

TEKTRONIX®

**4956
GRAPHICS
TABLET**

OPERATOR'S MANUAL

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CONTENTS

Section 1	General Information	Page
	Some Words About Terminology	1-1
	Introduction to the Graphics Tablet	1-1
	Graphics Tablet Components	1-2
Section 2	Graphics Tablet Operation	
	Introduction	2-1
	Generation of Coordinates	2-1
	Digitizing Modes	2-1
	Time and Distance Filters	2-2
	Origin and Coordinates	2-2
	Transfer of Coordinates	2-5
	Status Byte	2-5
	Back Panel Switches	2-7
	Input Procedure	2-8
	Example Program	2-9
	Tablet Controller Interrupt	2-9
	Optimizing Data Transfer	2-10
Section 3	Plot 50: Graphics Tablet Support Software	
	Introduction	3-1
	User-Definable Keys and Graphic Functions	3-1
	Internal Data Structure	3-2
	Tape Data Structure	3-4
	Operating Notes	3-6
	Initializing Plot 50: Graphics Tablet Support Software	3-7
	Programs for the Writing Pen (Menu Items 1-5)	3-8
	Pen Display Only	3-8
	Pen Display and Save	3-10
	Pen Save Only	3-14
	Pen Display and Store	3-17
	Pen Store Only	3-19
	Tape Editing Programs (Menu Items 6 and 7)	3-22
	Data Tape Edit	3-22
	Data Tape Merge	3-30

CONTENTS (cont)

	Page
Programs for the Four Button Cursor (Menu Items 8 through 12)	3-35
Cursor Display Only	3-36
Cursor Display and Save	3-38
Cursor Save Only	3-42
Cursor Display and Store	3-44
Cursor Store Only	3-47
 Section 4 Tablet Maintenance	
Biasing the Tablet	4-1
Checking the Tablet and Tablet Controller	4-3
Cleaning the Tablet Surface	4-3
 Section 5 Installation	
Introduction	5-1
Installation Steps	5-1
Setting Coordinate Units	5-3
AC Power Requirements	5-6
AC Power Cord and Grounding Requirements	5-6
Line Voltage Selection	5-7
Fuses	5-7
Repacking Information	5-7
 Section 6 Specifications	
 Appendix A Internal Switch Settings	
 Appendix B Plot 50: Support Software Variables	
 Appendix C Supplemental Programs	
 Appendix D Error Messages	
 Index	
 Change Information	

CONTENTS (cont)

ILLUSTRATIONS

Fig. No.		Page
1-1	Standard 4956 Graphics Tablet	Frontispiece
1-2	Graphics Tablet configuration in 4051 Graphic System	1-2
1-3	Standard Tablet default coordinate plane	1-3
1-4	Tablet Controller Front Panel	1-5
1-5	Tablet Controller Back Panel	1-6
2-1	Different Coordinate Planes	2-3
2-2	Back Panel Switch with factory settings	2-7
3-1	Four Button Cursor	3-35
4-1	Error caused by uneven Tablet bias	4-1
4-2	Biasing the Tablet	4-2
5-1	Tablet connection	5-1
5-2	GPIB cable connection	5-2
5-3	Internal switch locations	5-3

TABLES

Table		Page
2-1A	Normal Status Byte Values	2-6
2-1B	Special Four Button Cursor Status Byte Values	2-6
2-2	Back Panel Switch Bank	2-7
3-1	Graphic Functions Represented in D values	3-4
3-2	Cursor Button and User-Definable Key Functions	3-36
5-1	Range of Digitizing Units	5-4
5-2	4956 Operating Voltages	5-6
6-1	4956 Operating Voltage Specification	6-1

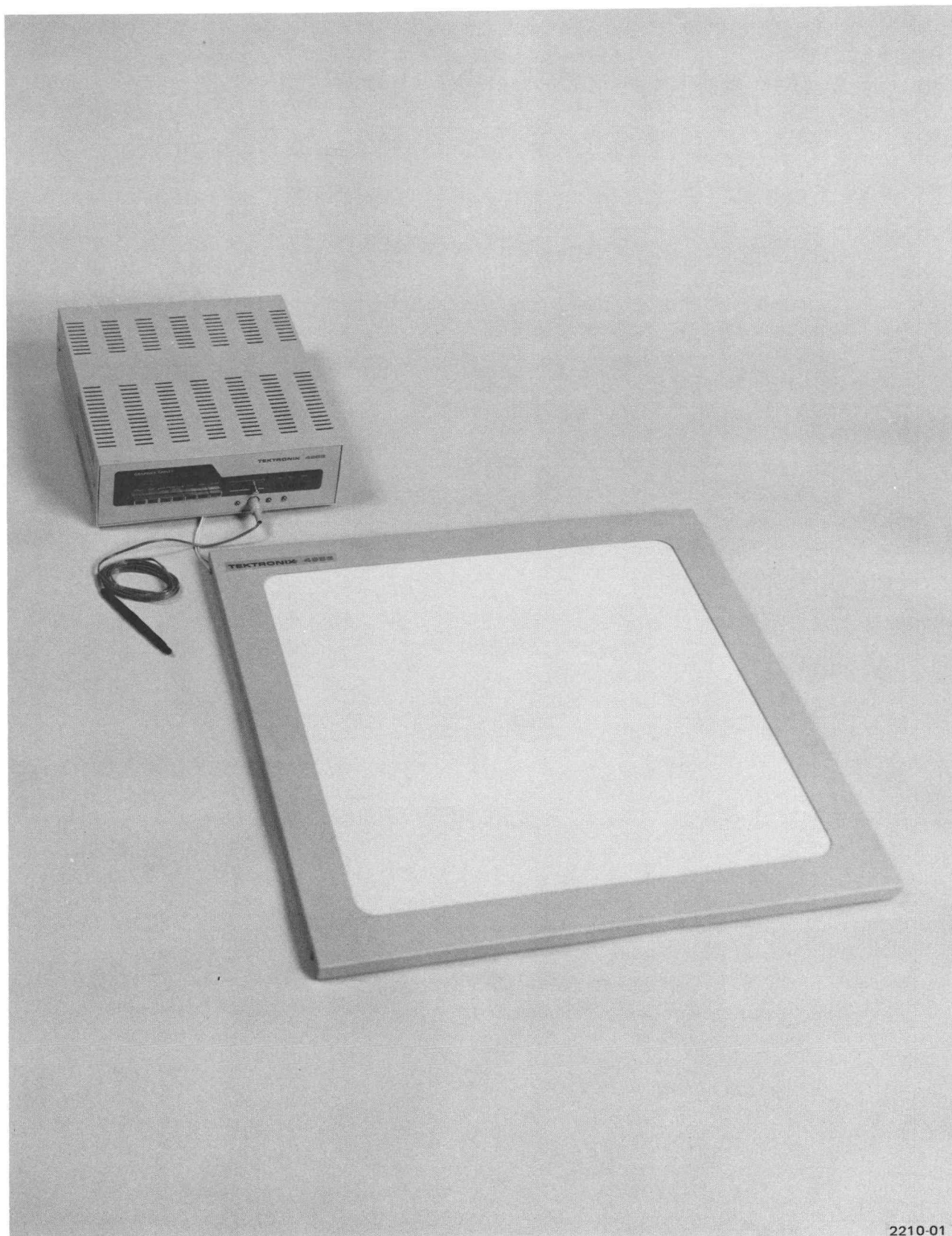


Fig. 1-1. Standard 4956 Graphics Tablet.

Section 1

GENERAL INFORMATION

SOME WORDS ABOUT TERMINOLOGY

The TEKTRONIX 4956 Graphics Tablet is designed to be used with a TEKTRONIX 4050-Series Graphic System. The term Graphics Tablet is used in this manual to refer to the 4956 Graphics Tablet which includes the 20" X 20" Tablet as a standard component, and Option 33 which substitutes a 36" X 48" Tablet. The term Graphic System is used to reference a 4050-Series Graphic System, which includes the 4051 Graphic System.

INTRODUCTION TO THE GRAPHICS TABLET

The Graphics Tablet inputs graphic data on command to the Graphic System through the GPIB interface. By using BASIC instructions, the Graphic System can display or store the graphic data using either existing software or user-designed special purpose programs. The graphic material can be in many forms, such as handwriting, schematics, or freehand design. With the feature of direct graphic input, the Graphics Tablet greatly enhances the graphic capabilities of the Graphic System.

This section describes the three basic components of the Graphics Tablet: the Tablet, the Writing Pen, and the Tablet Controller. Although the Tablet surfaces may vary in size, the operating procedure is the same. The Writing Pen and Tablet are used just like pen and paper. The function of the Tablet Controller is to convert the position of the Writing Pen on the Tablet surface to the corresponding ASCII character coordinate pair. This process is called digitizing. The coordinates and a status byte are sent to the Graphic System when an appropriate INPUT instruction is executed. The operating procedure is explained in Section 2 of this manual.

Section 3 describes the Plot 50: Graphics Tablet Support Software Tape which provides BASIC programs that use Tablet coordinates and status information to display and/or store the graphic data in memory or on magnetic tape. These programs are a convenient way to use the Graphics Tablet. The programs make use of user-definable keys and five special programs are included for use with the optional four-button Cursor. In addition, two programs edit data files created by the software programs.

GRAPHICS TABLET COMPONENTS

The configuration of the Graphics Tablet components in the Graphic System is shown in Fig. 1-2. The following paragraphs describe each component and how coordinates are digitized.

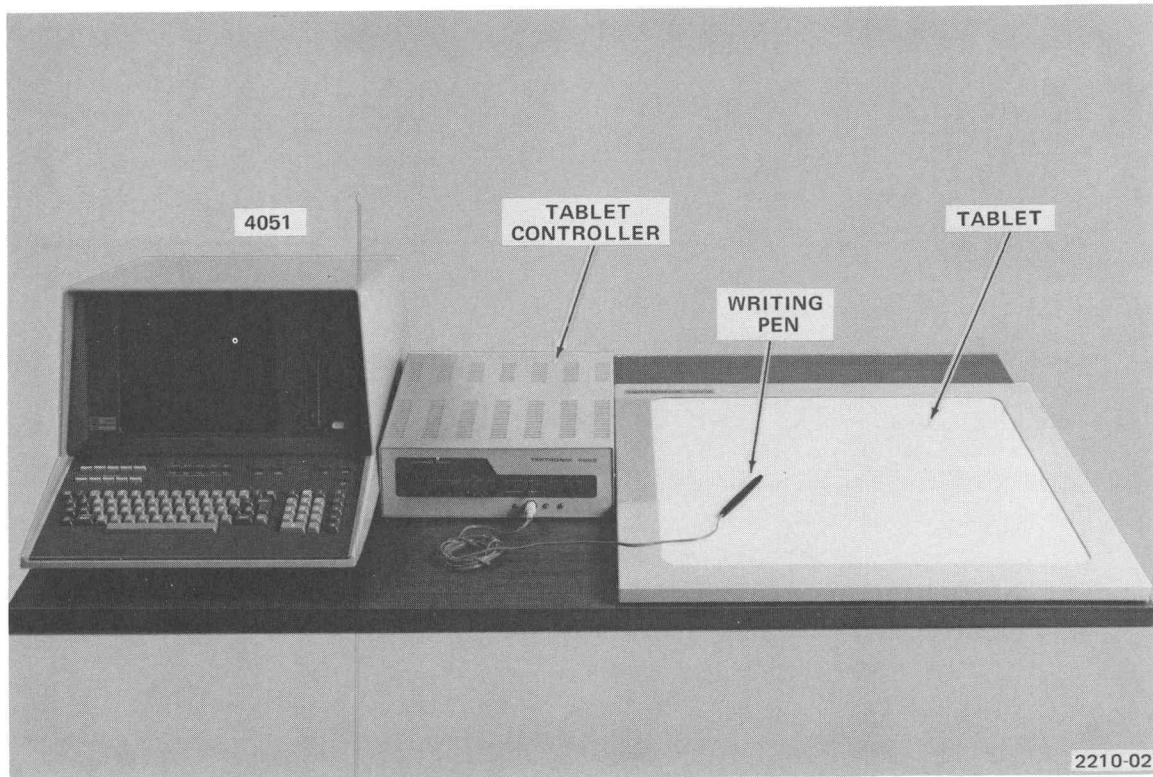


Fig. 1-2. Graphics Tablet configuration in 4051 Graphic System.

TABLET

The Tablet and the Writing Pen are used just like pen and paper. The Tablet has a flat surface on which paper (transparencies, etc.) is placed. The Writing Pen is used to trace or draw on the paper. The position of the Writing Pen on the Tablet surface is digitized and ASCII character coordinates are produced.

The coordinates lie on an X-Y coordinate plane and the values are relative to the origin. By default, the origin is at the lower left corner of the Tablet. X coordinates are measured horizontally from the origin and Y coordinates are measured vertically as shown in Fig. 1-3. Identifiable points are .005" apart.

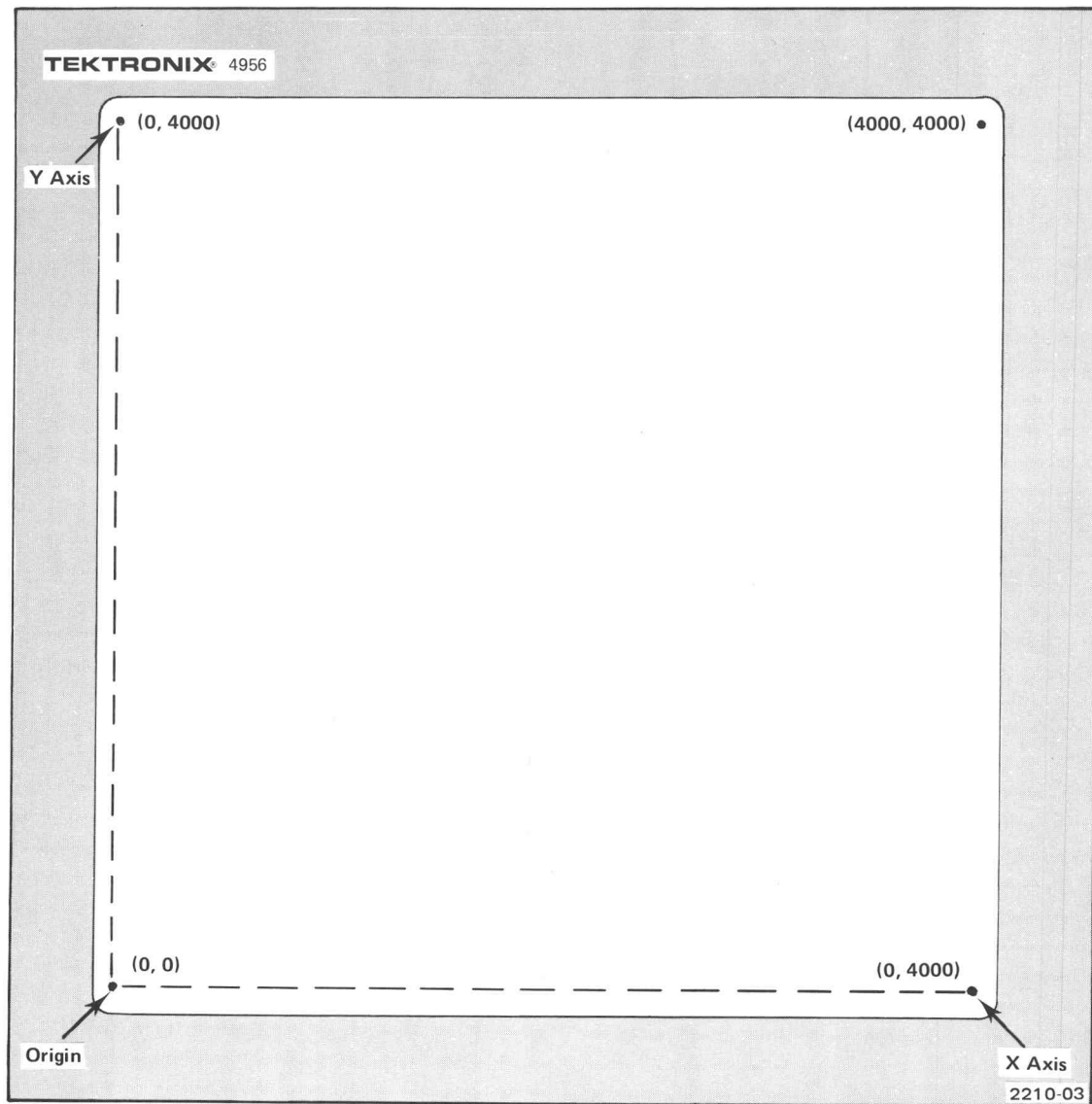


Fig. 1-3. Standard Tablet default coordinate plane.

To digitize coordinates, a grid of magnetized (biased) wires under the Tablet surface is used. The horizontal set of wires is for the X axis and the vertical set is for the Y axis. Pulses are propagated along these wires and detected by a sensitive coil in the tip of the Writing Pen. The time between transmission of a pulse and its detection represents a coordinate of a point. For each coordinate, two pulses are sequentially sent from opposite ends of the coordinates axis wires, producing two values. The Tablet Controller then performs calculations on the two values to produce highly accurate results.

Only a certain portion of the Tablet surface is used as the digitizing area. This area is not marked on the surface since it may move when the Tablet is biased. (Biasing is explained in Section 4.) However, the minimum size of the digitizing area is standard for each of the Tablet sizes. For example, the physical size of the standard 4956 Tablet is 27.75" X 27.75" while the digitizing area is 20" X 20". The digitizing area may be located by moving the Writing Pen on the Tablet surface near the metal frame while watching the PROX indicator on the front panel of the Tablet Controller. The PROX indicator illuminates when the Writing Pen is in the valid data area and extinguishes when the Pen leaves the area.

WRITING PEN

The Writing Pen is used to draw on the Tablet surface. The tip of the Writing Pen contains a sensitive pick-up coil. Whenever the tip of the Pen is within 5/32 inch of the Tablet surface, the pick-up coil detects the Tablet (the Pen is in Proximity). The coil detects the change in the magnetic field caused by the pulse on the Tablet wires. Coordinates are calculated when the Pen detects the pulse.

Pressing the tip of the Writing Pen against the Tablet surface moves the Pen's filler slightly into the Pen. This action activates a switch, located within the Writing Pen. The Z Axis indicator illuminates when the switch is activated. This switch can be used to separate coordinates obtained when moving the Pen in the Proximity area of the Tablet from those obtained when the Pen is actually on the Tablet surface as explained in Section 2.

The Writing Pen's inkless filler can be replaced by the blue ballpoint filler so that marks can be seen. If accuracy is desired, when tracing a drawing, for example, the Writing Pen can be replaced by an optional one-button or four-button Cursor. In the Cursor, the switch is activated by pressing the large button on top of the cursor.

TABLET CONTROLLER

The Tablet Controller contains the power supply and the necessary circuitry to digitize coordinates. Upon command of the Graphic System, the Tablet Controller conveys coordinate and status information through the General Purpose Interface Bus (GPIB). Power is applied to the Graphic Tablet by moving the power switch on the back panel of the Tablet Controller to the ON position. The front panel of the Tablet Controller, shown in Fig. 1-4, contains the following buttons and indicators.

