Tektronix®

COMMITTED TO EXCELLENCE

4663

INTERACTIVE
DIGITAL PLOTTER

OPERATOR'S MANUAL

BEFORE READING

PLEASE CHECK FOR CHANGE INFORMATION AT THE REAR OF THIS MANUAL.

WARRANTY

Tektronix warrants to the original purchaser that this product and options, excluding customer supplied equipment, is free from defects in materials and workmanship, under normal use, for a period of one (1) year from the date of shipment. Tektronix will, at its option, repair or replace the product if Tektronix determines it is defective within the warranty period, and it is returned, freight prepaid, to a Tektronix Service Center.

In the forty-eight (48) contiguous United States and the District of Columbia, and in other areas where Tektronix normally has service available for this product, Tektronix will provide on-site warranty service at no charge during the first ninety (90) days from the date of shipment.

Tektronix shall be under no obligation to furnish warranty service if:

a. Attempts to repair or service the product are made by personnel other than Tektronix service representatives.

b. Modifications are made to the hardware or software by personnel other than Tektronix representatives.

c. Damage results from connecting the product to incompatible equipment.

There is no implied warranty of fitness for a particular purpose. Tektronix is not liable for consequential damages.

This manual supports the following versions of this product: Serial Numbers B010100 and up

MANUAL REVISION STATUS

REV.	DATE	DESCRIPTION
@	8/79	Original Issue

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WARNING

*The following servicing instructions are for use by qualified personnel
only. To avoid personal injury, do not perform any servicing other than that
contained in operating instructions unless you are qualified to do so.*

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Figure 1-1. 4663 Interactive Digital Plotter.

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Section 1

CHARACTERISTICS

GENERAL DESCRIPTION

The TEKTRONIX 4663 (Figure 1-1) is a dual-pen Interactive Digital Plotter which provides permanent graphic recording capabilities from digital source devices. The standard 4663 Plotter is equipped with a RS-232-C Communications Interface enabling it to be used with Tektronix terminal-based systems. In addition, a selection of optional interface combinations will enable the Plotter to be connected to devices having 20/60 ma current loop, TTY, or GPIB (IEC)[1] interfaces (such as the TEKTRONIX 4924 Digital Cartridge Tape Drive or a 4050 Series Graphic System). However, only one type of serial interface is permitted to be resident in the plotter at any one time.

The X and Y axes of the Plotter are controlled by split-phase synchronous ac motors (two motors in the X axis and one motor in the Y axis). These motors control the movement of a pen carriage, containing two (2) pens, through a system of plastic-covered cables and pulleys. The internal circuitry converts external commands into appropriate vector movements. The two-pen carriage permits multi-color graphics or graphics with multiple pen types. (Note that only one pen can be drawing at any instant.) The pen carriage also contains a crosshair cursor which can be used to optically check and/or align plotted points and for digitizing.

The 4663 will draw on a variety of materials (media) in sheets up to 17 x 22 inches (43.18 x 55.88 cm). In addition, a media advance option is available (Option 36). This option uses a 200' roll of paper up to 18" wide with 1/2" tear-off strips (containing the sprocket holes) on each side. Sheet paper is held in position by electrostatic attraction generated by the platen and roll paper is held in position mechanically by the paper advance mechanism. When using the Media Advance option, the paper can be automatically advanced (under host control) between plots. This means that the Plotter can be run virtually unattended by an operator.

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[1] The GPIB interface is defined in IEEE Standard 488-1975: IEEE Standard Digital Interface for Programmable Instrumentation.

The 4663 offers high quality resolution and plotting capabilities using a variety of pen types, media, and page/viewport sizes. The most basic of the Plotter's operation is graphics — the moving of the pen carriage across the plotting surface, lifting and lowering either pen (only one pen can be active at any instant) to produce written vectors. It can also print alphanumeric characters in any 9 unique resident fonts. In addition, the Plotter can act as a digitizer, transmitting the coordinate position of the active pen along with pen status (up or down). Several user-definable variations of each of these basic operations can be used to increase the versatility of the Plotter. The variations include modification of the size of the plotting area, scaling of the plots, manual pen positioning using the Joystick [2], rotation of the plot, alteration of the axes and character dimensions, point digitizing, choice of plotting speeds, pen pressures, use of programmable macros, and the initiation of a Self Test. Actual implementation of these operations varies according to the interface being used. Several of these user-defined variations can be conveniently introduced via a front panel Parameter Entry card. Parameters selected in this manner remain stored in the Plotter for up to 90 days, even when the plotter is turned off. Detailed instructions concerning these variations are further described in this manual.

SPECIFICATIONS

The remainder of this section is devoted to a series of tables summarizing the physical properties, the electronic specifications, and the performance characteristics of the 4663 Interactive Digital Plotter. The following information and tables are included below:

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[2] Joystick is a trademark of Tektronix, Inc.

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Table 1-1

ACCESSORIES AND OPTIONS

Accessories		Tektronix Part Number
Standard	Power Cord	161-0066-00
	Pens, Fiber Tip (for paper)	
	Red (3 each)	016-0415-00
	Black (3 each)	016-0414-00
	Blue (3 each)	016-0416-00
	Green (3 each)	016-0417-00
	RS-232-C Interface Cable	012-0829-00
	Operator's Manual	070-2670-00
	Reference Guide	070-2828-00
Optional	Wet Ink Pen Assembly	
	with PL3 point (dia= .01" .3mm)	016-0444-00
	PL5 point (dia= .02", .5mm)	016-0442-00
	PL8 point (dia= .03", .8mm)	016-0443-00
	Replacement points	
	PL3 (dia= .01", .3mm)	214-2706-00
	PL5 (dia= .02", .5mm)	214-2760-00
(continued)	PL8 (dia= .03", .8mm)	214-2761-00

Table 1-1 (cont)

ACCESSORIES AND OPTIONS

Accessories		Tektronix Part Number
Optional (Continued)	Pen Replacement Part Kit	006-2968-00
	Contains: 1 cap	
	1 body section	
	1 barrel	
	1 locking nut	
	6 ink reservoirs	
	Ink Reservoir (6 per pkg)	
	Ink	016-0648-00
	For Film (3/4 oz. Squeeze bottle)	
	Black (each)	016-0427-00
	Red (each)	016-0426-00
	Green (each)	016-0424-00
	Blue (each)	016-0425-00
	Brown (each)	016-0423-00
	For Paper (3/4 oz. Squeeze Bottle)	
	Black (each)	016-0428-00
	Ball Point Pens:	
	Black (3 each)	016-0419-00
	Red (3 each)	016-0419-01
	Green (3 each)	016-0419-02
(continued)	Blue (3 each)	016-0419-03

Table 1-1 (cont)

ACCESSORIES AND OPTIONS

Accessories		Tektronix Part Number
Optional (Continued)	Fiber Tip Pens (water Soluble for acetate)	
	Black (3 each)	016-0418-00
	Brown (3 each)	016-0418-01
	Red (3 each)	016-0418-02
	Orange (3 each)	016-0418-03
	Yellow (3 each)	016-0418-04
	Green (3 each)	016-0418-05
	Blue (3 each)	016-0418-06
	Magenta (3 each)	016-0418-07
	Purple (3 each)	016-0418-08
	Dust Cover (soft Vinyl)	200-2392-00
	GPIB Cable	012-0630-03
	Roll Paper (18″ x 200′ for Option 36) (2 rolls per box)	006-2837-00
	Sheet Paper (17″ x 22″ 100 sheets/box)	006-2836-00
	Mylar (17″ x 22″ 100 sheets/box)	006-2835-00
	Service Manual	
	Test and Calibration Fixtures	
	Card Extender	067-0813-00
	Diagnostics	067-0859-00
	Limit Switch Alignment Y-Axis	003-0840-00
	Limit Switch Alignment X-Axis	003-0849-00

Table 1-1 (cont)

ACCESSORIES AND OPTIONS

Options	Description
Interface	Standard Instrument has RS-232-C with Full Duplex and to this these options are added (except for Options 2, 3, and 4):
	Option #1 — GPIB Interface
	Option #2 — TTY Interface (standard RS-232-C Interface is deleted)
	Option #3 — 20/60 ma Current Loop Interface (standard RS-232-C Interface is deleted)
	Option #4 — GPIB Interface Only (standard RS-232-C Interface is deleted)
	Option #30 — RS-232-C to Tektronix 4081 Interface
Performance	Option #31 — Circular Interpolation and Programmable Macros
	Option #32 — Math Character Set and Downloadable Characters
	Option #36 — Media Advance
	Option #37 — Additional Memory to Save and Recall up to 3 additional sets of Parameter Entry Setups
	Option #48 — 220 Volts 50 Hz

Table 1-2

PHYSICAL CHARACTERISTICS

Weight:	Approximately 80 lbs (36.4 Kg)	
Outside Dimensions:	Length	38.0" (96.5 cm)
	Width	30.1" (76.5 cm)
	Height	6.8" (17.3 cm)

Table 1-3

POWER REQUIREMENTS

Input Power @ 115 Vac	3.5 A maximum; 2.4 A typical
Line Voltage, Strap Selectable Limits	
110 Volts	90 to 130 Volts
220 Volts	180 to 250 Volts
Line Frequency	48 to 440 Hz

Table 1-4

ENVIRONMENTAL SPECIFICATIONS

Temperature	
Non-Operating	-55 to + 75° C (-67 to 167° F)
Operating	0 to 40° C (32 to 104° F)
Altitude	
Non-operating	To 50,000 feet (15240 m)
Operating	To 15,000 feet (4572 m)
Vibration	
(Non-operating)	Up to 40 Hz @ .010 inch (.03 cm) total displacement.
Shock	
(Non-operating)	To 30 Gs, 1/2 sine, 11 ms duration.
Transportation	Meets National Safe Transit Committee type of test when packaged as shipped by factory. Test procedure 1A, Category II with a 36″ drop.
Humidity	Mil-T-28800B per test conditions 810 B at 50.71, procedure IV (5 day operating and non-operating, 90 to 95% Relative Humidity).

Table 1-5

PERFORMANCE SPECIFICATIONS

Default Paper Size	A Size — 8 1/2 x 11 in (216 x 279 mm)
	B Size — 11 x 17 in (279 x 432 mm)
	C Size — 17 x 22 in (432 x 559 mm)
	A4 Size — 8.3 x 11.7 in (210 x 297 mm)
	A3 Size — 11.7 x 16.5 in (297 x 420 mm)
	A2 Size — 16.5 x 23.4 in (420 x 594 mm)
	Roll — 200 ft roll, 18 in wide with 1/2 in tear-off strips on each side.
Paper Control (Sheets)	Electrostatic Hold-Down
(Roll)	Mechanical Hold-Down used with Option 36
Paper Drive Speed (Option 36)	$\geq$4.5 ips (11.4 cm/s)
Paper Drive Resolution (Option 36)	0.016 in (0.4 mm)
Plotting Area	Y Axis $\leq$17.25 in (438 mm) X Axis $\leq$23.5 in (597 mm)
Plotting Speed	16.47 in per second along either axis, 23.3 ips at a 45° angle
Acceleration	600 ips^2 in PREVIEW, 400 ips^2 in NORMAL, 300 ips^2 in ENHANCED 1, and 240 ips^2 in EN-HANCED 2
Point Plotting Rate	10 Points/s (max)
Plotting Accuracy	0.15% of Vector Length $\pm$ 0.002 in
Repeatability	Will return to any previously Plotted Point to within $\pm$0.0025 in (0.0635 mm)

Table 1-5 (cont)

PERFORMANCE SPECIFICATIONS

Resolution (Addressable)	0.001 in (0.0254 mm)
Pen Pressure	Coarse Pressure Selected ± 25%
Pen Height (Up)	0.058 in ± 0.013 (1.47 ± 0.33 mm)
Linearity	
Geometry	Mean vector shall not deviate more than ± 0.015 in from a straight line between two points.
Line Aberrations	Short term non-linearity shall not deviate more than ± 0.002 in from mean vector.
Orthogonality	± 0.015 in (0.38mm) across the plotting surface.

