

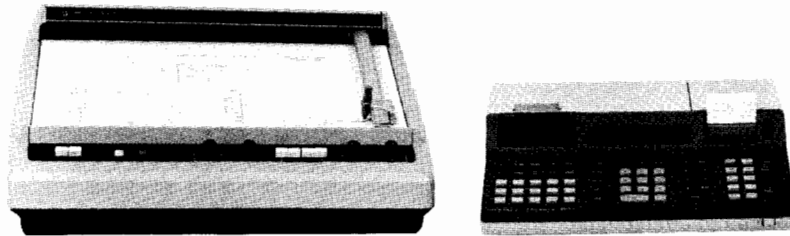
Hewlett-Packard 9815A Calculator

98132A Plotter Interface

Operating Manual



HP 98132A Plotter Interface



HP 9815A Calculator and HP 9862A Plotter



HEWLETT-PACKARD CALCULATOR PRODUCTS DIVISION

P.O. Box 301, Loveland, Colorado 80537, Tel. (303) 667-5000

(For World-wide Sales and Service Offices see rear of manual.)

Copyright by Hewlett-Packard Company 1975



HP Computer Museum
www.hpmuseum.net

For research and education purposes only.

TABLE OF CONTENTS

Section 1: INTRODUCTION

Option 002	1
Connecting the System	1
The HP 9862A Plotter	3
Line and Chart Hold	3
Loading Paper	3
Graph Limits	3
System Test	4
Accuracy Plot	5
Performance Plot	6

Section 2: PLOTTING and LETTERING

Introduction	9
Plotting	10
SCALE Instruction	10
AXES Drawing Instructions	11
PEN↑ Instruction	12
PLOT Instruction	12
DRAW+ Instruction	12
IPLOT Instruction	13
MOVE Instruction	13
Basic Plotting Example	13
Lettering	16
CSIZE Instruction	16
PRNTX Instruction	17
Lettering Instruction	18
Basic Lettering Example	19

Section 3: PROGRAM EXAMPLES

Plotting Example Program	21
Lettering Example Program	24
Plotting and Lettering Program	26

Section 4: DIGITIZING

Digitizing Mode Instructions	31
Exit Instruction	32
Accuracy	32
Basic Digitizing Example	33
Digitizing Program Example	34
Sample Data Plot	34
Area and Length Program	35
Program Details	40
PLOTTER INSTRUCTIONS and KEYBOARD FOLDOUT	(back of manual)
SALES and SERVICE OFFICES	(back of manual)
ERROR MESSAGES	(inside back cover)

FIGURES

Connecting the Interface	2
Accuracy Plot	6
Performance Plot	7
Basic Example Figure	15
Alpha Keyboard	18
Plot of $y = x^2$	22
Lettering Example Plot	26
Plot of $(\sin x)/x$	27
Sample Data Plot	35

Introduction

The addition of the HP 9862A Calculator Plotter to the HP 9815A Calculator produces a plotting system capable of providing hard-copy graphic solutions to problems solved by the calculator. The system also has the unique capability of using the plotter as a digitizer.

The calculator controls the functions of the plotter through the HP 98132A Plotter Interface. The plotter can be used to plot (draw histograms or charts), letter (characters or the result of a calculation), and digitize (lines and figures into scaled coordinate values).

Option 002

The calculator must be equipped with Option 002, Two-Channel I/O, before it is possible to connect the plotter interface.



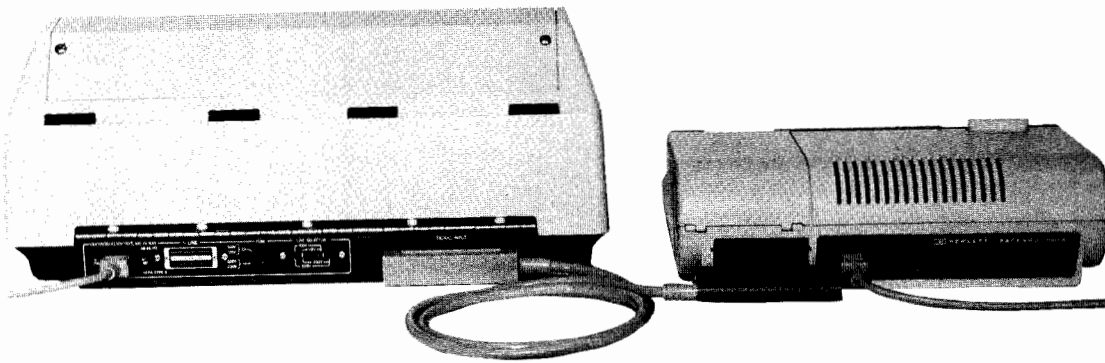
Connecting the System

NOTE

The calculator must be switched off before connecting the plotter interface.

The calculator-plotter system will function properly only if it is connected with the calculator switched off. If you accidentally connect the interface with the calculator on, you must switch the calculator off and then on again.




2 Introduction



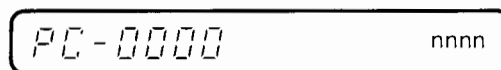
With the calculator switched off, connect the interface to the calculator and plotter as shown above. The interface may be connected to either I/O channel.

Now switch the calculator on.

The plotter interface requires the use of 72 calculator program steps, as can be seen by performing the following key sequences.

1. Switch to the Run mode. 
2. Press 
3. Switch to the Program mode. 

Resulting Display



PC-0000 nnnn

The number on the right side of the display (nnnn) should be 72 steps less than the number of steps available without the interface connected. The exact number of steps available depends upon the memory option your calculator has and the connection of any other interfaces.

The HP 9862A Plotter

Information concerning the plotter is contained in the HP 9862A Plotter Peripheral Manual (HP Part No. 09862-90012). Refer to that manual for complete information regarding plotter installation, initial turn-on procedure, plotter maintenance, etc. The following plotter “set up” information is included here for your convenience.

Before plotting, paper must be loaded and the physical limits of the plotting area must be established. The front-panel controls on the plotter are used for this purpose.

Line and Chart Hold

The LINE pushbutton is the power switch for the plotter; press it to apply power, and press it again to remove power. The white LINE indicator is lit whenever the plotter is ON.

Pressing CHART HOLD activates the paper hold-down mechanism. Pressing CHART HOLD again deactivates it. The plotter will not plot or letter, and the pen holder and arm can be moved freely when CHART HOLD is deactivated.

Loading Paper

To load paper, release CHART HOLD and manually move the pen arm all the way to one side of the plotter. Lay a sheet of paper on the plotting surface and smooth it out. Make sure that the paper is squarely against the ridge at the bottom of the plotting surface. Activate CHART HOLD and smooth the paper to the platen.

Graph Limits

The Graph Limit controls are used to determine the physical size of the plot.

LOWER LEFT and the two knobs to its left are used to determine the physical location of the lower left-hand corner of the plotting area.

UPPER RIGHT and the two knobs to its right are used to determine the physical location of the upper right-hand corner of the plotting area. Together, the upper right-hand corner and the lower left-hand corner determine the size of the plotting area.

Altering the lower left-hand setting will translate the upper right-hand setting by the same direction and amount.

4 Introduction

To specify the lower left-hand corner of the plotting area, press LOWER LEFT; the pen will move, without touching the paper, to the lower left-hand corner of the plotting area. This point can be set anywhere within the lower left-hand part of the plotting surface (platen) by adjusting the two knobs associated with LOWER LEFT. Once the lower left-hand has been set, the upper right-hand corner is set in the same way by pressing UPPER RIGHT and adjusting the two knobs associated with it. Once the plotting area has been determined, it can be relocated by moving the position of the lower left-hand corner – the upper right-hand corner will 'track' the change.

System Test

The following procedure will verify the operation of your plotter and plotter interface.

NOTE

This procedure requires that the calculator and plotter be properly connected. For installation instructions, refer to the beginning of this section.



1. Switch the calculator on.
2. Press "LINE ON" on the plotter.
3. On the plotter:
 - a. Place a sheet of 10 × 15 inch plotter paper, HP Part No. 9270-1004, on the platen and align the paper against the bottom and left-edge paper guides. Press CHART HOLD and smooth the paper on the platen.
 - b. Adjust the LOWER LEFT Graph Limit controls to align the pen exactly over the lower-left corner of the grid on the paper. Then adjust the UPPER RIGHT Graph Limit controls to align the pen over the upper-right corner of the grid. This procedure must be completed very carefully, as the accuracy of the plot depends on it.

Accuracy Plot

Insert the Utility and Test Cartridge (HP Part No. 09815-10004) into the tape drive and load file -12.

Press  12  

When the tape drive halts:

Press  

The resulting plot should duplicate the sample plot shown on page 6.

NOTE

“NO I/O DEVICE” error message will result if:

- The interface is not connected to either the calculator or plotter.
- The plotter is unplugged or switched off.

Plotter alignment can be verified by comparing the plot with the following specifications:

Alignment Verification - all vertical and horizontal lines (6) align within 0.01” of preprinted grid.

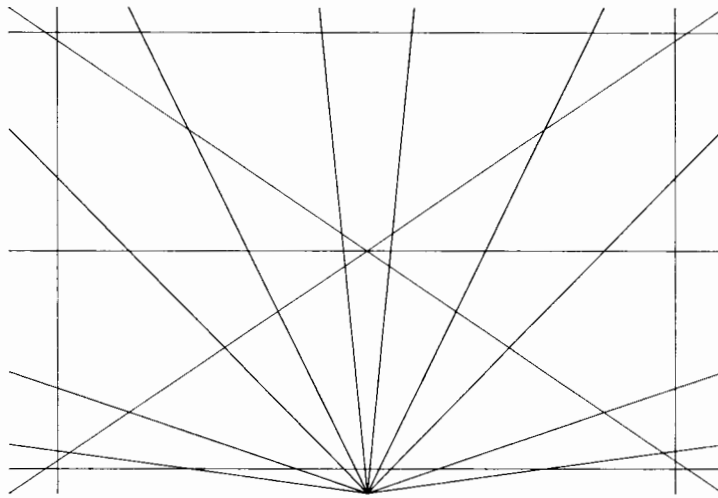
Retrace Verification - all retraced lines (10 radiating from bottom center) are open less than 0.015”.

Servo Matching Verification - the single horizontal trace (at bottom of plot) has inflections less than 0.015” in amplitude.

All angular lines bowed in no more than 0.04” from the true straight line between end points.

If the finished plot does not duplicate the sample plot or does not meet the alignment specifications, check the paper for proper position and corner alignment (see step 3, page 4) and repeat the test. Also check the pen as it may be skipping. This can be verified by replacing the pen and repeating the test. If the finished plot still does not duplicate the sample plot, contact the nearest HP Sales and Service Office for assistance. A listing of office locations is provided at the back of this manual.

6 Introduction



Accuracy Plot

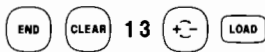
Performance Plot

Place a sheet of 10 × 15 inch plotter paper, HP Part No. 9270-1004, on the platen and align the paper against the bottom and left-edge paper guides. Press CHART HOLD and smooth the paper on the platen.

Adjust the LOWER LEFT controls to align the pen exactly over the lower-left corner of the grid on the paper. Then adjust the UPPER RIGHT Graph Limit controls to align the pen over the upper-right corner of the grid.

Load file – 13 from the tape cartridge:

Press



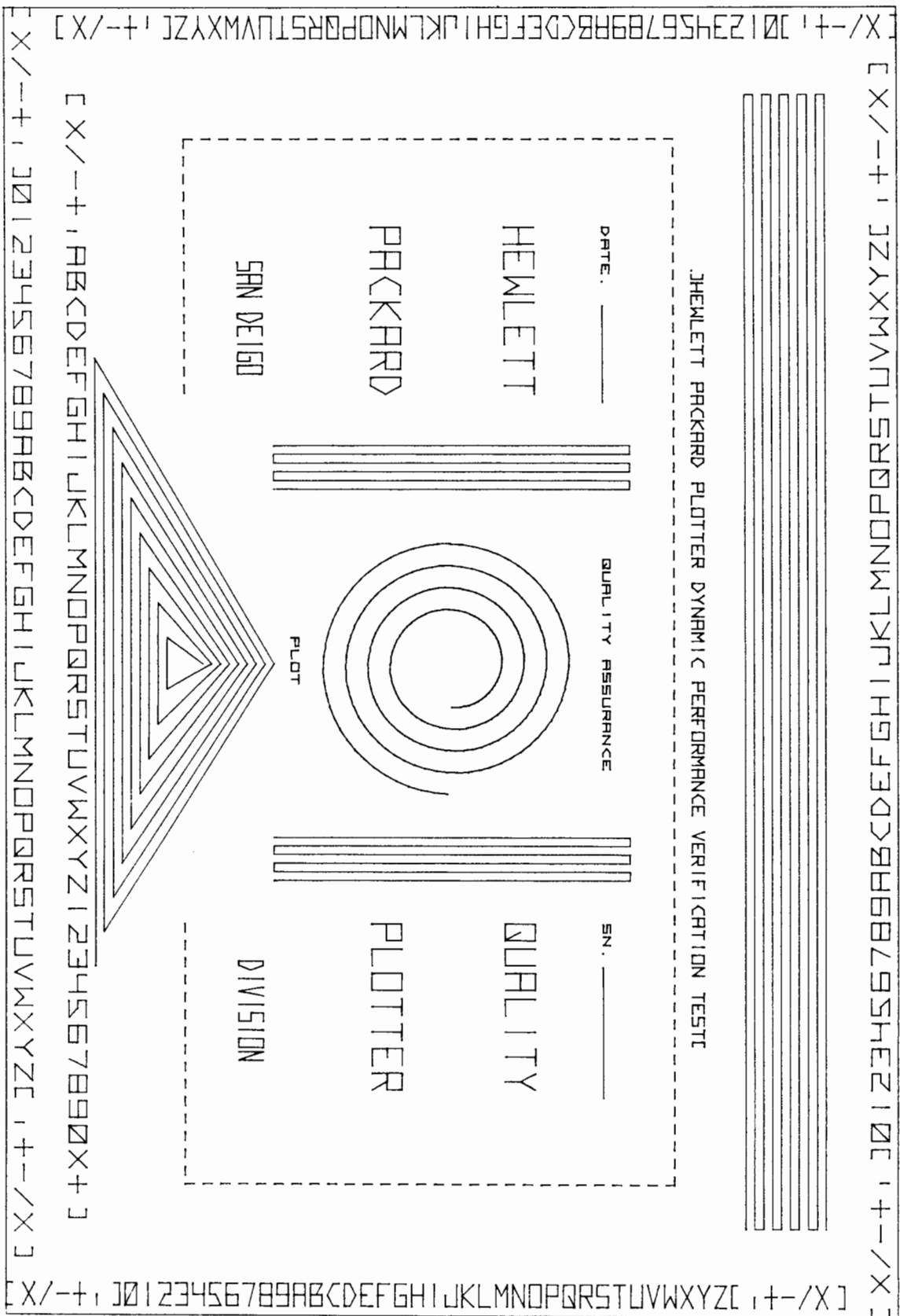
When the tape drive halts:

Press



The finished plot, which takes approximately 6 minutes to run, should exactly duplicate the plot shown on page 7. If some characters or lines are incorrectly drawn, the plotter pen may be skipping. This can be verified by installing a new pen and repeating the test procedure. Should the plot still differ from the sample plot on page 7, contact the nearest HP Sales and Service Office for assistance.

