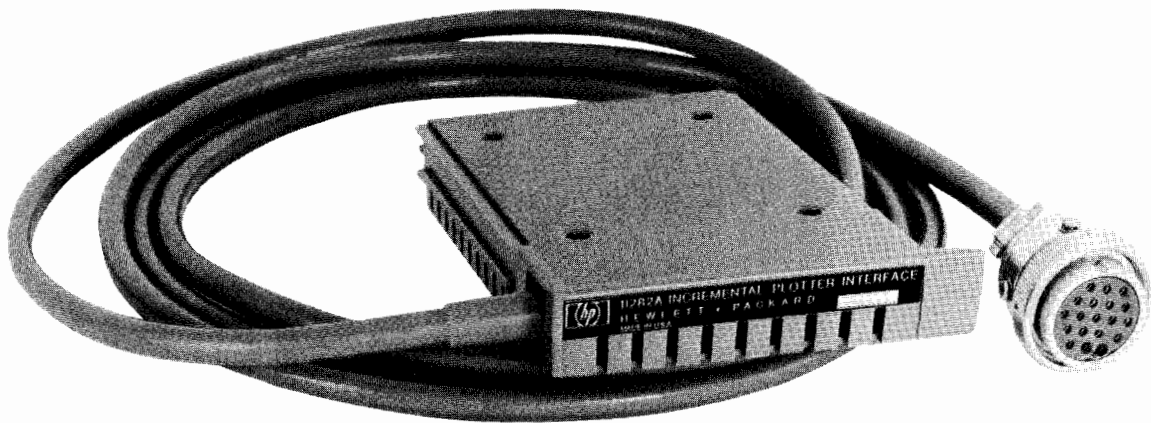MODEL
30

hp **HEWLETT-PACKARD 9830A CALCULATOR**
11282A INCREMENTAL PLOTTER INTERFACE

OPERATING and SERVICE MANUAL

OPERATING and SERVICE MANUAL

11282A

INCREMENTAL PLOTTER INTERFACE

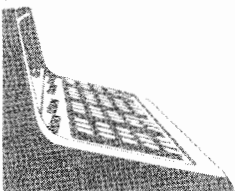# HP Computer Museum
www.hpmuseum.net

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PREFACE

The 11282A Incremental Plotter Interface enables the -hp- 9830A Calculator to control digital plotters from any of several manufacturers, including: CALCOMP Models 502, 563, and 565, and Houston Models DP-1 and DP-3. The interface is equipped for use with plotters which specify:

- Plotter speed of either 200 or 300 increments per second
- Plotter step size of either .01 inch, .005 inch or .1 mm

The direction and polarity of the X and Y axes may be defined by the user through a change in the connections of four wires within the plotter end connection of the interface cable.

The nine plotter statements enable you to:

- Set a scale for plotting.
- Draw X and Y axes of variable lengths, with or without tic marks.
- Designate the select code setting for program output.
- Raise or lower the pen either before or after plotting a point.
- Plot points with respect to the origin.
- Plot points with respect to the previously plotted point rather than the origin.
- Reset the origin so that points may be plotted with respect to the new origin.
- Draw alphanumeric characters, while specifying the width, height and angle of rotation.
- Reference FORMAT statements for character output.

Chapter 1

INSTRUCTIONS BEFORE USE

The 11282A Interface connects the HP 9830A Calculator with any of several digital plotters. The cable is equipped with an interface card on the calculator end and a 19-pin Cannon connector on the plotter end.

The interface card is pre-set at the factory to select code 14 and to a maximum plotter speed of 300 increments per second. If a plotter with a maximum operating speed of 200 increments per second is to be used, the position of a resistor on the interface card must be changed. (See Photo 1).

Option 001 for the 11282A Plotter Interface is necessary for use with the CALCOMP Model 502 digital plotter. This option has a different plotter end connection.

◆◆◆◆ EQUIPMENT SUPPLIED ◆◆◆◆◆

The following items are included with the 11282A Incremental Plotter Interface:

Operating and Service Manual -hp- Part No. 11282-90000, quantity 2

Program Tape Cassette -hp- Part No. 11282-90001, quantity 1

◆◆◆◆ INITIAL INSPECTION ◆◆◆◆

Please check to see that the accessories listed above are included with the 11282A Interface. Also, inspect the Interface and Program Tape for damage which may have occurred during shipment. If shipping damage is apparent, file a claim with the carrier and contact the nearest -hp- office. For any further assistance or information, contact your -hp- Sales and Service Office, listed at the back of this manual.

CHANGING THE PLOTTER SPEED CONNECTION

Refer to Photo 1. If a digital plotter with an operating speed of 200 increments per second is to be used, the position of a resistor within the interface card must be changed. To do so, disassemble the interface card by removing the four screws which hold it together. Unsolder the resistor from the solder pad marked "300". Resolder the connection to the pad marked "200". Reassemble the interface card.
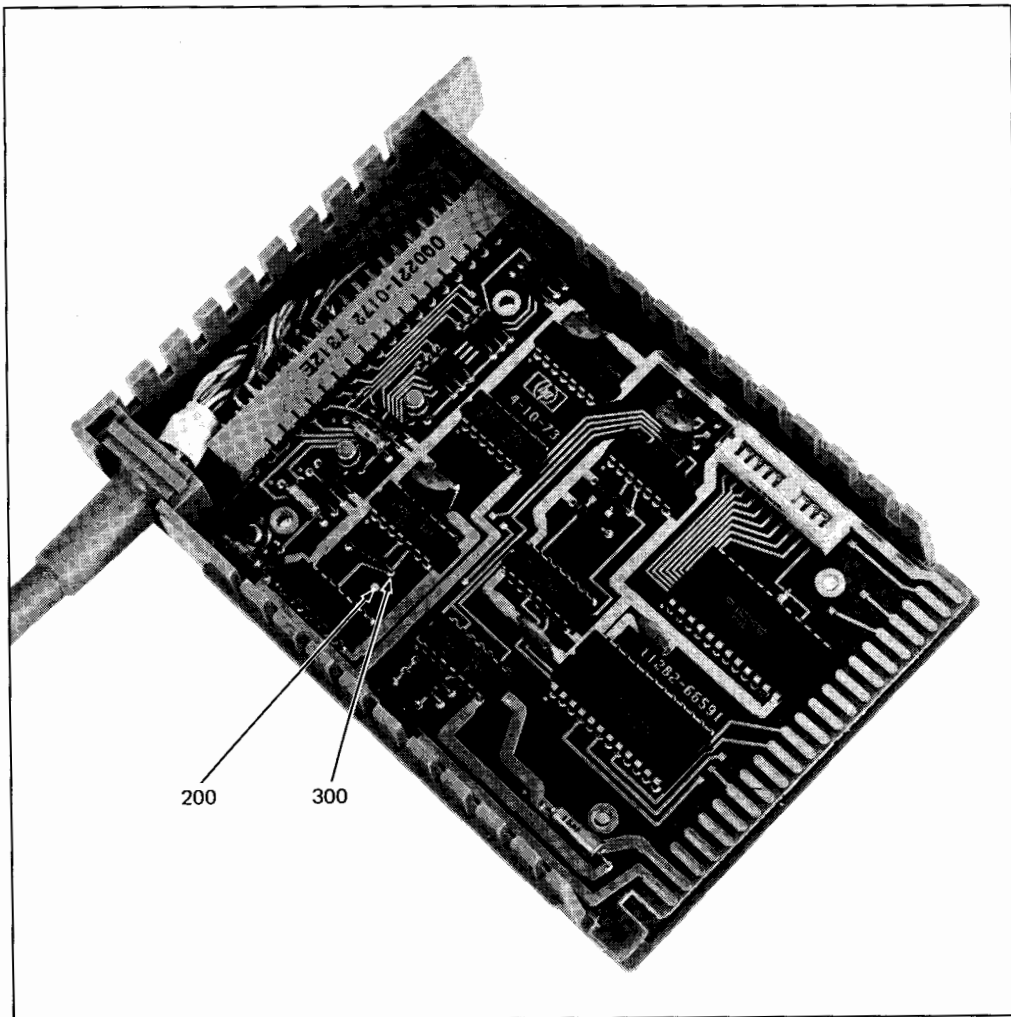
PHOTO 1: Changing the Plotter Speed Connection

◆◆◆◆ CHANGING THE SELECT CODE ◆◆◆◆

Refer to Photo 2. The interface card is preset at the factory to select code 14, which corresponds to 0 on the select code switch. To change the select code, first disassemble the interface card by removing the four screws which hold it together. Lift the clear plastic cover on the select code switch. Using a small screwdriver, rotate the slotted screw until it is set to the desired number (from 1 through 9). Replace the clear cover and reassemble the interface card.
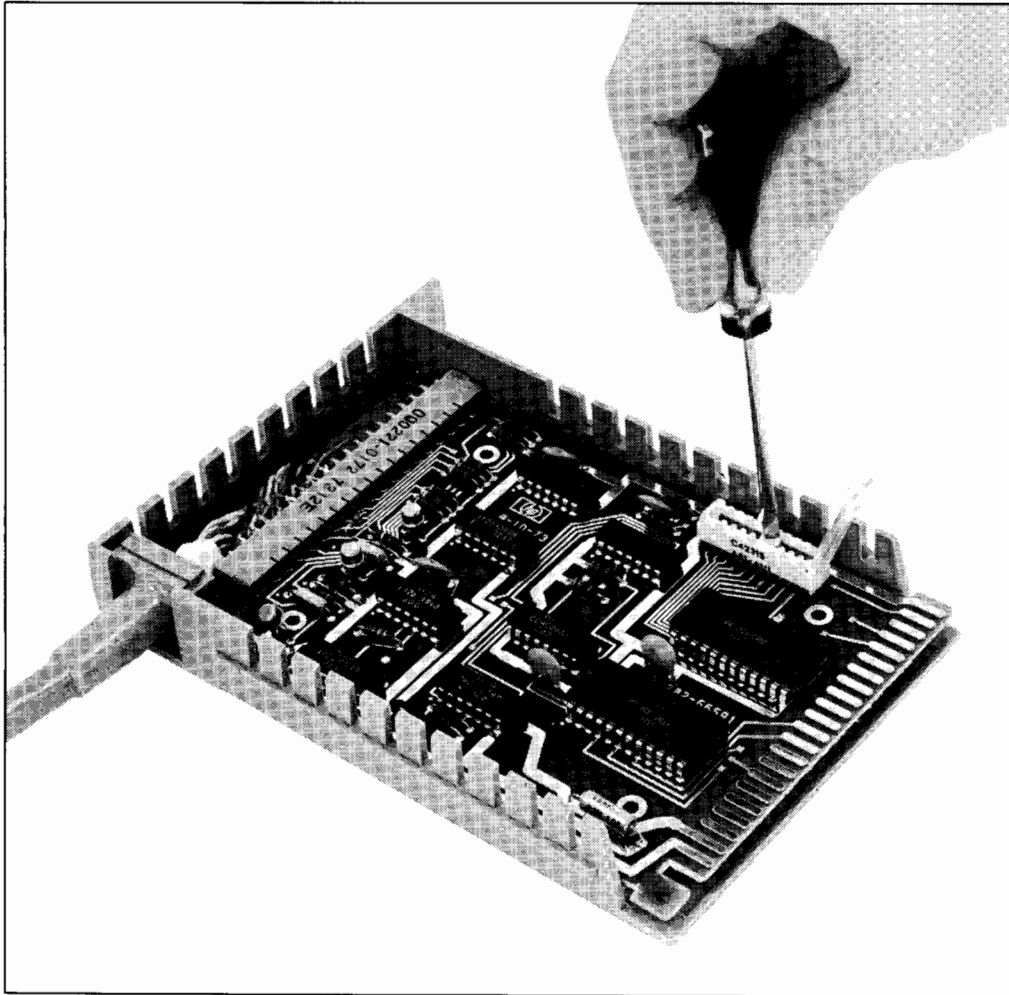
PHOTO 2: Changing the Select Code

◆◆◆◆ INSTALLING THE INTERFACE ◆◆◆◆

1. Turn off the 9830A Calculator and disconnect the plotter power cord.

WARNING

PERSONAL INJURY MAY RESULT IF THE PLOTTER IS NOT
UNPLUGGED WHILE THE INTERFACE IS BEING INSTALLED.