Table 1-6

PAGE SIZES (FULL PAGE ASPECT RATIO)

Margin	Orientation	Page Size & Media Dimensions	Measurements (width x height) (ENGLISH-inch)	(METRIC-mm)	Refer to Figure Number
Drafting	Horizontal	C 22 x 17	21.00 x 15.5	533.4 x 393.7	1-2
Drafting	Horizontal	B 17 x 11	15.76 x 10.24	400.3 x 260.1	1-2
Drafting	Horizontal	A 11 x 8.5	10.50 x 7.74	266.7 x 196.6	1-2
Drafting	Horizontal	A2 594 x 420 mm	22.72 x 15.75	574.0 x 400.0	1-3
Drafting	Horizontal	A3 420 x 297 mm	15.75 x 10.91	400.0 x 277.0	1-3
Drafting	Horizontal	A4 297 x 210 mm	10.91 x 7.48	277.0 x 190.0	1-3

Table 1-6 (cont)
PAGE SIZES (FULL PAGE ASPECT RATIO)

Margin	Orientation	Page Size & Media Dimensions	Measurements (width x height)		Refer to Figure Number
			(ENGLISH—inch)	(METRIC—mm)	
Drafting	Vertical	C 17 x 22	15.50 x [a]	393.7x [a]	1-2
Drafting	Vertical	B 11 x 17	10.24 x 15.76	260.1 x 400.3	1-2
Drafting	Vertical	A 8.5 x 11	7.74 x 10.50	196.6 x 266.7	1-2
Drafting	Vertical	A2 420 x 594 mm	15.75 x [a]	400.0 x [a]	1-3
Drafting	Vertical	A3 297 x 420 mm	10.91 x 15.75	277.0 x 400.0	1-3
Drafting	Vertical	A4 210 x 297 mm	7.48 x 10.91	190.0 x 277.0	1-3
Graphing	Horizontal	C 22 x 17	20.50 x 16.00	520.7 x 406.4	1-4
Graphing	Horizontal	B 16.5 x 11	15.00 x 10.00	381.0 x 254.0	1-4
Graphing	Horizontal	A 11 x 8.5	10.00 x 7.00	254.0 x 177.8	1-4
Graphing	Horizontal	A2 594 x 420 mm	22.20 x 15.75	564.0 x 400.0	1-5
Graphing	Horizontal	A3 420 x 297 mm	15.35 x 10.91	390.0 x 277.0	1-5
Graphing	Horizontal	A4 297 x 210 mm	10.91 x 7.28	277.0 x 185.0	1-5
Graphing	Vertical	C 17 x 22	16.00 x [a]	406.4 x [a]	1-4
Graphing	Vertical	B 11 x 16.5	10.00 x 15.00	254.00 x 381.0	1-4
Graphing	Vertical	A 8.5 x 11	7.00 x 10.00	177.8 x 254.0	1-4
Graphing	Vertical	A2 420 x 594 mm	15.75 x [a]	400.0 x [a]	1-5
Graphing	Vertical	A3 297 x 420 mm	10.91 x 15.35	277.0 x 390.0	1-5
Graphing	Vertical	A4 210 x 297 mm	7.28 x 10.91	185.0 x 277.0	1-5

[a]The page dimension is clipped since it would extend beyond the platen boundary.
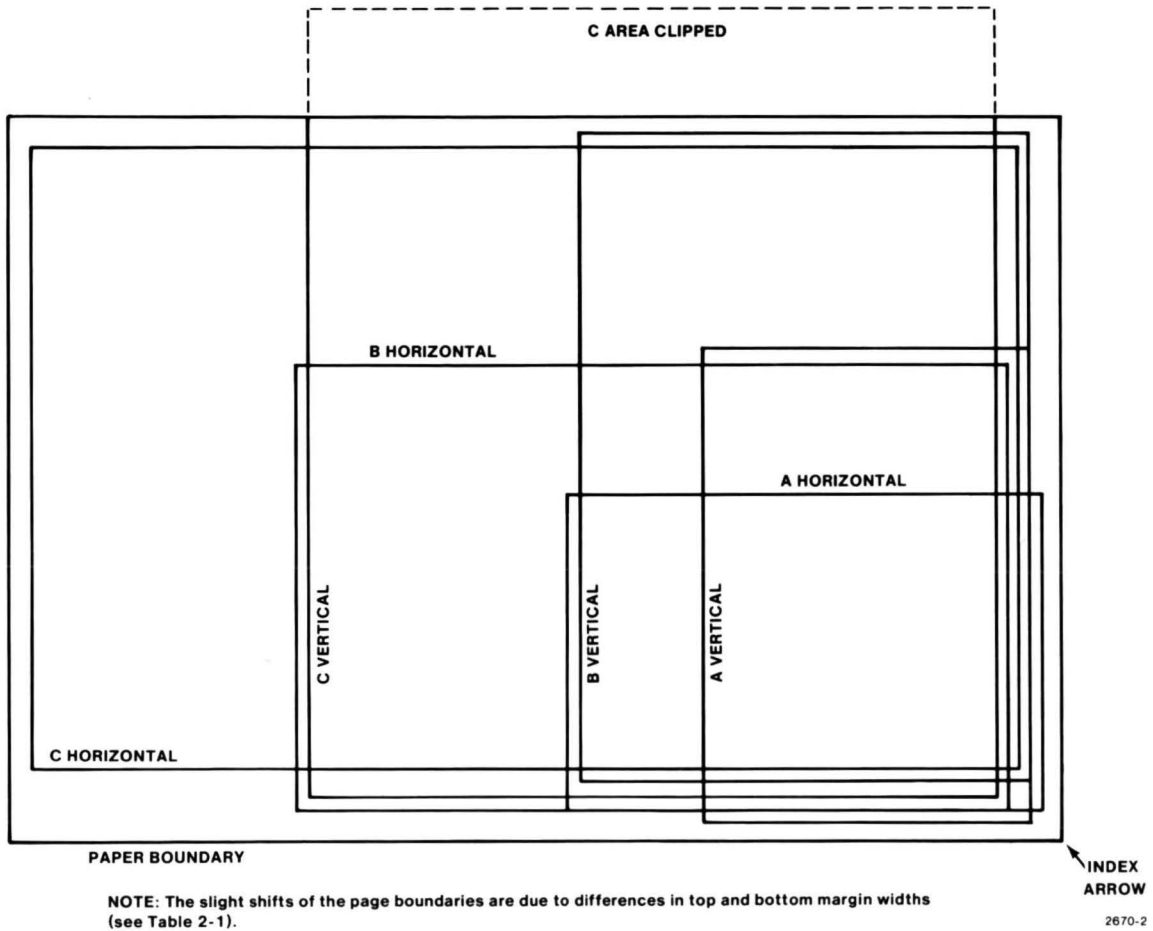
Figure 1-2. Horizontal and Vertical Page Orientations for English Page Sizes
(using DRAFTING Initial Page Format and FULL PAGE Initial Aspect Ratio).

Figure 1-3. Horizontal and Vertical Page Orientations for Metric Page Sizes
(using DRAFTING Initial Page Format and FULL PAGE Initial Aspect Ratio).

The following text appears within the figure:

CLIPPED AREA

A2 HORIZONTAL

A2 VERTICAL

A3 VERTICAL

A3 HORIZONTAL

A4 HORIZONTAL

A4 VERTICAL

BOUNDARY

PLATEN
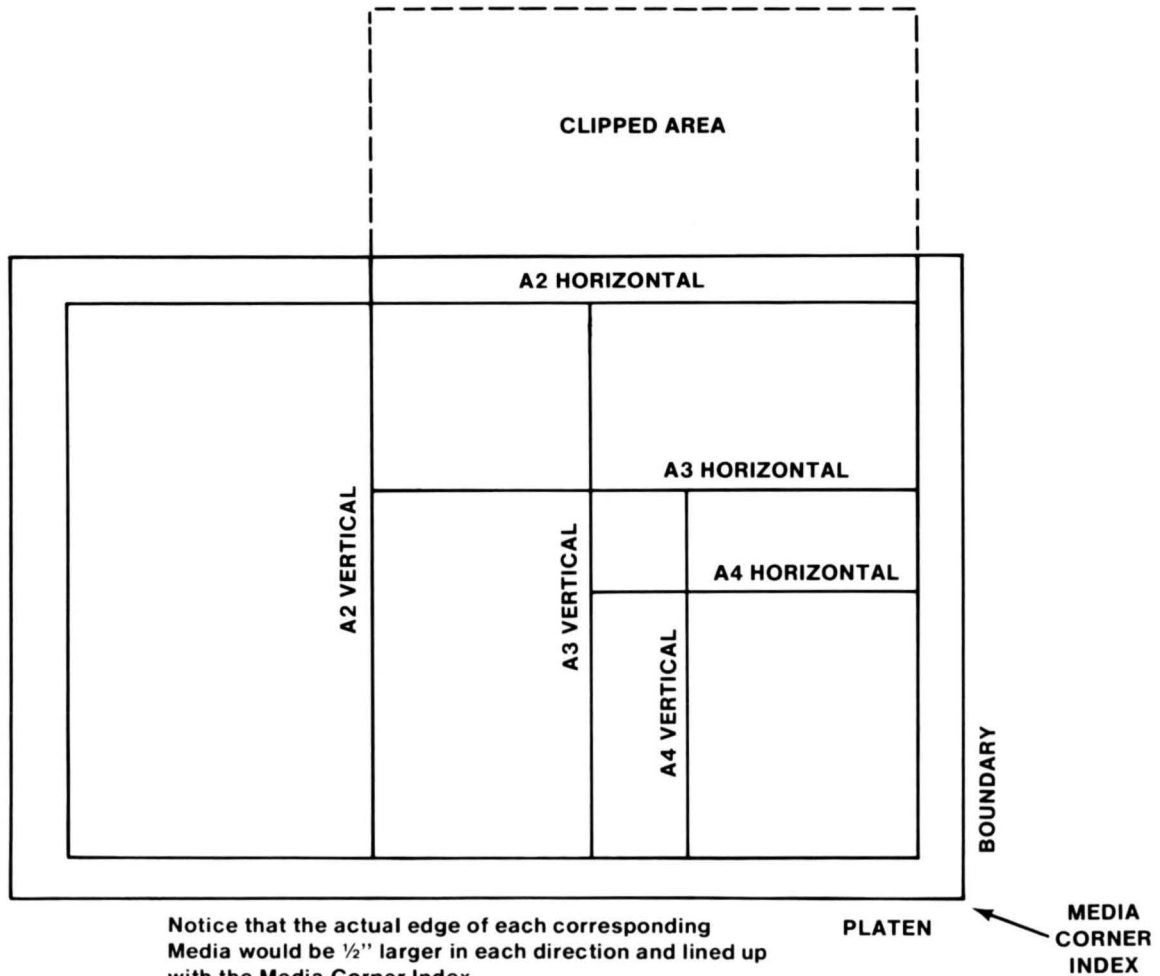
MEDIA CORNER INDEX

Notice that the actual edge of each corresponding
Media would be ½'' larger in each direction and lined up
with the Media Corner Index.

