BASIC Utility Graphics Software for the Hewlett-Packard 9845B Desktop Computer

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BASIC Utility Graphics Software

for a Desktop Computer

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ABSTRACT

This report describes an interactive BASIC language graphics utility program designed to facilitate easy plotting of X,Y data. The program operates on a Hewlett Packard 9845B desktop computer, in its standard configuration, and uses a Hewlett Packard 9872A four pen digital plotter. The program allows the user to view X,Y data graphically and provides a broad range of plotting options so that publication quality graphs and transparencies may be created using up to four colors on the digital plotter. Data may be digitized from a user's graph on the digital plotter, generated as a user-defined function, or input directly from the computer keyboard or magnetic tape cassette. Data may be plotted on the computer CRT, on the computer's internal thermal printer, or on the digital plotter.

KEYWORDS: BASIC; CRT; digital plotter; graphs; HP 9845B desktop computer; interactive thermal printer; magnetic cassette tape; plot; software; X,Y data.
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1. INTRODUCTION

Basic Utility Graphics Software (BUGS) is a menu-driven interactive BASIC language software package which allows up to 5,000 data points to be input, plotted and saved. It offers a broad range of media options to input, plot, and output the data. The user is guided interactively by a menu format. The program operates on a Hewlett-Packard 9845B desktop computer in its standard configuration (i.e., two tape drives, internal thermal printer, CRT graphics capabilities, and 187K of RAM with a graphics ROM). Plotter output makes use of a Hewlett-Packard 9872A digital plotter on which the following pens may be used: digitizing pen, drafting pen, and four (black, blue, red, green) felt tip or transparency pens. Output media on the digital plotter includes transparencies, drawing paper, and vellum drafting paper.

A maximum of 25 data files may be plotted at one time. The user is asked to specify the number of files to be input from each input mode; i.e., digitized, generated as a user defined function, or input directly from the computer keyboard or tape. The program then leads the user interactively through each of the input modes selected. The maximum number of points in any one file is equal to 5,000 divided by the total number of files to be input. When all files have been input, the user is taken to the Program Options Menu. Here, the user may choose to input new data, to save existing data, plot existing data, save a completed graph, retrieve a previously stored graph or to terminate the program.

When the option to plot the data is chosen the user is taken to menus to:
(1) choose scale type (linear, semi-log, log); (2) enter data ranges for X and Y axes; and (3) enter title and axes labels. Four plot option menus are then presented to the user to allow modification of plotting options which are initially set to their defaults. If the option to plot data has previously been chosen the user may choose to branch directly to the fourth menu (media options).

The first menu allows the user to return to re-enter or change any of the scaling and label parameters previously entered. Also, the user may change the number of labeled major tic marks on either axis.

The second menu presents plot and dimension options. Dimension options include changing the aspect ratio of the graph; or changing the character size of the title, axes labels, or labeled major tic marks. Plot options allow the user to normalize data, plot standard deviation, plot numbers in scientific notation, place annotation in graph, and to shade any or all data files.

The third menu allows the user to choose the plot type for each data file. Available plot types are: histograms, lines, symbols, or lines and symbols. One of 10 different line types may be selected. Any ASCII character may be used for the symbol, and the symbol size may be specified. The default is to plot lines using a solid line type.

The fourth menu lists the output media. At this point the user may also return to any of the previous three option menus to change any options, or may return to the Program Options Menu. Output plotting media include the computer CRT, internal thermal printer, or the digital plotter. If annotation or standard deviation are used, they must be entered by choosing the CRT option. The printer option outputs the contents of the CRT graphic screen onto the computer's thermal printer. The plotter option takes the user to additional menus to enter the size of the plot, and the plot type to be made. Plot types include normal and publication quality color plots on drawing paper and transparencies, or the drafting pen on vellum drafting paper. If the
drafting pen is not chosen, the user is asked to specify colors for the

title, axes labels, axes numbers, data files, and annotation (if used).

Since all plot options are initially set to their default values, the user
need only input data files and set scaling parameters in order to generate
a plot. The user's first plot, therefore, generally requires less than 10
minutes to create. As more options are selected, the plot will take more
operator and plotting time. Some options, such as the size options, are
harder to use than others, and will require practice in order to use them
effectively. A four-color publication quality plot using all options except
shading may be completed in 15 minutes by an experienced user.

Section 2 of this paper guides the user through each menu in the order
that they appear in the running program. Detailed instructions are given for
each menu which describe how the user is to respond to each input request and
then informs the user of which menu BUGS will branch to next according to the
options that he has chosen. Section 3 provides an overview of the modular
structural design of BUGS which is followed by a detailed description of the
key subroutines. Flowcharts for these subroutines may be found in APPENDIX D
and the entire program listing is given in APPENDIX C.

The document given here is intended to serve as an example of language
typical of desktop computers. To accomplish this objective requires making
reference to specific equipment and instruction sets by brand name. However,
no judgement as to the quality or suitability of the equipment discussed here
has been made by the National Bureau of Standards, and no recommendation,
favorable or otherwise, should be implied by this report.

2. USER DIRECTIONS AND MENUS

2.1 INTRODUCTION FOR THE USER DIRECTIONS

This chapter is primarily a user manual for BUGS. After setting up the
system (2.3 SYSTEM SET UP), the user may plot a graph by following the
instructions given in the menu descriptions. All descriptions begin with a
short narrative of what the menu does and how it is implemented by the user,
and is followed by step-by-step instructions on how to respond to the requested
inputs as they occur on the CRT screen. A copy of the menu accompanies the
instructions and is referred to in the menu description by its figure number.
Each time an input is requested a "?" will appear in the bottom left corner
of the screen. This is denoted in the instructions by a circled letter
which corresponds to that input line, as labeled, in the corresponding figure.
Data is entered or input by typing in the desired response on the keyboard
(or the numeric pad to the right of the keyboard), and pressing CONT. After
all inputs have been completed, the user is then informed of which menu BUGS
will branch to next. All menu descriptions are denoted by the name of that
menu in capital letters. The menu directions are presented in the same
order that they are displayed by the program with the following exceptions:
(1) 2.13 EDIT DATA menu is called by all the input menus and is therefore
the last input menu listed; (2) 2.21 CHANGE TICS menu is called from the
2.22 MENU 1: INPUT PARAMETERS menu and is listed immediately before so that
all menus called from MENU 1 will be listed together. Page numbers for the
menus are referenced in APPENDIX C.
2.2 DATA STRUCTURE AND ORGANIZATION

Because of the limitation of the length of the tape directory (see HP Operating and Programming manual, page 206), related groups of data files may be organized into a single set made up of the files. The set is referenced on the tape by a set name of up to 6 alphanumeric characters. Associated with each set is a data set descriptor as well as data file descriptors for each file in the set. If a single data file is stored it is considered to be a data set containing one file, and it will have a set name and both a set and file descriptor. In the KEYBOARD, DIGITIZING and DEFINE FUNCTION modes, the user is asked to input a file descriptor for each file that is input.

A data set may contain up to 25 files and 5,000 data points. The maximum number of points in any one data file is equal to 5,000 divided by the total number of files in that set. An ERROR 64 (subscript out of range) will occur if in at least one file the user has tried to enter more than the maximum number of points allowed. The user must be especially careful of this in inputting data from tape.

When the data is saved on tape, all the files that have been input (since either starting the program or since the last time the input option (#1) in the 2.4 PROGRAM OPTIONS menu) are saved on the tape as a data set along with all set and file descriptors.

2.3 SYSTEM SET UP

By using the auto-start feature of the 9845B, the program will be loaded and started automatically after performing the following operations:

1) Turn the desktop computer off.
2) Insert the BUGS program tape into the RIGHT tape drive (:T15).
3) Insert a data tape into the LEFT tape drive (:T14).
4) Ensure that the AUTOST key located in the upper left of the keyboard is in.
5) Turn the computer on.
6) Turn digital plotter on. The POWER button is located at the bottom right corner of the plotter.

It is important that the program tape be loaded in the right tape drive (:T15) before turning the machine on. If the user does not wish to use the auto-start feature, skip Steps 1,4 and 5 and type LOAD "AUTOST", and press EXECUTE. When the tape drive stops, press RUN.

The 9872A digital plotter should be set up when the program is loaded. If the plotter is not turned on when it is addressed to digitize or plot a data file the following will occur: (1) A fatal error; (2) the program will be terminated; and (3) all data in the memory will be lost. The user will then have to begin the program over by pressing RUN and re-entering the data.

To set up the digital plotter:

1) Clear everything off the platten as the pen will move diagonally across the platten to its starting position.
2) Push in the power button located on the front of the plotter near the bottom right hand corner.
3) Set up felt tip pens as follows: PEN #1: BLACK PEN #3: GREEN PEN #2: BLUE PEN #4: RED

For directions on how to load plotting media, refer to the 2.38 DIGITAL PLOTTER menu.
2.4 PROGRAM OPTIONS

The user has access to any portion of the program through this menu. This is the main pivot point of the program, and the user will always be returned to this menu until the program is terminated by choosing option #6. See figure 2.4 for a printout of the program options.

Explanation of PROGRAM OPTIONS:

1) Input data. The new data to be input will erase from memory any data previously entered. BUGS then branches to 2.5 INPUT OPTIONS.
2) Plot data. BUGS branches to the 2.18 SCALE TYPE menu if this is the first time that this option has been chosen since starting the program; otherwise it branches to the 2.17 PLOT DATA menu.
3) Save data. BUGS branches to the 2.14 SAVE DATA menu.
4) Retrieve graph. BUGS branches to the 2.15 RETRIEVE GRAPH menu.
5) Save graph. BUGS branches to the 2.16 SAVE GRAPH menu.
6) Exit program. BUGS is terminated.

   a) Enter the number which corresponds to the desired option.

If option #6 was not chosen follow the directions given in the explanation above, otherwise END OF PROGRAM will be displayed. The user may begin the program again by pressing the RUN key.

2.5 INPUT OPTIONS

In this menu BUGS is seeking user input of the number of files to be input from each input media. Input media include the computer keyboard, magnetic tape, digitizing a user's graph on the digital plotter, or generating a user defined function.

Figure 2.5 shows the printout of the narrative for the input menu. Lines a-d will be displayed one at a time, and the user is expected to input the number of files to be input from that input mode.

   a-d) As each input request is made (e.g. INPUT from KEYBOARD) enter the number of files to be input from that input media, or press CONT if no files will be input from that particular input media.

If the number of files to be input is out of range (less than one or greater than 25), press CONT and wait until the menu is rewritten on the screen and repeat steps a-d.

After user entry of the number of files to be entered for each input mode, BUGS selects the appropriate modes in the sequence 2.6 KEYBOARD INPUT, 2.7 TAPE INPUT, 2.8 SET UP DIGITIZING, 2.12 DEFINE FUNCTION. Only the menus for input with nonzero number of files will be selected.
PROGRAM OPTIONS

(1) INPUT NEW DATA from keyboard, tape, digitized on digital plotter, and as a user defined function

(2) PLOT DATA on CRT, thermal printer or digital plotter

(3) SAVE DATA on tape

(4) RETRIEVE GRAPH from tape.

(5) SAVE GRAPH on tape.

(6) EXIT PROGRAM

ENTER OPTION #

Figure 2.4. PROGRAM OPTIONS.

INPUT OPTIONS

This program allows you to input up to 5000 data points. You may input a maximum of 25 data files to be plotted and/or saved on tape. The maximum number of points allowed in each data file therefore equals 5000 divided by the number of files to be input.

To start program you must input at least one data file. Data files may be input from the keyboard, tape, digitized on the digital plotter, defined as a function by the user, or any combination of these.

You will now be asked interactively to enter the number of data files that you want to be input from each input mode.

ENTER # of FILES to be INPUT from KEYBOARD
INPUT from TAPE
DIGITIZED on DIGITAL PLOTTFR
FUNCTION DEFINED by USER

Figure 2.5. INPUT OPTIONS,
2.6 KEYBOARD INPUT

This input mode allows the user to input data from the computer keyboard. The user must begin by entering a file descriptor for this file and the number of points to be input. The directions on this page will be repeated for each file that the user has specified is to be input from the keyboard. The printout for this menu is figure 2.6.

See Section 2.2 for an explanation of what file descriptors are and how they are used.

a) Enter file descriptor for this file, or press CONT if no file descriptor is desired.

The menu informs the user of the maximum number of data pairs allowed for this file.

b) Enter the number of data pairs to be input

c) Enter 1 if there is a constant interval between the X values, else press CONT and go to Step g.

X values will be computed by incrementing the initial X value by the X interval every time a Y value is input.

d) Enter the first X value

e) Enter the value of the X interval

Input the Y values, one at a time, starting with the Y value which corresponds the initial X value.

f) Input Y data values

If there is a constant X interval, skip Step g.

g) User must now input all X,Y data pairs for this file. Input X value and press CONT. Input Y value and press CONT.

The user is now taken to the 2.13 EDIT DATA menu to review and/or edit this data file.

If more files are to be input from the keyboard, repeat directions on this page for the next data file. If more files are to be input from other input modes, BUGS branches to the next input mode in the sequence 2.7 TAPE INPUT, 2.8 SET UP DIGITIZING, 2.12 DEFINE FUNCTION. Only menus for input with non-zero number of files will be selected. If no more files are to be input, BUGS branches to the 2.4 PROGRAM OPTIONS menu.
INPUT FROM KEYBOARD

ENTER LABEL FOR DATA FILE # 1 ...UP TO 20 CHARACTERS

HOW MANY DATA PAIRS ARE TO BE INPUT INTO FILE # 1 ?

MAXIMUM ALLOWED IS 5000

IF DATA HAS CONSTANT INTERVAL BETWEEN X VALUES...ENTER 1

INPUT FIRST VALUE FOR X (i.e. X1(1)=?)

INPUT THE INCREMENT BETWEEN ADJACENT X VALUES

INPUT Y VALUES

INPUT # 1

INPUT X VALUE...PRESS CONT...ENTER Y VALUE

INPUT # 1

Figure 2.6. KEYBOARD INPUT.
2.7 TAPE INPUT

This menu begins by listing the data set names contained on the tape in the left tape drive (:T14) and the user is asked to input the desired set name. The set descriptor is then displayed, along with a numbered list of the file descriptors for that set. The user then enters the corresponding number for the desired file. See Section 2.2 for an explanation of the data structure and organization; and the use of set names, set descriptors and file descriptors. Figure 2.7 contains a printout of this menu.

If the list of set names on the tape runs off of the screen, the user may scroll up and down the list by pressing the arrows in the display pad at the top center of the keyboard.

   a) Enter the name of the set that is to be used...Up to 6 alphanumeric characters. The name must be one of those listed on the screen.

The set and file descriptors are then listed on the screen, and the user must choose a file to be input.

   b) Enter the number which corresponds to the file to be input; or if none of these is the correct file, press CONT and return to Step a.

BUGS now branches to the 2.13 EDIT DATA menu so that the user may review and/or edit data to verify if this is the correct data file.

   c) If this is not the correct file, enter 1 and go to Step e; else proceed to the next step.

If there are no more files to be input, BUGS branches to 2.4 PROGRAM OPTIONS. If there are no more files to be input from tape, BUGS branches to the next input mode.

The user now inputs the next file from the tape. The user may choose to input the file from the same set that the previous file was input from, or the user may input the file from a different set.

   d) Enter 1 to use a different set for data entry and return Step a, or press CONT to get another file from this set and go to Step b.

The user now may choose to try another file from the same set that the previous file was taken from, or the user may try a different set.

   e) Enter 1 to try a different set and go to Step a, or press CONT to try a different file from this set and go to Step b.
INPUT FROM TAPE

THE DATA TAPE IS ASSUMED TO BE IN THE LEFT <T14> CASSETTE DRIVE
IF NOT THEN LOAD THE CASSETTE...PRESS CONT TO PROCEED

<table>
<thead>
<tr>
<th>NAME</th>
<th>PRO TYPE</th>
<th>REC/FILE</th>
<th>BYTES/REC</th>
<th>ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>T14</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FUNKEY</td>
<td>KEYS</td>
<td>1</td>
<td>256</td>
<td>5</td>
</tr>
<tr>
<td>NEWSUN</td>
<td>KEYS</td>
<td>1</td>
<td>256</td>
<td>6</td>
</tr>
<tr>
<td>BUGS</td>
<td>PROG</td>
<td>294</td>
<td>256</td>
<td>7</td>
</tr>
<tr>
<td>MAINP</td>
<td>DATA</td>
<td>138</td>
<td>256</td>
<td>301</td>
</tr>
</tbody>
</table>

THIS IS A CATALOG OF THE DATA FILES ON THE TAPE...USE THE
ARROWS IN THE DISPLAY PAD ON THE KEYBOARD TO SCROLL UP AND DOWN

INPUT THE DATA SET TO BE USED FOR FILE # 1

DATA SET DISCRIPOR IS

VARIABLE ENERGY IR EXAMPLE

THE SET HAS 4 FILES ... DESCRIPTORS ARE

FILE # 1   KEV
FILE # 2   KEV
FILE # 3   KEV
FILE # 4   KEV

INPUT the data file number you want to use for FILE # 1

INPUT CHECK

IF THIS IS NOT THE CORRECT DATA FILE AND YOU WOULD LIKE
TO TRY ANOTHER ONE ... ENTER 1

GET NEXT FILE

ENTER 0...TO PLOT ANOTHER FILE FROM THIS DATA SET
ENTER 1...TO PLOT A FILE FROM A DIFFERENT DATA SET

ENTER 0...TO TRY A DIFFERENT DATA FILE

ENTER 1...TO TRY A DIFFERENT DATA SET

Figure 2.7. TAPE INPUT.
2.8 SET UP DIGITIZING

To digitize files, the user is required to initialize digitizing parameters for each graph to be used by (1) digitizing the four corners of the graph, (2) entering the scale type to be used (linear, semi-log, log), and (3) entering the scale range for each axis. Since this is done once for each graph, the user enters the number of files to be input on the current graph. See figure 2.8 for a printout of the menu as it appears on the CRT screen.

Follow directions in the menu to set up the digital plotter. The user may digitize one or more files per graph.

a) Enter the number of files to be digitized from the current graph.

Follow directions to digitize the corners of the graph. Each time a corner is digitized, the computer will beep and figure 2.6b, 1-4 will be displayed one at a time for the corresponding corner.

b) Digitize corners, then press CONT when all the corners are digitized.

c) Choose a scale type by entering corresponding option number.

The user is now asked to enter the minimum and maximum values which correspond to the digitized corners of the X and Y axes. If the axis is on a log scale, powers of ten must be entered (e.g. .001,1000).

d) Enter the minimum and maximum values for the X axis separated by a comma.

e) Enter the minimum and maximum values for the Y axis separated by a comma.

The digitizing parameters for this graph are now initialized. BUGS now takes the user to the DIGITIZE FILE menu.

2.9 DIGITIZE FILE

This menu allows the user to digitize the current file. Initially, the digitizing pen is moved to the lower left corner of the plotter by the program. The user then digitizes a file by using the arrows on the digital plotter to position the digitizing pen over the point to be digitized, and pressing the ENTER key on the plotter and continuing this process until all desired data points have been digitized. The user exits the digitizing mode (thus ending the file) by pressing the P1 button on the digital plotter. The user is given an opportunity later in the program to re-digitize, add or delete points. Figure 2.9 contains a printout of the menu.

a) Enter data file descriptor. See section 2.2 for an explanation of file descriptors.

b) Digitize file by following directions given in figure 2.9.

The program now takes the user to the 2.10 DIGITIZING EDIT OPTIONS menu so the user may have an opportunity to check and/or edit the current file.
DIGITIZE

TO SET UP PLOTTER FOR DIGITIZING:

1. TURN PLOTTER ON
2. LOAD GRAPH ANYWHERE ON PLATTEN
3. PUT DIGITIZING PEN INTO THE LEFTMOST PEN HOLDER

INPUT THE NUMBER OF DIFFERENT FILES THAT YOU WANT TO DIGITIZE ON THIS GRAPH?

INITIALIZE GRAPH

TO DIGITIZE: Press PEN DOWN button on PLOTTER
Position DIGITIZING PEN over point to be digitized
Press ENTER button on PLOTTER to input the point

1. DIGITIZE lower left corner of graph frame
2. DIGITIZE upper left corner of graph frame
3. DIGITIZE upper right corner of graph frame
4. DIGITIZE lower right corner of graph frame

CORNERS # 1 DIGITIZED
CORNERS # 2 DIGITIZED
CORNERS # 3 DIGITIZED
CORNERS # 4 DIGITIZED

PRESS CONT when you have DIGITIZED all four corners

SCALE TYPE

ENTER 1...IF PLOT IS LINEAR
ENTER 2...IF PLOT IS X-LIN, Y-LOG
ENTER 3...IF PLOT IS X-LOG, Y-LIN
ENTER 4...IF PLOT IS X-LOG, Y-LOG

NOTE: IF YOU ARE CHOOSING A LOG AXIS, THE SCALE LIMITS FOR THAT AXIS MUST BE POWERS OF TEN (i.e., 0.01, 100)

GRAPH RANGE

You will now be asked to input the limits of the scales on each axis of the graph that you are digitizing

INPUT THE X AXIS GRAPH LIMITS (MIN, MAX)

INPUT THE Y AXIS GRAPH LIMITS (MIN, MAX)

Figure 2.8. SET UP DIGITIZING.
2.10 DIGITIZING EDIT OPTIONS

In this menu the user has an opportunity to check and edit the current digitized file. For edit options, see figure 2.10.

Explanation of digitizing edit options:
1) Digitized data are plotted on the screen so that user may see what the digitized data looks like.
2) Digitized data are printed on the thermal printer.
3) Digitized data are edited numerically, reviewed on the screen or printed on the thermal printer.
4) Digitized data are edited by re-digitizing points, adding points, or deleting points on the digital plotter.

When an option is chosen, BUGS will branch to the appropriate service routine and then return to this menu.

a) Enter option number desired, or press CONT to exit digitizing edit.

If option #3 is chosen, BUGS takes the user to the 2.13 EDIT DATA menu. If option #4 is chosen, BUGS takes the user to the 2.11 RE-DIGITIZING OPTIONS menu.

If more files are to be digitized from this graph, BUGS returns to 2.9 DIGITIZE FILE. If more files are to be digitized from a different graph, BUGS returns to 2.8 SET UP DIGITIZING. If more files are to be input as a user defined function, BUGS branches to 2.12 DEFINE FUNCTION. If no more files are to be input, it branches to 2.4 PROGRAM OPTIONS.

2.11 RE-DIGITIZING OPTIONS

The user now has an opportunity to edit the digitized file by re-digitizing, adding or deleting points. THIS EDIT OPTION CANNOT BE USED IF THE ORIGINAL GRAPH HAS BEEN MOVED SINCE THE FILE WAS DIGITIZED. Upon selection of this option, the digitizing pen is moved by the computer immediately to the first digitized point for user comparison with the original graph. The user may then delete that point or re-digitize and add points until he chooses to let the computer move to the following digitized point or return to the 2.10 DIGITIZING EDIT OPTIONS menu. See figure 2.11 for re-digitizing options.

Directions for re-digitizing options:
1) Re-digitize a point:
   a) "RE-DIGITIZE THIS POINT NOW" is displayed.
   b) Reposition digitizing pen to the new position.
   c) Re-digitize point by pressing ENTER button on the plotter.
   d) When beep is heard, point is re-digitized.
   e) Press CONT.
2) Add a point:
   a) "DIGITIZE NEW POINT" is displayed.
   b) Follow directions in option #1 to digitize a new point.
3) Delete a point:
   a) "DATA POINT DELETED" is displayed.
   b) Press CONT.
4) Exit re-digitizing.
   a) Enter option number or press CONT to go on to the next point.
DIGITIZE FILES:

You are allowed to DIGITIZE up to 5000 points per file. Digitizing accuracy is generally 3%, therefore, three significant digits will be digitized.

(1) ENTER DESCRIPTOR for this data file...Up to 20 characters.

(2) TO DIGITIZE: Press PEN DOWN button on PLOTTER Position DIGITIZING PEN over point to be digitized Press ENTER button on PLOTTER to input the point.

(3) DELETE A POINT: Digitize that same point twice in a row.

(4) TO EXIT: DIGITIZING mode PRESS P1 PRESS ENTER

ENTER DATA DESCRIPTOR -

Figure 2.9. DIGITIZE FILES.

DIGITIZING EDIT OPTIONS

OPTION #
(1) PLOT DATA on CRT
(2) PRINT DATA on THERMAL PRINTER
(3) EDIT DATA using NUMERICAL values for edit
(4) EDIT DATA using your original graph on DIGITAL PLOTTER

PRESS CONT TO EXIT DIGITIZE routine and return to PROGRAM OPTIONS.

Figure 2.10. DIGITIZING EDIT OPTIONS.
RE-DIGITIZING OPTIONS cont.

a) Enter the edit option number or press CONT to go on to the next point.

When all the points have been edited, the user is returned to the 2.10 DIGITIZING EDIT OPTIONS menu.

2.12 DEFINE FUNCTION

This input mode allows the user to input data by generating a function of one variable (X). The user is requested to input the number of data points to be generated and the minimum and the maximum X values. The X data are generated by adding an even interval (which is equal to the X data range divided by the number of points to be input) to each successive X value starting with the X minimum that is input by the user. The Y value is generated by inserting the corresponding X value into the function defined by the user. To change the program to allow for functions of more than one variable see APPENDIX B.

The directions on this page are repeated for each file that the user has specified is to be input as a function. Figure 2.12 contains a printout of this menu.

a) Enter the file descriptor for this file. See Section 2.2 for an explanation of file descriptors and how they are used.

The maximum number of points allowed per file is 5000 divided by the total number of files.

b) Enter the number of points to be input into this data file.

All trigonometric functions will be computed using degrees. To change this to radians or gradians: (1) Type RAD or GRAD; (2) Press EXECUTE.

c) Enter the X minimum and maximum for the data range of the function separated by a comma.

To define the function, follow the directions in figure 2.12d.

d) Define a function of a single variable X.

The user is now taken to the 2.13 EDIT DATA menu to review and/or edit this data file.

If more files are to be defined, repeat the directions on this page for the next data file. If there are no more files to be input BUGS branches to the 2.4 PROGRAM OPTIONS menu.
RE-DIGITIZING OPTIONS

DO NOT remove GRAPH from its position on DIGITAL PLOTTER. The DIGITIZING PENCIL will be stepped across GRAPH showing the points which you have DIGITIZED.

OPTION #
(1) RE-DIGITIZE A POINT
(2) ADD A POINT
(3) DELETE A POINT
(4) EXIT RE-DIGITIZING and RETURN to DIGITIZING OPTIONS

ENTER OPTION #...To go on to NEXT point PRESS CONT

Figure 2.11. RE-DIGITIZING OPTIONS.

INPUT A FUNCTION

INPUT file DESCRIPTOR for this FUNCTION

INPUT NUMBER OF POINTS that you want to plot for this FUNCTION...MAXIMUM number ALLOWED is 2000

NOTE

ALL TRIGONOMETRIC FUNCTIONS WILL BE COMPUTED IN DEGREES

INPUT the DATA RANGE for X (X MIN, X MAX)

TO DEFINE FUNCTION:

(1) PRESS k0 Special Function Key... (upper right corner of keyboard)

(2) TYPE in function using HP format as described in the Operating and Programming Manual, Chapter 4

(3) PRESS STORE KEY...located directly above the right SHIFT KEY

PRESS CONT TO CONTINUE

Figure 2.12. DEFINE FUNCTION.
2.13 EDIT DATA

This menu gives the user a chance to review and/or edit current data file. See figure 2.13 for the editing options.

Explanation of Edit Options:
(1) Print data pairs on the screen in groups of 18 at a time
(2) Input new X,Y values for a selected data pair
(3) Print data on thermal printer

When an editing option is chosen, BUGS will branch to the appropriate service routine and then return to this menu.

a) Enter option number or press CONT to go back to the input mode.

If selected option was number 1 or 3, a numbered list of the data will be printed; and the user repeats to Step a until CONT is pressed to return to the appropriate input menu.

For the edit data option, the user must know the number which corresponds to the data point that he desires to change.

b) Enter the number of the data pair to change.

c) Enter new data values for both X and Y, separated by a comma.

d) Enter 1 to change another data pair and go to Step b, or press CONT to exit editing and return to Step a.
*** OPPORTUNITY TO REVIEW AND EDIT DATA FOR FILE #1 ***

(1) REVIEW DATA

(2) EDIT DATA

(3) PRINT DATA ON THERMAL PRINTER

ENTER the OPTION # that you would like to use. a

PRESS CONT TO CONTINUE ON TO NEXT FILE

EDIT DATA

INPUT THE # FOR THE DATA PAIR YOU WANT TO MODIFY b

x = 1   y = 1

INPUT NEW VALUES FOR x,y c

TO CONTINUE EDITING ENTER 1 d

Figure 2.13. EDIT DATA.
2.14 SAVE DATA

The data may be stored on the magnetic tape cassette in the left tape drive (:T14). All the files that have been input either since starting the program or since last choosing the input option in the 2.4 PROGRAM OPTIONS menu are saved on the tape as a set. The user must specify a name for the set that is used to reference the data on the tape. The program then lists the file descriptors that have been input and the user is requested to supply a set descriptor for the new set. If all the files were taken from the same set, the user has the option to re-save the data into that same set. See Section 2.2 for an explanation of the data structure and organization, and figure 2.14 for a printout of this menu.

If the user chooses to save the data into the same set, BUGS destroys the data that is there and writes the new data into that set.

   a) Enter 1 to store the input data back into the same data set, or press CONT to create a new set for the input data.

If the option to store data into the same set was chosen, BUGS returns to the 2.4 PROGRAM OPTIONS menu.

The data set name that is input is used to reference the the data set on the tape. The name may be up to 6 alphanumeric characters starting with a letter. Ensure that the name is not one of those already listed.

   b) Enter the data set name.

   c) Enter a data set descriptor...Up to 40 characters.