---

2. Connect the calculator end of the interface to any of the I/O slots at the back of the 9830A, making sure that the printing on the interface card faces up.

3. Plug the round plotter end connector of the interface into the back of the plotter, making sure the connector slot is correctly aligned. Push and turn the knurled ring to secure the connection.

4. Plug in the plotter power cord and turn on the 9830A.

◆◆◆◆ PROGRAM CASSETTE ◆◆◆◆

The binary tape program cassette provided with the 11282A Interface programs the 9830A Calculator to drive a digital plotter.

The program comes in two forms, one for digital plotters with a .01 inch or .1 mm step size and the other for plotters with a .005 inch step size. Refer to the specifications of your plotter to determine the step size that it uses.

The driver programs are loaded on the cassette at three locations each. Program A (for .01 inch/.1mm step size plotters) may be loaded from files #2, #12, or #22. Program B (for .005 inch step size plotters) may be loaded from files #4, #14, or #24.

A "short form" driver program for .01 inch or .1 mm step size plotters is also included in the program cassette, and may be loaded from files #8, #18, or #28. This version takes only 411 words of memory, rather than the 1424 word requirement of the regular driver programs. However, only three plotter statements may be used: **DSCALE**, **DPLOT** and **DIPLOT**. These statements are used in the same manner as for the regular driver program –– as described in Chapter 2.

A short exerciser program is stored in files #6, #16 and #26. This may be used to illustrate some of the plotting possibilities with the 11282A Interface and the 9830A Calculator.

CAUTION

DO NOT PUT THE CASSETTE NEAR ELECTRIC MOTORS OR
OTHER SOURCES OF MAGNETISM. KEEP THE TAPE RE-
WOUND AND STORE THE CASSETTE IN THE CASE PROVID-
ED – AWAY FROM HEAT AND MOISTURE.

The file organization on the tape cassette is as follows:

FILE #	PROGRAM NAME	WORD LENGTH
0	Executive	100
1	(empty)	10
2	.01 in/.l mm driver	1450
3	(empty)	10
4	.005 inch driver	1450
5	(empty)	10
6	Exerciser	1450
7	(empty)	10
8	.01 in/.1 mm short driver	420
9	(empty)	10
10-19	same as above	
20-29	same as above	

◆◆◆ LOADING THE DRIVER PROGRAMS ◆◆◆

1. Open the tape transport door and insert the cassette, with the word FRONT facing you. Close the transport door and, if necessary, rewind the tape by pressing: [REWIND]

2. Press: [SCRATCH] [A] [EXECUTE]   [LOAD] [EXECUTE]   [RUN] [EXECUTE]

3. The display will ask:

   [INPUT DRIVER TYPE:1=LONG,2=SHORT]

4A. For the regular driver program, press: [1] [EXECUTE]

   The display will ask:

   [INPUT SIZE:1=.01IN/.1MM,2=.005IN]

   For .01 inch or .1 mm step size plotters, press: [1] [EXECUTE]

   For .005 inch step size plotters, press: [2] [EXECUTE]

4B. For the short form driver program, press: [2] [EXECUTE]

5. When the tape stops and the 9830A display returns, press: [REWIND]
   and remove the cassette.

◆━◆━◆ USING THE EXERCISER PROGRAM ◆━◆━◆

The short exerciser program which is loaded on the tape cassette provided with the 11282A Plotter Interface will give some brief examples of plotter output. The exerciser can be loaded from files #6, #16, or #26. After connecting the interface and loading the binary program, use the plotter controls to position the pen close to the right-hand edge of the plotter drum (or to the lower left-hand corner on flat-bed plotters). Make sure that the pen is working correctly and that plotter paper is in place.

1. Press: ⌈LOAD⌉ ⌈6⌉ ⌈EXECUTE⌉

2. When the tape stops and the calculator display returns, press: ⌈RUN⌉ ⌈EXECUTE⌉

3. If you wish to have a program listing after the plotter stops, press: ⌈LIST⌉ ⌈EXECUTE⌉

4. Press: ⌈REWIND⌉

   and remove the cassette.

Figure 1-1. Exerciser Program
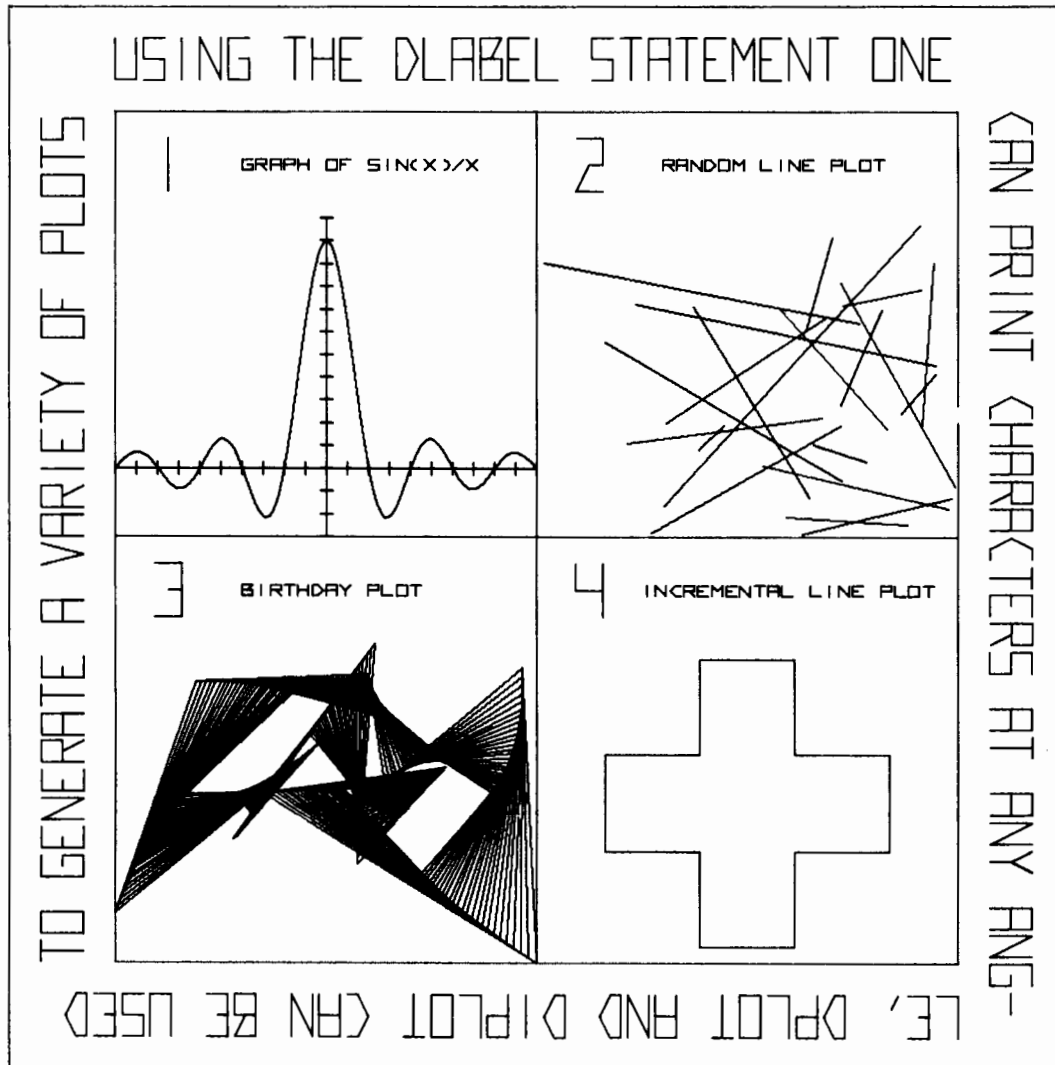
◆ CHANGING THE PLOTTER AXES DIRECTIONS ◆

The horizontal and vertical axes on the plotter are defined (i.e., polarity and axis rotation) by the position of four wires in the plotter end connector.

The examples below show some of the various wiring configurations and the resulting axes. Note that when using drum plotters, pins 1 and 2 define the vertical axis, and pins 3 and 4 define the horizontal axis.