For Roll Mode, each corresponding Page Boundary
would be moved up ½''.

2670-3
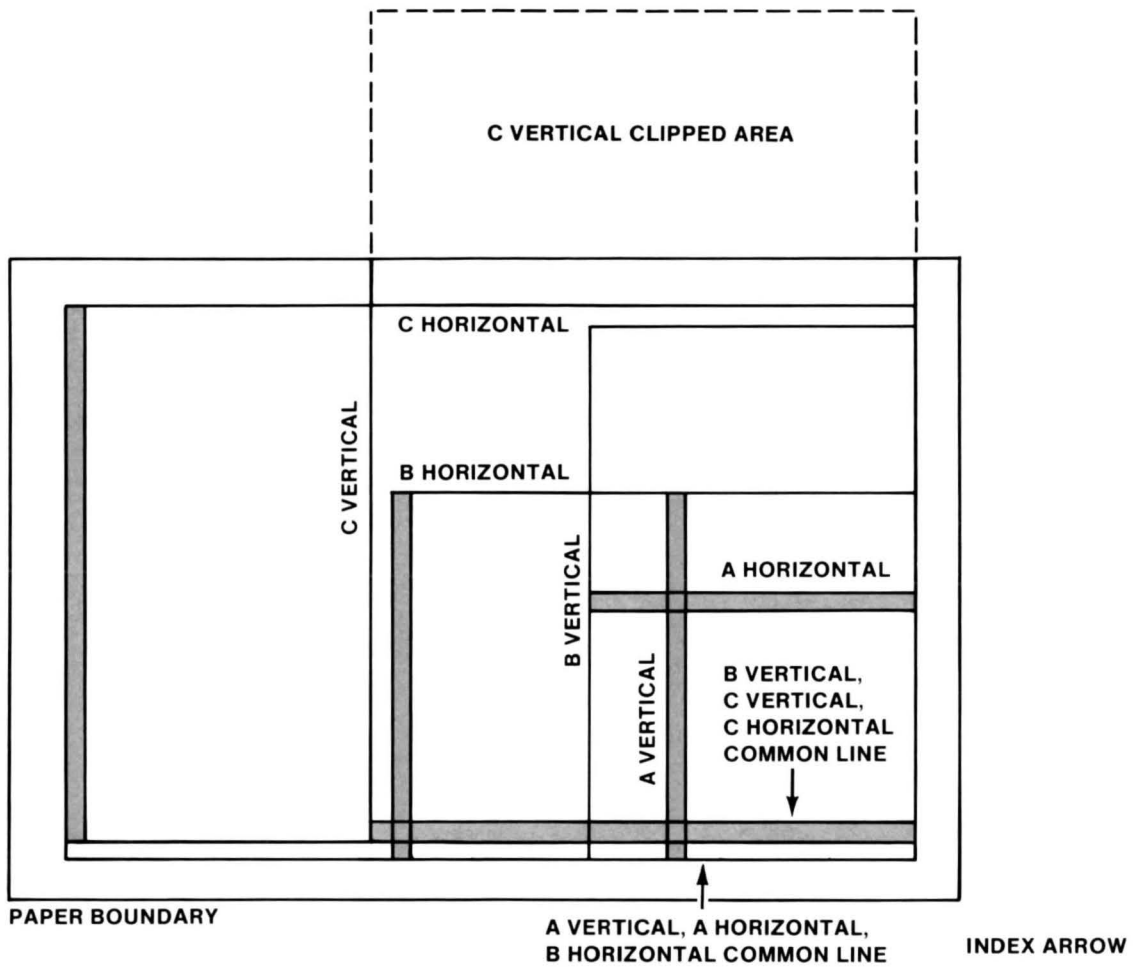
Shaded Area indicates increased Margin Area (see Table 2-1).

2670-4

Figure 1-4. Horizontal and Vertical Page Orientations for English Page Sizes
(using GRAPHING Initial Page Format and FULL PAGE Initial Aspect Ratio).

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A2 VERTICAL CLIPPED AREA

A2 HORIZONTAL

A2 VERTICAL

A3 HORIZONTAL

A4 HORIZONTAL

A3 VERTICAL

A4 VERTICAL

PAPER BOUNDARY

INDEX ARROW

Shaded Area indicates increased Margin Area (see Table 2-1).
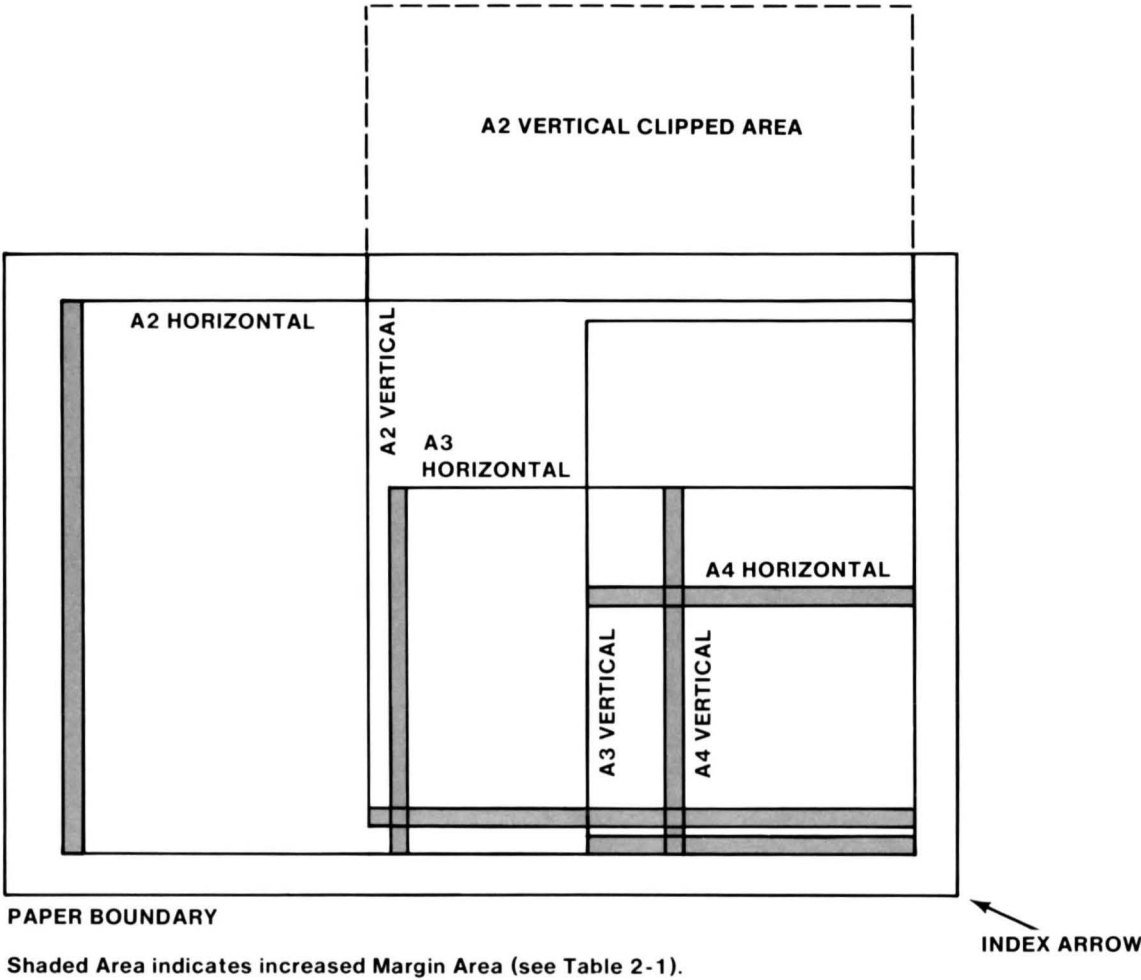
2670-5

Figure 1-5. Horizontal and Vertical Page Orientations for Metric Page Sizes
(using GRAPHING Initial Page Format and FULL PAGE Initial Aspect Ratio).

Section 2

OPERATION

ABOUT THIS SECTION

This section provides general information necessary to use the 4663 Interactive Digital Plotter. Information in this section is divided into four major categories: (1) First Time Operation (Part 1), (2) Front Panel and Parameter Entry Control Descriptions, (3) General Operating Instructions, and (4) Operator Considerations.

The First Time Operation is divided into three distinct procedures. Part 1, which is included in this section, will familiarize the operator with all of the front panel controls (including the Parameter Entry). This procedure does not require either a host computer or a terminal. Parts 2 and 3 of the First Time Operation make up Sections 4 and 5 of this manual. These sections familiarize the operator with the host commands that pass through a serial or a GPIB interface to the Plotter. It is recommended that the operator follow these instructions (Part 1) before proceeding to either Part 2 (located in Section 4) or Part 3 (located in Section 5).

The description of the Front Panel and Parameter Entry Controls includes information about each Plotter control — its purpose and application.

General Operating Instructions includes information pertinent to the operation of the Plotter, regardless of the interface being used (if any). This includes procedures for turning on the power, using the Parameter Entry card, loading and positioning paper, installing pens, adjusting paper and pens; information about the relationships of the two pens and the crosshair cursor; and other information of a general nature.

The last portion (Operator Considerations) of this section includes considerations (hints) that may be helpful to the operator when installing and/or operating the Plotter.

FIRST TIME OPERATION (Part 1)

About This Procedure

This sequence of operations may be used to familiarize the operator with the various functions of the Plotter, or as a general Plotter checkout procedure. After this sequence is performed, the operator should proceed to the First-Time Operation Through the Serial Interface (Part 2), or the First-Time Operation through the GPIB Interface (Part 3), depending upon which interface will be used.

These procedures are intended to provide familiarity with many of the various command sequences through first-hand experience. This will give the operator some idea of the actions the Plotter will take in response to these commands. The familiarization procedures do not cover every possible command or sequence of commands, but rather provide a general overview of Plotter operation.

NOTE

In the following discussion, the Plotter does not have to be connected to either a terminal or host. The only requirement is that it is powered with the proper operating voltage.

Introduction

It may be helpful to refer to the detailed description of each control encountered in this sequence. These descriptions are located later in this section. However, a brief description is included here to provide enough information for the operator to continue.

