  0337  ISCR,     SCR-1
2516   4340  4400  LOOK,     LOOKER
2517   4341  0100  KSAM,     SAM
2518   4342  0027  P27,      27
```

```
2519
2520    4343  0000    SETCLK, 0
2521    4344  3376            DCA CNTS
2522    4345  6133            CLAB
2523    4346  1374            TAD KK100
2524    4347  6132            CLLR
2525    4350  7200            CLA
2526    4351  1376            TAD CNTS
2527    4352  6133            CLAB
2528    4353  6135            CLSA
2529    4354  7200            CLA
2530    4355  1375            TAD KK300
2531    4356  6134            CLEN
2532    4357  7200            CLA
2533    4360  1743            TAD I SETCLK
2534    4361  6132            CLLR
2535    4362  6131            CLSK
2536    4363  7410            SKP
2537    4364  5367            JMP .+3
2538    4365  4463            CALL DISMOV     /REFRESH DISPLAY
2539    4366  5362            JMP .-4
2540    4367  6135            CLSA
2541    4370  7300            CLA CLL
2542    4371  6132            CLLR
2543    4372  2343            ISZ SETCLK
2544    4373  5743            JMP I SETCLK
2545    4374  0100    KK100,  100
2546    4375  0300    KK300,  300
2547    4376  0000    CNTS,   0
```

```
2548          4400          *4400
2549    4400  0000  LOOKER, 0
2550    4401  6032          KCC
2551    4402  4433          HEDIT1          /NO. OF SCANS=
2552    4403  5223          HD9
2553    4404  7125          STL IAC RAL     /*3
2554    4405  3062          DCA 62
2555    4406  1117          TAD RUN /IS NO. OF COMPLETED SCANS
2556    4407  4423          FLOAT
2557    4410  1044          TAD 44
2558    4411  3134          DCA MCTR        /KEEP TWO'S EXPONENT
2559    4412  4406          CALL 6
2560    4413  4432          CRLFD
2561    4414  4430  STLOOP, INITAR         /MCTR IS APPROX. 2'S DIVISOR
2562    4415  6031          KSF             /WANT TO CHANGE SCALE OR STOP?
2563    4416  7410          SKP             /NO
2564    4417  4305          JMS MULT        /YES, FIND OUT WHAT,
2565    4420  6211  LOOPIT, CDF 10
2566    4421  1411          TAD I YIND      /LOW ORDER
2567    4422  3155          DCA LOORD
2568    4423  1411          TAD I YIND      /HIGH ORDER
2569    4424  6201          CDF 0
2570    4425  3243          DCA LHORD
2571    4426  7127          STL IAC RTL     /*6
2572    4427  1011          TAD YIND        /GET EVERY 4TH VALUE
2573    4430  3011          DCA YIND
2574    4431  1134          TAD MCTR
2575    4432  7550          SPA SNA         /MCTR>0, I.E. NEED DIVIDE?
2576    4433  5250          JMP NODIV       /NO
2577
2578    4434  0303  DVID,   AND MSK17
2579    4435  1304          TAD CSCR
2580    4436  3244          DCA LHORD+1
2581    4437  1155          TAD LOORD       /LOAD MQ
2582    4440  6141          LINC
2583    4441  0354          SCR 14
2584    4442  1020          LDA 20
2585    4443  0000  LHORD,  0
2586    4444  0000          0               /WILL CONTAIN SCR N
2587    4445  0005          QAC
2588    4446  0002          PDP
2589    4447  5261          JMP DSPIT+1
2590    4450  7500  NODIV,  SMA             /MAGNIFY IT?
2591    4451  5260          JMP DSPIT       /DO NEITHER
2592    4452  3133          DCA LNCTR       /YES
2593    4453  1155          TAD LOORD       /VALUE IS ACTUALLY SINGLE PREC,
2594    4454  7104          CLL RAL         /MULT. BY 2
2595    4455  2133          ISZ LNCTR
2596    4456  5254          JMP .-2         /MULT. AGAIN
2597    4457  7410          SKP
```

```
2598
2599    4460  1155    DSPIT,  TAD LOORD
2600    4461  1105            TAD YLIM
2601    4462  3112            DCA YDIS
2602    4463  4463            CALL DISMOV     /MOVE POINT ON SCOPE
2603    4464  4471            CALL ADINX      /GET & INCR, X COORD
2604    4465  7107            CLL IAC RTL
2605    4466  1132            TAD CNTR
2606    4467  7500            SMA             /MORE PTS?
2607    4470  5214            JMP STLOOP      /NO
2608    4471  3132            DCA CNTR        /YES
2609    4472  5220            JMP LOOPIT
2610
2611    4473  4434    ENDCHK, HEDIT2          /MORE SCANS?
2612    4474  4435            ASK
2613    4475  7650            SNA CLA
2614    4476  5301            JMP .+3         /YES
2615    4477  7240            STA
2616    4500  3131            DCA PCTR
2617    4501  4432            CRLFD
2618    4502  5600            JMP I LOOKER
2619    4503  0017    MSK17,  17
2620    4504  0337    CSCR,   SCR-1
2621
2622    4505  0000    MULT,   0
2623    4506  6036            KRB
2624    4507  1327            TAD MD
2625    4510  7440            SZA             /DECREASE SIZE?
2626    4511  5314            JMP .+3         /NO
2627    4512  2134            ISZ MCTR
2628    4513  5705            JMP I MULT
2629    4514  1330            TAD MM
2630    4515  7440            SZA             /INCREASE SIZE?
2631    4516  5323            JMP MORE        /NO
2632    4517  7240            STA
2633    4520  1134            TAD MCTR
2634    4521  3134            DCA MCTR
2635    4522  5705            JMP I MULT
2636    4523  1331    MORE,   TAD MS
2637    4524  7650            SNA CLA         /GET '8' FOR STOP?
2638    4525  5273            JMP ENDCHK      /YES
2639    4526  5705            JMP I MULT
2640    4527  7474    MD,     -304
2641    4530  7767    MM,     304-315
2642    4531  7772    MS,     315-323
```

```
2643
2644   4532  0000   WIDTH, 0              /INPUT AND SCALE WIDTH VALUE
2645   4533  4407          ENTR
2646   4534  0004          READ
2647   4535  3473          FMPY I XMPY
2648   4536  0000          FEXT
2649   4537  4424          FIXT
2650   4540  3550          DCA I PIND2
2651   4541  5732          JMP I WIDTH
2652
2653   4542  4536   BTPBS, 4536
2654   4543  3651          3651
2655   4544  2101          2101
2656   4545  0177          0177
2657   4546  4523          4523
2658   4547  2151          2151
2659   4550  4122          4122
2660   4551  2651          2651
2661   4552  2414          2414
2662   4553  0477          0477
2663   4554  5172          5172
2664   4555  0651          0651
2665   4556  1506          1506
2666   4557  4225          4225
2667   4560  4443          4443
2668   4561  6050          6050
2669   4562  5126          5126
2670   4563  2651          2651
2671   4564  5122          5122
2672   4565  3651          3651
2673   4566  0000   ASPC,  0000
2674   4567  0000          0000
```