BUGS now returns to the 2.4 PROGRAM OPTIONS menu.
SAVE DATA ON TAPE

IF DATA WAS INPUT FROM ONE DATA SET AND IS TO BE STORED IN THE SAME DATA SET... ENTER 1

NOTE: IF YOU TRY TO RESTORE THE DATA FILES THAT YOU HAVE INPUT INTO THE SAME DATA SET THAT THEY CAME OUT OF, ANY FILES THAT WERE NOT INPUT FROM THAT SET WILL BE DESTROYED

<table>
<thead>
<tr>
<th>NAME</th>
<th>PRO TYPE</th>
<th>REC/FILE</th>
<th>BYTES/REC</th>
<th>ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>T14</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRO1</td>
<td>PROG</td>
<td>4</td>
<td>256</td>
<td>5</td>
</tr>
<tr>
<td>PRO2</td>
<td>PROG</td>
<td>4</td>
<td>256</td>
<td>9</td>
</tr>
<tr>
<td>PRO3</td>
<td>PROG</td>
<td>3</td>
<td>256</td>
<td>13</td>
</tr>
<tr>
<td>PRO4</td>
<td>PROG</td>
<td>2</td>
<td>256</td>
<td>16</td>
</tr>
<tr>
<td>SLIDES</td>
<td>DATA</td>
<td>831</td>
<td>256</td>
<td>18</td>
</tr>
</tbody>
</table>

INPUT NAME FOR THIS DATA SET... UP TO 6 CHARACTERS

INPUT DATA SET DESCRIPTOR

THERE ARE 4 DATA FILES IN THIS SET

FILE DESCRIPTORS FOR THE DATA FILES ARE:

<table>
<thead>
<tr>
<th>FILE #</th>
<th>DESCRIPTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 KEV</td>
</tr>
<tr>
<td>2</td>
<td>10 KEV</td>
</tr>
<tr>
<td>3</td>
<td>15 KEV</td>
</tr>
<tr>
<td>4</td>
<td>20 KEV</td>
</tr>
</tbody>
</table>

INPUT DATA DESCRIPTOR FOR DATA SET... UP TO 40 CHARACTERS

Figure 2.14. SAVE DATA.
2.15 RETRIEVE GRAPH

This menu allows the user to retrieve a previously stored graph. A list of the graph names as they are referenced on the tape will be displayed, and the user is asked to enter the name of the desired graph. The graph may then be plotted and revised. An example display for this menu is given in figure 2.15.

a) Enter the graph name as it appears in the list on the screen.

BUGS now branches directly to 2.35 MENU 4: OUTPUT MEDIA.

2.16 SAVE GRAPH

Completed graphs may be stored on the magnetic cassette tape in the left tape drive (:T14). The user has the option to re-store a graph into a previously created file, or create a new file. In the latter case the user must supply a new graph name that is used to reference the graph on the tape. BUGS saves the plotting parameters along with all the files used in the graph so there is no need to separately save the data files. For an example printout of this menu see figure 2.16.

If the user chooses to restore a graph into the same graph file, BUGS destroys the old graph and stores the new graph in its place.

a) Enter 1 to store a graph back into the same graph file, or press CONT to create a new graph file.

If the option to store the graph into the same data set was chosen, BUGS returns to the 2.4 PROGRAM OPTIONS menu.

b) Enter a new graph name of up to 6 alphanumeric characters. Ensure that the name is not one of those already listed.

c) Enter a graph descriptor of up to 40 characters.

BUGS now returns to the 2.4 PROGRAM OPTIONS menu.

2.17 PLOT DATA

Since the user has already been through all the scaling parameter and plot option menus once, he now has the option to skip directly to 2.35 MENU 4: OUTPUT MEDIA and use all the parameters from the previous plot. In MENU 4 the user has access to all the other plot option menus if any changes are desired. If the user does not choose to use this option, all plot options are set to their defaults and the user must re-enter the scaling parameters. See figure 12 for a printout of this menu.

a) Enter 1 to use previously input scale parameters and plot options, or press CONT to reset all plot options to their defaults.

If the user did not choose to use the previous parameters BUGS branches to the 2.18 SCALE TYPE menu. If the user did choose to use the previous parameters BUGS branches to 2.35 MENU 4: OUTPUT MEDIA.
RETRIEVE GRAPH

<table>
<thead>
<tr>
<th>NAME</th>
<th>PRO</th>
<th>TYPE</th>
<th>REC/FILE</th>
<th>BYTES/REC</th>
<th>ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>T14</td>
<td>PRO</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRO1</td>
<td>PROG</td>
<td>4</td>
<td>256</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>PRO2</td>
<td>PROG</td>
<td>4</td>
<td>256</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>PRO3</td>
<td>PROG</td>
<td>3</td>
<td>256</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>PRO4</td>
<td>PROG</td>
<td>2</td>
<td>256</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>SLIDES</td>
<td>DATA</td>
<td>831</td>
<td>256</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

INPUT THE FILE NAME OF THE GRAPH TO BE RETRIEVED

Figure 2.15. RETRIEVE GRAPH.

SAVE GRAPH ON TAPE

IF THIS GRAPH WAS RETRIEVED FROM THE TAPE AND IS TO BE RE-STORED INTO THAT SAME DATA FILE...ENTER 1

<table>
<thead>
<tr>
<th>NAME</th>
<th>PRO</th>
<th>TYPE</th>
<th>REC/FILE</th>
<th>BYTES/REC</th>
<th>ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>T14</td>
<td>PRO</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRO1</td>
<td>PROG</td>
<td>4</td>
<td>256</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>PRO2</td>
<td>PROG</td>
<td>4</td>
<td>256</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>PRO3</td>
<td>PROG</td>
<td>3</td>
<td>256</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>PRO4</td>
<td>PROG</td>
<td>2</td>
<td>256</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>SLIDES</td>
<td>DATA</td>
<td>831</td>
<td>256</td>
<td>13</td>
<td></td>
</tr>
</tbody>
</table>

INPUT NAME FOR THIS DATA SET...UP TO 6 CHARACTERS

INPUT GRAPH DESCRIPTION

INPUT THE NAME OF THE DATA FILE DESCRIPTOR FOR THIS GRAPH...UP TO 40 CHARACTERS

Figure 2.16. SAVE GRAPH.

TO USE PLOT OPTIONS & SCALE PARAMETERS FROM THE PREVIOUS RUN...ENTER 1

Figure 2.17. PLOT DATA.
2.18 SCALE TYPE

In this menu the user must choose linear, semi-log or log scales for the plot. The extremes of the data set will be displayed so that the user may analyze which scale type to use, i.e. if there is a very wide data range on an axis, a log scale should be chosen for that axis. See figure 2.18.

a) Enter the number that corresponds to desired scale type.

BUGS now branches to the 2.19 ENTER SCALES menu.

2.19 ENTER SCALES

In this menu the user must input the minimum and maximum values of the scale range for each axis. These values appear as the first and last numbers that are labeled on that axis. By entering values that are inside that data range, only that specific portion of the data within those values will be plotted on the graph. The printout of this menu is contained in figure 2.19.

If the axis uses a log scale, values entered must be powers of ten.

a) Enter minimum and maximum values to be used on the X axis, separated by a comma.

b) Enter minimum and maximum values to be used on the Y axis, separated by a comma.

If the 2.19 ENTER SCALES or 2.18 SCALE TYPE menus were accessed by choosing options #2 or #3 from 2.22 MENU 1: INPUT PARAMETERS, BUGS returns to the MENU 1 menu. If this is the first time BUGS has taken the user to the ENTER SCALES and/or SCALE TYPE menus since the program was started, BUGS branches to the 2.20 LABELS menu.

2.20 LABELS

In this menu the user may input a title and labels for the axes. The title may be up to 30 characters and the axes labels may be up to 20 characters. To change the length allowed for these parameters, see APPENDIX B. See figure 2.20 for the printout of this menu.

a) Enter title up to 30 characters, or enter " " to clear the title.

b) Enter label for the X axis of up to 20 characters, or enter " " to clear X axis label.

c) Enter label for the Y axis of up to 20 characters, or enter " " to clear Y axis label.

BUGS now branches to 2.22 MENU 1: INPUT PARAMETERS.
INPUT SCALE TYPE

EXTREMES of this DATA SET are...

\[ \begin{align*}
X_{\text{min}} &= 0 & X_{\text{max}} &= 128 \\
Y_{\text{min}} &= -21.3675 & Y_{\text{max}} &= 0
\end{align*} \]

You now must CHOOSE the TYPE of graph to PLOT

TO PLOT LINEAR ... ENTER 1
TO PLOT X-LIN Y-LOG ... ENTER 2
TO PLOT X-LOG Y-LIN ... ENTER 3
TO PLOT LOG-LOG ... ENTER 4

Figure 2.18. SCALE TYPE.

ENTER SCALE FOR X AXIS

\[ \begin{align*}
X \text{ COORDINATE RANGE} & : 0 \text{ TO } 128
\end{align*} \]

ENTER the MINIMUM and MAXIMUM values for the X AXIS

ENTER SCALE FOR Y AXIS

\[ \begin{align*}
Y \text{ COORDINATE RANGE} & : -21.3675 \text{ TO } 0
\end{align*} \]

ENTER the MINIMUM and MAXIMUM values for the Y AXIS

Figure 2.19. ENTER SCALES.

INPUT TITLE AND AXES LABELS

INPUT TITLE FOR PLOT...UP TO 30 CHARACTERS

INPUT LABEL FOR THE X AXIS...UP TO 20 CHARACTERS

INPUT LABEL FOR THE Y AXIS...UP TO 20 CHARACTERS

PRESS CONT TO CONTINUE

Figure 2.20. LABELS.
2.21 CHANGE TICKS

This menu allows the user to change the number of labeled major tic marks on a linear axis. After the data range for the axis is displayed the user is asked to input the number of major tics that divides most evenly into the range. The range is equal to the difference in the maximum and minimum values that were input for each axis in the 2.19 ENTER SCALES menu. To change the range the user must return to the MENU 1 menu and choose option #3. Log axes are set automatically by the program and cannot be changed. The printout of this menu is contained in figure 2.21.

NOTE: Using default size for numbers, there should be no more than 8 major tics on the X axis, and no more than 6 characters per number (including minus sign and decimal point) on either axis.

If the scale type chosen was not log-log skip Step a.

a) If the user has chosen a log-log scale in the 2.18 SCALE TYPE menu, the number of labelled major tic marks is set automatically. Press CONT and BUGS will return to 2.22 MENU 1: INPUT PARAMETERS.

The range that is displayed is equal to the difference between maximum and minimum values that were entered in 2.19 ENTER SCALES.

If the X axis is using a log scale, skip to Step d.

b) Input the number of major tics that will divide most evenly into the X range.

c) Enter 1 to try a different number of tics and go to Step b, or press CONT.

If Y is on a log scale, BUGS returns to 2.22 MENU 1: INPUT PARAMETERS.

d) Input the number of major tics that will divide most evenly into the Y range.

e) Enter 1 to try a different number of tics and go to Step d, or press CONT.

BUGS now returns to 2.22 MENU 1: INPUT PARAMETERS.
CHANGE TICK INTERVALS

YOU MAY CHANGE THE NUMBER OF MAJOR TICK INTERVALS
FOR LINEAR AXES ONLY
PRESS CONT TO CONTINUE

X AXIS MAJOR TICK INTERVAL

The RANGE that you have chosen for the X AXIS is 1
MAJOR TICK INTERVAL = RANGE
                              MAJOR TICKS
How many MAJOR TICKS do you want on X AXIS...
DEFAULT is 4

X MAJOR TICK INTERVAL = .25    X MINOR TICK INTERVAL = .05
TO TRY AGAIN...ENTER 1

Y AXIS MAJOR TICK INTERVAL

The RANGE that you have chosen for the Y AXIS is 1
MAJOR TICK INTERVAL = RANGE
                              MAJOR TICKS
How many MAJOR TICKS do you want on Y AXIS...
DEFAULT is 4

Y MAJOR TICK INTERVAL = .25    Y MINOR TICK INTERVAL = .05
TO TRY AGAIN...ENTER 1

Figure 2.21. CHANGE TICKS.
2.22 MENU 1: INPUT PARAMETERS

This menu allows the user to change the scaling parameters and labels that were input in the 2.18 SCALE TYPE, 2.19 ENTER SCALES, and 2.20 LABELS menus. In addition the user may change the number of labeled major tic marks on either axis. If an option number is entered the program will branch to the appropriate menu and then return the user to this menu. Parameters that have been input will appear on the screen. See figure 2.22 for an example menu.

Directions for options:
1. The program branches to the 2.20 LABELS menu.
2. The program branches to the 2.18 SCALE TYPE menu.
3. The program branches to the 2.19 ENTER SCALES menu.
4. The program branches to the 2.21 CHANGE TICS menu.

Step a may be repeated until the user chooses to exit this menu.

   a) Enter option number, or press CONT to exit this menu.

If this is the first time to MENU 1 since the start of the program, or if the defaults are being used, BUGS branches to 2.23 MENU 2: DIMENSIONS/ PLOT OPTIONS. If this menu was selected as option #4 from 2.35 MENU 4: OUTPUT MEDIA, BUGS returns to MENU 4.

2.23 MENU 2: DIMENSIONS/ PLOT OPTIONS

This menu allows the user to normalize the data, plot annotation or standard deviation, to shade any or all files, label linear axes in scientific notation, change the aspect ratio of the graph, or change the size of the title, axes labels or axes numbers. If an option number is entered the program will branch to the appropriate menu and then return the user to this menu. An example printout of this menu may be found in figure 2.23.

Directions for options:
1. The program branches to the 2.26 ANNOTATION menu.
2. The program branches to the 2.27 NORMALIZE menu.
3. The program branches to the 2.25 SCIENTIFIC NOTATION menu.
4. The program branches to the 2.24 STANDARD DEVIATION menu.
5. The program branches to the 2.28 SHADING menu.
6. The program branches to the 2.29 DIMENSIONS menu.
7. The program branches to the 2.30 TITLE SIZE menu.
8. The program branches to the 2.31 LABEL SIZE menu.
9. The program branches to the 2.32 NUMBER SIZE menu.

   a) Enter option number, or press CONT to exit this menu.

The options is processed and then BUGS returns to MENU 2. Step a may be repeated until the user chooses to exit this menu.

If this is the first time to MENU 2 or defaults are being used, BUGS branches to 2.33 MENU 3: PLOT TYPES. If this menu was selected as option #5 from 2.35 MENU 4: OUTPUT MEDIA, BUGS returns to MENU 4.
MENU 1: REVIEW INPUT PARAMETERS

OPTION #
(1) TITLE:
   _LABELED - X AXIS:
   Y AXIS:

(2) SCALE TYPE: LINEAR

(3) SCALE:
   X MIN = 0       X MAX = 1
   Y MIN = 0       Y MAX = 1

(4) MAJOR TICKS - X AXIS: 4 MAJOR TICK INTERVALS OF .25
   Y AXIS: 4 MAJOR TICK INTERVALS OF .25

TO CHANGE ANY OF THESE PARAMETERS...ENTER OPTION #
PRESS CONT TO CONTINUE

Figure 2.22. MENU 1: INPUT PARAMETERS.

MENU 2: DIMENSION/PLOT OPTIONS

PLOT OPTIONS

OPTION #
(1) ANNOTATION: NO
(2) NORMALIZE: NO
(3) SCIENTIFIC NOTATION: NO
(4) STANDARD DEVIATION: NO
(5) SHADING - FILES: ELASTIC

DIMENSION OPTIONS

OPTION #
(6) DIMENSIONS - X AXIS: 100
(7) TITLE SIZE: 1
(8) LABEL SIZE: 1
(9) NUMBER SIZE: 1

TO CHANGE ANY OF THESE PARAMETERS...INPUT NUMBER THAT CORRESPONDS TO OPTION #
PRESS CONT TO CONTINUE

Figure 2.23. MENU 2: DIMENSIONS/PLOT OPTIONS
2.24 STANDARD DEVIATION

The user may plot an error bar on the graph. The user is asked to input the numerical value of one standard deviation and the number of standard deviations to plot. Because the user must use the cursor to position the error bar on the graph, the graph must be plotted on the CRT before it is plotted on the digital plotter. See 2.36 STANDARD DEVIATION DIRECTIONS for a complete explanation of how to input the standard deviation error bar. See figure 2.24 for a printout of this menu.

a) Enter 1 to place standard deviation on the graph or press CONT to not have standard deviation plotted on the graph.

If standard deviation was not chosen, BUGS returns directly to 2.20 MENU 2: DIMENSIONS/PLOT OPTIONS.

b) Enter the numeric value for one standard deviation.

The user may plot one, two or three standard deviations.

c) Enter the number of standard deviations to plot.

BUGS now returns to the 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS menu.

2.25 SCIENTIFIC NOTATION

The user has the option to have linear axes labeled using scientific notation. Log axes will automatically be labeled as powers of ten. If the number size, the size of the X axis (see 2.29 DIMENSIONS), and the plot size are set to their defaults or larger, the Y axis label will be out of the medium plotting range. To plot the Y label, ensure that:

\[
\text{Number size} \times (\text{X axis size}/100) \times \text{Plot size} \leq 0.8.
\]

Plot size is only used on the digital plotter and is always set to 1 on the CRT and the internal printer. See figure 2.25 for a printout of this menu.

a) Enter 1 to use scientific notation, or press CONT to use the standard notation.

BUGS now returns to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS.
STANDARD DEVIATION

TO DISPLAY STD DEV ERROR BAR ON GRAPH ENTER 1

ENTER THE VALUE FOR 1 STANDARD DEVIATION

ENTER THE NUMBER OF STANDARD DEVIATIONS TO PLOT...FROM 1 TO 3

Figure 2.24. STANDARD DEVIATION.

SCIENTIFIC NOTATION

Jser may have SCIENTIFIC NOTATION on the LINEAR AXES

LOG AXES will AUTOMATICALLY be labelled as POWERS of 10

NOTE: If SCIENTIFIC NOTATION is used on the Y AXIS, the Y AXIS LABEL will not be printed on the CRT or on the DIGITAL PLOTTER if the default NUMBER SIZE of 1 is used. To print the Y AXIS LABEL, choose a NUMBER SIZE of .8 or SMALLER. On the DIGITAL PLOTTER, the situation may also be remedied by choosing a PLOT SIZE of .8 or SMALLER.

TO USE SCIENTIFIC NOTATION ENTER 1

Figure 2.25. SCIENTIFIC NOTATION.
2.26 ANNOTATION

This menu allows the user to place annotation in the graph and choose the annotation size. Because the annotation labels will be entered on the CRT screen after the graph is plotted, the user must plot the graph on the CRT screen before plotting it on the digital plotter. See 2.37 ANNOTATION DIRECTIONS for a complete explanation of how the annotation is entered. A copy of this menu may be found in figure 2.26.

a) Enter 1 if annotation is desired in the graph, or press CONT if annotation is not desired.

If annotation is not desired BUGS returns to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS.

The default size for annotation is 1. If the user wishes to change the size of the annotation, he may do so by entering a size multiplier. For example: if the user enters 2, the annotation will be twice the size of the default; if the user enters .5, the annotation will be half the size of the default. Generally, the multiplier should be between .85 and 1.

b) Input number between 0 and 2 to multiply default size by, or press CONT to use the default size.

BUGS now returns to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS.

2.27 NORMALIZE

In this menu the user may multiply the X and/or Y values of any file by a constant. The data ranges for each file are displayed and the user is asked if any files are to be normalized. If so the user must input the file number, the normalization factor for the X values and the normalization factor for the Y values of that file. The printout for this menu is found in figure 2.27.

Steps a and b may be repeated until the user chooses to exit this menu.

a) Enter 1 to normalize a data file, or press CONT.

If no files are to be normalized BUGS returns to 2.23 MENU 2: DIMENSIONS/PLOT OPTIONS.

The user must input a normalizing factor for both the X and Y values. If the user does not wish either X or Y values to be normalized, he may enter a one (1) as the factor.

b) Enter the file number, the X normalization factor and the Y normalization factor.

BUGS now branches back to Step a.
ANNOTATION

TO PLACE ANNOTATION ON YOUR GRAPH...ENTER 1

WARNING: If you wish to use ANNOTATION on the DIGITAL PLOTTER
you must FIRST PLOT graph on the CRT

Input MULTIPLIER between 0 and 2 for the ANNOTATION
CHARACTER SIZE...DEFAULT is 1

Figure 2.26. ANNOTATION.

NORMALIZE

DATA RANGES FOR FILES ARE:

<table>
<thead>
<tr>
<th>FILE #</th>
<th>X-MIN</th>
<th>X-MAX</th>
<th>Y-MIN</th>
<th>Y-MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-.04</td>
<td>123</td>
<td>.04</td>
<td>-17.0862</td>
</tr>
<tr>
<td>2</td>
<td>-.04</td>
<td>0</td>
<td>.04</td>
<td>0</td>
</tr>
</tbody>
</table>

NOTE: THE NEW VALUES FOR DATA PAIRS WILL BE ROUNDED
TO FOUR SIGNIFICANT DIGITS

TO NORMALIZE A DATA FILE ... ENTER 1

ENTER FILE #, MULTIPLIER FOR X DATA, MULTIPLIER FOR Y DATA

Figure 2.27. NORMALIZE.
This menu allows any or all data files to be shaded. The user will be asked if at least one file will be shaded. If so, the file descriptors are displayed one at a time and the user is asked to indicate whether that particular file is to be shaded. Figure 2.28 shows an example printout of this menu.

a) Enter 1 to shade any file, or press CONT if no files are to be shaded. If no files are to be shaded BUGS returns to 2.23 MENU 2: DIMENSIONS/ PLOT OPTIONS. The file numbers and descriptors are now displayed one at a time. The computer beeps and displays "SHADE THIS FILE?".

b) Enter 1 to have this file shaded, or press CONT to leave file unshaded.

Repeat Step b for each file. When all files have been displayed BUGS returns to 2.23 MENU 2: DIMENSIONS/ PLOT OPTIONS.

2.29 DIMENSIONS

The user may change the aspect ratio and/or the size of the graph. The user will be asked to enter the dimensions of both the X side (horizontal) and the Y side (vertical) of the plot in pre-defined graphic units. The maximum size allowed is 120 X units by 80 Y units, which is the total area of the screen in graphic units. On the plotter, one (1) inch is approximately equal to the ten (10) graphic units. The total graphics units along one axis equals axis length times the plot size. For example: A graph that has X axis length=40, Y axis length=40, and plot size = 1 has total plotting area in inches of:

X axis: \((40 \times 1)/10 = 4\); Y axis: \((40 \times 1)/10 = 4\); Area: 4" x 4"

Calculate the desired plot dimensions in inches and multiply these by ten. Remember, however, that the entire graph may be scaled down by a constant in 2.39 PLOT SIZE.

a) Enter in the size of the X side in graphic units, or press CONT to use the default size.

b) Enter in the size of the Y side in graphic units, or press CONT to use the default size.

BUGS returns to 2.23 MENU 2: DIMENSIONS/ PLOT OPTIONS.
SHADING

YOU MAY HAVE A PARTIAL FILLING OF THE SPACE BELOW YOUR CURVE IN THE DATA PLOT

NOTE: CHOOSING THIS WILL MEAN THAT THE PLOT WILL TAKE 3 TIMES AS LONG

TO CHOOSE THIS OPTION ... ENTER 1

FILE # - DESCRIPTOR
1 5 KEY

TO SHADE THIS FILE...ENTER 1 - ELSE PRESS CONT

Figure 2.28. SHADING.

DIMENSION PLOT

DEFAULT SIZE FOR PLOTTING IS 100 X UNITS BY 60 Y UNITS

ENTER SIZE FOR X AXIS...1 TO 120

ENTER SIZE FOR Y AXIS...1 TO 80

Figure 2.29. DIMENSIONS.
2.30 TITLE SIZE

The user may change the size of the title, axes labels, or axes numbers from the default size of 1. This is done by entering a factor by which the default size will be multiplied. If the user enters a factor of two, the output of these parameters will be twice the size of the default. Likewise, if the user enters .5, the output will be half the size of the default. The labels and numbers are also automatically scaled to the length of the axis and the plot size (if the digital plotter is used), so the user must take somewhat of a trial and error approach. For examples see APPENDIX F. The printout of the TITLE SIZE, AXES LABEL SIZE and NUMBER SIZE has been combined into figure 2.30 LABEL DIMENSIONS. Listed below are some example size factors.

Example sizes:
   size=0......Single point
   size=1-1.5...Normal size on plot
   size=2-3.....Most effective if hardcopy plot is to be 3 x 5 inches or less

Figure 2.30a LABEL DIMENSIONS is a printout of the query for the title size factor.

   a) Enter a number from 0 to 3 by which the default size will be multiplied, or press CONT to use the default size.

BUGS now returns to 2.23 MENU 2: DIMENSIONS/ PLOT OPTIONS.

2.31 LABEL SIZE

See figure 2.30b for a printout of the query in the LABEL SIZE menu. For an explanation of how the size factor is used, see 2.30 TITLE SIZE.

   b) Enter a number from 0 to 3 by which the default axes label size will be multiplied, or press CONT to use the default size.

BUGS now returns to 2.23 MENU 2: DIMENSION/ PLOT OPTIONS.

2.32 NUMBER SIZE

See figure 2.30c for a printout of this query in the LABEL SIZE menu. For an explanation of how the size factor is used, see 2.30 TITLE SIZE.

   c) Enter a number between 0 and 3 by which the default number size will be multiplied, or press CONT to use the default.

BUGS now returns to 2.23 MENU 2: DIMENSION/ PLOT OPTIONS.
TITLE SIZE

INPUT MULTIPLIER BETWEEN 0 AND 3 FOR TITLE

DEFAULT IS 1

AXES LABEL SIZE

INPUT MULTIPLIER BETWEEN 0 AND 3 FOR X AND Y LABEL SIZE

DEFAULT IS 1

NUMBER SIZE

ENTER MULTIPLIER BETWEEN 0 AND 2...DEFAULT IS 1

Figure 2.30. LABEL DIMENSIONS.
This menu displays the files, their descriptors and the plot types chosen by the user. The default type is a solid line. The user is asked if any changes are desired. If so the program branches to the 2.34 PLOT TYPES menu where the user may input a different plot type for all the files. Figure 2.33 shows an example of MENU 3 when all defaults are used; then the 2.34 PLOT TYPES menu (2.33b); and an example again of MENU 3 when options 1-4 are chosen from the 2.34 PLOT TYPES menu.

Choice of plot types are:
(1) Lines with choice of line type.
(2) Symbols with choice of symbol and symbol size.
(3) Lines and symbols.
(4) Histogram.

Step a may be repeated until the user chooses to exit this menu.

a) Enter 1 to change a plot type, or press CONT if no change is desired.

If no changes are desired the BUGS branches to 2.35 MENU 4: OUTPUT MEDIA. If changes are desired BUGS branches to the 2.33 PLOT TYPES menu and then returns to this menu.

2.34 PLOT TYPES

In this menu the user may change the plot type of any or all files. Each file will be presented one at a time. The user may then choose to plot lines, symbols, lines and symbols, or histograms. There are 10 different line types, any ASCII character may be used as a symbol, and the symbol size may be chosen. The program returns to 2.33 MENU 3: PLOT TYPES after all files have been presented. See figure 2.33.

a) Enter the option number, or press CONT if user does not wish to change the plot type for this file.

If the plot type selected is a histogram, skip Steps b-d. If the plot type is symbols only, skip Step b.

Information on line types is on page 18 of the ROM Graphics Manual.

b) Enter the line type number, or press CONT if no change is desired.

If the plot type selected does not use symbols, skip Steps c-d.

c) Enter a new symbol, or press CONT no change is desired.

d) Enter a number to multiply the default symbol size by, or press CONT if the user does not wish to change the symbol size.

Repeat Steps a through d until plot types have been selected for all the files. After all files have been presented the program returns to 2.33 MENU 3: PLOT TYPES. The new plot types will then be displayed. See figure 2.33f.
MENU 3: PLOT-TYPE OPTIONS

FILE # 1  LINE TYPE #  1
FILE # 2  LINE TYPE #  1
FILE # 3  LINE TYPE #  1
FILE # 4  LINE TYPE #  1

TO CHANGE ANY OF THESE FILES...ENTER 1
PRESS CONT TO CONTINUE

FILE 1: 5 KEV

FOR PLOTTING DATA YOU HAVE THE FOLLOWING OPTIONS...

ENTER 0...TO PLOT LINES
ENTER 1...TO PLOT SYMBOLS
ENTER 2...TO PLOT BOTH LINES AND SYMBOLS
ENTER 3...TO PLOT A HISTOGRAM-TYPE PLOT

INPUT LINE TYPE #...ref. page 18 of ROM graphics manual

ENTER THE SYMBOL TO BE USED

ENTER THE MULTIPLIER OF THE PRESENT CHARACTER SIZE FOR SYMBOLS

FILE # 1  LINE TYPE #  4
FILE # 2  SYMBOL = +
       SYMBOL MULT = 1
FILE # 3  LINE TYPE #  10
       SYMBOL = +
       SYMBOL MULT = .75
FILE # 4  PLOT HISTOGRAM

TO CHANGE ANY OF THESE FILES...ENTER 1
PRESS CONT TO CONTINUE

Figure 2.34. PLOT TYPES.
2.35 MENU 4: OUTPUT MEDIA

In this menu the user is presented with options to plot the graph on the CRT screen, internal thermal printer, or the digital plotter. Options are also given to return to any of the other option menus. After choosing any option the user is returned to this menu. If no options is chosen BUGS returns to the 2.4 PROGRAM OPTIONS menu. See Section 2.42 SPECIAL FUNCTION KEYS - PLOTTING AIDS for instructions on how to use the Special Function Keys for plotting. The printout of this menu is given in figure 2.35.

Directions for options:
1. Data is plotted on the screen using all scale parameters and plot options that have been entered.
   If the user has selected annotation or standard deviation option:
   - Wait until data is finished plotting.
   - Press CONT.
   If the standard deviation option was chosen, BUGS branches to the 2.36 STANDARD DEVIATION DIRECTIONS menu.
   If the annotation option was chosen, BUGS branches to the 2.37 ANNOTATION DIRECTIONS menu where the annotation labels may be entered on the graph.
2. Whatever was plotted last on the screen is dumped onto the printer.
   If this is the first time to MENU 4 since the start of the program, the user must plot data on the screen first.
3. Data is plotted on the digital plotter using up to 4 pen colors or a drafting pen. BUGS now branches to the 2.38 DIGITAL PLOTTER menu.
4. BUGS branches to the 2.22 MENU 1: INPUT PARAMETERS menu.
5. BUGS branches to the 2.23 MENU 2: DIMENSIONS/ PLOT OPTIONS menu.
6. BUGS branches to the 2.33 MENU 3: PLOT TYPES menu.

Step a may be repeated until the user chooses to exit this menu.

   a) Enter option number and follow the directions given above, or press CONT to exit plot mode and return to the 2.4 PROGRAM OPTIONS menu.

After each option has been serviced, BUGS returns the user to this menu until the user chooses to return to the 2.4 PROGRAM OPTIONS menu.

2.36 STANDARD DEVIATION DIRECTIONS

If the standard deviation option has been chosen, the sigma error bar is entered by waiting until the graph has finished plotting on the CRT; positioning the cursor to the bottom of the desired position of the error bar; and pressing CONT. The cursor is positioned by using the arrows in the display pad which is located at the top center of the computer keyboard. See figure 2.36 for the printout of this menu.