Only one wiring configuration is shown for flat bed plotters, since the resulting axes should be universally applicable.

```
                        CAUTION
      REMOVE PLOTTER POWER BEFORE CONNECTING OR DIS-
      CONNECTING THE INTERFACE.
```

DRUM PLOTTERS

STANDARD WIRING
+X,Yel ---PIN 2
-X,Orn ---PIN 1
+Y,Brn ---PIN 3
-Y,Red ---PIN 4
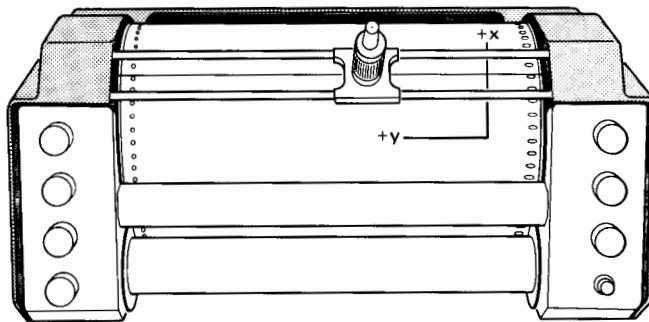
+X,Yel ---PIN 4
-X,Orn ---PIN 3
+Y,Brn ---PIN 2
-Y,Red ---PIN 1
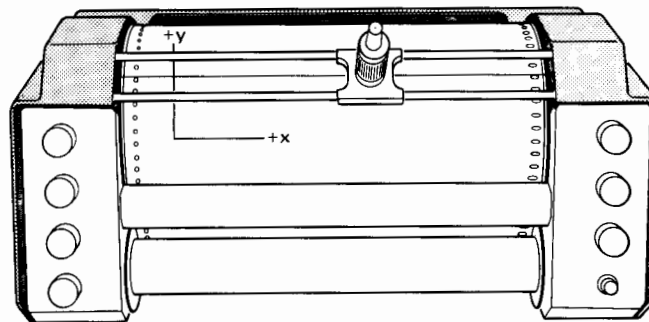
+X,Yel ---PIN 2
-X,Orn ---PIN 1
+Y,Brn ---PIN 4
-Y,Red ---PIN 3
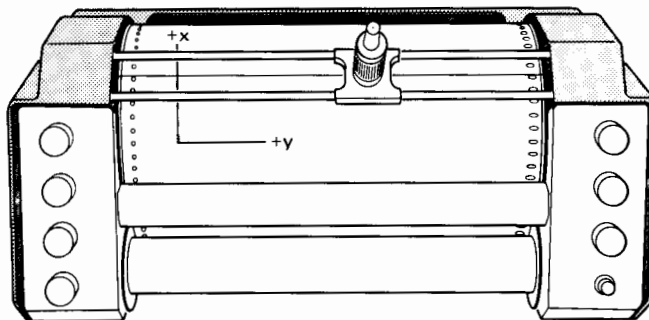
+X,Yel ---PIN 3
-X,Orn ---PIN 4
+Y,Brn ---PIN 2
-Y,Red ---PIN 1
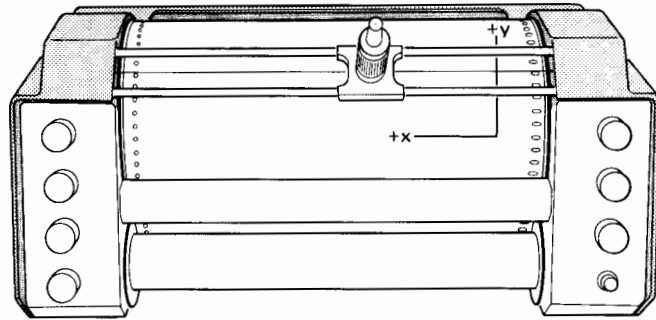
FLAT BED PLOTTER

STANDARD WIRING
+Y,Yel ---PIN 2
-X,Orn ---PIN 1
+Y,Brn ---PIN 3
-Y,Red ---PIN 4
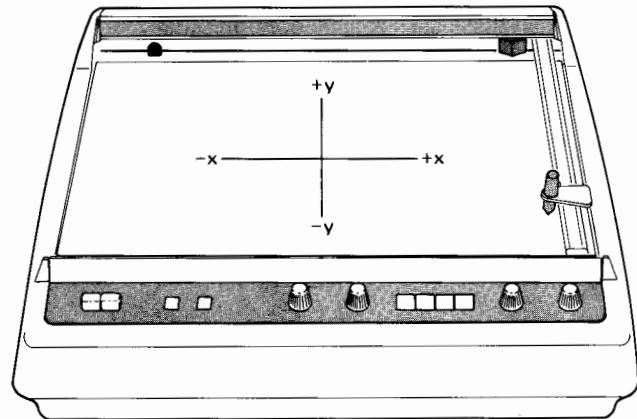
To change the pin connections:

1. Unscrew the clamp screws which secure the plotter end connector to the interface cable.

2. Remove the four screws which hold the connector together and separate the two halves of the connector.

3. Rotate the connector so that the numbers next to the pins are readable.

4. Check the color-coded wires to determine which should be changed; do not change any of the white ground wires.

5. Unsolder and disconnect the wires that are to be moved. Resolder each to the numbered pin desired.

6. Reconnect the two parts of the connector and reclamp the connector to the interface cable.

NOTES

Chapter 2

USING THE PLOTTER INTERFACE

This chapter contains the information necessary to program the 9830A Calculator for plotting through the 11282A Incremental Plotter Interface.

It is assumed that the user is familiar with the 9830A Calculator and BASIC programming.

All of the plotter statements can be executed in the "calculator mode" (directly from the keyboard) or in the "programming mode" (from a BASIC program).

NOTE

In the plotter statements and commands explained in the following pages, square brackets [] are used to show that certain specifications and punctuation marks are optional. All specifications which are not enclosed within brackets must be included or an error message will result.

◆◆◆◆◆◆ USER UNITS ◆◆◆◆◆◆

User units are the quantities of measure which are used to create and interpret a plot.

User units have no general correlation with plotter step size. They are specified by the user as appropriate to the output of each plot. Any specific meaning or value of a user unit is likewise established by the user as appropriate to each plot.

User units may represent inches, feet, miles, hours, etc. Thus, in a graph comparing production with man-hours, one user unit on the X-axis may well represent 10 man-hours, and one user unit on the Y-axis might represent $100 worth of material produced.

Specifically, to plot the point (10,20) the pen is moved to a point 10 user units from the origin in the X-direction and 20 user units from the origin in the Y-direction.

The physical size of a user unit on the plot is determined by the **DSCALE** statement, discussed next.

◆◆◆◆ DSCALE STATEMENT ◆◆◆◆

DSCALE X_{min},Xmax,Y_{min},Y_{max},DX,DY

sets the relationship between user units and inches, and establishes the present pen position as (X_{min},Y_{min})

a) X_{min},X_{max},Y_{min},Y_{max} are the minimum and maximum values, in user units, which should correspond to the anticipated X & Y limits of the plot.

b) DX specifies the distance in inches that X_{min} to X_{max} will be allotted on the plotter paper, thus establishing a physical length corresponding to a user unit in the X-direction.

c) DY specifies the distance in inches that Y_{min} to Y_{max} will be allotted on the plotter paper, thus establishing a physical length corresponding to a user unit in the Y-direction.

A DSCALE statement must be included before any "plotting" statements. Only DSCODE and DPEN, explained next, can precede the DSCALE statement. DSCALE statements can also be placed further within the program so that succeeding plotter output is appropriately "re-DSCALEd."

While points may be plotted accurately beyond the "limits" set by DSCALE, they must not extend beyond the limits of the plotter paper or errors will result. If this occurs, the DSCALE statement should be changed and the program rerun.

Example:

DSCALE -10,10,0,5,8,10

Sets a scale from -10 to 10 in the X-direction and from 0 to 5 in the Y-direction over a distance of 8 inches in the X-direction and 10 inches in the Y direction; i.e.: one user unit in the X-direction is 8"÷ 20 or .4" long, one user unit in the Y-direction is 10"÷ 5 or 2" long.

◆◆◆◆ DSCODE STATEMENT ◆◆◆◆

DSCODE C

specifies that the plotter interface has been set to respond to select code C.

DSCODE is necessary only if the factory-set select code of 14 is changed.

C may be a number, expression or variable, but the result must be a number from 1 through 9.

C will be rounded to the nearest integer, if necessary, and its positive value used. C must match the select code setting within the interface card.

Example:

DSCODE 8

indicates that the select code switch within the interface card has been changed to select code 8.

◆━◆━◆━◆━◆ DPEN STATEMENT ◆━◆━◆━◆

DPEN P

raises or lowers the pen before the next plot.

a) **P** may be a positive or negative number, expression or variable within the range ±32767. It will be rounded to the nearest integer. The only factor for pen control is whether **P** is even or odd.

b) If **P** is even, the pen is lowered.

c) If **P** is odd, the pen is raised.

Examples:

DPEN 1 raises the pen
DPEN -42 lowers the pen
DPEN 876.8 raises the pen (rounded to 877)

◆━◆━◆━◆━◆ DXAXIS STATEMENT ◆━◆━◆━◆

DXAXIS Y-offset[,Tic,1st[,Start point,End point]]

plots the X-axis according to the following specifications:

a) **Y-offset** is the Y value at the axis intersection. This is the only parameter which must be included in the **DXAXIS** statement.

b) **Tic** is the number of user units between tic marks, thus its value must be either a positive number or zero. A **Tic** value of 0 gives no tic marks.

c) **1st** is the distance between the beginning of the X-axis, as it is drawn, and the first tic mark. **1st** must be ≥0. The axis is drawn from its least value to its greatest value.

d) **Start point** and **End point** may be included to specify the first and last points, in user units, through which the axis is to be drawn. **Start point** must be less than **End point**. If no **Start point** and **End point** values are included, the axis will be drawn to the "limits" set by the **DSCALE** statement.

e) The pen will lift before and after drawing each axis.

Example:

DXAXIS 0,0.5,0,-10,10
plots an X-axis which intersects the Y-axis at Y = 0 (the origin), has tic marks .5 user units apart, which are made from the beginning as the axis is drawn. The axis will extend from -10 to +10.

◆◆◆◆ DYAXIS STATEMENT ◆◆◆◆

DYAXIS X-offset[,Tic,1st[,Start point,End point]]
> plots the Y-axis according to parameters which correspond to those of the DXAXIS statement.

NOTE
The X&Y directions on the plotter may be transposed by changing four connections within the plotter end connector, as described in Chapter 1.

Example:

DYAXIS 2
plots a Y-axis which intersects the X-axis at X = 2. There will be no tic marks. The axis will extend to the limits set by the **DSCALE** statement.

◆◆◆◆ DOFFST STATEMENT ◆◆◆◆

DOFFST X,Y
> moves the origin by the amounts specified for X and Y.

This statement resets the origin completely and any previous origin is eliminated from the memory. **DOFFST** does not move the pen or affect its up or down position, it simply translates the origin to a new position and interprets the present pen position in relation to the new origin.

Example:

DOFFST 2,-3
moves the origin to the point (2,-3), establishing that point as (0,0).

◆◆◆◆ DPLOT STATEMENT ◆◆◆◆

DPLOT X,Y[,Control pen]
> moves the plotter pen to the point (X,Y) as the **Control pen** parameter raises or lowers the pen.

When no **Control pen** parameter is included:

- if the pen is up, it will stay up while moving to the point specified and then lower, marking a point at (X,Y).

● if the pen is down, it will stay down while moving to the point specified, drawing a straight line on the paper from its previous position to (X,Y).

Control pen may be a number, or an expression or variable representing a number, within the range ±32767. The **Control pen** value will be rounded to the nearest integer if necessary.

The **Control Pen** value has five means of control:

EVEN -- lowers the pen
ODD -- raises the pen
POSITIVE -- control occurs before movement
NEGATIVE -- control occurs after movement
ZERO -- leaves pen unchanged

Examples:

DPLOT 4,6,-1
moves the pen to the point (4,6) then raises the pen.

DPLOT-2,-4,0
moves the pen to the point (-2,-4) without affecting pen control.

DIPLOT STATEMENT

DIPLOT X,Y[,Control pen]
an incremental plot command which plots a point X user units from the present X position and Y user units from the present Y position.

Control pen is an optional control used in the same manner as in **DPLOT**.

DIPLOT does not plot with respect to the origin (0,0), but only with respect to the previously plotted point, as determined by a **DPLOT, DIPLOT, DLABEL, DXAXIS**, or **DYAXIS** statement.