In the center of the front panel (shown in Figure 2-1) is a row of eight (8) FUNCTION switches; the rightmost six (6) of these have four (4) rows of labels above them. These six switches form a matrix with two unmarked switches located immediately to the right of the POWER switch. The two unmarked switches are SHIFT switches (similar to the SHIFT key on the typewriter). However, there are two SHIFT switches providing two levels of shift. These two SHIFT switches enable six of the FUNCTION switches to have three functions each (all other front panel switches have only one function each). The operator can simply press the desired FUNCTION switch alone (with no SHIFT) to activate the first possible function. The name of this function is printed directly above the FUNCTION switch. If the operator presses the lower of the two SHIFT switches (SHIFT 1) prior to pressing the same FUNCTION switch, the second possible function is activated.
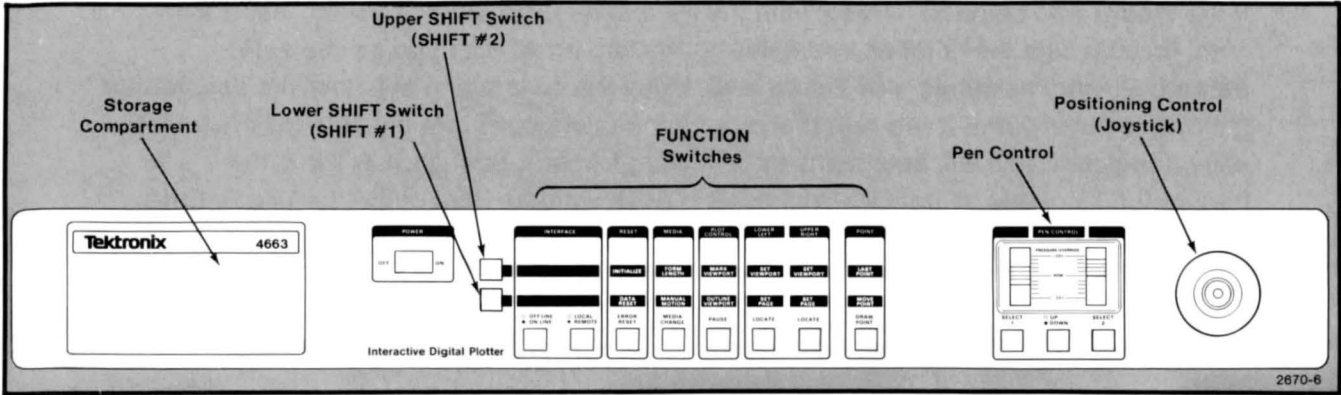
Figure 2-1. 4663 Front Panel.

NOTE

*Unlike the typewriter, the SHIFT switch does not have to be held down
when pressing the desired function switch. The fact that the SHIFT switch
is blinking indicates that the shift action will occur for the desired function
switch.*

The name of this function is printed in the second row above the switch; this label is one
of six labels in a horizontal row immediately to the right of this lower SHIFT switch. Lastly,
if the operator presses the upper of the two SHIFT switches (SHIFT 2) prior to pressing
the same FUNCTION switch, the third possible function is activated. Likewise, notice that
the name of this function is printed in the third row above the switch and that this label is
one of six labels in a horizontal row immediately to the right of this upper SHIFT switch.
Also notice that the names of the switches form the top row of labels. This label name is
simply a general term for the switch and does not refer to any one of its specific functions.

For the purposes of this procedure (and the remainder of the manual), the name of the
desired function will be called out, not the name of the switch (and the applicable SHIFT
switch). The operator must press the appropriate SHIFT switch (if needed) and then the
appropriate FUNCTION switch.

If the Plotter was shipped (stored) with the Parameter Entry card removed, insert that card, face up with the notches and holes on the left, into the slot below the eight Parameter Entry switches (see Figure 2-2). Move the card in and out slowly to ensure that it moves smoothly and freely and that a ratchet has engaged into the notches on the left side of the card (you will hear some faint clicking). Lastly, push the card into the Parameter Entry device until its front edge is flush with the front of the Parameter Entry bezel.
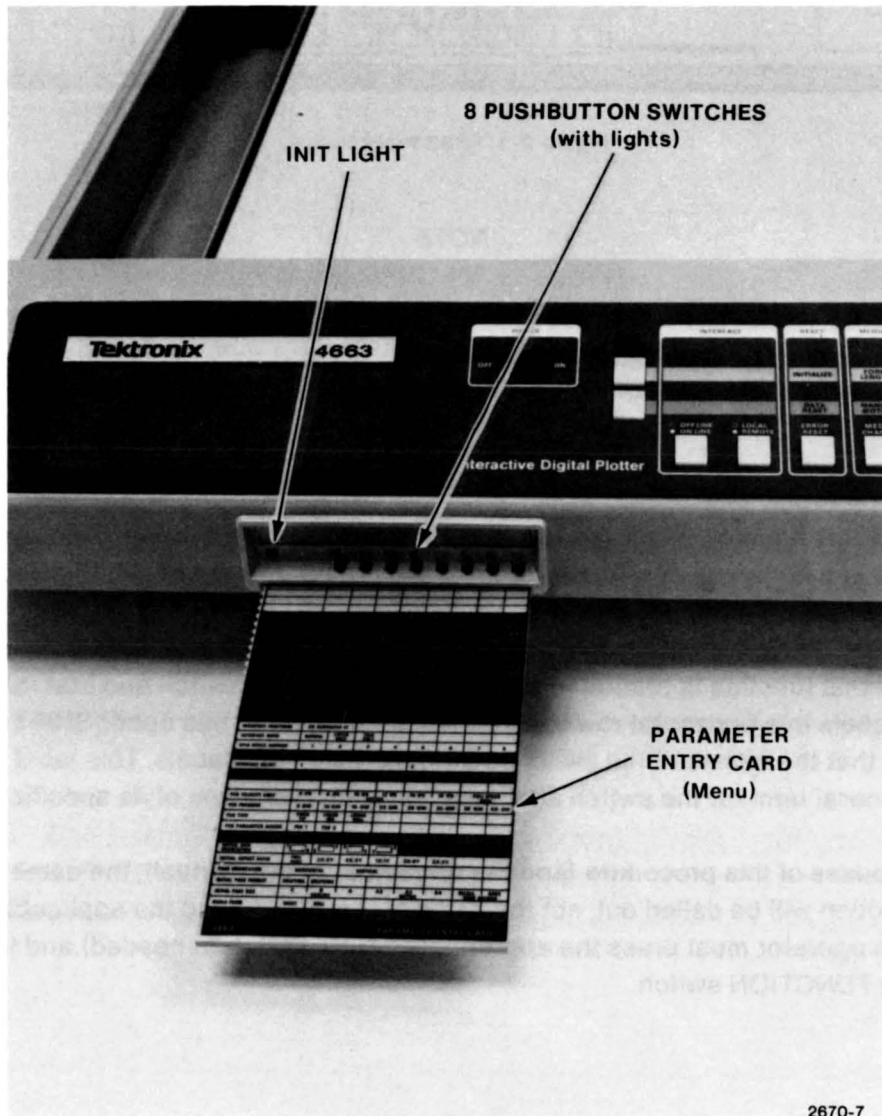
Figure 2-2. Parameter Entry Module.

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Procedure

1. Press the right side of the POWER switch to apply power. There will be a delay of approximately 5 seconds before the pen carriage moves to the right corner of the platen (the load point). During the first five (5) seconds, the Plotter will be initializing and the INIT light and the eight (8) Parameter Entry switches will be lighted; then they will go off (see Figure 2-2).

2. If the INIT light should remain on after the pen carriage has moved to the load point, move the Parameter Entry card slightly until it is fully inserted. The INIT light should go out, indicating that the Parameter Entry device is activated.

3. Pull the Parameter Entry card out slowly one line at a time and check that a lighted switch is on above each of the following operator-selectable parameters. If the light is on above another parameter, simply press the switch above the desired parameter (turning that light on and turning the other one off).

NOTE

If the Plotter has been in storage for more than approximately 90 days (45 days, if Option 37 is installed), the internal storage battery may have discharged enough to cause a loss of a function, even though there is a light on above that selection (normally indicating that this selection is currently active). In this case, it will be necessary to press the switch over all desired functions, regardless of whether the light over that selection is on or not. For Plotter power-off periods less than 90 days (or 45, with Option 37), it will not be necessary to select all desired parameters (except changes) each time the Plotter is powered-up, since the internal battery will keep these selections current.

Line   1   (Parameter Setup Select): Setup 1

Line   2   (Media Form: SHEET (The operator may set this to ROLL if the Plotter is
             equipped with the Media Advance option. In this case, follow the
             instructions for Replacing the Paper Roll, located later in this section.
             Then continue this procedure).

Line   3   (Initial Page Size): C

Line   4   (Initial Page Format): DRAFTING

Line   5   (Page Orientation): HORIZONTAL

Line   6   (Initial Aspect Ratio): FULL PAGE

Line   7   (Initial Axis Orientation): Column 1

Line   8   (Line Quality): PREVIEW

Line   9   (Pen Parameter Access): PEN 1

Line   10   (Pen Type): Press the switch corresponding to the type of pen to be
             installed in pen location 1. Refer to the instructions for Installing Pens
             (located later in this section).

Lines   11
and   12   (Pen Pressure and Pen Velocity Limit): The Plotter will automatically
             choose these parameters, based upon the type of pen chosen in line 10.

4. Go back to line 9 (Pen Parameter Access) and press the switch over PEN 2.

5. Press the switch corresponding to the type of pen to be installed in pen location 2.
    Install that pen at this time. Again the Plotter will automatically choose appropriate
    entries for lines 11 and 12.

6. For now disregard the remainder of the Parameter Entry Card.

7. Push the Parameter Entry card fully in. This card should always be kept fully pushed
    in to minimize potential damage.

8. If SHEET was selected on line 2 of step 3 above, follow the instructions for Loading
    Paper Sheet Mode (located later in this section). Use a C size piece of paper.

9. Move the joystick lever down and to the left to move the pen carriage away from the load point position and out onto the middle of the platen. Notice that the pen carriage moves in the same direction as the joystick is moved and that the pen carriage speed is directly proportional to the joystick deflection angle.

10. Check that the SELECT 1 light is on (left most of the three PEN CONTROL switches). If not, press that switch and the light will come on.

11. Press the UP/DOWN switch. The pen carriage will move about 1 inch (2.5 cm) diagonally (up and to the left), and then the pen will lower to the paper. Move the joystick around and notice that the pen draws a line wherever the joystick directs the pen. Press the UP/DOWN switch again and notice that the pen lifts and the pen carriage moves back, placing the crosshair cursor back over the last active position (the end of the line).

12. Press the PEN 2 SELECT switch and then the UP/DOWN switch. This time the pen carriage moves so that Pen 2 is placed over the last active position (the end of the line). This shows that either pen can use the same active position.

13. Press the UP/DOWN switch to raise Pen 2.

14. Press the PEN 1 SELECT switch again.

15. Press the MARK VIEWPORT function. To do this, simply press the upper SHIFT switch and the switch labeled PLOT CONTROL (see Figure 2-3). The Plotter will draw small 90°angle brackets near the corners of the paper (viewport). The viewport boundaries in this case are the same as the current page boundaries.

16. Press the OUTLINE VIEWPORT function. To do this, simply press the lower SHIFT switch and then the switch marked PLOT CONTROL (see Figure 2-4). The Plotter will draw a box around the boundaries of the viewport (also the page boundary in this case).