NOTE

Before applying power to the Graphics Tablet, see the installation instructions in Section 5.



Fig. 1-4. Tablet controller front panel.

Tablet Controller Front Panel Buttons

REMOTE—Reserved for custom modification.

POINT—A single point is digitized each time the Writing Pen is pressed on the surface of the Tablet (switch activated).

STREAM SWITCH—Points are digitized as long as the Writing Pen remains on the Tablet surface (switch activated).

STREAM SWITCH—Points are continuously digitized while the Writing Pen is in the Proximity area or on the Tablet surface.

CLEAR—The microprocessor is reset and the origin is set at the lower left corner of the Tablet surface. The GPIB interface is also cleared.

INCRE—To be accepted, the coordinates of a point must be at least 2 counts (0.1 inch) away from the last accepted point on the X or Y axis.

ORIGIN—When pressed, the origin is set at the next point digitized.

STREAM (slide)—The rate of digitization is adjusted on a time elapsed basis. Points are digitized approximately 3 per second at the Low setting and 30 per second at the High setting.

Tablet Controller Front Panel Indicators

Z AXIS—Illuminates when the Pen (or Cursor) switch is activated.

PROX—Illuminates when the Pen (or Cursor) is in Proximity (within 5/32 inch of the surface of the Tablet).

POWER—Illuminates when power is applied to the Graphics Tablet. The POWER switch is located on the back panel of the Tablet Controller as shown in Fig. 1-5.

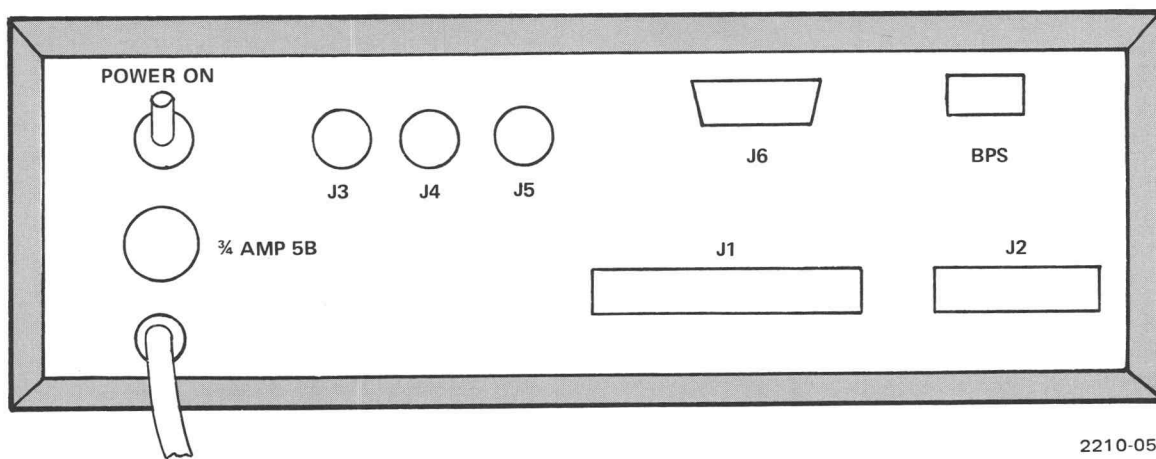


Fig. 1-5. Tablet Controller Back Panel.

STANDARD ACCESSORIES

The following standard accessories are included with the Graphics Tablet at no extra charge.

- Operator's Manual
- GPIB cable
- PLOT 50: Graphics Tablet Support Software Tape
- Biasing Magnet
- Fastener Pile
- Fastener Hook

OPTIONAL ACCESSORIES

The following optional accessories are available for the Graphics Tablet at additional cost. To order any accessory contact the nearest Tektronix, Inc. Field Office.

- Cursor (replaces Writing Pen)
 - One button
 - Four button
- Pen Filler
 - Dry
 - Blue
- Service Manual



Section 2

GRAPHICS TABLET OPERATION

INTRODUCTION

Two basic functions are performed by the Graphics Tablet: generation of coordinates and transfer of coordinates to the Graphic System. This section explains how these functions are controlled by setting Tablet Controller external buttons and by executing BASIC instructions from the Graphic System.

GENERATION OF COORDINATES

Digitization is controlled by the buttons on the front panel of the Tablet Controller. These buttons select one of three digitizing modes: point, stream switch, and stream switch. Other front panel buttons set time and distance filters and re-locate the origin.

DIGITIZING MODES

The Graphics Tablet can digitize in any of three modes: point, stream switch, or stream switch. The mode selected determines how the Proximity area and the Pen switch are used. The following paragraphs describe each mode.

POINT Mode

When the POINT button on the Tablet Controller front panel is pressed, the Tablet Controller digitizes one point and generates status information (see "Status Byte" in this section) each time the Writing Pen is pressed on the Tablet surface. The pen must be lifted and then pressed to the surface to generate another point. This mode is useful when only a particular point is required, for example, when specifying the endpoints of a straight line that is drawn by a BASIC DRAW instruction.

STREAM SWITCH Mode

By pressing the STREAM SWITCH button, points and status are generated continuously while the Writing Pen is on the Tablet surface and the Pen switch is activated. This mode is useful when tracing or drawing freehand.

STREAM SWITCH Mode

When STREAM SWITCH mode is selected, points and status are generated continuously while the Writing Pen is in Proximity (PROX indicator illuminates) or while the Pen switch is activated (Z AXIS indicator illuminates) by pressing the Pen on the Tablet surface. This mode may be useful when delicate paper is used or precise drawing is required.

TIME AND DISTANCE FILTERS

Filters are used to reduce the amount of data stored to manageable proportions and to reduce the effect of pen tremors that convey undesired data.

STREAM Slide (Time Filter)

A time filter is implemented by moving the STREAM slide. The time filter adjusts the rate of digitization on a time elapsed basis. The rate of digitization is increased as the STREAM slide is moved to the right.

A slow rate of digitization may be useful when storage capacity is a consideration, and a high rate of digitization may be useful when making curves or drawing quickly. The approximate range of the total time for generation and transfer of data is 3 points/second (LOW) to 30 points/second (HIGH). The actual time depends largely on the software (see "Optimizing Data Transfer" in this section).

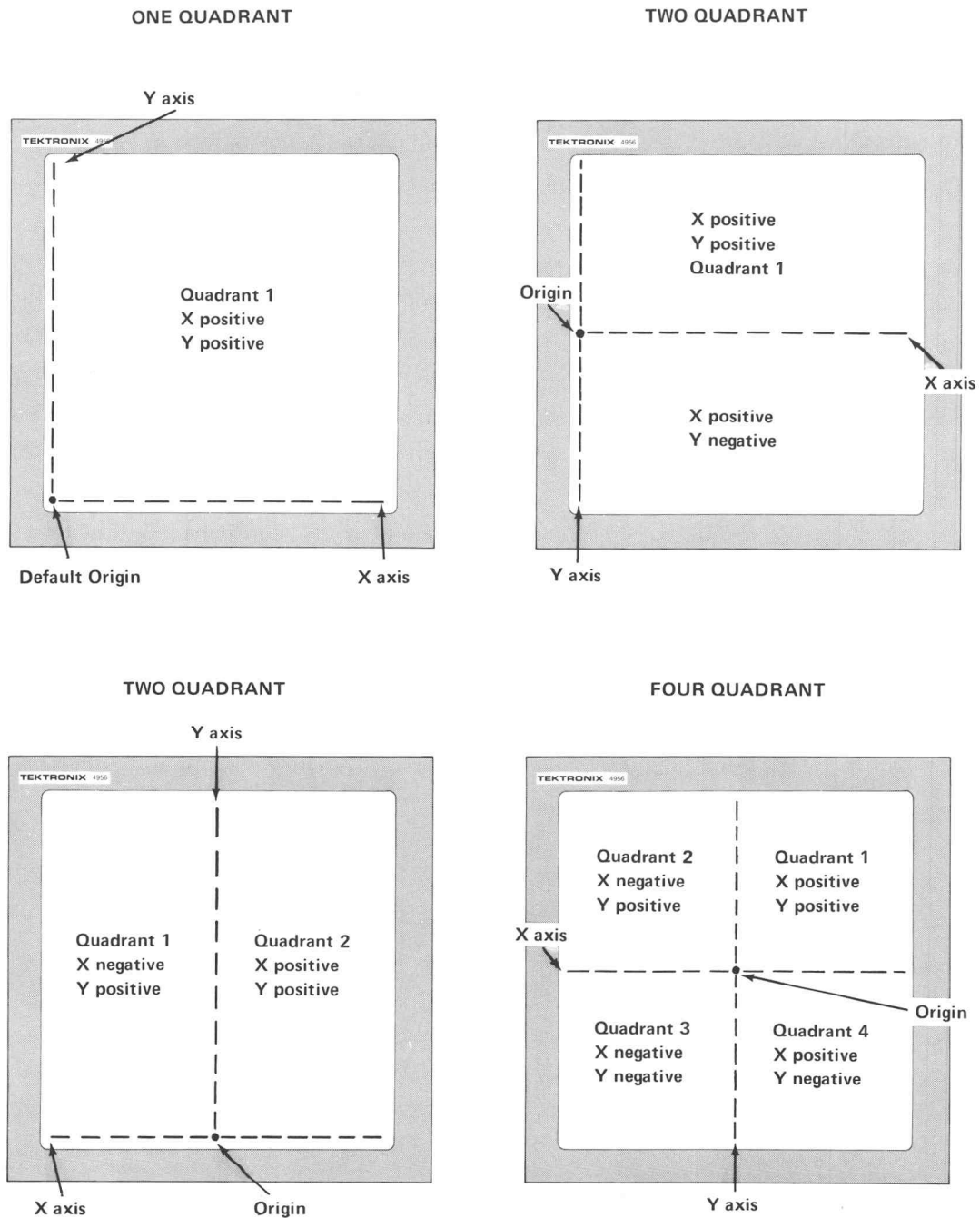
INCRE Button (Distance Filter)

When the INCRE button is pressed, a distance filter is implemented. The distance filter adjusts the rate of digitization on a distance basis. The Writing Pen must be moved at least .01 inch (two counts) in the X or Y direction before the next point is digitized and accepted. The distance filter checks points at the digitization rate set by the time filter. Because fewer points are generated, this feature is useful when storage capacity is a consideration. Also, when drawing slowly, the distance requirement reduces the effect of pen tremors.

ORIGIN AND COORDINATES

The coordinate system used for digitization can be a one-, two-, or four-quadrant coordinate plane, depending on the location of the origin. When power is applied, the default origin is at the lower left corner of the Tablet surface, which results in a one-quadrant coordinate plane with positive coordinate values.

The origin can be located at any valid data location. By moving the origin, the X and Y axes are moved and the Tablet surface is divided into one, two, or four areas (quadrants) as shown in Fig. 2-1. Coordinates are measured from the origin. Positive coordinates are generated upwards and to the right of the origin. Negative coordinates are generated downwards and to the left of the origin.



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Fig. 2-1. Different coordinate planes.

Tablet Controller internal switches control the measuring unit of the digitized coordinates. Coordinates can be generated in count, inch, or millimeter units. The default unit is counts. Because these switches are internal and not designed to be changed by an operator, information on internal switch settings is contained in Section 5, "Installation." Conversion from counts to millimeters or inches can also be accomplished by a BASIC instruction that multiplies each coordinate by the appropriate conversion factor as follows: 1 count = .005" = .127 mm (approximately). See the reference manual included with the Graphic System for details on BASIC instructions.

RELOCATING THE ORIGIN

The location of the origin determines the coordinate plane. The origin is relocated by pressing the ORIGIN button and generating a point. The process differs slightly depending on the mode of digitization.

In POINT mode, press the ORIGIN button and hold it in. Move the Writing Pen to the desired origin and press the Pen on the Tablet surface while holding the ORIGIN button in. Release the ORIGIN button and the origin is set.

In STREAM SWITCH mode, follow the procedure for POINT mode or use the method described in the following paragraph for STREAM SWITCH mode.

In STREAM SWITCH mode, first position the Writing Pen on the Tablet surface at the desired origin. Press the ORIGIN button while holding the Writing Pen on the Tablet surface. Release the ORIGIN button and the origin is set.

CLEAR

By pressing the CLEAR button, the default origin (lower left corner) is set. The CLEAR button initializes all Tablet Controller circuitry to default parameters and clears the GPIB interface.

NOTE

Do not press CLEAR while a program is inputting data from the Tablet Controller. Halt the program first by pressing the Graphic System keyboard BREAK key twice. If the CLEAR button is pressed during a data transfer, the Graphic System must be turned OFF before it will operate again.

TRANSFER OF COORDINATES

The General Purpose Interface Bus (GPIB) is used to transfer coordinates from the Tablet Controller to the Graphic System. To communicate, the Graphic System is assigned the role of "listener" and the Graphics Tablet is the "talker." By executing an INPUT instruction, specifying the address of the Graphics Tablet, the Graphic System receives X and Y coordinates and status information. A set of switches on the back panel of the Tablet Controller control the address and SRQ mode (SRQ is explained in the reference manuals included with the Graphic System). The following paragraphs describe the transfer procedure.

STATUS BYTE

A status byte is generated with each coordinate pair to indicate the position of the Writing Pen (or Cursor) and the button pressed on the optional four-button Cursor. The status byte is a single ASCII character. The normal status byte values and the associated meanings are shown in Table 2-1A.

A status byte of 1 can be obtained in any digitizing mode. A status byte of 0 is obtained when STREAM SWITCH mode is selected and the Pen is in Proximity. Status values 2, 4, and 8 are obtained when the four-button Cursor is used. These status byte values can be used to represent graphic functions such as draw, move, and halt. A BASIC program can branch to a particular subroutine to perform a graphic function depending on the value of a status byte.

NOTE

Other status byte values can be obtained by simultaneously pressing more than one button on the four-button Cursor. These status byte values are not normally used because of the difficulty of simultaneously pressing combinations of buttons. The possible status byte values that result from combinations of buttons on the four-button Cursor are listed in Table 2-1B.

Table 2-1A
NORMAL STATUS BYTE VALUES

ASCII Character Status Byte	Meaning
0	The Pen (or Cursor) is in Proximity.
1	The Pen (or Cursor) switch is activated.
2	Button 3 on the optional four-button Cursor is pressed.
4	Button 2 on the optional four-button Cursor is pressed.
8	Button 1 on the optional four-button Cursor is pressed.

Table 2-1B
SPECIAL FOUR-BUTTON CURSOR STATUS BYTE VALUES

ASCII Character Status Byte	Meaning
3	Button 3 and the Cursor switch button on the four-button Cursor are pressed.
5	Button 2 and the Cursor switch button on the four-button Cursor are pressed.
6	Buttons 2 and 3 on the four-button Cursor are pressed.
7	Buttons 2 and 3 and the Cursor switch button on the four-button Cursor are pressed.
9	Button 1 and the Cursor switch button on the four-button Cursor are pressed.
:	Buttons 1 and 3 on the four-button Cursor are pressed.
;	Buttons 1 and 3 and the Cursor switch button on the four-button Cursor are pressed.
<	Buttons 1 and 2 on the four-button Cursor are pressed.
=	Buttons 1 and 2 and the Cursor switch button on the four-button Cursor are pressed.
>	Buttons 1, 2, and 3 on the four-button Cursor are pressed.
?	All buttons on the four-button Cursor are pressed.

BACK PANEL SWITCHES

On the back panel of the Tablet Controller is a set of switches called the Back Panel Switch Bank (BPS). Switches on the BPS control the address of the Tablet Controller and SRQ (Service Request) mode.

The Tablet Controller address is factory set to 8 and the SRQ is disabled. Fig. 2-2 shows the BPS and the location of each switch. Table 2-2 gives the purpose of each switch in the ON and OFF positions. The switches are numbered and the ON position is marked on the switch bank. Switches 1 through 5 control the Tablet Controller address and switch 4 in the ON position is the factory address setting of 8. Switch 6 is set at the OFF position to disable SRQ.

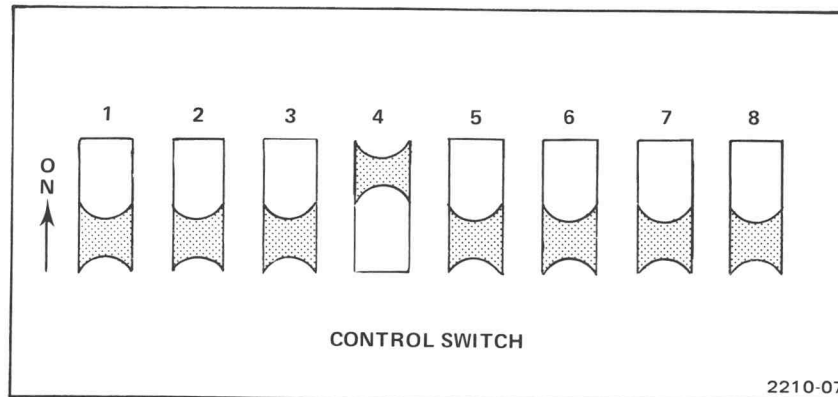


Fig. 2-2. Back Panel Switch Bank with factory settings.

Table 2-2

BACK PANEL SWITCH BANK

SWITCH	ON	OFF
1	Add 1 to address	
2	Add 2 to address	
3	Add 4 to address	
4	Add 8 to address	
5	Add 16 to address	
6	SRQ enabled	SRQ disabled
7	Decimal point enabled	Decimal point disabled
8	RESTRICTED USE	DO NOT ALTER

NOTE

Switch 7 must be used with other internal switches to implement the decimal point. Those internal switches are explained under the heading Setting Coordinate Units in Section 5.

INPUT PROCEDURE

The Graphic System receives coordinate and status information from the Tablet through the execution of an INPUT instruction. The Graphics Tablet sends data in the following order: X coordinate, Y coordinate, Status Byte. Each value is delimited by a RETURN (ASCII 13).

To receive data from the Tablet, execute an INPUT instruction in the following form:

Tablet	Coordinates	Status
Controller	X Y	Byte

INPUT @address:variable,variable,variable

TABLET CONTROLLER ADDRESS

The address of the Tablet Controller is factory set at 8. Devices on the General Purpose Interface Bus can use addresses ranging from 1 to 30. To change the address, use the information given under BACK PANEL SWITCHES in this section.

X AND Y COORDINATE VARIABLES

The coordinate values may be stored in either numeric or string variables. Each coordinate requires from 5 to 7 ASCII characters.

STATUS BYTE VARIABLE

The status byte should be stored in a string variable. This practice avoids any errors that would occur if a non-numeric character is generated and allows for examination of the status byte.