DIPLOT is not affected by a **DOFFST** command. Changes in **DSCALE** will only affect **DIPLOT** if the size of a user unit is redefined.

Examples:

DIPLOT -2,1,2
lowers the pen, then moves the pen 2 user units in the -X direction, and 1 user unit in the +Y direction.

DIPLOT 3,0
moves the pen 3 user units in the +X direction without affecting pen control.

◆━◆━◆━◆━ DLABEL STATEMENT ━◆━◆━◆━◆

DLABEL (line number or *[,CW,CH,Θ])[List]
>   draws alphanumeric characters according to the following specifications:

a) The first specification must be either the line number of a FORMAT statement or an asterisk (*) if no FORMAT statement is to be referenced. This is the only specification which must be included in a **DLABEL** command.

b) **CW** & **CH** determine the width and height of the characters in user units. In setting the **CW** & **CH** values, remember that a user unit in the X-direction may be a different actual length than a user unit in the Y-direction (see **DSCALE** statement).

c) Θ specifies the angle along which the characters are drawn. A Θ value of 0 results in characters drawn parallel to the X-axis. Positive angles are measured counterclockwise from Θ = 0. The user may specify whether Θ is expressed in degrees, radians or grads with a prior DEG, RAD or GRAD statement. The default unit in the 9830A is radians.

NOTE

The values for **CW,CH** and Θ will be stored in the 9830A memory until new values are substituted in another **DLABEL** statement or the memory is scratched.

---

d) **List** contains the characters which are to be drawn. These may be variables, expressions, characters enclosed within quotation marks, or "FORMAT B" numbers (see Appendix 1). **List** is an optional addition to the **DLABEL** statement as you may want to include **DLABEL** specifications early in your program, but actually plot characters later.

DLABEL will draw characters from the current pen position. To reposition the pen prior to **DLABEL**ing, use a **DPLOT** or **DIPLOT** statement.

Each character made with the **DLABEL** statement will be drawn the actual size (in user units) that is specified by the **CW** and **CH** values. However, a "character space," 33% larger in both width and height will be allowed for each character drawn. This is to achieve the proper spacing between letters and between lines. See Figure 2-1 .

A carriage return/line feed will be executed after each **DLABEL** command with a **List** unless a semi-colon follows that **List**. The carriage return/line feed repositions the pen to a point one character space below the first character of the current line.

A character counter in the program software is incremented each time a character is drawn. This counter value is used to determine the number of character spaces to go back for the carriage return/line feed. The character counter is set to zero each time a **DLABEL** statement with **CW**, **CH** and Θ is encountered, or if a **DPLOT**, **DIPLOT**, **DOFFST**, **DXAXIS** or **DYAXIS** statement is executed. That is, the first character drawn after any of these statements will establish the beginning of a "new line."
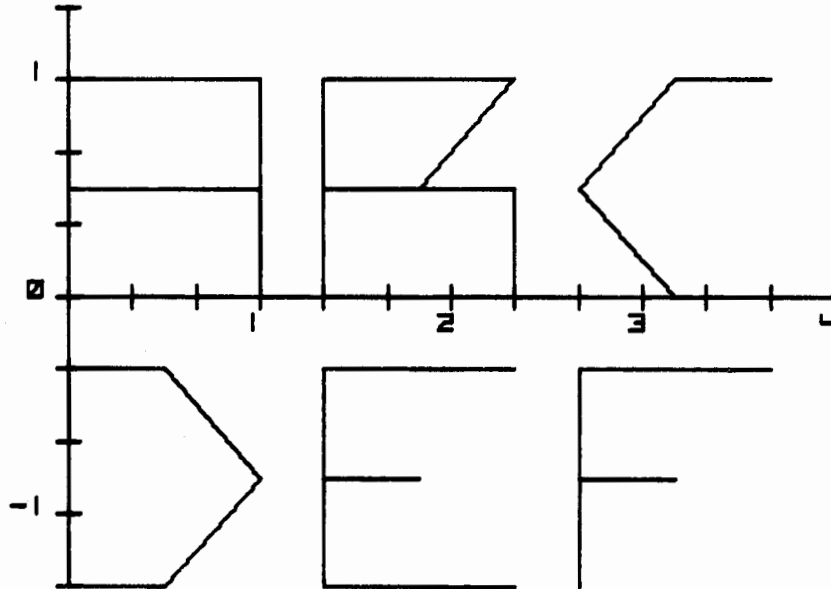
Figure 2-1. The Character Space

Examples:

DLABEL (*,1,1.5,0)
establishes that characters will be drawn 1 user unit wide and 1.5 user units high at an angle of 0. No characters will be drawn.

DLABEL(*) "STAND"
draws the word "stand" according to specifications from the preceding **DLABEL** statement.

DLABEL (10,1,1,0) PI
draws the number equivalent of pi according to the specifications in the FORMAT statement in line 10 of your program, at a character width and height of 1 user unit, and at an angle of 0.

◆◆◆◆ **EXAMPLE PROGRAM 1** ◆◆◆◆

This program illustrates the use of the **DPLOT, DXAXIS** and **DYAXIS** statements to make a simple graph. It plots the graph of Y = (Cos X)/X.

Notice that line 50 is included to prevent division by zero; also that line 60 is used to keep the plotter pen within the limits set by the **DSCALE** statement and thus prevent plotting errors when the value of (Cos X)/X becomes very large or very small.

```
10 DSCALE -3*PI,3*PI,-7,6.8
20 DXAXIS 0,PI,PI/2
30 DYAXIS 0,1,0
40 FOR X=-3*PI TO 3*PI STEP PI/50
50 IF X=0 THEN 80
60 IF ABS(COSX/X) >= 7 THEN 100
70 DPLOT X,COSX/X
80 NEXT X
90 GOTO 120
100 DPEN 1
110 GOTO 80
120 DPEN 1
130 END
```
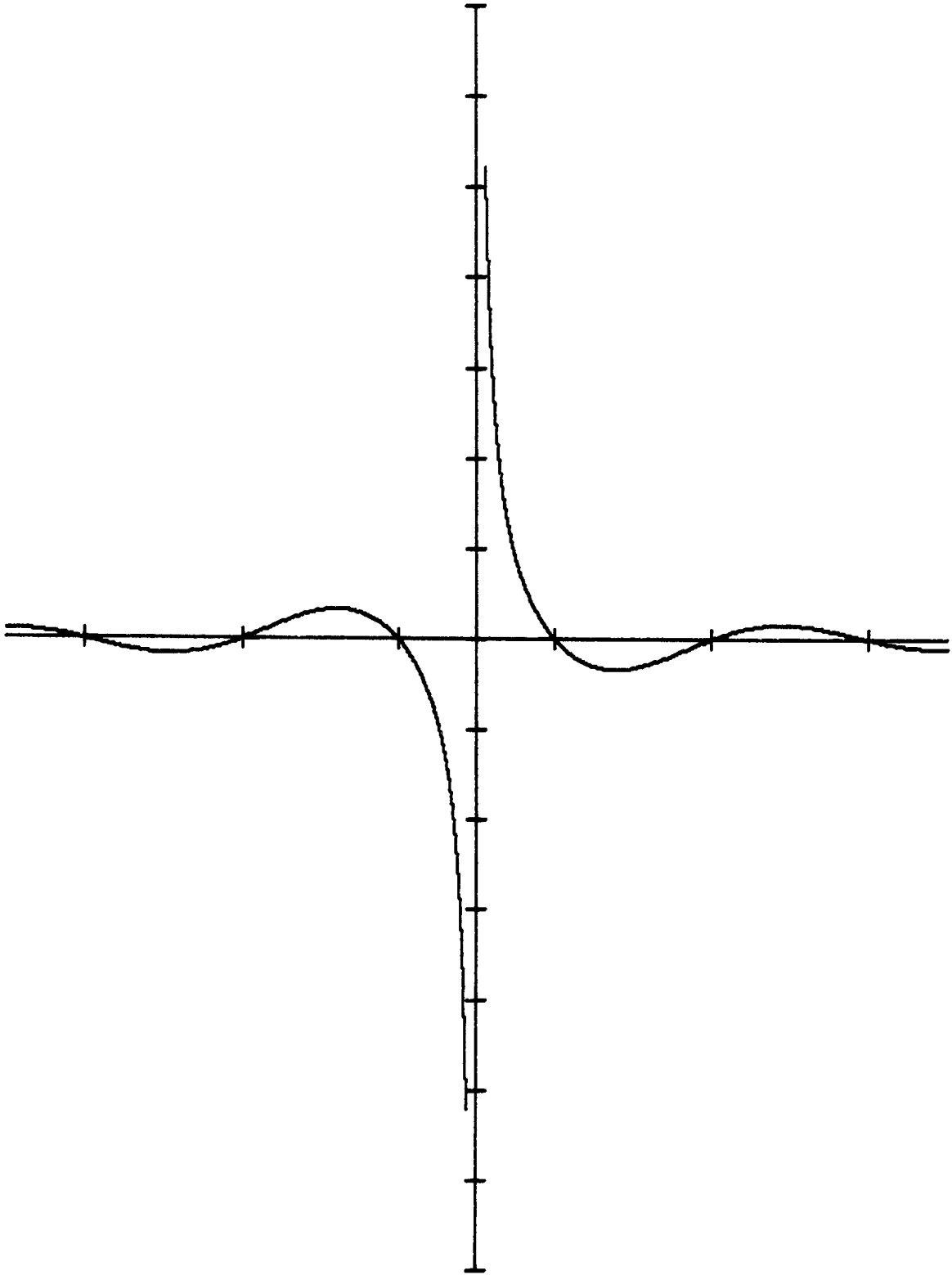
Figure 2-2. Example Program #1

◆◆◆◆ EXAMPLE PROGRAM 2 ◆◆◆◆

This sample program has an interesting output and at the same time illustrates a number of different uses of the plotter statements. Notice the ways that **DXAXIS, DYAXIS, DPLOT, DIPLOT** and **DOFFST** are used.