17. Use the joystick to move the pen carriage to any point well inside the outlined viewport.

18. Press the LOWER LEFT SET VIEWPORT function (before pressing the LOWER LEFT switch, be sure to press the upper SHIFT switch — see Figure 2-5).

19. Use the joystick to move the pen carriage in a 45 degree angle up and to the right a distance of 3 to 6 inches (7 to 15 cm).

20. Press the UPPER RIGHT SET VIEWPORT function (before pressing the UPPER RIGHT switch, be sure to press the upper SHIFT switch).

To MARK VIEWPORT, 1) Press the upper SHIFT switch, and then 2) press the PLOT CONTROL switch.

Desired Function

To MARK VIEWPORT, 1 press the upper
SHIFT switch, and then 2 press the PLOT
CONTROL switch.

2670-8
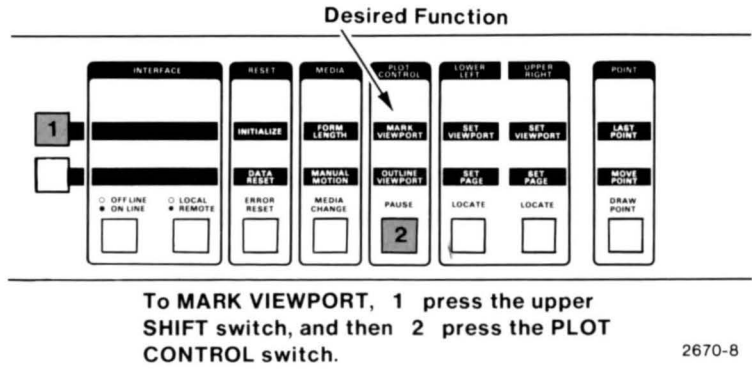
Figure 2-3. Mark Viewport Function.

To OUTLINE VIEWPORT, 1) press the lower SHIFT switch, and then 2) press the PLOT CONTROL switch.

Desired Function

To OUTLINE VIEWPORT, 1 press the lower
SHIFT switch, and then 2 press the PLOT
CONTROL switch.

2670-9
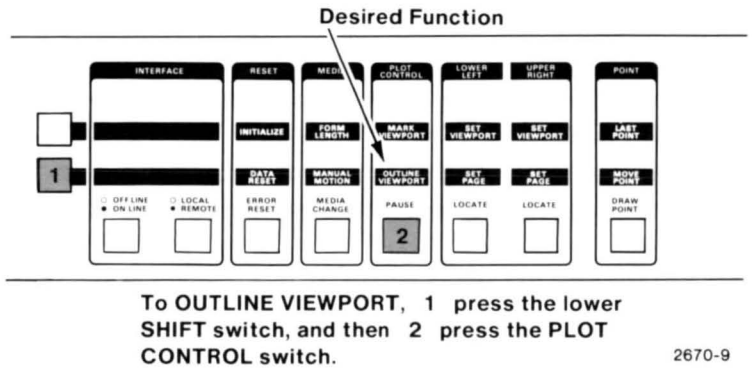
Figure 2-4. Outline Viewport Function.

To SET LOWER LEFT VIEWPORT corner, 1) press upper SHIFT switch, and then 2) press the LOWER LEFT switch.
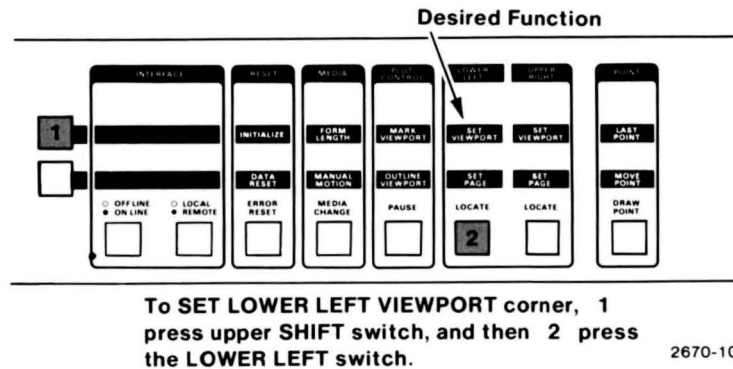
Figure 2-5. Set Lower Left Viewport Function.

21. Press the OUTLINE VIEWPORT function (before pressing the UPPER RIGHT switch, be sure to press the upper SHIFT switch).

22. Press the LOWER LEFT LOCATE switch (no SHIFT switch is used) and hold it down until the bell sounds (approximately 2 seconds); then release the switch. Notice that the crosshair cursor will move to two positions. The first lower left corner position (when this switch is first pressed) is the lower left corner of the page boundary. Then after the bell sounds and the switch is released, the crosshair cursor moves to the lower left corner of the new viewport boundary. Similarly, the UPPER RIGHT LOCATE switch will also locate the upper right corners of the page and viewport boundaries.

23. Pull the Parameter Entry card out to the third line (INIT PAGE SIZE) and press the switch above A. Notice that the light above C goes out and the light above A turns on. The Plotter has now been reprogrammed for an A size page and the previous viewport is lost. Push the Parameter Entry card back in.

24. Press the OUTLINE VIEWPORT function. The Plotter will draw a boundary around the A size page and viewport areas (they are both the same in default — you could verify this by pressing LOWER LEFT LOCATE and holding it down until the bell sounds. The pen carriage will make only one move to the lower left corner of the box around the A size area. The UPPER RIGHT LOCATE function will do the same thing for the upper right corners of the PAGE/VIEWPORT.

25. Pull the Parameter Entry card out to the fifth line (PAGE ORIENTATION) and press either of the two switches above VERTICAL (that switch should light and the one above HORIZONTAL should go out). Push the Parameter Entry card back in.

26. Press the OUTLINE VIEWPORT function. The Plotter will draw a boundary around the A size page and viewport areas, but notice that the area appears to be rotated around the lower right corner of the original viewport. In fact, the axes have also rotated with the viewport. Press and hold (until the bell sounds) the LOWER LEFT and UPPER RIGHT LOCATE switches (not simultaneously). This will verify that these corners have rotated with the viewport.

27. Pull the Parameter Entry card out to the third line (INITIAL PAGE SIZE) and press the switch above A even though it is presently lit. Again push the card back in.

28. Press the OUTLINE VIEWPORT function. Again the Plotter will draw a boundary around the vertically oriented A size viewport area, but notice that the viewport area has been moved over slightly. The operator should keep in mind that when english page boundaries are rotated, only the viewport (and page) is rotated, not the margins. Since english page dimensions generally use different dimensions for the top/bottom margins than the sides, the top/bottom margin of the new rotated viewport will be equal to the side margin of the unrotated viewport. The Plotter has internally moved the viewport (whose X-Y dimensions are never changed) over to match the previously established margins. This has caused a slight shift in the viewport placement equal to the difference between the top/bottom and the side margin widths. To establish the correct margins, simply press the INITIAL PAGE SIZE selection again after choosing the desired PAGE ORIENTATION (see Step 27 above).

29. Notice that the Plotter normally uses lower right justification for the placement of the resident page (viewport) sized areas. The operator could use the joystick and the two front panel SET PAGE functions (LOWER LEFT and UPPER RIGHT) to reposition these standard page sizes (similar to steps 17-21, except using SET PAGE rather than SET VIEWPORT). However, unless extreme care is used, this procedure may lead to inaccurate (and inconsistent) page dimensions. Instead, the Plotter is designed to reposition any page boundary anywhere on the platen using only the SET PAGE LOWER LEFT functions (even non-standard ones set up by the operator through SET PAGE LOWER LEFT and UPPER RIGHT — see Special Considerations). In this case, the Plotter automatically moves the upper right corner of the page boundary an amount corresponding to the displacement of the lower left page boundary. The next few steps demonstrate this. First, press the LOWER LEFT LOCATE function. This will locate the lower left corner of the vertically oriented corner of the A sized page.

30. Use the joystick to move the pen carriage up and to the left 1 or 2 inches (2-5 cm).

31. Press the SET PAGE LOWER LEFT function (to do this, press the SHIFT switch first and then the switch labeled LOWER LEFT).

32. Press the OUTLINE VIEWPORT function. The Plotter will draw a box around an A size vertically oriented page, whose lower left corner is at the location established in step 30 above. Use a ruler to verify that the dimension of this box is the same as that drawn in step 26 (the default standard size).

33. Pull the Parameter Entry card back out and change the PAGE ORIENTATION back to HORIZONTAL (press either switch above HORIZONTAL). Then change the INITIAL PAGE SIZE to C size (be sure to do in this order — see step 28 above).

34. Press MEDIA CHANGE (no SHIFT is necessary) to change the paper. If SHEET mode is used, the electrostatic paper hold-down will turn off and the pen carriage will move to the load point position (upper right corner), enabling the operator to change the paper. The blinking light indicates that the motion circuitry is inhibited during the paper changing operation. Refer to the instructions under Loading Paper (Sheet Mode) to change paper. Use C size paper. Lastly, press the blinking MEDIA CHANGE switch again to turn on the electrostatic paper hold-down and enable the motion circuitry. You can then use your hands to smooth out any wrinkles in the paper. If ROLL mode is programmed (and with the presence of the Media Advance option), the pen carriage will move to the load point position, the paper will automatically advance. After checking to see that the paper is laying on the platen smoothly and without wrinkles, proceed to Step 35. Refer to the instructions on Loading Paper (Roll Mode) for further information.

35. Pull out the Parameter Entry card to the EXECUTE SELF TEST line (last line on the card) and press the switch over column 2. All front panel switches should light up. Press this switch again to return the front panel switch lights to their previous condition.

36. Press the switch over column 1 (EXECUTE SELF TEST). The Plotter will draw the plot shown in Figure 2-6.

37. Repeat Step 34 to change the paper.

This completes the familiarization procedure (Part 1) for the front panel controls. To continue with the complete familiarization procedure for first-time operation, proceed with First Time Operation Part 2, if the Plotter is equipped with a serial interface, or First Time Operation Part 3, if the Plotter is equipped with a GPIB interface. Both of these procedures are located later in this section.

Plot ends here after Joystick use. One half of the intersection is drawn early in the plot, while the remainder of the intersection is drawn at the end to verify repeatability.