EXAMPLE PROGRAM

The following program inputs X and Y coordinates and the status byte and prints them on the screen. After entering the program and executing a RUN command, move the Writing Pen randomly on the Tablet surface to generate points. If the printed coordinate values do not seem reasonable, see Section 4 under the heading Checking the Tablet and Tablet Controller. With the standard 20" X 20" Tablet and the default origin, the coordinates should be in the range from 0 to 4000. To stop the program, press the BREAK key twice.

```
100 INIT
110 PAGE
120 FOR I=1 TO 30
130 INPUT @8:X,Y,Z$
140 PRINT X,Y,Z$
150 NEXT I
160 GO TO 110
```

NOTE

If coordinates are generated while a program is running, a buffer holds the first point until the appropriate INPUT command is executed or the interface is cleared. Only one point can be stored in the buffer. All points generated while the buffer is full are ignored.

TABLET CONTROLLER INTERRUPT (SRQ)

The Tablet Controller can generate an interrupt by activating the SRQ (Service Request) signal line. To allow this signal to be activated, switch 6 on the BACK PANEL SWITCH BANK must be set to the ON position. (See the information under BACK PANEL SWITCHES in this section.) When coordinates are ready to be transferred, the Tablet Controller signals the Graphic System by activating the SRQ line. When the Graphic System executes a POLL command followed by an INPUT command to receive the data, the SRQ line is released. The status word returned is 64 (ASCII). For more information on interrupt conditions, see the reference manuals included with the Graphic System.

SAMPLE PROGRAM USING SRQ INTERRUPT

This program inputs and prints coordinate data from two Tablet Controllers using the serial poll capabilities of the Graphic System to handle interrupts. One Tablet Controller has address 8, the other has address 9. The SRQ switch (BACK PANEL SWITCH 6) must be ON to operate in this mode.

```

100 INIT
110 PRINT @32,26:2
120 ON SRQ THEN 160
130 PRINT "WAITING FOR SERVICE REQUEST"
140 WAIT
150 GO TO 130
160 POLL M,N;8;9
170 GO TO M OF 200,240
180 PRINT "NO SERVICE ROUTINE FOR DEVICE"
190 END
200 REM SERVICE ROUTINE FOR TABLET @8
210 INPUT @8:X,Y,Z$
220 PRINT "TABLET @8  X=";X,"  Y=";Y
230 RETURN
240 REM SERVICE ROUTINE FOR TABLET @9
250 INPUT @9:X,Y,Z$
260 PRINT "TABLET @9  X=";X,"  Y=";Y
270 RETURN
    
```

OPTIMIZING DATA TRANSFER

The following text contains sample programs which provide simple fast methods to input data from the Tablet Controller without the user-oriented features of the Plot 50: Graphics Tablet Support Software. The speed of data transfer is optimized so that a program inputs as many coordinates as possible and the number of points that are lost when the buffer is full and points are generated is minimized.

The speed of data transfer depends largely on the number of statements in the processing loop that inputs and displays or stores the data and the type of coordinate unit used. In general, the input rate with counts is 1 to 2 points per second more than the input rate with other units. To optimize the rate of digitization, the STREAM slide should be set at the HIGH position and the INCRE button should not be pressed. Either STREAM SWITCH or STREAM SWITCH mode should be selected. With these considerations, these programs can serve as a foundation so that efficient programs can be written for individual needs.

SAMPLE PROGRAM FOR DISPLAY

This program inputs coordinates from the Tablet Controller and uses that data to draw the design on the display screen.

```

100 INIT
110 X1=Minimum X value in digitizing window
120 X2=Maximum X value in digitizing window
130 Y1=Minimum Y value in digitizing window
140 Y2=Maximum Y value in digitizing window
150 WINDOW X1,X2,Y1,Y2
160 VIEWPORT 0,100,0,100
170 PAGE
180 INPUT @8:X,Y,Z$
190 DRAW X,Y
200 GO TO 180

```

In the above sample program, lines 110-140 are not actual program lines. A value, specifying the window boundaries should replace the string of text on the right of the equal sign.

After assigning the Window values and with the Tablet Controller address set at 8, the program can be executed as shown. With counts unit, the typical transfer rate is 13 points per second.

SAMPLE PROGRAM FOR INTERNAL STORAGE

The following program stores coordinates in array X and Y in any memory configuration. The number of data items that can be stored depends entirely on the size of available memory.

```

100 INIT
110 M0=300+INT(MEMORY/8192)*500
120 DIM X(M0),Y(M0)
130 FOR I=1 TO M0
140 INPUT @8:X(I),Y(I),Z$
150 NEXT I
160 PRINT "GG FINISHED"
170 END

```

With the Tablet Controller address set at 8, this program will execute as shown. When all of available memory has been filled, the bell rings twice and "FINISHED" is printed on the screen. The typical transfer rate with counts unit is approximately 24 points per second.

Another step can be taken towards optimizing the speed of data transfer. The following program increases the transfer rate for counts unit to 30 points per second. The program uses the array capability of the Graphic System and all data is stored in array X. This program is not recommended for general use because of the possibility of a non-numeric status byte.

```

100 INIT
110 M0=600+INT(MEMORY/8192)*1000
120 DIM X(M0)
130 INPUT @8:X
140 PRINT "GG FINISHED"
150 END

```

SAMPLE PROGRAM FOR TAPE STORAGE

The following program stores coordinates on a marked magnetic tape file. The number of coordinates stored depends on the size of the file.

```

100 INIT
110 F1=Target data file number
120 FIND F1
130 INPUT @8:X,Y,Z$
140 WRITE @33:X,Y
150 GO TO 130

```

In the above sample program, line 110 is not an actual program line. A value, specifying the number of the target data file should replace the string of text on the right side of the equal sign.

After specifying the file number and with the Tablet Controller at address 8, the program can be executed as shown. The program is stopped by pressing the BREAK key twice. To close the tape file after an END command. With counts unit, the typical transfer rate is 18 points per second.

The status byte can be stored for later examination by changing line 140 as follows:

```

140 WRITE @33: X,Y,Z$

```

If line 140 is changed as shown, the transfer rate is 17 points per second.

Section 3

PLOT 50: GRAPHICS TABLET SUPPORT SOFTWARE

INTRODUCTION

The BASIC programs stored on the Plot 50: Graphics Tablet Support Software Tape are a convenient way to use the Graphics Tablet. Programs are provided that list or graphically display the coordinate data and/or store it in memory or on magnetic tape. Five programs make use of function keys and 5 programs implement the optional four-button Cursor instead of function keys. In addition, two programs are provided to edit data tapes.

These programs provide a general method to implement the Graphics Tablet. Interactive dialogue and many data tests are incorporated in the programs. For more specific needs, original programs can be constructed using the information in Section 2 and a listing of these programs as a guide. Appendix B contains a list of the variables used in each program and their purpose.

This section describes the common features of the programs: User-Definable Keys and Graphic Functions, Internal Data Structure, Tape Data Structure, and general Operating Notes. The programs are then divided into three categories: programs for the Writing Pen, programs for data tape editing, and programs for the optional four-button Cursor. Each program is explained in detail.

USER-DEFINABLE KEYS AND GRAPHIC FUNCTIONS

The support software inputs coordinates and implements the status byte or user-definable keys to indicate four functions: draw, move, delete, and halt. When the four-button Cursor is used, the status byte indicates all functions. When the Writing Pen or one-button Cursor is used, either the status byte or user-definable keys indicate the function.

DRAW

A draw indicates that a visible vector (line) connects the points. A draw results from activating the Pen (or Cursor) switch, giving a status byte of 1.

MOVE

A move can be thought of as temporarily interrupting the input stream. An invisible vector connects points. A move results from pressing user-definable key 2 and then pressing the Pen on the Tablet surface. With the four-button Cursor, a move is indicated by pressing button 2 giving a status byte of 4.

DELETE

The last point entered is removed from the data list by pressing user-definable key 1 and then pressing the Pen on the Tablet surface. Note that the point entered after pressing user-definable key 1 is ignored as a data point. With the four-button Cursor, the delete function is performed by pressing button 1, giving a status byte of 8.

HALT

The input process is terminated by pressing user-definable key 3 and then pressing the Pen on the Tablet surface. The point is included in the data list and has the graphic function HALT. This key must always be used to end the input stream when storing data on tape. The HALT point is not considered part of the design and is not displayed graphically. With the four-button Cursor, the halt function is performed by pressing button 3, giving a status byte of 2.

The halt function can be used for special purposes. For example, the coordinates of the HALT point may serve as a pointer to a Tablet menu for user-designed programs.

INTERNAL DATA STRUCTURE

DATA COMPACTION

All numeric variables used in the Graphic System are stored as 64-bit floating point numbers. Because a single coordinate does not require a full 64 bits, the support software packs a coordinate pair into a single floating point number. Essentially, the X coordinate is stored to the left of the decimal point, and the Y coordinate is stored to the right. The following paragraphs explain how the numbers are compacted.

To preserve the sign, the values are first adjusted by converting the number to tens complement notation. This is accomplished by the following computation where: X=X coordinate, X'=X coordinate in tens complement notation, Y=Y coordinate, and Y'=Y coordinate in tens complement notation.

$$X'=1E5-X$$

$$Y'=1E5-Y$$

The following program can be used to illustrate the process of converting to tens complement notation.

```
X=12345
Y=-54321
X1=1E5-X
Y1=1E5-Y
PRINT X, X1, Y, Y1
X1=1E5-X1
Y1=1E5-Y1
PRINT X, X1, Y, Y1
```

After executing this program, notice that the first set of variables printed show the coordinate and its tens complement notation side-by-side. The second set of variables printed show how the original values are recomputed by taking the tens complement again.

The actual formula used in the programs compacts the X and Y coordinates in tens complement notation into a single floating point variable using the following formula:

$$D = 1E5 - X + (1E5 - Y) / 1E6$$

In addition, the graphic function of a coordinate pair is also encoded into the floating point number using the following procedure. Notice that the graphic function is represented by adding a constant which is a multiple of 1E5 to the original equation.

```
DRAW— D=0 + 1E5-X + (1E5-Y) / 1E6
MOVE— D=2E5 + 1E5-X + (1E5-Y) / 1E6
HALT— D=8E5 + 1E5-X + (1E5-Y) / 1E6
```

The resulting values of D can be decoded into the graphic function by using Table 3-1. The coordinate values stored in D can be restored by using the following equations:

```
F=INT (D/2E5)
D1=INT (D-F*2E5)
X=INT (1E5-D1)
Y=INT (1E5-((D-D1-F*2E5)*1E6))
```

F contains the graphic function represented by the following code:

```
F=0→DRAW
F=1→MOVE
F=4→HALT
```

X contains the signed X coordinate and Y contains the signed Y coordinate.

Table 3-1

GRAPHIC FUNCTIONS REPRESENTED IN D VALUES

Value of D	Graphic Function Representation
$0 \leq D < 200000$	DRAW
$200000 \leq D < 400000$	MOVE
$400000 \leq D < 1000000$	HALT

INTERNAL STRUCTURE

All programs that store or display data request that the origin and digitizing window be set. The Window is used to set the screen viewport in the same aspect ratio as the Tablet so that the design displayed is in the same proportions as the original design. This may result in only a part of the screen being used to display the design. The Window is also used to edit out points that are outside the Window boundary.

A single dimension array named D is used in data save programs to store coordinates internally. The first two elements of array D, D(1) and D(2), contain the corner coordinates of the digitizing window. Element D(1) contains the lower left coordinate and D(2) contains the upper right coordinate. The rest of array D contains the points as they are digitized. All data points are stored in compacted form. The size of array D is determined by the memory configuration of the Graphic System. To determine the size of array D, the variable MØ is used. MØ is given values as follows:

MØ=202 for a memory of 8K
MØ=1202 for a memory of 16K
MØ=2202 for a memory of 24K
MØ=3202 for a memory of 32K

TAPE DATA STRUCTURE

When tape storage is used in a program, the data is formatted in a binary data file in the following order:

filename—an alphanumeric string up to 40 characters in length
coordinate unit—the coordinate unit is represented by this code:
1=counts or millimeters with no decimal or post decimal digits
2=inches with implied decimal and three post decimal digits or millimeters with implied decimal and one post decimal digit
3=inches with decimal and three post decimal digits
data—the data points are stored in this order:
lower left corner of Window
Upper right corner of Window
data points

When reading the tape after the data is stored, the Window corner points may be used to set the Window and Viewport. The data points may then be used in turn. All data points are stored in packed tens complement notation, as previously described.

The following algorithm is a guide for writing programs to read data from a valid tape data file as stored by the support software. Appendix C contains an example program that uses this algorithm to read and display data from tape.

1. Find the data file.
2. Read the filename and coordinate unit code. Print them if desired. The coordinate unit may be used to handle post decimal digits.
3. Read the Window coordinates and unpack the notation. Use the unpacked result to set the Window and Viewport if desired.
4. Read the data point and unpack the notation.
5. Perform the desired operation.
6. If the graphic function of the coordinate is HALT, then stop.
7. Else, go to 4.

For a display program, exchange steps 5 and 6 if the HALT point is not part of the design. Another alternative is to treat the HALT point like a MOVE and leave steps 5 and 6 in the order shown.

MARKING FILES

In all support software programs, the specified data file must be marked before attempting to store data. To mark a file, first locate the beginning of the file by executing a FIND statement specifying the number of the desired data file. For example:

FIND 15

Next, execute a MARK statement specifying the number of files to be marked and the size of the files in bytes. To estimate the necessary file size, multiply the expected number of points by 10 and then add 100. An example MARK statement is:

MARK 1,2000

By executing the above commands, file 15 is allocated at least 2000 bytes on the tape. For more details on marking files, see the reference manuals included with the Graphic System.

NOTE

All specified data files must have a heading of NEW or BINARY DATA.

The PLOT 50 tape can be used for storage, however, this practice is not recommended. The write protect arrow on the cartridge must be rotated 180° away from the SAFE mark to be able to write on the tape.

CAUTION

If using the PLOT 50 tape for data storage, do not use files 1 through 13. These files contain the support software.

OPERATING NOTES

TABLET CONTROLLER ADDRESS

To use the programs included in the PLOT 50 support software, the Tablet Controller address must be 8 (factory setting). See Section 2 under the heading BACK PANEL SWITCHES for details on how to set the device address if the address has been changed.

DIGITIZING MODES

Data digitized in STREAM SWITCH mode is treated the same as data digitized in STREAM SWITCH mode. The Writing Pen switch must be activated for the data to be accepted.

COORDINATE UNIT

Data digitized in millimeters with a decimal and one post decimal digit is not supported by the PLOT 50 software. If this setting is used, invalid data results when the points are stored.

USING THE DEFAULT ORIGIN

Every Pen or Cursor program requests that the origin be set. To use the default origin when the request for the origin is displayed, press the Pen on the Tablet surface to satisfy the requirement that a point be entered. The point is ignored and the default origin is used because the ORIGIN button is not pressed when the point is entered.

NAMING CONVENTIONS

The programs with "DISPLAY" in the title display the data graphically or as a coordinate list as it is entered. The programs with "SAVE" in the title store the graphic data internally and optionally store the data on tape. Because the data is stored internally, it can be used by user-designed programs. The number of points that can be stored is limited by the memory size of the Graphic System and the size of the data file if the data is stored on tape. Programs with "STORE" in the title save the data on tape as it is entered. The number of points that can be stored depends only on the size of the data file.

INITIALIZING PLOT 50: GRAPHICS TABLET SUPPORT SOFTWARE

After installing the components of the Graphics Tablet as explained in Section 5 and applying power to both the Graphic System and the Graphics Tablet, insert the Plot 50 tape cartridge. Press the AUTOLOAD key. The display screen erases and the following menu is displayed.

**** PLOT 50: GRAPHIC TABLET SUPPORT SOFTWARE ****

PROGRAM	TITLE
1	PEN DISPLAY ONLY
2	PEN DISPLAY AND SAVE
3	PEN SAVE ONLY
4	PEN DISPLAY AND STORE
5	PEN STORE ONLY

6	DATA TAPE EDIT
7	DATA TAPE MERGE

**** FOR OPTIONAL CURSOR ONLY ****

8	CURSOR DISPLAY ONLY
9	CURSOR DISPLAY AND SAVE
10	CURSOR SAVE ONLY
11	CURSOR DISPLAY AND STORE
12	CURSOR STORE ONLY

ENTER THE PROGRAM NUMBER YOU WANT:

To select a program, type the number of the program you want and press RETURN. After running a program, the Menu can be obtained by pressing AUTOLOAD. The same program can be performed again by executing a RUN command.

PROGRAMS FOR THE WRITING PEN (MENU ITEMS 1 THROUGH 5)

The following paragraphs detail programs 1 through 5. These programs are designed to input graphic data with either the Writing Pen or the one-button Cursor. The optional four-button Cursor may be used with these programs, but only the white button is active. (Programs 8 through 12 are especially designed to use all buttons on the four-button Cursor.)

PEN DISPLAY ONLY

This program accepts and displays any number of points as they are digitized in the user-selected mode. The points can be displayed graphically as line segments or listed as coordinates and graphic function.

Specifications

MEMORY REQUIREMENTS: approximately 2700 bytes.

User-Definable Keys

Key 1—This message is displayed: KEY FUNCTION NOT DEFINED

Key 2—The next point entered is a MOVE

Key 3—The program terminates after the next point is entered.

How To Use The PEN DISPLAY ONLY Program

When menu item 1 is selected, the screen erases and the following statements appear:

DATA DISPLAY ONLY HAS BEEN SELECTED

Position the Pen and set the digitizing window's ORIGIN.

**Select the display mode (graphics or listing) by
entering either g or a. Entry**

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button, then press the Writing Pen on the Tablet surface at the desired location. Release the ORIGIN button.

Set the display mode by typing g or a and then pressing RETURN. If g is entered, graphic display is selected. If a is entered, coordinates and the graphic function will be listed.

This statement appears:

Move the Pen to the lower left corner of the digitizing window and press once.

In POINT mode, touch the Writing Pen on the Tablet surface at the lower left corner of the desired window. This statement appears:

Move the Pen to the upper right corner of the digitizing window and press again.

In POINT mode, move the Writing Pen to the upper right corner of the desired window and press the tip on the Tablet surface. The window is then set. If the window is not properly set, for example if the upper right corner is set before the lower left, the program will start over from the beginning.

These statements appear:

To temporarily interrupt input, press USER DEFINABLE 2.

To permanently interrupt input, press USER DEFINABLE 3.

Position the Pen at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Pen and digitizing.

The design can now be made. After the first point is digitized, the screen erases and points are displayed in the selected display mode. Any of the digitizing modes can be used. The program halts when USER-DEFINABLE KEY 3 is pressed and the last point is entered. The program can be started again by executing a RUN command. The menu is obtained by pressing AUTOLOAD.

Sample Listing

By selecting coordinate and graphic function listing as the display mode, a listing like the following is obtained. Only the design data points are listed. Notice for number 3, by pressing USER-DEFINABLE KEY 2 a MOVE is made rather than a DRAW. When USER-DEFINABLE KEY 3 is pressed, the program halts and the last point entered shows this as a graphic function.

NUMBER	X VALUE	Y VALUE	FUNCTION
1	-398	-196	DRAW
2	-35	104	DRAW
3	229	-229	MOVE
4	148	-439	DRAW
5	178	-584	HALT

PEN DISPLAY AND SAVE

This program accepts and displays at least 200 points as they are digitized in the user-selected mode. The maximum number of points accepted depends on the memory size of the Graphic System. The data can be displayed graphically as line segments or listed as coordinates and the graphic function. After the points have been entered, the data may be stored on tape if desired.