After the graph has finished plotting, press CONT.

   1) Press CONT to get back to the graphics screen.
   2) Position the cursor to the bottom of the desired position of the bar.
   3) Press CONT.

If the annotation option was chosen, BUGS branches to the annotation menu; otherwise it returns to 2.35 MENU 4: OUTPUT MEDIA.
MENU 4: OUTPUT MEDIA

OPTION #
(1) CRT
(2) THERMAL PRINTER
(3) DIGITAL PLOTTER

OPTION #
(4) MENU 1: INPUT PARAMETERS
(5) MENU 2: DIMENSIONS/OPTIONS
(6) MENU 3: PLOT TYPES

INPUT OPTION # THAT CORRESPONDS TO WHAT YOU WANT TO DO
OR PRESS CONT TO GO BACK TO PROGRAM OPTIONS

Figure 2.35. MENU 4: OUTPUT MEDIA.

PLOT STANDARD DEVIATION

THE PROGRAM IS NOW READY TO PLOT THE SIGMA ERROR BAR.
(1) PRESS CONT TO GO BACK TO THE PLOT ON THE CRT
(2) POSITION THE CURSOR AT THE BOTTOM OF WHERE THE ERROR BAR WILL BE PLOTTED
(3) PRESS CONT

THE PROGRAM WILL THEN PLOT THE ERROR BAR ON THE CRT
PRESS CONT TO RETURN TO MENU 4: OUTPUT MEDIA

Figure 2.36. STANDARD DEVIATION DIRECTIONS.

WE ARE NOW READY TO LET YOU PROVIDE ANNOTATION FOR THE
GRAPH WHICH YOU HAVE JUST DREW

POSITION THE CURSOR TO THE LEFT EDGE OF THE POSITION WHERE YOU WANT TO START YOUR LABEL AND PRESS CONT

THE SCREEN WILL PAUSE TO THE KEYBOARD MODE AND YOU THEN ENTER THE ANNOTATION THAT YOU WANT

CONTINUE AS MANY TIMES AS YOU WANT

TO EXIT ANNOTATION...ENTER SAME CURSOR POINT TWICE

...TO START ANNOTATION PRESS CONT

Figure 2.37. ANNOTATION DIRECTIONS.
2.37 ANNOTATION DIRECTIONS

If annotation has been chosen, the user may enter up to 30 annotation labels of up to 30 characters each by: (1) Positioning the cursor to the left edge of desired label position; (2) Pressing CONT to digitize that label position, (3) Entering the label from the keyboard; and (4) Pressing CONT to see the label printed on the graph. This process is repeated until user chooses to exit annotation mode by digitizing the same label position twice in a row. The cursor is positioned by using the arrows at the top center of the keyboard. See figure 2.37 for a printout of the menu.

1) Press CONT to return to the graphics display and then position the cursor to the desired position for the first letter of the label.

2) Press CONT and then enter the label of up to 30 characters from the keyboard.

3) Repeat steps 1 and 2 for all annotation labels. After the last label has been plotted, press CONT twice to exit the annotation mode.

BUGS now returns the user to 2.35 MENU 4: OUTPUT MEDIA.

2.38 DIGITAL PLOTTER

The digital plotter allows the user to create normal and publication quality plots on paper or transparencies using up to four pen colors, or using the drafting pen on vellum drafting paper. APPENDIX F contains an example of each plotting medium. For more information on the different types of pens and papers that can be used, see APPENDIX A. See figure 2.38 for digital plotter options and examples of how long each option takes to plot.

To set up the digital plotter:

1) Turn plotter on.
2) To load plotting medium:
   a) Press CHART LOAD.
   b) Place paper on platten.
   c) Press CHART HOLD.

Plot time will increase with the number of plot options used. A publication quality graph with one file using shading will require about 5 minutes.

   a) Enter option number.

BUGS now takes the user to 2.39 PLOT SIZE menu.
DIGITAL PLOTTER

There are three output medium options for the digital plotter:

OPTION #
(1) FELT TIP PENS - NORMAL QUALITY
(2) FELT TIP PENS - PUBLICATION QUALITY
(3) TRANSPARENCIES
(4) DRAFTING PEN

Using defaults, the time it take to plot one graph using using one data file is:

(1) Normal Quality - about two minutes
(2) Publication quality - twice as long
(3) Transparencies - twice as long
(4) Drafting pen - four times as long.

INPUT the OPTION # that you would like to use.

Figure 2.38. DIGITAL PLOTTER.

INPUT PLOT SIZE

You now have a chance to pick the plot size.

Plot size must be a number from 0 to 1.

EXAMPLES:

SIZE=1.00...Full plotter limits
SIZE=0.65...Standard 3 1/2 x 11 inch page
SIZE=0.00...Single point on the page

INPUT PLOT SIZE ?

Figure 2.39. PLOT SIZE.
2.39 PLOT SIZE

Plot time will significantly decrease as plot size decreases from the default size of 1. The default size will plot the graph exactly as it appeared on the CRT screen. Therefore, if any part of the graph except for the far right side is plotted off the screen when plotted on the CRT (such as title, axes labels, or axes number), these parameters will also not be plotted on the digital plotter when the default size is used. To allow room to plot these parameters, choose a smaller plot size. See figure 2.39 for a printout of this menu and example plot sizes.

a) Enter plot size (number from 0 to 1).

BUGS now takes the user to the 2.40 PLOT COLORS menu if the drafting pen option was not chosen. If the drafting pen option was chosen, BUGS plots the graph, and returns the user the user to 2.35 MENU 4: OUTPUT MEDIA.

2.40 PLOT COLORS

This menu gives the user an opportunity to select colors for the plot parameters if the drafting pen option was not chosen in the 2.38 DIGITAL PLOTTER menu. The user may continue to change pen colors for any parameter until no more parameters are chosen. Choosing a pen number of 0 will cause that plot parameter not to be plotted. This is useful in plotting different data files on different transparencies for viewgraph presentations. The program then takes the user to 2.41 ANNOTATION COLORS if annotation is to be used, or plots the graph and returns the user to 2.35 MENU 4: OUTPUT MEDIA. Figure 2.40 gives an example printout for this menu.

a) Enter the number that corresponds to the parameter that is to be changed, or press CONT to exit PLOT COLORS menu.

If no parameters were changed, BUGS takes the user to 2.41 ANNOTATION COLORS if annotation is used, or returns the user to 2.35 MENU 4: OUTPUT MEDIA after the graph has been plotted.

If a file (option #4) was not chosen, skip Step b.

b) Enter number that corresponds to the file to be changed.

c) Enter number between 0 and 4 for the new pen color.

The user may now have the menu rewritten to see new parameter colors displayed.

d) Enter one to review new parameter colors, or press CONT to input next color option.

BUGS now returns the user to Step a. This gives the user the option to continue changing colors or to exit this menu.
PLOT COLORS

PEN #1 - BLACK  PEN #3 - GREEN
PEN #2 - BLUE   PEN #4 - RED

(1) TITLE: BLACK   (2) AXES LABELS: BLACK
(3) AXES AND TICK MARKS: BLACK
(4) FILE #
  1 - RED: 5 KEV
  2 - BLUE: 10 KEV
  3 - GREEN: 15 KEV
  4 - RED: 20 KEV

TO CHANGE A COLOR...ENTER OPTION # - else PRESS CONT TO CONTINUE

INPUT FILE #

INPUT NEW PEN #

TO REVIEW NEW COLORS...ENTER 1 - PRESS CONT TO CONTINUE

Figure 2.40. PLOT COLORS.

ANNOTATION COLORS

PEN #1 - BLACK  PEN #3 - GREEN
PEN #2 - BLUE   PEN #4 - RED

LABEL #
  1) BLACK - CR on $I$
  2) RED  - * - 5 kev
  3) BLUE - + - 10 kev
  4) GREEN - # - 20 kev
  5) BLACK - & - 40 kev

TO CHANGE A COLOR...ENTER LABEL # - else PRESS CONT to CONTINUE

INPUT NEW PEN #

TO REVIEW NEW COLORS...ENTER 1 - PRESS CONT TO CONTINUE

Figure 2.41. ANNOTATION COLORS.
2.41 ANNOTATION COLORS

This menu gives the user an opportunity to select colors for the annotation labels. The user may continue to change pen colors for the labels until no more labels are chosen. Figure 2.41 contains a printout for this menu.

a) Enter the number of the annotation label to change, or press CONT to exit this menu.

If user has chosen to exit this menu, BUGS will plot the graph and return to 2.35 MENU 4: OUTPUT MEDIA.

b) Enter the number for the new pen color.

The user may now have the option to have this menu rewritten to see new label colors displayed.

c) Enter 1 to review new label colors, or press CONT to enter to label color.

BUGS now returns the user to Step a. This gives the user the option to continue changing colors or to exit this menu.

2.42 SPECIAL FUNCTION KEYS- PLOTTING AIDS

Before plotting a graph on the CRT or the digital plotter, the Special Functions Keys (SFK's) located in the upper right hand corner of the keyboard may be used to switch plotting parameters on and off, center the graph on the digital plotter, plot previously annotation and standard deviation directly on the CRT to avoid having to input them each time, and have access to basic 9845 system commands at the push of button. The default is ON for all keys.

SWITCHES: The frame, tic marks, numbers, axes labels, data files, shading, annotation, and standard deviation may be switched on or off before plotting by pressing the appropriate SFK to turn the parameter on, and SHIFT SFK to turn it off. It is especially helpful when editing a single portion of the graph to turn off other parameters in order to save plotting time. It can also be used effectively in viewgraph presentations by displaying different parts of the graph serially on different transparencies.

CENTERING THE GRAPH: To center a graph on the digital plotter, the user must determine the X and Y offsets in inches and multiply this value by ten. Positive values move the graph to the right or up while negative values move it to the left or down. Once these are determined, input the X offset by pressing SFK k2, typing in the offset, and pressing CONT. The Y offset is entered the same way, using SFK k3.

PLOTTING ANNOTATION AND STANDARD DEVIATION DIRECTLY ON THE CRT: Every time the user chooses to plot on the CRT, the annotation and standard deviation must be input again. The user may avoid this and plot all previously input
annotation and standard deviation on the screen directly by pressing SFK k1. By pressing SHIFT k1 before the CRT option is chosen in MENU 4: OUTPUT MEDIA, the user may return to the input the input mode.

BASIC 9845 SYSTEM COMMANDS: Below are listed some basic 9845 system commands which the user might find helpful. NOTE: These commands do NOT effect the running of the BUGS program.

GRAPHICS EXIT GRAPHICS
The 9845 has two CRT modes: the alphanumeric screen which presents all menus; and the graphics on screen which the graph is plotted. Any time the alphanumeric screen is displayed, the user may display the graph by pressing SFK k5 (GRAPHICS). Likewise SHIFT k5 will return the user to the alphanumeric screen, if the graphics screen is currently being displayed.

PRINTER IS 0
PRINTER IS 16
PRINTER IS 0 causes the 9845 to print on the internal thermal printer while PRINTER IS 16 causes the system to print on the CRT. Each time one of the BUGS menus is printed on the thermal printer, the system will skip to the top of the next page. SFK k6 will print on the printer. SFK k7 will print on the CRT.

CAT :T15
CAT :T14
The CAT statement will list the directories of the tapes in either the right (:T15) or the left (:T14) tape drives. SHIFT k7 will list :T15 while SHIFT k6 will list :T14.

SUMMARY OF KEYS:

PLOTTING SFK's

SHIFT SFK

SFK

k1 Plot annotation and standard deviation directly on CRT
k2 Input horizontal offset
k3 Input vertical offset

k8 Plot frame.
k9 Plot tic marks.
k10 Plot numbers.
k11 Plot axes labels and title.
k12 Plot all files
k13 Plot shading.
k14 Plot annotation.
k15 Plot standard deviation.

No frame.
No tic marks.
No number.
No axes labels or title.
No files.
No shading.
No annotation.
No standard deviation.

FUNCTION SFK's

EXIT GRAPHICS

k5 GRAPHICS
k6 PRINTER IS 0
k7 PRINTER IS 16

CAT :T14
CAT :T15
3. PROGRAM DESCRIPTION

3.1 INTRODUCTION TO PROGRAM DESCRIPTION

This introduction is intended to provide a broad overview of the program structure followed by a guide on the use of the subroutine descriptions.

PROGRAM PLOT (1) declares all variables, (2) takes the user to the PROGRAM OPTIONS menu to manipulate and plot data, and (3) terminates the program. The centerpoint of the program is the OPTIONS subroutine which outputs the PROGRAM OPTIONS menu and divides the program into the five basic program modes that (1) INPUT DATA, (2) SAVE DATA, (3) RETRIEVE GRAPHS, (4) SAVE GRAPHS, and (5) PLOT DATA. The INPUT DATA subroutine drives the four input modes: (1) KEYBOARD; (2) TAPE; (3) DIGITIZE; and (4) DEFINE FUNCTION. SAVE DATA and SAVE GRAPH are stand alone subroutines that save the data files and completed graphs, respectively. RETRIEVE GRAPH is also a stand alone subroutine that retrieves a previously stored graph. The PLOT DATA subroutine supervises the input of the scale parameters and plot options, and the output of the plot. It's centerpoint is the MENU 4 subroutine which presents the MENU 4: OUTPUT MEDIA menu that allows the user to choose the output media or return to any of the other plot option menus. The actual plotting is driven by the PLOT subroutine.

This program is modular in design. Each subroutine typically performs only one specific task such as initializing variables, outputing menus, computing data, or plotting the graph. The subroutine descriptions therefore begin with a statement of the function of that subroutine. A definitions of the variables follows. Some variables which occur throughout the program are given only a brief description and a reference to another subroutine description containing a more complete definition of that variable. Most subroutine descriptions include a line by line explanation of the logic. The subroutine descriptions end with a list of the subroutines that call the subroutine.

All subroutine descriptions are denoted by the subroutine name in capital letters. Menus that are output by the subroutine are denoted by the name of the menu as given in the menu instruction (Chapter 2) and their corresponding figure numbers.

Most subroutine descriptions have an accompanying flowchart which may be found in APPENDIX D. A listing of the entire program is given in APPENDIX C. APPENDIX E contains an index to all of the subroutine flowcharts, menus, and listings.

3.2 PROGRAM PLOT

FUNCTION: Input, save and plot up to 10 data files at a time for a total of 2,000 data points.

LINE #: 20: Set up COMMON and initialize variables.
   30: Take the user to the PLOT OPTIONS menu and branch to the appropriate subroutines according to the user's chosen option.
   40: End program.
3.3 SUBROUTINE INIT

FUNCTION:
1) Set up COMMON and initialize variables to 0 or blanks.
2) Load Special Function Key to be used in Define_function subroutine.

VARIABLES:
Defaults: Set flag to set all plot options defaults.

LINE #:
90: Trigonometric functions are computed in degrees.
100: All array subscripts will start with 1.
110-210: Set up COMMON.
220-240: Declare temporary input arrays for use in 3.6 TAPE and 3.7 DIGITIZE subroutines.
340: Set flag to set all plotting defaults.

CALLED FROM: Program 3.2 PLOT.

3.4 SUBROUTINE INPUT_DATA

FUNCTION:
1) Input the number of files to be input from each input mode, and branch to those subroutines.
2) Compute Pfile, Pts.

VARIABLES:
Log_ck: If new data are input and plotted using previous plot parameters of log or semi-log scale types, this flag will cause logs of the new data to be taken in 3.16 PLOT DATA subprogram.
Dig_flag: Flag for 3.13 EDIT_DATA subroutine to also change temporary data arrays Xtemp and Ytemp if data is edited numerically in 3.10 DIG_OPTS subroutine.
In(1): Number of files to be input from the keyboard.
In(2): Number of files to be input from tape.
In(3): Number of files to be digitized on the digital plotter.
In(4): Number of files to be generated as a user defined function.
Pfile: Total number of files to be input.
Pts: Maximum number of points allowed per file.
Xl(Pfile,Pts),Yl(Pfile,Pts): Short precision arrays to hold X and Y input data.
F$\$(Pfile): File descriptor for input data.
Npt(Pfile): Number of points in each data file.
LI: Current file number; set to 1 to start data input.

LINE #:
680-740: Set all flags for that depend on new data.
750-760: Re-dimension and initialize input arrays to full dimensions.
770-880: Display Figure 1 INPUT OPTIONS.
890-1000: Input number of files for each input mode.
1010-1120: Error checks.
1130-1160: Branch to input subroutines.
3.5 SUBROUTINE KEYBOARD

FUNCTION: Input In(1) data files from the computer keyboard.

VARIABLES:
- Key: Counter for the number of files that have been input from the keyboard.
  When Key > In(1), exit subroutine.
- X0: Initial X value if there is a constant X interval.
- Dx: Value of constant X interval.
- X1(L1,I),Y1(L1,I),L1,Pfile,Npt(L1),FS(L1): See 3.4 INPUT_DATA subroutine.

LINE #:
- 1190-1380: Output Figure 2.6a-c INPUT FROM KEYBOARD; input FS(L1),Npt(L1)
- 1390-1470: Output Figure 2.6f; input X,Y data pairs if there is no constant X interval.
- 1480-1580: Output Figure 2.6 d,e,g; input X0,Dx; input Y data values.

CALLED FROM: Subroutine 3.4 INPUT_DATA.

3.6 SUBROUTINE TAPE

FUNCTION: Input In(2) data files from tape.

VARIABLES:
- Tape: Counter for the number of files that have been input from the tape.
  When Tape > In(2), exit subroutine.
- DS: Name for the data set to be input from tape.
- A$: Data set descriptor for DS.
- Nfile: Number of files in DS.
- Ntemp(Nfile): Number of points in each file of DS.
- Ftemp(Nfile): File descriptors for DS.
- Xtemp(Pfile,Pts),Ytemp(Pfile,Pts): Short precision temporary data arrays to hold X and Y data from tape.
- Ifile: Number of data file from the DS data set that the user has chosen to input.

LINE #:
- 1650-1760: Display Figure 2.7a INPUT FROM TAPE; input DS; Compute CS.
- 1770-192: Input data into temporary data arrays.
- 1930-2140: Display Figure 2.7b; input Ifile.
- 2150-2200: Put selected data file into permanent data array.
  - 2210: Give user a chance to review data file to verify that this is the correct data file.
- 2200-2300: Display Figure 2.7c; input A1.
  If this is the correct file (A1=0), increment tape and file counters. If Tape > In(2), return to 3.4 INPUT_DATA subroutine.
- 2310-2410: Display Figures 2.7d-e; input A1.
  Go back to get a different data set or a different data file from current data set depending on A1.

CALLED FROM: Subroutine 3.4 INPUT_DATA.
3.7 SUBROUTINE DIGITIZE

FUNCTION: Digitize In(3) data files using the digital plotter. Each new graph is initialized by digitizing the corners, and inputting the scale type and scale ranges. The user chooses to digitize more than one file per graph, the graph need not be re-initialized. After the file is digitized into Xtemp(L1,K) and Ytemp(L1,K), the data is rotated and scaled into X1(L1,I),Y1(L1,I).

VARIABLES:
- Dig_flag: Set flag for 3.13 EDIT DATA subroutine to change temporary data arrays Xtemp and Ytemp if digitized values are to be edited numerically.
- Digitt: Counter for the number of files that have been digitized.
- Graph: Counter for the number of files that have been digitized off of the current graph.
- Gr: Number of files to be digitized from the current graph.
- Scaleck: Flag to scale data to user units.

CALLING TREE:

DIG_INIT: Input number of files to be input from current graph.
- Digitize corners of current graph.
- Input scale type.
- Input scale ranges for the axes.
DIGIT: Digitize data file from the current graph.
DIG_OPTS: Check and/or edit digitized file.
- DIG_SCALE: Rotate and scale digitized file.
  - ROTATE: Rotate data and corners.
  - RESCALE: Scale data.
- ROUND: Round data to three significant digits.
DIG_PLOT: Plot rotated unscaled temporary data file on the CRT.
EDIT_DATA: Edit data numerically and review.
HARD: Print digitized data on the thermal printer.
DIG_EDIT: Edit unscaled, unrotated digitized data by re-digitizing selected points.
- ROTATE_BACK: Rotate the temporary data back to original position.
  - Set Scaleck flag to rescale permanent data file.

CALLED FROM: Subroutine 3.4 INPUT_DATA.

3.8 SUBROUTINE DIG_INIT

FUNCTION: Digitize corners of the graph to allow rotation and scaling of the digitized data.
- Input scale type.
- Input scale ranges for the axes.

VARIABLES:
- Gr: Number of files to be digitized from the current graph.
- Xframe(*),Yframe(*): Digitized corners of current graph.
- Pt: Scale type.
- Xmn,Xmx,Ymn,Ymx: Scale ranges for the X and Y axes.
- Check lgt: Test if the scale ranges that have been input for a log axis are powers of ten.
SUBROUTINE DIG_INIT cont.

LINE #:
2710-2880: Output Figure 2.8a SET UP DIGITIZING; input Gr.
2890-2960: Output Figure 2.8b.
2970-1050: Digitize corners of the current graph.
1060-3180: Output Figure 2.8c; input Pt.
3190-3460: Output Figure 2.8d-e; input Xmn,Xmx,Ymn,Ymx

CALLED FROM: Subroutine 3.9 DIGIT.

3.9 SUBROUTINE DIGIT

FUNCTION: Digitize file number L1.

VARIABLES:
K: Number of points digitized.
Xtemp,Ytemp: Temporary arrays for digitized data. See 3.7 DIGITIZE Subroutine.
Data will be rotated but not scaled in these arrays.

LINE #:
3480-3600: Output Figure 2.9 DIGITIZE FILES; input FS(L1).
3610-3730: Digitize file number L1.
3650: Test to end digitizing.
3670: Test to delete a point.
3700-3410: Signal end of digitizing.

CALLED FROM: Subroutine DIGITIZE.

3.10 SUBROUTINE DIG_OPTS

FUNCTION: Scale data for permanent data array, rotate temporary data array, present digitizing edit options to the user, input the option number that the user has selected, and branch to appropriate subroutines.

VARIABLES:
Ed: Passed to the HARD subroutine to flag program to print the data on the thermal printer instead of the CRT.
Scaleck: Scale check. Counts the number of digitizing edit options that have been chosen in 3.10 DIG_OPTS. When Scaleck=1, it flags DIG_OPTS to branch to DIG_SCALE to scale digitized data to user units. By incrementing it each time an option is chosen, data is only scaled once, except to be rescaled after going to 3.11 DIG_EDIT where it has been set back to 0.
D0: Digitizing edit option number input by the user.

LINE #:
3750-3940: Output Figure 2.10 DIGITIZING EDIT OPTIONS; input D0.
3880: Increment scaling flag.
3950: Scale digitized data once.
3960-3980: Branch to appropriate subroutines or return to 3.7 DIGITIZING subroutine if user did not input an option number.

CALLED FROM: Subroutine 3.7 DIGITIZING.
3.11 SUBROUTINE DIG_EDIT

FUNCTION: Let the user edit the digitized data by stepping the digitizing pen to the points that have been digitized and allowing the user to re-digitize, delete or add additional points.

VARIABLES:
K: Number of points in file number L1.
I: Point that is to be changed or deleted.
I+1: Point to be added.

LINE #:
4770-4860: Output Figure 2.11 RE-DIGITIZING OPTIONS.
4870: Reset flag to scale the data.
4880: Rotate the data back to its original values.
4910: Step digitizing pen to point number I.
4930: Input option number.
4990-5020: Branch to appropriate options.
5030-5080: Re-digitize point I.
5090-5150: Delete point I by bumping down all subsequent points by 1.
5160-5250: Add a point by digitizing a new point and bumping all subsequent points up by 1.

CALLED FROM: Subroutine 3.10 DIG_OPTS.

3.12 SUBROUTINE DEFINE_FUNCTION

FUNCTION: Allow user to input the number of data files (stored in In(4)) by defining a function and storing it directly into the program at line 5770.

VARIABLES:
Function: Counts the of files that have been defined. Used to flag the return to 3.4 INPUT_DATA subroutine.
Xmnn,Xmxx: Data range For the function of X input by the user.
Inc: Increment between X values ( (Xmxx-Xmnn)/Npt(L1) ).
Start: Initial X value.

LINE #:
5280-5560: Output Figure 2.12a-c DEFINE FUNCTION; input FS(L1),Npt(L1),Xmxx,Xmnn
5570-5620: Output Figure 2.12d.
5630-5720: Generate data by adding a constant interval to Xmnn to get the X value, and using that X value in the user defined function to obtain the corresponding Y value.
5740-5750: Get the next function.
5770: Function that has been defined and stored by the user.

CALLED FROM: Subroutine 3.4 INPUT_DATA.
3.13 SUBROUTINE EDIT_DATA

FUNCTION: Allow the user to choose to print, review or edit file number L1, and branch to appropriate subroutine until user choosed to exit edit mode.

VARIABLES:
- Ed: Edit option number chosen by the user.
- Dig_flag: If EDIT_DATA has been called from DIG_OPTS subroutine, change temporary data files Xtemp and Ytemp also and scale them back to plotter units.
- C0: Counter to print data on the CRT in groups of 18.

LINE #:
5780-5910: Display Figure 9a EDIT DATA; input Ed.
5920-5930: Depending on the user's choice:
   (1) Branch to REVIEW subroutine to print on CRT.
   (2) Branch to EDIT_IT subroutine to display Figure ; input new X and Y data values for data pair #Al.
   (3) Branch to HARD subroutine to print on thermal printer.
5940: Repeat until the user choosed to exit edit mode.

CALLED FROM:
Subroutine KEYBOARD.
Subroutine TAPE.
Subroutine DIGITIZE.
Subroutine DEFINE_FUNCTION.

3.14 SUBROUTINE OPTIONS

FUNCTION: This is the main pivot point in the program. User will always be returned to this menu until option #4 is chosen. Program control will then be returned to the main program which will call a subroutine to terminate the program.

VARIABLES:
- Al: Options number input by the user.

LINE #:
410-540: Output Figure 2.4 PROGRAM OPTIONS; input Al.
550-610: Branch to subroutines or return to 3.2 PROGRAM PLOT.

CALLED FROM: 3.2 PROGRAM PLOT.
3.15 SUBROUTINE SAVE_DATA

FUNCTION: If the data were input from tape, they may be restored into
the same data set on tape. If the data were input in the other
modes, they may be stored into a new set on tape.

VARIABLES:
DS: Data set name input by the user.
AS: Data set descriptor input by the user.
Nr: Number of records to create for the data set storage.
Mxnpt: The largest number of points in any one file.
Restore: Flag to store data into the same set.

LINE #:
6450-6520: Output Figure 2.14a SAVE DATA; input Al.
6530-6570: Output Figure 2.14b; input DS.
6570-6680: Compute Mxnpt, Nr; purge the old file; and create a new file
on the tape.
6690-6770: Output Figure 2.14c; input AS.
6780-6900: Print data onto the tape.

CALLED FROM: Subroutine 3.14 OPTIONS.

3.16 SUBROUTINE PLOT_DATA

FUNCTION: Present all user with all scaling and plot options and plot on
CRT, thermal printer or digital plotter.

VARIABLES:
Defaults: Flag to set all the plot options the their defaults and to force
the user to run through all the plot option menus.
An: Flag input by the user to use the previous run's parameters. In the
program it will cause the program to scale the data if a log axis is
used and skip directly to MENU 4 subroutine.
Log_ck: Flag that new data have been input. Set at the INPUT_DATA subroutine.

LINE #:
7950-8040: Pass the COMMON variables.
8050: Save the total number of files.
8060: If the graph was retrieved from tape, skip directly to 3.38 Menu_4.
8070: If Defaults is true, the plot options will be set to their
defaults and the user must enter all scale options.
8080-8110: Output Figure 2.17 PLOT DATA menu and input An.
8130: Find the ranges of the data files.
8140-8150: If there are new data and the user wishes to plot a log scale
take logarithms of the new data.
8170-8230: Go to all the plot option menus.

CALLED FROM: Subroutine 3.14 OPTIONS.
3.17 SUBROUTINE FIND_RANGE

FUNCTION: Find the X and Y data ranges for each file and for the entire data set.

VARIABLES:
X min(*), X max(*), Y min(*), Y max(*): Data ranges for each file to be used in 3.34 NORMALIZE subroutine.
Xmin, Xmax, Ymin, Ymax: Data ranges for entire data set to be used in 3.21 SCALE_TYPE and 3.22 ENTER_SCALES subroutines.

CALLED FROM:
Subprogram 3.16 PLOT_DATA.
Subroutine 3.21 SCALE_TYPE.
Subroutine 3.34 NORMALIZE.

3.18 SUBROUTINE SET_DEFAULTS

FUNCTION: Set all plot options to their defaults and set Default flag to false.

CALLED FROM: Subprogram 3.16 PLOT_DATA.

3.19 SUBROUTINES X_LIN_TO_LOG and Y_LIN_TO_LOG

FUNCTION: Scale the data set from user input form to graphing form.

CALLED FROM:
Subprogram 3.16 PLOT_DATA.
Subroutine 3.21 SCALE_TYPE.

3.20 SUBROUTINES X_LOG_TO_LIN and Y_LOG_TO_LIN

FUNCTION: Scale data set back from graphing form to user input form.

CALLED FROM: Subroutine 3.21 SCALE_TYPE.

3.21 SUBROUTINE SCALE_TYPE

FUNCTION:
1) Convert data to and from plotting units if log or semi-log scale types were chosen by the user.
2) Input scale type.
3) Branch to 3.22 ENTER_SCALES subroutine to input X and Y scale range.

VARIABLES:
Pt: Scale type input by the user.
SUBROUTINE SCALE_TYPE cont.

LINE #:
9090-9110: Convert data from log form to linear form if previous scale type chosen was log for either axis.
9120: Find ranges for the data set.
9130-9510: Output Figure 2.18 SCALE TYPE menu; input Pt.
9520-9530: Convert data to log form for log axes.
9550: Get new scale ranges.

CALLED FROM: Subprogram 3.16 PLOT_DATA.
             Subroutine 3.25 MENU_T.

3.22 SUBROUTINE ENTER_SCALES

FUNCTION: Input scale ranges for the X and Y axes.

VARIABLES:
Xmn,Xmx,Ymn,Ymx: Values input by the user for the X and Y axis scaling ranges.
Nx,Ny: Distance between minor tics on the linear axes, or the number of major tics on the log axes.
Xm,Ym: Number of major ticks.
Xt,Yt: Value of the minor tics in user units on linear axes.
Dmin,Dmax: Check if input values for log units are powers of ten.