*This procedure must be completed very carefully, as the accuracy of the plot depends on it.



Performance Plot

2

Plotting and Lettering

Introduction

This section explains the calculator instructions used to control the plotter. The preceding section should be read before continuing, to insure that the calculator-plotter system is properly connected and its operation has been verified.

NOTE

This section assumes that the reader is familiar with the operation of the calculator as described in the HP 9815A Operating and Programming Manual.

The calculator controls the plotter through various key sequence instructions. Shown below are the key sequences and the instructions they represent. The entire key sequence must be pressed each time an instruction is used.

Key Sequence	Sample Printout	Instruction	
	SCALE	Sets the scaled size of the plot area.	
	XAXIS	Draws an x-axis.	
	YAXIS	Draws a y-axis.	
Plotting Instructions 1 followed by one key		RAISE	Raises the pen.
		PLOT	Plots x, y coordinate values.
	DRAW+	Draws a "+" at the current pen position.	
	IPLOT	Plots incremental values from the current pen position.	
	MOVE	Relocates the pen to a specified point.	
Lettering Instructions 1 followed by one key		OSIZE	Sets the character size and direction for lettering.
		PRNTX	Letters the current value in X.
Digitizing Instructions 1 followed by one key		PLOT α	Sets an Alpha Mode for lettering.
		DGTZR	Any key sequence sets the digitizer mode, then press or to move the pen in the indicated direction. Press the key to terminate the mode.
		DGTZR	
		DGTZR	
		DGTZR	
	DGTZR		
	EXIT	Enters the current pen coordinates into X and Y.	

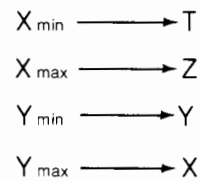
Plotting

This part describes the various plotting instructions: scaling, drawing and marking axes, and plotting functions, lines and points. Example programs showing typical use of plotting instructions are given in Section 3.

SCALE Instruction



Stack



The SCALE instruction establishes the full-scale values, in user-units, for the plot. X_{\min} to X_{\max} and Y_{\min} to Y_{\max} correspond exactly to the respective limits of the horizontal and vertical edges of the plotting area (the area is established mechanically, as previously described). This instruction also establishes the point, on or off the plotting area, where the origin (point 0,0) of the coordinate system is located.

To execute the SCALE instruction, you enter parameters into the stack and press the SCALE key sequence. These scale values will be used until you either execute a new SCALE instruction with new parameters or switch the calculator off.

It is important that you enter the parameter values in the proper order. If you do not, the calculator will printout the error message:

ILLEGAL ARGUMENT

When the calculator is first switched on, the following scale values are automatically set:

$X_{\min} = 0$
 $X_{\max} = 9999$
 $Y_{\min} = 0$
 $Y_{\max} = 9999$

Axes Drawing Instructions

XAXIS

CALL ALPHA 1 0

YAXIS

CALL ALPHA 1 H

Start Point → T

End Point → Z

±Tic Interval → Y

Offset Point → X

Each AXIS instruction requires that the desired axis parameters, in user-units, be entered into the stack in the order shown above. The pen is automatically raised before moving to the starting point and again after drawing the axis.

NOTE

Since the parameters perform identical functions for both axes instructions, the following explanation of XAXIS can be used for YAXIS by replacing the words "left" and "right" with the words "bottom" and "top", respectively.

The start and end parameters determine where the end points of the axis are, and the axis is drawn only between those points. If the start-point is less than the end-point, the axis is drawn from left to right. If the start-point is greater than the end-point, the axis is drawn from right to left.

The tic parameter specifies that tic marks be made along the axis as it is drawn; the value determines the spacing, in user-units, between tics. The first tic is drawn at the starting point of the line.

A positive tic value results in:

- Normal tic spacing if the axis is drawn from left to right.
- A tic only at the right end of the axis if the axis is drawn from right to left.

A negative tic value results in,

- A tic at the left end of the axis if the axis is drawn from left to right.
- Normal tic spacing if the axis is drawn from right to left.

A tic value of "0" results in no tic marks.

12 Plotting

The offset parameter determines the point at which the x-axis intersects the y-axis, and vice versa.

NOTE

Entering parameters (start, end or offset), that are outside the limits set by the SCALE instruction, will cause the calculator to printout the error message: `ILLEGAL ARGUMENT`

Pen ↑ Instruction



The PEN ↑ instruction raises the pen without otherwise changing its position.

Plot Instruction



y-coordinate → Y

x-coordinate → X

The PLOT instruction moves the pen directly to the point specified by the values in the X and Y-registers; any values in the Z and T-registers are ignored. If the pen is up when the PLOT instruction is executed, it moves to the point specified and then lowers, marking a point on the paper. If the pen is down when the PLOT instruction is executed, it remains down and moves to the point specified; thus drawing a straight line on the paper. The pen is left down after a PLOT instruction.

If the point specified is outside the scaled values of the plot, the pen lifts, moves to the appropriate boundary and waits for the next instruction.

DRAW+ Instruction



The DRAW+ instruction draws a "+" centered at the current pen position. The pen is left down and centered on the "+". The contents of the stack do not affect the instruction.



I PLOT Instruction



y-increment → Y
 x-increment → X

The IPLOT instruction moves the pen (from its current position) in the x-direction and in the y-direction by the amounts specified by the values in the X and Y-registers. The pen behavior is the same as that of the regular PLOT instruction.

Note that the IPLOT instruction plots a point with respect to the **current pen position** and not with respect to the origin (0,0) of the graph.

M O V E Instruction



y-coordinate → Y
 x-coordinate → X

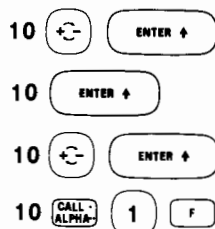
The MOVE instruction lifts the pen and moves it to the point specified by the x and y-coordinate values in the X and Y-registers. The pen remains up over the desired point. No marks are made on the paper with this instruction.

B a s i c Plotting Example

For this example, the Graph Limit controls should be set for a square plotting area. For details on setting the limit controls and paper and pen installation, refer to Section 1.



Press



```

-10.00
ENTER↑
 10.00
ENTER↑
-10.00
ENTER↑
 10.00
SCALE
    
```

The plot area is now scaled to be -10 to 10 units for the x-axis and -10 to 10 units for the y-axis.

14 Plotting

Press

10			
10			ENTER↑
1			ENTER↑
0			

-10.00
10.00
1.00
0.00
XAXIS

The XAXIS instruction draws an axis from -10 to 10 with 1 unit tic marks and is positioned to cross the y-axis at 0. See the example plot shown on page 15.

Press

10			
10			ENTER↑
.5			ENTER↑
0			

-10.00
10.00
0.50
0.00
YAXIS

The YAXIS instruction draws an axis from -10 to 10 with $1/2$ unit tic marks and crosses the x-axis at 0.

Press

5			5.00
			

ENTER↑
PLOT

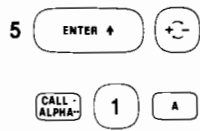
The PLOT instruction sends the pen to the point $(x = 5, y = 5)$. The pen is lowered upon reaching the point.

5			
			

-5.00
ENTER↑
PLOT

The PLOT instruction sends the pen to the point $(x = -5, y = -5)$. Since the pen is lowered, a straight line is drawn between the two points.

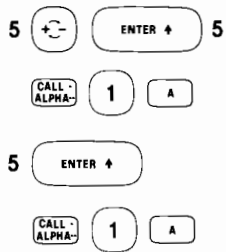
Press



5.00
 ENTER↑
 + $\frac{\pm}{-}$
 PLOT

The pen draws a line to the point $(x = -5, y = 5)$.

Press



-5.00
 ENTER↑
 5.00
 PLOT
 5.00
 ENTER↑
 PLOT

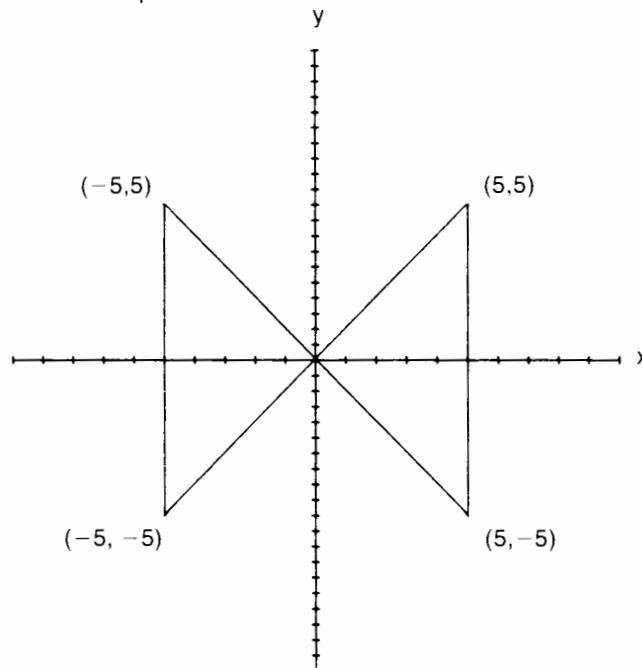
The pen is sent first to the point $(x = 5, y = -5)$ and then back to the point $(x = 5, y = 5)$.

Press



PEN↑

The PEN↑ instruction raises the pen.



Example Plot

Lettering

This part describes the various instructions used to letter labels, titles or the value currently in the X-register. Lettering can be done in any size, aspect ratio or direction (left to right, right to left, top to bottom or bottom to top).

In general, the instructions use the same format as the plotting instructions; you enter the appropriate parameters in the stack registers and execute the instruction by pressing the appropriate key sequence.

Characters are lettered from the point at which you position the pen. The pen begins at the lower left corner of the character and stops in position to letter the next character.

Example programs showing typical use of lettering instructions are given in Section 3.

CSIZE Instruction



Plot Area Ratio (Height/width)	→	T
Aspect Ratio (Letter height/width)	→	Z
Size (% of plot height)	→	Y
Direction (0 = →; 1 = ↑; 2 = ←; 3 = ↓)	→	X

The character size instruction (CSIZE) establishes the character dimensions and the direction of lettering to be used. When the calculator is first switched on, the following CSIZE parameters are automatically established.

Plot Area Ratio = 1 (square paper)

Size = 2% (of plot height)

Aspect Ratio = 1.67 (tall letters)

Direction = 0 (left to right)

You can use the CSIZE instruction to change all or part of the parameters which were automatically set by the calculator. To change all of the parameters, you enter the new ones into the stack, in the order shown on the previous page, and press the CSIZE key sequence. To change only specific parameters, you enter a zero followed by the new parameters into the stack, as shown in the table below. Now when the CSIZE key sequence is pressed, only the parameters in registers below the register containing zero are changed. The remaining parameters are unchanged.



Change Direction only		Change Direction and size		Change direction, size and aspect ratio	
*	→ T	*	→ T	0	→ T
*	→ Z	0	→ Z	new aspect	→ Z
0	→ Y	New size	→ Y	New size	→ Y
New		New		New	
Direction	→ X	Direction	→ X	Direction	→ X

*The registers above the first register containing 0 are ignored by the CSIZE instruction.

PRNTX Instruction



Value to be printed → X

The PRNTX instruction letters the number currently in X, in the form set by the current number format (FIX, SCI, or SCI 3). Lettering starts at the current pen position. The pen is usually positioned with a MOVE instruction before executing PRNTX.

Basic Lettering Example

For this example the plotter limit controls should be set for a square plotting area.

Press the following keys:

10			
			-10.00
10			ENTER↑
			10.00
10			ENTER↑
			-10.00
10			ENTER↑
			10.00
			SCALE

The SCALE instruction scales the plot area to be -10 to 10 for the x-axis and -10 to 10 for the y-axis.