Lines 30- 60 --	**DXAXIS & DYAXIS** with offset intersect
Lines 340-370 --	**DIPLOT** with pen control
Lines 410-460 --	**DOFFST** with variables. (Since **DOFFST** resets the origin, line 460 is used to counteract line 410.)

```
10 DSCALE -15,15,-15,15,7,7
20 DEG
30 DXAXIS 5
40 DYAXIS 5
50 DXAXIS -5
60 DYAXIS -5
70 DPLOT -10,10
80 GOSUB 340
90 X=0
100 Y=10
110 GOSUB 400
120 X=10
130 Y=10
140 GOSUB 400
150 X=-10
160 Y=0
170 GOSUB 400
180 DPLOT 0,0
190 GOSUB 340
200 X=10
210 Y=0
220 GOSUB 400
230 DPLOT -10,-10
240 GOSUB 340
250 X=0
260 Y=-10
270 GOSUB 400
280 DPLOT 10,-10
290 GOSUB 340
300 DPEN 1
310 DPLOT -14,14,-2
320 DPLOT 14,-14,-1
330 STOP
340 DIPLOT -1.5,2,-2
350 DIPLOT 3,-4,-1
360 DIPLOT 0,4,-2
370 DIPLOT -3,-4,-1
380 RETURN
390 STOP
```

```
400 DPEN 1
410 DOFFST X,Y
420 FOR I=0 TO 360 STEP 20
430 DPLOT 3*COSI,3*SINI
440 NEXT I
450 DPEN 1
460 DOFFST -X,-Y
470 RETURN
480 DPLOT -7.5,7.5,-2
490 DPLOT 7.5,-7.5,-1
500 END
```
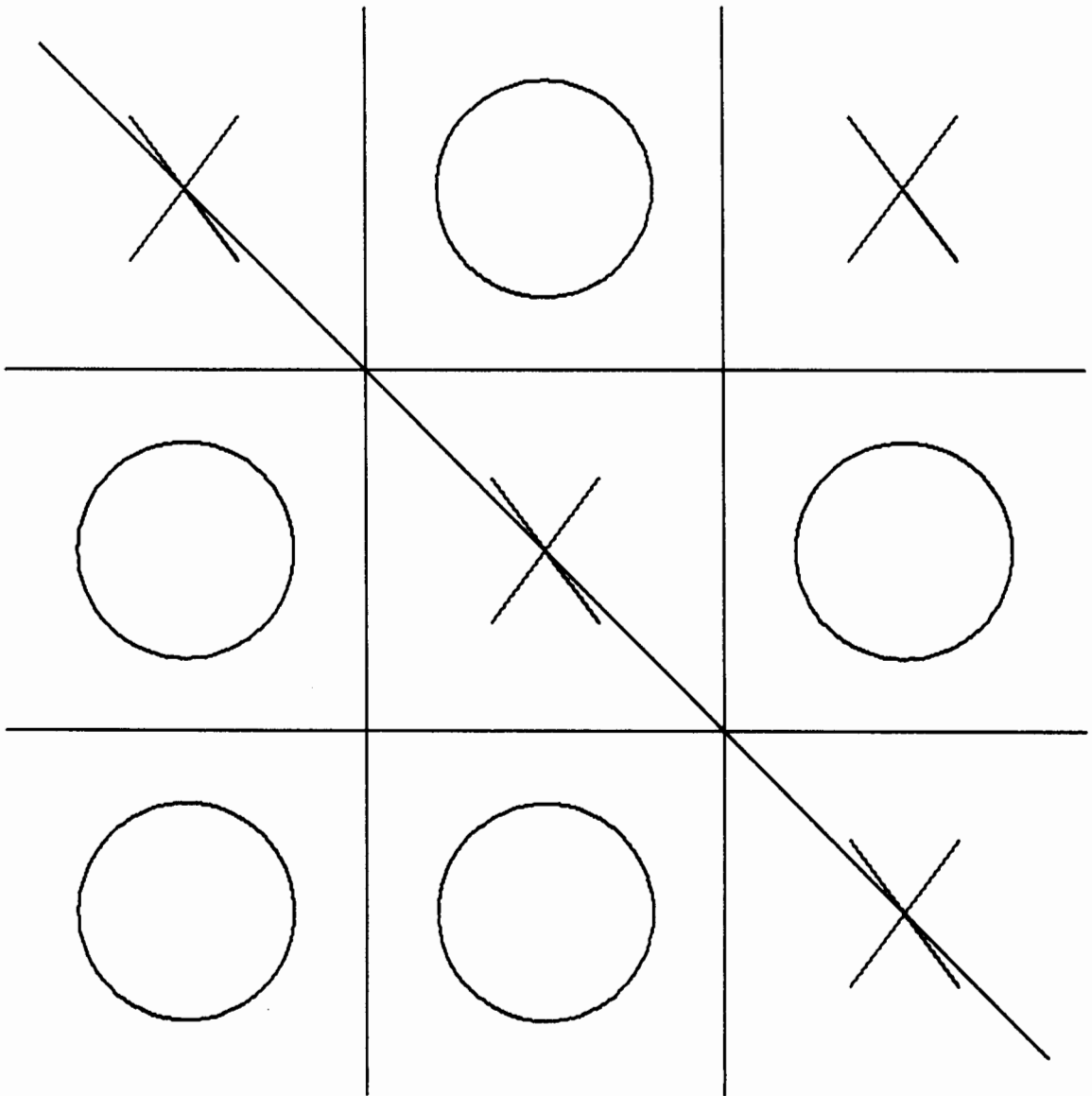

Figure 2-3. Example Program #2

◆◆◆◆ **EXAMPLE PROGRAM 3** ◆◆◆◆

This program illustrates how to label axes and how to title your graph.

The only tic marks have been placed at the end of the axes and at the origin so that they may serve to give emphasis to the coordinates' values which are drawn. Note that these plotted values are offset a bit from the actual end of the axes so that the numbers may be read more easily (lines 60-130).

```
10 DSCALE -12,12,-12,12,8,8
20 DEG
30 DXAXIS 0,7,0,-7,7
40 DYAXIS 0,7,0,-7,7
50 DLABEL (*,0.2,0.23,0)
60 DPLOT 0,7.5,1
70 DLABEL (*)"0,7";
80 DPLOT 7,0.5,1
90 DLABEL (*)"7,0";
100 DPLOT 0,-7.5,1
110 DLABEL (*)"0,-7";
120 DPLOT -7,0.5,1
130 DLABEL (*)"-7,0";
140 FOR I=0 TO 180 STEP 1
150 A=7
160 B=9
170 DPLOT SINI*(A*COS(B*I)),COSI*(A*COS(B*I))
180 NEXT I
190 DPEN 1
200 DPLOT -12,11,1
210 DLABEL (*,0.3,0.5,0)"PLOT OF"
220 DLABEL (*)"SINX*(A*COS(B*X)),COSX*(A*COS(B*X))"
230 DLABEL (*)"WHERE A=7 AND B=9";
240 DPEN 1
250 END
```

PLOT OF
SINX*(A*COS(B*X))/COSX*(A*COS(B*X))
WHERE A=7 AND B=9

Figure 2-4. Example Program #3

◆◆◆◆◆ **DLABEL SAMPLER** ◆◆◆◆◆

This program illustrates many of the ways that you can use the **DLABEL** statement. Check over the program coding to see:
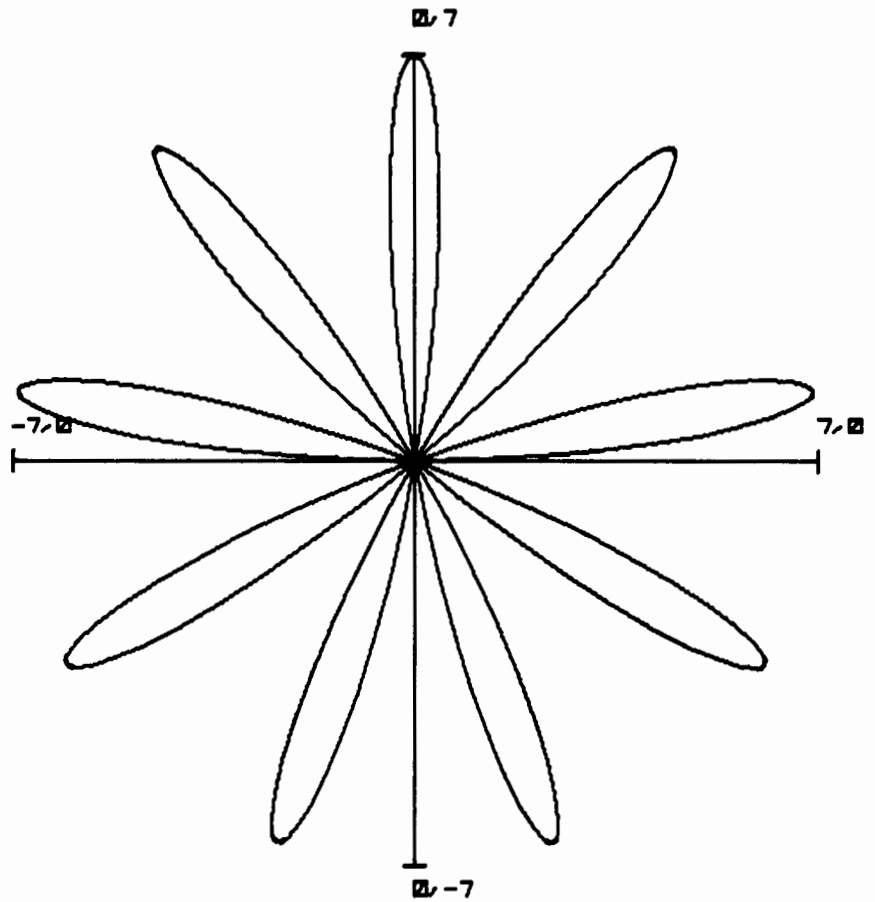
Lines 270-340 --	**DLABEL** with the characters drawn at an angle.
Lines 360,410, 440 --	Positioning the first character with **DPLOT**.
Lines 370-390 --	**DLABEL** with and without carriage return/line feed; carryover of optional **DLABEL** specifications.
Lines 420-450 --	Changes in **DLABEL CW & CH** specifications.
Lines 490-560 --	**DLABEL** with a FORMAT statement; "FORMAT B" to produce characters; **DLABEL** with variables and angles.

```
10 DSCALE 0,20,-20,0,7,7
20 DEG
30 DPEN 1
40 DPLOT -1.5,1.5,-2
50 DPLOT 21.5,1.5
60 DPLOT 21.5,-21.5
70 DPLOT -1.5,-21.5
80 DPLOT -1.5,1.5,-1
90 DPLOT 0,0,-2
100 FOR X=1 TO 19 STEP 2
110 DPLOT X,-1
120 DPLOT X+1,0
130 NEXT X
140 FOR Y=-1 TO -19 STEP -2
150 DPLOT 19,Y
160 DPLOT 20,Y-1
170 NEXT Y
180 FOR X=19 TO 0 STEP -2
190 DPLOT X,-19
200 DPLOT X-1,-20
210 NEXT X
220 FOR Y=-19 TO -1 STEP 2
230 DPLOT 1,Y
240 DPLOT 0,Y+1
250 NEXT Y
260 DPEN 1
270 DPLOT -0.2,-1.8,1
280 DLABEL (*,0.9,0.9,45)"H P";
290 DPLOT 18,0,2,1
300 DLABEL (*,0.9,0.9,-45)"H P";
310 DPLOT 20.3,-18,2,1
320 DLABEL (*,0.9,0.9,-135)"H P";
330 DPLOT 2,-20,2,1
340 DLABEL (*,0.9,0.9,135)"H P";
350 DPEN 1
360 DPLOT 1.5,-3,-2
370 DLABEL (*,1,1,0)"ABCDEFGHIJKLM"
```

```
380 DLABEL (*)"NOPQRSTUVWXYZ"
390 DLABEL (*)"01234567890!?";
400 DPEN 1
410 DPLOT 2.5,-7.5,-2
420 DLABEL (*,2,1,0)"A B C";
430 DPEN 1
440 DPLOT 1.5,-10,-2
450 DLABEL (*,1,2,0)"A B C D E F G";
460 DPEN 1
470 DOFFST 10,-14.5
480 DPLOT 0,0,0
490 M=64
500 FOR I=0 TO 340 STEP 20
510 M=M+1
520 DPLOT 0,0
530 DLABEL (560,0.6,0.6,I)"     "M;
540 NEXT I
550 DPEN 1
560 FORMAT B
570 END
```
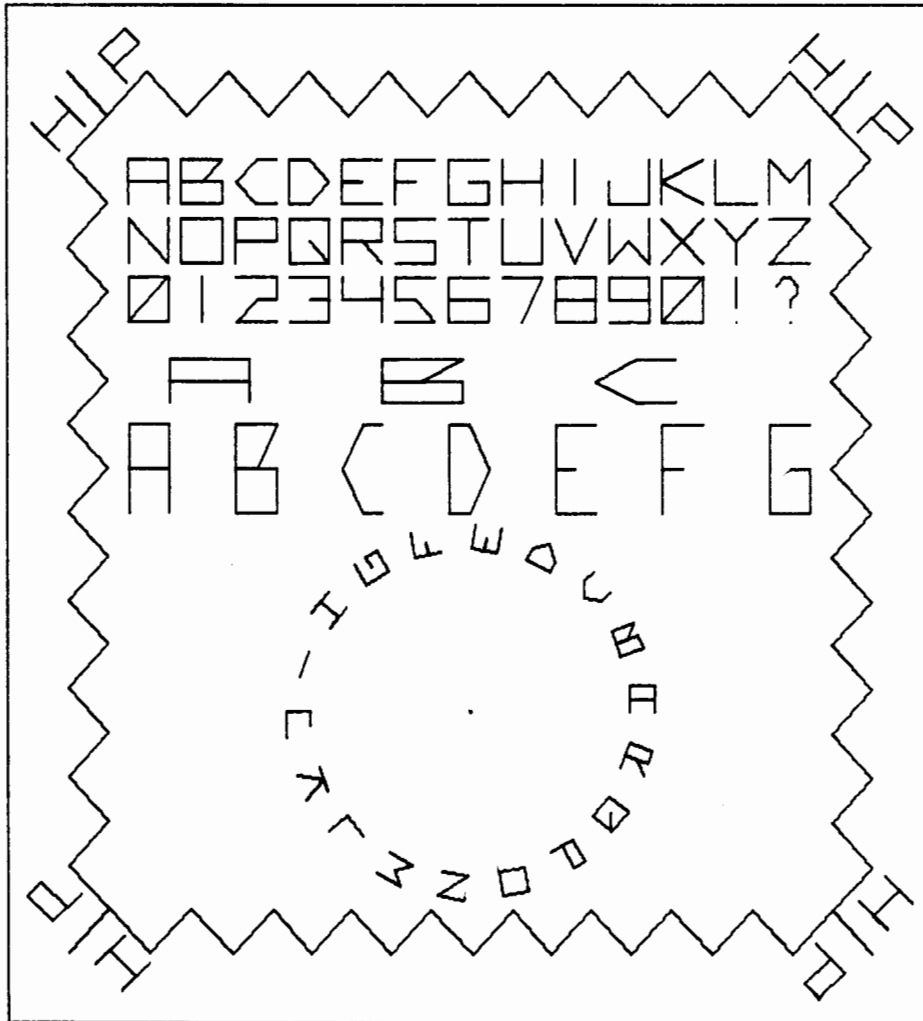