LINE #:
9570-9590: Output Figure 2.19a ENTER SCALES.
9610-9830: Enter Xmn,Xmx for log axis.
9850-9930: Enter Xmn,Xmx for linear axis.
9940-9960: Output Figure 2.19b.
9980-10180: Enter Ymn,Ymx for log axis.
10200-10280: Enter Ymn,Ymx for linear axis.

CALLED FROM:
             Subroutine 3.21 SCALE_TYPE.
             Subroutine 3.25 MENU_T.

3.23 SUBROUTINE LABELS

FUNCTION: Input title and axes labels for the plot.

VARIABLES:
TS: Title.
XS: X axis label.
YS: Y axis label.

CALLED FROM:
             Subprogram 3.16 PLOT_DATA.
             Subroutine 3.25 MENU_T.
3.24 SUBROUTINE TIC_COUNT

FUNCTION:
1) Input the number of labelled major tics.
2) Compute new X and Y minor tics (Xt,Yt) in user units.

VARIABLES:
Xm,Ym: Number of major tics input by user.
Xt,Yt: minor tic values in user units.

LINE #:
10420-10470: Output Figure 2.21a CHANGE TICS.
10490-10580: Output Figure 2.21b.
   Input Xm.
   Compute Xt,Nx.
10590-10650: Output Figure 2.21c; input A1.
10680-10770: Output Figure 2.21d.
   Input Ym.
   Compute Yt,Ny.
10780-10830: Output Figure 2.21e; input A1.

CALLED FROM: Subroutine 3.25 MENU_1.

3.25 SUBROUTINE MENU_1

FUNCTION: Branch to subroutines that corresponds to option number chosen by the user until no option is chosen (A1=0).

VARIABLES:
A1: Option number input by the user.

CALLED FROM:
Subprogram 3.16 PLOT_DATA.
Subroutine 3.38 MENU_4.

3.26 SUBROUTINE MENU_2

FUNCTION: Branch to subroutine that corresponds to the option number input by the user until no option is chosen (A1=0).

VARIABLES:
A1: Option number input by the user.

CALLED FROM:
Subprogram 3.16 PLOT_DATA.
Subroutine 3.38 MENU_4.
3.27 SUBROUTINE STD_DEV

FUNCTION: Output the 2.24 STANDARD DEVIATION menu, input the standard deviation flag; and if standard deviation is used, input the value of one standard deviation and the number of standard deviations to plot.

VARIABLES:
   Sd: Input flag to plot standard deviation.
   Num_sd: Number of standard deviations to plot.
   Std: Value of one standard deviation.

CALLED FROM: Subroutine 3.26 MENU_2.

3.28 SUBROUTINE SCI_NOT

FUNCTION: Output the 3.25 SCIENTIFIC NOTATION menu, and input the flag to use scientific notation.

VARIABLES:
   Sci_not: Flag to plot scientific notation.

CALLED FROM: Subroutine 3.26 MENU_2.

3.29 SUBROUTINE TITLE_SIZE

FUNCTION: Output the figure 2.30 TITLE SIZE menu and input Tsize. Tsize will be used in the LABEL subroutine which is called from the PLOT subroutine.

VARIABLES:
   Tsize: Character size multiplier for the title.

CALLED FROM: Subroutine 3.26 MENU_2.

3.30 SUBROUTINE LABEL_SIZE

FUNCTION: Output the figure 2.31 LABEL SIZE menu and input Lsize. Lsize will be used in the LABEL subroutine which is called from PLOT subroutine.

VARIABLES:
   Lsize: Character size multiplier for the X and Y axes labels.

CALLED FROM: Subroutine 3.26 MENU_2.

3.31 SUBROUTINE NUMBER_SIZE

FUNCTION: Output the figure 2.32 NUMBER SIZE menu and input Nsize. Nsize will be used in the NUMBER subroutine which is called from PLOT subroutine.

VARIABLES:
   Nsize: Character size multiplier for the labels for the major tics on the X and Y axes.

CALLED FROM: 3.26 MENU_2.
3.32 SUBROUTINE DIMENSIONS

FUNCTION: Reset
plot aspect ratios to their defaults, output 2.29 DIMENSIONS
menu and input sizes.

VARIABLES:
Xsize, Ysize: Length of horizontal and vertical sides of the graph
in graphic units.

CALLED FROM: 3.26 MENU_2.

3.33 SUBROUTINE ANNOTATION

FUNCTION: Output 2.26 ANNOTATION menu, input annotation flag and input annotation
size if annotation is to be used.

VARIABLES:
Annot: Flag use annotation in graph.
Asize: Character size multiplier for annotation.

CALLED FROM: 3.26 MENU_2.

3.34 SUBROUTINE NORMALIZE

FUNCTION: If data are normalized, set flag and normalize the selected
data file.

VARIABLES:
X_min(L1), X_max(L1), Y_min(L1), Y_max(L1): Data ranges for file number L1.
X_min$(L1), X_max$(L1), Y_min$(L1T), Y_max$(L1): Character values of the
- data ranges for file number L1.-
Norm: Flag that a file has been normalized.
Xmult, Ymult: Multipliers for the X and Y data values.
File: File number to be normalized.

LINE #:
12300-12470: Output Figure 2.27 NORMALIZE; input A1.
12490: Set normalize flag.
12500: Input File, Xmult, Ymult.
12510-12590: Normalize data file number File.
12600-12590: Set display string for use in 3.26 MENU_2.
12700: Find new values for the data ranges.

CALLED FROM: 3.26 MENU_2.
3.35 SUBROUTINE SHADING

FUNCTION: Input flag if a data file is to be shaded and if so input which data files are to be shaded.

VARIABLES:
Shade: Flag if any data file is to be shaded.
Shade(L1): Flag to shade file number L1. Used in PLOT subroutine.
Shade$(L1): Print character for L1 in 3.26 MENU 2.
L1$: Print L1 as a character in the 3.35 SHADING menu.

LINE #:
12760-12830: Output Figure 3.35a SHADING; input Shade.
12860-12940: Output Figure 3.35b; input shade flags for each file.
12950-13040: Set output string for use in Menu 2
12950-13040: Set up output string for use in 3.26 MENU_2.

CALLED FROM: 3.26 MENU_2.

3.36 SUBROUTINE MENU_3

FUNCTION: Output 2.33a MENU 3: PLOT TYPES and input A1. Branch to 3.37 PLOT_TYPES subroutine until user chooses to exit this menu (A1=0).

VARIABLES:
A1: Flag to change plot types.

CALLED FROM:
Subprogram 3.16 PLOT DATA.
Subroutine 3.38 MENU_4.

3.37 SUBROUTINE PLOT_TYPES

FUNCTION: Output 2.33b PLOT TYPES menu for each file and input new plot type and line type, symbol and symbol size, if used.

VARIABLES:
P1(L1): Plot type for file number L1. Used in PLOT subroutine.
Lt(L1): Line type for file number L1. Used in LINES subroutine which is called from PLOT subroutine.
LS(L1): Symbol for file number L1. Used in SYMBOLS subroutine which is called from PLOT subroutine.
Cm(L1): Symbol size for file number L1.

CALLED FROM: 3.36 MENU_3.
3.38 SUBROUTINE MENU_4

FUNCTION: Branch to subroutine that correspond to the option number entered by the user from 2.35 MENU 4: OUTPUT MEDIA menu until no option is chosen (Al=0). The user has options to plot data on the CRT, thermal printer and digital plotter or the user may return to any of the other three options menus.

VARIABLES:
   Al: Option number

CALLED FROM: 3.16 PLOT_DATA.

3.39 SUBROUTINE CRT

FUNCTION: Set plotting variables to the CRT defaults and plot data on the CRT.

VARIABLES:
   S: Set the size of the plot to the size of the CRT.
   Xdp,Ydp: Set plotting offsets to 0. Used in PLOT subroutine to center the graph on the digital plotter platten.

CALLED FROM: 3.38 MENU_4.

3.40 SUBROUTINE PRINTER

FUNCTION: Dump whatever is on the graphics CRT onto the thermal printer.

CALLED FROM: 3.38 MENU_4.

3.41 SUBROUTINE STAN_DEV

FUNCTION: If the PLOT subroutine is called from the CRT subroutine, this subroutine allows the user to digitize the bottom of the desired position of the error bar. However, if PLOT was called from the PLOTTER subroutine, the error bar is plotted where the last error bar position was digitized.

VARIABLES:
   Sdx,Sdy: Coordinates for the digitized position of the error bar.
   Nsd_gu: Length of the error bar in graphic units.
   Num_sd: The number of standard deviation ot plot. Input in the 3.27 STD_DEV subroutine.
   Nsd: Value of one standard deviation. Input in the 3.27 STD_DEV subroutine.

LINE #:
18240-18320: Output 2.36 STANDARD DEVIATION DIRECTIONS menu.
18330-18350: Set cursor on screen; digitize position; find length of bar.
18360-18410: Draw the error bar.
18420-18510: Draw plus or minus the number of standard deviations.

CALLED FROM: Subroutine PLOT.
3.42 SUBROUTINE ANNOTATE

FUNCTION: If called from the CRT subroutine, user is allowed to enter up to thirty annotation labels by digitizing the point where the annotation is to be labeled and then entering the annotation label from the keyboard. The user signals the end of the annotation by digitizing the same point twice. If called from the PLOTTER subroutine, the annotation will be plotted where it was last entered from the CRT.

VARIABLES:
L: Subscript for the annotation array.
Ann: Number of labels input. Used in 3.45 COLORS to input colors for the annotation labels.
Xa(L),Ya(L): X,Y coordinate of the first letter of annotation label number L.
Asize: Character size multiplier for the annotation. It is input by the user in the ANNOTATION subroutine.

LOGIC:
Output 3.37 ANNOTATION DIRECTIONS menu.

Until user chooses to stop inputting annotation, set a loop to:
a) Digitize position for the label.
b) Input labels from the keyboard (Plabel$$(L)).
c) Write the label on the CRT.
d) Exit loop when the same point is digitized twice i.e. Xa(L-1)=Xa(L) and Ya(L-1)=Ya(L).

If plotting on the digital plotter;
a) Pick pen for label.
b) Skip everything but the labeling in line #15670.

LINE #:
18580-18660: Output Figure 3.37 ANNOTATION DIRECTIONS menu.
18690: Put cursor on the CRT screen.
18720&18760: Test to exit annotation loop.
18740: Digitize label position on the CRT.
18780-18850: Label the annotation.

CALLED FROM:
3.39 CRT.
Subroutine PLOTTER.
3.43 SUBROUTINE PLOTTER_MENU

FUNCTION: Output 2.38 DIGITAL PLOTTER menu for the digital plotter, input the output media chosen by the user and branch to the appropriate subroutine.

VARIABLES:
   Do: Input option number.

CALLED FROM: Subroutine PLOTTER.

3.44 SUBROUTINE SIZE

FUNCTION: Output 2.39 PLOT SIZE menu, input plot size, and compute plotting offsets Xdp and Ydp.

VARIABLES:
   S: Plot size input by the user.
   Xdp,Ydp: Offsets to center the graph on the platten.

CALLED FROM: Subroutine PLOTTER.

3.45 SUBROUTINE COLORS

FUNCTION: Output 2.40 PLOT COLORS and 2.41 ANNOTATION COLORS menus. Input option number to change color, file number (if needed), and new pen number until user choosed to go to next menu or plot the data by not choosing an option number (A1=0).

VARIABLES:
   Pen$: BLACK,BLUE,GREEN,RED color array.
   Pc1: Color for axes, standard deviation and tic marks.
   Pc2(L1): Color for file number L1.
   Pc3: Color for the title.
   Pc4: Color for the axes labels.
   Op: Option number input by the user.
   Fil: File number to be changed if option number 4 was chosen.
   P: New pen number.
   Annot: Flag to go to the annotation menu if annotation is used.
   Ann-1: Number of annotation labels.
   PlabelS: Array of annotation labels.

CALLED FROM: Subroutine PLOTTER.
APPENDIX A: MATERIALS
APPENDIX A: MATERIALS

This appendix contains tips on the output media materials that may be used on the internal thermal printer and/or the digital plotter. The appendix is broken up into sections describing the (1) paper; (2) pens; and (3) miscellaneous materials. Each section begins with a description on the best use of each material followed by a list of these materials that contains a description of the material, the order number, and the quantity per order.

Section 1: PAPER

INTERNAL THERMAL PRINTER: Hewlett Packard produces two types of thermal paper: (1) continuous roll; and (2) perforated 8.5 x 11 inch roll with black print. One graph using all the size defaults uses two-thirds of an 8.5 x 11 inch page. If the perforated paper is used and the TOP OF FORM button on the 9645 is not pressed after one graph, the next graph will be plotted over the perforation leaving a one inch gap in the graph. For this reason the continuous paper is the one recommended.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ORDER #</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP continuous blue print thermal paper</td>
<td>92161R</td>
<td>6 rolls</td>
</tr>
<tr>
<td>HP perforated Page-Perf high contrast black print thermal paper</td>
<td>92161D</td>
<td>6 rolls</td>
</tr>
</tbody>
</table>

DIGITAL PLOTTER:

PLOTTING WITH FELT TIP PENS: The drawing paper is a medium weight cotton fiber paper that definitely produces the best results. It yields a clear solid line and does not darken or wrinkle easily. If slides of plots are to be made, this is the only paper recommended.

Thermal paper may also be used. It yields a bright, clear line, but darkens and wrinkles easily. However, it is a good idea to use this as scrap paper for trial plots before plotting on the more expensive paper or transparencies.

PLOTTING WITH THE DRAFTING PEN: The drafting pen can be used on almost any kind of paper, but the vellum drafting paper yields the most pleasing results.

PLOTTING TRANSPARENCIES: By far the best transparency film used so far is made by Hewlett Packard as it does not smear.

PLOTTING WITH SPECTRUM PENS: The Spectrum Graphics Kit is new from Hewlett Packard. The kit contains subtractive ink pens, i.e., pens that blend their colors together as they overwrite each other. It is definitely recommended to use spectrum paper with the spectrum pens. The inks will blend on different types of paper; but they
appear dark and mixing more than two colors generally produces black. The stacked bar chart effect in Figure 7 of APPENDIX F was created by assigning a different color to each file and shading.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ORDER #</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transparencies</td>
<td>9270-0639</td>
<td>100 8.5&quot;x11&quot; sheets</td>
</tr>
<tr>
<td>Spectrum Paper</td>
<td>9280-0516</td>
<td>100 8.5&quot;x11&quot; sheets</td>
</tr>
</tbody>
</table>

Section 2: PENS

FELT TIP PENS: The Hewlett Packard felt tip pens for the digital plotter come in regular tip (0.3 mm) and broad tip (0.7 mm). Regular tip pens work well for everything but should especially be used if the plot size is less than 0.65. The broad tip pens are good for (1) paper that doesn't absorb ink well (such as the vellum) (2) making numbers, title and axes labels stand out more; and (3) making the shading completely solid.

TRANSPARENCY PENS: Hewlett Packard transparency pens should be used on the Hewlett Packard transparency film. Felt tip pens should not be used on the transparency film because it smears badly. The transparency pens also come in two tip widths and are used in the same way as the felt tip pens. If the program is being used to make viewgraphs, the broad tip pens should be used.

DRAFTING PEN: The Hewlett Packard liquid ink drafting pen is the only satisfactory drafting pen that has been tried so far. It is used just as the felt tip pens are; however, because it is bigger, the user must be careful that the plotter does not try to put the pen away into one of the pen stables as this can cause considerable damage to the plotter.

SPECTRUM PENS: Hewlett Packard claims that the new subtractive ink pens can create up to 100 different colors. They work especially well for large shaded areas. There are only 12 distinct colors that may be created, while the other 90 rely on adding differing concentrations of dots on another color, causing the eye to blend them together into another slightly different shade. Figure 7 in APPENDIX F shows the three primary colors (yellow, magenta, and cyan) and the intermediate colors produced by mixing 2 colors together. Care should be taken when using these pens that the pens stables have been cleaned out carefully with a cotton tipped swab, and they should not be used in conjunction with the regular felt tip pens.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>ORDER #</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrow tip felt tip plotting pens</td>
<td>5060-6810</td>
<td>1 pack of 4 colors (black, blue, red, green)</td>
</tr>
<tr>
<td>Wide tip felt tip plotting pens</td>
<td>5060-6858</td>
<td>1 pack of 4 colors (black, blue, red, green)</td>
</tr>
</tbody>
</table>
### Section 3: MISCELLANEOUS

**TAPES:** The only storage medium used by this program is the magnetic minicassette tapes that may be ordered from Hewlett Packard.

**KITS:** Hewlett Packard provides a transparency kit and a spectrum graphics kit. The transparency kit contains 200 sheets of transparency film, a 1 ounce bottle of ink solvent, and one package each of blue, black, red, green; and violet, gold, orange, and black pens in broad and regular tips. The spectrum graphics kit contains 100 sheets of spectrum paper and four packages of spectrum pens. These kits do not save any money but they are more convenient to order.
APPENDIX B: MODIFICATIONS
APPENDIX B: MODIFICATIONS

In using BUGS, there are occasions which require changes to be made in the program to accommodate a particular graph. Below are listed some changes that have been needed most frequently.

I. A line of the program may be changed by:
   1) Pressing the STOP key to the right of the alphanumeric keyboard.
   2) Typing EDITLINE and the number of the line to be changed.
   3) Pressing EXECUTE.
   4) Typing in the desired change, using the arrows in the display pad to move the cursor.
   5) Pressing the STORE key located directly above the right SHIFT key.
   6) Pressing the RUN key located beneath the STOP key to begin the program over.
   7) BUGS may be changed permanently on the program tape by typing RESTORE "BUGS" and pressing EXECUTE.

II. Modifying Plot Input.
   A. Modifying array and string dimensions: All data and plotting arrays are declared in the INIT and SET DEFAULTS subroutines. Data arrays are declared by the array name followed by parentheses containing the number of elements in the array. String arrays are similar with the addition of the number of characters contained in each element declared in brackets after the parentheses. NOTE: If the number of elements or characters allowed in an array is changed, the user may not store the graph on tape unless 1) the user makes this a permanent change in the program and restores any previously stored graphs in the new format; or 2) Make sure that the changes in the program have been made again before the graph is retrieved.
   1. Change the number of annotation labels allowed:
      Line 160, 180, 210: Change the subscripts in Xa, Ya, LabelS, and Plabel to the new number of annotation labels allowed.
      18700: Change the 40 to the new number of labels allowed.
   2. Change the number of characters allowed in string variables. Below is a list of all string variables that may be changed.
      Title:              TS[30]
      X axis label:      XS[20]
      Y axis label:      YS[20]
      Annotation labels: Labels(40)[80]
   B. Define a function of more than one variable: To change the function both the program and the special function key file "FUNKEY" must be changed.
      1. In the program, line 5700 must be changed to call the function of all the variables that are to be passed. Variables may be added by inserting the new variables separated by commas within the parentheses.
      2. The special function key file must be changed by:
         a. Typing EDIT KEY 0 and then pressing EXECUTE.
         b. Press the DEL LINE key in the edit pad at the top left of the keyboard.
         c. Add new variables within the parentheses in the same order as they are listed in the program line 5700.
         d. Press EXECUTE.
e. To change the program permanently:
   1) Press special function key k0.
   2) Type PURGE "FUNKEY" and then press EXECUTE.

f. Type STORE KEY "FUNKEY" and then press EXECUTE.

III. Modifying plotting defaults: All defaults are set in the Set defaults subroutine. There are two kinds of defaults used: (1) variables that flag the use of an option; and (2) size and dimension specifiers. Below is a list of the plot defaults that may be changed that contains the program variable name and function with their default values.

<table>
<thead>
<tr>
<th>A. Size specifiers: Function</th>
<th>Variable name</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title size</td>
<td>Tsize</td>
<td>1</td>
</tr>
<tr>
<td>Axes label size:</td>
<td>Lsize</td>
<td>1</td>
</tr>
<tr>
<td>Number size:</td>
<td>Nsize</td>
<td>1</td>
</tr>
<tr>
<td>Annotation size:</td>
<td>Asize</td>
<td>1</td>
</tr>
<tr>
<td>Length of X axis:</td>
<td>Xsize</td>
<td>100</td>
</tr>
<tr>
<td>Length of Y axis:</td>
<td>Ysize</td>
<td>60</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Options Flags:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Shading:</td>
<td>Shade</td>
<td>No</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>Sd</td>
<td>No</td>
</tr>
<tr>
<td>Annotation</td>
<td>Annot</td>
<td>No</td>
</tr>
<tr>
<td>Scientific Notation</td>
<td>Scinot</td>
<td>No</td>
</tr>
<tr>
<td>Plot type</td>
<td>Pl(*)</td>
<td>Lines</td>
</tr>
<tr>
<td>Line type</td>
<td>Lt(*)</td>
<td>Solid</td>
</tr>
<tr>
<td>Symbol</td>
<td>L$(*$)</td>
<td>&quot;*&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Graph parameters:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame</td>
<td>Frame</td>
<td>1</td>
</tr>
<tr>
<td>Tic marks</td>
<td>Axes</td>
<td>1</td>
</tr>
<tr>
<td>Numbers</td>
<td>Number</td>
<td>1</td>
</tr>
<tr>
<td>Axes labels</td>
<td>Label</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>D. Miscellaneous:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>$T$</td>
<td>Null</td>
</tr>
<tr>
<td>X axis label</td>
<td>$X$</td>
<td>Null</td>
</tr>
<tr>
<td>Y axis label</td>
<td>$Y$</td>
<td>Null</td>
</tr>
<tr>
<td>Major tic</td>
<td>Xm,Ym</td>
<td>4</td>
</tr>
</tbody>
</table>

IV. Modifying Plot Output.

A. Modifying histogram bar width: The width of the bar is given by half the distance between the smallest interval between any two X values minus two graphics units. For many plots, this gap appears much too small. To change this, replace the 4 in line 17650 with five times the new width. NOTE: The bars appear much thicker on the CRT than on the plotter.
APPENDIX C: PROGRAM LISTINGS
10 ! ################################################################################ PROGRAM PLOT ################################################################################
20 GOSBJ Init
30 GOSJB Options
40 GOSJB End it
50 End: END ! ################################################################################ END PLOT ################################################################################
60 !
70 !
80 Init: ! ################################################################################ SUBROUTINE TO INITIALIZE PROGRAM ################################################################################
90 !
100 DEG
110 OPTION BASE 1
120 COM F$(25)[20], SHORT X1(25,200), Y1(25,200)
130 COM INTEGER Npt(25), Defaults, Log_ck, Pfile, P1(25), Lt(25), Pc2(25)
140 COM INTEGER Pt, Xm, Ym, Xsize, Ysize, Norm, Shade, Annot, Sd, File, Nt, Nx, Ny
150 COM INTEGER Pc1, Pc3, Pc4, Scinot, Num_sd, Ann, Frame, Axes, Number, Label
160 COM SHORT XmX, Xn, Ymn, Xm, Ym, Xt, Yt, Tsize, Lsize, Nsize, Asize, Xmult, Ymult, S
170 COM SHORT Xmax, Xmin, Ymax, Ymin, Sdx, Sdy, Nsd, Options
180 COM L$(25)[1], T$(30), X$(20), Y$(20), V$(10), P$(4)[12], Label$(40)[80]
190 COM Pen$(4)[5], Shade$(30), Norm$(30)
200 COM X_max$(25)[12], X_min$(25)[12], Y_max$(25)[12], Y_min$(25)[12]
210 COM INTEGER Norm(25), Shade(25), Plabel(40)
220 SHORT Xtemp(25,200), Ytemp(25,200)
230 INTEGER Ntemp(25)
240 DIM A$(20), B$(30), C$(30), D$(6), Ftemp$(25)[20], E$(20)
250 !
260 Pen$(1)"BLACK"
270 Pen$(2)"BLUE"
280 Pen$(3)"GREEN"
290 Pen$(4)"RED"
300 P$(1)"LINEAR"
310 P$(2)"X-LIN, Y-LOG"
320 P$(3)"X-LOG, Y-LIN"
330 P$(4)"X-LOG, Y-LOG"
340 Defaults=1
350 RETURN
360 ! ################################################################################ PROGRAM OPTIONS ################################################################################
370 ! *
380 ! *
390 ! *
400 ! ################################################################################
410 Options: PRINT PAGE; LNK(2); TAB(30); "PROGRAM OPTIONS"
420 PRINT LNK(2); TAB(15); "(1) INPUT NEW DATA from keyboard, tape,
digitized on digital"
PRINT TAB(34);"plotter, and as a user defined function"
PRINT LIN(2);TAB(15);"(2) PLOT DATA on CRT, thermal printer or
digital plotter"
PRINT LIN(2);TAB(15);"(3) SAVE DATA on tape"
PRINT LIN(2);TAB(15);"(4) RETRIEVE GRAPH from tape."
PRINT LIN(2);TAB(15);"(5) SAVE GRAPH on tape."
PRINT LIN(2);TAB(15);"(6) EXIT PROGRAM"
Options=0
INPUT "ENTER OPTION ", Options
IF (Options)<1) AND (Options<6) THEN GOTO Goto_sub
GOTO Options
PRINT LIN(2);TAB(15);"OPTION NOT WITHIN 1 AND 6...TRY AGAIN"
GOTO 490
Goto_sub: IF Options=1 THEN GOSUB Input_data
IF Options=2 THEN CALL Plot_data
IF Options=3 THEN GOSUB Save_data
IF Options=4 THEN GOSUB Retrieve_graph
IF Options=5 THEN GOSUB Save_graph
IF Options=6 THEN RETURN
GOTO Options
RETURN
!
INPUT DATA
!
!
Input_data: L1=1
Log_ck=0
Dig_flag=0
Norm=0
MAT Norm=(0)
Norm$=""
Crt=0
REDIM X1(25,200),Y1(25,200),Nnt(25),F$(25)
REDIM Xtemp(25,200),Ytemp(25,200)
Start_in: PRINT PAGE;LIN(1);TAB(30);"INPUT OPTIONS"
PRINT LIN(1);TAB(5);"This program allows you to input up to 5000
data points."
PRINT TAB(5);"You may input a maximum of 25 data files to be plo
ted and/or"
PRINT TAB(5);"saved on tape. The maximum number of points allowe
d in each"
PRINT TAB(5);"data file therefore equals 5000 divided by the num
er of files."
PRINT TAB(5);"to be input."
PRINT LIN(1);TAB(5);"To start program you must input at least on
e data file."
PRINT TAB(5);"Data files may be input from the keyboard, tape, d
igitized on"
PRINT TAB(5); "the digital plotter, defined as a function by the user, or any"
PRINT TAB(5); "combination of these."
PRINT LIN(1); TAB(5); "You will now be asked interactively to enter the number of data files"
PRINT TAB(5); "that you want to be input from each input mode."
Go_back: PRINT LIN(1); TAB(5); "ENTER # of FILES to be INPUT from KE YBOARD"