Please exercise the joystick

2670-11
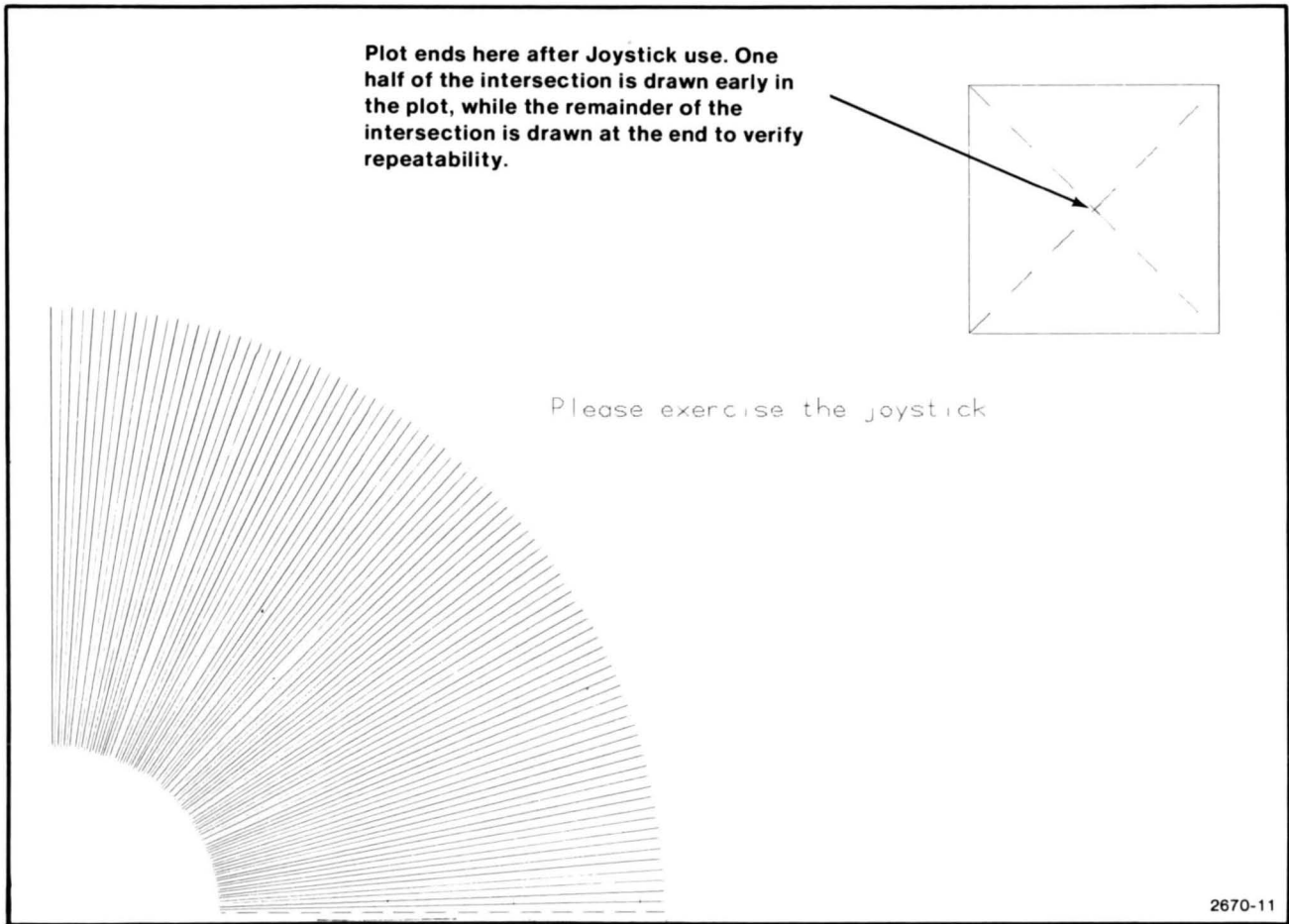
Figure 2-6. Test Pattern Produced by Self-Test Feature.

FRONT PANEL AND PARAMETER ENTRY CONTROL DESCRIPTIONS

The operator controls on the Plotter consist of a number of switches and lights across the front panel and a user card/switch/indicator combination referred to as the Parameter Entry. For this description, these two groups of controls will be described separately.

Front Panel Switches and Indicators

The front panel has four major areas of switches and indicators (see Figure 2-1): Power Switch, Function Switches, Pen Control, and Positioning Control. Each of these will be described in greater detail in subsequent paragraphs.

Power Switch

The POWER switch is a rocker switch used for applying electrical power to the 4663 Plotter. When the right side of the switch is pressed down, power is applied to the Plotter.

Function Switches

The function switches make up a matrix of 10 switches (shown in Figure 2-7). Notice that (1) on the left side of this matrix are two unmarked switches, shown in Figure 2-7 as SHIFT switches, and (2) six of the remaining eight switches have four rows of labels above them. The two SHIFT switches act like the SHIFT key on a typewriter to select alternate meanings for the six unique function switches. There are, however, two SHIFT switches, providing 2 levels of shift. These two SHIFT switches enable these six function switches to have three functions each. The operator can simply press the desired function switch alone (with no SHIFT) to activate the first desired function. The name of this function is printed directly above the function switch (see Figure 2-8A). If the operator presses the lower of the two SHIFT switches (SHIFT 1) prior to pressing the same function switch, the second possible function is activated (see Figure 2-8B). Notice that (1) the SHIFT light starts blinking after it is pressed, and (2) the name of this function is printed in the second row above the switch. This label is one of six labels in a horizontal row immediately to the right of this lower SHIFT switch. After pressing the function switch, the blinking SHIFT light goes off. In a similar manner, if the operator presses the *upper* of the two SHIFT switches (SHIFT 2) prior to pressing the same function switch, the third possible function is activated (see Figure 2-8C). Likewise, notice that the SHIFT switch starts blinking after it is pressed, and the name of this function is printed in the third row above the switch. This label is one of six labels in a horizontal row immediately to the right of this upper SHIFT switch. For all eight switches, the top row of labels is simply a general term for the switch and does not necessarily refer to any of its specific functions.
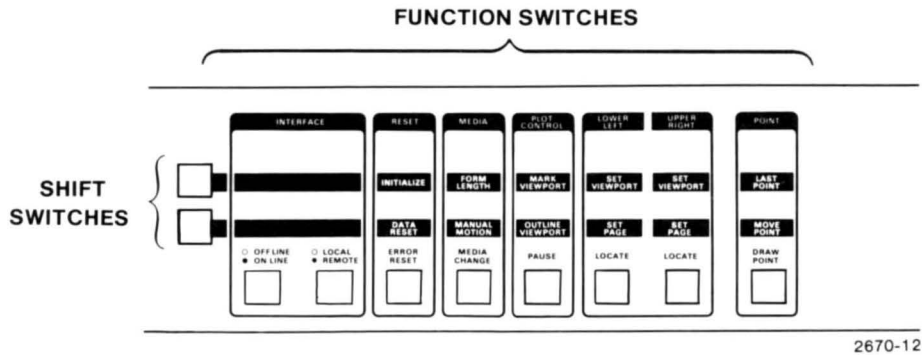
FUNCTION SWITCHES

Figure 2-7. Function Switch Matrix.

NOTE

Unlike the typewriter, the SHIFT switch does not have to be held down when pressing the desired function switch. The fact that the SHIFT switch is blinking indicates that the shift action will occur for the desired function switch.

For the purposes of this procedure (and the remainder of the manual), the name of the desired function will be called out, not the name of the switch (and the applicable SHIFT switch). The operator must press the appropriate SHIFT switch (if needed) and then the appropriate function switch.

After pressing a SHIFT switch first and then a function switch, the SHIFT function will be automatically cancelled for any further commands. To reactivate the SHIFT command, the SHIFT switch will have to be pressed again prior to the pressing of another function switch. This means that the SHIFT function remains active for only one function command at a time.

To cancel the SHIFT switch prior to the pressing of a function switch, simply press the lighted SHIFT switch again.

To change to another SHIFT switch, simply press the desired SHIFT switch and the first SHIFT switch will be cancelled.

The meanings of each of the eight function switches are described in detail in the following paragraphs.
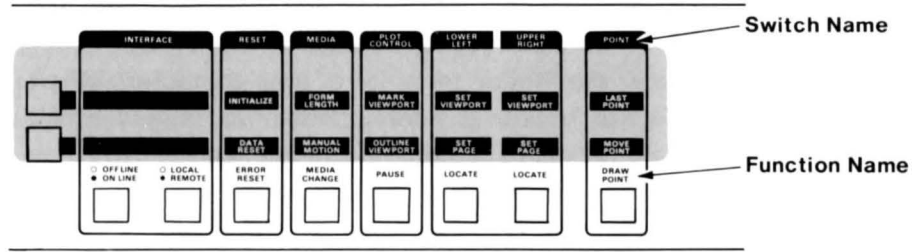
A. Normal Switch Functions (NO SHIFT)
(uses Function Name immediately above Switch)
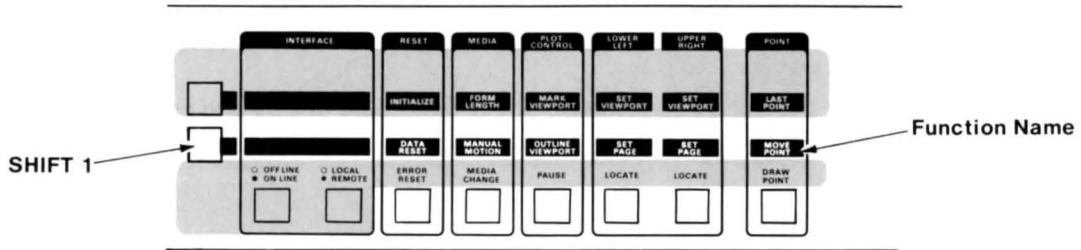
B. Switch Functions with SHIFT 1
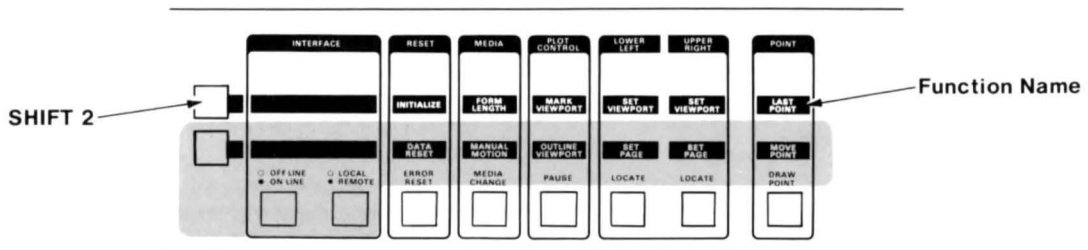
C. Switch Functions with SHIFT 2

2670-13

Figure 2-8. Function Switches Showing SHIFTS.

Interface. The INTERFACE function consists of two switches which are used in combination with each other to connect or disconnect (logically) the communications line between devices (such as the Plotter, terminal, or host computer). When the interface logic is disabled, the Plotter ignores any commands or messages present on the interface lines, and cannot place any commands on the communications line.

The two switches permit four (4) possible communication interface modes. Each of these modes affects either the serial interface or the GPIB interface. These are:

1. OFF-LINE LOCAL

2. OFF-LINE REMOTE

3. ON-LINE LOCAL

4. ON-LINE REMOTE

Each switch has an indicator light inside, and the light turns on and off on alternate switch pressings.

The description of each of these communications modes is described below with the assumption that the interconnecting cables are connected as per the instructions in Section 7 — Installation. Figure 2-9 shows the relationships of the devices on a serial communications line with each of the four interface modes. GPIB, on the other hand, is similar, but not quite the same, as described below.

1. OFF-LINE LOCAL (both lights OFF)

    In serial interface operation, this mode breaks all connections between the terminal, Plotter, and host. This provides a method of equipment isolation for troubleshooting.

    With GPIB operation, the Plotter is electrically isolated from the GPIB bus.

2. OFF-LINE REMOTE (OFF/ON-LINE light OFF and LOCAL/REMOTE light ON)

    In serial interface operation, this mode connects the terminal to the host, but disconnects the Plotter from both of them.