Press

1			1.00
			ENTER↑
2			2.00
			ENTER↑
5			5.00
			ENTER↑
0			0.00
			CSIZE

The CSIZE instruction sets these character parameters:

1 (square paper)	→	T
2 (tall letters)	→	Z
5 (big letters)	→	Y
0 (left to right)	→	X

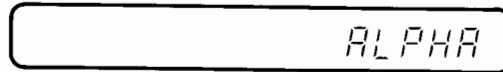
Press

7		10			7.00
					ENTER↑
					-10.00
					MOVE

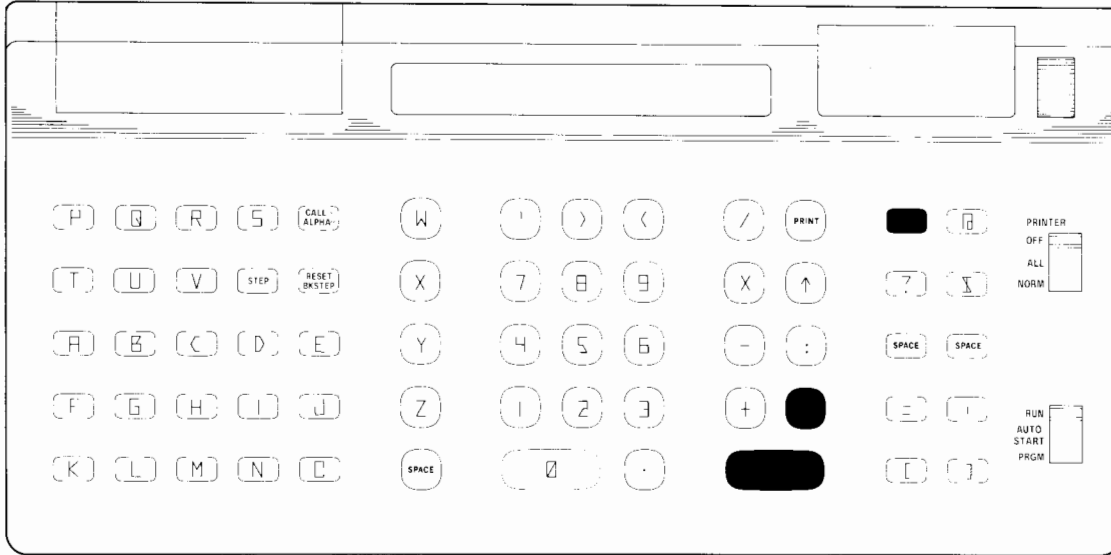
The MOVE instruction raises the pen and moves it to the point (-10,7).

20 Lettering

Press



This key sequence sets the Alpha mode. The keyboard is redefined as shown below.



Alpha Keyboard

Press


(Any alpha keys)

As you press a character key, the plotter immediately letters the character at the current pen position. The plotter will letter along a horizontal line until it reaches the plot area limit. At the plot area limit, the pen draws only the vertical components of the characters. To relocate the pen, the Alpha mode must be terminated and an instruction, such as MOVE, used to reposition the pen to continue lettering.

When you want to end the Alpha mode:

Press



The  key (END α) terminates the Alpha mode.

3

Program Examples

Before plotting, lettering or digitizing with your plotter, you should first verify that it is properly connected and operating properly as explained in Section 1.

NOTE

The calculator must be switched off when the plotter interface is connected. If the connection is made with the calculator on, you must initialize the interface by switching the calculator off, and then on again.

Plotting Example Program

Plotting is most effectively used when incorporated into a program format. The following example plots the function $y = x^2$ for values of x from -10 to 10 .

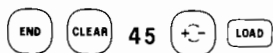
Upon examining the expression, you will see that as x varies from -10 to 10 the value of y will vary from 100 through 0 and back to 100 . For this example, the graph scale values will be: $X_{\min} = -10$; $X_{\max} = 10$; $Y_{\min} = 0$; $Y_{\max} = 100$.

The plot will be shown with x and y -coordinate axes drawn and divided into unit intervals. The program will draw a "+" at each point as it is plotted.

This program is stored on your test cartridge at file -45 . To load the program:

Set the calculator to the RUN mode.

Press

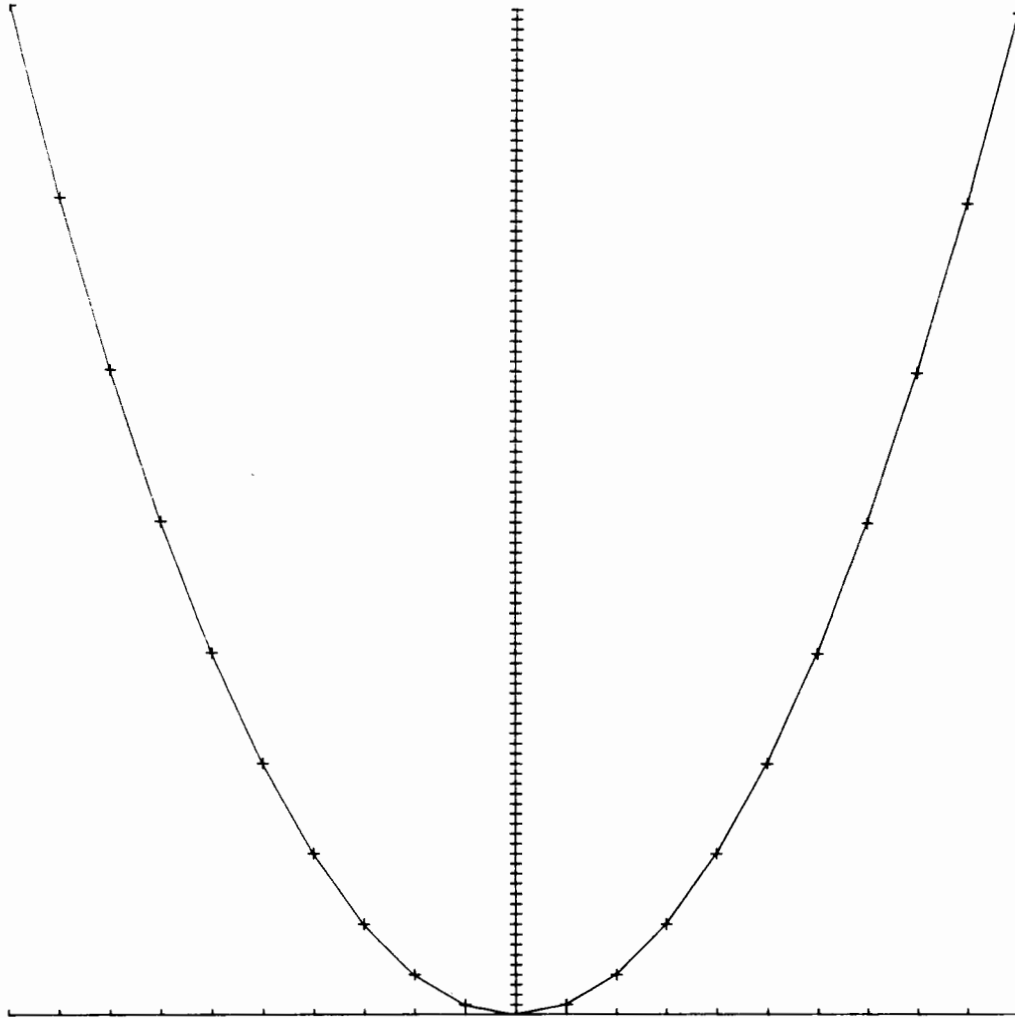
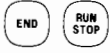


22 Programs

Set the plotter Graph Limit controls for a square 10" × 10" plot area.

To run the program:

Press



Plot of $y = x^2$

y = x² Program Listing

<pre> 0000 1 0001 0 0002 +±- 0003 ENTER↑ 0004 1 0005 0 0006 ENTER↑ 0007 0 0008 ENTER↑ 0009 1 0010 0 0011 0 0012 SCALE 0014 1 0015 0 0016 +±- 0017 ENTER↑ 0018 1 0019 0 0020 ENTER↑ 0021 1 0022 ENTER↑ 0023 0 0024 XAXIS 0026 0 0027 ENTER↑ 0028 1 0029 0 0030 0 0031 ENTER↑ 0032 1 0033 ENTER↑ 0034 0 0035 YAXIS 0037 1 0038 0 0039 +±- 0040 STO A 0041 RCL A 0042 2 0043 Y↑X 0044 RCL A 0045 PLOT 0047 DRAW+ 0049 1 0050 0 0051 IF X=Y 0052 GOTO 0058 0054 1 0055 STO+ A 0056 GOTO 0041 0058 PEN↑ 0060 END </pre>	<p>The SCALE instruction sets the plot area as</p> <pre> -10 → T 10 → Z 0 → Y 100 → X </pre> <p>Draws x-axis from -10 to 10, 1 unit tics, crosses y-axis at 0.</p> <p>Draws y-axis from 0 to 100, 1 unit tics, crosses x-axis at 0.</p> <p>Store -10 in A calculate A²</p> <p>A² → Y; A → X; PLOT (X,Y); DRAW+</p> <p>If A = 10, Goto step 58; if A < 10, add 1 to reg A and goto step 41.</p> <p>Raise the pen and end.</p>
--	--

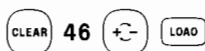
Lettering Example Program

The lettering instructions are most useful within programs to label coordinate axes, title plots, number increments, etc.

The following example program will use lettering instructions to label the axes and title a graph to plot TIME vs. DISTANCE.

This program is recorded on the Test Cartridge on File -46. To load it into the calculator:

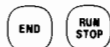
Press



Set the plotter for an 8" x 10" plotting area.

To run the program:

Press



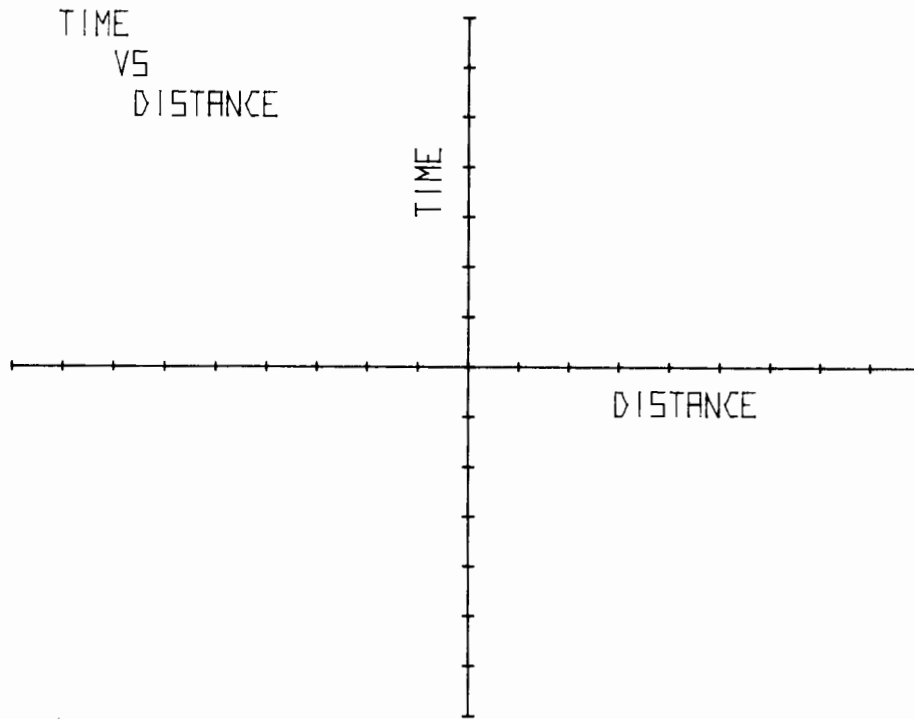
Program Listing

<pre> 0000 1 0001 0 0002 +↵- 0003 ENTER↑ 0004 +↵- 0005 ENTER↑ 0006 8 0007 +↵- 0008 ENTER↑ 0009 +↵- 0010 SCALE 0012 1 0013 0 0014 +↵- 0015 ENTER↑ 0016 +↵- 0017 ENTER↑ 0018 1 0019 ENTER↑ 0020 0 0021 XAXIS </pre>	<p>Set scale</p> <p>-10 → T 10 → Z -8 → Y 8 → X</p>	<pre> 0023 8 0024 +↵- 0025 ENTER↑ 0026 +↵- 0027 ENTER↑ 0028 1 0029 ENTER↑ 0030 0 0031 YAXIS 0033 . 0034 8 0035 ENTER↑ 0036 2 0037 ENTER↑ 0038 3 0039 ENTER↑ 0040 0 0041 CSIZE 0043 1 0044 +↵- 0045 ENTER↑ 0046 3 0047 MOVE </pre>	<p>Draw y-axis from -8 to 8, 1 unit tics, cross x-axis at 0.</p>	<p>Set character size parameters</p> <p>.8 → T 2 → Z 3 → Y 0 → X</p>	<p>Draw x-axis from -10 to 10, 1 unit tics, cross the y-axis at 0.</p>	<p>Move the pen to (3, -1)</p>
---	--	---	--	--	--	--------------------------------

(Cont.)

0049 PLOT α	} Set alpha mode; letter "DISTANCE"; end alpha mode	0094 6	} Move the pen to (-7.9,6.2)		
0051 D		0095 .			
0052 I		0096 2			
0053 S		0097 ENTER↑			
0054 T		0098 7			
0055 A		0099 .			
0056 N		0100 9			
0057 C		0101 + \hat{e} -			
0058 E		0102 MOVE			
0059 END α		0104 PLOT α			
0060 3	} Move the pen to (-5,3)	0106 V	} Set alpha mode; letter "VS"; end alpha mode		
0061 ENTER↑		0107 S			
0062 .		0108 END α			
0063 5		0109 5			
0064 + \hat{e} -		0110 .			
0065 MOVE		0111 4			
0067 CLEAR		0112 ENTER↑			
0068 1		0113 7			
0069 CSIZE		0114 .			
0071 PLOT α		0115 5			
0073 T	} Change only direction to ↑(1)	0116 + \hat{e} -	} Move the pen to (-7.5,5.4)		
0074 I		0117 MOVE			
0075 M		0119 PLOT α			
0076 E		0121 D			
0077 END α		0122 I			
0078 7		0123 S			
0079 ENTER↑		0124 T			
0080 9		0125 A			
0081 + \hat{e} -		0126 N			
0082 MOVE		0127 C			
0084 CLEAR	} Set alpha mode; letter "TIME"; end alpha mode	0128 E	} Set alpha mode; letter "DISTANCE"; end alpha mode		
0085 CSIZE		0129 END α			
0087 PLOT α		0130 8			
0089 T		0131 ENTER↑			
0090 I		0132 1			
0091 M		0133 0			
0092 E		0134 MOVE			
0093 END α		0136 END			
		} Change only direction to →(0)			} Move the pen to (10,8)





Lettering Example Plot

Plotting and Lettering Example Program

Plot of $(\sin x)/x$

This program uses plotting and lettering instructions to plot and title the function $(\sin x)/x$ for values of x from -4π to 4π . Since the function is undefined at $x = 0$, the increment chosen ($\pi/20$) skips that value of x . The scale values to be used are -4.5π to 4.5π and $-.3$ to 1.1 . The axes extend from -4π to 4π for the x -axis and from $-.2$ to 1 for the y -axis.