In(1)=0
PRINT TAB(23); "INPUT from TAPE"
In(2)=0
PRINT TAB(23); "DIGITIZED on DIGITAL PLOTTER"
In(3)=0
PRINT TAB(23); "FUNCTION DEFINED by USER"
In(4)=0
PRINT TAB(5); "You may only input up to 25 files...Press CONT to TRY AGAIN"
In<1>=0 THEN GOTO Start_in
GOTO Start_in
IF In<2>=0 THEN 1100
GOTO Start_in
IF In<3>=0 THEN GOTO Start_in
IF In<4>=0 THEN GOTO Start_in
Pts=INT(5000/Pfile)
REDim X1(Pfile, Pts), Y1(Pfile, Pts), Npt(Pfile), F$(Pfile)
REDim Xtemp(PFile, Pts), Ytemp(PFile, Pts), Ntemp(Pfile, Ftemp$<Pfile)
IF In<1>=0 THEN GOSUB Keyboard
IF In<2>=0 THEN GOSUB Tape
IF In<3>=0 THEN GOSUB Digitize
IF In<4>=0 THEN GOSUB Define_function
RETURN
Keyboard: ! DAT A INPUT FROM KEYBOARD
###
 Key=1
PRINT PAGE; LIN(2); TAB(25); "INPUT FROM KEYBOARD"; LIN(2)
PRINT LIN(2); TAB(10); "ENTER LABEL FOR DATA FILE #"; L1; "...UP TO 20 CHARACTERS"; LIN(3)
PRINT F$(L1)
PRINT LIN(1); TAB(10); "HOW MANY DATA PAIRS ARE TO BE INPUT INTO F ILE #"; L1; "?"
PRINT LIN(1); TAB(25); "MAXIMUM ALLOWED IS"; Pts
Npt(L1)=0
1260 INPJT Npt(L1)
1270 IF Npt(L1)<0 THEN GOTO 1310
1280 BEEP
1290 PRINT LIN(2);TAB(10);"YOU MUST INPUT AT LEAST ONE DATA PAIR"
1300 GOTO 1230
1310 IF Npt(L1)=Pts THEN GOTO 1350
1320 BEEP
1330 PRINT LIN(2);TAB(10);"THE MAXIMUM NUMBER OF POINTS FOR ";Pfile;" 
FILE(S) IS ";Pts;"...TRY AGAIN"
1340 GOTO 1230
1350 PRINT LIN(2);TAB(10);"IF DATA HAS CONSTANT INTERVAL BETWEEN X VA 
LUES...ENTER 1"
1360 A1=3
1370 INPJT A1
1380 IF A1=1 THEN GOTO Constant_x
1390 PRINT PAGE
1400 PRINT LIN(2);TAB(10);"INPUT X VALUE...PRESS CONT...ENTER Y VAL 
UE";LIN(2)
1410 FOR I=1 TO Npt(L1)
1420 BEEP
1430 PRINT TAB(20);"INPUT # ";I
1440 INPUT X1(L1,I)
1450 INPUT Y1(L1,I)
1460 NEXT I
1470 GOTO Fixit
1480 Constant_x: PRINT LIN(3);TAB(10);"INPUT FIRST VALUE FOR X (i.e. 
X1(1)=?)"
1490 INPJT X0
1500 PRINT LIN(2);TAB(10);"INPUT THE INCREMENT BETWEEN ADJACENT X VA 
LUES"
1510 INPJT Dx
1520 PRINT PAGE;LIN(2);TAB(20);"INPUT Y VALUES"
1530 FOR I=1 TO Npt(L1)
1540 X1(L1,I)=X0+(I-1)*Dx
1550 BEEP
1560 PRINT LIN(2);TAB(20);"INPUT # ";I
1570 INPUT Y1(L1,I)
1580 NEXT I
1590 C$="KEYBOARD"
1600 Fixit: GOSUB Edit_data
1610 L1=1+1
1620 Keyp=Key+1
1630 IF <Key>=In(1) THEN GOTO 1200
1640 RETURN
1650 Tape: ! ################################## DATA INPUT FROM TAPE ##################################
1660 PRINT PAGE;LIN(4);TAB(25);"INPUT FROM TAPE";LIN(2)
1670 PRINT "THE DATA TAPE IS ASSUMED TO BE IN THE LEFT (:T14) CASSETTE 
DRIVE"
1680 PRINT "IF NOT THEN LOAD THE CASSETTE...PRESS CONT TO PROCEED"; 
LIN(2)
1693  INPUT A1
1700  Tape=1
1710  Cat: CAT ";T14"
1720  PRINT LlN(2);"THIS IS A CATOLOG OF THE DATA FILES ON THE TAPE...
USE THE"
1730  PRINT "ARROWS IN THE DISPLAY PAD ON THE KEYBOARD TO SCROLL UP AN
D DOWN"
1740  PRINT LlN(2);"INPUT THE DATA SET TO BE USED FOR FILE ";L1;LlN(2
1750  INPUT D$
1760  C$=D$&";T14"
1770  ON ERROR GOTO Name_err
1780  ASSIGNED #1 TO C$
1790  OFF ERROR
1800  READ #1;A$,Nfile
1810  REDIM Ntemp(Nfile),Ftemp$(Nfile)
1820  REDIM Xtemp(Nfile,5000/Nfile),Ytemp(Nfile,5000/Nfile)
1830  READ #1;Ntemp(*),Ftemp$(*)
1840  FOR K=1 TO Nfile
1850       FOR J=1 TO Ntemp(K)
1860               READ #1;Xtemp(K,J)
1870       NEXT J
1880    NEXT K
1890  ASSIGN #1 TO *
1900  Pickfile: PRINT PAGE
1910  PRINT LlN(2);TAB(23);"DATA SET DISCRPTOR IS";LlN(2);TAB(23);A$;
LlN(3)
1920  PRINT TAB(15);"THE SET HAS";Nfile;"FILES ... DESCRPTORS ARE";Ll
1930  N(2)
1940    FOR I=1 TO Nfile
1950     PRINT USING 1980;"FILE ";I,Ftemp$(I)
1960     IMAGE 25X,6A,DD,5X,20A
1970    NEXT I
1980  PRINT LlN(3);TAB(10);"INPUT the data file number you want to u
se for FILE ";L1
1990  Ifile=0
2000  INPUT Ifile
2010  IF Ifile=0 THEN GOTO Cat
2020  K=Ifile
2030  IF (Ifile>0) AND (Ifile<Nfile+1) THEN GOTO 2090
2040  BEEP
2050  PRINT LlN(2);TAB(15);"FILE # IS NOT WITHIN THE SET...TRY AGAIN"
2060  GOTO 2020
2070  IF Xtemp(Ifile)<=Pts THEN GOTO Fill
2080  BEEP
2090  PRINT PAGE;LlN(4);TAB(30);"DIMENSION ERROR"
2100  PRINT LlN(4);TAB(20);"THIS FILE HAS ";Ntemp(Ifile)+20;" POINTS I
N IT."  
2133 PRINT LIN(2);TAB(10);"THE MAXIMUM NUMBER OF POINTS ALLOWED FOR "  
;Ffile;" FILE(S) IS ";Fpts  
2140 GOTJ 2370  
2150 Fill: F$(L1)=Ftemp$(Ifile)  
2160 FOR K=1 TO Htemp(Ifile)  
2170 X1(L1,K)=Xtemp(Ifile,K)  
2180 Y1(L1,K)=Ytemp(Ifile,K)  
2190 NEXT K  
2200 Npt(L1)=Ntemp(Ifile)  
2210 GOSUB Edit_data  
2220 PRINT PAGE; LIN(6); TAB(30); "INPUT CHECK"  
2230 PRINT LIN(4); TAB(10); "IF THIS IS NOT THE CORRECT DATA FILE AND YOU WOULD LIKE"  
2240 PRINT LIN(2); TAB(10); "TO TRY ANOTHER ONE ... ENTER 1"  
2250 Again=0  
2260 INPUT Again  
2270 IF Again=1 THEN GOTO 2370  
2280 L1=L1+1  
2290 Tape=Tape+1  
2300 IF Tape>In(2) THEN RETURN  
2310 PRINT PAGE; LIN(4); TAB(30); "GET NEXT FILE"  
2320 PRINT LIN(4); TAB(10); "ENTER 0...TO PLOT ANOTHER FILE FROM THIS DATA SET"  
2330 PRINT LIN(2); TAB(10); "ENTER 1...TO PLOT A FILE FROM A DIFFERENT DATA SET"  
2340 A1=3  
2350 INPUT A1  
2360 ON A1+1 GOTO Pickfile,Cat  
2370 PRINT LIN(4); TAB(10); "ENTER 0...TO TRY A DIFFERENT DATA FILE"  
2380 PRINT LIN(2); TAB(10); "ENTER 1...TO TRY A DIFFERENT DATA SET"  
2390 A1=3  
2400 INPUT A1  
2410 ON A1+1 GOTO Pickfile,Cat  
2420 Name_err: E=ERRN  
2430 IF E<53 THEN GOTO 2480  
2440 BEEP  
2450 PRINT LIN(2); "ERROR 53: IMPROPER FILE NAME ...PRESS CONT TO TRY AGAIN"  
2460 INPUT A1  
2470 GOTJ Cat  
2480 IF E<56 THEN GOTO 2530  
2490 BEEP  
2500 PRINT "ERROR 56: FILE NAME DOES NOT EXIST...PRESS CONT TO TRY AGAIN"  
2510 INPUT A1  
2520 GOTJ Cat  
2530 GOTJ Error_end  
2540 RETURN  
2550 Digitize: ! ############### DIGITIZED INPUT ###############
C$="DIGITIZED"

Dig_flag=1

Digit=1

GOSJB Dig_init

Graph=1

GOSJB Digit

Scaleck=0

GOSJB Dig_opts

Li=-1+1

Graph=Graph+1

Digit=Digit+1

IF Digit>Inf(3) THEN RETURN

GOTO 2590

GOTO 2590

RETURN

Dig_init: ! ### SUBROUTINE TO DIGITIZE CORNERS OF GRAPH

PRINT PAGE;LIN(3);TAB(30);"DIGITIZE"

PRINT LIN(3);TAB(15);"TO SET UP PLOTTER FOR DIGITIZING:"

PRINT LIN(2);TAB(19);"(1) TURN PLOTTER ON"

PRINT TAB(19);"(2) LOAD GRAPH ANYWHERE ON PLATTEN"

PRINT TAB(19);"(3) PUT DIGITIZING PEN INTO THE LEFTMOST PEN HOLER"

PRINT LIN(3);TAB(15);"INPUT THE NUMBER OF DIFFERENT FILES THAT"

PRINT TAB(17);"YOU WANT TO DIGITIZE ON THIS GRAPH?"

Gr=0

INPUT "?",Gr

IF Gr<>0 THEN 2350

BEEP

PRINT LIN(1);TAB(8);"YOU MUST INPUT AT LEAST ONE FILE ON THIS GRAPH...TRY AGAIN"

GOTO 2300

IF Gr+Digit-1<=Inf(3) THEN GOTO 2390

BEEP

PRINT LIN(1);TAB(8);"THE NUMBER OF GRAPHS LEFT TO BE DIGITIZED IS":Inf(3)-Digit+1;"...TRY AGAIN"

GOTO 2300

PRINT PAGE;TAB(30);"INITIALIZE GRAPH"

PRINT LIN(1);TAB(5);"TO DIGITIZE: Press PEN DOWN button on PLOTTERT"

PRINT TAB(18);"Position DIGITIZING PEN over point to be digitized"

PRINT TAB(18);"Press ENTER button on PLOTTER to input the point"n

PRINT LIN(1);TAB(15);"(1) DIGITIZE lower left corner of graph frame"

PRINT LIN(1);TAB(15);"(2) DIGITIZE upper left corner of graph frame"

PRINT LIN(1);TAB(15);"(3) DIGITIZE upper right corner of graph frame"

PRINT LIN(1);TAB(15);"(4) DIGITIZE lower right corner of graph
PRINT PAGE; LINK(1); TAB(12); "NOTE: LOG ENTER LIMITS" 
PRINT LINK(2); TAB(10); "GRAPH RANGE" 
PRINT LINK(2); TAB(10); "You will now be asked to input the limits of the scales" 
PRINT LINK(2); TAB(10); "on each axis of the graph that you are digitizing" 
PRINT LINK(2); TAB(15); "INPUT THE X AXIS GRAPH LIMITS (MIN,MAX)" 
INPUT Xmn, Xmx 
IF Xmx-Xmn<0 THEN GOTO 3280 
BEEP 
PRINT LINK(2); TAB(10); "The graph range must be greater than 0. TRY AGAIN" 
GOTO 3230 
IF Pt<3 THEN GOTO 3350 
Check_lgt=INT(LGT(Xmx))-LGT(Xmn)+INT(LGT(Xmn+)-LGT(Xmn)) 
IF Check_lgt THEN GOTO 3350 
BEEP 
PRINT LINK(2); TAB(10); "The graph limits for a log axis must be powers of 10" 
PRINT LINK(2); TAB(10); "(i.e. .001,1000)...TRY AGAIN" 
GOTO 3350 
PRINT LINK(2); TAB(15); "INPUT THE Y AXIS GRAPH LIMITS (MIN,MAX)" 
INPUT Ymn, Ymx 
IF Ymx-Ymn<0 THEN GOTO 3410 
BEEP
3390   PRINT LIN(2);TAB(10);"The graph range must be greater than 0.
       TRY AGAIN"
3400   GOTO 3360
3410   IF (Pt=1) OR (Pt=3) THEN GOTO 3470
3420   Check_lgt=INT(LGT(Ymx))-LGT(Ymn)+INT(LGT(Ymn))-LGT(Ymn)
3430   IF Check_lgt=0 THEN GOTO 3470
3440   PRINT LIN(2);TAB(10);"The graph limits for a log axis must be
       powers of 10"
3450   PRINT TAB(10);"(i.e. .001,1000)...TRY AGAIN"
3460   GOTO 3360
3470   RETURN
3480   Digit: ! "SUBROUTINE TO DIGITIZE FILES "
3490   PRINT PAGE;TAB(30);"DIGITIZE FILES:"
3500   PRINT LIN(2);TAB(15);"You are allowed to DIGITIZE up to";Pts;"p
       oints per file"
3510   PRINT TAB(15);"Digitizing accuracy is generally 3%, therefore, thre"n
3520   PRINT TAB(15);"significant digits will be digitized"
3530   PRINT LIN(2);TAB(8);"(1) ENTER DESCRIPTOR for this data file
       ...Up to 20 characters"
3540   PRINT LIN(2);TAB(8);"(2) TO DIGITIZE: Press PEN DOWN butto
       n on PLOTTER"
3550   PRINT TAB(26);"Position DIGITIZING PEN over point to be digitiz ed"
3560   PRINT TAB(26);"Press ENTER button on PLOTTER to input the poi
       nt"
3570   PRINT LIN(1);TAB(8);"(3). DELETE A POINT: Digitize that same
       point twice in a row"
3580   PRINT LIN(2);TAB(8);"(4) TO EXIT: DIGITIZING mode PRESS P1
       "
3590   PRINT TAB(38);"PRESS ENTER"
3600   LINPUT "ENTER DATA DESCRIPTOR =",F$(L1)
3610   K=1
3620   PLOTTER IS 7,5,"9872A"
3630   Digit: DIGITIZE Xtemp(L1,K),Ytemp(L1,K)
3640   BEEP
3650   IF (Xtemp(L1,K)=0) AND (Ytemp(L1,K)=0) THEN Exit
3660   IF K=1 THEN GOTO 3680
3670   IF (Xtemp(L1,K)=Xtemp(L1,K-1)) AND (Ytemp(L1,K)=Ytemp(L1,K-1))
       THEN K=K-2
3680   K=K+1
3690   GOTO Digit
3700   Exit: IF K<>1 THEN K=K-1
3710   BEEP
3720   WAIT 500
3730   BEEP
3740   RETURN
3750   Digit:pts: ! "SUBROUTINE FOR DIG, OUTPUT OPTIONS & EDITING
3760   Ed=3
3773 PRINT PAGE;LIN(1);TAB(25);"DIGITIZING EDIT OPTIONS"
3783 PRINT LIN(2);TAB(12);"OPTION #"
3793 PRINT TAB(14);"(1) PLOT DATA on CRT";LIN(1)
3803 PRINT TAB(14);"(2) PRINT DATA on THERMAL PRINTER";LIN(1)
3810 PRINT TAB(14);"(3) EDIT DATA using NUMERICAL values for edit";LIN(1)
3823 PRINT TAB(14);"(4) EDIT DATA using your original graph on DIGITAL PLOTTER";LIN(1)
3833 IF Digitt=In(3) THEN GOTO 3860
3843 PRINT LIN(2);TAB(22);"PRESS CONT DIGITIZE next file";LIN(2)
3850 GOTO 3860
3860 PRINT LIN(2);TAB(22);"PRESS CONT TO EXIT DIGITIZE routine and"
3873 PRINT LIN(1);TAB(12);"DIGITIZE OPTION is not between 1 and 4. ..TRY AGAIN"
3890 GOTO 3900
3920 IF Scaleck=1 THEN GOSUB Dig_scale
3933 IF D0=0 THEN RETURN
3963 ON D0 GOSUB Dig_plot,Hard,Edit_data,Dig_edit
3983 GOTO Dig_opts
3993 RETURN
4003 Dig_scale: ! ### SUBROUTINE TO CONVERT DATA TO USER UNITS
4013 Npt(L1)=K
4023 Theta=0
4033 IF Xframe(1)=Xframe(4) THEN 4060
4043 Theta=ATN((Yframe(4)-Yframe(1))/(Xframe(4)-Xframe(1)))
4053 GOSUB Rotate
4060 GOSUB Rescale
4073 GOSUB Round
4083 RETURN
4093 Rotate:!
4103 FOR I=1 TO 4
4110 Xframe(I)=Xframe(I)*COS(Theta)+Yframe(I)*SIN(Theta)
4120 Yframe(I)=-Xframe(I)*SIN(Theta)+Yframe(I)*COS(Theta)
4130 NEXT I
4140 FOR I=1 TO K
4153 Xtemp(L1,I)=Xtemp(L1,I)*COS(Theta)+Ytemp(L1,I)*SIN(Theta)
4163 Ytemp(L1,I)=-Xtemp(L1,I)*SIN(Theta)+Ytemp(L1,I)*COS(Theta)
4173 NEXT I
4183 RETURN
4193 Rescale:!
4203 Yscale=Yframe(3)-Yframe(1)
4213 Xscale=Xframe(3)-Xframe(1)
4223 ON Pt GOTO 4230,4290,4260,4320
SUBROUTINE TO SCALE DATA BACK TO GRAPH UNIT

Xsc=(Xmx-Xmn)/Xscale
Ysc=(Ymx-Ymn)/Yscale
GOTO 4340
Xsc=(LGT(Xmx)-LGT(Xmn))/Xscale
Ysc=(Ymx-Ymn)/Yscale
GOTO 4340
Xsc=(Xmx-Xmn)/Xscale
Ysc=(LGT(Ymx)-LGT(Ymn))/Yscale
GOTO 4340
Xsc=(Xmx-Xmn)/Xscale
Ysc=(LGT(Ymx)-LGT(Ymn))/Yscale

FJR I=1 TO K
IF (Pt=1) OR (Pt=2) THEN X1(L1,I)=Xmn+(Xtemp(L1,I)-Xframe(1))*(Xsc)
IF (Pt=3) OR (Pt=4) THEN X1(L1,I)=Xmn+10^((Xtemp(L1,I)-Xframe(1))*Xsc)
IF (Pt=1) OR (Pt=3) THEN Y1(L1,I)=Ymn+(Ytemp(L1,I)-Yframe(1))*Ysc
IF (Pt=2) OR (Pt=4) THEN Y1(L1,I)=Ymn+10^((Ytemp(L1,I)-Yframe(1))*Ysc)
NEXT I
RETURN

Round: !

FJR I=1 TO K
X1(L1,I)=LGT(abs(X1(L1,I)))
Y1(L1,I)=LGT(abs(Y1(L1,I)))
X1(L1,I)=ROUND(X1(L1,I),Tenx)
Y1(L1,I)=ROUND(Y1(L1,I),Teny)
NEXT I

Rotate_back: !

IF Theta=0 THEN GOTO 4500
Theta=-Theta
GOSJB Rotate
RETURN

Dig_plot: !

IF Yscale/100>Xscale/123 THEN S=100/Yscale
IF Xscale/123=Yscale/100 THEN S=123/Xscale
PLOTTER IS 13,"GRAPHICS"
GRAPHICS
LOCATE 0,Xscale*S,0,Yscale*S
SCALE Xframe(1),Xframe(3),Yframe(1),Yframe(3)
LIVE TYPE 1
FRAME
LOG 5
CSIZE 2
IF K>100 THEN CSIZE 1
4670 MOVE Xtemp(L1,1),Ytemp(L1,1)
4680 FOR I=1 TO K
4690 DRAW Xtemp(L1,I),Ytemp(L1,I)
4700 L$="0"
4710 LABEL L$
4720 MOVE Xtemp(L1,I),Ytemp(L1,I)
4730 NEXT I
4740 PAUSE
4750 EXIT GRAPHICS
4760 RETURN
4770 Dig_edit: ! ### SUBROUTINE TO EDIT DIGITIZED DATA USING DIGITAL PLOTTER
4780 PRINT PAGE;LIN(2);TAB(25);"RE-DIGITIZING OPTIONS"
4790 PRINT LIN(2);TAB(10);"DO NOT remove GRAPH from its position on DIGITAL PLOTTER."
4800 PRINT TAB(10);"The DIGITIZING PEN will be stepped across GRAPH showing the"
4810 PRINT TAB(10);"points which you have DIGITIZED."
4820 PRINT LIN(1);TAB(3);"OPTION #"
4830 PRINT TAB(10);"(1) RE-DIGITIZE A POINT ";LIN(1)
4840 PRINT TAB(10);"(2) ADD A POINT ";LIN(1)
4850 PRINT TAB(10);"(3) DELETE A POINT";LIN(1)
4860 PRINT TAB(10);"(4) EXIT RE-DIGITIZING and RETURN to DIGITIZING OPTIONS"
4870 Scaleck=0
4880 GOSUB Rotate_back
4890 PLOTTER IS 7,5,"9872A"
4900 FOR I=1 TO K
4910 MOVE Xtemp(L1,I),Ytemp(L1,I)
4920 R1=0
4930 INPUT " ENTER OPTION #...To go on to NEXT point PRESS CONT",A1
4940 IF (A1>=0) AND (A1<=4) THEN GOTO 4990
4950 BEEP
4960 PRINT LIN(2);TAB(3);"OPTION # is not between 1 and 4...Press CONT and TRY AGAIN"
4970 PAUSE
4980 JOTO 4780
4990 IF A1=0 THEN GOTO 5250
5000 IF A1=4 THEN RETURN
5010 IF A1=3 THEN GOTO 5090
5020 IF A1=2 THEN GOTO 5160
5030 DISP TAB(10);"RE-DIGITIZE this POINT NOW."
5040 INPUT Xtemp(L1,I),Ytemp(L1,I)
5050 DIGITIZE Xtemp(L1,I),Ytemp(L1,I)
5060 BEEP
5070 INPUT " DATA POINT RE-DIGITIZED...PRESS CONT to END next OPTION ";A1
5080 JOTO 5250
5090 FOR J=1 TO K-1
Xtemp(L1,J) = Xtemp(L1,J+1)
Ytemp(L1,J) = Ytemp(L1,J+1)

NEXT J

INPUT " DATA POINT DELETED...PRESS CONT to ENTER ne xt OPTION ", A1

<=K-1

J=TO S250

POINTER Xtemp(L1,I), Ytemp(L1,I)

FOR J=K TO I+1 STEP -1

Xtemp(L1,J+1) = Xtemp(L1,J)
Ytemp(L1,J+1) = Ytemp(L1,J)

NEXT J

DISP " DIGITIZE NEW POINT NOW"

DIGITIZE Xtemp(L1,I+1), Ytemp(L1,I+1)

BEEP

INPUT " NEW POINT DIGITIZED...PRESS CONT to ENTER n ext OPTION ", A1

NEXT I

GOSJB Rotate_back

RETURN

Define_function: ! ######################## SUBROUTINE TO LET USER ########################

! DEFINE A FUNCTION TO PLOT

C$="FUNCTION"

FOR Function=1 TO ln(4)

PRINT PAGE; LIN(1); TAB(27); "INPUT A FUNCTION"

PRINT LIN(3); TAB(15); "INPUT file DESCRIPTOR for this FUNCTION"

INPUT F$(L1)

PRINT LIN(2); TAB(15); "INPUT NUMBER OF POINTS that you want to plot for"

PRINT LIN(1); TAB(15); "this FUNCTION...MAXIMUM number ALLOWED is "; Pts

Npt(L1)=0

INPUT Npt(L1)

IF Npt(L1)=0 THEN GOTO 5430

BEEP

PRINT LIN(1); TAB(15); "You must INPUT the NUMBER of POINTS to be plotted...TRY AGAIN"

GOTO 5380

IF Npt(L1)<>Pts THEN GOTO 5480

BEEP

PRINT LIN(1); TAB(15); "The NUMBER of points you have INPUT is greater"

PRINT TAB(15); "than", Pts; "...TRY AGAIN"

GOTO 5380

PRINT LIN(2); TAB(33); "NOTE"

PRINT LIN(1); TAB(8); "ALL TRIGONOMETRIC FUNCTIONS WILL BE COMPUTED IN DEGREES"

PRINT LIN(2); TAB(15); "INPUT the DATA RANGE for X (X MIN, X MAX)"
Xmnn=Xmxx=0
INPUT Xmnn,Xmxx
IF Xmxx-Xmnn>0 THEN GOTO 5570
BEEP
PRINT LIN(1);TAB(15);"X DATA RANGE must be GREATER than 0.
..TRY AGAIN"
GOTO 5510
PRINT PAGE;LIN(2);TAB(30);"TO DEFINE FUNCTION:
PRINT LIN(3);TAB(9);"(1) PRESS k0 Special Function Key.\n(upper right corner of keyboard)"
PRINT LIN(2);TAB(3);"(2) TYPE in function using HP format
as described in the"
PRINT TAB(21);"Operating and Programming Manual, Chapter 4
PRINT LIN(2);TAB(9);"(3) PRESS STORE KEY...located direc-
tly above the right SHIFT KEY"
INPUT "  PRESS CONT TO CONTINUE",A1
Inc=Xmxx-Xmnn
IF Npt(L1)<1 THEN Inc=Inc/(Npt(L1)-1)
IF Inc<0 THEN Inc=ROUND(Inc,INT(LGT(ABS(Inc)))-3)
Start=Xmnn-Inc
FOR I=1 TO Npt(L1)
X1(L1,I)=Start+I*Inc
X=X1(L1,I)
Y1(L1,I)=FNX(X)
IF Y1(L1,I)<0 THEN Y1(L1,I)=ROUND(Y1(L1,I),INT(LGT(ABS
(Y1(L1,I))))-3)
NEXT I
GOSUB Edit_data
L1=L1+1
NEXT Function
RETURN
DEF 'NX(X)=3*3IN(X)
Edit_data: PRINT PAGE;LIN(2)
L1$=VAL$(L1)
PRINT TAB(6);" *** OPPORTUNITY TO REVIEW AND EDIT DATA FOR FILE
","L1$;" ***"
PRINT LIN(4);TAB(20);"(1) REVIEW DATA";LIN(3);TAB(20);"(2) ED
IT DATA"
PRINT LIN(2);TAB(20);"(3) PRINT DATA ON THERMAL PRINTER"
PRINT LIN(3);TAB(10);"ENTER the OPTION # that you would like to use."
PRINT LIN(2);TAB(10);"PRESS CONT TO CONTINUE ON TO NEXT FILE"
Ed=3
INPUT Ed
IF (Ed<0) AND (Ed<=3) THEN GOTO 5920
BEEP
INPUT "  OPTION # IS NOT WITHIN 0 AND 3...TRY AGAIN",Ed
5910  GOTJ 5830
5920  IF Ed=0 THEN RETURN
5930  ON Ed GOSUB Review, Edit_it, Hard
5940  GOTJ Edit_data
5950  RETURN
5960  Edit_it: PRINT PAGE; LIN(2); TAB(30); "EDIT DATA"
5970  PRINT LIN(2); TAB(10); "INPUT THE # FOR THE DATA PAIR YOU WANT TO MODIFY"
5980  INPJT A1
5990  IF (A1>0) AND (A1<Npt(L1)+1) THEN GOTO Ok
6000  BEEP
6010  INPJT "        # FOR DATA PAIR IS OUT OF RANGE..TRY AGAIN", A1
6020  GOTJ 5990
6030  Ok: "PRINT LIN(2); TAB(10); "X ="; X1(L1, A1); " Y ="; Y1(L1, A1)
6040  PRINT LIN(2); TAB(10); "INPUT NEW VALUES FOR X, Y"
6050  INPJT X1(L1, A1), Y1(L1, A1)
6060  IF NOT Dig_flag THEN GOTO 6110
6070  IF (Pt=1) OR (Pt=2) THEN Xtemp(L1, A1)= (X1(L1, A1)-Xmn)/Xsc+Xframe (1)
6080  IF (Pt=3) OR (Pt=4) THEN Xtemp(L1, A1)=LGT(X1(L1, A1)/Xmn)/Xsc+Xframe (1)
6090  IF (Pt=1) OR (Pt=3) THEN Ytemp(L1, A1)=(Y1(L1, A1)-Ymn)/Ysc+Yframe (1)
6100  IF (Pt=2) OR (Pt=4) THEN Ytemp(L1, A1)=LGT(Y1(L1, A1)/Ymn)/Ysc+Yframe (1)
6110  A1=3
6120  PRINT LIN(2); TAB(10); "TO CONTINUE EDITING ENTER 1"
6130  INPJT A1
6140  IF A1=1 THEN GOTO Edit_it
6150  RETURN
6160  Review: PRINT PAGE
6170  Hard: IF Ed=3 THEN PRINTER IS 0
6180  PRINT TAB(20); "DATA SET: "; C$; LIN(1)
6190  PRINT TAB(20); "DATA FILE #"; L1; " "; F$(L1)
6200  PRINT LIN(2)
6210  PRINT USING 6220; "PAIR "; "X VALUE"; "Y VALUE"
6220  IMAGE 9X, 20A, 20A, 20A
6230  CO=3
6240  FOR I=1 TO Npt(L1)
6250    X1$=VAL$(X1(L1, I))
6260    Y1$=VAL$(Y1(L1, I))
6270    I$=" "; VAL$(I)
6280    PRINT USING 6220; I$; X1$; Y1$
6290    CO=CO+1
6300  IF (CO<18) OR (Ed=3) THEN GOTO 6340
6310  CO=0
6320  PRINT "PRESS CONT TO CONTINUE"
6330  INPUT A1
6340  NEXT I
6350  IF Ed=3 THEN PRINTER IS 16
IF Ed=1 THEN PAUSE
RETURN
End_edit: RETURN

IF d=l THEN PAUSE
RETURN
End_edit:

SAVE DATA ON DATA TAPE

PRINT PAGE;LIN(3);TAB(30);"SAVE DATA ON TAPE"
PRINT LIN(4);TAB(10);"IF DATA WAS INPUT FROM ONE DATA SET AND IS
TO BE STORED"
PRINT LIN(1);TAB(10);"IN THE SAME DATA SET...ENTER 1"
PRINT LIN(4);TAB(4);"NOTE: IF YOU TRY TO RESTORE THE DATA FILE
THAT YOU HAVE INPUT INTO"
PRINT TAB(10);"THE SAME DATA SET THAT THEY CAME OUT OF, ANY FILE
THAT WERE NOT"
PRINT TAB(10);"INPUT FROM THAT SET WILL BE DESTROYED"
Restore=0
PRINT Restore
PRINT PAGE
CAT ":T14"
PRINT LIN(2);"INPUT NAME FOR THIS DATA SET...UP TO 6 CHARACTERS"
INPUT D$
C$=0##":T14"
IF Restore=1 THEN PURGE C$
Mxnot=-999999
Npt=0
FOR L1=1 TO Pfile
   IF Npt(L1)>Mxnot THEN Mxpt=Npt(L1)
   Npt=Npt+Npt(L1)*2
NEXT L1
Nr=32+32*Pfile+4*Npt
Nr=INT(Nr/30)+1
CREATE C$,Nr,80
IF Restore=1 THEN Skip_label
PRINT PAGE;LIN(2);TAB(25);"INPUT DATA SET DESCRIPTOR"
PRINT LIN(2);TAB(20);"THERE ARE";Pfile;"DATA FILES IN THIS SET"
PRINT LIN(1);TAB(17);"FILE DESCRIPTORS FOR THE DATA FILES ARE:";
PRINT LIN(1);TAB(25);"FILE # DESCRIPTOR";LIN(2)
FOR K=1 TO Pfile
   PRINT TAB(26);K;TAB(35);F$(K)
NEXT K
PRINT LIN(4);TAB(10);"INPUT DATA DESCRIPTOR FOR DATA SET...UP TO
40 CHARACTERS"
6770  INPJT A$
6780  Skip_d: GOSUB Print_data
6790  RETURN
6800  Print data:  C$=D$&";T14"
6810  ASSIGN #2 TO C$
6820  PRINT #2;A$,Pfile,Npt(*),F$(*)
6830  FOR L1=1 TO Pfile
6840    FOR J=1 TO Npt(L1)
6850      PRINT #2;X1(L1,J)
6860    NEXT J
6870  FOR J=1 TO Npt(L1)
6880    PRINT #2;Y1(L1,J)
6890  NEXT J
6900  NEXT L1
6910  RETURN
6920  Save_graph: !
6930  PRINT PAGE;LIN(3);TAB(25);"SAVE GRAPH ON TAPE"
6940  PRINT LIN(4);TAB(10);"IF THIS GRAPH WAS RETRIEVED FROM THE TAPE
AND IS"
6950  PRINT TAB(10);"TO BE RE-STORED INTO THAT SAME DATA FILE...ENTER
1"
6960  Restore=0
6970  INPJT Restore
6980  PRINT PAGE
6990  CAT ":T14"
7000  PRINT LIN(2);"INPUT NAME FOR THIS DATA SET...UP TO 6 CHARACTERS"
7010  INPUT D$
7020  C$=D$&";T14"
7030  IF Restore=1 THEN PURGE C$
7040  Mxnot=-99999
7050  Npt=0
7060  FOR L1=1 TO Pfile
7070    IF Npt(L1)>Mxnot THEN Mxnot=Npt(L1)
7080  Npt=Npt+Npt(L1)+2
7090  NEXT L1
7100  Nr=348+Ann*100+25+45+52+32+Pfile+4+Npt
7110  Nr=INT(Nr/80)+1
7120  CREATE C$,Nr,80
7130  IF Restore=1 THEN GOTO Skip_g
7140  PRINT PAGE;LIN(4);TAB(28);"INPUT GRAPH DESCRIPTION"
7150  PRINT LIN(3);TAB(18);"INPUT THE NAME OF THE DATA FILE DESCRIPTOR"
7160  PRINT LIN(1);TAB(21);"FOR THIS GRAPH...UP TO 40 CHARACTERS"
7170  INPJT A$
7180  Skip_g: GOSUB Print_data
7190  Option=4
7200  PRINT #2;Defaults,Log_ck,P1(*),Lt(*),Pc2(*),Pt,Xm,Ym,Xsize,Ysize,
Norm
7210  PRINT #2;Shade,Annot,Sp,File,Nt,Nx,Ny,Pc1,Pc3,Pc4,Scinot,Num_sd,
Xmn,Xmax