Specifications

MEMORY REQUIREMENTS: approximately 5400 bytes in 8K memory
 13400 bytes in 16K memory
 21400 bytes in 24K memory
 29400 bytes in 32K memory

MAXIMUM NUMBER OF POINTS ACCEPTED: 202 in 8K memory
 1202 in 16K memory
 2202 in 24K memory
 3202 in 32K memory

User-Definable Keys

Key 1—The last point entered will be deleted when the next point is entered.
Key 2—The next point entered is a MOVE.
Key 3—The input process terminates after the next point is entered.

How To Use The PEN DISPLAY AND SAVE Program

When menu item 2 is selected, the screen erases and the following statements appear:

DATA DISPLAY AND SAVE HAS BEEN SELECTED

Position the Pen and set the digitizing window's ORIGIN.

**Select the display mode (graphics or listing) by
entering either g or a. Entry**

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button, then press the Writing Pen on the Tablet surface at the desired location. Release the ORIGIN button.

Set the display mode by typing g or a and then pressing RETURN. If g is entered, graphic display is selected. If a is entered, coordinates and the graphic function will be listed.

This statement appears:

**Move the Pen to the lower left corner of the
digitizing window and press once.**

In POINT mode, touch the Writing Pen on the Tablet surface at the lower left corner of the desired window. This statement appears:

**Move the Pen to the upper right corner of the digitizing
window and press again.**

In POINT mode, move the Writing Pen to the upper right corner of the desired window and press the tip on the Tablet surface. The window is then set. If the window is not properly set, for example, if the upper right corner is set before the lower left, the program will start over from the beginning.

These statements appear:

To delete the last point entered, press USER DEFINABLE 1.

To interrupt input temporarily, press USER DEFINABLE 2.

To permanently interrupt input, press USER DEFINABLE 3.

Position the Pen at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Pen and digitizing.

The design can now be made. After the first point is digitized, the screen erases and points are displayed in the selected display mode. Any of the digitizing modes can be used. After USER-DEFINABLE KEY 3 is pressed and the last point entered, this statement appears:

Enter file number or zero

If 0 (ZERO) is entered, the program terminates. The program can be started by executing a RUN command. The menu can be obtained by pressing AUTOLOAD.

To enter the file number, insert the data tape and enter the number of a marked file. This statement appears:

Enter file name for identification

The file name can be any alphanumeric character string up to 40 characters in length. After entering the file name, the data is stored in the marked file. When the storing process is complete, the screen erases and this statement appears:

Target Data File stored

The program then terminates. Start the program again by executing a RUN command, or return to the menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified file is not large enough to hold the data, this statement appears:

Target File too small! Remark & restore

The program then terminates. The program must be rerun using a file with more allocated space. See the heading MARKING FILES in this section for details on allocating space.

The data can be saved by starting the program at the point where the file number is specified. Execute the following command:

RUN 760

The program will start by asking for the data file number and continue as before. The data can then be stored on a file large enough to hold the entire data set.

Sample Listing

By selecting a coordinate listing as the display mode, a listing like the following is obtained. Only the design data points are included in the listing. For number 3, USER-DEFINABLE KEY 2 was pressed to perform a MOVE instead of a DRAW. Number 4 shows the use of USER-DEFINABLE KEY 1. The first number 4 is deleted by pressing USER-DEFINABLE KEY 1 and then pressing the Pen on the surface. The next point entered then becomes number 4. The graphic function HALT is obtained by pressing USER-DEFINABLE KEY 3. The input process halts after this point is entered.

NUMBER	X VALUE	Y VALUE	FUNCTION
1	1144	889	DRAW
2	1590	796	DRAW
3	1249	912	MOVE
4	996	926	DRAW
	*** POINT DELETED ***		
4	577	835	DRAW
5	1544	801	DRAW
6	1666	585	HALT

PEN SAVE ONLY

This program accepts and saves at least 200 points as they are digitized in the user-selected mode. The maximum number of points accepted depends on the memory size of the Graphic System. After the points are entered, the data may be stored on tape if desired.

Specifications

MEMORY REQUIREMENTS: approximately 4700 bytes in 8K memory
 12700 bytes in 16K memory
 20700 bytes in 24K memory
 28700 bytes in 32K memory

MAXIMUM NUMBER OF POINTS ACCEPTED: 202 in 8K memory
 1202 in 16K memory
 2202 in 24K memory
 3202 in 32K memory

User-Definable Keys

Key 1—The last point entered will be deleted when the next point is entered.
Key 2—The next point entered is a MOVE.
Key 3—The input process terminates after the next point is entered.

How To Use The PEN SAVE ONLY Program

When menu item 3 is selected, the screen erases and the following statements appear on the screen:

DATA SAVE ONLY HAS BEEN SELECTED

Position the Pen and set the digitizing window's ORIGIN.

Press RETURN when ready

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button then press the Writing Pen on the Tablet surface at the desired location. Release the ORIGIN button. Press RETURN.

This statement appears:

Move the Pen to the lower left corner of the digitizing window and press once.

In POINT mode, touch the Writing Pen on the Tablet surface at the lower left corner of the desired window. This statement appears:

Move the Pen to the upper right corner of the digitizing window and press again.

In POINT mode, move the Writing Pen to the upper right corner of the desired window and press the tip on the Tablet surface. The window is then set. If the window is not properly set, for example if the upper right corner is set before the lower left, the program will start over from the beginning.

These statements appear:

To delete the last point entered, press USER DEFINABLE 1.

To interrupt input temporarily, press USER DEFINABLE 2.

To permanently interrupt input, press USER DEFINABLE 3.

Position the Pen at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Pen and digitizing.

The design can now be made. Points are digitized in any digitizing mode. No display is produced. After USER-DEFINABLE KEY 3 is pressed and the last point entered, the screen erases and the following statement appears:

Enter file number or zero

If 0 (ZERO) is entered, the program terminates. The program can be started by executing a RUN command. The menu can be obtained by pressing AUTOLOAD.

To enter the file number, insert the data tape and type the number of a marked file. This statement appears:

Enter file name for identification

Specify the file name by typing any alphanumeric string up to 40 characters in length. The data is then stored in the previously marked file. When the storing process is complete, this statement appears:

Target Data File stored

The program then terminates. Start the program again by executing a RUN command, or return to the menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified file is too small to hold the data, this statement appears:

Target File too small! Remark & restore

The program then terminates. The program must be rerun using a data file with more allocated space. See the heading MARKING FILES in this section for details on allocating space.

The data may be saved by starting the program at the point where the data file number is specified. Execute the following command:

RUN 700

The program will start by asking for the data file number and continue as before. The data can then be stored on a file large enough to hold the entire data set.

PEN DISPLAY AND STORE

This program accepts, displays, and stores any number of points as they are digitized in the user-selected mode. The points can be displayed graphically as line segments or listed as coordinates and graphic function. After all points are entered and stored in the specified file, the file is closed.

Specifications

MEMORY REQUIREMENTS: approximately 5000 bytes.

User-Definable Keys

Key 1—The last point entered will be deleted when the next point is entered.

Key 2—The next point entered is a MOVE.

Key 3—The input process terminates after the next point is entered.

How To Use The PEN DISPLAY AND STORE Program

When menu item 4 is selected, the screen erases and the following statements appear:

DATA DISPLAY AND STORE HAS BEEN SELECTED

Position the Pen and set the digitizing window's ORIGIN.

**Select the display mode (graphics or listing) by
entering either g or a. Entry**

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button then press the Writing Pen on the Tablet surface at the desired location. Release the ORIGIN button.

Set the display mode by typing g or a and then pressing RETURN. If g is entered, graphic display is selected. If a is entered, coordinates and the graphic function will be listed.

This statement appears:

Enter Data Tape file number

Insert the data tape and type the number of a marked file. This statement appears:

Enter file name for identification

Specify the file name by entering any alphanumeric string up to 40 characters in length. This statement appears:

**Move the Pen to the lower left corner of the
digitizing window and press once.**

In POINT mode, touch the Writing Pen on the Tablet surface at the lower left corner of the desired window. This statement appears:

Move the Pen to the upper right corner of the digitizing window and press again.

In POINT mode, move the Writing Pen to the upper right corner of the desired window and press the tip on the Tablet surface. The window is then set. If the window is not properly set, for example if the upper right corner is set before the lower left, the program will start over from the beginning.

The following statements appear:

To delete the last point entered, press USER DEFINABLE 1.

To interrupt input temporarily, press USER DEFINABLE 2.

To permanently interrupt input, press USER DEFINABLE 3.

Position the Pen at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Cursor and digitizing.

The design can now be made. After the first point is digitized, the screen erases and points are displayed in the selected display mode. Any of the digitizing modes can be used. After USER-DEFINABLE KEY 3 is pressed and the last point entered, the screen erases and this statement appears:

Target Data File stored

The program then terminates. Start the program again by executing a RUN command, or return to the menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified file is too small to hold the data, this statement appears:

Target File too small! Remark & rerun.

The program then terminates. Some data may be stored in the specified file, but the file is invalid because the last point stored does not have a HALT function. Appendix C contains a program to make the data file valid by changing the function of the last point to HALT as required. The points that could not fit in the file must be entered again and stored on another file. The two files can then be merged.

Sample Listing

By selecting a coordinate listing as the display mode, a listing like the following is obtained. Only the design data points are listed. For number 3, USER-DEFINABLE KEY 2 was pressed to perform a MOVE instead of a DRAW. USER-DEFINABLE KEY 1 was used to delete the first listing for number 4 when the next point is entered. The following point entered becomes number 4. The graphic function HALT, shown in number 5, is obtained by pressing USER-DEFINABLE KEY 3. The input process halts after this point is entered.

NUMBER	X VALUE	Y VALUE	FUNCTION
1	-196	-285	DRAW
2	45	-354	DRAW
3	-60	-398	MOVE
4	-455	-407	DRAW
	*** POINT DELETED ***		
4	416	-619	DRAW
5	-201	-492	HALT

PEN STORE ONLY

This program accepts and stores on tape any number of points as they are digitized in the user-selected mode. After all points have been entered and stored in the specified file, the file is closed.

Specifications

MEMORY REQUIREMENTS: approximately 4300 bytes.

User-Definable Keys

- Key 1—The last point entered will be deleted when the next point is entered.
- Key 2—The next point entered is a MOVE.
- Key 3—The input process terminates after the next point is entered.

How To Use The PEN STORE ONLY Program

When menu item 5 is selected, the screen erases and the following statements appear:

DATA STORE ONLY HAS BEEN SELECTED

Position the Pen and set the digitizing window's ORIGIN.

Press RETURN when ready

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button then press the Writing Pen on the Tablet surface at the desired location. Release the ORIGIN button. Press RETURN.

This statement appears:

Enter Data Tape file number

Insert the data tape and type the number of a marked file. This statement appears:

Enter file name for identification

Specify the file name by entering any alphanumeric string up to 40 characters in length. This statement appears:

Move the Pen to the lower left corner of the digitizing window and press once.

In POINT mode, touch the Writing Pen on the Tablet surface at the lower left corner of the desired window. This statement appears:

Move the Pen to the upper right corner of the digitizing window and press again.

In POINT mode, move the Writing Pen to the upper right corner of the desired window and press the tip on the Tablet surface. The window is then set. If the window is not properly set, for example if the upper right corner is set before the lower left, the program will start over from the beginning.

These statements appear:

To delete the last point entered, press USER DEFINABLE 1.

To interrupt input temporarily, press USER DEFINABLE 2.

To permanently interrupt input, press USER DEFINABLE 3.

Position the Pen at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Pen and digitizing.

The design can now be made. Points are digitized in any digitizing mode. No display is produced. After USER-DEFINABLE KEY 3 is pressed and the last point entered, the screen erases and the following statement appears:

Target Data File Stored

The program then terminates. The program can be started by executing a RUN command, or the menu can be obtained by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified file is too small to hold the data, this statement appears:

Target File too small! Remark & rerun.

The program then terminates. Some data may be stored in the specified file, but the file is invalid because the last point stored does not have a HALT function. Appendix C contains a program to make the data file valid by changing the function of the last point to HALT as required. The points that could not fit in the file must be entered again and stored on another file. The two files can then be merged.

TAPE EDITING PROGRAMS (MENU ITEMS 6 AND 7)

The following paragraphs detail programs 6 and 7, which are designed to edit data files made through the use of the PLOT 50: Graphics Tablet Support Software. All specified data files must be on the same magnetic tape cartridge.

The DATA TAPE EDIT program provides functions to delete and insert data points into an existing data tape file. In addition, each point can be examined and the graphic function and coordinate values can be changed. The DATA TAPE MERGE displays data graphically or lists the coordinate values and also provides a function to merge two data files together.

Each program has a menu to select the editing function desired. After selecting a function, the menu can be obtained and the program restarted by entering an M in response to the statement that asks for:

- the function
- the data files
- the indices

The menu is not obtainable at any other time during the execution of the program.

Only one function can be performed with each execution of the program. After performing a function, another function can be performed by executing a RUN command when the program terminates. The program restarts and the menu is displayed.

DATA TAPE EDIT

This program performs three functions: change data points, insert data points, and delete data points on files created by the PLOT 50 programs. In addition, the data may be listed. A target file is created when the editing functions are performed. The target file is a data file that holds the data after editing is completed.

Specifications

MEMORY REQUIREMENTS: approximately 5300 bytes for 8K memory
 13300 bytes for 16K memory
 21300 bytes for 24K memory
 29300 bytes for 32K memory

How To Use The DATA TAPE EDIT Program

When menu item 6 is selected, the screen erases and the following statements appear:

DATA TAPE EDIT HAS BEEN SELECTED

EDITING FUNCTIONS:

- | | |
|---|--------------------|
| 1 | LIST DATA |
| 2 | CHANGE DATA POINTS |
| 3 | INSERT DATA POINTS |
| 4 | DELETE DATA POINTS |

To re-display this menu enter n.

Enter desired function number

EDITING FUNCTION 1—LIST DATA. To see a listing of the data on file, enter a 1 in response to ENTER DESIRED FUNCTION NUMBER. This statement appears:

Enter object data file number

Insert the data tape and enter the number of the data file to be listed. The screen erases and the contents of the file specified are listed in the following format. First the file name is printed. Then, the coordinates and graphic functions are listed under column headings, as shown in the following sample listing. The Window corner values are not included.

The program terminates when the last entry has been printed. Start the program again by executing a RUN command, or return to the PLOT 50 menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified file contains an invalid file, this statement appears:

Object File INVALID! Remark & restore.

GRAPHICS TABLET SUPPORT SOFTWARE
DATA TAPE EDIT

The program then terminates. An invalid file may be created by not using USER-DEFINABLE KEY 3 to halt the program or by storing data in a file that is not large enough to hold the entire data set. Appendix C contains a program to make the data file valid by changing the function of the last point to HALT as required.

mine

NUMBER	X VALUE	Y VALUE	FUNCTION
1	-679	-846	DRAW
2	-88	-853	DRAW
3	-216	-624	DRAW
4	144	-958	DRAW
5	-506	-798	DRAW
6	-122	-689	MOVE
7	34	-889	DRAW
8	75	-934	HALT

EDITING FUNCTION 2—CHANGE DATA POINTS. To change the coordinate values and/or the graphic function of any entry on a data file, enter a 2 in response to ENTER DESIRED FUNCTION NUMBER. This statement appears:

Enter object data file number

Insert the data tape and enter the number of the data file to be edited. This statement appears:

Enter target data file number

The target data file holds the edited data file. The target data file may be any marked data file on the tape except the object data file. After entering the target data file number, the screen erases and these statements appear:

Enter indices of points to be edited:

Conclude by entering an r.

1:

The indices of points can be found on a listing of the object data file as produced by editing function 1. Specify the points to be changed, one per line, in any order. Twenty five points can be entered. Out of range indices are ignored. After entering the points, enter an r as the last entry.

If an invalid data file was specified, this statement appears:

Object File INVALID! Remark & restore.

The program then terminates. An invalid file may be created by not using USER-DEFINABLE KEY 3 to halt the creation program or by storing data in a file that is too small to hold the entire data set. Appendix C contains a program to make the data file valid by changing the function of the last point to HALT as required.

If the file is valid, the indices are sorted and each point specified is examined in the following format. First, the point is listed by number and the graphic function is stated. For example:

Point 3

Operation is DRAW change (yes/no)

If YES is entered, the operation becomes a DRAW if MOVE is the stated operation or the operation becomes MOVE if DRAW is the stated operation. A NO retains the stated operation. A HALT operation is not changed even if YES is entered.

Next, the X coordinate is printed and can be changed if desired. For example:

X value is -637 change to

To retain the current value, press RETURN. The value is changed by entering a new value. The value should be within the Window used and in the same coordinate unit.

The Y coordinate is then printed and can be changed like the X coordinate:

Y value is -750 change to

As before, enter a new value or press RETURN to retain the current value. The new value should be within the Window used and in the same coordinate unit.

After each point is examined, the data file is stored in the target file previously specified and this statement appears:

Target file stored

The program then terminates. Start the program again by executing a RUN command or return to the PLOT 50 menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified target file is too small to hold the entire data set, this statement appears:

```
Target File too small! Remark & rerun.
```

The program then terminates. Because the file is too small, not all the data points are stored. Some data may be stored in the specified file, but the file is invalid because the last point stored does not have a HALT function. Appendix C contains a program to make the data file valid by changing the function of the last point to HALT as required.

Because some points are lost, another alternative is to run the program again, specify a larger target file, and make the changes on the object file as before.

EDITING FUNCTION 3—INSERT DATA POINTS. To insert points at any locations in a data file, enter a 3 in response to ENTER DESIRED FUNCTION NUMBER. This statement appears:

```
Enter object data file number
```

Insert the data tape and enter the number of the data file to be edited. This statement appears:

```
Enter target data file number
```

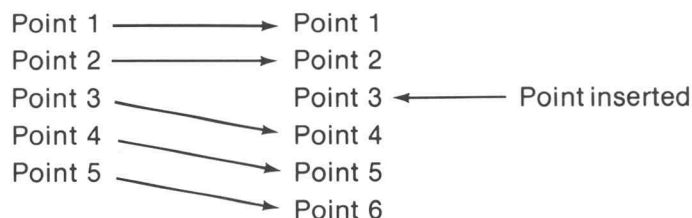
The target data file holds the edited data file. The target data file may be any marked data file on the tape except the object data file. After entering the target file number, the screen erases and these statements appear:

```
Enter indicies of points to be edited:
```

```
Conclude by entering an r.
```

```
1:
```

The indices of points can be found on a listing of the object data file as produced by editing function 1. Specify up to twenty-five points, one per line, in any order. Although the insertions will change the indices, specify the points as they appear in the object file listing. The indices are updated after all insertions are made. For example, if five points are on a file and at point 3 a new point is inserted, the result is:



No point can be inserted after the last (HALT) point. Out of range indices are ignored. After entering the points, enter an r as the last entry.