Figure 2-5. DLABEL Sampler

◆◆◆◆◆◆ **FORMAT B** ◆◆◆◆◆◆

The following program and resultant plot illustrate the characters available with the use of Format B. With this Format coding you may use the **DLABEL** statement to draw a number of otherwise unobtainable characters, such as square brackets and quotation marks. Notice the use of Format B in the **DLABEL** Sampler.

```
10 DSCALE 0,70,0,100,6,9
20 X=0
30 Y=90
40 DPLOT X,Y,1
50 FOR J=32 TO 104 STEP 24
60 X=X+14
70 DPLOT X,Y,1
80 FOR K=J TO J+23
90 DLABEL (120,0,8,1,3,0)K,K
100 NEXT K
110 NEXT J
120 FORMAT F4.0,2X,B,/
130 DPEN 1
140 END
```

32	(space)	56	8	80	P	104	H
33	!	57	9	81	Q	105	I
34	"	58	:	82	R	106	J
35	#	59	;	83	S	107	K
36	$	60	<	84	T	108	L
37	%	61	=	85	U	109	M
38	&	62	>	86	V	110	N
39	'	63	?	87	W	111	O
40	(	64	@	88	X	112	P
41	)	65	A	89	Y	113	Q
42	*	66	B	90	Z	114	R
43	+	67	C	91	[	115	S
44	,	68	D	92	\	116	T
45	-	69	E	93	]	117	U
46	.	70	F	94	↑	118	V
47	/	71	G	95	⊢	119	W
48	0	72	H	96	@	120	X
49	1	73	I	97	A	121	Y
50	2	74	J	98	B	122	Z
51	3	75	K	99	C	123	[
52	4	76	L	100	D	124	\
53	5	77	M	101	E	125	]
54	6	78	N	102	F	126	↑
55	7	79	O	103	G	127	⊢

Figure 2-6. Format B

NOTES

Chapter 3

THEORY OF OPERATION

The 11282A Incremental Plotter Interface allows the 9830A Calculator to be used with certain digital incremental plotters. The 11282A processes 6-bit commands from the 9830A to control the plotter functions.
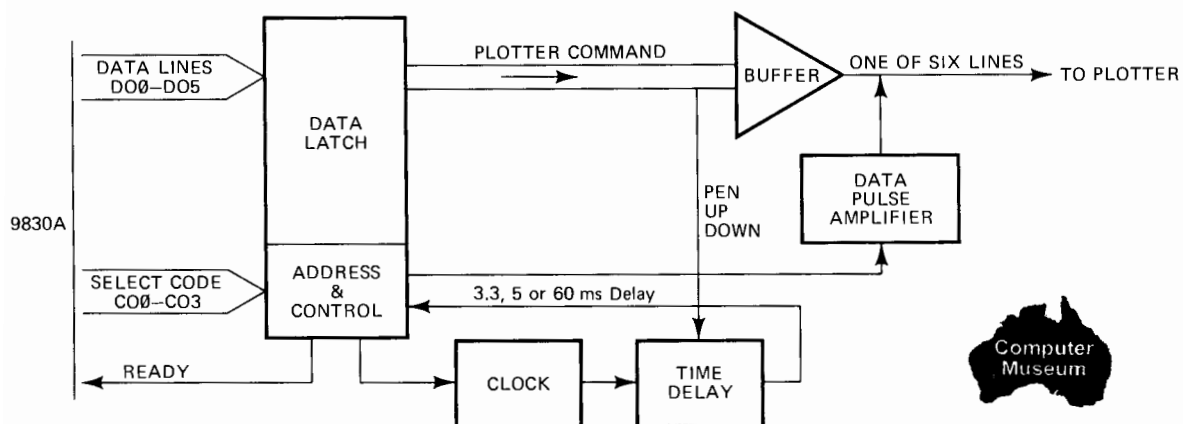

Figure 3-1. 11282A Block Diagram

The interface data latch (refer to Figure 3-1) temporarily stores the 6-bit commands from the 9830A. The delay circuit allows the plotter to respond to each command before a ready signal is sent to the calculator for the next command. Command signals to the plotter are applied for 12 microseconds by the data pulse amplifier.

Three delay times are generated by the interface. A 3.3 ms delay (before the interface indicates ready) allows the plotter to step approximately 300 steps/second. R13 on the 11282-66591 assembly may be moved to increase the delay to 5 ms. This increased delay will allow larger plotters to be operated at a rate of approximately 200 steps/second. If a pen up or pen down command is received, a 60 ms delay is generated to provide time for the pen to respond.

◆◆◆◆ LOGIC DEFINITIONS ◆◆◆◆

Logic levels are nominally ∅ volts or +5 volts; ∅ volts is referred to as the 'low' state and +5 volts is referred to as the 'high' state.

◆◆◆◆◆ DETAILED THEORY ◆◆◆◆◆

The calculator OTA instruction initiates the transfer of the select code and plotter command from the calculator A register to the 11282A interface. When the command (DO0-DO5) and the select code (CO0-CO3) have settled, the negative true 'Device Ready' (CEO) signal is sent from the calculator I/O to U7B to initiate the plotter response (Refer to Figures 4-I and 4-2). The interface responds by latching the command and setting the busy flag. The busy flag sent to the calculator on the SI0 line, indicates to the calculator that the interface is busy.

The busy flag, through U7D also enables the clock and the data pulse amplifier. The data pulse amplifier applies a +12V pulse to the open collectors of U3A-U3F.

The inputs to U3A-U3F have already been set for the plotter command. Those sections of U3 with 0 inputs will have grounded outputs. The U3 outputs not pulled to ground (plotter command) allow the +12V pulse from the data pulse amplifier to be applied to the plotter. The +12V pulse is applied for the first half cycle of the clock ($\approx$12 us). The first negative going edge of the clock sets the data pulse flip-flop, turning off the data pulse amplifier and thus removing the +12V from U3A-U3F. The binary counter (U1) then begins to count the clock, and U2 decodes the count, to provide the correct time delay.

For an operating speed of 300 steps/second (R13 loaded at position 300) U2B will enable at count 128 providing a 3.3 ms delay. For an operating speed of 200 steps/second (R13 loaded at position 200) U2B will enable at count 192 providing a 5 ms delay. For a pen up or pen down command, U7C disables U2B and the counter must count to 2304 before U2C is enabled (60 ms delay). When U2B or U2C are enabled, the latch (U8) is reset and the busy flag is cleared. The cleared busy flag indicates that the plotter is ready to accept the next command.

Chapter 4

TROUBLESHOOTING

This chapter will assist in troubleshooting the 11282-66591 assembly.

◆◆◆◆ ISOLATING THE PROBLEM ◆◆◆◆

When isolating a problem, the calculator diagnostic tests should be run to determine if the calculator is the cause of the problem (refer to the Systems Test Instructions Manual, -hp- Part Number 09830-90032). The 11282A Interface Cable should be replaced with a known good cable to isolate the problem to the interface cable. If the problem is still present after checking the calculator and interface, it can be assumed that the problem is in the plotter. Maintenance of the plotter is to be performed by the plotter manufacturer's representative.

◆◆◆◆ EQUIPMENT REQUIRED ◆◆◆◆

With the exception of the outputs of U3 and the data pulse amplifier, the 11282-66591 assembly may be tested using an -hp- 11252A Logic Probe. The U3 output lines and the data pulse amplifier output should be checked using an oscilloscope. The waveform should match that described on the timing diagram.