C17
PRINT #2; Ym, Yn, Xt, Yt, Tsize, Lsize, Nsize, Asize, Xm, Ym, S, Option
PRINT #2; Xmax(*), Xmin(*), Ymax(*), Ymin(*), Cm(*), Xdp, Ydp, Xmax, Xmin
PRINT #2; Ymax, Ymin, Sdx, Sdy, Nsd, Ld(*), Td(*), Yd(*), Norm(*), Shade(*), A.nn
PRINT #2; Shade$, Norm$, Frame, Axes, Number, Label
FOR I=1 TO Ann+1
   PRINT #2; Xa(I), Ya(I), PLabel(I), Label$(I)[1, 80]
NEXT I
ASSIGN #2 TO *
RETURN
Tape_err: E=ERRN
IF E<>54 THEN GOTO 7360
BEE
PRINT LIN(4); "ERROR 54: DUPLICATE FILE NAME...TRY AGAIN"
GOTO 6550
IF E<>55 THEN GOTO 7420
BEE
PRINT LIN(4); TA3(10); "ERROR 55: DIRECTORY OVERFLOW...TRY A DIFFERENT TAPE"
PRINT LIN(4); TA3(10); "AND PRESS CONT TO SAVE DATA SET"
PRINT LIN(4); TA3(10); "NOTE: TAPE MUST BE INITIALIZED"
GOTO 6550
IF E<>53 THEN GOTO Error_end
BEE
PRINT LIN(4); TA3(10); "ERROR 53: IMPROPER FILE NAME...TRY AGAIN"
GOTO 6550
Error_end: PRINT PAGE; LIN(5); TA3(20); "UNRECOVERABLE ERROR"
E=ERRN
PRINT LIN(3); TA3(10); "ERROR "; E; " ON LINE"; E; " YOU MUST BEGIN PROGRAM AGAIN"; LIN(3)
GOSJB End_it
Retrieve_graph: !
PRINT PAGE
CAT " .T14"
PRINT LIN(2); "INPUT THE FILE NAME OF THE GRAPH TO BE RETRIEVED"
INPT D$
C$=D$&" .T14"
ASSIGN #3 TO C$
READ #3; A$, Pfile
Pts=INT(25*200/Pfile)
REDIM Npt(Pfile), F$(Pfile), X1(Pfile, Pts), Y1(Pfile, Pts)
REDIM Ntemp(Pfile), Ftemp$(Pfile), Xtemp(Pfile, Pts), Ytemp(Pfile, Pts)
READ #3; Npt(*), F$(*)
FOR L1=1 TO Pfile
   FOR J=1 TO Npt(L1)
      READ #3; X1(L1, J)
   NEXT J
FOR J=1 TO Npt(L1)
READ #3;Y1(L1,J)
NEXT J
READ #3;Defaults,Log_ck,P1(*),Lt(*),Pc2(*),Pt,Xm,Ym,Xsize,Ysize,
Norm
READ #3;Shade,Annot,Sd,File,nt,Nx,Ny,Pc1,Pc3,Pc4,Scinot,Num_sd,X
mx,Xmn
READ #3;Ymx,Ymn,xt,Yt,tsize,Lsize,Nsize,Asize,Xmult,Ymult,S,Options
READ #3;X_max(*),X_min(*),Y_max(*),Y_min(*),Cm(*),Xdp,Ydp,Xmax,X
min
READ #3;Ymax,Ymin,Sdx,Sdy,Nsd,L(*),T$,X$,Y$,Norm(*),Shade(*),An
n
READ #3;Shade$,Norm$,Frame,Axes,Number,Label
IF Annot=0 THEN 7810
FJR I=1 TO Ann+1
READ #3;Xa(I),Ya(I),Plabel(I),Label$(I)
NEXT I
ASSIGN * TO #3
CALL Plot_data
RETURN

END PROGRAM ROUTINE

Print_page;lin(3)
Print Tab(33);"END OF PROGRAM"
GOTO End
RETURN

SUB Plot_data

DEG
COM F$(*),SHORT X1(*),Y1(*)
COM INTEGER Npt(*),Defaults,Log_ck,File,P1(*),Lt(*),Pc2(*)
COM INTEGER Pt,Xm,Ym,Xsize,Ysize,Norm,Shade,Annot,Sd,File,Nt,Nx,
Ny
COM INTEGER Pc1,Pc3,Pc4,Scinot,Num_sd,Ann,Frame,Axes,Label,Numbe
r
COM SHORT Xmx,Xmn,Ymx,Ymn,Xt,Yt,tsize,Lsize,Nsize,Asize,Xmult,Ym
ult,S
COM SHORT X_max(*),X_min(*),Y_max(*),Y_min(*),Xa(*),Ya(*),Cm(*),
Xdp,Ydp
COM SHORT Xmax,Xmin,Ymax,Ymin,Sdx,Sdy,Nsd,Options
COM L$(*),T$,X$,Y$,V$,P$(*),Label$(*),Pen$(*),Shade$,Norm$
COM X_max$(*),X_min$(*),Y_max$(*),Y_min$(*)
COM INTEGER Norm(*),Shade(*),Plabel(*)
If Options=4 THEN 8230
IF Defaults THEN 8170
PRINT PAGE;LIN(6);TAB(10);"TO USE PLOT OPTIONS & SCALE PARAMETER SET FROM"
PRINT TAB(10);"THE PREVIOUS RUN...ENTER 1"
An=0
INPUT An
IF An>1 THEN GOTO 8170
GOSUB Find_range
IF (Log_ck=0) AND ((Pt=3) OR (Pt=4)) THEN GOSUB X_lin_to_log
IF (Log_ck=0) AND ((Pt=2) OR (Pt=4)) THEN GOSUB Y_lin_to_log
GOTO 8230
GOSUB Set_defaults
GOSUB Scale_type
GOSUB Labels
GOSUB Menu_1
GOSUB Menu_2
GOSUB Menu_3
GOSUB Menu_4
SUBEDIT Set_jefau1s:
RESTORE
READ Tsize,Lsize,Hsize,Asize,Xsize,Ysize,Norm,Shade,Sd,Ym,Xm,Spt,Pt,An,Annot
DATA 1 , 1 , 1 , 1 , 1 , 100 , 60 , 0 , 0 , 0 , 4 , 4 , 1 , 1 , 0 , 3
READ Scinot,Dp_init,Ann,Frame,Axes,Number,Label
DATA 0 , 1 , 0 , 1 , 1 , 1 , 1 , 1
Defaults=0
T$=" 
X$=" 
Y$=" 
MAT P1=(0)
MAT L1=(1)
MAT Cm=(1)
MAT Pc2=(1)
Pc1=1
Pc3=1
Pc4=1
MAT Plabel=(1)
FOR L=1 TO 40
Label$(L)=" 
NEXT L
FOR Xa=(0)
MAT Ya=(0)
FOR L1=1 TO 10
L$(L1)=" 
NEXT L1
RETURN
Find_range:  
Xmin=99999
3540 Xmax=-99999
3550 Ymin=99999
3560 Ymax=-99999
3570 JIR L1=1 TO Pfile
3580 X_min(L1)=99999
3590 X_max(L1)=-99999
3600 Y_min(L1)=99999
3610 Y_max(L1)=-99999
3620 NEXT L1
3630 JIR L1=1 TO Pfile
3640 FOR I=1 TO Npt(L1)
3650 IF X1(L1,I)>Xmax THEN Xmax=X1(L1,I)
3660 IF X1(L1,I)>X_max(L1) THEN X_max(L1)=X1(L1,I)
3670 IF X1(L1,I)<Xmin THEN Xmin=X1(L1,I)
3680 IF X1(L1,I)<X_min(L1) THEN X_min(L1)=X1(L1,I)
3690 IF Y1(L1,I)>Ymax THEN Ymax=Y1(L1,I)
3700 IF Y1(L1,I)>Y_max(L1) THEN Y_max(L1)=Y1(L1,I)
3710 IF Y1(L1,I)<Ymin THEN Ymin=Y1(L1,I)
3720 IF Y1(L1,I)<Y_min(L1) THEN Y_min(L1)=Y1(L1,I)
3730 NEXT I
3740 NEXT L1
3750 RETURN
3760 Y_lin_to_log: !
3770 JIR L1=1 TO Pfile
3780 FOR I=1 TO Npt(L1)
3790 Y1(L1,I)=LGT(Y1(L1,I))—
3800 NEXT I
3810 NEXT L1
3820 Log_ck=1
3830 RETURN
3840 X_lin_to_log: !
3850 JIR L1=1 TO Pfile
3860 FOR I=1 TO Npt(L1)
3870 X1(L1,I)=LGT(X1(L1,I))
3880 NEXT I
3890 NEXT L1
3900 Log_ck=1
3910 RETURN
3920 Y_log_to_lin: !
3930 JIR L1=1 TO Pfile
3940 FOR I=1 TO Npt(L1)
3950 Y1(L1,I)=10^Y1(L1,I)
3960 Y1(L1,I)=PROUND(Y1(L1,I),INT(LGT(ABS(Y1(L1,I)))-4)
3970 NEXT I
3980 NEXT L1
3990 RETURN
4000 X_log_to_lin: !
4010 JIR L1=1 TO Pfile
4020 FOR I=1 TO Npt(L1)
4030 X1(L1,I)=10^X1(L1,I)
X1(L1,I)=ROUND(X1(L1,I),INT(LGT(ABS(X1(L1,I))))-4)
NEXT I
NEXT L1
RETURN
Scale_type: ! SUBROUTINE TO CHOOSE SCALE TYPE 
IF Pt<2 THEN GOSUB X_log_to_lin
IF (Pt=2 OR Pt=4) THEN GOSUB Y_log_to_lin
IF (Pt=2) OR (Pt=4) THEN Ym=4
GOSUB Find_range
Scale_it: PRINT PAGE;LIN(2);TAB(23);"INPUT SCALE TYPE"
PRINT LIN(2);TAB(10);"EXTREMES of this DATA SET are...";LIN(2)
Xmin$=VAL$(Xmin)
Xmax$=VAL$(Xmax)
PRINT USING 9180;"Xmin = ";Xmin$,"Xmax = ";Xmax$
IMAGE 9X,7A,20A,7A,20A
Ymin$=VAL$(Ymin)
Ymax$=VAL$(Ymax)
PRINT LIN(1)
PRINT USING 9180;"Ymin = ";Ymin$,"Ymax = ";Ymax$
PRINT LIN(3);TAB(10);"You now must CHOOSE the TYPE of graph to PLOT"
PRINT LIN(1);TAB(15);"TO PLOT LINEAR ... ENTER 1"
PRINT TAB(15);"TO PLOT X-LIN Y-LIN ... ENTER 2"
PRINT TAB(15);"TO PLOT X-LOG Y-LIN ... ENTER 3"
PRINT TAB(15);"TO PLOT LOG-LOG ... ENTER 4"
Pt=3
IMPJT Pt
IF (Pt=1) AND (Pt<=4) THEN GOTO 9340
GOTO 9300
IMPJT "Option not within range...TRY AGAIN",Pt
GOTO 9300
IF Pt=1 THEN 9550
IF Pt=3 THEN GOTO Check_xmn
If Ymin<0 THEN GOTO Ymn_ok
PRINT PAGE;LIN(6);TAB(20);"Y VALUES ARE LESS THAN OR EQUAL TO ZERO."
PRINT LIN(1);TAB(17);"THIS IS NOT ALLOWED FOR A LOG PLOT...TRY AGAIN."
PRINT LIN(6);TAB(30);"PRESS CONT TO TRY AGAIN"
IMPJT A1
Pt=1
GOTO Scale_it
Ymn_ok: IF Pt=2 THEN 9520
Check_xmn: IF Xmin<0 THEN 9520
BEEQ
PRINT PAGE;LIN(8);TAB(20);"X VALUES ARE LESS THAN OR EQUAL TO ZERO."
PRINT LIN(1);TAB(17);"THIS IS NOT ALLOWED FOR A LOG PLOT...TRY AGAIN."
PRINT LIN(2);TAB(30);"PRESS CONT TO TRY AGAIN"
9490  INPJT A1
9500  Pt=1
9510  GOTO Scale_it
9520  IF Pt>2 THEN GOSUB X_lin_to_log
9530  IF (Pt=2) OR (Pt=4) THEN GOSUB Y_lin_to_log
9540  IF Pt<1 THEN Sd=0
9550  GOSUB Enter_scales
9560  RETURN
9570  Enter_scales: PRINT PAGE;LIN(2);TAB(25);"ENTER SCALE FOR X AXIS"
9580  PRINT LIN(3);TAB(10);"X COORDINATE RANGE: ";Xmin;" TO ";Xmax;LIN(2)
9590  PRINT TAB(10);"ENTER the MINIMUM and MAXIMUM values for the X AXIS"
9600  IF (Pt=1) OR (Pt=2) THEN GOTO 9850
9610  PRINT LIN(1);TAB(10);"Since this is a LOG axis, values must be a POWER of 10 (i.e. .01,100)"
9620  INPJT Xmn,Xmx
9630  IF Xmx-Xmn>0 THEN GOTO 9680
9640  BEE^  
9650  PRINT LIN(2);TAB(10);"The scaling range that you have input for the X axis"
9660  PRINT TAB(10);"is less than or equal to 0...TRY AGAIN"
9670  GOTO 9620
9680  IF Xmn<0 THEN GOTO 9740
9690  BEE^  
9700  PRINT LIN(2);"MINIMUM must be greater than 0 for a LOG plot...TRY AGAIN"
9710  PRINT LIN(2);"PRESS CONT TO CONTINUE"
9720  INPJT A1
9730  GOTO 9620
9740  Dmin=INT(LGT(Xmx))=LGT(Xmn)
9750  Dmax=INT(LGT(Xmx))=LGT(Xmx)
9760  IF (Dmin=0) AND (Dmax=0) THEN GOTO 9810
9770  BEE^  
9780  PRINT LIN(2);TAB(10);"The values you entered were";Xmn;"and";Xmx
9790  PRINT TAB(10);"One of these is not a POWER of TEN"
9800  GOTO 9620
9810  Xm=LGT(Xmx)-LGT(Xmn)
9820  Nx=INT(LGT(Xmx)-LGT(Xmn))
9830  X1=2
9840  GOTO 9940
9850  INPJT Xmn,Xmx
9860  IF Xmx-Xmn>0 THEN GOTO 9910
9870  BEE^  
9880  PRINT LIN(2);TAB(10);"The scaling range that you have input for the X axis"
9890  PRINT TAB(10);"is less than or equal to 0...TRY AGAIN"
9900  GOTO 9850
9910  IF X1=2 THEN Xm=4
Xt=(Xmax-Xmin)/(5*Xm)
Nn=INT((Xmax-Xmin)/(Xt+5))
PRINT PAGE;LIN(2);TAB(25);"ENTER SCALE FOR Y AXIS"
PRINT LIN(3);TAB(10);"Y COORDINATE RANGE: ";Ymin;" TO ";Ymax;LIN(2)
PRINT TAB(10);"ENTER the MINIMUM and MAXIMUM values for the Y AX IS"
IF (Pt=1) OR (Pt=3) THEN GOTO 10200
PRINT LIN(1);TAB(10);"Since this is a LOG axis, values must be a POWER of 10 (i.e. .01,100)"
INPUT Ymn,Ymx
IF Ymx-Ymn>0 THEN GOTO 10050
BEEP?
PRINT LIN(2);TAB(10);"The scaling range that you have input for the Y axis"
PRINT TAB(10);"is less than or equal to 0...TRY AGAIN"
GOTO 9990
IF Ymn>0 THEN GOTO 10090
BEEP?
PRINT LIN(2);TAB(10);"MINIMUM must be greater than 0 for a LOG plot...TRY AGAIN"
GOTO 9990
Dmin=INT(LGT(Ymn))-LGT(Ymn)
Dmax=INT(LGT(Ymx))-LGT(Ymx)
IF (Dmin=0) AND (Dmax=0) THEN GOTO 10160
BEEP?
PRINT LIN(2);TAB(10);"The values you entered were ";Ymn;" and ";Ymx
PRINT TAB(10);"Since this is a LOG axis, values must be a POWER of 10 (i.e. .01,100)"
GOTO 9990
Ym=LGT(Ymx)-LGT(Ymn)
Ny=INT(LGT(Ymx)-LGT(Ymn))
Yt=1
GOTO 10290
INPUT Ymn,Ymx
IF Ymx-Ymn>0 THEN GOTO 10260
BEEP?
PRINT LIN(2);TAB(10);"The scaling range that you have input for the Y axis"
PRINT TAB(10);"is less than or equal to 0...TRY AGAIN"
GOTO 10200
IF Yt=2 THEN Ym=4
Yt=(Ymx-Ymn)/(5*Ym)
Ny=INT((Ymx-Ymn)/(Yt+5))
RETJRN

Lab3:############ INPUT LABELS AND TITLE ###################
PRINT PAGE;LIN(2);TAB(20);"INPUT TITLE AND AXES LABELS"
PRINT LIN(4);TAB(12);"INPUT TITLE FOR PLOT...UP TO 30 CHARACTERS"
10330 INPJT T$
10340 PRINT LIN(3);TAB(12);"INPUT LABEL FOR THE X AXIS...UP TO 20 CHAR
ACTERS"
10350 INPJT X$
10360 PRINT LIN(2);TAB(12);"INPUT LABEL FOR THE Y AXIS...UP TO 20 CHAR
ACTERS"
10370 INPJT Y$
10380 PRINT LIN(4);TAB(5);"PRESS CONT TO CONTINUE"
10390 INPJT Y$
10400 RETURN
10410 Tic<_count:!
10420 PRINT PAGE
10430 IF Pt<2 THEN GOTO 10670
10440 PRINT PAGE;TAB(23);"Y AXIS MAJOR TICK INTERVAL";LIN(3)
10450 PRINT TAB(10);"The RANGE that you have chosen for the Y AXIS is
";Ymx-Ymn
10520 PRINT LIN(2);TAB(10);" MAJOR TICK INTERVAL = ___ RANGE ___
"
10530 PRINT TAB(40);"MAJOR TICKS";LIN(1)
10540 PRINT LIN(1);TAB(10);"How many MAJOR TICKS do you want on X AXIS..."
10550 PRINT LIN(1);TAB(10);"DEFAULT is 4";LIN(3)
10560 INPJT Xm
10570 Xt=(Xmx-Xmn)/(5*Xm)
10580 Xn=Xm
10590 Xn=VAL$(5*Xt)
10600 Xt=VAL$(Xt)
10610 PRINT USING 10620;"X MAJOR TICK INTERVAL = ";Xm$;"X MINOR TICK INTERVAL = ";Xt$
10620 IMAGE 9X,24A,6A,2X,24A,6A
10630 PRINT LIN(2);TAB(10);"TO TRY AGAIN...ENTER 1"
10640 A1=3
10650 INPJT A1
10660 IF A1=1 THEN GOTO 10490
10670 IF (Pt=2) OR (Pt=4) THEN RETURN
10680 PRINT PAGE;TAB(23);"Y AXIS MAJOR TICK INTERVAL";LIN(3)
10690 PRINT TAB(10);"The RANGE that you have chosen for the Y AXIS is
";Ymx-Ymn
10700 PRINT LIN(2);TAB(10);" MAJOR TICK INTERVAL = ___ RANGE ___
"
10710 PRINT TAB(40);"MAJOR TICKS";LIN(1)
10720 PRINT TAB(10);"How many MAJOR TICKS do you want on Y AXIS..."
10730 PRINT LIN(1);TAB(10);"DEFAULT is 4";LIN(3)
10740 INPJ Ym
10750 Yt=(Ymx-Ymn)/(5*Ym)
10750 Yt=ROUND(Yt,INT(LGT(ABS(Yt)))-2)
10770 Ny=Ym
10730 Ym$=VAL$(5*Yt)
10730 Yt$=VAL$(Yt)
10830 PRINT USING 10620;"Y MAJOR TICK INTERVAL = ";Ym$;"Y MINOR TICK INTERVAL = ";Yt$
10810 PRINT LIN(2);TAB(10);"TO TRY AGAIN...ENTER 1"
10820 A1=3
10830 INJ PT A1
10840 IF A1=1 THEN GOTO 10690
10850 RETURN
10860 Menu_1: PRINT PAGE
10870 PRINT USING 10650;"MENU 1: REVIEW INPUT PARAMETERS";LIN(1)
10880 PRINT "OPTION #"
10890 PRINT " (1) TITLE: ";T$
10900 PRINT LIN(1);" LABELS - X AXIS: ";X$
10910 PRINT " Y AXIS: ";Y$
10920 PRINT LIN(1);" (2) SCALE TYPE: ";P$(Pt);LIN(1)
10930 Xmn$=VAL$(Xmn)
10940 Xmx$=VAL$(Xmx)
10950 Ymn$=VAL$(Ymn)
10960 Ymx$=VAL$(Ymx)
10970 PRINT USING 11040;"(3) SCALE :";X MIN = ";Xmn$;X MAX = ";Xmx$
10980 PRINT USING 11050;" Y MIN = ";Ymn$;Y MAX = ";Ymx$
10990 PRINT LIN(1)
11000 IF Pt<2 THEN PRINT " (4) MAJOR TICKS - X AXIS: ";Xm;" MAJOR TICK INTERVALS OF ";Xt$=5
11010 IF Pt>2 THEN PRINT " (4) MAJOR TICKS - X AXIS: ";Xm;" MAJOR TICKS"
11020 IF (Pt=1) OR (Pt=3) THEN PRINT TAB(25);"Y AXIS: ";Ym;" MAJOR TICK INTERVALS OF ";Yt$=5
11030 IF (Pt=2) OR (Pt=4) THEN PRINT TAB(25);"Y AXIS: ";Ym;" MAJOR T
11040 IMAGE 2X,22A,10A,16A,9A,9A
11050 IMAGE 2X,22A,8A,16A,9A,9A
11060 PRINT LIN(1);"TO CHANGE ANY OF THESE PARAMETERS...ENTER OPTION #"
11070 PRINT LIN(1);"PRESS CONT TO CONTINUE"
11080 A1=0
11090 INPUT A1
11100 IF A1=0 THEN RETURN
11110 ON A1 GOSUB Labels,Scale_type,Enter_scales,Tick_count
11120 GOTO Menu_1
11130 RETURN
11140 Menu_2:PRINT PAGE;TAB(22);"MENU 2: DIMENSION/PLLOT OPTIONS";LIN
11150 PRINT USING 11160;"PLOT OPTIONS","DIMENSION OPTIONS"
11160 IMAGE 9X,12A,27X,17A
11170 PRINT "OPTION #";TAB(41);"OPTION #"
11180 IMAGE 2X,29A,4D
11190 IMAGE 2X,27A,4D
11200 Asize=VAL$(Asize)
11210 IF Annot=0 THEN PRINT USING 11230;"(1) ANNOTATION: NO";;"
11220 IF Annot<>0 THEN PRINT USING 11230;"(1) ANNOTATION: YES - SIZE = ";Asize$;
11230 IMAGE #,2X,33A,7A
11240 PRINT "DIMENSIONS - X AXIS:";Xsize
11250 PRINT TAB(62);"Y AXIS:";Ysize
11260 IF Norm=0 THEN PRINT USING 11280;" (2) NORMALIZE: NO";;"
11270 IF Norm<>0 THEN PRINT USING 11280;" (2) NORMALIZE - FILE: "
;Norm$;
11280 IMAGE #,27A,17A
11290 PRINT "(7) TITLE SIZE: ";Tsize;LIN(1)
11300 IF VOT Scinot THEN PRINT USING 11320;" (3) SCIENTIFIC NOTATION: NO";
11310 IF Scinot THEN PRINT USING 11320;" (3) SCIENTIFIC NOTATION: YES"
11320 IMAGE #,44A
11330 PRINT "(3) LABEL SIZE: ";Lsize;LIN(1)
11340 IMAGE #,44A
11350 PRINT USING 11340;" (4) STANDARD "
11360 PRINT "(9) NUMBER SIZE: ";Nsize
11370 IF 3d<>0 THEN PRINT " DEVIATION: +/-";Num_sd;"SIGMA ERR OR BAR";LIN(1)
11380 IF 3d=0 THEN PRINT " DEVIATION: NO";LIN(1)
11390 IF Shade=0 THEN PRINT " (5) SHADING: NO"
11400 IF Shade<>0 THEN PRINT USING 11410;" (5) SHADING - FILES: "
;Shade$;
11410 IMAGE 27A,30A
11420 PRINT LIN(1);" TO CHANGE ANY OF THESE PARAMETERS...INPUT NUMBER THAT"
11430 PRINT " CORRESPONDS TO OPTION #"
11440 PRINT LIN(1);"PRESS CONT TO CONTINUE"
11450 A1=3
11460 INPT A1
11470 IF A1=0 THEN RETURN
11480 ON A1 GOSUB Annotation,Normalize,Sci_not,Std_dev,Shading,Dimensions,Title_size,Label_size,Number_size
11490 GOT0 Menu_2
11500 RETURN
11510 ! #---------- STANDARD DEVIATION #----------
11520 Std_dev;PRINT PAGE;LIN(4);TAB(28);"STANDARD DEVIATION"
11530 IF $t=1 THEN GOTO 11580
11540 PRINT LIN(3);TAB(12);"STANDARD DEVIATION MAY BE USED ON A LINEAR SCALE ON_Y"
11550 PRINT LIN(2);TAB(29);"PRESS CONT TO CONTINUE"
11560 PAUSE
```
11570 RETJRH
11580 PRINT LIN(4);TAB(15);"TO DISPLAY STD DEV ERROR BAR ON GRAPH ENTER 1"
11590 SD=3
11600 INPUT SD
11610 IF SD=0 THEN RETURN
11620 CRT=0
11630 HSd=SQR(20000*Ymax-Ymin)/20000
11640 PRINT LIN(4);TAB(15);"ENTER THE VALUE FOR 1 STANDARD DEVIATION"
11650 INPUT NSd
11660 PRINT LIN(3);TAB(8);"ENTER THE NUMBER OF STANDARD DEVIATIONS TO PLOT... BETWEEN 1 AND 3"
11670 INPUT Num_sd
11680 IF (Num_sd=1) AND (Num_sd=3) THEN RETURN
11690 BEEP
11700 INPUT "THE NUMBER OF STANDARD DEVIATIONS TO PLOT MUST BE BETWEEN 1 AND 3...TRY AGAIN";Num_sd
11710 GOTO 11630
11720 RETJRH
11730 Sci_not:=1 ############################ SCIENTIFIC NOTATION ############################
11740 PRINT PAGE;LIN(3);TAB(25);"SCIENTIFIC NOTATION"
11750 PRINT LIN(2);TAB(10);"User may have SCIENTIFIC NOTATION on the LINEAR AXES"
11760 PRINT LIN(1);TAB(3);"LOG AXES will AUTOMATICALLY be labelled as POWERS of 10"
11770 PRINT LIN(2);"NOTE: If SCIENTIFIC NOTATION is used on the Y AX IS, the Y AXIS LABEL "
11780 PRINT TAB(7);"will not be printed on the CRT or on the DIGITAL PLOTTER if the"
11790 PRINT TAB(7);"default NUMBER SIZE of 1 is used. To print the Y AXIS LABEL, choose"
11800 PRINT TAB(7);"a NUMBER SIZE of .8 or SMALLER. On the DIGITAL PLOTTER, the"
11810 PRINT TAB(7);"situation may also be remedied by choosing a PLOT SIZE of .3 or SMALLER."
11820 Sci_not=0
11830 PRINT LIN(3);TAB(20);"TO USE SCIENTIFIC NOTATION ENTER 1"
11840 INPUT Sci_not
11850 RETJRH
11860 Title_size:=! ################ INPUT TITLE SIZE ###############################
11870 PRINT PAGE;LIN(4);TAB(30);"TITLE SIZE"
11880 PRINT LIN(5);TAB(15);"INPUT MULTIPLIER BETWEEN 0 AND 3 FOR TITLE"
11890 PRINT LIN(2);TAB(15);"DEFAULT IS 1"
11900 INPUT Tsize
11910 RETJRH
11920 Label_size:=! ################ INPUT LABEL SIZE #############################1
11930 PRINT PAGE;LIN(4);TAB(30);"AXES LABEL SIZE"
11940 PRINT LIN(5);TAB(10);"INPUT MULTIPLIER BETWEEN 0 AND 3 FOR X AND
```
Y LABEL SIZE
11950 PRINT LIN(2);TAB(10);"DEFAULT IS 1"
11960 INPUT Lsize
11970 RETURN
11990 ! """"""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""
11990 Number_size: PRINT PAGE;LIN(4);TAB(30);"NUMBER SIZE"
12000 PRINT LIN(2);TAB(15);"ENTER MULTIPLIER BETWEEN 0 AND 2...DEFAULT IS 1"
12010 INPUT Hsize
12020 RETURN
12030 Dimensions:!! """""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""
12040 PRINT PAGE;LIN(4);TAB(28);"DIMENSION PLOT"
12050 PRINT LIN(2);TAB(10);"DEFAULT SIZE FOR PLOTTING IS 100 X UNITS B
Y 60 Y UNITS"
12060 PRINT LIN(2);TAB(20);"ENTER SIZE FOR X AXIS...1 TO 120"
12070 INPUT Xsize
12080 PRINT LIN(2);TAB(20);"ENTER SIZE FOR Y AXIS...1 TO 60"
12090 INPUT Ysize
12100 RETURN
12110 Annotation:!! """""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""
12120 PRINT PAGE;LIN(2);TAB(36);"ANNOTATION"
12130 PRINT LIN(3);TAB(20);"TO PLACE ANNOTATION ON YOUR GRAPH...ENTE
R 1"
12140 Annot=0
12150 INPUT Annot
12160 IF Annot=0 THEN RETURN
12170 Cnt=0
12180 PRINT LIN(3);TAB(10);"WARNING: If you wish to use ANNOTATION
on the DIGITAL PLOTTER"
12190 PRINT LIN(1);TAB(19);"you must FIRST PLOT graph on the CRT"
12200 PRINT LIN(3);TAB(20);"Input MULTIPLIER between 0 and 2 for the
ANNOTATION"
12210 PRINT LIN(1);TAB(28);"CHARACTER SIZE...DEFAULT is 1"
12220 Asize=1
12230 INPUT Asize
12240 IF (Asize)=0 AND (Asize)=2 THEN RETURN
12250 BEEP
12260 INPUT "CHARACTER size MULTIPLIER must be between
0 and 2...TRY AGAIN",Asize
12270 GOTO 12240
12280 RETURN
12290 Normalize:!! """""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""""
12300 PRINT PAGE;LIN(2);TAB(29);"NORMALIZE"
12310 PRINT LIN(2);TAB(22);"DATA RANGES FOR FILES ARE:"
12320 IMAGE 10X,10A,12A,12A,12A,12A
12330 PRINT USING 12320;"FILE # ","X-MIN","X-MAX","Y-MIN","Y-MAX"
12340 FOR L1=1 TO Pfile
12350 L1$=VAL$(L1)
TSLB<