If an invalid data file was specified, this statement appears:

Object File INVALID! Remark & restore.

The program then terminates. An invalid file may be created by not using USER-DEFINABLE KEY 3 to halt the creation program or by storing data in a file not large enough to hold the entire data set. Appendix C contains a program to make data files valid by changing the function of the last point to HALT as required.

If the file is valid, the screen erases, the indices are sorted, and each point is examined in numerical order in the following format. First the point is identified and the graphic operation is specified. For example:

Point insertion at 4

Enter operation (move/draw)

Specify the desired graphic function by typing either MOVE or DRAW. The X coordinate is then given a value. This statement appears:

Enter X value

The coordinate value should be within the Window used and in the same coordinate unit. After specifying the X value, the Y coordinate is given a value:

Enter Y value

Specify the Y value desired. The coordinate should be within the Window used and in the same coordinate unit.

As the insertion process proceeds, the points are inserted into the data list and the existing indices are adjusted as needed. When all points are inserted and stored in the specified target file, this statement appears:

Target file stored

The program then terminates. Start the program again by executing a RUN command or return to the PLOT 50 menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified target file is too small to hold the entire data set, this statement appears:

Target File too small! Remark & rerun.

The program then terminates. Because the file is too small, not all the data points are stored. Some data may be stored in the file, but the file is invalid. Appendix C contains a program to make data files valid by changing the function of the last point to HALT as required.

Because some points are lost, another alternative is to run the program again, specify a larger target file, and make the insertions as before.

EDITING FUNCTION 4—DELETE DATA POINTS. To delete data points at any locations in a data file, enter a 4 in response to ENTER DESIRED FUNCTION NUMBER. This statement appears:

Enter object data file number

Insert the data tape and enter the number of the data file to be edited. This statement appears:

Enter target data file number

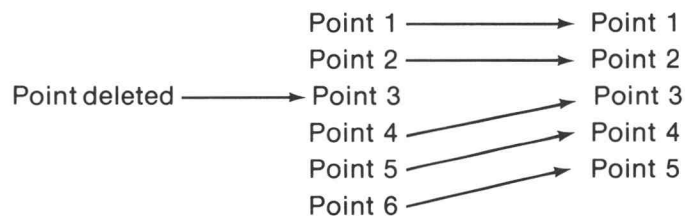
The target data file holds the edited data file. The target data file may be any marked file on the tape except the object data file. After entering the target data file number, the screen erases and these statements appear:

Enter indices of points to be edited:

Conclude by entering an r.

1:

The indices of points can be found on a listing of the object data file as produced by editing function 1. Specify up to twenty-five data points, one per line, in any order. Although deletions will change the indices, specify the indices as they appear in the object file listing. The indices are updated after all deletions are made. For example, if six points are on a file and at point 3 a point is deleted, the result is:



The last data point cannot be deleted. Out of range indices are ignored. After specifying the indices, enter an r as the last entry.

If an invalid data file was specified, this statement appears:

Object File INVALID! Remark & restore.

The program terminates. An invalid data file may be created by not using USER-DEFINABLE KEY 3 to halt the creation program or by storing data in a file not large enough to hold the entire data set. Appendix C contains a program to make the data file valid by changing the function of the last point to HALT as required.

If the file is valid, the indices are sorted, the points are deleted, and each deleted point and the coordinate values are listed. For example:

Point 3

X value -637 Y value -750 DELETED

Point 4

X value -543 Y value -850 DELETED

When all points have been listed and the remaining points stored in the target file, the following statement appears:

Target file stored

The program then terminates. The program can be started again by executing a RUN command, or the menu can be obtained by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified target file is too small to hold the entire data set, this statement appears:

Target File too small! Remark & rerun.

The program then terminates. Because the file is too small, not all the data points are stored. Some data may be stored in the file, but the file is invalid. Appendix C contains a program to make data files valid by changing the function of the last point to HALT as required.

Because some points are lost, another alternative is to run the program again, specify a larger target file, and make the deletions as before.

DATA TAPE MERGE

This program merges two data files created by other programs in the software package. In addition, graphic display or coordinate listings of files may be made.

Specifications

MEMORY REQUIREMENTS: approximately 4400 bytes for 8K memory
 12400 bytes for 16K memory
 20400 bytes for 24K memory
 28400 bytes for 32K memory

How To Use The DATA TAPE MERGE Program

When menu item 7 is selected, the screen erases and the following statements appear:

DATA TAPE MERGE HAS BEEN SELECTED

EDITING FUNCTIONS:

- | | |
|---|------------------|
| 1 | DISPLAY DATA |
| 2 | LIST DATA |
| 3 | MERGE DATA FILES |

To re-display this menu enter m.

Enter desired function number

EDITING FUNCTION 1—DISPLAY DATA. To see a graphic display of the data on a file, enter a 1 in response to ENTER DESIRED FUNCTION NUMBER. This statement appears:

Enter object data file number

Insert the data tape and enter the number of the data file to be displayed. The screen erases and the contents of the file are graphically shown. The program then terminates. Start the program again by executing a RUN command, or return to the menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If an invalid data file is specified, this statement appears:

Object File one INVALID! Remark & restore.

The program then terminates. An invalid data file results from not using USER-DEFINABLE KEY 3 to halt the creation program, or storing data in a file not large enough to hold the entire data set. Appendix C contains a program to make data files valid by changing the function of the last point to HALT as required.

EDITING FUNCTION 2—LIST DATA. To see a coordinate listing of data on a file, enter a 2 in response to ENTER DESIRED FUNCTION NUMBER. This statement appears:

Enter object data file number

Insert the data tape and enter the number of the data file to be listed. The screen erases and the contents of the file are listed in the following format. First the file name is printed. Then, the coordinates and graphic functions are listed under column headings as shown in the following sample listing.

When the last point has been listed, the program terminates. Start the program again by executing a RUN command, or insert the PLOT 50 tape and press AUTOLOAD to see the program menu.

If an invalid data file is specified, this statement appears:

Object File one INVALID! Remark & restore.

The program then terminates. An invalid data file results from not using USER-DEFINABLE KEY 3 to halt the creation program or storing data in a file not large enough to hold the entire data set. Appendix C contains a program to make data files valid by changing the function of the last point to HALT as required.

Mine

NUMBER	X VALUE	Y VALUE	FUNCTION
1	-679	-846	DRAW
2	-88	-853	DRAW
3	-216	-624	DRAW
4	144	-958	DRAW
5	-506	-798	DRAW
6	-122	-689	MOVE
7	34	-889	DRAW
8	75	-934	HALT

EDITING FUNCTION 3—MERGE DATA FILES. To merge two data files, enter a 3 in response to ENTER DESIRED FUNCTION NUMBER. This statement appears:

Enter object data file number

Insert the data tape and enter the number of one of the data files to be merged. This statement appears:

Enter second object data file number

Enter the number of the other data file involved in the merge. The digitizing window of the second object file must be no larger than the digitizing window of the first object file, or out of range data will be stored. After entering the file number, this statement appears:

Enter target data file number

The target data file holds the merged data. The file must be large enough to hold both the object data files. The target file can be the first object file, but not the second object file, or the target file can be any other marked data file large enough to hold both object files. When the target data file number is entered, the second object data file is appended to the first object data file and then both files are stored in the specified target data file.

NOTE

If files are to be merged, the second object file's first point should be a MOVE, unless it is desired that a visible line connects the last point on the first object file with the first point on the second object file.

If the first object file is invalid this statement appears:

Object File one INVALID! Remark & restore.

If the second object file is invalid this statement appears:

Object File two INVALID! Remark & restore.

The program then terminates. The resulting target file is also invalid. An invalid data file results from not using USER-DEFINABLE KEY 3 to halt a creation program or storing data in a file not large enough to hold the entire data set. Appendix C contains a program to make data files valid by changing the function of the last point to HALT as required.

If both object files are valid, the object data files are merged and stored, and this statement appears:

Target Data File Stored

The program then terminates. The program may be started again by executing a RUN command, or the menu can be obtained by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified target file is too small to hold the entire data sets, this statement appears:

Target File too small! Remark & rerun.

The program then terminates. Some data may be stored in the file, but the file is invalid. The program in Appendix C can be used to make the file valid, but some points are lost. In this case, it may be easier to run the merge function again using a larger target file.

PROGRAMS FOR THE OPTIONAL FOUR-BUTTON CURSOR (MENU ITEMS 8 THROUGH 12)

The following paragraphs detail programs 8 through 12, which are designed to be used with the optional four-button Cursor. These programs will not operate properly if the Writing Pen or the one-button Cursor is used. The programs are basically the same as menu items 1 through 5, except the features of the four-button Cursor are implemented instead of user-definable keys.

The four-button Cursor (Fig. 3-1) performs the same functions as the pen switch and the user-definable keys as used in programs 1 through 5. When using the four-button Cursor, the operator does not need to be close to the Graphic System to perform a delete, halt, or move. In addition to performing a function, the buttons on the Cursor also enter a point simultaneously. Table 3-2 illustrates the relationship of the four-button Cursor with the pen and user-definable keys.

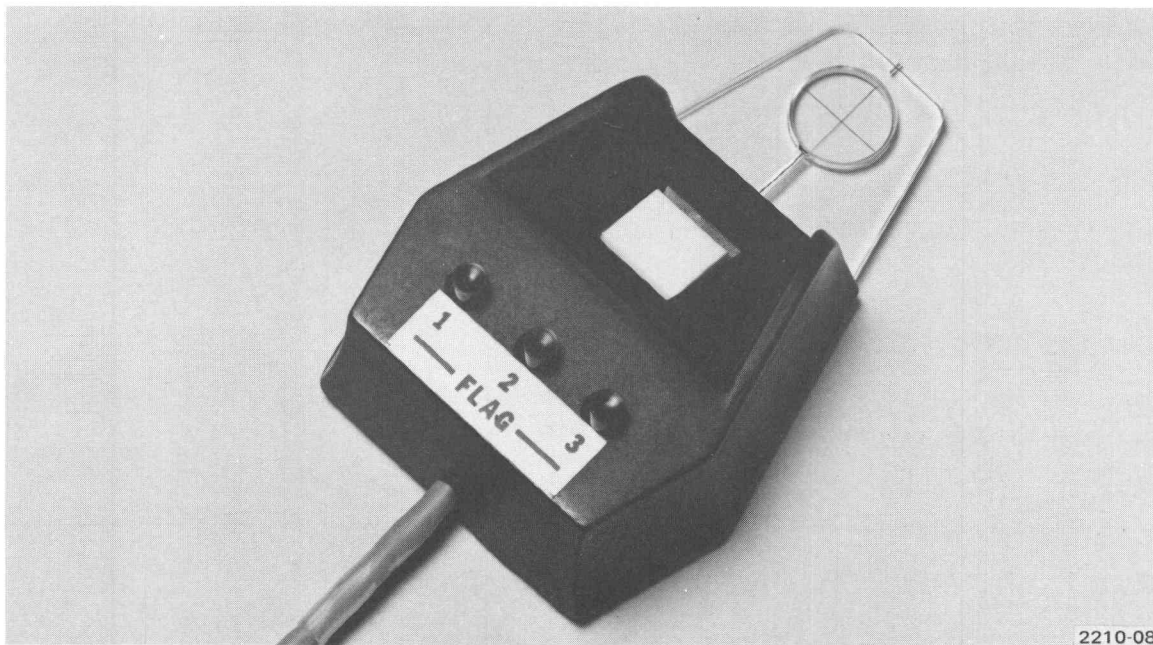


Fig. 3-1. Four-Button Cursor.

Table 3-2
CURSOR BUTTONS AND USER-DEFINABLE KEY FUNCTIONS

Cursor Button	Pen and User Definable Keys	Function
white key	pen switch	The point entered is a DRAW.
1	USER-DEFINABLE KEY 1 and next point entered	Delete the last point entered. (Point entered is ignored.)
2	USER-DEFINABLE KEY 2 and next point entered	The point entered is a MOVE.
3	USER-DEFINABLE KEY 3 and next point entered	Halt the input process.

CURSOR DISPLAY ONLY

This program accepts and displays any number of points as they are digitized in the user-selected mode. The points can be displayed graphically as line segments or listed as coordinates and graphic function.

Specifications

MEMORY REQUIREMENTS: approximately 2500 bytes

Cursor Buttons

Button 1 Ignored
 Button 2 The point entered is a MOVE
 Button 3 Halt the input process

How To Use The CURSOR DISPLAY ONLY Program

When menu item 8 is selected, the screen erases and the following statements appear:

DATA DISPLAY ONLY HAS BEEN SELECTED

Position the Cursor and set the digitizing window's ORIGIN.

Select the display mode (graphics or listing) by
 entering either g or a. Entry

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button then move the Cursor to the origin location on the Tablet surface. Press the white key on the Cursor, and then release the ORIGIN button.

Set the display mode by typing g or a and then pressing RETURN. If g is entered, graphic display is selected. If a is entered, coordinates and the graphic function will be listed.

This statement appears:

Move the Cursor to the lower left corner of the digitizing window and press the white key on the Cursor.

In POINT mode, move the Cursor to the lower left corner of the desired window on the Tablet surface and press the white button.

This statement appears:

Move the Cursor to the upper right corner of the digitizing window and press the white key again.

In POINT mode, move the Cursor to the upper right corner of the desired window and press the white button. The window is set. If the window is not properly set, for example if the upper right corner is set first then the lower left, the program will start over from the beginning.

These statements appear:

To temporarily interrupt input, press Cursor Button 2.

To permanently interrupt input, press Cursor Button 3.

Position the Cursor at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Cursor and digitizing.

The design can now be made. After the first point is entered, the screen erases and points are displayed in the selected display mode. Any of the digitizing modes can be used. The program halts when Cursor button 3 is pressed. The program can be started again by executing a RUN command. The program menu can be displayed by pressing AUTOLOAD.

Sample Listing

By selecting coordinate and graphic function listing as the display mode, a listing similar to the following is obtained. Only the design data points are listed. Notice for number 3, by pressing Cursor button 2 a MOVE is made rather than a DRAW. When Cursor button 3 is pressed, the program halts and the last point entered shows this as a graphic function.

NUMBER	X VALUE	Y VALUE	FUNCTION
1	56	-29	DRAW
2	-51	-536	DRAW
3	-503	-498	MOVE
4	319	-543	DRAW
5	880	104	DRAW
6	-447	244	HALT

CURSOR DISPLAY AND SAVE

This program accepts and displays at least 200 points as they are digitized in the user-selected mode. The maximum number of points accepted depends on the memory size of the Graphic System. The data can be displayed graphically as line segments or listed as coordinates and the graphic function. After the points have been entered, the data may be stored on tape if desired.

Specifications

MEMORY REQUIREMENTS: approximately 5400 bytes for 8K memory
 13400 bytes for 16K memory
 21400 bytes for 24K memory
 29400 bytes for 32K memory

MAXIMUM NUMBER OF POINTS ACCEPTED: 202 in 8K memory
 1202 in 16K memory
 2202 in 24K memory
 3202 in 32K memory

Cursor Buttons

Button 1 The last point entered will be deleted
Button 2 The point entered is a MOVE
Button 3 Halt the input process

How To Use The CURSOR DISPLAY AND SAVE Program

When menu item 9 is selected, the screen erases and the following statements appear:

DATA DISPLAY AND SAVE HAS BEEN SELECTED

Position the Cursor and set the digitizing window's ORIGIN.

**Select the display mode (graphics or listing) by
entering either g or a. Entry**

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button, then move the Cursor to the origin location on the Tablet surface. Press the white key on the Cursor, and then release the ORIGIN button.

Set the display mode by typing g or a and then pressing RETURN. If g is entered, graphic display is selected. If a is entered, coordinates and the graphic function will be listed.

This statement appears:

**Move the Cursor to the lower left corner of the
digitizing window and press the white key on the Cursor.**

In POINT mode, move the Cursor to the lower left corner of the desired window on the Tablet surface and press the white button. This statement appears:

**Move the Cursor to the upper right corner of the digitizing
window and press the white key again.**

In POINT mode, move the Cursor to the upper right corner of the desired window and press the white button. The window is set. If the window is not properly set, for example if the upper right corner is set first then the lower left, the program will start over from the beginning.

These statements appear:

To delete the last point entered, press Cursor Button 1.

To interrupt input temporarily, press Cursor Button 2.

To permanently interrupt input, press Cursor Button 3.

Position the Cursor at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Cursor and digitizing.

The design can now be made. After the first point is digitized, the screen erases and points are displayed in the selected display mode. Any of the digitizing modes can be used. After Cursor button 3 has been pressed and the input process halted, this statement appears:

Enter file number or zero

If 0 (ZERO) is entered, the program terminates. The program can be started by executing a RUN command. The menu can be obtained by pressing AUTOLOAD.

To enter the file number, insert the data tape and enter the number of the marked data file. This statement appears:

Enter file name for identification

The file name can be any alphanumeric string up to 40 characters in length. After entering the file name, the data is stored in the marked file. When the storing process is complete, the screen erases and this statement appears:

Target Data File stored

The program then terminates. Start the program by executing a RUN command or return to the menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified file is too small to hold the data, this statement appears:

Target File too small! Remark & restore.

The program terminates. The program must be run again using a data file with more allocated space. See the heading MARKING FILES in this section for details on allocation of space.

The data may be saved by starting the program at the point where the file number is specified. Execute the following command.

RUN 770

The program will start by asking for the data file number and continue as before. The data can then be stored on a file large enough to hold the entire data set.

Sample Listing

By selecting a coordinate listing as the display mode, a listing like the following is obtained. Only the design data points are listed. Number 2 shows the use of Cursor button 1. The first entry number 2 is deleted and the next point entered becomes point number 2. Cursor button 2 was pressed to make number 3 a MOVE instead of a DRAW. To HALT the input process, Cursor button 3 was pressed as shown in number 5.

NUMBER	X VALUE	Y VALUE	FUNCTION
1	595	586	DRAW
2	1334	1135	DRAW
	*** POINT DELETED ***		
2	1246	586	DRAW
3	-256	230	MOVE
4	411	831	DRAW
5	426	834	HALT

CURSOR SAVE ONLY

This program accepts and saves at least 200 points as they are digitized in the user-selected mode. The maximum number of points accepted depends on the memory size of the Graphic System. After the points are entered, the data may be stored on tape if desired.

Specifications

MEMORY REQUIREMENTS: approximately 4600 bytes for 8K memory
 12600 bytes for 16K memory
 20600 bytes for 24K memory
 28600 bytes for 32K memory

MAXIMUM NUMBER OF POINTS ACCEPTED: 202 in 8K memory
 1202 in 16K memory
 2202 in 24K memory
 3202 in 32K memory

Cursor Buttons

Button 1 The last point entered will be deleted
Button 2 The point entered is a MOVE
Button 3 Halt the input process

How To Use The CURSOR SAVE ONLY Program

When menu item 10 is selected, the screen erases and the following statements appear on the screen:

DATA SAVE ONLY HAS BEEN SELECTED

Position the Cursor and set the digitizing window's ORIGIN.

Press RETURN when ready

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button then move the Cursor to the origin location on the Tablet surface. Press the white key on the Cursor, and then release the ORIGIN button. Press RETURN.