    For GPIB operation, this mode is the same as OFF-LINE LOCAL.

Light OFF

A. OFF-LINE LOCAL

Terminal

Plotter

Host

INTERFACE

OFF LINE / ON LINE   LOCAL / REMOTE

B. OFF-LINE REMOTE

Terminal

Plotter

Host

INTERFACE

OFF LINE / ON LINE   LOCAL / REMOTE

C. ON-LINE LOCAL

Terminal

Plotter

Host

INTERFACE

OFF LINE / ON LINE   LOCAL / REMOTE

D. ON-LINE REMOTE

Terminal

Plotter

Host

INTERFACE

OFF LINE / ON LINE   LOCAL / REMOTE

2670-14
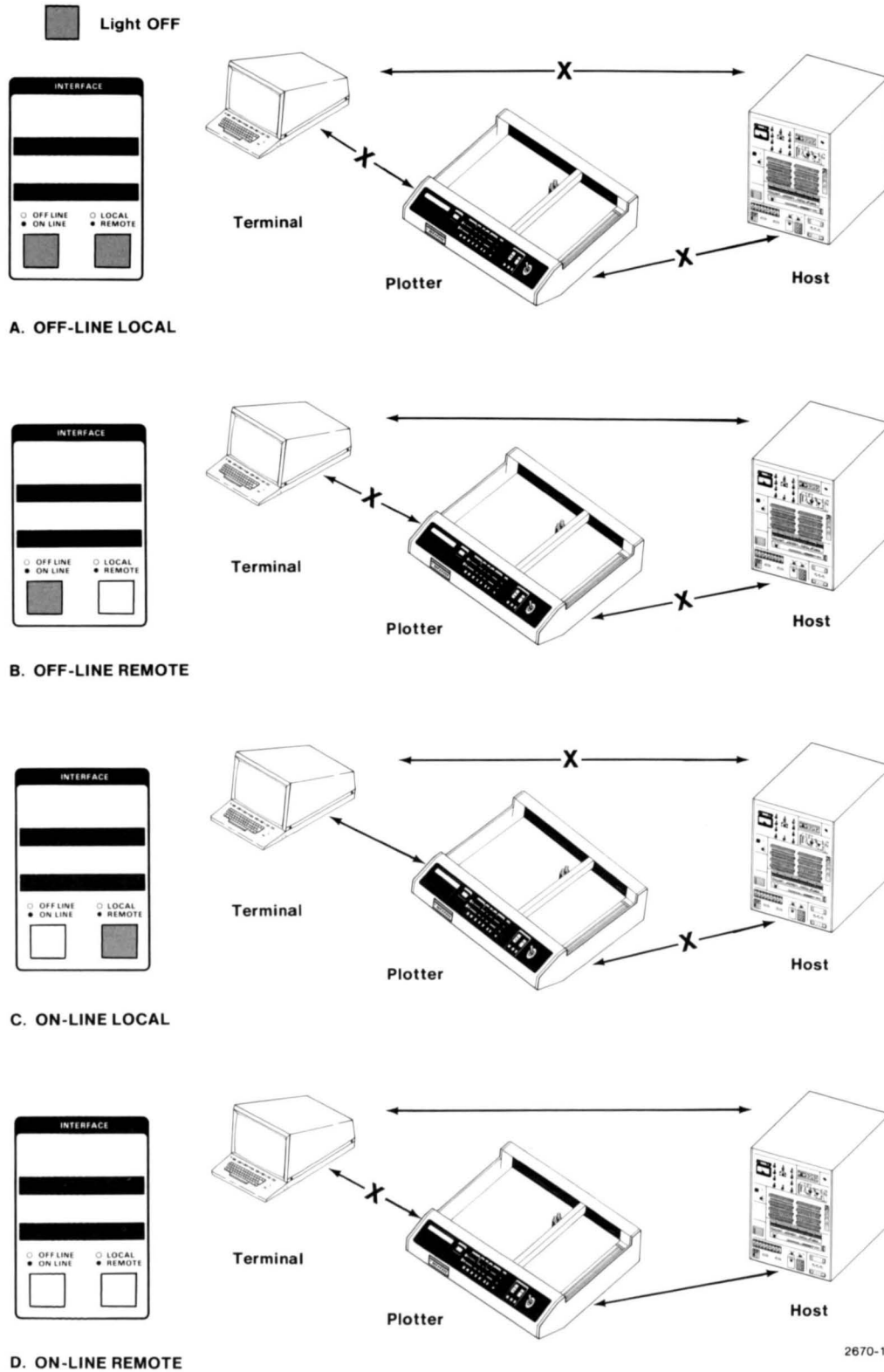
Figure 2-9. Communications Interface Modes (Shows Serial Interface Connections).

3. ON-LINE LOCAL (OFF/ON LINE light ON and LOCAL/REMOTE light OFF)

    In serial interface operation, the terminal is connected to the Plotter only. Both
    the terminal and the Plotter are disconnected from the host computer.

    In GPIB operation, the Plotter will handshake, but ignore all commands and data
    sent to it.

4. ON-LINE REMOTE (both INTERFACE lights are ON)

    In serial interface operation, the terminal, Plotter, and the host computer are all
    connected together. This is the normal mode for interactive plotting from the
    host computer and is the default mode at power-up.

    For GPIB interface operation, this is both the normal mode of operation and the
    default interface mode at power-up.

Reset. The RESET functions allow the user to selectively clear or reset sections of the
Plotter. If the RESET light is blinking, it indicates that a nonfatal error condition (such as a
parity error) has been detected; the Plotter made an appropriate assumption, and
operation is continuing. A steady light indicates that a fatal error condition (such as a
ROM checksum error) has been detected; an appropriate assumption was not possible
and the Plotter has stopped. The type of error encountered can be identified by decoding
the Parameter Entry switch lights (see Identifying Errors located later in this section).

A nonfatal error indication (blinking light) is cancelled by pressing the ERROR RESET
function. This turns off the RESET light and clears the Parameter Entry error code.

A fatal error condition (steady light) is reset by turning the power off and then on again
(after correcting the cause of the error).

DATA RESET is used to clear the Plotter input buffer of Plotter commands and data. This
does not affect any of the programmable Parameter Entry Selections currently in use. If
the pen is active (and plotting) when this function is activated, up to 10 previously
processed commands (stored in the output motion queue) may be executed anyway, even
though the Plotter's input buffer has been cleared. If Plotter commands continue to be
received, plotting will continue using the new data. Some Plotter actions such as Self-
Test, Arcs, Circles, Programmable Macros and Axis commands may also be terminated by
a DATA RESET. If, however, the current Plotter activity is not terminated with the receipt
of the DATA RESET, the DATA RESET will be performed at the completion of that Plotter
action. DATA RESET also causes the Local Data Reset bit in Device Status Word to be set
(see Read Status command in Section 3).

The INIT function is used to reset the active interface when communications with the host computer have been lost or "hung up." This function causes the Plotter to switch from Block mode to Continuous mode and cancels any pending interface communication actions (such as an output message or a block received acknowledge). However, it does not modify any of the current programmable interface parameters (such as prompt character, signature character, turn-around delay time, etc.). The INIT function causes the interface (not the Plotter) to undergo a power-up condition. With this function, the Plotter turns the interface logically off (equivalent to a Device Off command), selects Pen 1, cancels any pending output messages, and causes the pen carriage to perform an axis seek. The axis seek allows the Plotter to redetermine the position of the pen in case the pen was blocked or bumped with a sufficient force to cause a loss of axis position. The INIT function also causes the Local Position Modification and Local Data Reset bits to be set in the Device Status Word (see Read Status command in Section 3).

Media. The MEDIA switch enables the operator to choose any of the following three functions:

> MEDIA CHANGE
>
> MANUAL MOTION
>
> FORM LENGTH

The MEDIA CHANGE function enables the operator to load a new piece of paper (or media — see Note below) onto the plotting surface. If the Plotter is in SHEET mode, and this function is activated, the pen is first moved to the load point (upper right corner of the platen), and then the electrostatic paper hold-down is turned off permitting the paper change. While the paper is being changed, the MEDIA CHANGE light will be blinking. For details of the paper changing process, refer to the description of Changing Paper located later in this section. Activating the MEDIA CHANGE a second time turns off the blinking light and turns on the electrostatic paper hold-down, permitting plotting to resume.

On the other hand, if the Plotter is equipped with Option 36 (Media Advance Option) and ROLL mode has been selected on the Parameter Entry card, the activation of MEDIA CHANGE causes the Plotter to advance a new portion of the roll media onto the plotting surface. When this function is activated, the pen moves to the load point (upper right corner of the platen) and the paper (or media — see Note below) starts to move across the platen. The media will stop after moving an amount determined from current Parameter Entry card selections or the SET FORM LENGTH function sequence described later. Notice that no electrostatic paper hold-down is used during plotting with the Plotter in ROLL mode. Instead, the paper is kept smooth by a spring loaded clutch on the media supply spool shaft. Unless the PAUSE function is initiated before the MEDIA CHANGE function, the Plotter will automatically resume plotting after the paper has stopped moving.

If the paper does not advance at least approximately one-half inch, or if the end of the media roll passes by the left edge of the platen (before the completion of the media advance operation), the Plotter will indicate an Out Of Media condition. This is shown by a flashing PAUSE light and the setting of the appropriate bit in the Device Status Word (see Read Status command in Section 3). After more paper has been installed (refer to the description of Changing Paper later in this section), the PAUSE function is canceled by pressing the PAUSE switch. The Out Of Paper status is determined and updated only at the end of a ROLL media advance cycle.

If the Plotter was busy plotting when the MEDIA CHANGE function was initiated, several motion commands previously processed and stored in the motion control queue, will be executed before the media change sequence begins.

Keep in mind that if the MEDIA FORM type is changed on the Parameter Entry card (i.e., SHEET to ROLL mode or vice-versa), the change will not be effective until after the completion of the next MEDIA CHANGE operation (or power-up process).

Read Status is the only interface command which will be processed while a MEDIA CHANGE is in process.

NOTE

Although the word "paper" is used frequently throughout this manual, the Plotter will draw or print on a wide variety of materials (media). These include, but are not limited to, mylar, acetate, vellum, thin cardboard and paper.

The MANUAL MOTION function (operates only if the Media Advance Option 36 is present and the Plotter is in ROLL mode) permits the operator, using the joystick, to move the paper across the platen in either direction. Activating the MANUAL MOTION function (turning on that light steady) enables the joystick's X axis to control the media advance motor drive. Then, moving the joystick to the right causes the paper to advance to the right, while moving the joystick to the left causes the paper to move to the left. Paper movement speed is directly proportional to the joystick deflection angle. Pressing the MANUAL MOTION switch again will disable the function and turn off the light.

MANUAL MOTION may be used to reposition the paper slightly or to spool back a series of connected plots so that they may be manually separated using the paper tear bar. Notice that moving the media to the left may require some operator assistance. Refer to Moving The Paper To the Left/Right Using the Joystick for further information. This description is located later in this section.