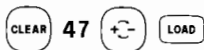
The program first numbers the units used for each axis. An incremented for-next loop is used to move the pen to the proper point and to generate the value to be lettered for each tic mark. After the function is plotted, the title is lettered in the upper left-hand corner of the plot area.

NOTE

Set the plotter for an 8" × 10" rectangular plot area.

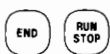
This program is recorded on the test cartridge on file -47. To load it into the calculator:

Press

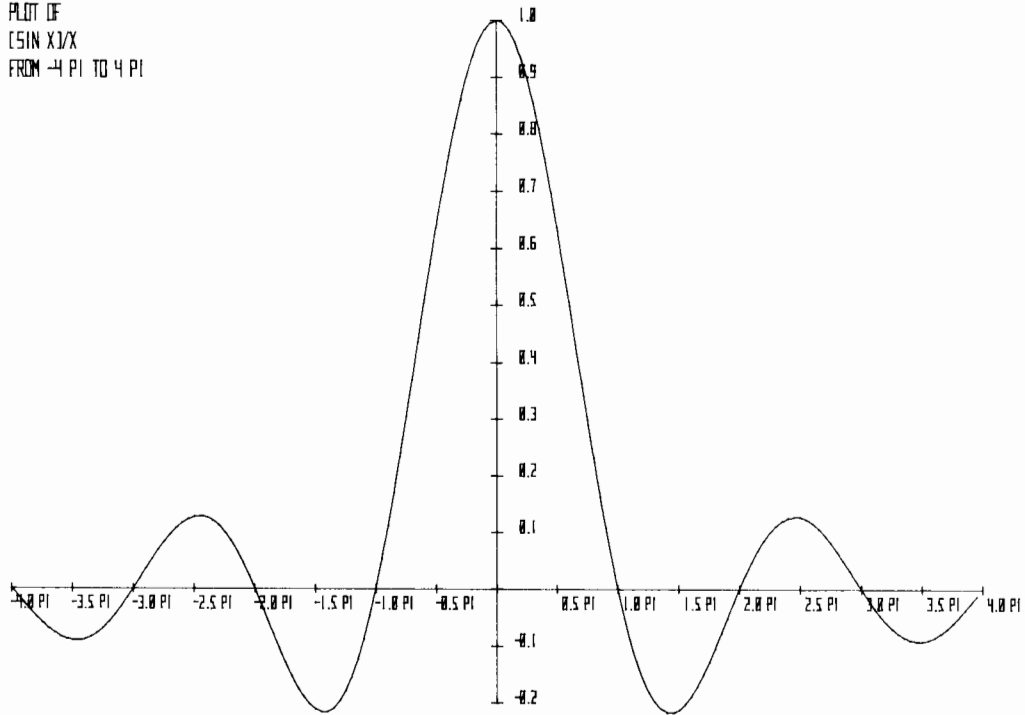


To run the program after it is loaded:

Press



PLOT OF
(SIN X)/X
FROM -4 PI TO 4 PI



Plot of (sinx)/x

Program Listing

```
0000 4
0001 .
0002 5
0003 ENTER↑
0004 π
0005 *
0006 +÷-
0007 ENTER↑
0008 +÷-
0009 ENTER↑
0010 .
0011 3
0012 +÷-
0013 ENTER↑
0014 1
0015 .
0016 1
0017 SCALE
```

Set scale
 $-4.5\pi \rightarrow T$
 $4.5\pi \rightarrow Z$
 $-.3 \rightarrow Y$
 $1.1 \rightarrow X$

```
0019 4
0020 ENTER↑
0021 π
0022 *
0023 +÷-
0024 ENTER↑
0025 +÷-
0026 ENTER↑
0027 .
0028 5
0029 ENTER↑
0030 π
0031 *
0032 ENTER↑
0033 0
0034 XAXIS
```

Draw x-axis from -4π to 4π , .5π tics, cross y-axis at 0.

(Cont.)

28 Programs

0036 .				0094 PRINT			
0037 2				0095			
0038 + $\frac{\pi}{2}$ -				0096 P			
0039 ENTER↑				0097 I			
0040 1	}	Draw y-axis from -2 to 1, (.1 unit tics); cross x-axis at 0.		0098 END α			
0041 ENTER↑					0099 NEXT C		
0042 .					0100 .		
0043 1					0101 2		
0044 ENTER↑					0102 + $\frac{\pi}{2}$ -		
0045 0					0103 STO C		
0046 YAXIS					0104 1		
0048 FIX 1			}	Fix 1 format Set Radians	0105 STO H		
0050 RADS					0106 .		
0051 8					0107 1		
0052 ENTER↑			0108 STO D				
0053 1			0109 .				
0054 0			0110 1				
0055 +			0111 5				
0056 3			0112 ENTER↑				
0057 .	}	Character Size 8 → T 3.5 → Z 1 → Y 0 → X	0113 π				
0058 5			0114 *				
0059 ENTER↑			0115 STO B				
0060 1			0116 FOR C+HD				
0061 .			0117 RCL C				
0062 5	0118 RCL B						
0063 ENTER↑	0119 MOVE						
0064 0	0121 RCL C						
0065 CSIZE	0122 IF 0						
0067 4	0123 GOTO 0129						
0068 + $\frac{\pi}{2}$ -	0125 RCL C						
0069 STO C	0126 PLOT α						
0070 4	0128 PRINT						
0071 STO H	0129 END α						
0072 .	0130 NEXT C						
0073 5							
0074 STO D							
0075 .							
0076 0							
0077 3							
0078 5							
0079 + $\frac{\pi}{2}$ -	}	For-next loop starts at -4, stops at 4. Numbers x-axis in 5π increments, skipping 0.					
0080 STO B							
0081 FOR C+HD							
0082 RCL B							
0083 RCL C							
0084 π							
0085 *							
0086 MOVE							
0088 IF 0							
0089 GOTO 0099							
0091 RCL C							
0092 PLOT α							

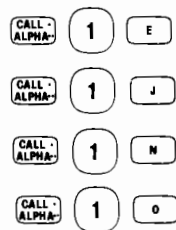
(Cont.)

4

Digitizing

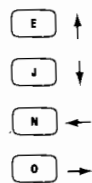
The unique digitizing mode enables you to find the x, y-coordinates of any point within the plot area. You move the pen to the desired point through calculator instructions; then the coordinates of the point, in user units, are entered into the stack. These values can be used to calculate functions such as line length, surface area, etc. The digitizing instructions can also be used to move the pen into position for lettering or IPLOT instructions.

Digitizing Mode Instructions



Any one of the four key sequences shown here sets the digitizer mode. The sequences do not move the pen when setting the mode, therefore the sequence used is arbitrary. When a sequence is executed from a program, it sets the digitizer mode and halts the program.

Direction Keys



Once the mode is set, you press only the direction keys to move the pen. Each time a key is pressed, the pen moves one increment in the direction specified. By holding a key down, you can move the pen in multiple increments at an increasing speed. In this manner you position the pen at the desired point.

Pressing either the **M** or the **RUN STOP** key terminates the digitizer mode. The coordinate values of the current pen position are entered in X and Y. If the digitizing mode was entered from a program, the **M** key restarts the program but the **RUN STOP** key does not.

NOTE

It is recommended that you cover the original document to be digitized with a clear plastic cover to prevent the pen from marking on it during the digitizing process.

EXIT Instruction



The EXIT instruction is a “one-step” digitizing process which:

1. Sets the digitizer mode.
2. Enters the current pen coordinates into X and Y.
3. Exits the digitizer mode.

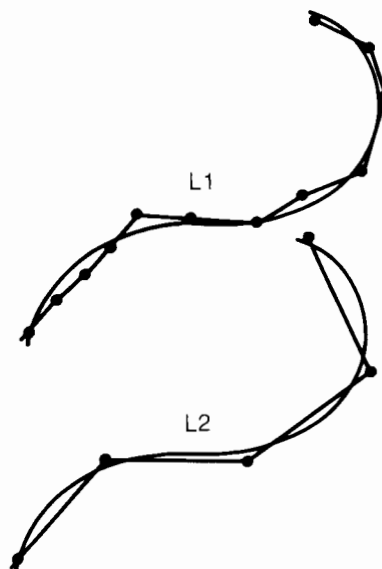
EXIT is useful whenever the x and y-coordinates of the pen position are needed for reference. For example, the pen’s coordinates are needed for reference with an I PLOT instruction.

Accuracy

When in the digitizing mode, the plot area (as set by the Graph-Limit controls and a scale instruction) is divided into 1000 increments in each direction. For example, a 10” × 10” scaled plot area would have digitizing increments of .01”. Since these increments determine the resolution of the digitized data values, you should set the plot area limits for the smallest scaled area that contains the figure to be digitized.

The number of points digitized along a line (the sample density) can have a significant effect on accuracy. A straight line segment is best digitized by taking as few samples as possible, preferably only the endpoints of the segment. A curved line segment, on the other hand, is best digitized by taking as many samples as possible along its length.

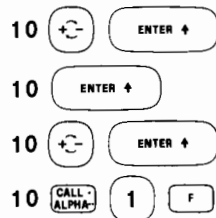
In the figure shown at the right, the identical lines L1 and L2 have been digitized. L1 had 12 samples taken and L2 had 5. The resulting data from L1 is a much better representation of the actual line than is the data from L2.



Basic Digitizing Example

For this example, place the figure from the basic plotting example (page 14) on the plotter platen. Set the same plot area limits that were originally used for that example.

Press



```

-10.00
ENTER↑
10.00
ENTER↑
-10.00
ENTER↑
10.00
SCALE
  
```



The plot area is now scaled to be the same as it was for the plotting example; -10 to 10 units for the x-axis and -10 to 10 units for the y-axis.

Press



```
DGTZR
```

You have now set the calculator to the digitizing mode. Use the **E** **J** **N** **O** keys to position the pen over the upper right corner point of the figure. When you have the pen positioned over the corner point:

Press



The coordinates of the point are entered into the X and Y-registers and the digitizing mode is terminated.

Press

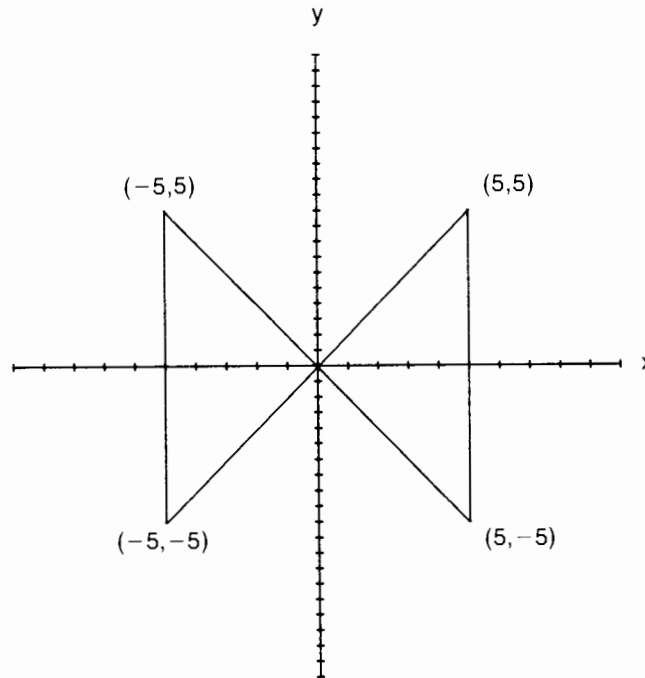


```

PRINT
5.00
X<->Y
PRINT
5.00
  
```

34 Digitizing

The printout records the coordinates of the point digitized. Reenter the digitizing mode by pressing one of the digitizing key sequences, then locate and print the coordinates of each corner of the figure. Compare your coordinate values with those on the figure below.



Example Figure

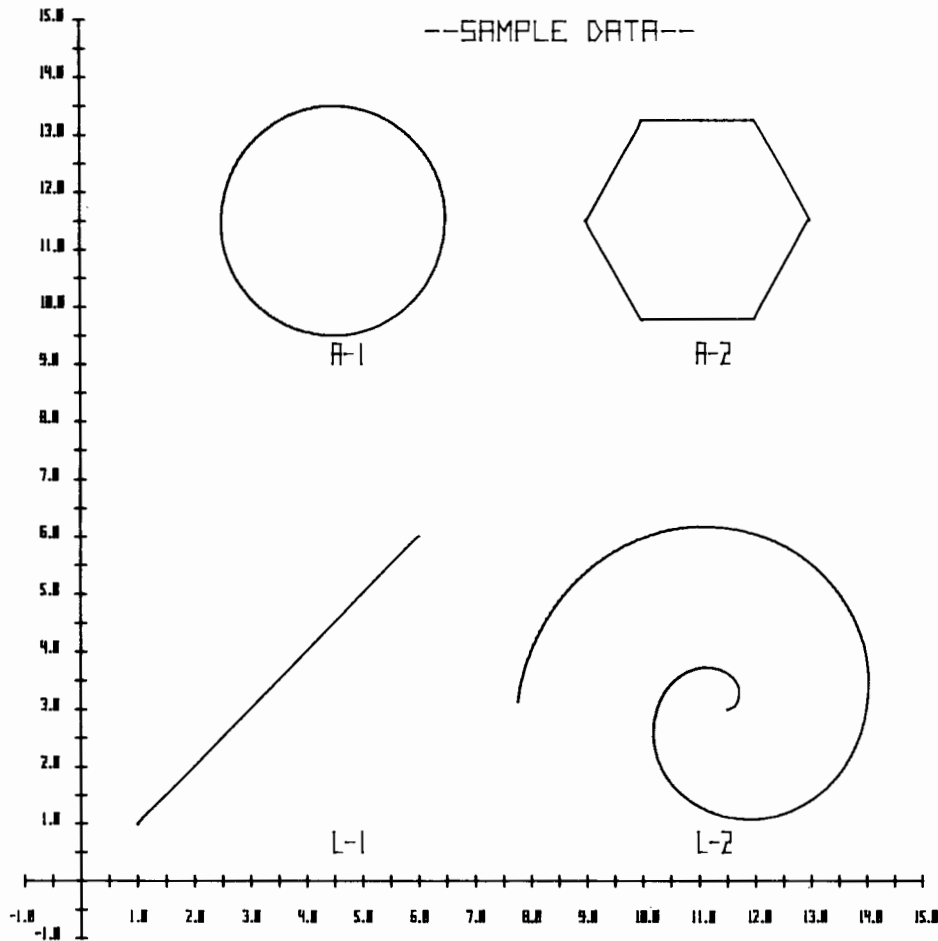
Digitizing Program Example

Sample Data Plot

Set the plotter for a 10" square plot area.