```
2675
2676
2677            4600            *4600
2678    4600    4430    DERIV,  INITAR          /FORMS 5TH PT. DIFFERENCES
2679    4601    1261            TAD PLS5
2680    4602    1011            TAD YIND
2681    4603    3011            DCA YIND
2682    4604    1261            TAD PLS5
2683    4605    1132            TAD CNTR
2684    4606    3132            DCA CNTR
2685    4607    1012            TAD ZIND
2686    4610    3010            DCA XIND
2687    4611    6211            CDF 10
2688    4612    1412    DRLOP1, TAD I ZIND      /PUT Y(I+5)-Y(I)*SHF INTO Y(I)
2689    4613    7041            CIA
2690    4614    1411            TAD I YIND
2691    4615    1262            TAD SHF         /ADD OFFSET FOR CENTERED DISPLAY
2692    4616    3410            DCA I XIND
2693    4617    2132            ISZ CNTR
2694    4620    5212            JMP DRLOP1
2695    4621    1010            TAD XIND
2696    4622    3135            DCA TEMP
2697    4623    1535            TAD I TEMP      /PUT Y(N-5) INTO Y(N-4) AND Y(N-3)
2698    4624    3410            DCA I XIND
2699    4625    1535            TAD I TEMP
2700    4626    3410            DCA I XIND
2701    4627    1010            TAD XIND        /SET UP TO SHIFT ARRAY UP BY 3
2702    4630    3135            DCA TEMP        /SUCH THAT FINAL ARRAY HAS VALUES
2703    4631    7125            STL IAC RAL     /Y(I)=Y(I+2)=Y(I-2)+SHF
2704    4632    1135            TAD TEMP        /WHERE Y(1)=Y(2)=Y(3) AND
2705    4633    3136            DCA TEMP1       /Y(N-2)=Y(N-1)=Y(N)
2706    4634    7346            CLL STA RTL
2707    4635    1074            TAD NPTS
2708    4636    7041            CIA
2709    4637    3132            DCA CNTR
2710    4640    1535    DRLOP2, TAD I TEMP      /PUT Y(I) INTO Y(I+3)
2711    4641    3536            DCA I TEMP1
2712    4642    7240            STA
2713    4643    1135            TAD TEMP
2714    4644    3135            DCA TEMP
2715    4645    7240            STA
2716    4646    1136            TAD TEMP1
2717    4647    3136            DCA TEMP1
2718    4650    2132            ISZ CNTR
2719    4651    5240            JMP DRLOP2
2720    4652    2135            ISZ TEMP
2721    4653    1535            TAD I TEMP
2722    4654    3536            DCA I TEMP1
2723    4655    1536            TAD I TEMP1
2724    4656    2135            ISZ TEMP
2725    4657    3535            DCA I TEMP
2726    4660    5467            DISPLAY
2727    4661    0005    PLS5,   5
2728    4662    0764    SHF,    764
```

```
2729
2730
2731   4663  1074   SQEEZE, TAD NPTS        /COMPRESS ONE OR BOTH BUFFERS
2732   4664  7110           CLL RAR         /BY AVERAGING ADJACENT PTS,
2733   4665  3074           DCA NPTS
2734   4666  7240           STA
2735   4667  1144           TAD BLOCK
2736   4670  7750           SPA SNA CLA     /BLOCK=2 FOR DOUBLE SQUEEZE?
2737   4671  5274           JMP .+3         /NO
2738   4672  3144           DCA BLOCK       /SQUEEZE BUFF. 1 FIRST
2739   4673  7240           STA
2740   4674  3135           DCA TEMP        /=-1 FOR DOUBLE SQUEEZE, 0 FOR SINGLE
2741   4675  4430           INITAR
2742   4676  6211           CDF 10
2743   4677  1411   SQLP,   TAD I YIND
2744   4700  1411           TAD I YIND
2745   4701  7110           CLL RAR
2746   4702  7430           SZL             /ROUNDOFF?
2747   4703  7001           IAC             /YES
2748   4704  3412           DCA I ZIND
2749   4705  2132           ISZ CNTR
2750   4706  5277           JMP SQLP
2751   4707  2135           ISZ TEMP        /FINISHED?
2752   4710  5467           DISPLAY         /YES OR IS SINGLE SQUEEZE
2753   4711  7001           IAC             /NO, DO BUFF. 2
2754   4712  3144           DCA BLOCK
2755   4713  5275           JMP SQLP-2
2756
2757   4714  0000   POSTN,  0               /GET POSITION AND SCALE IT
2758   4715  4407           ENTR
2759   4716  0004           READ
2760   4717  2501           FSUB I X1
2761   4720  3473           FMPY I XMPY
2762   4721  1123           FADD HALF
2763   4722  0000           FEXT
2764   4723  4424           FIXT
2765   4724  3551           DCA I PIND3
2766   4725  5714           JMP I POSTN
2767
```

```
2768
2769    4726  4430    XFLIP,  INITAR          /INVERT X AXIS
2770    4727  1011            TAD YIND        /Y(I)=Y(NPTS+1-I)
2771    4730  1074            TAD NPTS
2772    4731  3135            DCA TEMP
2773    4732  1132            TAD CNTR
2774    4733  7130            STL RAR
2775    4734  3132            DCA CNTR
2776    4735  6211            CDF 10
2777    4736  1411    FLX,    TAD I YIND
2778    4737  3136            DCA TEMP1
2779    4740  1535            TAD I TEMP
2780    4741  3412            DCA I ZIND
2781    4742  1136            TAD TEMP1
2782    4743  3535            DCA I TEMP
2783    4744  7240            STA
2784    4745  1135            TAD TEMP
2785    4746  3135            DCA TEMP
2786    4747  2132            ISZ CNTR
2787    4750  5336            JMP FLX
2788    4751  5467            DISPLAY
2789
2790    4752  4760    COPY,   CALL SPCIN      /COPY DISP. CHAN INTO OTHER
2791    4753  1411            TAD I YIND
2792    4754  3413            DCA I AUTO
2793    4755  2132            ISZ CNTR
2794    4756  5353            JMP .-3
2795    4757  5467            DISPLAY
2796    4760  3014    SPCIN,  SPINIT
2797
2798    4761  4433    MULP,   HEDIT1          /MIN=
2799    4762  5157            HD5
2800    4763  4425            GETNO
2801    4764  4424            FIXT
2802    4765  3141            DCA MIN
2803    4766  4433            HEDIT1          /MPY=
2804    4767  5165            HD5+6
2805    4770  4407            ENTR
2806    4771  0004            READ
2807    4772  6174            FPUT YSCLFC
2808    4773  0000            FEXT
2809    4774  5775            JMP I .+1
2810    4775  1535            SKL-1
```