"BELOW THE TABULATION"

"SHADING"
TO CHOOSE THIS OPTION ... ENTER 1

PRUT Shade=0
INPJT Shade
IF Shade=0 THEN RETURN
PRINT PAGE
PRINT LIN(2);TAB(25);"FILE # - DESCRIPTOR"
FOR L1=1 TO Pfile
LI$=VAL$(L1)
PRINT USING 12900;L1$;F$(L1)
IMAGE 26X,7A,20A
BEEP
Shade(L1)=0
INPUT "TO SHADE THIS FILE...ENTER 1 - ELSE PRESS CONT",Shade$(L1)
NEXT L1
IF J<10 THEN Shade$(I-1)=" 
NEXT LIN
IF P1(L1)=3 THEN PRINT TAB(20);"FILE ";L1;" PLOT HISTOGRAM 
IF (P1(L1)=0) OR (P1(L1)=2) THEN PRINT TAB(20);"FILE ";L1;" LINE TYPE 
IF P1(L1)=1 THEN PRINT TAB(20);"FILE ";L1;" SYMBOL = 
IF P1(L1)=2 OR (P1(L1)=1) THEN PRINT TAB(31);"SYMBOL MULT 
NEXT L1
PRINT LIN(2);TAB(17);"TO CHANGE ANY OF THESE FILES...ENTER 1"
PRINT LIN(1);TAB(25);"PRESS CONT TO CONTINUE"
A1=3
INPUT A1
IF A1=0 THEN RETURN
GOSJB Plot_types
GOTO Menu_3
RETJRN
Plot_types: ! ######## INPUT PLOT TYPES ! ! ! ! ! ! ! ! !
FOR L1=1 TO Pfile
PRINT PAGE;LIN(2)
13250 PRINT USING 13270; "FILE "; L1, ":"; F$(L1)
13270 IMAGE 2X, 5A, DD, A, 2X, 20A
13280 PRINT LIN(2); TAB(10); "FOR PLOTTING DATA YOU HAVE THE FOLLOWING OPTIONS..."; LIN(2)
13290 PRINT TAB(20); "ENTER 0...TO PLOT LINES"
13300 PRINT TAB(20); "ENTER 1...TO PLOT SYMBOLS"
13310 PRINT TAB(20); "ENTER 2...TO PLOT BOTH LINES AND SYMBOLS"
13320 PRINT TAB(20); "ENTER 3...TO PLOT A HISTOGRAM-TYPE PLOT"
13330 INPUT P1(L1)
13340 IF (P1(L1)<>0) AND (P1(L1)<=3) THEN GOTO 13380
13350 BEEP
13360 PRINT LIN(2); TAB(10); "OPTION # IS NOT 0 THROUGH 3...TRY AGAIN"
13370 GOTO 13330
13380 IF P1(L1)=1 THEN GOTO 13430
13390 IF P1(L1)=3 THEN GOTO 13470
13400 PRINT LIN(2); TAB(10); "ENTER THE SYMBOL TO BE USED"; LIN(2)
13410 INPUT L$<L1>
13420 IF P1(L1)<>2 THEN GOTO 13470
13430 PRINT LIN(2); TAB(10); "ENTER THE MULTIPLIER OF THE PRESENT CHARACTER SIZE FOR SYMBOLS"
13440 INPUT L$<L1>
13450 PRINT TAB(20); "ENTER THE SYMBOL TO BE USED"; LIN(2)
13460 INPUT Cm<L1>
13470 NEXT L1
13480 RETURN
13490 Menu 4: ! " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " " 
13500 PRINT PAGE; LIN(2); TAB(25); "MENU 4: OUTPUT MEDIA"
13510 PRINT LIN(2); "OPTION "; TAB(43); "OPTION ";
13520 PRINT " (1) CRT"; TAB(45); " (4) MENU 1: INPUT PARAMETERS"
13530 PRINT LIN(2); " (2) THERMAL PRINTER"; TAB(45); " (5) MENU 2: DIMENSIONS/OPTIONS"
13540 PRINT LIN(2); " (3) DIGITAL PLOTTER"; TAB(45); " (6) MENU 3: PLOT TYPES"
13550 PRINT LIN(4); "INPUT OPTION # THAT CORRESPONDS TO WHAT YOU WANT TO DO"
13560 PRINT " OR PRESS CONT TO GO BACK TO PROGRAM OPTIONS"
13570 X1=3
13580 INPUT X1
13590 IF (X1)=0 AND (X1)=6 THEN GOTO 13630
13600 BEEP
13610 INPUT "OPTION CHOOSEN IS NOT BETWEEN 1 AND 6...TRY AGAIN", X1
13620 GOTO 13590
13630 IF X1=0 THEN RETURN
13640 IF X1=3 THEN ON X1=3 GOSUB Menu_1, Menu_2, Menu_3
13650 IF X1=3 THEN GOTO Menu_4
13660 IF (X1=1) OR (Crt=1) OR (Options=4) THEN 13710
13670 IF (Annor<>1) AND (Sd<>1) THEN 13710
13680 BEEP
INPT "ANNOTATION OR STN. DEV. MUST BE PLOTTED ON CRT FIRST...TRY AGAIN",X1
13730 GOTO 13590
13730 IF (X1>0) AND (X1<4) THEN ON X1 GOSUB Crt,Printer,Plotter
13730 GOTO Menu_4

13740 Crt:=! PLOT ON CRT
13750 PLOTTER IS 13,"GRAPHICS"
13760 GRAPHICS
13770 Crt=1 en
13780 S1=S
13790 S=1
13800 Xdo1=Xdp
eters
13810 Ydo1=Ydp
13820 Xdo=0
13830 Ydo=0
13840 GOSUB Plot
13850 PAUSE

13850 EXIT GRAPHICS
13870 Xdo=Xdp1
13880 Ydo=Ydp1
13890 S=31
13900 RETURN
13910 !
13920 !
13930 Printer:! PRINT ON THERMAL PRINTER
13940 DUMP GRAPHICS
13950 RETURN
13960 !
13970 !
13980 Plotter:! DIGITAL PLOTTER OPTIONS
13990 Dp=1
14000 PLOTTER IS 7,5,"9872A"
14010 IF Dp_init=1 THEN GOSUB Initialize pen
14020 GOSUB Size medium, and
14030 GOSUB Plotter_menu colors
14040 GOSUB Plot
14050 IF draft=0 THEN PEN 0
14060 if not
14070 EXIT GRAPHICS

13630 INPT "ANNOTATION OR STN. DEV. MUST BE PLOTTED ON CRT FIRST...TRY AGAIN",X1
13730 GOTO 13590
13730 IF (X1>0) AND (X1<4) THEN ON X1 GOSUB Crt,Printer,Plotter
13730 GOTO Menu_4

13740 Crt:=! PLOT ON CRT
13750 PLOTTER IS 13,"GRAPHICS"
13760 GRAPHICS
13770 Crt=1 en
13780 S1=S
13790 S=1
13800 Xdo1=Xdp
eters
13810 Ydo1=Ydp
13820 Xdo=0
13830 Ydo=0
13840 GOSUB Plot
13850 PAUSE

13850 EXIT GRAPHICS
13870 Xdo=Xdp1
13880 Ydo=Ydp1
13890 S=31
13900 RETURN
13910 !
13920 !
13930 Printer:! PRINT ON THERMAL PRINTER
13940 DUMP GRAPHICS
13950 RETURN
13960 !
13970 !
13980 Plotter:! DIGITAL PLOTTER OPTIONS
13990 Dp=1
14000 PLOTTER IS 7,5,"9872A"
14010 IF Dp_init=1 THEN GOSUB Initialize pen
14020 GOSUB Size medium, and
14030 GOSUB Plotter_menu colors
14040 GOSUB Plot
14050 IF draft=0 THEN PEN 0
14060 if not
14070 EXIT GRAPHICS

13630 INPT "ANNOTATION OR STN. DEV. MUST BE PLOTTED ON CRT FIRST...TRY AGAIN",X1
13730 GOTO 13590
13730 IF (X1>0) AND (X1<4) THEN ON X1 GOSUB Crt,Printer,Plotter
13730 GOTO Menu_4

13740 Crt:=! PLOT ON CRT
13750 PLOTTER IS 13,"GRAPHICS"
13760 GRAPHICS
13770 Crt=1 en
13780 S1=S
13790 S=1
13800 Xdo1=Xdp
eters
13810 Ydo1=Ydp
13820 Xdo=0
13830 Ydo=0
13840 GOSUB Plot
13850 PAUSE

13850 EXIT GRAPHICS
13870 Xdo=Xdp1
13880 Ydo=Ydp1
13890 S=31
13900 RETURN
13910 !
13920 !
13930 Printer:! PRINT ON THERMAL PRINTER
13940 DUMP GRAPHICS
13950 RETURN
13960 !
13970 !
13980 Plotter:! DIGITAL PLOTTER OPTIONS
13990 Dp=1
14000 PLOTTER IS 7,5,"9872A"
14010 IF Dp_init=1 THEN GOSUB Initialize pen
14020 GOSUB Size medium, and
14030 GOSUB Plotter_menu colors
14040 GOSUB Plot
14050 IF draft=0 THEN PEN 0
14060 if not
14070 EXIT GRAPHICS

13630 INPT "ANNOTATION OR STN. DEV. MUST BE PLOTTED ON CRT FIRST...TRY AGAIN",X1
13730 GOTO 13590
13730 IF (X1>0) AND (X1<4) THEN ON X1 GOSUB Crt,Printer,Plotter
13730 GOTO Menu_4

13740 Crt:=! PLOT ON CRT
13750 PLOTTER IS 13,"GRAPHICS"
13760 GRAPHICS
13770 Crt=1 en
13780 S1=S
13790 S=1
13800 Xdo1=Xdp
eters
13810 Ydo1=Ydp
13820 Xdo=0
13830 Ydo=0
13840 GOSUB Plot
13850 PAUSE

13850 EXIT GRAPHICS
13870 Xdo=Xdp1
13880 Ydo=Ydp1
13890 S=31
13900 RETURN
13910 !
13920 !
13930 Printer:! PRINT ON THERMAL PRINTER
13940 DUMP GRAPHICS
13950 RETURN
13960 !
13970 !
13980 Plotter:! DIGITAL PLOTTER OPTIONS
13990 Dp=1
14000 PLOTTER IS 7,5,"9872A"
14010 IF Dp_init=1 THEN GOSUB Initialize pen
14020 GOSUB Size medium, and
14030 GOSUB Plotter_menu colors
14040 GOSUB Plot
14050 IF draft=0 THEN PEN 0
14060 if not
14070 EXIT GRAPHICS
<table>
<thead>
<tr>
<th>Line</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>14070</td>
<td>Dp=3</td>
<td>Reset plotter flag.</td>
</tr>
<tr>
<td>14080</td>
<td>RETURN</td>
<td></td>
</tr>
<tr>
<td>14090</td>
<td>Init: Pc1=1</td>
<td></td>
</tr>
<tr>
<td>14100</td>
<td>MAT Pc2=(1)</td>
<td></td>
</tr>
<tr>
<td>14110</td>
<td>Pc3=1</td>
<td></td>
</tr>
<tr>
<td>14120</td>
<td>Pc4=1</td>
<td></td>
</tr>
<tr>
<td>14130</td>
<td>MAT P label=(1)</td>
<td></td>
</tr>
<tr>
<td>14140</td>
<td>Pc5=1</td>
<td></td>
</tr>
<tr>
<td>14150</td>
<td>Padraft=0</td>
<td></td>
</tr>
<tr>
<td>14160</td>
<td>Dp_init=0</td>
<td></td>
</tr>
<tr>
<td>14170</td>
<td>RETURN</td>
<td></td>
</tr>
<tr>
<td>14180</td>
<td>Size: PRINT PAGE; LIN(2); TAB(28); &quot;INPUT PLOT SIZE&quot;</td>
<td></td>
</tr>
<tr>
<td>14190</td>
<td>PRINT LIN(2); TAB(15); &quot;You now have a chance to pick the plot size&quot;</td>
<td></td>
</tr>
<tr>
<td>14200</td>
<td>PRINT LIN(1); TAB(15); &quot;Plot size must be a number between 0 and 1&quot;</td>
<td></td>
</tr>
<tr>
<td>14210</td>
<td>PRINT LIN(3); TAB(15); &quot;EXAMPLES:&quot;</td>
<td></td>
</tr>
<tr>
<td>14220</td>
<td>PRINT LIN(1); TAB(20); &quot;SIZE=1.00...Full plotter limits&quot;</td>
<td></td>
</tr>
<tr>
<td>14230</td>
<td>PRINT TAB(20); &quot;SIZE=0.65...Standard 8 1/2 x 11 inch page&quot;</td>
<td></td>
</tr>
<tr>
<td>14240</td>
<td>PRINT TAB(20); &quot;SIZE=0.00...Single point on the page&quot;</td>
<td></td>
</tr>
<tr>
<td>14250</td>
<td>INPUT &quot;</td>
<td>INPUT PLOT SIZE ?&quot;, S</td>
</tr>
<tr>
<td>14260</td>
<td>IF (S&gt;=0) AND (S&lt;=1) THEN RETURN</td>
<td></td>
</tr>
<tr>
<td>14270</td>
<td>BEEP</td>
<td></td>
</tr>
<tr>
<td>14280</td>
<td>INPUT &quot;</td>
<td>PLOT SIZE is not between 0 and 1...PRESS CONT AND TRY AGAIN&quot;, Ai</td>
</tr>
<tr>
<td>14290</td>
<td>GOTO 14250</td>
<td></td>
</tr>
<tr>
<td>14300</td>
<td>RETURN</td>
<td></td>
</tr>
<tr>
<td>14310</td>
<td>Plotter_menu: PRINT PAGE; LIN(2); TAB(38); &quot;DIGITAL PLOTTER&quot;; LIN(2)</td>
<td></td>
</tr>
<tr>
<td>14320</td>
<td>PRINT TAB(10); &quot;There are three output medium options for the digital plotter:&quot;</td>
<td></td>
</tr>
<tr>
<td>14330</td>
<td>PRINT LIN(1); TAB(17); &quot;OPTION #&quot;</td>
<td></td>
</tr>
<tr>
<td>14340</td>
<td>PRINT TAB(19); &quot;(1) FELT TIP PENS - NORMAL QUALITY&quot;</td>
<td></td>
</tr>
<tr>
<td>14350</td>
<td>PRINT TAB(19); &quot;(2) FELT TIP PENS - PUBLICATION QUALITY&quot;</td>
<td></td>
</tr>
<tr>
<td>14360</td>
<td>PRINT TAB(19); &quot;(3) TRANSPARENCIES&quot;</td>
<td></td>
</tr>
<tr>
<td>14370</td>
<td>PRINT TAB(19); &quot;(4) DRAFTING PEN&quot;; LIN(1)</td>
<td></td>
</tr>
<tr>
<td>14380</td>
<td>PRINT TAB(10); &quot;Using defaults, the time it take to plot one graph using&quot;</td>
<td></td>
</tr>
<tr>
<td>14390</td>
<td>PRINT TAB(10); &quot;using one data file is:&quot;; LIN(1)</td>
<td></td>
</tr>
<tr>
<td>14400</td>
<td>PRINT TAB(18); &quot;(1) Normal Quality - about two minutes&quot;</td>
<td></td>
</tr>
<tr>
<td>14410</td>
<td>PRINT TAB(18); &quot;(2) Publication quality - twice as long&quot;</td>
<td></td>
</tr>
<tr>
<td>14420</td>
<td>PRINT TAB(18); &quot;(3) Transparencies - twice as long&quot;</td>
<td></td>
</tr>
<tr>
<td>14430</td>
<td>PRINT TAB(18); &quot;(4) Drafting pen - four times as long.&quot;; LIN(2)</td>
<td></td>
</tr>
<tr>
<td>14440</td>
<td>Do=1</td>
<td></td>
</tr>
<tr>
<td>14450</td>
<td>INPUT &quot;</td>
<td>INPUT the OPTION # that you would like to use&quot;, D</td>
</tr>
<tr>
<td>14460</td>
<td>IF (Do&gt;=1) AND (Do&lt;=4) THEN GOTO 14500</td>
<td></td>
</tr>
<tr>
<td>14470</td>
<td>BEEP</td>
<td></td>
</tr>
<tr>
<td>14480</td>
<td>INPUT &quot;</td>
<td>OPTION # NOT WITHIN RANGE...PRESS CONT AND TRY AGAIN&quot;, Ai</td>
</tr>
</tbody>
</table>
14490 GOTJ 14500
14500 ON DO GOSUB Normal,Pub,Pub,Draft
14510 RETRN
14520 Normal: OUTPUT 7,5;"VS 2" ! Plot fast (8 cm./sec.)
14530 GOSJB Colors ! and go get colors
14540 RETRN
14550 Pub: OUTPUT 7,5;"VS 3" ! Plot slow (3 cm./sec.)
14560 GOSJB Colors ! and get colors
14570 RETRN
14580 Draft: OUTPUT 7,5;"VS 1" ! Plot at drafting speed (1 cm.
14590 GOSJB Init
14600 Pdraft=1 ! Set drafting flag
14610 PRINT PAGE;LIN(4);TAB(25);"DRAFTING PEN"
14620 PRINT LIN(4);TAB(20);"LOAD THE DRAFTING PEN NOW"
14630 PRINT LIN(4);TAB(10);"PRESS CONT TO CONTINUE"
14640 PAUSE
14650 RETRN
14660 Costs:PRINT PAGE;LIN(2);TAB(30);"PLOT COLORS"
14670 PRINT LIN(1);TAB(20);"PEN #1 - BLACK    PEN #3 - GREEN"
14680 PRINT TAB(20);"PEN #2 - BLUE     PEN #4 - RED"
14690 PRINT LIN(2);TAB(15);"(1) TITLE: ";Pen$(Pc3);TAB(39);"(2) AXE
S LABELS: ";Pen$(Pc4)
14700 PRINT LIN(1);TAB(15);"(3) AXES AND TICK MARKS: ";Pen$(Pc1)
14710 K=3
14720 PRINT LIN(1);TAB(15);"(4) FILE #"
14730 IF L1=1 TO File
14740 ES=F$(L1)[11]
14750 Pen$=""
14760 IF Pc2(L1)<0 THEN Pen$=Pen$(Pc2(L1))
14770 PRINT TAB(21);L1;" - ";Pen$;": ";F$(L1)
14780 NEXT L1
14790 Op=Op+1=0
14800 INPJT "TO CHANGE A COLOR...ENTER OPTION # - else PRESS
CONT TO CONTINUE",Op
14810 IF Op=0 THEN GOTO 15020
14820 IF (Op)=1 AND (Op<=4) THEN GOTO 14860
14830 BEE>
14840 INPJT "OPTION # NOT WITHIN RANGE...PRESS CONT AND TRY AGAI
N",A1
14850 GOTO 14800
14860 IF Op<4 THEN GOTO 14920
14870 INPJT "INPUT FILE ";Fi
14880 IF (Fi1)=1 AND (Fi1=Pfile) THEN GOTO 14920
14890 BEE>
14900 INPJT "FILE # NOT WITHIN RANGE...PRESS CONT AND TRY AGAIN" 
A1
14910 GOTO 14870
14920 INPJT "INPUT NEW PEN ";P
14930 IF (P)=0 AND (P<=4) THEN GOTO 14970
14940 BEE".
14950 INPJT " PEN # NOT WITHIN 0 AND 4...PRESS CONT AND TRY AGAIN ",A1
14960 GOTO 14920
14970 ON 3p GOSUB Tit,Lab,Ax,Files
14980 A1=3
14990 INPJT " TO REVIEW NEW COLORS...ENTER 1 - PRESS CONT TO CONT
INUE",A1
15000 IF $1=1 THEN GOTO Colors
15010 GOTO 14790
15020 IF 3nnot<>1 THEN RETURN
15030 PRINT PAGE;LIN(2);TAB(27);"ANNOTATION COLORS"
15040 PRINT LIN(1);TAB(20);"PEN #1 - BLACK  PEN #3 - GREEN"
15050 PRINT TAB(20);"PEN #2 - BLUE  PEN #4 - RED";LIN(1)
15060 PRINT TAB(20);"LABEL #"
15070 FOR K=2 TO Ann
15080 Pen$=""
15090 IF Plabel(K)<<0 THEN Pen$=Pen$(Plabel(K))
15100 PRINT USING 15110;K-1;"";Pen$;" - ";Label$(K)
15110 IMAGE 20X,2D,A,3X,5A,3A,20A
15120 NEXT K
15130 Fil=P=0
15140 INPJT " TO CHANGE A COLOR...ENTER LABEL # - else PRESS CONT
to CONTINUE";Fil
15150 IF Fil=0 THEN RETURN
15160 IF (Fil)=0) AND (Fil<Ann-1) THEN GOTO 15210
15170 BEE".
15180 DISP " LABEL # NOT WITHIN 0 AND";Ann-1;"...PRESS CONT AND T
RY AGAIN"
15190 PAUSE
15200 GOTO 15140
15210 INPJT " INPUT NEW PEN ",P
15220 IF (P)=0) AND (P<=4) THEN GOTO 15260
15230 BEE"
15240 INPJT " PEN # NOT WITHIN 0 AND 4...PRESS CONT AND TRY AGAIN ",A1
15250 GOTO 15210
15260 Plabel(K+1)=P
15270 A1=3
15280 GOTO 15140
15290 IF $1=1 THEN GOTO 15030
15300 GOTO 15130
15310 RETURN
15320 Tit=Pc3=P ! Set new pen for title
15330 RETURN
15340 Lab=Pc4=P ! Set new pen for axes labels
15350 RETURN
15360 Ax=Pc1=P ! Set new pen for axes and numb ers.
15370 RET JRN
15380 File s:Pc2(Fil)=P
                   ! Set new pen color for file #
Fil
15390 RET JRN
15400 !                                                                 #
15410 !                                                                 #
15420 !                                                                 #
15430 !                                                                 #
15440 !                                                                 #
15450 Plot:!!
15460 IF t=1 THEN GOTO 15550 ! TAKE LOGS OF SCALE RANGES FOR THE LOG
AXES
15470 IF t=3 THEN GOTO 15550
15480 Ymx=LGT(Ymx)
15490 Ymn=LGT(Ymn)
15500 IF t=2 THEN GOTO 15550
15510 Xmx=LGT(Xmx)
15520 Xmn=LGT(Xmn)
15530 ! PLOT AREA = 20*PLOT SIZE + PLOTTER DISPLACEMENTS (Xdp,Ydp)
 FOR LOWER X AND LEFT Y AXES
15540 x (20+SIZE OF AXIS (Xsize,Ysize))*PLOT SIZE+DISPLACEMENTS FOR THE TOP X AND RIGHT Y SIDES
15550 LOCATE 20*S+Xdp,(20+Xsize)*S+Ydp,20+3+S+Ydp,(20+Ysize)*S+Ydp
15560 SCALE Xmn,Xmx,Ymn,Ymx ! Scale graph into user units
15570 IF Dp AND NOT Pdraft THEN PEN Pc1
15580 LINE TYPE 1
15590 IF Frame THEN FRAME
                   ! Draw FRAME using a solid LINE TYPE
15600 IF Axes THEN GOSUB Axes
                   ! Draw TIC MARKS in USER UNITS
15610 IF Dp AND NOT Pdraft THEN PEN Pc1
15620 IF Number THEN GOSUB Number
                   ! LABEL axes NUMBERS in GRAPHICS UNITS
15630 IF Dp AND NOT Pdraft THEN PEN Pc3
15640 IF _label THEN GOSUB Label
                   ! LABEL TITLE and AXES LABELS in GRAPHICS UNITS
15650 FOR L1=1 TO Pfile
                   ! PLOT FILES in USER UNITS
15660 IF Dp AND NOT Pdraft THEN PEN Pc2(L1)
15670 LOCATE 20+S+Xdp,(20+Xsize)*S+Xdp,20+S+Ydp,(20+Ysize)*S+Ydp
15680 SCALE Xmn,Xmx,Ymn,Ymx
15690 IF P1(L1)=3 THEN GOSUB Histogram
15700 IF (P1(L1)=0) OR (P1(L1)=2) THEN GOSUB Lines
15710 IF (P1(L1)=1) OR (P1(L1)=2) THEN GOSUB Symbols
15720 IF Shade AND (P1(L1)<3) THEN GOSUB Shade_it
15730 NEXT L1
15740 IF Dp AND NOT Pdraft THEN PEN Pc1
15750 SETGU
15760 IF 3d THEN GOSUB Stan_dev
                   ! PLOT STANDARD DEVIATION in GRAPHICS UNITS
15770 IF Annot THEN GOSUB Annotate
                   ! PLOT ANNOTATION in GRAPHICS UNITS
15730 IF \( t=1 \) THEN GOTO 15850
15740 IF \( t=3 \) THEN GOTO 15820

! Convert SCALE RANGES back to LINE
AR values
15830 Ymx=10^Ymx
15840 Ymn=10^Ymn
15850 IF \( t=2 \) THEN GOTO 15850
15860 Xmx=10^Xmx
15870 Xmn=10^Xmn
15880 RETURN

15850 Axes:

\[ \text{DRAW AXES} \]

###

15870 LINE TYPE 1
15880 \( X_i=(X_{mx}-X_{mn})/90 \)
15890 \( Y_i=(Y_{mx}-Y_{mn})/70 \)

! Compute size of X minor tic
! Compute size of Y minor tic

15900 IF \( Pt=1 \) THEN GOTO 16320
15910 IF \( Pt=3 \) THEN GOTO 16090
15920 FOR \( K=Y_{mn} \) TO \( Y_{mx}-1 \)
\( X_{mn},K \)
\( \text{DRAW } X_{mn}+X_i*2,K \)
\( \text{FOR } L=2 \text{ TO } 9 \)
\( \text{MOVE } X_{mn},K+\text{LT}(L) \)
\( \text{DRAW } X_{mn}+X_i,K+\text{LT}(L) \)
\( \text{NEXT } L \)
\( \text{NEXT } K \)

16000 FOR \( K=Y_{mn} \) TO \( Y_{mx}-1 \)
\( \text{DRAW } K,Y_{nin}+Y_i*2 \)
\( \text{FOR } L=2 \text{ TO } 9 \)
\( \text{MOVE } K+\text{LT}(L),Y_{mn} \)
\( \text{DRAW } K+\text{LT}(L),Y_{mn}+Y_i \)
\( \text{NEXT } L \)
\( \text{NEXT } K \)

16100 IF \( Pt=2 \) THEN GOTO 16290
16200 FOR \( K=X_{mn} \) TO \( X_{mx}-1 \)
\( \text{DRAW } K,X_{mn}+X_i*2 \)
\( \text{FOR } L=2 \text{ TO } 9 \)
\( \text{MOVE } K+\text{LT}(L),X_{mn} \)
\( \text{DRAW } K+\text{LT}(L),X_{mn}-X_i \)
\( \text{NEXT } L \)
\( \text{NEXT } K \)

16300 IF \( Pt=3 \) THEN GOTO 16590
16400 FOR \( K=X_{mn} \) TO \( X_{mx}-1 \)
\( \text{DRAW } K,X_{mn}+X_i*2 \)
\( \text{FOR } L=2 \text{ TO } 9 \)
\( \text{MOVE } K+\text{LT}(L),X_{mn} \)
\( \text{DRAW } K+\text{LT}(L),X_{mn}-X_i \)
\( \text{NEXT } L \)
\( \text{NEXT } K \)
CREATE 3kip X'MS' V"Y" M"I'X'M"mN'Y'M"mN'5'5'3

PLACE the X value of the middle of the number.