Load and run file -48 from the test cartridge.

The program will draw axes and figures to use with the digitizing program. Leave the plot on the plotter for use with the Area and Length Program.




Sample Data Plot

Area and Length Program

Load and run file -49 from the test cartridge.

Initial printout

SCALE?

Enter the scale values to be used into the proper registers and press . The scale values for the sample are:

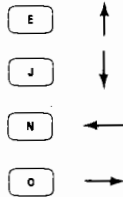
	-2 → T
-2.000	16 → Z
16.000	-2 → Y
-2.000	16 → X
16.000	

36 Digitizing

AREA OR LENGTH?

1.0000

?



AREA= 10.190
PERIMETER=
11.880
CONTINUE?

NEW SCALE?


AREA OR LENGTH?

0.0000






OPEN OR CLOSED?

1.0000

?

You may now choose a program by entering a 1 for area or a 0 for length and pressing .

To begin with, enter 1 for the area program. As a first example, trace the hexagon, Figure A1, with the pen.


The digitizer mode instructions have been defined as user definable functions. You simply press , ,  or  to move the pen to the corner point of the hexagon you wish to start at, then press  to enter the point coordinates into the X and Y-registers.


Each time you digitize a point you must press the

 key to restart the program.

Digitize each corner point progressively around the figure.

When you return to the starting point, the program will print the results.

You are now asked if you wish to continue digitizing; 1 for yes; 0 for no. To continue with this example enter 1 and press the  key.


You may now change the scale if you wish; 1 for yes; 0 for no. To continue with this example enter 0 and press .

To use the length program, enter 0.

To find the length of L1, enter 1 for an open figure.

Move the pen to either end point of the line, and digitize that point. You can now digitize the opposite end point, as two points are sufficient data for a straight line segment.

```
LENGTH=    7.071  
CONTINUE?
```

When the last point of an open figure is digitized, the length is calculated and printed out by pressing the  key.

You may now digitize either the remaining figures or something of your own. To digitize a figure of your own, locate it on the plotter platen, set the Graph Limit controls to contain the figure, and enter the scale values for the figure. It is helpful to set the scale values in such a way as to locate the origin in the lower-left corner of your figure. It may also be helpful to protect the figure with a clear covering to prevent marking on it with the pen. If you digitize the remaining figures on the sample, the areas and perimeters of A-1 and A-2 and the lengths of L-1 and L-2 are given below.

A-1	A-2	L-1	L-2
Area = 12.566	Area = 10.190	Length = 7.071	Length = 15.650
Perimeter = 12.566	Perimeter = 11.880		

You may wish to compare your results with these. By using various sample densities, you will see the affect it has on accuracy.

Listing of the Area and Length Program

0000	CLRA+J			0055	PRNT α			
0001	0			0057	0			
0002	#REGS			0058	F			
0003	5			0059	E			
0004	#REGS			0060	N			
0005	CFG	2	Initialize registers and flags.	0061				
0006	CFG	3		0062	0			
0007	CFG	4		0063	R			
0008	FIX	3		0064		If length, select open or closed figure.		
0010	IF SFG	1		0065	C			
0011	GOTO	0027		0066	L			
0013	PRNT α			0067	0			
0015	S			0068	S			
0016	C			0069	E			
0017	A			0070	D			
0018	L			0071	?			
0019	E			0072	LINE			
0020	?		SCALE instruction input.	0073	END α			
0021	LINE			0074	STOP			
0022	END α			0075	PRINT		If closed figure, set flag 2.	
0023	STOP			0076	IF 0			
0024	SCALE			0077	SFG	2		
0026	PRTSTK		0078	PRNT α				
0027	PRNT α		0080	?				
0029	A		0081	END α				
0030	R		0082	STOP				
0031	E		0083	STO	B	Enter first point; store x in regs. B & C. Store y in regs. D & G.		
0032	A		0084	STO	C			
0033			0085	ROLL \downarrow				
0034	0		0086	STO	D			
0035	R		0087	STO	G			
0036			0088	PRNT α				
0037	L		0090	?		Enter another point.		
0038	E		0091	END α				
0039	N		0092	STOP				
0040	G		0093	IF SFG	7	If last entry, go to print instructions.		
0041	T		0094	GOTO	0121			
0042	H		0096	IF SFG	2	Check for closure.		
0043	?		0097	GOSUB	L77			
0044	LINE		0099	IF SFG	4	If area program; go to area subroutine.		
0045	END α		0100	GOSUB	L55			
0046	STOP		0102	RCL	B			
0047	PRINT		0103	GOSUB	L66			
0048	IF 0		0105	RCL	D			
0049	GOTO	0055	0106	GOSUB	L66			
0051	SFG	4	0108	+		Calculate and accumulate length in reg. 1.		
0052	SFG	2	0109	SQRT				
0053	GOTO	0078	0110	STO+	R001			

(Cont.)

```

0112 RCL      H
0113 STO      B
0114 RCL      I
0115 STO      D
0116 IF SFG 3
0117 GOTO     0121
0119 GOTO     0088
0121 IF SFG 4
0122 GOTO     0143
0124 IF SFG 2
0125 GOTO     0156
0127 RCL      R001
0129 PRNTα
0131 L
0132 E
0133 N
0134 G
0135 T
0136 H
0137 =
0138
0139 PRINT
0140 ENDα
0141 GOTO     0239
0143 RCL      R004
0145 PRNTα
0147 A
0148 R
0149 E
0150 A
0151 =
0152
0153 PRINT
0154 LINE
0155 ENDα
0156 RCL      R001
0158 PRNTα
0160 P
0161 E
0162 R
0163 I
0164 M
0165 E
0166 T
0167 E
0168 R
0169 =
0170 LINE
0171 PRINT
0172 ENDα
0173 GOTO     0239

```

Store X & Y for use with next point.

If figure is complete, check program type. If not, go to next point.

Print "LENGTH = ".
Go to ending questions.

Print "AREA =
PERIMETER = ". Go
to ending questions.

```

0175 LBL
---- 77
0177 STO      H
0178 ROLL↓
0179 STO      I
0180 ROLL↑
0181 RCL      C
0182 GOSUB    L66
0184 RCL      G
0185 GOSUB    L66
0187 +
0188 SQRT
0189 .
0190 0
0191 3
0192 IF X≥Y
0193 SFG      3
0194 RCL      I
0195 RCL      H
0196 RETURN
0197 LBL
---- 66
0199 -
0200 2
0201 Y↑X
0202 X≠Y
0203 RETURN
0204 LBL
---- 55
0206 RCL      B
0207 -
0208 X≠Y
0209 RCL      D
0210 +
0211 *
0212 2
0213 ÷
0214 STO+     R004
0216 RCL      I
0217 RCL      H
0218 RETURN
0219 LBL
---- J
0221 DGTZR
0223 RETURN
0224 LBL
---- E
0226 DGTZR
0228 RETURN

```



Subroutine to check for closure.

Subroutine to calculate
 $(X_n - X_{n-1})^2$ and
 $(Y_n - Y_{n-1})^2$

Subroutine to calculate
area and accumulate in
R4.

Functions defining digitizing keys.

(Cont.)

40 Digitizing

0229 LBL		0256 PRNT α	
---- 0		0258 N	
0231 DGTZR	} Functions defining digitizing keys.	0259 E	
0233 RETURN		0260 W	
0234 LBL		0261	
---- N		0262 S	
0236 DGTZR		0263 C	
0238 RETURN		0264 A	
0239 CFG 1		0265 L	
0240 PRNT α		0266 E	
0242 C		0267 ?	
0243 0		0268 END α	
0244 N	0269 STOP		
0245 T	0270 IF 0		
0246 I	0271 SFG 1		
0247 N	0272 GOTO 0000	} If the program is to continue, is the SCALE instruction new or the same?	
0248 U	0274 END		
0249 E			
0250 ?			
0251 END α			
0252 STOP			
0253 IF 0			
0254 GOTO 0274			

Program Details

The Area Program

The area program may be used to find either the area of any closed figure or the area under a curve. This program can detect the fact that a closed figure has been completely digitized; this is called "detecting closure" and involves a tolerance of .02 scale units. This value determines how closely the pen must return to the starting point before closure will occur.

Applying the Area Program

When finding the area of a closed figure, notice if the figure has borders that cross each other, as in a figure eight. When digitizing figures with that property, follow this rule: **Never digitize along a path that crosses a border that has already been digitized.**

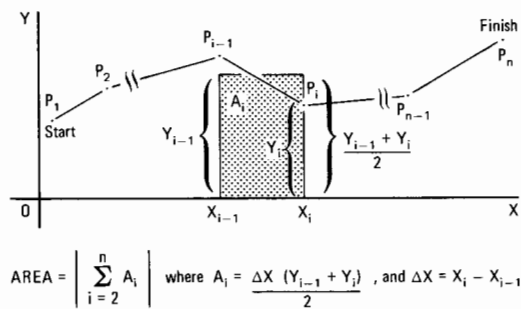
The path followed may touch or partially coincide with a previously digitized border, but the path must not cross. A figure eight, for instance, would be digitized as shown below.



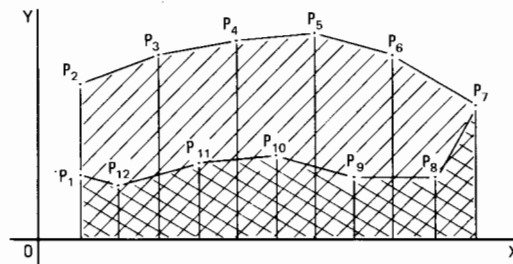
To use this program to find the area under a curve, treat the area as a closed figure. The borders of this closed figure would be: 1) the curve itself; 2) the segment of the axis of the independent variable against which the curve was plotted; 3) the lines (if they exist) that are drawn perpendicular to the axis of the independent variable and pass through the end points of the interval to be digitized.

The Integration Algorithm

The area program calculates the required area by summing the areas of rectangles described by the incoming data.



The sign of A_i depends upon the direction of pen movement that produced each particular A_i . The signs of the individual A_i are useful, and allow the program to compute the area of closed figures.



In the last figure, the area of the cross-hatched region is automatically removed from the result; thus, only the area of the single-lined region remains as the answer. This is a direct consequence of the changes in sign of each individual A_i , as the direction of pen movement alters while the figure is being digitized.

Automatic Closure

To accomplish "automatic closure", the area program stores the first point digitized (P_1); then a circle of radius .02 units is drawn around P_1 . Closure occurs when some P_n (lying inside the circle) is accepted. After the computations for P_n are completed, P_1 is compared with P_n ; if the distance from P_1 to P_n is less than .02 units, closure is put into effect.

42 Digitizing

The Line Length Program

The line length program can be used to find the length of any line or to find the distance between points. The program is selected by entering 0 for length and by entering the type of figure (Enter 1 for open or 0 for closed) to be digitized.

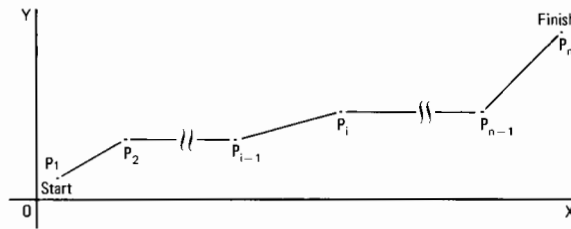
The Distance Measuring Algorithm

The line length program computes a distance along a path defined by a series of points.

The distance from P_1 to P_n along a path of n points is: $(P_1 - P_n)$

$$\overline{P_1 P_n} = \sum_{i=2}^n \overline{P_{i-1} P_i} \quad \text{where} \quad \overline{P_{i-1} P_i} = \sqrt{(X_i - X_{i-1})^2 + (Y_i - Y_{i-1})^2}$$

is the straight line distance from P_{i-1} to P_i .



To measure a curved line, a number of closely spaced samples are taken, resulting in an approximation of the length of the curved line.

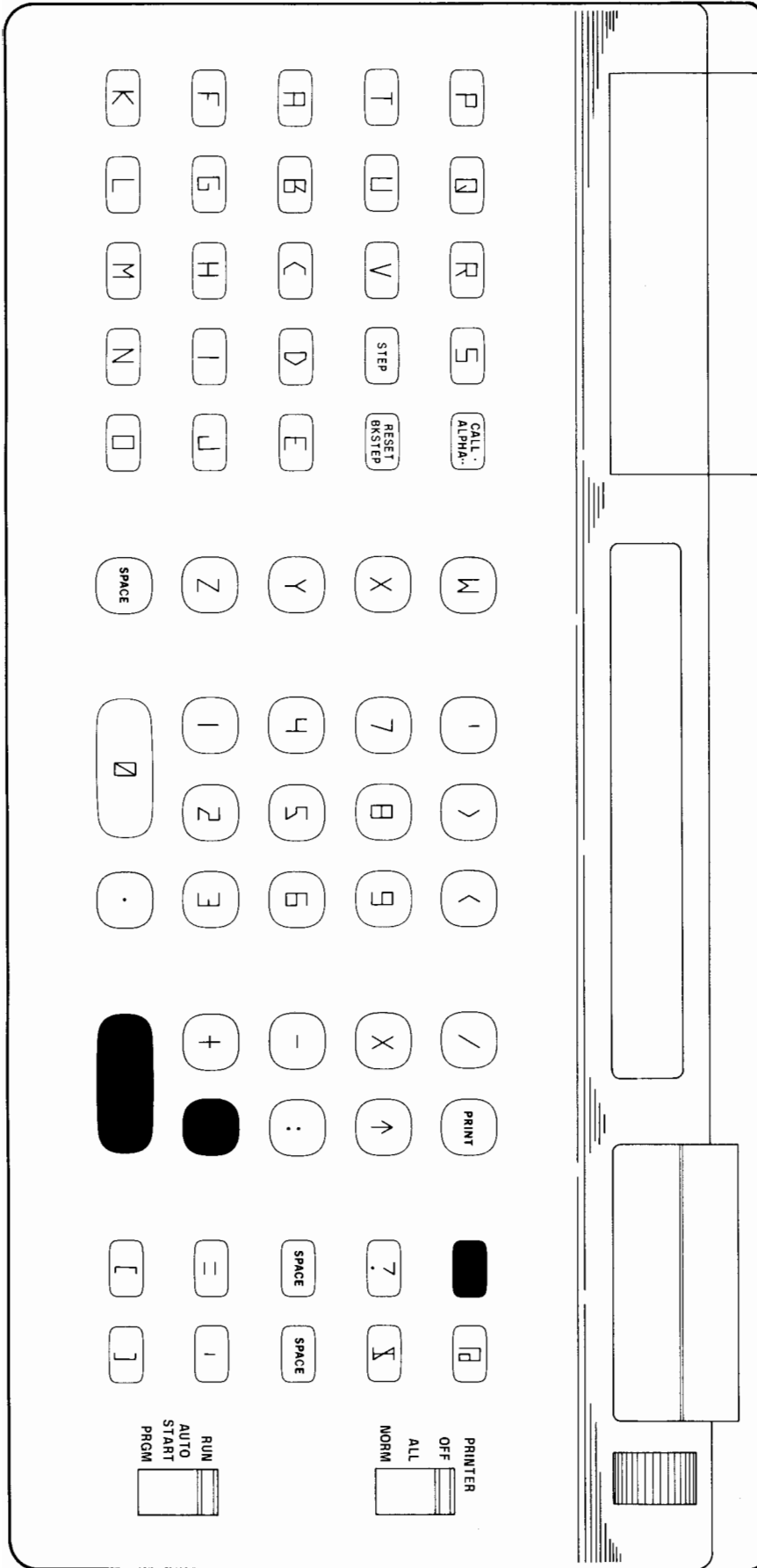
Automatic Closure

The line length program utilizes the same closure mechanism used in the area program; refer to page 40.