```
2811          5000          *5000
2812                        /DISPLAYS DECIMAL VALUES OF CURSORS
2813    5000  0000  CRDIS,  0
2814    5001  7200          CLA
2815    5002  6141          LINC
2816    5003  0004          ESF
2817    5004  4001          STC 1
2818    5005  0642          LDF 2
2819    5006  0002          PDP
2820    5007  1250          TAD YTP
2821    5010  3265          DCA YCD
2822    5011  1251          TAD CDTB
2823    5012  3013          DCA AUTO
2824    5013  1126          TAD NEG4
2825    5014  3140          DCA TEM3
2826    5015  3136          DCA TEMP1
2827    5016  1126  LP1,    TAD NEG4
2828    5017  3142          DCA MAX
2829    5020  1253          TAD MTBF
2830    5021  3137          DCA TEM2
2831    5022  1413          TAD I AUTO
2832    5023  3135  LP2,    DCA TEMP
2833    5024  1135          TAD TEMP
2834    5025  1537          TAD I TEM2
2835    5026  2136          ISZ TEMP1
2836    5027  7500          SMA
2837    5030  5223          JMP LP2
2838    5031  7240          STA
2839    5032  1136          TAD TEMP1
2840    5033  7104          CLL RAL
2841    5034  4260          JMS CHRDIS
2842    5035  3136          DCA TEMP1
2843    5036  2137          ISZ TEM2
2844    5037  2142          ISZ MAX
2845    5040  5224          JMP LP2+1
2846    5041  1252          TAD KSPC
2847    5042  4260          JMS CHRDIS
2848    5043  1252          TAD KSPC
2849    5044  4260          JMS CHRDIS
2850    5045  2140          ISZ TEM3
2851    5046  5216          JMP LP1
2852    5047  5600          JMP I CRDIS
2853    5050  0340  YTP,    340
2854    5051  3304  CDTB,   TPNT-1
2855    5052  0024  KSPC,   ASPC-BTPBS
2856    5053  5054  MTBF,   .+1
2857    5054  6030          -1750
2858    5055  7634          -144
2859    5056  7766          -12
2860    5057  7777          -1
```

```
2861    5060  0000    CHRDIS, 0
2862    5061  1273            TAD BTBS
2863    5062  6141            LINC
2864    5063  4002            STC 2
2865    5064  1020            LDA 20
2866    5065  0000    YCD,    0
2867    5066  1762            DSC 20 2
2868    5067  1762            DSC 20 2
2869    5070  0002            PDP
2870    5071  7300            CLA CLL
2871    5072  5660            JMP I CHRDIS
2872    5073  4541    BTBS,   BTPBS-1
2873
2874    5074  0000    EXTRAP, 0
2875    5075  4407            ENTR
2876    5076  7045            FLOT 45
2877    5077  3174            FMPY YSCLFC
2878    5100  0003            NEGATE
2879    5101  1166            FADD YMIN
2880    5102  6166            FPUT YMIN
2881    5103  0000            FEXT
2882    5104  4424            FIXT
2883    5105  3141            DCA MIN
2884    5106  5674            JMP I EXTRAP
2885
2886
2887    5107  3603    HD1,    TEXT    /*CATACAL LIVES!**TITLE!/
        5110  0124
        5111  0103
        5112  0114
        5113  4014
        5114  1126
        5115  0523
        5116  4136
        5117  3624
        5120  1124
        5121  1405
        5122  7200
2888    5123  3636            TEXT    /**OK, HIT ME!**/
        5124  1713
        5125  5440
        5126  1011
        5127  2440
        5130  1505
        5131  4136
        5132  3600
2889    5133  3616    HD2,    TEXT    /*NO. POINTS= /
        5134  1756
        5135  4020
        5136  1711
        5137  1624
        5140  2375
        5141  4000
2890    5142  2024            TEXT    /PTS. TO SKIP=/
        5143  2356
```

```
                5144  4024
                5145  1740
                5146  2313
                5147  1120
                5150  7500
2891            5151  1411    HD3,    TEXT    /LINE PLOT?/
                5152  1605
                5153  4020
                5154  1417
                5155  2477
                5156  0000
2892            5157  3615    HD5,    TEXT    /*MIN=/
                5160  1116
                5161  7500
2893            5162  1501            TEXT    /MAX=/
                5163  3075
                5164  0000
2894            5165  1520            TEXT    /MPY=/
                5166  3175
                5167  0000
2895            5170  2014    HD6,    TEXT    /PLOTTER OFF?/
                5171  1724
                5172  2405
                5173  2240
                5174  1706
                5175  0677
                5176  0000
2896            5177  0310    HD7,    TEXT    /CHANNEL= /
                5200  0116
                5201  1605
                5202  1475
                5203  4000
2897            5204  2305    HD8,    TEXT    \SEC/SCAN=\
                5205  0357
                5206  2303
                5207  0116
                5210  7500
2898            5211  2305            TEXT    /SENSE!/
                5212  1623
                5213  0572
                5214  0000
2899            5215  0405            TEXT    /DELAY(SEC)=/
                5216  1401
                5217  3150
                5220  2305
                5221  0351
                5222  7500
2900            5223  1617    HD9,    TEXT    /NO, SCANS= /
                5224  5640
                5225  2303
                5226  0116
                5227  2375
                5230  4000
2901            5231  1517            TEXT    /MORE SCANS?/
                5232  2205
```