This statement appears:

**Move the Cursor to the lower left corner of the
digitizing window and press the white key on the Cursor.**

In POINT mode, move the Cursor to the lower left corner of the desired window on the Tablet surface and press the white button. This statement appears:

Move the Cursor to the upper right corner of the digitizing window and press the white key again.

In POINT mode, move the Cursor to the upper right corner of the desired window and press the white button. The window is set. If the window is not properly set, for example if the upper right corner is set first then the lower left, the program will start over from the beginning.

These statements appear:

To delete the last point entered, press Cursor Button 1.

To interrupt input temporarily, press Cursor Button 2.

To permanently interrupt input, press Cursor Button 3.

Position the Cursor at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Cursor and digitizing.

The design can now be made. Points are digitized in any digitizing mode. No display is produced. After Cursor button 3 is pressed, the following statement appears:

Enter file number or zero

If 0 (ZERO) is entered, the program terminates. The program can be started by executing a RUN command. The program menu can be obtained by pressing AUTOLOAD.

To enter a file number, insert the data tape and type the number of a marked file. Press the PAGE key. This statement appears:

Enter file name for identification

GRAPHICS TABLET SUPPORT SOFTWARE
CURSOR DISPLAY AND STORE

Specify the file name by typing any alphanumeric string up to 40 characters in length. The data is then stored in the file. When the storing process is complete, this statement appears:

Target Data File stored

The program then terminates. Start the program again by executing a RUN command, or return to the menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified file is too small to hold the data, this statement appears:

Target File too small! Remark & restore.

The program then terminates. The program must be run again using a data file with more allocated space. See the heading MARKING FILES in this section for details on allocating space.

The data may be saved by starting the program at the point where the file number is specified. Execute the following command.

RUN 710

The program will start by asking for the data file number and continue as before. The data can then be stored on a file large enough to hold the entire data set.

CURSOR DISPLAY AND STORE

This program accepts, displays, and stores any number of points as they are digitized in the user-selected mode. The points can be displayed graphically as line segments or listed as coordinates and graphic function. After all points are entered and stored in the specified file, the file is closed.

Specifications

MEMORY REQUIREMENTS: approximately 4900 bytes

Cursor Buttons

- Button 1 The last point entered will be deleted
- Button 2 The point entered is a MOVE
- Button 3 Halt the input process

How To Use The CURSOR DISPLAY AND STORE Program

When menu item 11 is selected, the screen erases and the following statements appear:

DATA DISPLAY AND STORE HAS BEEN SELECTED

Position the Cursor and set the digitizing window's ORIGIN.

**Select the display mode (graphics or listing) by
entering either g or a. Entry**

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button then move the Cursor to the origin location on the Tablet surface. Press the white key on the Cursor, and then release the ORIGIN button.

Set the display mode by typing g or a and then pressing RETURN. If g is entered, graphic display is selected. If a is entered, coordinates and the graphic function will be listed.

This statement appears:

Enter Data Tape file number

Insert the data tape and type the number of a marked file. This statement appears:

Enter file name for identification

Specify the file name by entering any alphanumeric string up to 40 characters in length. This statement appears:

**Move the Cursor to the lower left corner of the
digitizing window and press the white key on the Cursor.**

In POINT mode, move the Cursor to the lower left corner of the desired window on the Tablet surface and press the white button. This statement appears:

**Move the Cursor to the upper right corner of the digitizing
window and press the white key again.**

In POINT mode, move the Cursor to the upper right corner of the desired window and press the white button. The window is set. If the window is not properly set, for example if the upper right corner is set first then the lower left, the program will start over from the beginning.

The following statements appear:

To delete the last point entered, press Cursor Button 1.

To interrupt input temporarily, press Cursor Button 2.

To permanently interrupt input, press Cursor Button 3.

Position the Cursor at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Cursor and digitizing.

The design can now be made. After the first point is digitized, the screen erases and points are displayed in the selected display mode. Any of the digitizing modes can be used. After Cursor button 3 is pressed, the screen erases and this statement appears:

Target Data File Stored

The program then terminates. Start the program again by executing a RUN command, or return to the menu by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified target file is too small to hold the data, this statement appears:

Target File too small! Remark & rerun.

The program then terminates. Some data may be stored in the specified file, but the file is invalid. Appendix C contains a program to make data files valid by changing the function to the last point to HALT as required. The points that could not fit on the file must be entered again and stored on another file. The two files can then be merged.

Sample Listing

By selecting a coordinate listing as the display mode, a listing like the following is obtained. Only the design data points are listed. For number 2, Cursor button 1 was used to delete the first entry for number 2. The next point entered becomes number 2. Cursor button 2 was used to perform a MOVE instead of a DRAW in number 3. The graphic function HALT, shown in number 5 was obtained by pressing Cursor button 3. The input process halts after this point is entered.

NUMBER	X VALUE	Y VALUE	FUNCTION
1	856	72	DRAW
2	1595	-114	DRAW
	*** POINT DELETED ***		
2	1466	-773	DRAW
3	-397	-370	MOVE
4	271	25	DRAW
5	246	-1111	HALT

CURSOR STORE ONLY

This program accepts and stores on tape any number of points as they are digitized in the user-selected mode. After all points are entered and stored in the specified file, the file is closed.

Specifications

MEMORY REQUIREMENTS: approximately 4200 bytes

Cursor Buttons

- Button 1 The last point entered will be deleted
- Button 2 The point entered is a MOVE
- Button 3 Halt the input process

How To Use The CURSOR STORE ONLY Program

When menu item 12 is selected, the screen erases and the following statements appear:

DATA STORE ONLY HAS BEEN SELECTED

Position the Cursor and set the digitizing window's ORIGIN.

Press RETURN when ready

To set the origin, POINT mode must be selected. Press and hold the ORIGIN button then move the Cursor to the origin location on the Tablet surface. Press the white key on the Cursor, and then release the ORIGIN button. Press RETURN.

This statement appears:

Enter Data Tape file number

Insert the data tape and type the number of a marked file. This statement appears:

Enter file name for identification

Specify the file name by entering any alphanumeric string up to 40 characters in length. This statement appears:

Move the Cursor to the lower left corner of the digitizing window and press the white key on the Cursor.

In POINT mode, move the Cursor to the lower left corner of the desired window on the Tablet surface and press the white button. This statement appears:

Move the Cursor to the upper right corner of the digitizing window and press the white key again.

In POINT mode, move the Cursor to the upper right corner of the desired window and press the white button. The window is set. If the window is not properly set, for example if the upper right corner is set first then the lower left, the program will start over from the beginning.

These statements appear:

To delete the last point entered, press Cursor Button 1.

To interrupt input temporarily, press Cursor Button 2.

To permanently interrupt input, press Cursor Button 3.

Position the Cursor at the first point to be digitized.

Select the desired input mode for the Tablet by pressing one of the STREAM SWITCH Buttons, or by leaving the POINT Button depressed.

Begin moving the Cursor and digitizing.

The design can now be made. Points are digitized in any digitizing mode. No display is produced. After Cursor button 3 is pressed, the screen erases and the following statement appears:

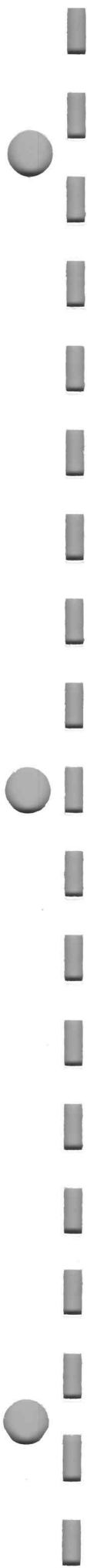
Target Data File Stored

The program then terminates. The program can be started again by executing a RUN command, or the program menu can be obtained by inserting the PLOT 50 tape and pressing AUTOLOAD.

If the specified target file is too small to hold the data, this statement appears:

Target File too small! Remark & rerun.

The program then terminates. Some data may be stored in the specified file, but the file is invalid. Appendix C contains a program to make data files valid by changing the function of the last point to HALT as required. The points that could not fit on the file must be entered again and stored on another file. The two files can then be merged.



Section 4

TABLET MAINTENANCE

BIASING THE TABLET

The Tablet has a grid of permanently magnetized (biased) wires under the Tablet surface. The magnetic bias of these wires must remain stable in order for the Tablet to operate properly.

If the Tablet is exposed to a magnetic field (higher than 40 gauss) the bias will be affected and digitizing errors will occur (Fig. 4-1). When digitizing errors occur, or the Tablet does not operate properly, use the following procedure to restore the Tablet bias.

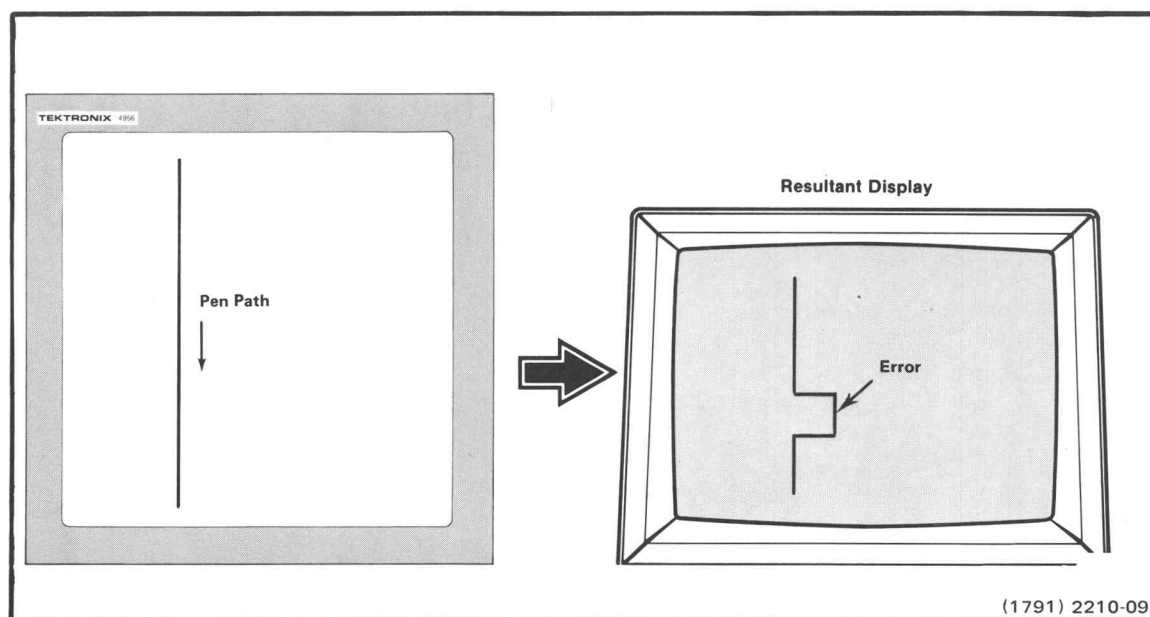


Fig. 4-1. Error caused by uneven tablet bias.

1. Move the POWER switch, located on the rear panel of the Tablet Controller, to the OFF position. Disconnect the two tablet cable connectors from the Tablet Controller. Move the Tablet to an area where there is sufficient room to freely move the biasing magnet. Check the magnet to see if metal particles have settled on it. The Tablet surface can be scratched by particles on the magnet. Wipe the magnet before using if necessary.

2. Place the biasing magnet on the upper left corner of the Tablet surface at a 45° angle to the Tablet edges as shown in Fig. 4-2. Note the markings on the magnet label. The arrows on the label must be pointing forward (steel side up).
3. With the magnet centered on the upper corner of the surface, slowly and evenly move the biasing magnet diagonally across the Tablet surface, from the upper left to the lower right, until it is well past the lower right corner. Remove the magnet from the Tablet area. The biasing must be done in a continuous motion, in approximately 2 to 3 seconds.
4. Repeat steps 2 and 3.
5. Connect the two Tablet cable connectors to the Tablet Controller and move the POWER switch to the ON position. Test the biasing of the Tablet to make sure digitizing errors do not occur by using the program under the heading Checking the Tablet and Tablet Controller. Repeat the biasing procedure if necessary.

CAUTION

Store the biasing magnet away from the Tablet area and magnetic tapes.

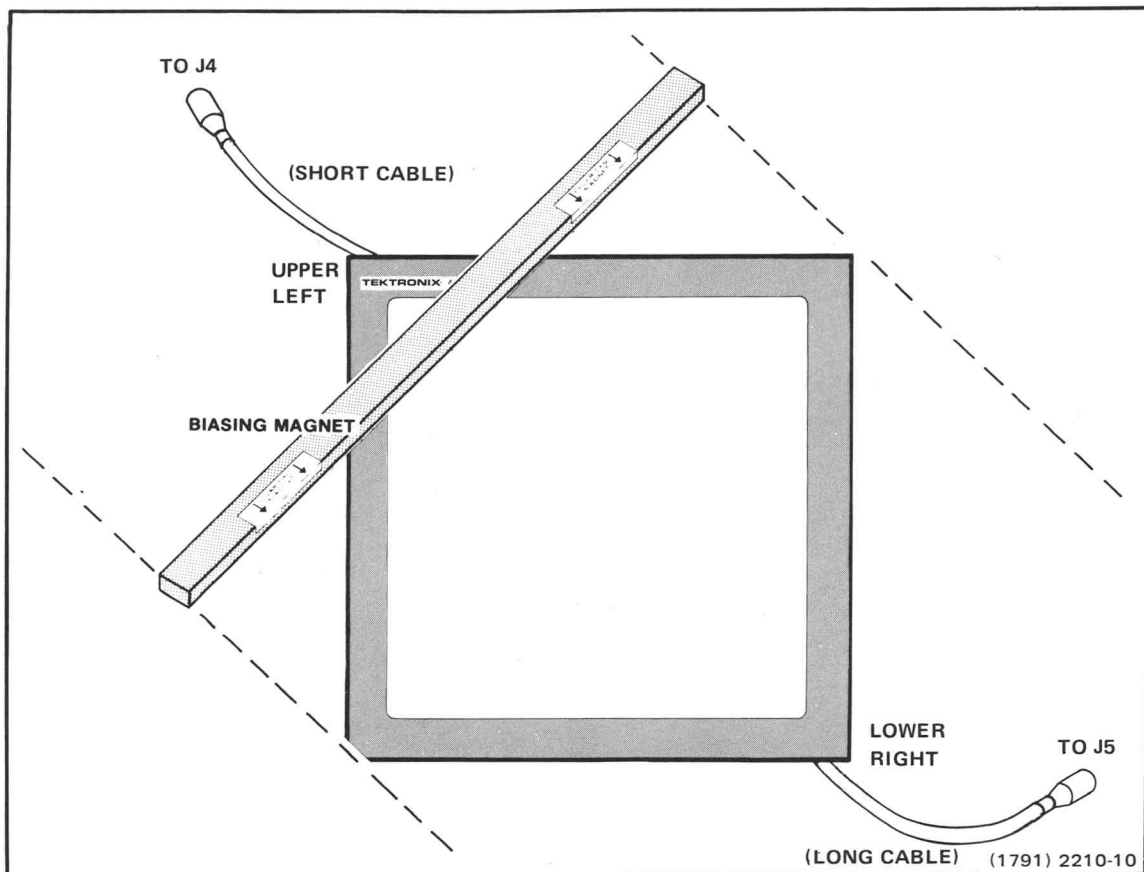


Fig. 4-2. Biasing the Tablet.

CHECKING THE TABLET AND TABLET CONTROLLER.

The following program is designed to check the biasing of the 20" X 20" Tablet and the interface between the Tablet Controller and the Graphic System. (The Window should be adjusted for the 36" X 48" Tablet.) The Tablet Controller should be operating at factory settings; address 8 and counts unit. Enter the following program.

```
100 INIT
110 WINDOW 0,4000,0,4000
120 VIEWPORT 0,100,0,100
130 PAGE
140 FOR J=1 TO 5
150 INPUT @8:X,Y,Z$
160 IF J>1 THEN 180
170 MOVE X,Y
180 DRAW X,Y
190 NEXT J
200 END
```

Draw a five inch square on another sheet of paper. Label each corner using the letters A through D. Place the paper on the Tablet surface, as parallel to the sides as possible. Enter RUN. Touch the corners of the square with the Writing Pen in this order: A, B, C, D, A. The display screen should show a square in relatively the same place on the screen as the square is on the Tablet surface. The sides should be straight and parallel. If this is not the case, bias the Tablet and try again.

CLEANING THE TABLET SURFACE

To remove marks on the Tablet surface, use a soft clean cloth and a glass cleaner or isopropyl alcohol.

CAUTION

The Tablet surface may be damaged by cleaning products that contain hydrocarbons. This includes any product made from petroleum derivatives, such as benzene.



Section 5

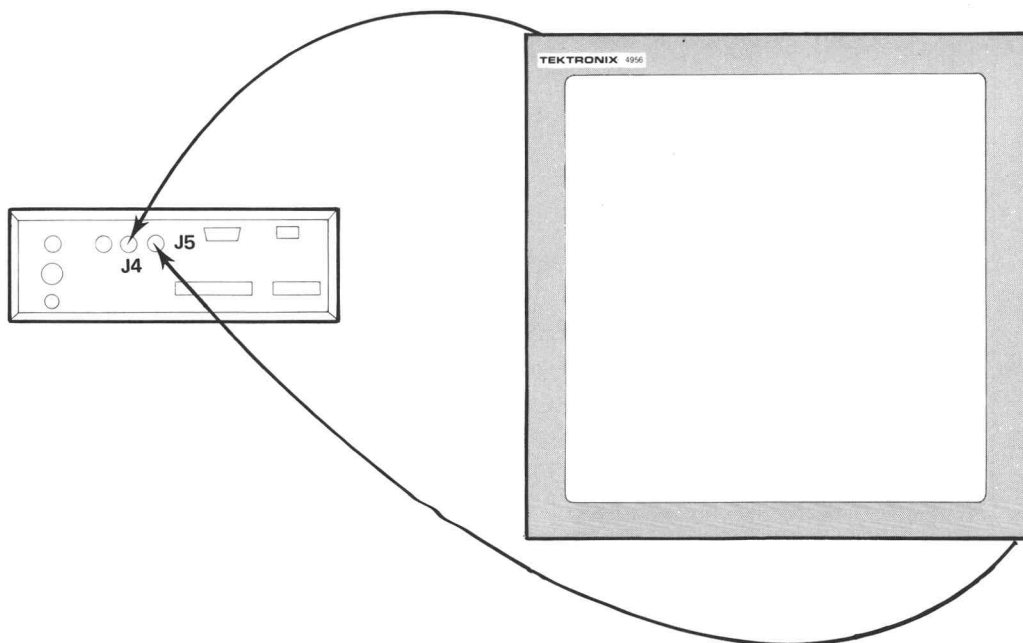
INSTALLATION

INTRODUCTION

This section contains instructions for installing the components of the 4956 Graphics Tablet in the Graphic System. The installation procedure consists of making certain the Graphics Tablet is wired for the available line voltage, connecting the Graphics Tablet components together, connecting the Tablet Controller to the Graphic System, and biasing the Tablet. Power is applied after all the components are installed.