Plotter Instructions

Key Sequence	Sample Printout	Instruction	Stack Contents
Plotting Instructions <small>CALL ALPHA</small> 1 followed by one key	(F) SCALE	Sets the scaled size of the plot area.	X _{min} → T X _{max} → Z Y _{min} → Y Y _{max} → X
	(G) XAXIS	Draws an x-axis.	Start → T Stop → Z Tic → Y Offset → X
	(H) YAXIS	Draws a y-axis.	No Parameters
	(B) PENT	Raises the pen.	No Parameters
	(A) PLOT	Plots x, y coordinate values.	y-coordinate → Y x-coordinate → X
	(I) DRAW+	Draws a "+" at the current pen position.	No Parameter
	(C) IPLOT	Plots incremental values from the current pen position.	y-increment → Y x-increment → X
Lettering Instructions <small>CALL ALPHA</small> 1 followed by one key	(D) MOVE	Relocates the pen to a specified point.	y-coordinate → Y x-coordinate → X
	(L) CSIZE	Sets the character size and direction for lettering.	Plot Area Ratio → T Aspect Ratio → Z Size → Y Direction → X
	(K) PRNTX	Letters the current value in X.	Value → X
	<small>CALL ALPHA</small> PLOT α	Sets an Alpha Mode for lettering.	No Parameter
Digitizing Instructions <small>CALL ALPHA</small> 1 followed by one key	(E) DGTZR	Any key sequence sets the digitizer mode, then press (E) (J) (N) or (O) to move the pen in the indicated direction. Press the (M) key to terminate the mode.	The coordinates of the pen location are entered into X and Y when the digitizing mode is terminated.
	(J) DGTZR		
	(N) DGTZR		
	(O) DGTZR		
	(M) EXIT		

Keyboard





SALES & SERVICE OFFICES

UNITED STATES

ALABAMA
8290 Whitesburg Dr., S.E.
P.O. Box 4207
Huntsville 35802
Tel: (205) 881-4591
TWX: 810-726-2204

Medical Only
228 W. Valley Ave.,
Room 302
Birmingham 35209
Tel: (205) 879-2081/2

ARIZONA
2336 E. Magnolia St.
Phoenix 85034
Tel: (602) 244-1361
TWX: 910-951-1331

2424 East Aragon Rd.
Tucson 85706
Tel: (602) 889-4661

ARKANSAS
Medical Service Only
Little Rock 72205
Tel: (501) 664-8773

CALIFORNIA
1430 East Orangethorpe Ave.
Fullerton 92631
Tel: (714) 870-1000
TWX: 910-592-1288

3939 Lankershim Boulevard
North Hollywood 91604
Tel: (213) 877-1282
TWX: 910-499-2170

6305 Arizona Place
Los Angeles 90045
Tel: (213) 649-2511
TWX: 910-328-6147

Los Angeles
3003 Scott Boulevard
Santa Clara 95050
Tel: (408) 249-7000
TWX: 910-338-0518

Ridgeway
Tel: (714) 446-6165

2220 Watt Ave.
Sacramento 95825
Tel: (916) 482-1463
TWX: 910-367-2092

9606 Aero Drive
P.O. Box 23333
San Diego 92123
Tel: (714) 275-3200
TWX: 910-335-2000

Calculators Only
601 California St.
San Francisco 94108
Tel: (415) 989-8470

COLORADO
5600 South Ulster Parkway
Englewood 80110
Tel: (303) 771-5455
TWX: 910-935-0705

CONNECTICUT
12 Lunar Drive
New Haven 06525
Tel: (203) 389-6551
TWX: 710-465-2029

FLORIDA
P.O. Box 24210
2806 W. Oakland Park Blvd.
Ft. Lauderdale 33307
Tel: (305) 731-2020
TWX: 510-955-4099

Jacksonville
Medical Service Only
Tel: (904) 725-6333

P.O. Box 13910
6177 Lake Eleanor Dr.
Orlando 32809
Tel: (305) 855-2900
TWX: 810-850-0113

21 East Wright St.
Suite 1
Panama City 32501
Tel: (904) 434-4081

GEORGIA
P.O. Box 28234
450 Interstate North
Atlanta 30328
Tel: (404) 434-4000
TWX: 910-766-4890

HAWAII
2875 So. King Street
Honolulu 96814
Tel: (808) 955-4455

ILLINOIS
5500 Howard Street
Skokie 60076
Tel: (312) 677-0400
TWX: 910-223-3613

St. Joseph
Tel: (217) 469-2133

INDIANA
7301 North Shadeland Ave.
Indianapolis 46250
Tel: (317) 842-1000
TWX: 610-260-1796

IOWA
1902 Broadway
Iowa City 52240
Tel: (319) 338-9466
Night: (319) 338-9467

KANSAS
Derby
Tel: (316) 267-3655

LOUISIANA
P.O. Box 840
3239 Williams Boulevard
Kenner 70062
Tel: (504) 721-6201
TWX: 810-955-5524

KENTUCKY
Medical/Calculator Only
8003 Troutwood Court
Louisville 40291
Tel: (502) 426-4341

MARYLAND
6707 Whitestone Road
Baltimore 21207
Tel: (301) 944-5400
TWX: 710-862-9157

4 Choke Cherry Road
Rockville 20850
Tel: (301) 948-6370
TWX: 710-828-9685
710-828-0487

P.O. Box 1648
2 Choke Cherry Road
Rockville 20850
Tel: (301) 948-6370
TWX: 710-828-9684

MASSACHUSETTS
32 Hartwell Ave.
Lexington 02173
Tel: (617) 861-8960
TWX: 710-326-8904

MICHIGAN
23855 Research Drive
Farmington 48024
Tel: (313) 476-6400
TWX: 810-242-2900

MINNESOTA
2400 N. Prior Ave.
Roseville 55113
Tel: (612) 636-0700
TWX: 910-563-3734

MISSISSIPPI
Jackson
Medical Service Only
Tel: (601) 982-9363

MISSOURI
11311 Colorado Ave.
Kansas City 64137
Tel: (816) 763-8000
TWX: 910-771-2087

148 Weldon Parkway
Maryland Heights 63043
Tel: (314) 567-1435
TWX: 910-764-0830

NEBRASKA
Medical Only
11902 Elm Street
Suite 4C
Omaha 68144
Tel: (402) 333-6017

NEW JERSEY
W. 120 Century Rd.
Paramus 07652
Tel: (201) 265-5000
TWX: 710-990-4951

NEW MEXICO
P.O. Box 11634
Station E
11300 Lomas Blvd., N.E.
Albuquerque 87123
Tel: (505) 292-1330
TWX: 910-989-1185

156 Wyatt Drive
Laa Cruces 88001
Tel: (505) 526-2485
TWX: 910-963-0550

NEW YORK
6 Automation Lane
Computer Park
Albany 12205
Tel: (518) 458-1550
TWX: 710-441-8270

1251 Avenue of the Americas
Floor 32 - Suite 3296
New York City 10020
Tel: (212) 265-5675

New York City
Manhattan, Bronx
Contact Paramus, NJ Office
Tel: (201) 265-5000
Brooklyn, Queens, Richmond
Contact Woodbury, NY Office
Tel: (516) 921-0300

201 South Avenue
Poughkeepsie 12601
Tel: (914) 434-7330
TWX: 510-248-0012

39 Saginaw Drive
Rochester 14623
Tel: (716) 473-9500
TWX: 510-233-5981

8555 East Mollay Road
Syracuse 13211
Tel: (315) 455-2486
TWX: 710-541-0482

1 Crossways Park West
Woodbury 11797
Tel: (516) 921-0300
TWX: 910-221-2168

NORTH CAROLINA
P.O. Box 5188
1923 North Main Street
High Point 27262
Tel: (919) 885-8101
TWX: 510-926-1516

OHIO
16500 Sprague Road
Cleveland 44130
Tel: (216) 243-7300
Night: 243-7305
TWX: 610-423-9431

330 Progress Rd.
Dayton 45449
Tel: (513) 859-8202
TWX: 810-459-1925

1041 Kingsmill Parkway
Columbus 43229
Tel: (614) 436-1041

OKLAHOMA
P.O. Box 32008
Oklahoma City 73132
Tel: (405) 721-0200
TWX: 910-830-6662

OREGON
17890 SW Boones Ferry Road
Tualatin 97062
Tel: (503) 620-3350
TWX: 910-467-8714

PENNSYLVANIA
111 Zeta Drive
Pittsburgh 15238
Tel: (412) 782-0400
Night: 782-0401
TWX: 710-795-3124

1021 8th Avenue
King of Prussia Industrial Park
King of Prussia 19406
Tel: (215) 265-7000
TWX: 510-660-2670

SOUTH CAROLINA
6941-0 N. Trenholm Road
Columbia 29260
Tel: (803) 782-6493

TENNESSEE
Memphis
Medical Service Only
Tel: (901) 274-7472

Nashville
Medical Service Only
Tel: (615) 244-5448

TEXAS
P.O. Box 1270
201 E. Arapaho Rd.
Richardson 75080
Tel: (214) 231-6101
TWX: 910-867-4723

P.O. Box 27409
6300 Westpark Drive
Suite 100
Houston 77027
Tel: (713) 781-6000
TWX: 910-881-2645

205 Billy Mitchell Road
San Antonio 78226
Tel: (512) 434-8241
TWX: 910-871-1170

UTAH
2890 South Main Street
Salt Lake City 84115
Tel: (801) 487-0715
TWX: 910-925-5661

VIRGINIA
Medical Only
P.O. Box 12778
No. 7 Koger Exec. Center
Suite 212
Norfolk 23502
Tel: (804) 497-1026/7
P.O. Box 9854
2914 Hungary Springs Road
Richmond 23278
Tel: (804) 285-3431
TWX: 710-956-0157

WASHINGTON
Bellevue Office Pk.
1203-114th SE
Bellevue 98004
Tel: (206) 454-3871
TWX: 910-443-2446

WEST VIRGINIA
Medical/Analytical Only
Charleston
Tel: (804) 345-1640

WISCONSIN
9431 W. Beloit Road
Suite 117
Milwaukee 53227
Tel: (414) 541-0350

FOR U.S. AREAS NOT LISTED:
Contact the regional office
nearest you: Atlanta, Georgia...
North Hollywood, California...
Rockville, (4 Choke Cherry Rd.)
Maryland... Skokie, Illinois...
Their complete addresses
are listed above.

Service Only

CANADA

ALBERTA
Hewlett-Packard (Canada) Ltd.
11748 Kingsway Ave.
Edmonton T5G 0K5
Tel: (403) 452-3670
TWX: 610-831-2431

Hewlett-Packard (Canada) Ltd.
915-42 Avenue S.E. Suite 102
Calgary T2G 121
Tel: (403) 287-1672

BRITISH COLUMBIA
Hewlett-Packard (Canada) Ltd.
637 E. Cordova Street
Vancouver V6A 3R2
Tel: (604) 254-0531
TWX: 610-922-5059

MANITOBA
Hewlett-Packard (Canada) Ltd.
513 Century St.
St. James
Winnipeg R3H 0L8
Tel: (204) 786-7581
TWX: 610-671-3531

NOVA SCOTIA
Hewlett-Packard (Canada) Ltd.
800 Windmill Road
Dartmouth B3C 1L1
Tel: (902) 469-7820

ONTARIO
Hewlett-Packard (Canada) Ltd.
1785 Woodward Dr.
Ottawa K1Z 0P9
Tel: (613) 223-6530
TWX: 610-562-8968

Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
Mississauga L4V 1L9
Tel: (416) 515-9430
TWX: 610-492-4246

QUEBEC
Hewlett-Packard (Canada) Ltd.
275 Hymus Blvd.
Pointe Claire H9R 1G7
Tel: (514) 697-4232
TWX: 610-422-3022
TLX: 05-821521 HPCL

Hewlett-Packard (Canada) Ltd.
2376 Galvani Street
Ste-Foy G1N 4G4
Tel: (418) 688-8710

FOR CANADIAN AREAS NOT LISTED:
Contact Hewlett-Packard (Canada)
Ltd. in Mississauga.