MOVE (20+(Lu+2)+Xs/2)*S*Xsize+S*I/Nx+Xdp,(20-Ys)*S+Ydp

LABEL U$ ! middle of the entire length of number

GOTO 16770 ! i.e. "10U$"

Xnum=Xnum+Xt*5*I ! If linear axis, compute number value

IF Xnum=0 THEN Xexp=0 ! and value of the exponent

IF Xnum=0 THEN GOTO 16570

Xexp=INT(LGT(ABS(Xnum)))

IF Sci<1 THEN GOTO 16700

MOVE 20*S+5*Xsize*I+Xt*S/(Xmx-Xmn)+Xdp,(20-1.5*Ys)*S+Ydp

Xnum=DROUND(Xnum/10^Xexp,2) ! Round number to d.d

FIXED 1

V$=VAL$(Xnum)"x10" ! Label mantissa
STANDARD
LABEL V$
Lu=LEN(V$
U$=VAL$(X$exp$
Lu=LEN(U$
Move (20+(Lu+Lu)*Xs/2)*S+5*Xsize*I*Xs/S/(X$mXm)+Xdp,(20-Ys)*S+Ydp
LABEL U$
GOTO 16770
Move 20*S+5*Xsize*I*Xs/S/(X$mXm)+Xdp,(20-1.5*Ys)*S+Ydp
Xnum=ROUND(Xnum,Xexp-3)
V$=VAL$(Xnum)
Place exp. the same a for log
16670
LABEL U$
16670
GOTO 16770
16670
Move 20*S+5*Xsize*I*Xs/S/(X$mXm)+Xdp,(20-1.5*Ys)*S+Ydp
Round number to 3 significant digits
V$=VAL$(Xnum)
! and add leading 0 if necessary
16720
IF (Xnum<1) AND (Xnum>0) THEN V$="0"&V$
16730
IF (Xnum>-1) AND (Xnum<0) THEN V$="-0"&VAL$(ABS(Xnum))
16750
LABEL V$
16770
NEXT I
16790
LOG 7
16790
LABEL V$
16790
GOTO 16870
16790
IF (Pt=2) OR (Pt=4) THEN GOTO 16870
Skip to log section for log axis
16800
Len=0
16810
FOR I=0 TO N
16820
Gosub Ynumber
16820
! Find the length of the longest number
16830
Ln=LEN(V$
16840
IF Ln>Len THEN Len=Ln
16850
NEXT I
16860
Ly=3
16870
FOR I=0 TO N
16870
! Loop for the number of major tick
16890
IF (Pt=1) OR (Pt=3) THEN GOTO 16890
Skip to linear section
16890
Ly=LEN(VAL$(Y$m))
16890
! Find length of longest exponent
16900
IF LEN(VAL$(Y$m))>Ly THEN Ly=LEN(VAL$(Y$m))
16900
! Place "10" width of
16910
Move (20-(Ly+2)*Xs+.5*Ys)*S+Xdp,20*S+Ysize+S*I/Ny+Ydp! entire number away
16920
V$="10"!
16920
! from the left Y axis side
16930
LABEL V$
16930
Label exp. width of longest exponent
16940
Move (20-(Ly+2)*Xs+.5*Ys)*S+Xdp,(20+Ys/2)*S+Ysize+S*I/Ny+Ydp! away from the
16950
V$=VAL$(Y$m+I)
16950
! left Y axis side
16970
Goto 17200
16980
IF Sci<1 THEN GOTO 17170
! Skip to standard numbers
16990
Ynum=Y$m+Yt+5*I
16990
! Compute the value of the number
17000 IF Ynum=0 THEN Yexp=0 ! and the exponent
17010 IF Ynum=0 THEN GOTO 17040
17020 Yexp=INT(LOG(ABS(Ynum))
17030 Ynum=ROUND(Ynum/10^Yexp,-1) ! Compute mantissa d.d
17040 FIXED 1
17050 V$=VAL$(Ynum)&"x10"
17060 STANDARD
17070 U$=VAL$(Yexp)
17080 L=LEN(V$) ! Place number the width of the whole
17090 L=LEN(U$) ! number away from the Y axis
17100 MOVE (20-(Lu+Lu)*Xs-.5*Ys)*S+Xdp,20*S+Ysize*S*I/Ny+Ydp ! from Y axis
17110 LABEL V$ ! Place exp. the width of the exp. away
17120 MOVE (20-Lu*Xs-.5*Ys)*S+Xdp,(20+Ys/2)*S+Ysize*S*I/Ny+Ydp ! from Y axis
17130 LABEL U$ ! Find length of longest number
17140 Lyt=Lu+Lu
17150 IF Lyt>Ly THEN Ly=Lyt
17160 GOTO 17200
17170 GOSUB Ynumber ! For standard numbers, get Y number
17180 MOVE (20-Len*Xs-.5*Ys)*S+Xdp,20*S+Ysize*S*I/Ny+Ydp
17190 LABEL V$ ! Place it the width of the longest
17200 NEXT I ! number away from the Y axis
17210 RETURN
17220 Ynumber: Ynum=Ymn+Yt*5*I ! Compute value of the number
17230 IF Ynum=0 THEN GOTO 17250
17240 Ynum=ROUND(Ynum,3) ! round to 3 significant digits
17250 V$=VAL$(Ynum) ! and add leading 0 if necessary
17260 IF (Ynum<1) AND (Ynum>0) THEN V$="0"&V$
17270 IF (Ynum<1) AND (Ynum<0) THEN V$="-0"&VAL$(ABS(Ynum))
17280 RETURN
17290 Label: !#################### LABEL AXES AND TITLE #####################
17300 SETJU
17310 LOCATE 0,130*S,0,100*S ! Set clip units to whole plot size
17320 LOGI 4 !
17330 C$=5*S+Tsize ! Define title size
17340 IF Dp=0 THEN GOTO 17370
17350 FJR I=0 TO 0 ! Make title a little thicker
17360 A=I/10 ! on the digital plotter
17370 MOVE (20+Xsize/2)*S+Xdp+A,(25+Ysize)*S+Ydp ! Move title to the middle
17330 IF Dp THEN PEN Pc3 ! of X axis and 5 units above graph
17390 LABEL T$ !
17400 IF Dp=0 THEN GOTO 17430 !
17410 NEXT I !
17420 FOR I=0 TO 0 ! Make axes labels thicker o
17430 LONG 6 ! f the
17440 CSIZE 5*S*Lsize ! Define label character size
17450 MOVE (20+Xsize/2)*S+Xdp+A,(20-2.5*Ys)*S+Ydp ! Place X label in the
17460 IF Dp THEN PEN Pc4 ! middle of X axis and 1 letter
17470 LABEL X$ ! size below the numbers
17480 LONG 4 !
17490 MOVE (20-|Len|-Xs-1.5*Ys)*S+Xdp,(20+Ysize/2)*S+Ydp ! Place Y label in the mittl
17500 IF (Pt=2) OR (Pt=4) THEN MOVE (20-(|Ly|*Xs+1.5*Ys))*S+Xdp, (20+Ysize/2)*S+Ydp+I/10 ! o the left
17510 LDIR 90 ! Y axis and 1 letter size t
17520 LABEL Y$ ! o the Y numbers and rotat
17530 IF Dp=0) OR (Pdraft=1) THEN RETURN ! e
17550 NEXT I !
17560 NEXT I !
17570 RETURN
17580 Histogram; !
17590 Xii=(Xmx-Xmn)/Xsize*.25*(1/S) ! If shading is used, make the shade .25 graphic units apart
17600 Xi=99999
17610 FOR I=2 TO Npt(Ll) ! Find the smallest distance between
17530 Xii=(Xmx-Xmn)/Xsize*.25*(1/S) ! If shading is used, make the shade .25 graphic units apart
17600 Xi=99999
17610 FOR I=2 TO Npt(Ll) ! Find the smallest distance between
17620 J=X1(L1,I)-X1(L1,I-1) ! any 2 points
17630 IF J<0 THEN Xi=J
17640 NEXT I
17650 Xi=(Xi-20*Xii)/2 ! ALGORITHM: Draw a rectangle with:
17660 FOR I=1 TO Npt(Ll) ! HEIGHT= Y value (Y1(L1,I))
17670 MOVE X1(L1,I)-Xi,Ymn ! WIDTH= + Xi
17680 DRAW X1(L1,I)-Xi,Y1(L1,I) ! Xi = (Smallest distance between any
17690 DRAW X1(L1,I)+Xi,Y1(L1,I) ! 2 points - 1 graphic unit
DRAW X1(L1,I)+%i,Ymn       ! (4*Xii)/2
IF Shade<>1 THEN GOTO 17760
FOR Ix=X1(L1,I)-%i+Xii TO X1(L1,I)+%i-Xii STEP Xii
MOVE Ix,Ymn
DRAW Ix,Y1(L1,I)           ! Shade Histogram with lines
NEXT Ix
NEXT I
RETURN
!

FOR Ix=XKLl,I>-Xi+Xi TO XKLl,I
    NEXT I
RETURN
!

LINES:! ?????????????????????????? PLOT LINES ?????????????????
MOVE X1(L1,1),Y1(L1,1)    ! Move pen to first data pair
LINE TYPE Lt(L1)         ! Set line type chosen in PLOT TYPES
FOR J=1 TO Npt(L1)
    DRAW X1(L1,J),Y1(L1,J)
    NEXT J
RETURN
!

Symbols:!! ?????????????????????? PLOT SYMBOLS ????????????????
LINE TYPE 1                ! Make sure symbol is drawn solid
CSIZE Cm(L1)+3.3*S          ! Set character size - 3.3 is default
LORG 5                     ! Label symbol in the center of point
FOR I=1 TO Npt(L1)         ! Make sure point is within the frame
    IF (X1(L1,I)<Xmn) OR (X1(L1,I)>Xmx) THEN GOTO 17980
    IF (Y1(L1,I)<Ymn) OR (Y1(L1,I)>Ymx) THEN GOTO 17980
    MOVE Y1(L1,I),Y1(L1,I)
    LABEL L$<L1>
    NEXT I
RETURN
!
!
!

Shade_it:!! ?????????????????????? SHADING ????????????????
LINE TYPE 1
X1=(Xmx-Xmn)/Xsize*.25*(1/S) ! Make shade lines 1/4 graphic unit apart
Stop=INT((X1(L1,Npt(L1))-X1(L1,1))/%i)     ! Compute # of shade lines to draw
Xf=X1(L1,1)                  ! Initialize x value of first shade line
K=1
FOR I=0 TO Stop
X1=X1(L1,K)
X2=X1(L1,K+1)
Y1=Y1(L1,K)
Y2=Y1(L1,K+1)
IF Y2>Y1 THEN GOTO 18150 !If Y values of adjacent points are equal get next po

int
Yf=Y1
GOTO 18160
Yf=(Xf-X1)/(X2-X1)*(Y2-Y1)+Y1
MOVE Xf,Ymn !Draw shade line
DRAW Xf,Yf !Get next shade line
Xf=Xf+Xi
IF XF>=X2 THEN K=K+1
NEXT I
RETURN
Stan_dev=! ################################ DRAW +/- STD. DEV. ###################

###
IF Dp THEN 18350 !If plotter is used skip input part
EXIT GRAPHICS
PRINT PAGE;LIN(1);TAB(20);"PLOT STANDARD DEVIATION"
PRINT LIN(2);TAB(10);"THE PROGRAM IS NOW READY TO PLOT THE SIGMA ERROR BAR."
PRINT LIN(1);TAB(10);"(1) PRESS CONT TO GO BACK TO THE PLOT ON THE CRT"
PRINT TAB(10);"(2) POSITION THE CURSOR AT THE BOTTOM OF WHERE THE ERROR BAR WILL"
PRINT TAB(15);"BE PLOTTED"
PRINT LIN(1);TAB(10);"(3) PRESS CONT"
PRINT LIN(1);TAB(10);"THE PROGRAM WILL THEN PLOT THE ERROR BAR ON THE CRT"
PRINT LIN(1);TAB(10);"PRESS CONT TO RETURN TO MENU 4: OUTPUT MEDIA"
INPJT A1
GRAPHICS
POINTER 60,70,2 !Allow user to digitize where the
DIGITIZE Sdx,Sdy !error bar will be plotted
Nsd_gu=Ysize/(Ymx-Ymn)*Nsd !Convert user unit error bar into
MOVE Sdx*S+Xdp,Sdy*S+Ydp !graphic units
DRAW Sdx*S+Xdp,(Sdy+2*Nnum_sd*Nsd_gu)*S+Ydp !Draw error bar
MOVE (Sdx-.2)*S+Xdp,(Sdy+2*Nnum_sd*Nsd_gu)*S+Ydp !Draw ends on the bar
DRAW (Sdx+.2)*S+Xdp,Sdy*S+Ydp
MOVE (Sdx-.2)*S+Xdp,Sdy*S+Ydp
DRAW (Sdx+.2)*S+Xdp,Sdy*S+Ydp
LABEL 2 !Label number of standard d
18430 MOVE (Sdx+2)*S+Xdp,(Sdy+Num_sd*Nsd_gu)*S+Ydp ! in the middle of the bar
18440 CSIZE 3.5*S
18450 U=3.5*(9/15)*S ! Find size of character in graphic
18460 U$=" + "&VAL$(Num_sd)"o"
18470 LABEL U$
18480 MOVE (Sdx+2)*S+Xdp,(Sdy+Num_sd*Nsd_gu+.3)*S+Ydp ! Label minus sign
18490 LABEL "-" ! Make "o" into a sigma by adding a
18500 MOVE (Sdx+2.25)*S+4*U+Xdp,(Sdy+Num_sd*Nsd_gu+.2)*S+Ydp .
18510 LABEL "-" ! bar on top of it
18520 RETJRN
18530 Annotate: ! #~~~~~~~~~~~~~~~~~~~ ANNOTATION #~~~~~~~~~~~~~~~~~~~
18540 CSIZE 4*S*Asize ! Set character size
18550 LORI 2 ! Label from rightmost character
18560 IF Dp=1 THEN 18700 ! On plotter, skip input section
18570 WAIT 500 ! Force user to press key to trigger input
18580 EXIT GRAPHICS ! Force user to go back to graphics
18590 PRINT PAGE;LIN(4);"WE ARE NOW READY TO LET YOU PROVIDE ANNOTATION FOR THE" ! alpha screen
18600 PRINT "GRAPH WHICH YOU HAVE JUST DRAWN";LIN(1)
18610 PRINT "POSITION THE CURSOR TO THE LEFT EDGE OF THE POSITION WHICH YOU " !
18620 PRINT "WANT TO START YOUR LABEL AND PRESS CONT";LIN(1)
18630 PRINT "THE SCREEN WILL PAUSE TO THE KEYBOARD MODE AND YOU THEN ENTER"
18640 PRINT "THE ANNOTATION THAT YOU WANT";LIN(2)
18650 PRINT "CONTINUE AS MANY TIMES AS YOU WANT" !
18660 PRINT LIN(2);"TO EXIT ANNOTATION...ENTER SAME CURSOR POINT TWICE"
18670 PRINT LIN(2);"...TO START ANNOTATION PRESS CONT"
18680 PAUSE 
18690 GRAPHICS
18700 CSIZE .5
18710 POINTER 60,70,2 ! screen and set cursor
18720 FJR L=2 TO 30 ! Up to 29 labels
18730 ! If on plotter check if point was digitized twice
18740 IF (Dp=1) AND ((Xa(L)=Xa(L-1)) AND (Ya(L)=Ya(L-1))) THEN RET
18750 ! If not on plotter, digitize next label position
18760 IF Dp=0 THEN DIGITIZE Xa(L),Ya(L)
18770 IF this is the same position, exit annotation loop
18780 IF (Dp=0) AND ((Xa(L)=Xa(L-1)) AND (Ya(L)=Ya(L-1))) THEN RETUR
N
! else move pen to label position
18730 MOVE Xa(L)+S+Xdp,Ya(L)+S+Ydp
18790 ! If on CRT, enter label
18800 IF Dp=0 THEN INPUT "INPUT ANNOTATION LABEL",Label$(L)
18810 ! Pick up pen on plotter for the next label
18820 IF Dp=1 THEN PEN Plabel(L)
18830 ! Label annotation
18840 CSIZE 4*S*Asize ! Set character size
18850 LABEL Label$(L)
18860 ! CSIZE .5 &--------------------------------------------------------------------------------------------------
18870 ! Count number of labels for use in annotation colors
18880 Ann=L
18890 NEXT L
18900 RETJRN
18910 SUBEND
18920 ! ############ END PROGRAM ROUTINE ###############
18930 End_it:PRINT PAGE;LIN(15)
18940 PRINT TAB(25);"END OF PROGRAM"
18950 GOT) End
18960 RETJRN 7005
APPENDIX D: FLOW CHARTS
PLOT PROGRAM DRIVER

START

INIT
Set up common
Initialize flag
LOAD SK' s

INPUT DATA
From Keyboard,
Tape, Plotter,
Define function

OPTIONS
Input new data
Save data
Plot data,
End program

END
Output end
message and
End program

SUBROUTINE INIT

Set DEGREES
Print on the CRT (16)
Arrays start at 1
LOAD SK' S

RETURN

INPUT_DATA SUBROUTINE

L1=1
Log ck=0
REDIN XI,Y1,
FS,Npt, to
full limit

OUTPUT
Input
Options
Figure 1.

INPUT.
In(1), In(2),
In(3), In(4)

COMPUTE
Pfile=In(1)+In(2)+
In(3)+In(4)
Pts=INT(2000/Pfile)
REDIM Npt(Pfile),
XI(Pfile,Pts),
Y1(Pfile,Pts),FS(Pfile)

<table>
<thead>
<tr>
<th>KEYBOARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUT In(1) number of files</td>
</tr>
</tbody>
</table>

| TAPE |
| INPUT In(2) of files from tape |

| DIGIT |
| INPUT In(3) of files from D. P. |

| DEFINE FUNCTION |
| Define In(4) of function |

RETURN
SUBROUTINE KEYBOARD

Key = 1

1

OUTPUT
Keyboard
Input Menu
Figure 3a-c

INPUT
Z(L1)
Npt(L1)
A1

A1 = 1?

Y

OUTPUT
Figure 3d-e

INPUT
X0, Dx

I = 1, Npt(L1)

I = 1, Npt(L1)

INPUT
X1(L1;I), Y1(L1;I)

COMPUTE
X1(L1;I) = X0 + (I-1)*Dx

INPUT
Y1(L1;I)

NEXT I

EXIT DATA
Review and
Edit file #L1

L1 = L1 + 1
Key = Key + 1

RETURN

Key > In(1)?
SUBROUTINE TAPE

Tape=1

2

OUTPUT
Catalogue
Figure 3a
INPUT D$

INPUT
ASSIGN 0; D$: T14
READ 0;
A$, Nfile(*),
Ntemp(*), Xtemp(*), Ytemp(*)

3

OUTPUT
File Menu
Figure 3b
INPUT Ifile

COMPUTE
X1(*) = Xtemp(*)
Y1(*) = Ytemp(*)
Npt(L1) =
Ntemp(Ifile)

EDIT DATA
Review/edit data

OUTPUT
Input check
Figure 3c
INPUT Again

OUTPUT
Same set?
Figure 3d
INPUT A1

2

A1=0?

3

OUTPUT
Same set?
Figure 3e
INPUT A1

RETURN
SUBROUTINE DIG_INIT

OUTPUT
Digitize Menu
Figure 4a

INPUT
Gr

OUTPUT
Initialize Graph Menu
Figure 4b

DIGITIZE
Xframe(T) Yframe(I)

I=1,4
NEXT I

OUTPUT
Scale Type Menu
Figure 4d

INPUT
Pz

OUTPUT
Graph Range Menu
Figure 4e

INPUT
Xmn, Xmx, Ymn, Ymx

RETURN

SUBROUTINE DIGITIZE

Digitize=1
Dig_flag=1

DIG_INIT
Digitize corners
Enter Scale type
Enter Data Range
INPUT Gr

Graph=1

DIGIT
Digitize File #11

Scaleck=0

DIG_OPTS
Review, edit and scale digitized file

L1=L1+1
Graph=Graph+1
Digit=Digit+1

Graph>Gr?

Digit>Int(3)

RETURN
SUBROUTINE DIG_OPTS

Ed=3
Scaleck=Scaleck+1

OUTPUT
Digitizing Edit Options Menu
Figure 6

INPUT
D0

Scaleck=1?

Y
DIG_SCALE
Rotate graph and convert data according to scale type

N
DIG_PLOT
Plot rotated unscaled temporary data array

D0=1?

Y

N
D0=2?

Y
HARD
Print rotated scaled data on printer

N
D0=3?

Y
EDIT DATA
Edit rotated and scaled data numerically

N
RETURN

RETURN

SUBROUTINE DIGIT

OUTPUT
Digitize File Menu
Figure 5

INPUT
F$(L1)

K=1

DIGITIZE
Xtemp(L1,K)
Ytemp(L1,K)

Point=To previous point?

Y

K=K-2

N
Point inside frame?

Y

K=K+1

N

K<>1?

Y

K=K-1

N

RETURN
SUBROUTINE DIG_EDIT

OUTPUT
Re-digitizing
Menu
Figure 7

Scaleck=0
PLOTTER IS
"9872A"

ROTATE_BACK
Rotate unscaled
data back to
angle digitized

I=1, K
NEXT I

OUTPUT
"Input
Option 0?"

INPUT
A1

A1=2?
Y

A1=1?
Y

ADD_PT
Add a new
point after
point I

A1=2?
N

DELETE_PT
Delete point
I

A1=3?
N

A1=4?
Y

RE_DIG
Re-digitize
point I

A1=2?
N

A1=3?
N

A1=4?
Y

RETURN
**SUBROUTINE SAVE_DATA**

INPUT
A1

N
A1=1?

Y

INPUT
DS, AS

OUTPUT
Catalogue and file menu
Figure 11b-a

OUTPUT
Assign $1$ to DS
PRINT $1; AS, Npt(*), Fg(*), Xtemp(*), Ytemp(*)

RETURN

**SUBROUTINE OPTIONS**

INPUT
A1

A1=1?

A1=2?

A1=3?

A1=4?

A1=5?

INPUT DATA from keyboard, tape, function or digitized.

PLOT_DATA on CRT, printer, or plotter.

SAVE_DATA on magnetic cassette tape.

SAVE_GRAPH on magnetic tape.

RETRIEVE_GRAPH from tape.

RETURN
SUBROUTINE ENTER SCALES

OUTPUT
Scale Range
Menu
Figure 14a

INPUT
Xxx, Xnn

Pt>2?

Y

INPUT
Xnn, Xnn

COMPUTE
Xt=(Xxx-Xnn)/(5*Ym)

COMPUTE
Ym=LGT(Xxx)-LGT(Xnn)

OUTPUT
Scale Range
Menu
Figure 14b

INPUT
Yxx, Ynn

Pt=2 or
Pt=4?

Y

INPUT
Yxx, Ynn

COMPUTE
Yt=(Yxx-Ynn)/(5*Ym)

COMPUTE
Ym=LGT(Yxx)-LGT(Ynn)

RETURN
SUBPROGRAM PLOT_DATA

Defaults= 0?

OUTPUT
Plot Data
Menu
Figure 12

INPUT
An.

An=1?

N

SET_DEFAULTS
Set plot options to defaults

Y

SCALE_TYPE
Input scale type & ranges

LABELS
Enter title & axis labels

MENU_1
Input Parameters

MENU_2
Dimensions/
Plot Options

MENU_3
Plot Types

MENU_4
Output Media

RETURN

Log_ck=0?

N

X_LIN_TO_LOG
Scale X data
to log scale

Y

Log_ck=0
and
Pr=2 or 4?

Y_LIN_TO_LOG
Scale Y data
to log scale

SUBROUTINE MENU_1

OUTPUT
Input Parameters
Options Menu
Figure 17

INPUT A1

A1=1?
Y
LABELS
Input new
title & axes
labels

N
A1=2?
Y
SCALE_TYPE
Input new
scale type

N
A1=3?
Y
ENTER_SCALES
Enter new
scale ranges
for both axes

N
A1=4?
Y
TIC_COUNT
Change number
of major tic
intervals

N
-RETURN

SUBROUTINE MENU_3

OUTPUT
Menu 3:
Plot Types
Figure 26a

INPUT A1

A1=1?
Y
PLOT_TYPES
Assign new
plot types
to each file

N
RETURN
SUBROUTINE MENU_2

11 OUTPUT
Plot options
Dimensions
Menu 2
Figure 18

INPUT A1

A1=1?
Y
ANNOTATION
Input flag for annotation & size

N
NORMALIZE
Multiply X or Y values of a file by a constant

A1=2?
Y

N
SCI NOT
Set flag to use scientific notation

A1=3?
Y

N
STD DEV
Set S.D. flag
Enter 1 S.D.
Enter number of S.D. to plot

A1=4?
Y

N
SHADING
Enter flags to shade any data file

A1=5?
Y

N
A1=6?
Y
DIMENSIONS
Enter new sizes for X and Y axes

N
A1=7?
Y
TITLE SIZE
Input Multiplier for character size

N
A1=8?
Y
LABEL SIZE
Input size multiplier for labels

N
A1=9?
Y
NUMBER SIZE
Input size multiplier for the axes numbers

N
RETURN

12
SUBROUTINE PLOTTER

Dp=$0
PLOTTER IS "9872A"

Dp_init=1?

N:

SIZE
Input plot size

PLOTTER_MENU
Input plot media and pen colors

PLOT
Plot graph on plotter

Dp=0
EXIT GRAPHICS

RETURN

SUBROUTINE PLOTTER_MENU

OUTPUT
Plotter Menu

Figure 30

INPUT
Do

Do=1?

Y
NORMAL
Pen speed= 8 cm./sec
CALL COLORS

N

Do=2?

Y
PUB
Pen speed= 3 cm./sec
CALL COLORS

N

Do=3?

Y
TRAN
Pen speed= 1 cm./sec
CALL COLORS

N

Do=4?

Y
DRAFT
Pen speed= 1 cm./sec.

RETURN
SUBROUTINE CRT

- Plot data on CRT
- Return

SUBROUTINE PRINTER

- Dump Graphics
- Return

OUTPUT
- Menu 4: Output
- Media
- Figure 27

INPUT A1

- A1=1?
  - Plot graph on the CRT
- A1=2?
  - Dump Graphics screen onto printer
- A1=3?
  - Plot graph on digital plotter
- A1=4?
  - Return to the Scale options Menu
- A1=5?
  - Return to the Plot options/dimensions
- A1=6?
  - Return to the Plot types Menu
- RETURN
SUBROUTINE COLORS

OUTPUT Colors Menu
Figure 32a

OUTPUT Enter option number? Figure 32b
INPUT Op

Op<>0?

N

16

Y

Op=4?

N

16

Y

Output Input file number? Figure 32c
INPUT F1

OUTPUT Enter new pen number? Figure 32d
INPUT P

Op=1?

Y

TIT Pc3=P

N

Op=2?

Y

LAB Pc4=P

N

Op=3?

Y

AX Pcl=P

N

Op=4?

Y

FILES Pc2(L1)=P

N

OUTPUT Review new colors? Figure 32e
INPUT A1

15

N

A1<>0?

Y

15

Y

Annot=1?

N

18

Y

OUTPUT Annotation Colors Menu
Figure 33a

OUTPUT Enter new Label pen & Figure 33b
INPUT F1

F1<>0?

N

RETURN

OUTPUT "Input new pen number?"
INPUT P

OUTPUT "Review new colors?"
INPUT A1

17

N

A1<>1?

Y

18
SUBROUTINE PLOT

Pt=1?

Pt=3?

Pt<>2?

EXECUTE LOCATE Area
SCALE GU's
Draw FRAME

EXECUTE PEN Pc2(L1)
LOCATE Frame
SCALE UU's

HISTOGRAM
Draw Histogram for file $L1$
and shade if Shade(L1)=1

P1(L1)=3?

P1(L1)=0
P1(L1)=2?

P1(L1)=1
P1(L1)=2?

P1(L1)<3
and Shade(L1)=1?

SHADE IT
Shade file 2
Li if it isn't a histogram

19

20

19

NEXT L1!
SUBROUTINE PLOT cont.

21

Annot=1?

N

Y

STAND_DEV
Enter S.D. on the CRT & plot S.D. on plotter

Sd=1?

N

Y

Pt<>1?

N

Y

Pt=3?

N

Y

Pt<>2?

N

RETURN

OTHERWISE

COMPUTE
Ymx=10^*Ymx
Ymn=10^*Ymn

Pt=3?

N

Y

COMPUTE
Xmx=10^*Xmx
Xmn=10^*Xmn

SUBROUTINE END_IT

OUTPUT

"End of Program"

RETURN

D19
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APPENDIX E: INDEX TO MENU, LISTING AND FLOWCHART FIGURES

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APPENDIX F: OUTPUT EXAMPLES
Appendix F contains examples of the plotting options available. Listed below are the examples and the plot options that are used in the order that they appear using the materials recommended in Appendix A.

**VARIABLE ENERGY**
1) Thin tipped felt tip pens used on cotton drawing paper.
2) Multiple data files using line types 1,4,6,8 and symbols #,&,*, and +.
3) Scientific notation.
4) Standard deviation.
5) Graph dimensions 60x80 graphic units.
6) Plot size .65.
7) Five major tics on the Y axis, four major tics on the X axis.

**MONTE CARLO LINE PROFILE**
1) Shading using wide tip pen.
2) Annotation.
3) Y values normalized by 1000.
4) Data input from keyboard.

**PZT5A**
1) Drafting pen on vellum.
2) Data digitized off plotter from experimental curve.
3) Dimensions 80x80, plot size .5, graph ends up 4"x4".

**RELATIVE AREA**
1) No frame, tics, numbers, title, or axes labels.
2) Picture digitized from a hand drawing.
3) Numbers and title have been input using the annotation option.

**BA 100EV**
1) HP transparency film using the HP transparency thin tipped pens.
2) Logarithmic scale on the Y axis.
3) Annotation used for the Figure caption.

**SPECTRUM SINE WAVE**
1) HP spectrum paper and pens.
2) Fourteen distinguishable colors using up color combinations of up to three colors.
3) Sine waves input from the Define Function mode using 36 sine waves with amplitudes ranging from 17 to 2 and X data range of 0 to 360.

**HARDWARE PRODUCTION COMPANY**
1) Histogram plots for three data files.
2) Histograms are shaded.
3) Spectrum pens were used. Overwriting the first data file (magenta) by the second (yellow), created the green color for nails. Overwriting with the third file (cyan) created the purple color for bolts.
4) The lines in the key were digitized after the histogram graph was completed.
5) Notice the ten major tics on the Y axis.
VARIABLE ENERGY

CR on SI
* - 5 kev
+ - 10 kev
# - 20 kev
& - 40 kev

X Axis (Micrometers)

MONTE CARLO LINE PROFILE

CR on SI 0.5 mm wide 0.14 mm thick 20 Kev
10 nm beam 40 deg. edge

X Axis (Micrometers)
RELATIVE AREA OF MEASUREMENT POSITIONS
Figure 5-9  Differential cross sections for electron impact on barium at 100 eV.
# BASIC Utility Graphics Software for a Desktop Computer

## 5. AUTHOR(S)
Clare Y. Trahan and Stephen W. Jensen

## 11. ABSTRACT
This report describes an interactive BASIC language graphics utility program designed to facilitate easy plotting of X,Y data. The program operates on a Hewlett-Packard 9845B desktop computer, in its standard configuration, and uses a Hewlett-Packard 9872 A four pen digital plotter. The program allows the user to view X,Y data graphically, and provides a broad range of plotting options so that publication quality graphs and transparencies may be created using up to four colors on the digital plotter. Data may be digitized from a user's graph on the digital plotter, generated as a user defined function, or input directly from the computer keyboard or magnetic tape cassette. Data may be plotted on the computer CRT, on the computer's internal thermal printer, or on the digital plotter.

## 12. KEY WORDS
- BASIC
- CRT
- digital plotter
- graphs
- HP 9845B desktop computer
- interactive
- internal thermal printer
- magnetic cassette tape
- plot
- software
- X,Y data

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