INSTALLATION STEPS

1. Move the power switch on the Graphic System to the OFF position.
2. Connect the cables from the Tablet to the rear panel of the Tablet Controller. Cable connector 4, located on the upper left corner of the Tablet, connects to J4 on the Tablet Controller rear panel. Cable connector 5, located on the lower right corner of the Tablet, connects to J5 (Fig. 5-1). There is a keying notch at the top of the rear panel connectors, which is used to align the key on the Tablet Controller connectors.



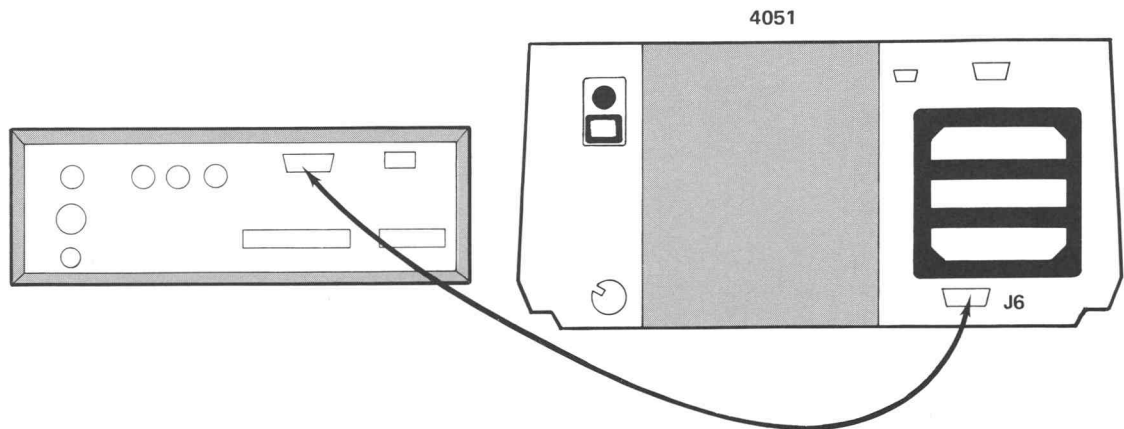
2210-11

Fig. 5-1. Tablet connection.

3. Connect the cable from the Writing Pen to the front panel on the Tablet Controller. There is also a keying notch on this connector to align with the key on the pen cable connector.
4. Connect one end of the GPIB cable to J6 on the back panel of the Graphic System. Connect the other end to the 24 pin connector on the back panel of the Tablet Controller and secure with the two attaching screws (Fig 5-2).

NOTE

According to the IEEE GPIB Standard: If several devices are connected to the GPIB bus, one more than 50% of the devices must be turned on (regardless of whether they are actually used), or the bus may be loaded down by the turned-off devices, causing a spurious SRQ signal on the bus.



2210-12

Fig. 5-2. GPIB cable connection.

5. After checking the ac power requirements in this section and making sure the available line voltage conforms to the specifications, plug the Tablet Controller power cord into the line voltage outlet. Apply power by moving the POWER switch on the back panel of the Tablet Controller up. Then, move the power switch on the Graphic System to the ON position.
6. Bias the Tablet as described in Section 4. Initially, the biasing procedure may need to be repeated several times. Use the program under the heading Checking the Tablet and Tablet Controller in Section 4 to verify the biasing.

SETTING COORDINATE UNITS

By factory setting, the coordinate unit is counts. One count is .005 inch. By setting internal switches, the coordinate unit can also be measured in inches or millimeters, with or without a decimal point. Table 5-1 shows the range of each unit setting and the following paragraphs show how the switches are set to obtain each type of unit. Appendix A contains a summary of internal switch settings.

WARNING

When setting internal switches, dangerous voltages are present. These switches should only be set by qualified service personnel.

To change coordinate units, Switch Bank 1 and the Back Panel Switch Bank are used. The location of these switch banks is shown in Fig. 5-3. Switches 7 and 8 on Switch Bank 1 determine the coordinate unit and switch 7 on the Back Panel Switch Bank controls the decimal point.

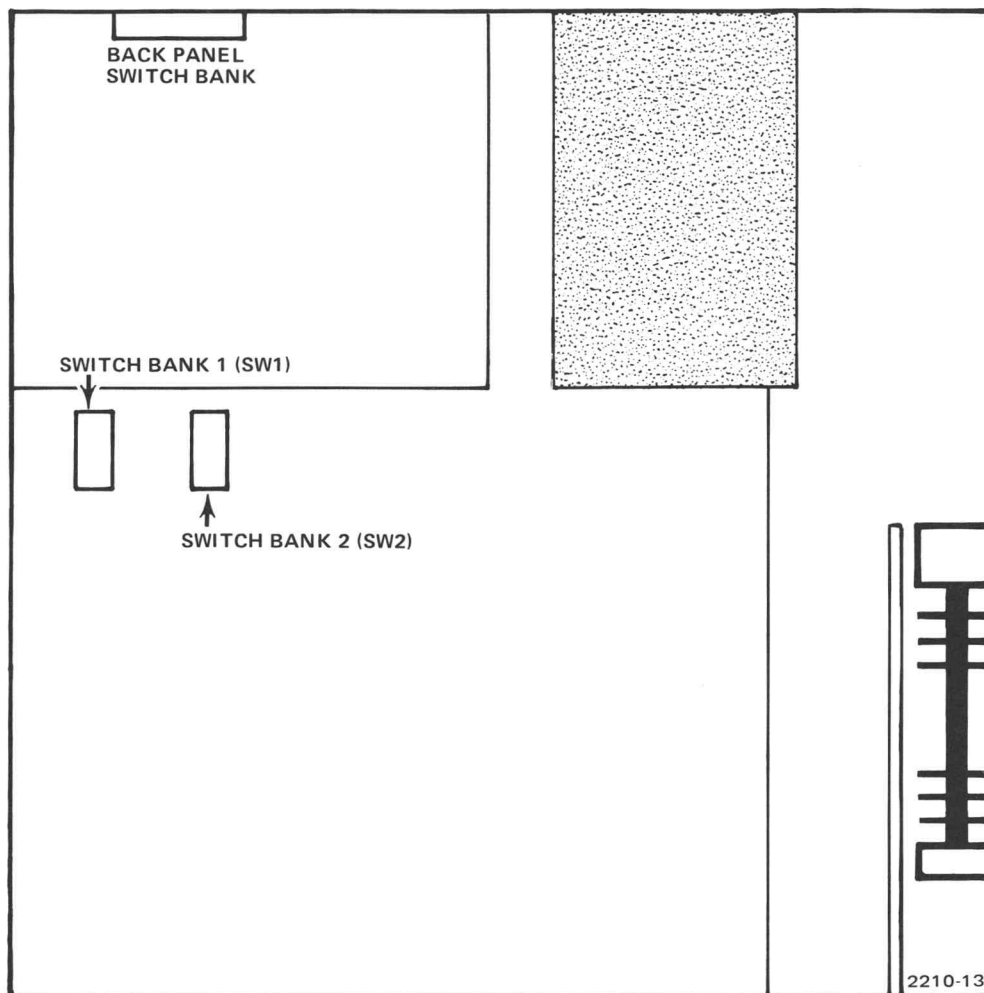


Fig. 5-3. Internal switch locations.

NOTE

Before the Tablet Controller changes units, the CLEAR button must be pressed or an INIT statement must be executed.

Table 5-1
RANGE OF DIGITIZING UNITS

Option	Active Surface	Range Inches	Range Counts	Range Millimeters
std	20" X 20"	20.000 X 20.000	4000 X 4000	508.0 X 508.0
33	36" X 48"	36.000 X 48.000	7200 X 9600	914.4 X 1219.2

CAUTION

Operating the Tablet with any switch on Switch Bank 2 in a changed condition may necessitate recalibration of the instrument.

INCHES

To digitize in inches, the setting of switch bank 1 and the back panel switch should be as follows:

SW1		BPS
7	8	7
OFF	OFF	OFF

A resulting coordinate is in inch units with no decimal point, but a three digit post decimal fraction is included.

To insert a decimal point, use the following configuration:

SW1		BPS
7	8	7
OFF	OFF	ON

A resulting coordinate is in inch units with a decimal point and 3 post decimal digits.

COUNTS

Because counts are always measured with whole numbers, no decimal point or fraction can result. Either of the following configurations is needed to digitize in counts:

SW1		BPS	
7	8	7	
OFF	ON	OFF	*Factory Setting
OFF	ON	ON	

MILLIMETERS

To digitize in millimeters without a decimal point or post decimal digits, use either of the following configurations:

SW1		BPS
7	8	7
ON	ON	ON
ON	ON	OFF

The following configuration digitizes in millimeters with a decimal point and one post decimal digit:

SW1		BPS
7	8	7
ON	OFF	ON

By using the following configuration, coordinates are digitized in millimeters with a single post decimal digit, but without a decimal point inserted.

SW1		BPS
7	8	7
ON	OFF	OFF

AC POWER REQUIREMENTS

CAUTION

The Graphics Tablet is intended to be operated from a single-phase power source that has one of its current-carrying conductors (neutral) at ground (earth) potential. Operation from other power sources where both current-carrying conductors are live with respect to ground (such as phase-to-phase on a multi-phase system, or across the legs of a 115/230 volt single phase three-wire system) is not recommended, since only the line conductor has over-current (fuse) protection within the instrument.

The Graphics Tablet is designed to operate from either a 100-volt, 115-volt, or 230-volt nominal line voltage source that has a frequency of 48 to 66 Hz. Voltage and current requirements are listed in Table 5-2.

Table 5-2
4956 OPERATING VOLTAGES

Nominal Voltage	Tolerance	Voltage Range	Current	Frequency Range
100 V ac	±10%	95 to 116 V ac	.5 Amps.	48 to 66 Hz
115 V ac	±10%	108 to 132 V ac	.6 Amps.	48 to 66 Hz
230 V ac	±10%	198 to 242 V ac	.26 Amps.	48 to 66 Hz

AC POWER CORD AND GROUNDING REQUIREMENTS

This instrument has a three-wire power cord with a three-wire terminal polarized plug for connection to the power source and safety earth. The safety earth terminal is connected to the instrument frame for electric shock protection. Insert this plug only in a mating outlet with a safety earth contact, or otherwise connect the frame of the unit to a safety earth system.

LINE VOLTAGE SELECTION

The line voltage selection should be changed by qualified service personnel only. Contact the nearest Tektronix, Inc. Field Office if the line voltage must be changed.

FUSES

There is one fuse, located at the lower left corner of the Tablet Controller back panel. The line voltage fuse is a 1.2 A slow-blow fuse for operation in the 115 V ac range. For the 230 V ac range, the line voltage fuse is a 0.6 A slow-blow.

REPACKING INFORMATION

If the 4956 Graphics Tablet must be repackaged for shipping, use the original packing materials if possible. If they are not available, pack the Tablet Controller and the Tablet in separate containers. For each component, choose a box that is sturdy enough to support the weight of the component. Before placing the component in the box, wrap it in a thick plastic sheet to avoid damage to the outer surfaces. After placing it in the box, surround it with stiff foam material so that the component cannot move within the box.

For Option 33, the following packing box is available for the Tablet:

Tablet Size	Part Number Packing Box	Packing Box Dimensions
36" X 48"	004-1629-00	49.75" X 62" X 5"

CAUTION

Improper packing may cause damage to the Tablet surface during shipping.



Section 6

SPECIFICATIONS

ENVIRONMENTAL TEMPERATURE

Operating: 15° C to 30° C.
Storage: -20° C to 70° C.

HUMIDITY

Storage to 95% humidity non-condensing.

PHYSICAL

TABLET SIZE (4956 standard)

27.75" wide X 27.75" long X .875" high;
70.485 cm X 70.485 cm X 2.22 cm.

TABLET SIZE (option 33)

43.75" wide X 55.75" long X 1.06" high
111.12 cm X 141.6 cm X 2.69 cm

TABLET CONTROLLER SIZE

13.44" wide X 14.69" long X 4.31" high;
34.14 cm wide X 37.31 cm long X 10.95 cm high.

GPIB CABLE LENGTH

2.187 yards.
2 meters.

ELECTRICAL

The Graphics Tablet operates from any of the line voltage ranges shown in Table 6-1.

Table 6-1

4956 OPERATING VOLTAGE SPECIFICATIONS

Nominal Voltage	Tolerance	Voltage Range	Current	Frequency Range
100 V ac	±10%	95 to 116 V ac	.5 Amps.	48 to 66 Hz
115 V ac	±10%	108 to 132 V ac	.6 Amps.	48 to 66 Hz
230 V ac	±10%	198 to 242 V ac	.26 Amps.	48 to 66 Hz

MAXIMUM INPUT VOLTAGE

250 V ac.

POWER CONSUMPTION

75 watts maximum.

FUSE

1.2 A Slo-Blo for 115 V ac;
0.6 A Slo-Blo for 230 V ac.

PROXIMITY DISTANCE

With the Pen or Cursor within 5/32 inch (.397 cm) of the Tablet surface, the data obtained will be stable with respect to the steadiness of the physical positioning of the Pen or Cursor.

PROXIMITY AREA

OPTION	ACTIVE SURFACE	ACTIVE SURFACE
	inches	centimeters
std	20" X 20"	50.8 cm X 50.8 cm
33	36" X 48"	91.44 cm X 121.92 cm

RESOLUTION

0.005" (.0127 cm).

ACCURACY

±0.004" ±1 count (.010 cm).

REPEATABILITY

± 1/2 count.

APPENDIX A

INTERNAL SWITCH SETTINGS

Table A-1

COORDINATE UNIT SWITCH SETTINGS

Coordinate Unit	Switch Bank 1		Back Panel Switch	
	7	8	7	
COUNTS no decimal	OFF	ON	OFF	*factory setting
COUNTS no decimal	OFF	ON	ON	
INCHES no decimal				
three post decimal digits	OFF	OFF	OFF	
INCHES with decimal and				
three post decimal digits	OFF	OFF	ON	
MILLIMETERS no decimal and				
no post decimal digit	ON	ON	OFF	
MILLIMETERS no decimal and				
no post decimal digit	ON	ON	ON	
MILLIMETERS with decimal and				
one post decimal digit	ON	OFF	ON	
MILLIMETERS no decimal and				
one post decimal digit	ON	OFF	OFF	

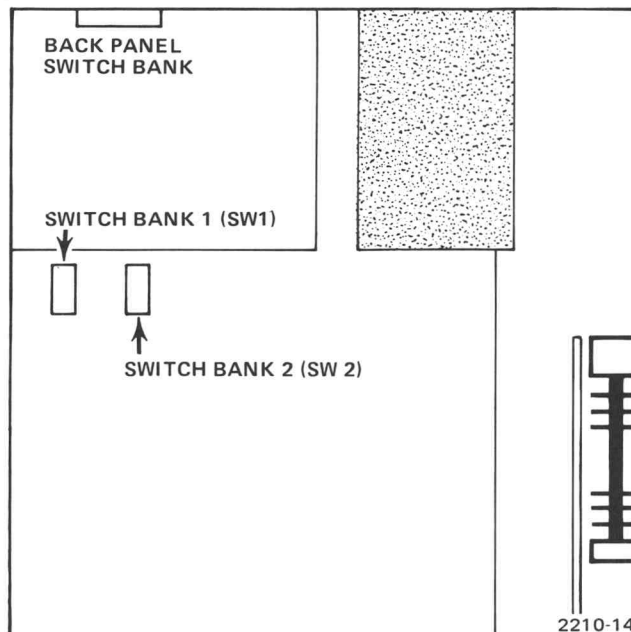


Fig. A-1. Internal Switch Locations.

Table A-2

BACK PANEL SWITCH BANK

Switch	On	Off
1	Add 1 to address	
2	Add 2 to address	
3	Add 4 to address	
4	Add 8 to address	
5	Add 16 to address	
6	SRQ enabled	SRQ disabled
7	Decimal point enabled	Decimal point disabled
8	RESTRICTED USE	DO NOT ALTER

Table A-3

SWITCH BANK 1

Switch	
1	RESTRICTED USE DO NOT ALTER
2	RESTRICTED USE DO NOT ALTER
3	RESTRICTED USE DO NOT ALTER
4	RESTRICTED USE DO NOT ALTER
5	RESTRICTED USE DO NOT ALTER
6	RESTRICTED USE DO NOT ALTER
7	SETTING DETERMINES COORDINATE UNIT
8	SETTING DETERMINES COORDINATE UNIT

SWITCH BANK 2

All switches are restricted. Operating the Tablet with any switch on SWITCH BANK 2 in a changed condition may necessitate recalibration of the instrument.

APPENDIX B

PLOT 50: SUPPORT SOFTWARE VARIABLES

PEN DISPLAY ONLY (MENU ITEM 1)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain graphic function name.
X\$	Used to contain file-name.
Z\$	Used to accept status byte from graphic tablet. Z\$=0 indicates proximity only; Z\$=1 indicates pen pressed down.
00	Used to store coordinate input counter.
01	Used as line counter for listing data.
05	Used as a logic variable. 05=1 graphic display required; 05=2 coordinate listing required.
06	Low X window boundary.
07	Low Y window boundary.
08	High X window boundary.
09	High Y window boundary.
X	Current X value.
Y	Current Y value.
Z	Current graphic function from Z\$. Z=0 proximity only; Z=1 draw or subject to the value of Z1.
Z\$	Set by User-Definable Keys: Z1=1 next input is DRAW; Z1=2 next input is MOVE; Z1=4 halt after next input.

PEN DISPLAY AND SAVE (MENU ITEM 2)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
Z\$	Used to accept the status byte from the Graphics Tablet.
D	Used to store the data vector.
F	Used to store file number.
M0	Used to store the size of array D: M0=202 for 8K memory; M0=1202 for 16K memory; M0=2202 for 24K memory; M0=3202 for 32K memory.
00	Used to store coordinate input counter.
01	Used as line counter for alpha listings.
02	Used to adjust data for measurement type.
03	Used as a logic variable: 03=1 measurements in counts; 03=2 measurements in inches no decimal; 03=3 measurements in inches with decimal.
04	Used as a counter in writing D to tape.
05	Used as a logic variable: 05=1 graphic display required; 05=2 coordinate listing required.
06	Used for low X window boundary.
07	Used for low Y window boundary.
08	Used for high X window boundary.
09	Used for high Y window boundary.
X	Used for current X value.
Y	Used for current Y value.
Z	Used to store graphic function: Z=0 proximity only; Z=1 input is processed.
Z1	Set by User-Definable Keys: Z1=1 next input is a DRAW; Z1=2 next input is a MOVE; Z1=3 delete last input; Z1=4 halt after next input.