```
                5233  4023
                5234  0301
                5235  1623
                5236  7700
2902            5237  2303    HD15,   TEXT   /SCAN INT'L?/
                5240  0116
                5241  4011
                5242  1624
                5243  4714
                5244  7700
2903            5245  0122            TEXT   /AREA=/
                5246  0501
                5247  7500
2904            5250  1617    HD20A,  TEXT   /NO. PEAKS=/
                5251  5640
                5252  2005
                5253  0113
                5254  2375
                5255  0000
2905            5256  3040    HD20B,  TEXT   /X RNG, X1, INT.MPLR, BASE, LOR, FR.(0=1)!*/
                5257  2216
                5260  0754
                5261  4030
                5262  6154
                5263  4011
                5264  1624
                5265  5615
                5266  2014
                5267  2254
                5270  4002
                5271  0123
                5272  0554
                5273  4014
                5274  1722
                5275  5640
                5276  0622
                5277  5650
                5300  6055
                5301  6151
                5302  7236
                5303  0000
2906            5304  1007            TEXT   /HGT,H=WIDTH,POS!*/
                5305  2454
                5306  1055
                5307  2711
                5310  0424
                5311  1054
                5312  2017
                5313  2372
                5314  3600
2907            5315  2013    HD21,   TEXT   /PK,PA,VL!/
                5316  5420
                5317  0154
                5320  2614
                5321  7200
```

```
2908   5322  3603   HD23,   TEXT   /↑COOL IT./
       5323  1717
       5324  1440
       5325  1124
       5326  5600
2909   5327  2324   HD25,   TEXT   /STRIP PEAK?/
       5330  2211
       5331  2040
       5332  2005
       5333  0113
       5334  7700
2910   5335  0625           TEXT   /FULL BASE?/
       5336  1414
       5337  4002
       5340  0123
       5341  0577
       5342  0000
2911   5343  3602   HD26,   TEXT   /↑BAD X PTS!↑/
       5344  0104
       5345  4030
       5346  4020
       5347  2423
       5350  4136
       5351  0000
2912
2913   5352  3631   DIHD1,  TEXT   /↑Y RANGE & MIN!/
       5353  4022
       5354  0116
       5355  0705
       5356  4046
       5357  4015
       5360  1116
       5361  7200
2914   5362  1503   HDSP,   TEXT   /MCT(SEC)=/
       5363  2450
       5364  2305
       5365  0351
       5366  7500
2915   5367  0214   THD1,   TEXT   /BLK1, U, M(0=W)! /
       5370  1361
       5371  5440
       5372  2554
       5373  4015
       5374  5060
       5375  7527
       5376  5172
       5377  4000
```

```
             7600              *7600
                                                /WILL BE CLOBBERED BY PARA'S
      7600   0000    DIALOG,   Ø                /IS USED ONLY FOR FIRST STARTUP
      7601   4433              HEDIT1           /WORKING W/  ABS. DIPS?
      7602   764Ø              DHD1
      7603   4435              ASK
      7604   765Ø              SNA CLA
      7605   521Ø              JMP .+3
      7606   1237              TAD NOOP         /NO, INSERT NOP
      7607   3634              DCA I INSCHN
      761Ø   4434              HEDIT2           /EQUAL WIDTHS?
      7611   4435              ASK
      7612   3632              DCA I WDSWT
      7613   4434              HEDIT2           /CUTOFF AT 8*W?
      7614   4435              ASK
      7615   765Ø              SNA CLA
      7616   5221              JMP .+3          /YES, LEAVE AS IS
      7617   1235              TAD SPECJ        /NO, FULL BORE CALC.
      762Ø   3636              DCA I CALCJ
      7621   4432              CRLFD
      7622   4432              CRLFD
      7623   724Ø              STA
      7624   12ØØ              TAD DIALOG
      7625   3237              DCA NOOP
      7626   1233              TAD SKIP         /THIS WILL PREVENT RECALL OF
      7627   3637              DCA I NOOP
      763Ø   22ØØ              ISZ DIALOG
      7631   56ØØ              JMP I DIALOG     /THIS ROUTINE AGAIN W/O RELOADING.
      7632   2235    WDSWT,    WIDSWT
      7633   741Ø    SKIP,     SKP
      7634   25Ø5    INSCHN,   BSCHNG
      7635   5242    SPECJ,    SPCJ
      7636   2417    CALCJ,    YCLC+1
      7637   7ØØØ    NOOP,     NOP
      764Ø   Ø1Ø2    DHD1,     TEXT     /ABSORPTION 'DIPS'?/
      7641   2317
      7642   222Ø
      7643   2411
      7644   1716
      7645   4Ø47
      7646   Ø411
      7647   2Ø23
      765Ø   4777
      7651   ØØØØ
      7652   2711              TEXT     /WIDTHS EQUAL?/
      7653   Ø424
      7654   1Ø23
      7655   4ØØ5
      7656   2125
      7657   Ø114
      766Ø   77ØØ
      7661   Ø325              TEXT     /CUTOFF AT 8*WIDTH?/
      7662   2417
      7663   Ø6Ø6
      7664   4ØØ1
```

9.

```
7665  2440
7666  7052
7667  2711
7670  0424
7671  1077
7672  0000
```

```
2953                        /THE FOLLOWING ARE A SET OF OVERLAYS
2954                        /FOR FLOATING POINT PKGS, #1,2, & 4
2955                        /WHICH ALLOWS INPUT FROM THE HIGH
2956                        /OR LOW SPEED READERS. SET IOSWT=1 TO USE
2957                        /THE HIGH SPEED READER OR PUNCH.
2958                        /HERE ALSO IS AN OVERLAY WHICH ALLOWS
2959                        /BLANKS TO FOLLOW A + OR - SIGN ON INPUT.
2960                        /PLUS SIGNS ARE DELETED FROM OUTPUT.
2961
2962     0055               *55
2963 0055 0000             0
2964 0056 0000  IOSWT,     0
2965
2966     7142               *7142
2967 7142 0000  INPUT,     0                /THIS IS THE INPUT OVERLAY
2968 7143 1056             TAD IOSWT        /CHECK I/O SWITCH
2969 7144 7110             CLL RAR
2970 7145 7630             SZL CLA          /SETS LINK FOR HI SPD RDR.
2971 7146 5351             JMP .+3          /USE HI SPD RDR.
2972 7147 4427             RDTTY
2973 7150 7410             SKP
2974 7151 4770             CALL HSRI
2975 7152 3057  CHECK,     DCA 57
2976 7153 1057             TAD 57
2977 7154 7450             SNA
2978 7155 5343             JMP INPUT+1
2979     7167  MRBOUT=RESTRT              /OCTAL VALUE OF RESTRT=-377.
2980 7156 1367             TAD MRBOUT
2981 7157 7640             SZA CLA
2982 7160 5364             JMP GOOD
2983     7037  XCPT=7037                  /4241 PRINTS AS 241.
2984 7161 1237             TAD XCPT         /PRINT '!' IF RUBOUT.
2985 7162 4766             CALL OUTPT       /NO
2986 7163 5767             JMP I RESTRT
2987 7164 1057  GOOD,      TAD 57
2988 7165 5742             JMP I INPUT
2989 7166 7344  OUTPT,     7344
2990 7167 7401  RESTRT,    7401
2991 7170 6573  HSRI,      HSR
2992
2993     6573               *6573
2994 6573 0000  HSR,       0
2995 6574 6011             RSF
2996 6575 5374             JMP .-1
2997 6576 6016             RRB RFC
2998 6577 5773             JMP I HSR
2999
3000     7327               *7327
3001 7327 0240             240              /REPLACE ASCII + WITH SPACE
3002 7330 0015             255-240
```