CENTRAL AND SOUTH AMERICA

ARGENTINA
Hewlett-Packard Argentina
S.A.C. e I.
Lavalle 1171-3º Piso
Buenos Aires
Tel: 35-0436, 35-0627, 35-0341
Telex: 012-1009
Cable: HEWPACK ARG

Hewlett-Packard Do Brasil
I.E.C. Ltda.
Rua Siqueira Campos, 53, 4º
andar Copacabana
2000-Rio de Janeiro-GB
Tel: 257-80-94-DDD (021)
Telex: 2100 79 HEWPACK
Cable: HEWPACK
Rio de Janeiro

BOLIVIA
Stambuk & Mark (Bolivia) Ltda
Av. Marschal, Santa Cruz 1342
La Paz
Tel: 40626, 53163, 52421
Telex: 3580014
Cable: BUKMAR

BRAZIL
Hewlett-Packard Do Brasil
I.E.C. Ltda.
Rua Frei Caneca, 1.152-Bela Vista
01307-São Paulo-SP
Tel: 288-71-11, 287-81-20,
287-61-90
Telex: 309151/2/3
Cable: HEWPACK São Paulo

COLOMBIA
Instrumentación
Henrik A. Langebak & Kier S.A.
Carrera 7 No. 48-59
Apartado Aéreo 6267
Bogotá, D.E.
Tel: 45-78-06, 45-55-46
Cable: AARIS Bogotá
Telex: 44400INSTCO

COSTA RICA
Científica Costarricense S.A.
Apartado 10159
San José
Tel: 21-86-13
Cable: GALGUR San José

GUATEMALA
IPESA
Avenida La Reforma 3-48,
Zona 9
Guatemala
Tel: 63627, 64786
Telex: 4192 TELTRO GU

MEXICO
Hewlett-Packard Mexicana,
S.A. de C.V.
Torres Adalid No. 21, 11º Piso
Col. del Valle
Mexico 12, D.F.
Tel: (905) 543-42-32
Telex: 017-74-507

Hewlett-Packard Mexicana,
S.A. de C.V.
Ave. Constitución No. 2184
Monterrey, N.L.
Tel: 48-71-32, 48-71-84

NICARAGUA
Roberto Terán G.
Apartado Postal 689
Edificio Terán
Managua
Tel: 3451, 3452
Cable: ROTERAN Managua

PANAMA
Electrónico Balboa, S.A.
P.O. Box 4929
Calle Samuel Lewis
Ciudad de Panamá
Lima
Tel: 64-2700
Telex: 3431103 Curunda,
Canal Zone
Cable: ELECTRON Panama

PARAGUAY
Z.J. Melamed S.R.L.
Division: Aparatos y Equipos
Medicos
Division: Aparatos y Equipos
de Investigación
P.O. Box 676
Chile, 482, Edificio Victoria
Asunción
Tel: 4-5099, 4-6272
Cable: RAMEL

PERU
Compañía Electro Médica S.A.
Ave. Enrique Canaval 312
San Isidro
Casilla 1030
Lima
Tel: 22-3900
Cable: ELMEO Lima

PUERTO RICO
San Juan Electronics, Inc.
P.O. Box 5167
Ponce de León 154
Pda. 3-PIA de Tierra
San Juan 00906
Tel: (809) 725-3342, 722-3342
Cable: SATRONICS San Juan
Telex: SATRON 3450 332

URUGUAY
Pablo Ferrando S.A.
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
Montevideo
Tel: 40-3102
Cable: RAOLIM Montevideo

VENEZUELA
Hewlett-Packard de Venezuela
C.A.
Apartado 50933
Edificio Segre
Tercera Transversal
Los Ruices Norte
Caracas 107
Tel: 35-00-11
Telex: 21146 HEWPACK
Cable: HEWPACK Caracas

FOR AREAS NOT LISTED, CONTACT:
Hewlett-Packard
Inter-Americas
3200 Hillview Ave
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1260
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

EUROPE

AUSTRIA
Hewlett-Packard Ges. m. b. H.
Handelska 52/3
P. O. Box 7
A-1205 Vienna
Tel: (0222) 33 86 06 to 09
Cable: HEWPAK Vienna
Telex: 75923 hewpak a

BELGIUM
Hewlett-Packard Benelux
S.A./N.V.
Avenue de Col-Vert, 1,
(Groenkraaglaan)
B-1170 Brussels
Tel: (02) 672 22 40
Cable: PALOBN Brussels
Telex: 23 494 paloben bru

DENMARK
Hewlett-Packard A/S
Datavej 52
DK-3460 Birkerød
Tel: (01) 81 65 40
Cable: HEWPAK AS
Telex: 166 40 hp as
Hewlett-Packard A/S
Navnvej 1
DK-8600 Silkeborg
Tel: (06) 82 71 66
Telex: 166 40 hp as
Cable: HEWPAK AS

FINLAND
Hewlett-Packard Oy
Nankkavuontie 5
P. O. Box 6
SF-00211 Helsinki 21
Tel: 6923031
Cable: HEWPAKYOY Helsinki
Telex: 12-1563

FRANCE
Hewlett-Packard France
Quartier de Courtabouef
Boite Postale No. 6
F-91401 Orsay
Tel: (1) 907 78 25
Cable: HEWPAK Orsay
Telex: 60048

Hewlett-Packard France
Agence Régionale
Chemin des Moulins
Boite Postale No. 12
F-69130 Ecully
Tel: (70) 33 81 25
Cable: HEWPAK Ecully
Telex: 31 617

Hewlett-Packard France
Agence Régionale
Zone Aéronautique
Avenue Clément Ader
F-31770 Colomiers
Tel: (61) 78 11 55
Telex: 51957

Hewlett-Packard France
Agence Régionale
Centre d'aviation générale
F-13721 Aéroport de
Marseille
Tel: (91) 89 12 36
TWX: 41770 F
Telex: 74 912 F

Hewlett-Packard France
Agence Régionale
63, Avenue de Rochester
F-35000 Rennes
Tel: 74912 F
Telex: 74 912 F

Hewlett-Packard France
Agence Régionale
74, Allée de la Roberteau
F-67000 Strasbourg
Tel: (88) 35 23 20/21
Telex: 89141
Cable: HEWPAK STRBG
Medical/Calculator Only
Hewlett-Packard France
Agence Régionale
Centre Vauban
201, rue Colbert
Entrée A2
F-59000 Lille
Tel: (20) 51 44 14

GERMAN FEDERAL REPUBLIC
Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Bernarstrasse 117
Postfach 560 140
D-6000 Frankfurt 56
Tel: (0611) 50 04-1
Cable: HEWPAKSA Frankfurt
Telex: 41 32 49 fra
Hewlett-Packard GmbH
Technisches Buero Boblingen
Herrenbergerstrasse 110
201, rue Württemberg
D-70031 Boblingen
Tel: (07031) 66 72 87
Cable: HEPAK Boblingen
Telex: 72 65 739 bbn

Hewlett-Packard GmbH
Technisches Buero Düsseldorf
Vogelsanger Weg 36
D-4000 Düsseldorf
Tel: (0211) 53 80 31/5
Telex: 8586 333 hpd d
Hewlett-Packard GmbH
Technisches Buero Hamburg
Wendenstrasse 23
D-2000 Hamburg 1
Tel: (040) 24 12 83
Cable: HEWPAKSA Hamburg
Telex: 21 63 032 hphh d

Hewlett-Packard GmbH
Technisches Buero Hannover
Mellendorfer Strasse 3
D-3000 Hannover-Kloeefeld
Tel: (0511) 55 50 46
Telex: 092 3259

Hewlett-Packard GmbH
Technisches Buero Nuremberg
Herbruckerstrasse 42
D-8500 Nuremberg
Tel: (0911) 57 10 65
Telex: 623 860

Hewlett-Packard GmbH
Technisches Buero München
Uffenhager Strasse 28
ISAR-Süden
D-8012 Ottobrunn
Tel: (089) 601 30 61/7
Telex: 52 49 85
Cable: HEWPAKSA München
Telex: 32046

Hewlett-Packard GmbH
Technisches Buero Berlin
Keith Strasse 2-4
D-1000 Berlin 30
Tel: (030) 24 90 86
Telex: 16 34 05 hpbm d

GREECE
Kostas Karayannis
18, Ermou Street
GR-Athens 126
Tel: 3230-303 Sales/SVC
3230-305 Adm. Order Proc.
Cable: RAKAR Athens
Tel: 21 59 62 rkar gr
Hewlett-Packard S.A.
Mediterranean & Middle East
Operations
35 Kolokotroni Street
Patis Kettalarou
GR-Kifissia-Athens
Tel: 8080337, 8080359,
8080429, 8018693
Telex: 21 63 04
Cable: HEWPAKSA Athens

Analytical Only
"INTECO" G. Papatthanasios & Co.
Marni 17
GR - Athens 103
Tel: 7 63 91, 7 73 93
Cable: INTEKNUKA
Telex: 21 5329 INTE GR
Medical Only
Technomed Hellas Ltd.
52, Skoufa Street
GR - Athens 135
Tel: 626 922
Cable: ETALAK Athens
Telex: 21-4653 ETAL GR

IRELAND
Hewlett-Packard Ltd
King Street Lane
Winnersh, Wokingham
GB-Berkshire RG11 5AR
Tel: Wokingham 784774
Telex: 84778/848179
Hewlett-Packard Ltd
"The Graffons"
Stamford New Road
GB-Altrincham, Cheshire
Tel: (061) 928-9021
Telex: 668068

ITALY
Hewlett-Packard Italiana S.p.A.
Via Amerigo Vespucci 2
I-20121 Milano
Tel: (2) 6251 (10 lines)
Cable: HEWPAKIT Milan
Telex: 32046

Hewlett-Packard Italiana S.p.A.
Via Pietro Maroncelli 40
(ang. via Visentini)
I-35100 Padova
Tel: 66 40 6266 31 88
Telex: 32046 via Milan

Medical Only
Hewlett-Packard Italiana S.p.A.
Via Medaglia d'Oro, 2
I-56100 Pisa
Tel: (050) 2 32 04
Telex: 32046 via Milan
Hewlett-Packard S.p.A.
Via G. Armetini 10
I-00143 Rome-Eur
Tel: (6) 59125445
Telex: 61514
Cable: HEWPAKIT Rome

Hewlett-Packard Italiana S.p.A.
Via San Quintino, 46
I-10121 Turin
Tel: 53 82 64/54 84 68
Telex: 32046 via Milan
Medical/Calculators Only
Hewlett-Packard Italiana S.p.A.
Via Pietro Maroncelli 43 G/C
I-95126 Catania
Tel: (095) 370505

LUXEMBURG
Hewlett-Packard Benelux
S.A./N.V.
Avenue de Col-Vert, 1,
(Groenkraaglaan)
B-1170 Brussels
Tel: (02) 672 22 40
Cable: PALOBN Brussels
Telex: 23 494

NETHERLANDS
Hewlett-Packard Benelux N.V.
Weerdstein 117
P.O. Box 7825
NL-Amsterdam, 1011
Tel: (020) 5411522
Cable: PALOBN Amsterdam
Telex: 13 216 hepa nl

NORWAY
Hewlett-Packard Norge A/S
Nesveien 13
Box 149
N-1344 Haslum
Tel: (02) 53 83 60
Telex: 16621 hpnas n

POLAND
Analytical/Medical Only
Hewlett-Packard
Warsaw Technical Office
Szpitalna 1
00-120 Warsaw
Tel: 268031
Telex: 812453

PORTUGAL
Telectra-Empresa Técnica de
Equipamentos Eléctricos S. a. r. l.
Rua Rodrigo da Fonseca 103
P. O. Box 2531
P-Lisbon
Tel: (19) 68 60 72
Cable: TELETRA Lisbon
Tel: 268031
Telex: 812453

Mundinter
Intercambio Mundial de Comercio
Sarl Avenida Antonio Augusto
de Aguilar 138
P.O. Box 2761
P - Lisbon
Tel: (19) 53 21 31/7
Cable: INTERCAMBIO Lisbon

SPAIN
Hewlett-Packard Española, S.A.
Jeréz Mo. 3
E-Madrid 16
Tel: (1) 458 26 00 (10 lines)
Telex: 23515 hpe

Hewlett-Packard Española, S.A.
Mijasense 21-23
E-Barcelona 17
Tel: (3) 203 6200 (5 lines)
Telex: 52603 hpbe e
Hewlett-Packard Española, S.A.
P.O. Box 2761
E-Sevilla
Tel: 64 44 54/58

Hewlett-Packard Española S.A.
Edificio Albia II 7º B
E-Bilbao
Tel: 23 83 06/23 82 06
Calculators Only
Hewlett-Packard Española S.A.
Alvaro Bazan, 12
(Edificio Luz)
E - Valencia - 10
Tel: 60 42 00

SWEDEN
Hewlett-Packard Sverige AB
Enghetsvägen 1-3
Fack
S-161 20 Bromma 20
Tel: (08) 730 05 50
Cable: MEASUREMENTS
Stockholm
Telex: 10721

Hewlett-Packard Sverige AB
Hagagersplan 9C
S-431 41 Mölndal
Tel: (031) 27 68 00/01
Telex: Via Bromma

SWITZERLAND
Hilt-Packard (Schweiz) AG
Zürcherstrasse 20
P. O. Box 64
CH-8618 Schlieren Zurich
Tel: (01) 98 18 21
Cable: HPAG CH
Telex: 53933 hpz

Hewlett-Packard (Schweiz) AG
9, chemin Louis-Pictet
CH-1214 Vernier-Geneva
Tel: (022) 41 49 50
Cable: HEWPAKSA Geneva
Telex: 27 333 hpss ch

TURKEY
Telekom Engineering Bureau
Saglik Sok. No. 15/1
Ayaspaşa-Beyoğlu
P. O. Box 437
TR-Istanbul
Tel: 49 40 40
Cable: TELEMATIOM Istanbul

UNITED KINGDOM
Hewlett-Packard Ltd.
King Street Lane
Winnersh, Wokingham
GB-Berkshire RG11 5AR
Tel: Wokingham 784774
Telex: 84778/848179
Hewlett-Packard Ltd.
"The Graffons"
Stamford New Road
GB-Altrincham, Cheshire
Tel: (061) 928-9021
Telex: 668068

Hewlett-Packard Ltd.
c/o Makro
South Service Wholesale Centre
Amber Way
Halesowen Industrial Estate
GB-Halesowen, Worcs
Tel: Birmingham 7860