PEN SAVE ONLY (MENU ITEM 3)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
Z\$	Used to accept the status byte from the Graphics Tablet.
D	Used to store the data vector.
F	Used to store file number.
M0	Used to store the size of array D: M0=102 for 8K memory; M0=1202 for 16K memory; M0=2202 for 24K memory; M0=3202 for 32K memoyr.
00	Used to store coordinate input counter.
02	Used to adjust data for measurement type.
03	Used as a logic variable: 03=1 measurements in counts; 03=2 measurements in inches no decimal; 03=3 measurements in inches with decimal.
04	Used as a counter in writing D to tape.
06	Used for low X window boundary.
07	Used for low Y window boundary.
08	Used for high X window boundary.
09	Used for high Y window boundary.
X	Used for current X value.
Y	Used for current Y value.
Z	Used to store graphic function: Z=0 proximity only; Z=1 input is processed.
Z1	Set by User-Definable Keys: Z1=1 next input is a DRAW; Z1=2 next input is a MOVE; Z1=3 delete last input; Z1=4 halt after next input.

PEN DISPLAY AND STORE (MENU ITEM 4)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
Z\$	Used to accept the status byte from the Graphics Tablet.
D	Used to store the data buffer of 100 points.
F	Used to store file number.
M0	Used to indicate the next point in the data buffer which should be written to tape.
00	Used to store coordinate input counter.
01	Used as line counter for alpha listings.
02	Used to adjust data for measurement type.
03	Used as a logic variable: 03=1 measurements in counts; 03=2 measurements in inches no decimal; 03=3 measurements in inches with decimal.
04	Used as coordinate output counter.
05	Used as a logic variable: 05=1 graphic display required; 05=2 coordinate listing required.
06	Used for low X window boundary.
07	Used for low Y window boundary.
08	Used for high X window boundary.
09	Used for high Y window boundary.
X	Used for current X value.
Y	Used for current Y value.
Z	Used to store graphic function: Z=0 proximity only; Z=1 input is processed.
Z1	Set by User-Definable Keys: Z1=1 next input is a DRAW; Z1=2 next input is a MOVE; Z1=3 delete last input; Z1=4 halt after next input.

PEN STORE ONLY (MENU ITEM 5)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
Z\$	Used to accept the status byte from the Graphics Tablet.
D	Used to store the data buffer of 100 points.
F	Used to store file number.
MØ	Used to point at the next point in the data buffer which should be written.
00	Used to store coordinate input counter.
01	Used as a coordinate output counter.
02	Used to adjust data for measurement type.
03	Used as a logic variable: 03=1 measurements in counts; 03=2 measurements in inches no decimal; 03=3 measurements in inches with decimal.
06	Used for low X window boundary.
07	Used for low Y window boundary.
08	Used for high X window boundary.
09	Used for high Y window boundary.
X	Used for current X value.
Y	Used for current Y value.
Z	Used to store graphic function: Z=Ø proximity only; Z=1 input is processed.
Z1	Set by User-Definable Keys: Z1=1 next input is a DRAW; Z1=2 next input is a MOVE; Z1=3 delete last input; Z1=4 halt after next input.

DATA TAPE EDIT (MENU ITEM 6)

Variable	Description
F\$	Used to accept single-digit input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
D	Used to store the data buffer.
F1	Used to store object file number.
F2	Used to store target file number.
I	Used to store up to 25 data indices.
M0	Used as secondary counter in reading from object data file. Used as a counter while editing the data.
M1	Used as a counter to enter data indices for editing. After entry contains the number of indices.
M2	Used as the primary counter in sorting data indices. Used to count the number of points edited.
M3	Used as temporary storage while sorting data indices. Used as counter in reading blocks from object data file.
M4	Used as the secondary counter in sorting data indices. Used as the counter of points written on the target data file.
M5	Used to store graphic function during data point insert procedure.
M6	Used to store size of array D: M6= 50 for 8K memory; M6=1050 for 16K memory; M6=2050 for 24K memory; M6=3050 for 32K memory.
00	Used to store coordinate input counter.
01	Used as a line counter for coordinate listing and as a counter of the number of blocks processed from the object data file.

DATA TAPE EDIT (MENU ITEM 6) Cont.

02	Used as a logic variable: 02=1 LIST DATA selected; 02=2 CHANGE DATA POINTS selected; 02=3 INSERT DATA POINTS selected; 02=4 DELETE DATA POINTS selected.
03	Used as a logic variable: 03=0 numeric entry invalid; 03>0 numeric entry valid.
04	Used to store measurement type: 04=1 measurements in counts; 04=2 measurements in inches no decimal; 04=3 measurements in inches with decimal.
05	Used to contain graphic function: 05=0 point is a DRAW; 05=1 point is a MOVE; 05=4 point is HALT.
X	Used for current X value.
Y	Used for current Y value and to read points from object data tape and target data tape.

DATA TAPE MERGE (MENU ITEM 7)

Variable	Description
F\$	Used to accept single-digit input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
D	Used to store the data buffer.
F1	Used to store object file number.
F2	Used to store second object file number.
F3	Used to store target file number.
M0	Used as secondary counter in reading from object and target data files.
M3	Used as primary counter in reading blocks from object data file.
M4	Used to count points in the first object file. Used as the counter of points written on the target data file.
M6	Used to store size of array D. M6= 50 for 8K memory; M6=1050 for 16K memory; M6=2050 for 24K memory; M6=3050 for 32K memory.
00	Used to store coordinate input counter.
01	Used as a line counter for coordinate listing and as a counter of the number of blocks processed from the object data file.
02	Used as logic variable: 02=1 DISPLAY DATA selected; 02=2 LIST DATA selected; 02=3 MERGE DATA FILES selected.
03	Used as a logic variable: 03=0 numeric entry invalid; 03>0 numeric entry valid.
04	Used to store measurement type: 04=1 measurements in counts; 04=2 measurements in inches no decimal; 04=3 measurements in inches with decimal.
05	Used to contain graphic function: 05=0 point is a DRAW; 05=1 point is a MOVE; 05=4 point is HALT.
06	Low X window boundary.
07	Low Y window boundary.
08	High X window boundary.
09	High Y window boundary.
X	Used for current X value
Y	Used for current Y value and to read points from object data tape and target data tape.

CURSOR DISPLAY ONLY (MENU ITEM 8)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain graphic function.
X\$	Used to contain file-name.
Z\$	Used to accept status byte from graphic tablet: Z\$=0 indicates proximity only; Z\$=1 indicates Cursor white button pressed; Z\$=2 indicates Cursor button 3 pressed; A\$=4 indicates Cursor button 2 pressed; Z\$=8 indicates Cursor button 1 pressed.
00	Used to store coordinate input counter.
01	Used as line counter for listing data.
05	Used as a logic variable: 05=1 graphic display required; 05=2 coordinate listing required.
06	Low X window boundary.
07	Low Y window boundary.
08	High X window boundary.
09	High Y window boundary.
X	Current X value.
Y	Current Y value.
Z	Current graphic function from Z\$: Z=0 proximity only; Z=1 draw or subject to the value of Z\$; Z=2 halt with input; Z=4 input is a move; Z=8 ignored.

CURSOR DISPLAY AND SAVE (MENU ITEM 9)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
Z\$	Used to accept the status byte from the Graphics Tablet.
D	Used to store the data vector.
F	Used to store file number.
M0	Used to store the size of array D: M0= 202 for 8K memory; M0=1202 for 16K memory; M0=2202 for 24K memory; M0=3202 for 32K memory.
00	Used to store coordinate input counter.
01	Used as line counter for coordinate listings.
02	Used to adjust data for measurement type.
03	Used as a logic variable: 03=1 measurements in counts; 03=2 measurements in inches no decimal; 03=3 measurements in inches with decimal.
04	Used as a counter in writing D to tape.
05	Used as a logic variable: 05=1 graphic display required; 05=2 coordinate listing required.
06	Used for low X window boundary.
07	Used for low Y window boundary.
08	Used for high X window boundary.
09	Used for high Y window boundary.
X	Used for current X value.
Y	Used for current Y value.
Z	Used to store graphic function: Z=0 proximity only; Z=1 input is a DRAW; Z=2 halt after input; Z=4 this point is a MOVE; Z=8 delete last input.

CURSOR SAVE ONLY (MENU ITEM 10)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
Z\$	Used to accept the status byte from the Graphics Tablet.
D	Used to store the data vector.
F	Used to store file number.
MØ	Used to store the size of array D: MØ= 2Ø2 for 8K memory; MØ=12Ø2 for 16K memory; MØ=22Ø2 for 24K memory; MØ=32Ø2 for 32K memory.
ØØ	Used to store coordinate input counter.
Ø2	Used to adjust data for measurement type.
Ø3	Used as a logic variable: Ø3=1 measurements in counts; Ø3=2 measurements in inches no decimal; Ø3=3 measurements in inches with decimal.
Ø4	Used as a counter in writing D to tape.
Ø6	Used for low X window boundary.
Ø7	Used for low Y window boundary.
Ø8	Used for high X window boundary.
Ø9	Used for high Y window boundary.
X	Used for current X value.
Y	Used for current Y value.
Z	Used to store graphic function: Z=Ø proximity only; Z=1 input is a DRAW; Z=2 halt after input; Z=4 input is a move; Z=8 delete last input.

CURSOR DISPLAY AND STORE (MENU ITEM 11)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
Z\$	Used to accept the status byte from the Graphics Tablet.
D	Used to store the data buffer of 100 points.
F	Use to store the number.
M0	Used to indicate the next point in the data buffer which should be written to tape.
00	Used to store coordinate input counter.
01	Used as line counter for coordinate listings.
02	Used to adjust data for measurement type.
03	Used as a logic variable: 03=1 measurements in counts; 03=2 measurements in inches no decimal; 03=3 measurements in inches with decimal.
04	Used as a coordinate output counter.
05	Used as a logic variable: 05=1 graphic display required; 05=2 coordinate listing required.
06	Used for low X window boundary.
07	Used for low Y window boundary.
08	Used for high X window boundary.
09	Used for high Y window boundary.
X	Used for current X value.
Y	Used for current Y value.
Z	Used to store graphic function: Z=0 proximity only; Z=1 input is a DRAW; Z=2 halt with input; Z=4 input is a MOVE; Z=8 delete last input.

CURSOR STORE ONLY (MENU ITEM 12)

Variable	Description
F\$	Used to accept single-character input.
G\$	Used to accept multi-character input and to contain the graphic function.
X\$	Used to contain the file-name.
Z\$	Used to accept the status byte from the Graphics Tablet.
D	Used to store the data buffer of 100 points.
F	Used to store file number.
M0	Used to point at the next point in the data buffer which should be written.
00	Used to store coordinate input counter.
01	Used to store coordinate output counter.
02	Used to adjust data for measurement type.
03	Used as a logic variable: 03=1 measurements in counts; 03=2 measurements in inches no decimal; 03=3 measurements in inches with decimal.
06	Used for low X boundary.
07	Used for low Y boundary.
08	Used for high X boundary.
09	Used for high Y boundary.
X	Used for current X value.
Y	Used for current Y value.
Z	Used to store graphic function: Z=0 proximity only; Z=1 input is a DRAW; Z=2 halt with input; Z=4 input is a MOVE; Z=8 delete last input.



APPENDIX C

SUPPLEMENTAL PROGRAMS

PROGRAM TO RECOVER INVALID DATA FILES

```
100 INIT
110 DIM X$(40)
120 PAGE
130 ON EOF (3) THEN 390
140 PRINT "Enter number of invalid Object Data File ";
150 REM Accept and test file number.
160 INPUT F
170 IF F<1 THEN 140
180 REM Find file and read title and parameters.
190 FIND F
200 READ @33:X$,L,H,C
210 REM Initialize counter, then read until End-Of-File.
220 O0=0
230 ON EOF (3) THEN 280
240 READ @33:X
250 Y=X
260 O0=O0+1
270 GO TO 240
280 REM* Re-read data and write halt point.
290 ON EOF (3) THEN 390
300 FIND F
310 READ @33:X$,L,H,C
320 FOR O1=1 TO O0-1
330 READ @33:X
340 NEXT O1
350 REM Halt point is computed from last valid data point.
360 WRITE @33:Y+(9-INT(Y/100000))*100000
370 PRINT "PROGRAM STOREDGG"
380 END
390 PRINT "--Object Data File not recoverable!!G"
400 END
```

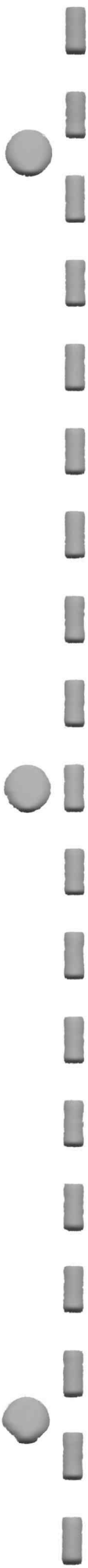
PROGRAM TO READ AND DISPLAY DATA FILES

```
100 REM--This program reads and displays data files
110 REM--created by the tablet support software tape
120 REM
130 REM--Get the file number
140 INIT
150 PRINT "TYPE FILE NUMBER"
160 INPUT F
170 FIND F
180 REM
190 REM--Read the filename and coordinate unit
200 READ @33:N$,U
210 REM
220 REM--Read the lower left window coordinate and unpack
230 READ @33:D
240 GOSUB 560
250 X1=X
260 Y1=Y
270 REM--Read the upper right window coordinte and unpack
280 READ @33:D
290 GOSUB 560
300 X2=X
310 Y2=Y
320 REM--Use the window coordinates to set the window and viewport
330 WINDOW X1,X2,Y1,Y2
340 VIEWPORT 0,100 MIN (X2-X1)/(Y2-Y1)*100,0,100 MIN (Y2-Y1)/(X2-X1)*100
350 PAGE
360 REM
370 REM--Print the filename and coordinate unit
380 PRINT "NAME",N$,"COORDINATE CODE",U
390 REM
400 REM--Read a coordinate and unpack
410 READ @33:D
420 GOSUB 560
430 REM--F=4 means HALT close file and stop
440 IF F=4 THEN 630
450 REM--F=0 means DRAW
460 IF F=0 THEN 500
470 REM--F should equal 1 meaning MOVE (could check this)
480 MOVE X,Y
490 GO TO 530
500 DRAW X,Y
510 REM
520 REM--Get next coordinate
530 GO TO 410
540 REM
550 REM--This section is used as a subroutine to unpack coordinates
560 F=INT(D/200000)
570 D1=INT(D-F*200000)
580 X=INT(100000-D1)
590 Y=INT(100000-(D-D1-F*200000)*100000)
600 RETURN
610 REM--End of unpack subroutine
620 REM
630 END
```

APPENDIX D

ERROR MESSAGES

MESSAGE NUMBER	ERROR MESSAGE —PROBABLE CAUSE
40	EOF ON UNIT 0 —The specified file is not large enough to hold the entire data set.
43	NO SRQ ON UNIT —The POWER switch on the Tablet Controller was moved while the Graphic System is operating.
52	MAG TAPE NOT FOUND —The specified file is not marked on the tape.
55	MAG TAPE ERROR —An attempt has been made to edit a program file. —The specified data file is not marked NEW or BINARY.
57	MAG TAPE CARTRIDGE REQUIRED —A tape cartridge has not been inserted.
63	INVALID I/O OPERATION —An attempt has been made to input character data in a numeric variable.
69	GP INTERFACE I/O ERROR —The external device specified in an I/O command could not be found because of incorrect addressing or the POWER not being applied.



INDEX

- AC Power Requirements 5-6
- Accessories 1-7
- Address, Tablet Controller 2-8
- Aspect 3-4
- Back Panel Switch Bank 2-7
- Biasing the Tablet 4-1
- Biasing Magnet 1-7, 4-1
- BPS (see Back Panel Switch Bank)
- Buttons, Tablet Controller 1-5
- Change Data Points 3-24
- Checking the Tablet and Tablet Controller 4-3
- Cleaning the Tablet Surface 4-3
- Clear 1-5, 2-4
- Coordinate plane 1-3, 2-2
- Coordinate units 2-4, 5-3
- Counts unit 5-5
- Cursor
 - one button 1-4
 - four button 1-4, 3-35
- Cursor Display Only 3-36
- Cursor Display and Save 3-38
- Cursor Display and Store 3-44
- Cursor Save Only 3-42
- Cursor Store Only 3-47
- Cursor switch 1-4
- Data buffer 2-9
- Data Compaction 3-2
- Data Tape Edit 3-22
- Data Tape Merge 3-30
- Data transfer 2-8
- Decimal Point switch 5-3
- Delete Data Points 3-28
- Digitizing 1-3
- Digitizing area 1-4
- Digitizing modes 2-1
- Display Data 3-31
- Distance Filter 2-2
- Editing Data Files 3-22
- Error Messages D-1
- Files
 - marking 3-5
 - name 3-4
- Filters, time and distance 2-2
- Four Button Cursor
 - Button functions 3-36
 - Button status values 2-6
 - Programs for 3-35
- Fuses 5-7
- Generation of coordinates 2-1
- GPIB (General Purpose Interface Bus) 2-5
- INCRE 1-5, 2-2
- Indicators, Tablet Controller 1-6
- Initializing Plot 50: support software 3-7
- Inch Unit 5-4
- INPUT instruction 2-8
- Input Procedure 2-8
- Insert Data Points 3-26
- Installation 5-1
- Internal Data Structure 3-2
- Internal Switch Settings 5-3, A-1
- Invalid data file, program for C-1
- List Data (Data Tape Edit) 3-23
- List Data (Data Tape Merge) 3-32
- Line Voltage Selection 5-7
- Menu
 - Plot 50: Graphics Tablet Support Software 3-7
 - Data Tape Edit 3-23
 - Data Tape Merge 3-31
- Merge Data Files 3-32
- Millimeters unit 5-5
- Naming Conventions 3-7
- Operating Notes 3-6
- Optimizing Data Transfer 2-10
- Option 33 1-1
- ORIGIN
 - default 2-2
 - relocating 2-4
- Origin and Coordinates 2-2
- Pen (see Writing Pen)
- Pen Display Only 3-8
- Pen Display and Save 3-10
- Pen Display and Store 3-17
- Pen Save Only 3-14
- Pen Store Only 3-19
- Pen switch 1-4
- POINT 1-5, 2-1
- Power Cord 5-6
- Power switch and indicator 1-6
- PROX 1-6
- Proximity area 1-4
- Quadrant 2-2
- Range of coordinate units 5-4
- Reading Data Tape Files 3-5
- REMOTE 1-5
- Service Manual 1-7
- SRQ (Service Request) 2-9
- Status byte 2-5
- Status byte variable 2-8
- STREAM slide 1-5, 2-2
- STREAM SWITCH 1-5, 2-1
- STREAM SWITCH 1-5, 2-1
- Supplemental Programs C-1
- Tablet 1-2
- Tablet Controller 1-4
 - Address 2-8
 - Back Panel 1-6
 - Front Panel 1-5
 - Internal Switches 5-3, A-1
 - Interrupt 2-9
- Tape Data Structure 3-4
- Tape Editing Programs 3-22
- Tape Storage 3-4
- Tens Complement Notation 3-2
- Time Filter 2-2
- Transfer of coordinates 2-5
- User Definable Keys and Graphic Function 3-1
- Variables, Plot 50 programs A-1
- Viewport 3-4
- Window 3-4
- Writing Pen 1-4
- X and Y coordinate variables 2-8
- Z AXIS 1-6