```
3003
3004          7004              *7004              /MODIFY 'DECONV' TO ACCEPT SPACES
3005    7004  3266              DCA 7066           /AFTER + OR - SIGN.
3006    7005  4342              JMS INPUT
3007    7006  1336              TAD 7136
3008    7007  7450              SNA                /GET + SIGN?
3009    7010  5215              JMP SPCHK          /YES, CHECK FOR SPACES
3010    7011  1335              TAD 7135
3011    7012  7440              SZA                /GET - SIGN?
3012    7013  5220              JMP 7020           /NO
3013    7014  7240              STA                /SET SIGN SWITCH TO -1
3014    7015  5616    SPCHK,    JMP I ,+1          /READ SPACES, IF ANY; RETURN .+3
3015    7016  6766              CHKBLK
3016
3017          6766              *6766
3018    6766  3777    CHKBLK,   DCA I SIGN         /0 IF +; -1 IF -.
3019    6767  4776              CALL INPT
3020    6770  1375              TAD MBLNK
3021    6771  7640              SZA CLA
3022    6772  5774              JMP I RETDEC
3023    6773  5367              JMP .-4
3024    6774  7020    RETDEC,   SPCHK+3
3025    6775  7540    MBLNK,    -240
3026    6776  7142    INPT,     INPUT
3027    6777  7065    SIGN,     7065
3028
3029          5675              *5675   /REPLACE FNOR CALL WITH FLOAT
3030    5675  0567              INTFLT
3031
3032          7345              *7345   /SELECT OUTPUT DEVICE
3033    7345  4747              CALL .+2
3034    7346  5744              JMP I .-2
3035    7347  0607              SELECT
3036
3037          7430              *7430   /CAN'T USE INTERPRETIVE FNOR ON INPUT
3038    7430  4775              CALL 7575
3039    7431  4407              ENTR
3040          7575              *7575
3041    7575  6600              6600
3042
3043          6547              *6547   /INTERPRETIVE INSTR. JUMP TABLE
3044    6547  6000              6000
3045    6550  0600              READER
3046    6551  7200              7200
3047    6552  1740              HEDER2
3048    6553  6600              6600
3049    6554  2600              FLEXPO
```

```
3050
3051
3052                    /CHANGES TO FLOATING POINT OUTPUT ROUTINE
3053                    /TO ALLOW OPTIONAL FIXED POINT OUTPUT
3054                    /IF (62)=0, OUTPUT FLOATING
3055                    /OTHERWISE C(62) = NUMBER OF DIGITS
3056                    /C(AC) = NUMBER OF DECIMAL PLACES
3057                    /C(15) LOST DURING EXECUTION
3058
3059
3060            7200    *7200
3061
3062    7200    0000    FOUT,   0
3063    7201    3775            DCA I SCAD /SAVE C(AC)
3064    7202    1045            TAD HORDER
3065    7203    7710            SPA CLA
3066    7204    1330            TAD SMINUS
3067    7205    1327            TAD SPLUS
3068    7206    4344            JMS ASCOUT /PRINT "SPACE" OR "-"
3069    7207    1376            TAD BFRST
3070    7210    3015            DCA 15      /INITIALIZE AUTO-INDEX
3071    7211    5234            JMP 7234    /CONVERT MANTISSA AND BUFFER THE DIGITS
3072
3073    7212    1324    RETN,   TAD BEXP
3074    7213    3044            DCA 44      /STORE DECIMAL EXPONENT
3075    7214    4777            CALL  FXAD /GO TO OUTPUT THE NUMBER
3076    7215    5223            JMP CRLF    /FIXED POINT RETURN
3077    7216    1343            TAD CHE     /FLOATING POINT RETURN
3078    7217    4344            JMS ASCOUT /PRINT "E"
3079    7220    7000            NOP
3080    7221    7000            NOP
3081    7222    4737            CALL  EXPT /GO TO OUTPUT EXPONENT
3082    7223    1055    CRLF,   TAD SWIT1
3083    7224    7650            SNA CLA     /PRINT CR-LF?
3084    7225    5600            JMP I FOUT /NO, EXIT
3085    7226    1341            TAD CARRTN /YES
3086    7227    4344            JMS ASCOUT
3087    7230    1342            TAD LNFEED
3088    7231    4344            JMS ASCOUT
3089    7232    5600            JMP I FOUT /EXIT
3090
3091
```

```
3092
3093
3094
3095            7375    *7375
3096
3097    7375    5565    SCAD,   SAC
3098    7376    5566    BFRST,  BUFFER-1
3099    7377    5400    FXAD,   FIX
3100
3101
3102            7301    *7301
3103
3104    7301    3415            DCA I 15
3105
3106
3107            7305    *7305
3108
3109    7305    3415            DCA I 15
3110
3111
3112            7310    *7310
3113
3114    7310    5212            JMP RETN
3115
3116
3117
3118
3119            0045    HORDER=45
3120            7330    SMINUS=7330
3121            7327    SPLUS=7327
3122            7324    BEXP=7324
3123            7343    CHE=7343
3124            7337    EXPT=7337
3125            7344    ASCOUT=7344
3126            0055    SWIT1=55
3127            7341    CARRTN=7341
3128            7342    LNFEED=7342
```