◆◆◆◆ LOGIC PROBE CONNECTION ◆◆◆◆

The logic probe requires +5 volts for operation, and should be connected between the + side of C9 and ground.

◆◆◆◆ TROUBLESHOOTING TIPS ◆◆◆◆

If any one of the plotter functions (e.g., +X, pen down) are inoperative, the problem is probably in the associated section of U3 or U8.

If no commands are accepted by the plotter, first ensure that +5V is being supplied to the 11282-66591 assembly; then with the calculator in an idle condition, check the following on the interface card:

1. Check the SI∅ line (busy) for a ∅ signal. If not, trace the signals back to U8 and U9.
2. Check U6B Pin4 (reset) for a 1. If not, check the signals back to the clock counter U1.
3. To check the clock circuit remove connector XA1, and momentarily ground U6 pin 6. Monitor the clock output at U6A pin2. The logic probe light should be dim (pulsing) indicating the clock is operating.

With the exerciser program loaded and operating, check for the following conditions:

1. Pulse bursts at U6 pin2.
2. ∅ pulses (logic probe blinking) at U4 pin8.

If all the above checks are satisfactory, the data pulse amplifier is probably bad, or a timing problem exists in the interface.

◆◆→ 11282A REPLACEABLE PARTS LIST ←◆◆

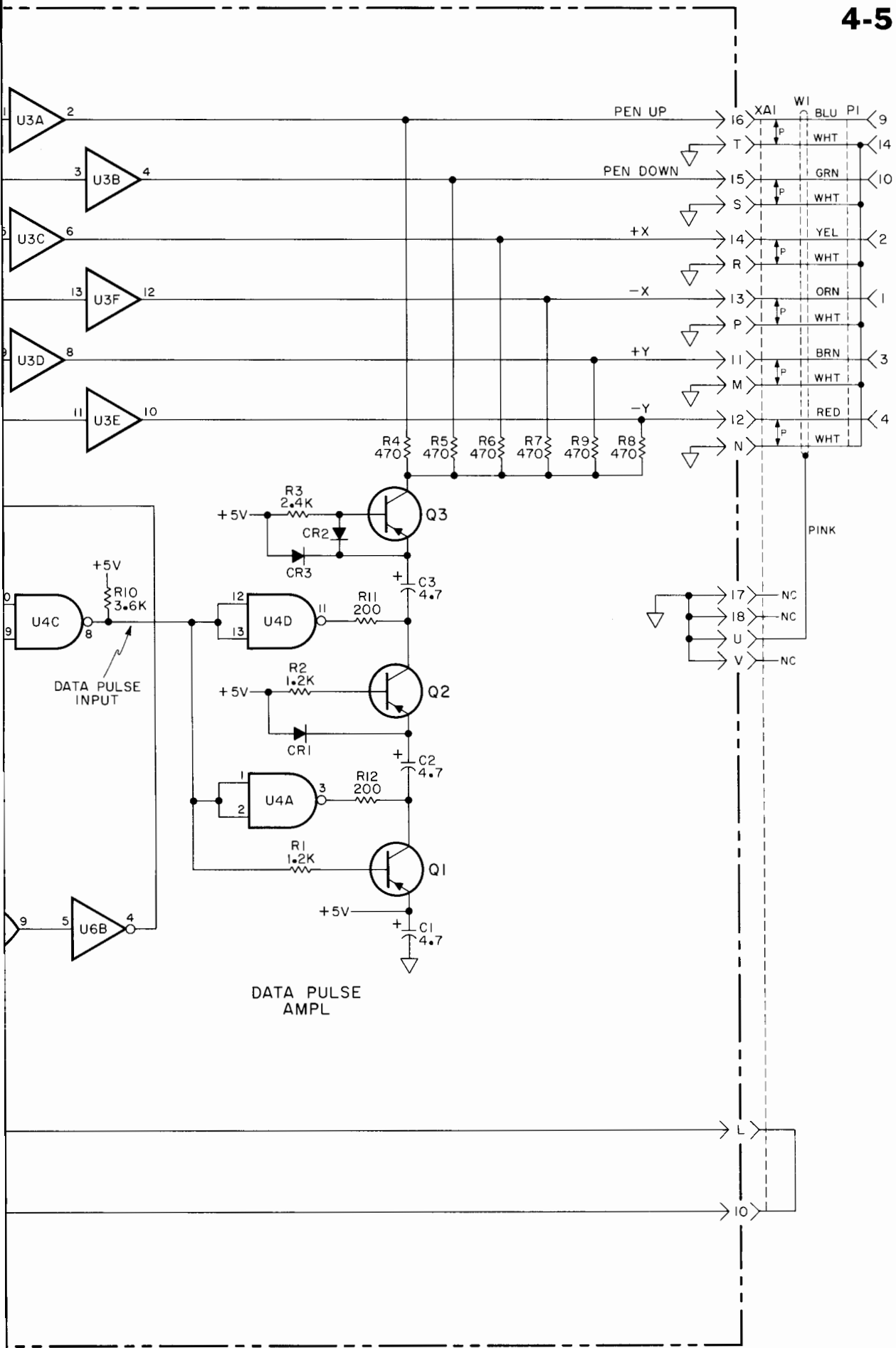| REFERENCE DESIGNATOR	-hp- PART NUMBER	QTY	DESCRIPTION
A1	11282-66591	1	P.C. Assembly, Interface
C6	0140-0220	1	C: fxd 200 PF 330V
C4,C5,C7,C8,C10	0160-3847	5	C: fxd .01 uf 25V
C1-3	0180-0309	3	C: fxd 4.7 uf 10V
C9	0180-1746	1	C: fxd 15 uf 20V
R13	0683-0275	1	R: fxd 2.7 ohm 5%
R1,R2	0683-1225	2	R: fxd 1200 ohm 5%
R11,R12	0683-2015	2	R: fxd 200 ohm 5%
R3	0683-2425	1	R: fxd 2400 ohm 5%
R10,R16-R19	0683-3625	5	R: fxd 3600 ohm 5%
R4-R9	0683-4715	6	R: fxd 470 ohm 5%
R15	0757-0472	1	R: fxd 200K 1%
U4	1820-0269	1	IC: Quad 2-input NAND gate
U7	1820-0584	1	IC: Quad 2-input NOR gate
U8	1820-0614	1	IC: Data Latch
U3	1820-0668	1	IC: Hex Buffer/Driver (open collector)
U9	1820-0702	1	IC: 1 of 16 Decoder
U1	1820-0935	1	IC: 14 Stage Binary Counter
U2	1820-0943	1	IC: 3-3 input NAND gate
U5	1820-0946	1	IC: Quad 2 input NOR gate
U6	1820-0979	1	IC: Hex inverter
Q1-Q3	1853-0093	3	Transistor-Si, PNP
CR1-CR3	1901-0040	3	Diode-Si, .05A 30V
S1	3101-1677	1	Switch, programming, 10 position
	5040-5911	1	Boot, Bottom
	7120-3635	1	Plate, I/O
	11200-04101	1	Cover, I/O
	11282-61601	1	Cable assembly
	11282-90000	2	Operating and Service Manual
	11282-90001	1	Cassette Driver/Exerciser*

*Exchange credit will be allowed for the damaged cassette.