Hewlett-Packard Ltd.
4th Floor
Wedg House
799, London Road
GB-Thornton Heath CR4 6XL
Surrey
Tel: (01) 684 0105
Telex: 946825

Hewlett-Packard Ltd.
c/o Makro
South Service Wholesale Centre
West Industrial Estate
Washington
GB-New Town, County Durham
Tel: Washington 464001 ext. 57/58

Hewlett-Packard Ltd.'s registered
address for V.A.T. purposes
only
70, Finsbury Pavement
London, EC2A 1SX
Registered No. 690597

USSR
Hewlett-Packard USSR
c/o Commercial Office
American Embassy (Box M)
A-1091 Vienna, Austria
Tel: 7825 hewpak SU

YUGOSLAVIA
Istka-Standard/Hewlett-Packard
Topniska 58/3
61000 Ljubljana
Tel: 315-879/321-674
Telex: 31300

**SOCIALIST COUNTRIES
PLEASE CONTACT:**
Hewlett-Packard S.A.
7, rue du Bois-du-Lan
P. O. Box 349
CH-1211 Meyrin 1 Geneva
Switzerland
Tel: (022) 41 54 00
Cable: HEWPAKSA Geneva
Telex: 2 24 66

AFRICA, ASIA, AUSTRALIA

ANGOLA
Telectra
Empresa Técnica de
Equipamentos
S. A. R. L.
R. Barbosa Rodrigues, 42-1ºDT.
Caixa Postal, 6487-Luanda
Tel: 35515/6
Cable: TELETRA Luanda

AUSTRALIA
Hewlett-Packard Australia
Pty. Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
Tel: 49-6351, 89-6306
Telex: 31-024
Cable: HEWPARO Melbourne
Hewlett-Packard Australia
Pty. Ltd.
31 Bridge Street
Pymble,
New South Wales, 2073
Tel: 449-6566
Telex: 21561
Cable: HEWPARO Sydney
Hewlett-Packard Australia
Pty. Ltd.
97 Churchill Road
Prospect 5082
South Australia
Tel: 44 8151
Cable: HEWPARO Adelaide
Hewlett-Packard Australia
Pty. Ltd.
141 Stirling Highway
Claremont, W.A. 6010
Tel: 86-5455
Telex: 93059
Cable: HEWPARO
Hewlett-Packard Australia
Pty. Ltd.
121 Wollongong Street
Fyshwick, A.C.T., 2609
Tel: 95 3733
Hewlett-Packard Australia
Pty. Ltd.
5th Floor
Teachers Union Building
495-499 Boundary Street
Spring Hill, 4000 Queensland
Tel: 29-1544
Telex: AA-42133

CEYLON
United Electricals Ltd
P. O. Box 681
60, Park St
Colombo 2
Tel: 26806
Cable: HDTPPOINT Colombo

CYPRUS
Kypronics
19 Gregorios & Xenopoulos Rd
P. O. Box 1152
CY Nicosia
Tel: 45628/29
Cable: KYPRONICS PANDEHS

HONG KONG
Schmidt & Co (Hong Kong) Ltd.
P. O. Box 297
Cognalight Centre
8th Floor
Connaught Road, Central
Hong Kong
Tel: 240168, 232735
Telex: HK4782
Cable: SCHMIDTCO Hong Kong

INDIA
Hewlett-Packard Australia
Pty. Ltd.
31-41 Joseph Street
Blackburn, Victoria 3130
Tel: 49-6351, 89-6306
Telex: 31-024
Cable: HEWPARO Melbourne
Hewlett-Packard Australia
Pty. Ltd.
31 Bridge Street
Pymble,
New South Wales, 2073
Tel: 449-6566
Telex: 21561
Cable: HEWPARO Sydney
Hewlett-Packard Australia
Pty. Ltd.
97 Churchill Road
Prospect 5082
South Australia
Tel: 44 8151
Cable: HEWPARO Adelaide
Hewlett-Packard Australia
Pty. Ltd.
141 Stirling Highway
Claremont, W.A. 6010
Tel: 86-5455
Telex: 93059
Cable: HEWPARO
Hewlett-Packard Australia
Pty. Ltd.
121 Wollongong Street
Fyshwick, A.C.T., 2609
Tel: 95 3733
Hewlett-Packard Australia
Pty. Ltd.
5th Floor
Teachers Union Building
495-499 Boundary Street
Spring Hill, 4000 Queensland
Tel: 29-1544
Telex: AA-42133

INDONESIA
BERCA Indonesia P.T.
P. O. Box 496
1st Floor J.L. Cikini Raya 61
Jakarta
Tel: 56038, 40369, 49886
Telex: 2895 Jakarta

IRAN
Multi Corp International Ltd.
Avenue Soraya 130
P. O. Box 1212
Jr-Teheran
Tel: 83 10 35 39
Cable: MULTICORP Tehran
Telex: 2893 mcs in

ISRAEL
Electronics & Engineering
Div. of Motorola Israel Ltd.
17 Aminadav Street
Tel-Aviv
Tel: 36941 (3 lines)
Cable: BASTEL Tel-Aviv
Telex: 33569

JAPAN
Yokogawa-Hewlett-Packard Ltd.
Onashi Building
1-59-1 Yoyogi
Shibuya-ku, Tokyo
Tel: 03-370-2281/92
Telex: 232-2024YHP
Cable: YHPMARKET TOK 23-724

Yokogawa-Hewlett-Packard Ltd.
Nishi Ibaragi Bldg.
2-2-8 Kasuga
Ibaragi-Shi
Osaka
Tel: (0726) 23-1641
Telex: 5332-385 YHP OSAKA
Yokogawa-Hewlett-Packard Ltd.
Nakamo Building
No. 24 Kamisazuma-cho
Nakamura-ku, Nagoya City
Tel: (052) 571-5171

Blue Star Ltd
1-1-117/1
Sarojini Oevi Road
Secunderabad 500 003
India
Tel: 7 63 91, 7 73 93
Cable: BLUEFROST
Telex: 459

Blue Star Ltd.
23/24 Second Line Beach
Madras 600 001
India
Tel: 23954
Telex: 379
Cable: BLUESTAR
Blue Star Ltd.
Kasturi Buildings
Jamsheedi Tata Rd
Naljarai, Madras
2nd Floor Bistapur
Jamaheddpur 831 001
India
Tel: 38 04
Cable: BLUESTAR
Telex: 240

KENYA
Technical Engineering Services
P. O. Box 16311
Nairobi, Kenya
Tel: 57726
Cable: PROTON

KOREA
American Trading Company
Korea
I.P. O. Box 1103
Dae Kyung Bldg., 8th Floor
107 Sejong-Ro,
Chongju-Ku, Seoul
Tel: (4 lines) 73-8924-7
Cable: AMTRACO Seoul

KUWAIT
Al-Khaldiya Trading &
Contracting Co.
Al Soor Street
Michaan Bldg. No. 4
Kuwait
Tel: 42 99 10
Cable: VISCOUNT

LEBANON
Constantin E. Macridis
Clémenceau Street 34
P. O. Box 7213
Ri-Beirut
Tel: 220846
Telex: 21114 Leb
Cable: ELECTRONUCLEAR Beirut

MALAYSIA
MECOMB Malaysia Ltd.
2 Lorong 13/6A
Section 13
Petaling Jaya, Selangor
Cable: MECOMB Kuala Lumpur

MOZAMBIQUE
A. N. Goncalves, Lda
162, 1º Apt. 14 Av. D. Luis
Caxaa Postal, 107
Lourenço Marques
Tel: 27091, 27114
Cable: NEGOS Negon Mo
Telex: 6-203

Yokogawa-Hewlett-Packard Ltd.
Tanigawa Building
2-24-1 Tsuruya-cho
Kanagawa-ku
Yokohama 221
Tel: 045-312-1252
Telex: 362-3204 YHP YOK

Yokogawa-Hewlett-Packard Ltd.
Mitsubishi Building
14-73 San-no-maru
Mito, 310
Tel: 0292-25-7470
Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1248-3, Asahi-cho, 1-chome
Atsugi, 243
Tel: 0462-24-0452

NEW ZEALAND
Hewlett-Packard (N.Z.) Ltd.
94-96 Dixon Street
P. O. Box 9443
Wellington
Tel: 59-559
Telex: 3896
Cable: HEWPAK Wellington
Hewlett-Packard (N.Z.) Ltd.
Pakuranga Professional Centre
267 Pakuranga Highway
Pakuranga
Tel: 569-651
Cable: HEWPAK, Auckland
Analytical/Medical Only
Dental & Medical Supply Co. Ltd.
Scientific Division
79 Carlton Gore Road
Newmarket
P. O. Box 1234
Auckland
Tel: 75-269
Cable: DENTAL Auckland

NIGERIA
The Electronics
Instrumentation Ltd.
NEB/770 Oyo Road
Oluseun House
P. M. B. 5402
Ibadan
Tel: 23295
Cable: THETEL Ibadan
The Electronics Instrumentation
Ltd. (TEL)
16th Floor, Cocoa House
P. M. B. 5402
Ibadan
Tel: 23225
Cable: THETEL Ibadan

PAKISTAN
Mushko & Company, Ltd.
Oosman Chambers
Abdullah Haroon Road
Karachi 3
Tel: 511027, 512927
Cable: COOPERATOR Karachi
Mushko & Company, Ltd.
38B, Satellite Town
Rawalpindi
Tel: 41924
Cable: FEMUS Rawalpindi

PHILIPPINES
Electromex, Inc.
6th Floor, Amalgamated
Development Corp. Bldg.
Ayala Avenue, Makati, Rizal
C. P. O. Box 1026
Makati, Rizal
Tel: 86-18-87, 87-76-77,
Cable: ELEMEX Manila

SINGAPORE
Mechanical & Combustion
Engineering Company Pte.,
Ltd.
10/12, Jalan Kilang
Red Hill Industrial Estate
Singapore, 3
Tel: 847151 (7 lines)
Cable: MECOMB Singapore
Hewlett-Packard Singapore
(Pte.) Ltd.
Blok. 2, 6th FLOOR, Jalan
Buntik Merah
Rehail Industrial Estate
Alexandra P. O. Box 67,
Singapore 3
Tel: 630222
Cable: HPSG RS 21486
Cable: HEWPAK, Singapore

SOUTH AFRICA
Hewlett-Packard South Africa
(Pty.) Ltd.
Hewlett-Packard House
Daphne Street, Windywood
Sandton, Transvaal 2001
Tel: 802 1040
Telex: SA424-4782 JH
Cable: HEWPAK
Hewlett-Packard South Africa
(Pty.) Ltd.
Breccaste House
Bree Street
Cape Town
Tel: 2-69412/3
Cable: HEWPAK Cape Town
Telex: 0006 CT

Hewlett-Packard South Africa
(Pty.) Ltd.
641 Ridge Road, Durban
P. O. Box 37099
Overport, Durban, 4067
Tel: 6-6102
Telex: 6-7954

TAIWAN
Hewlett-Packard Taiwan
39 Chung Shiao West Road
Sec. 1 Overseas Insurance
Corp. Bldg., 7th Floor
Taipei
Tel: 389160 1, 2
Telex: TP824 HEWPAK
Cable: HEWPAK Taipei
Hewlett-Packard Taiwan
38, Po-Ai Lane, San Min Chu,
Kaohsiung
Tel: 297319

THAILAND
UNIMESA Co., Ltd.
Elsom Research Building
Bangkok Sukumvit Ave
Bangkok
Tel: 932877, 930338
Cable: UNIMESA Bangkok

UGANDA
Uganda Tele-Electric Co., Ltd.
P. O. Box 4449
Kampala
Tel: 57279
Cable: COMCO Kampala

VIETNAM
Peninsular Trading Inc.
P. O. Box H-3
14, rue Vuong
Sai-gon
Tel: 20-805, 93398
Cable: CENTRA, SAIGON 242










ZAMBIA
R.J. Tiburyi (Zambia) Ltd.
P. O. Box 2792
Lusaka
Zambia, Central Africa
Tel: 73193
Cable: ARJAYTEE, Lusaka

**MEDITERRANEAN AND
MIDDLE EAST COUNTRIES
NOT SHOWN PLEASE CONTACT:**
Hewlett-Packard S.A.
Mediterranean and Middle
East Operations
35, Kolokotroni Street
Platia Kefalliarou
GR-Kifissia-Athens
Telex: 23-6588
Cable: HEWPAKSA Athens

OTHER AREAS NOT LISTED, CONTACT:
Hewlett-Packard
Export Trade Company
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX 910-373-1267
Cable: HEWPAK Palo Alto
Tel: 034-8300, 034-8493

ERROR MESSAGES



* OVERFLOW	Number or result exceeds calculating range.
* SORT OF NEG #	
* DIVISION BY ZERO	
* LOG OF # <=0	
* NO I/O DEVICE	Peripheral device or interface not connected.
ILLEGAL ADDRESS	Improper step address or storage register specified.
ILLEGAL ARGUMENT	Improper value for operation (e.g., improper scale or axis parameters).
MEMORY OVERFLOW	Program instruction, storage register assignment, or program loaded from tape exceeds available memory.
GOSUB OVERFLOW	More than seven subroutines (including special functions) nested at a time.
KEY NOT DEFINED	Special function just called is not defined.
IMPROPER SYNTAX	Incorrect use of        or 
* CHECKSUM ERROR	Program or data loaded into calculator not identical to that in file; this usually indicates a dirty tape head or a worn tape.
* VERIFY FAILED	Program or data in file not identical to that in calculator.
WRONG FILE TYPE	Attempting to load an empty, extra, or binary file; recording on an extra file.
END OF TAPE	End of tape reached during MARK operation. Also indicates a broken or defective tape; if the tape does not appear to be broken, (advance it using the drive wheel), replace the cartridge, press  , and continue.
PROTECTED TAPE	The cartridge RECORD slide is positioned to prevent MARK and RECORD operations.
SECURED MEMORY	Attempting to list, edit, or record a secured program.
MISSING FOR STMT	
LABEL NOT FOUND	
FILE NOT FOUND	
CARTRIDGE OUT	
MISSING GOSUB	

*These messages are suppressable; see "Flags" in Section 3 of the calculator operating manual.