```
3129
3130                    /IN THE COMMENTS BELOW:-
3131                    /   F = NUMBER OF DIGITS TO BE OUTPUT
3132                    /   D = NUMBER OF DECIMAL PLACES
3133                    /   E = DECIMAL EXPONENT
3134                    /   P = NUMBER OF PLACES REMAINING TO BE
3135                    /       PRINTED BEFORE DECIMAL POINT
3136
3137
3138          5400      *5400
3139
3140    5400  0000  FIX,     0
3141    5401  1062          TAD 62
3142    5402  7450          SNA           /FLOATING OUTPUT?
3143    5403  5225          JMP R6        /YES, ROUND OFF TO 6 PLACES
3144    5404  7041          CIA
3145    5405  1365          TAD SAC
3146    5406  7510          SPA           /   F-D > 0 ?
3147    5407  5214          JMP .+5       /YES
3148    5410  7240          CLA CMA
3149    5411  1062          TAD 62
3150    5412  3365          DCA SAC       /MAKE D = F-1
3151    5413  7040          CMA
3152    5414  1044          TAD 44
3153    5415  7500          SMA           /   F-D > E ?
3154    5416  7200          CLA           /NO, ROUND OFF TO F PLACES
3155    5417  1062          TAD 62        /YES
3156    5420  7510          SPA           /   D+E < 0 ?
3157    5421  5250          JMP PRNT-1    /YES, NO ROUNDING NEEDED, GO TO PRINT
3158    5422  1354          TAD M6        /NO, ROUND TO D+E PLACES,
3159    5423  7500          SMA           /TO A MAXIMUM OF 6 PLACES
3160    5424  7200          CLA
3161    5425  1353  R6,     TAD K7
3162    5426  3364          DCA TEMPX     /SAVE NUMBER+1 OF PLACES TO ROUND TO
3163    5427  1356          TAD BUFST
3164    5430  1364          TAD TEMPX     /SET UP BUFFER ADDRESS AT WHICH
3165    5431  3366          DCA PLCE      /ROUNDING OFF SHOULD START
3166    5432  1364          TAD TEMPX
3167    5433  7041          CIA           /SET UP COUNT OF MAXIMUM NUMBER
3168    5434  3364          DCA TEMPX     /OF CARRIES ALLOWABLE
3169    5435  7107          CLL IAC RTL       /+4
3170    5436  2766  RET,    ISZ I PLCE    /ADD 1 TO DIGIT AT CURRENT POSITION
3171    5437  1766          TAD I PLCE
3172    5440  1355          TAD M10
3173    5441  7710          SPA CLA       /CARRY REQUIRED?
3174    5442  5251          JMP PRNT      /NO, GO TO OUTPUT
3175    5443  3766          DCA I PLCE    /YES, MAKE CURRENT DIGIT A ZERO
3176    5444  2364          ISZ TEMPX     /BEGINNING OF BUFFER REACHED?
3177    5445  5313          JMP DECR      /NO, DECREMENT BUFFER ADDRESS AND REPEAT
```

```
3178
3179    5446  2766            ISZ I PLCE /YES, SET MANTISSA TO 0,1
3180    5447  2044            ISZ 44     /COMPENSATE BY INCREMENTING EXPONENT
3181    5450  7200            CLA
3182    5451  1356    PRNT,   TAD BUFST
3183    5452  3015            DCA 15     /SET AUTO-INDEX REGISTER
3184    5453  1062            TAD 62
3185    5454  7450            SNA        /   F = 0 ?
3186    5455  5342            JMP FLOP   /YES, OUTPUT AS FLOATING NUMBER
3187    5456  7041            CIA        /NO,
3188    5457  3366            DCA FCOUNT /SET UP COUNT TO PRINT F PLACES
3189    5460  1366            TAD FCOUNT
3190    5461  1044            TAD 44
3191    5462  7540            SMA SZA    /   E > F ?
3192    5463  5317            JMP XXX    /YES, PRINT X'S
3193    5464  1365            TAD SAC
3194    5465  7500            SMA        /   E < F-D ?
3195    5466  7200            CLA        /NO, TAKE P = E
3196    5467  7041            CIA        /YES, TAKE P = F-D
3197    5470  1044            TAD 44
3198    5471  7041            CIA
3199    5472  3364            DCA TEMPX  /SET UP MINUS P
3200    5473  1361            TAD M7
3201    5474  3365            DCA SCOUNT /SET COUNT OF MAX, NO, OF SIG, FIGS,
3202    5475  1044    BACK,   TAD 44
3203    5476  1364            TAD TEMPX
3204    5477  7650            SNA CLA    /   P = E ?
3205    5500  5330            JMP DIG    /YES, PRINT DIGIT
3206    5501  1364            TAD TEMPX  /NO,
3207    5502  7001            IAC
3208    5503  7710            SPA CLA    /   P > 1 ?
3209    5504  1360            TAD SPACE  /YES, TAKE SPACE; OTHERWISE ZERO
3210    5505  4323    IN,     JMS OUTX   /PRINT CHARACTER
3211    5506  2364            ISZ TEMPX  /P CHARACTERS PRINTED?
3212    5507  5275            JMP BACK   /NO
3213    5510  1362            TAD POINT  /YES,
3214    5511  4757            CALL  OPUT /PRINT DECIMAL POINT
3215    5512  5275            JMP BACK
3216
3217    5513  7040    DECR,   CMA
3218    5514  1366            TAD PLCE
3219    5515  3366            DCA PLCE
3220    5516  5236            JMP RET
```

```
3221
3222
3223    5517  7200    XXX,    CLA
3224    5520  1363            TAD CHX
3225    5521  4323            JMS OUTX    /PRINT "X"
3226    5522  5320            JMP .-2     /AND REPEAT
3227
3228    5523  0000    OUTX,   0
3229    5524  4757            CALL  OPUT /PRINT CHARACTER
3230    5525  2366            ISZ FCOUNT /F CHARACTERS PRINTED?
3231    5526  5723            JMP I OUTX /NO, RETURN
3232    5527  5600            JMP I FIX  /YES, NUMBER FINISHED
3233
3234    5530  7040    DIG,    CMA
3235    5531  1044            TAD 44      /REDUCE E BY 1
3236    5532  3044            DCA 44
3237    5533  2365            ISZ SCOUNT /6 SIG. FIGS. PRINTED?
3238    5534  5340            JMP .+4     /NO
3239    5535  7040            CMA         /YES,
3240    5536  3365            DCA SCOUNT /RESET COUNT TO -1
3241    5537  5305            JMP IN      /AND LEAVE C(AC) = 0
3242    5540  1415            TAD I 15    /TAKE NEXT DIGIT FROM BUFFER
3243    5541  5305            JMP IN
3244
3245    5542  1354    FLOP,   TAD M6      /SET COUNT TO PRINT
3246    5543  3366            DCA FCOUNT /6 DIGITS AFTER DECIMAL POINT
3247    5544  4757            CALL  OPUT /PRINT "0"
3248    5545  1362            TAD POINT
3249    5546  4757            CALL  OPUT /PRINT "."
3250    5547  2200            ISZ FIX     /INCREMENT RETURN ADDRESS
3251    5550  1415            TAD I 15    /TAKE NEXT DIGIT FROM BUFFER
3252    5551  4323            JMS OUTX    /PRINT IT
3253    5552  5350            JMP .-2     /AND REPEAT
3254
3255    5553  0007    K7,     7
3256    5554  7772    M6,     -6
3257    5555  7766    M10,    -12
3258    5556  5566    BUFST,  BUFFER-1
3259    5557  7352    OPUT,   7352
3260    5560  7760    SPACE,  240-260
3261    5561  7771    M7,     -7
3262    5562  7776    POINT,  256-260
3263    5563  0050    CHX,    330-260
3264    5564  0000    TEMPX,  0
3265                  SAC,
3266    5565  0000    SCOUNT, 0
3267                  PLCE,
3268    5566  0000    FCOUNT, 0
3269                  BUFFER,
3270
3271
3272                  $
```