Figure 4-2. 11282A Schematic Diagram

PEN UP — 11

PEN DOWN — 9

+X — 7

−X — 5

+Y — 21

−Y — 23

17

RESET

DATA PULSE
FLIP-FLOP

U5D 13 12 11

U6F 14 15

U5C 9 8 10

U7D 11 12 13 +5V R19 3.6K

U1
CLOCK
COUNTER

CLR 11

Q1 9

SEE NOTE 2

Q7 6 200 R13 2.7

300

Q8 13

Q9 12

Q12 1

+5V R18 3.6K

U7C 9 8 10

U2B 3 4 5 6

U2C 11 12 13 10

U2A 8 1 2

TIME DELAY

CLK 10

16 8
+5V

CLOCK CIRCUIT

+5V 16,1

U5A 1 2 3

U5B 5 6 4

U6A 3 2 8

R14* R20*

R15
200K

C6
200 PF

CALCULATOR I/O CONNECTOR

DO5   10
DO4   8
DO3   6
DO2   4
DO1   20
DO0   22

U8 COMMAND LATCH

$\overline{CEO}$ 21

R16 3.6K   16
+5V

+5V   R17 3.6K

U7B   4   7   U6C   6

2
3
14
15

1
13

24   12
+5V

CO0   23
CO1   22
CO2   21
CO3   20
$\overline{SIH}$ 18
19

U9 DECODER

24   12
+5V

S1

2
3
4
5
6
7
8
9
10
16

1
2
3
4
5
6
7
8
9
0

SELECT CODE SWITCH
SEE NOTE 1

$\overline{SI0}$ R   6   U4B   4   1   U7A   2

5   3   BUSY FLAG

+5V   2

B

+
C9 15
C8 .01
C7 .01
C4 .01
C5 .01
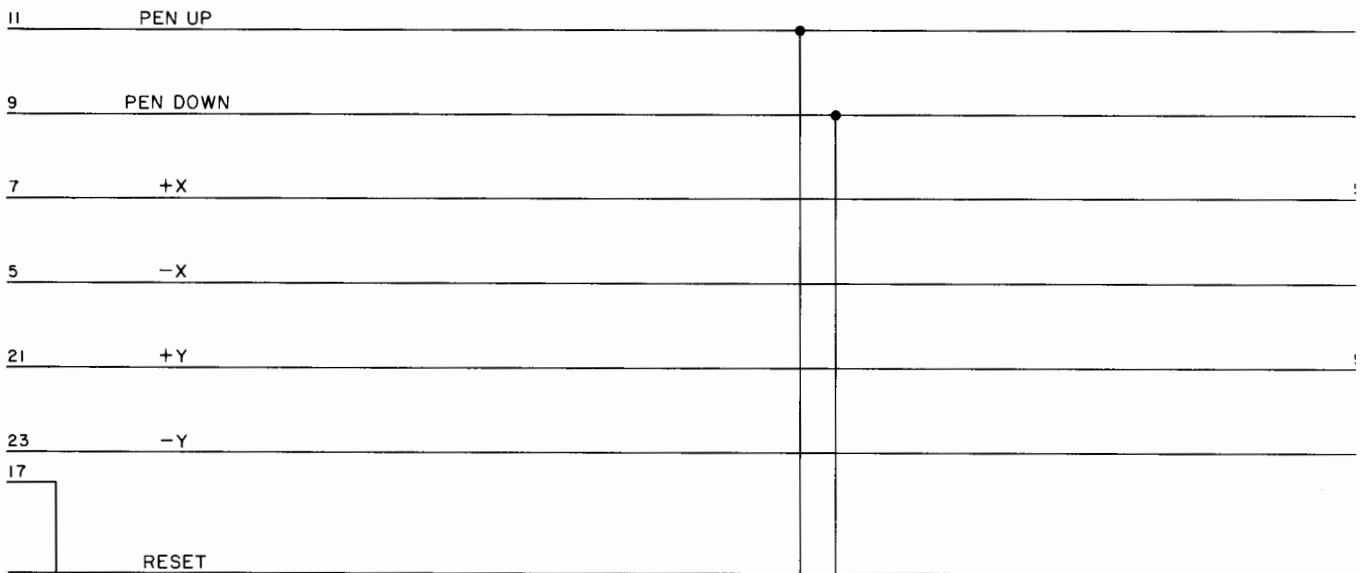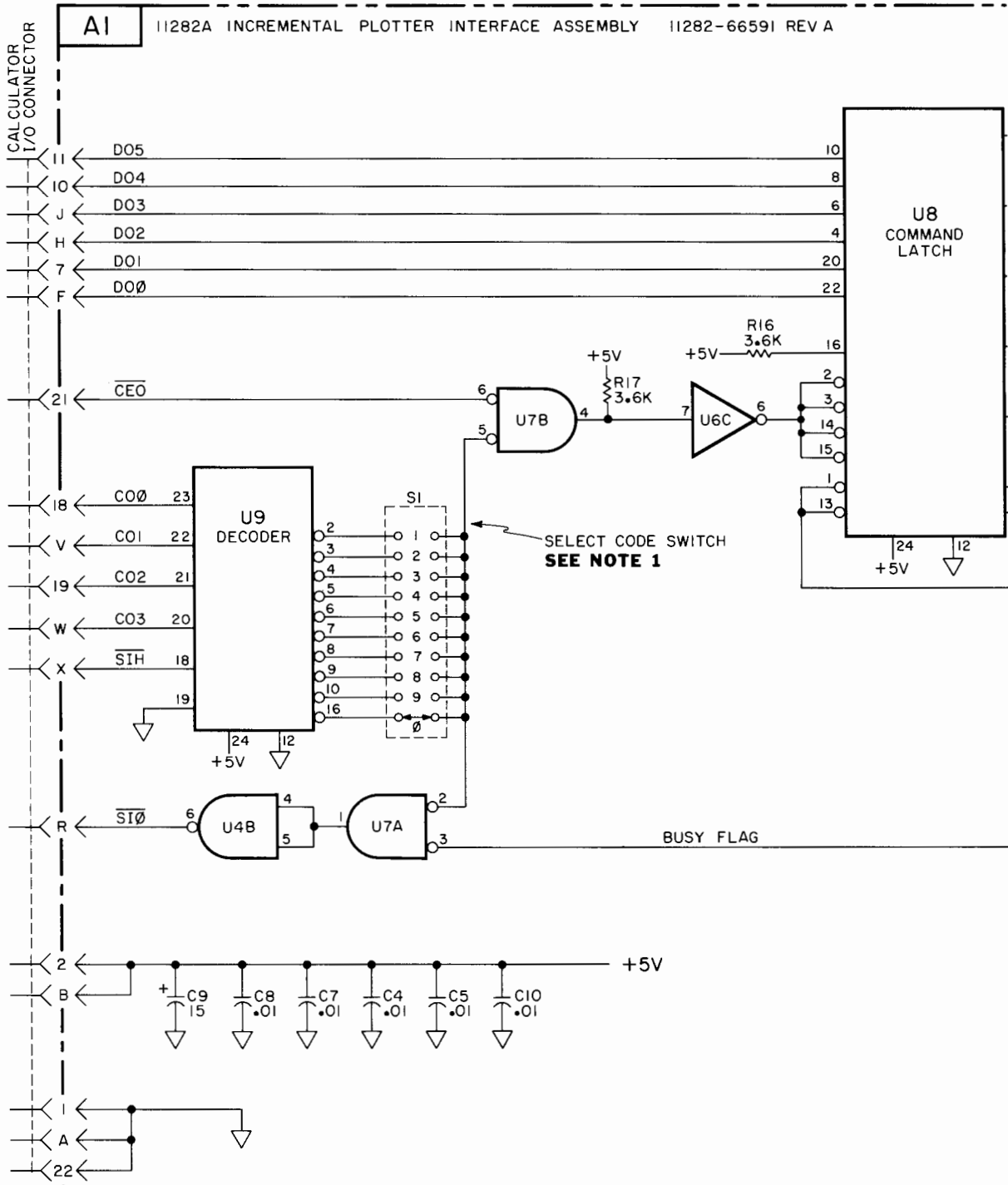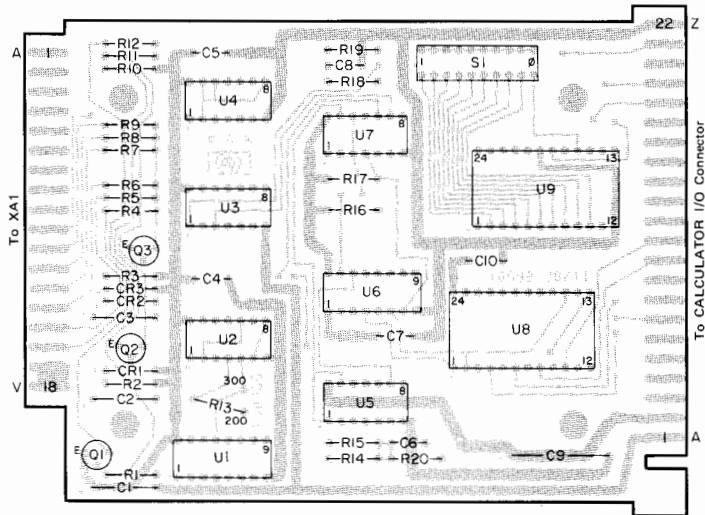C10 .01

1

A

22

NOTE 1   The select code switch is set to select code 14
(position 'O'). See page 1-3 before resetting
this switch.

NOTE 2   R13 shown in the 200 steps/second position.

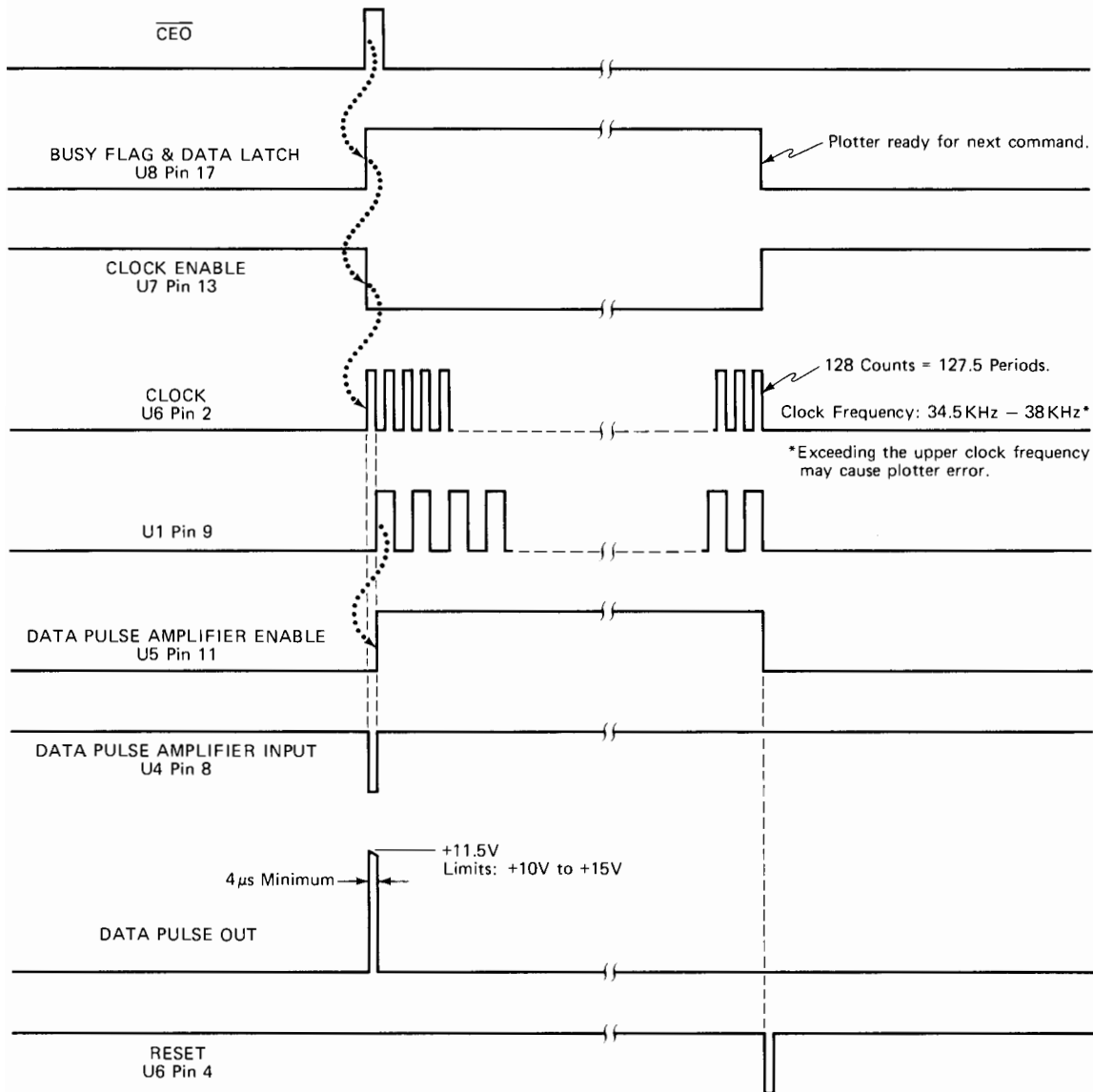11282A-J-50482

COMPONENT SIDE

A1

hp Part No. 11282–66591

$\overline{\text{CEO}}$

BUSY FLAG & DATA LATCH
U8 Pin 17

Plotter ready for next command.

CLOCK ENABLE
U7 Pin 13

CLOCK
U6 Pin 2

128 Counts = 127.5 Periods.

Clock Frequency: 34.5 KHz — 38 KHz*

*Exceeding the upper clock frequency
may cause plotter error.

U1 Pin 9

DATA PULSE AMPLIFIER ENABLE
U5 Pin 11

DATA PULSE AMPLIFIER INPUT
U4 Pin 8

+11.5V
Limits: +10V to +15V

4 µs Minimum

DATA PULSE OUT

RESET
U6 Pin 4

Figure 4-1. Timing Diagram

◆◆◆◆ ERROR MESSAGES ◆◆◆◆

The 11282A Incremental Plotter Interface has three special error messages. Any other error messages are explained in the 9830A Operating and Programming manual.

Code	Message
ERROR 80	Attempt to execute a DXAXIS, DYAXIS, DOFFST, DPLOT or DIPLOT command before executing a DSCALE statement.
ERROR 200	Attempt to execute a DXAXIS or DYAXIS command when the End point value is less than, or equal to, the Start point.
ERROR 201	Attempt to execute a DSCODE statement when the C value is less than 1 or greater than 9. Remember that C will be rounded to the nearest integer.

hp