```
0000  00000111  11110000  11111111  11111111  00000000  00000110  00011111  11111111
0100  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111110

0200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111110

0400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11100000

0600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
0700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111100

1000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1100  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111110

1200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

1400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111110

1600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
1700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

2000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2100  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111110

2200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11110000

2400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11110000

2600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
2700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111000

3000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3100  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111000

3200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

3400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11110000

3600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
3700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
```

```
4000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
4100  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

4200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
4300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111110

4400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
4500  11111111  11111111  11111111  11111111  11111111  11111111  11111111  00000000

4600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
4700  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111100

5000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
5100  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

5200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
5300  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111

5400  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
5500  11111111  11111111  11111111  11111111  11111111  11111111  11111110  00000000

5600  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000100
5700  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000

6000
6100

6200
6300

6400  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
6500  00000000  00000000  00000000  00000000  00000001  11111000  00000000  00011111

6600  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
6700  00000000  00000000  00000000  00000000  00000000  00000000  00000011  11111111

7000  00001111  11111110  00000000  00000000  00000000  00000000  00000000  00000000
7100  00000000  00000000  00000000  00000000  00111111  11111111  11111111  10000000

7200  11111111  11111111  11111111  11100000  00000000  00000000  00000000  00000000
7300  01000100  10000000  00000001  10000000  00000111  00000000  00000000  00000111

7400  00000000  00000000  00000000  11000000  00000000  00000000  00000000  00000000
7500  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000100

7600  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11100000
7700  00000000  00000000  00000000  00000000  00000000  00000000  00000000  00000000
```

A	2663	CALSET	4153	DISPLA	5467	FOUT	7200
ADCON	0065	CARRTN	7341	DISPTS	3324	FPNORM	0565
ADCONV	1124	CCLDR	1117	DIV1	0555	FPOUT	1400
ADDMX	1557	CDISPL	2073	DIVD	4314	FTEM1	0152
ADDTWO	3156	CDTB	5051	DLATM	0153	FTEM2	0155
ADDUP	4227	CHE	7343	DLBUF	4000	FUDGE	3377
ADINX	0071	CHECK	7152	DNE	1426	FUGCY	4172
AGO	4020	CHKBLK	6766	DNPEN	1154	FXAD	7377
ALLGS	2463	CHLOP	2040	DONE	0552	GASFR	0103
ANINPT	4003	CHRDIS	5060	DPTR	3376	GCAL	2232
AS260	0337	CHTAB	2074	DRLOP1	4612	GETNO	4425
ASCOUT	7344	CHX	5563	DRLOP2	4640	GETOCT	4151
ASK	4435	CLARR	2234	DSPIT	4460	GETPTS	2750
ASKER	1066	CLKSET	1121	DSPTS	0521	GETVAR	2237
ASKIO	1435	CLRR	3535	DTEM	0355	GLFRAC	2754
ASPC	4566	CLSTRT	1004	DUMPIT	2241	GOOD	7164
AUTO	0013	CLTM	0152	DVID	4434	GOSUM	4223
AVGMR	4200	CMPINT	3466	ENDCHK	4473	GOTIT	0231
AVLOP	4207	CNTR	0132	ENTR	4407	GSCAN	1615
AVSUM	0121	CNTS	4376	EQUAL	0343	GTAD	4232
AX1	0203	COLON	0344	ERRD	3251	GTCHR	0276
AX2	0400	COPY	4752	ERRQ	2066	GTNPT	3747
AX3	0575	CORTAB	0661	ESRNMR	4152	GTP2	2337
AXL	0006	COTAG	3124	EXPFC	0122	GTER	1237
AXR	0764	CRDC	3755	EXPON	0010	HALF	0123
AY1	7603	CRDIS	5000	EXPT	7337	HD1	5107
AY2	0000	CRLF	7223	EXTRAP	5074	HD15	5237
AY3	0175	CRLFD	4432	EXTRP	3304	HD2	5133
AYL	7406	CRTLFD	0032	F125	3125	HD20A	5250
AYR	0764	CSAM	1133	F161	3130	HD20B	5256
B	2666	CSCR	4504	FCOUNT	5566	HD21	5315
BACK	5475	CSET	1714	FGASF	0100	HD23	5322
BAD	0333	CSXL	4147	FIX	5400	HD25	5327
BEGCAL	3600	CURSET	3507	FIXER	0024	HD26	5343
BEGDIS	0421	CURSR	3170	FIXR	0524	HD3	5151
BEXP	7324	CWRC	3754	FIXT	4424	HD5	5157
BFRST	7376	CXOB	3750	FK3	4164	HD6	5170
BLKIO	3702	CYCTM	4167	FLAG2	2662	HD7	5177
BLOCK	0144	D	2674	FLEXPO	2600	HD8	5204
BSCHNG	2505	DATYP	1307	FLGASF	1775	HD9	5223
BTBS	5073	DCT	3375	FLIN	0606	HDIO	1446
BTPBS	4542	DCTAB	2127	FLLORF	1174	HDSP	5362
BUF1	0000	DECR	5513	FLOAT	4423	HEADR1	0033
BUFFER	5567	DERIV	4600	FLOATR	0556	HEADR2	0034
BUFST	5556	DHD1	7640	FLOP	5542	HEDER1	1730
C	2671	DIALOG	7600	FLORF	0077	HEDER2	1740
C200	1212	DIG	5530	FLOTER	0023	HEDIT	0006
CALBEG	2517	DIHD1	5352	FLX	4736	HEDIT1	4433
CALBRT	1000	DILST	4011	FLY	1370	HEDIT2	4434
CALCJ	7636	DISCUR	3374	FNISH	0323	HGT	2356
CALCY	2240	DISM2	0067	FNOR	0007	HIGH	1502
CALPRT	2243	DISMOV	0063	FNTOT	3422	HIGHT	0771

HIORD	4253	LOOPIT	4420	MS	4531	PAR1	0146
HNDRD	1163	LOORD	0155	MS7	0345	PARDMP	2520
HOLD	0026	LORCL4	2200	MSEE	0336	PARPTR	0075
HORDER	0045	LORFR	0102	MSK17	4503	PCTR	0131
HSR	6573	LOW	1477	MTBF	5053	PEKDMP	2544
HSR1	7170	LP1	5016	MULP	4761	PENDN	0037
HUNDRD	0076	LP2	5023	MULT	4505	PENUP	0036
IN	5505	LRG	0544	NCNTR	0351	PIND1	0147
INCR	1504	LSCHR	0353	NCY	4175	PIND2	0150
INIT	0030	LSLOC	0352	NDIG	1431	PIND3	0151
INITAR	4430	M10	5555	NEG4	0126	PK100	2774
INITIZ	3756	M12	3135	NEGATE	0003	PK14	4146
INOCT	3746	M13	0554	NEGIT	2660	PKDMP	2242
INPT	6776	M256	3753	NEWMP	2176	PKPRNT	2550
INPUT	7142	M261	2070	NEWY	3035	PKS	0145
INSCHN	7634	M272	2071	NLIN	1432	PL13	3133
INSTRK	1007	M300	2067	NLOC	0225	PLCE	5566
INTEG	3400	M36	1774	NMCHK	2055	PLEXT	1707
INTFLT	0567	M6	5554	NO	1057	PLS5	4661
INTRP	0522	M7	5561	NODIV	4450	PLTINC	1600
INTSP	2373	MALT	0523	NOOP	7637	PLTINT	1335
INVAL	2034	MARKER	0630	NORMAT	0762	PLTLOP	1342
IOASK	0064	MARKR	1064	NPR	1742	PLTMOV	1365
IOSWT	0056	MAX	0142	NPTS	0074	PLTMV	0660
ISCR	4337	MBLNK	6775	NUCALC	2354	PLTXIT	1065
ISDIG	1244	MCHAN	0120	NULINE	1406	PNTPLT	1364
ISXL	4150	MCTR	0134	NUMP	2353	POINT	5562
JMPTB	2076	MD	4527	NUPEEK	2211	POS	2360
JUMPTB	2075	MDCR	0375	NUPNT	2407	POSTN	4714
K1000	0130	MDLF	0376	NXPK	2500	PPSET	0070
K3100	1123	MEM	1061	NXPT	3333	PR1T	2346
K7	5553	MEN	0346	OCTIN	0272	PRNT	5451
KK100	4374	MES	0347	OCTOUT	0252	PRTT	1767
KK300	4375	MGEE	1060	OFFSET	0111	PSTAB	2355
KSAM	4341	MIN	0141	OLDX	1715	PT1	3432
KSPC	5052	MIN1	0761	OLDY	1716	PT2	3445
LEADER	1200	MIN3	2351	ONE	2702	PTABST	7600
LEDER	1434	MIN5	3136	OPUT	5557	PTINT	3511
LEFY	3522	MK7	3751	ORGN	1050	PTPLT	1063
LGZE	2677	MM	4530	OUT	0031	PU	0001
LGFRAC	2352	MN7	0341	OUTCHR	0627	PX	4000
LHORD	4443	MODCR	0366	OUTPT	7166	PY	2000
LNCTR	0133	MODE	0143	OUTPUT	0005	QUERY	0035
LNFEED	7342	MODTTI	0356	OUTX	5523	QUES	1055
LNUM	1211	MOH	1062	P123	2314	QUEST	0350
LOADX	2516	MORE	4523	P13	0566	R6	5425
LOKIN	0633	MPYR	0072	P236	1773	RDTTY	4427
LOOK	4340	MPYRI	1171	P256	3752	RDY	3523
LOOKER	4400	MRBKS	3737	P27	4342	READ	0004
LOOP4	1462	MRBOUT	7167	P336	1772	READER	0600
LOOP6	1410	MRBT	0340	P6	3134	READXY	0025
LOOP9	3046	MRRED	2025	P7M0	0342	RECALC	2161

REMOV	3275	STRPK	3262	XYSCAL	1265		
RESET	1134	STRTIT	0200	YCALC	2400		
RESTRT	7167	STYN	0441	YCD	5065		
RET	5436	SUBTRT	2361	YCLC	2416		
RETDEC	6774	SWAPBL	3000	YDIS	0112		
RETN	7212	SWIT1	0055	YES	1056		
RM77	0127	SWLOOP	3003	YFLIP	1366		
RUBIT	2072	TAGCO	3137	YIND	0011		
RUN	0117	TAP1	3661	YLIM	0105		
SAC	5565	TAPHAN	3613	YMAX	1044		
SBPTR	3671	TELRED	0027	YMIN	0166		
SCAD	7375	TEM2	0137	YONE	0110		
SCALY	1453	TEM3	0140	YRNG	0107		
SCANIT	1662	TEMFP	0160	YSCLFC	0174		
SCASM	3545	TEMP	0135	YSCVAL	1556		
SCOUNT	5565	TEMP1	0136	YSTEP	3311		
SCPINT	0426	TEMPX	5564	YSVAL	1324		
SCPLOP	0454	THD1	5367	YTP	5050		
SELECT	0607	TMCTR	0157	ZIND	0012		
SERVIS	2000	TMXP	0156				
SET	1122	TPNT	3305				
SETCLK	4343	TTOUT	0621				
SETIT	0257	TXSM	0115				
SETLY	3510	TYPCH	1753				
SETPP	1717	UPPEN	1144				
SETSTR	3200	VALU	0354				
SHF	4662	VARGET	2715				
SIGN	6777	WDSWT	7632				
SINE	2661	WID	2357				
SKIP	7633	WIDONE	2236				
SKL	1536	WIDSWT	2235				
SMINUS	7330	WIDTH	4532				
SMOT11	3025	WRTP	3711				
SPAACE	1433	X1	0101				
SPACE	5560	X1I	2751				
SPCHK	7015	XCPT	7037				
SPCIN	4760	XDIS	0005				
SPCJ	5242	XFLIP	4726				
SPECJ	7635	XIND	0010				
SPINIT	3014	XLIM	0104				
SPLUS	7327	XLOAD	2705				
SQEEZE	4663	XMAX	1040				
SQLP	4677	XMIN	0163				
SQROOT	0002	XMPY	0073				
SQUARE	0001	XMPYI	1166				
STALL	1103	XNC	0113				
START	0403	XOBL	3707				
STBLK	3712	XRNG	0106				
STLOOP	4414	XSCLFC	0171				
STRBS	3267	XSET	0066				
STRCI	2442	XSETUP	1213				
STRIPR	3254	XXX	5517				

```
ERRORS DETECTED: 0
LINKS GENERATED: 0
RUN-TIME:  29 SECONDS
3K CORE USED
```