The FORM LENGTH function is used to set the form length for media change operations at other than the "normal" form lengths set via Parameter Entry card. This function allows the Plotter to automatically advance a desired non-standard length of paper onto the platen each time the MEDIA CHANGE switch is pressed (or the Page Change command is received). To set a desired form length, activate the FORM LENGTH function. This causes the MEDIA light to begin to blink (indicating that a form length modification is in progress) and enables the joystick for manual media motion. Using the joystick, advance the paper (media) the desired length and then press the FORM LENGTH function again. This new form length replaces any Parameter Entry card selection made previously.

NOTE

If necessary, the operator can then establish the lower left and upper right page/viewport boundaries, entering them with SAVE on the USER DEFINED INITIAL PAGE SIZE line (Parameter Entry card).

This form length setting will be canceled by selecting any of the INITIAL PAGE SIZE choices (except SAVE and RECALL) or by repeating this form length procedure.

Plot Control. The PLOT CONTROL is used both to mark the paper with the current viewport boundaries and temporarily to interrupt the plotting process of the Plotter. As previously described, this switch has three functions. These functions are:

PAUSE

OUTLINE VIEWPORT

MARK VIEWPORT

The PAUSE function interrupts the Plotter's plotting process AFTER executing all commands that were previously stored in the output motion command queue. It must be noted that PAUSE does not cause the Plotter instantaneously to stop and wait. There may be several separate move and draw motions executed before the Plotter stops and the PAUSE light comes on (blinking). Pressing the PAUSE switch again releases the pause function and the Plotter resumes plotting from where it left off. Care must be exercised in pressing this switch while data is being sent to the Plotter from a host. If data is sent to the Plotter in a continuous mode, the Plotter can not notify the host that it is stopped. The input buffer may then fill up and lose all further commands. Although Interface commands may continue to be received while in the PAUSE state, a Read Status command is the only command which may be executed while in the PAUSE state, but if any pen motion is required (other than the LOCATE function), the command will not be executed until after the PAUSE state is canceled. This means that the joystick can be used to maneuver the pen carriage, new operating configurations can be entered on the Parameter Entry card, viewports marked, etc.

It might be helpful to use the PAUSE function switch when changing paper, permitting the operator to ensure that the paper is properly held down by the electrostatic attraction before plotting resumes. This procedure might include (1) Press MEDIA CHANGE (2) change paper (3) press PAUSE (4) press MEDIA CHANGE again to complete the paper change (5) smooth paper by hand (6) press PAUSE to release the pause function allowing the plotting to resume.

The OUTLINE VIEWPORT function draws a solid border around the current viewport area (in the FULL PAGE default case, this is usually also the page area defined by the lower left and upper right points). After the box is drawn, a move (unwritten vector) is generated, moving the pen carriage to its previous loction. If the pen is currently active (Plotter is plotting) when this function is initiated, the motion commands previously stored in the motion control queue will be executed, and then the viewport outline will be drawn. After the outline is drawn, normal plotting resumes.

The MARK VIEWPORT is identical to the OUTLINE VIEWPORT, except that instead of a solid border drawn around the viewport area, "90 degree corner bracket" marks are drawn at each corner of the viewport area.

Both functions (OUTLINE VIEWPORT and MARK VIEWPORT) are useful for composing plots or alignment marks for overlay projection transparencies, etc.

Lower Left/Upper Right. The LOWER LEFT and UPPER RIGHT functional group allows the operator to locate (check) or alter the area (page or viewport) on the platen which is used for plotting. The word "page" is generally associated with the size of the paper (or media) that is plotted upon, and the plotted area on that page takes into account normal margins (shown in Table 2-1).

Often, it is not desirable to have the plot (drawing) fill the entire page area (less the margins). For example, the operator may desire that the drawing will share the same page as text, or maybe several drawings will occupy one page. In either case, the drawing will occupy an area smaller than the page. This reduced area is defined as the viewport. Generally, the page and viewport dimensions are initially the same, depending upon which Initial Aspect Ratio selection is current (see the Initial Aspect Ratio Parameter Entry card line description later in this section). If a viewport is desired other than the Parameter Entry card choices, it can be specified with either the host-supplied Set Viewport command or by the operator using these two switches. However, the viewport size can never be larger than the current page size.

Each of these two switches (LOWER LEFT and UPPER RIGHT) has four functions. These are:

LOCATE (Page and Viewport)

SET PAGE

SET VIEWPORT

The LOCATE functions are used to confirm or check the locations of the corners (lower left or upper right) of both the page and viewport. The respective corner of the page is located by momentarily pressing the appropriate LOCATE switch. The crosshair cursor will move to the desired page corner. If the same LOCATE switch is held down after locating the page corner until the bell sounds (approximately two seconds) and then released, the crosshair cursor will move to the desired viewport corner. Notice that if the corresponding page and viewport corners are the same, there will be no second move.

The SET PAGE functions allow the operator to use the joystick to reposition or alter the initial page boundaries. The joystick is used to maneuver the crosshair cursor over the desired corner of the page boundary, and then the appropriate front panel switch function (SET PAGE LOWER LEFT or SET PAGE UPPER RIGHT) is activated. All subsequent alphanumeric or graphic data will be proportionally scaled to fit within the new page size. For instance, this function can be used to adjust the page boundaries of a drawing made on preprinted forms that individually differ in size because of changes in humidity, etc. It must be remembered, however, that any change in the position of the page's lower left corner by this function (SET PAGE LOWER LEFT) will result in the same change in the location of the upper right corner (i.e., the upper right page corner moves in step with the lower left page corner). In other words, positioning the lower left corner of the page (with SET PAGE LOWER LEFT) will not change the page size, only its position (even if that page is moved off the edge of the platen or past the current clipping limit point). Therefore, it is necessary to establish the lower left page corner first and then the upper right corner.

The SET VIEWPORT functions allow the operator to use the joystick to reposition or alter the viewport boundaries, which, in the case of FULL PAGE Initial Aspect Ratio, are the same as the initial page boundaries. The joystick is used to maneuver the crosshair cursor over the desired corner of the intended viewport, and then the appropriate front panel switch funciton (SET VIEWPORT LOWER LEFT or SET VIEWPORT UPPER RIGHT) is activated. All subsequent alphanumeric or graphic data will be proportionally scaled to fit within the new viewport size. A common use of this function might be to reduce the size of the drawings so that several drawings will fit on a single piece of paper, or to allow alphanumeric text (such as labeling) to be printed outside the actual drawing area. Unlike the SET PAGE function, the two SET VIEWPORT switches (SET VIEWPORT LOWER LEFT and SET VIEWPORT UPPER RIGHT) are independent of each other. Also, if there is an attempt to place the viewport boundary outside of the current page boundary, the Plotter will set that corner of the viewport boundary to the nearest point on the current page boundary.

If the Select Clipping Control (see Section 3) is zero (the default case), all attempts to draw or print text outside of the viewport will be clipped at the viewport boundary.

This function can also be activated by the Set Viewport command (see Section 3).

Point Switch. The POINT functions are used in Digitizing operations and to indicate an operator prompt. Digitizing allows the Plotter to save the current coordinate position of the active pen for transmission to a host. The pen coordinates are transmitted in accordance with the communications protocol associated with the interface in use. It must be remembered that the coordinates correspond to the crosshair cursor when not receiving MOVE or DRAW commands (see Pen/Crosshair Cursor Relationship description located later in this section). When the Operator Digitize mode is enabled (refer to the Digitizing Operating Commands description located in Section 3), the POINT switch's light is turned on. This switch then has three possible functions. These functions are:

DRAW POINT

MOVE POINT

LAST POINT

The X and Y coordinate output generated by each of these three functions is accompanied by a corresponding identifying tag value. This tag value can be used by a suitable host applications program to define a MOVE (unwritten vector), DRAW with the pen down (written vector) or the LAST POINT function. The LAST POINT function can be used to inform the applications program that no more coordinates are to be transmitted.

The POINT light is turned on flashing when a Prompt Light On command is received (see Digitizing Operating Commands in Section 3). This could be used to inform an operator to change pens or paper, etc. When a Prompt Light Off command is received, the light is changed to reflect the current Digitize Enable state (either steady on or off).

Pen Control

The Pen Control consists of three switches (with light indicators inside) and two adjustment controls. This group allows the operator to select manually the active pen or to make slight (fine) adjustments to the pens' pressure on the paper when down and writing.

Select. The SELECT function consists of two switches which designate which pen will be used for the next Draw command. This designation is indicated by a solid light in one of the two switches. The leftmost of the two SELECT switches corresponds to Pen #1 (the pen closest to the front panel), while the rightmost of the two SELECT switches corresponds to Pen #2 (the pen closest to the rear panel).

Pen selection can also be made via the Select Pen command (see Section 3).

Up/Down. The UP/DOWN switch allows the operator to manually raise or lower the active pen. The active pen (one with the SELECT light on) is alternately raised or lowered with repeated pressings of this switch. The active pen is down (writing on the paper) when the indicator light inside this switch is on. This is true whether the pen is lowered automatically by the Plotter while under program control (when executing a Draw, Arc, or Circle command — see Section 3) or whether the operator manually lowered the pen with this switch.

Pressure Override. The two PRESSURE OVERRIDE adjustments are simply fine adjustments for the pens' pressure on the paper. The coarse pen pressure is set automatically according to an entry of the particular type of pen used to the Parameter Entry (described later). This control allows the operator to make slight adjustments for line quality and minimize pen tip wear. Moving the control to + increases the pen pressure on the paper, while moving the control to − decreases the pen pressure. The full range of this control varies the pen pressure about ± 25% of the total coarse pressure set by the Parameter Entry module. The left control affects Pen #1 (closest to the front panel), while the right control affects Pen #2.

Positioning Control (Joystick)

The POSITIONING control is a joystick located on the right edge of the front panel. It allows the operator to manually move the pen carriage to any location on the plotting surface. It is automatically enabled 1/2 second after the last plotting command has been completed, or if the Plotter has been stopped with pressing of the PAUSE function. Direction of pen carriage motion is indicated by the direction in which the control lever is tilted or pushed; pen velocity increases with the displacement angle of the control lever.

Normally, when moving the pen carriage with the joystick, all positioning is done with respect to the crosshair cursor. However, if either of the pens has been lowered (by the pressing of the front panel UP/DOWN switch, not a host supplied Draw command), all subsequent positioning with the joystick is done with respect to the lowered pen.

If the optional Media Advance (Option 36) is present, the joystick can be used to move paper across the platen in either direction under the front panel MANUAL MOTION function (described earlier in this section).

Either or both of the two joystick axes may be disabled by a host supplied Joystick Disable command (see Section 3).

Parameter Entry Switches and Indicators

The Parameter Entry module is located in the lower left side of the front panel. It consists of a row of eight (8) push-button switches (with lights inside) and a card (menu) that pulls out of a slot below the switches (see Figure 2-10). The card, with a list of operational configurations, is used by the operator to select Plotter operating parameters. The detents along the left side enable the Plotter to keep track of which operational parameter line the operator is currently addressing. If the parameter entry card should lose "synchronization" with the internal circuitry of the Plotter (such as when the instrument is powered-up with the card partially pulled out), an INITIALIZATION (INIT) light, located just to the left of the push-button switches, will come on. The Parameter Entry module will not accept any more inputs or changes at this time and will require that the operator re-establish "synch" by pushing the parameter entry card fully in. The INIT light will then go off, and the operator is free to pull out the card to continue making operating changes or check their status.
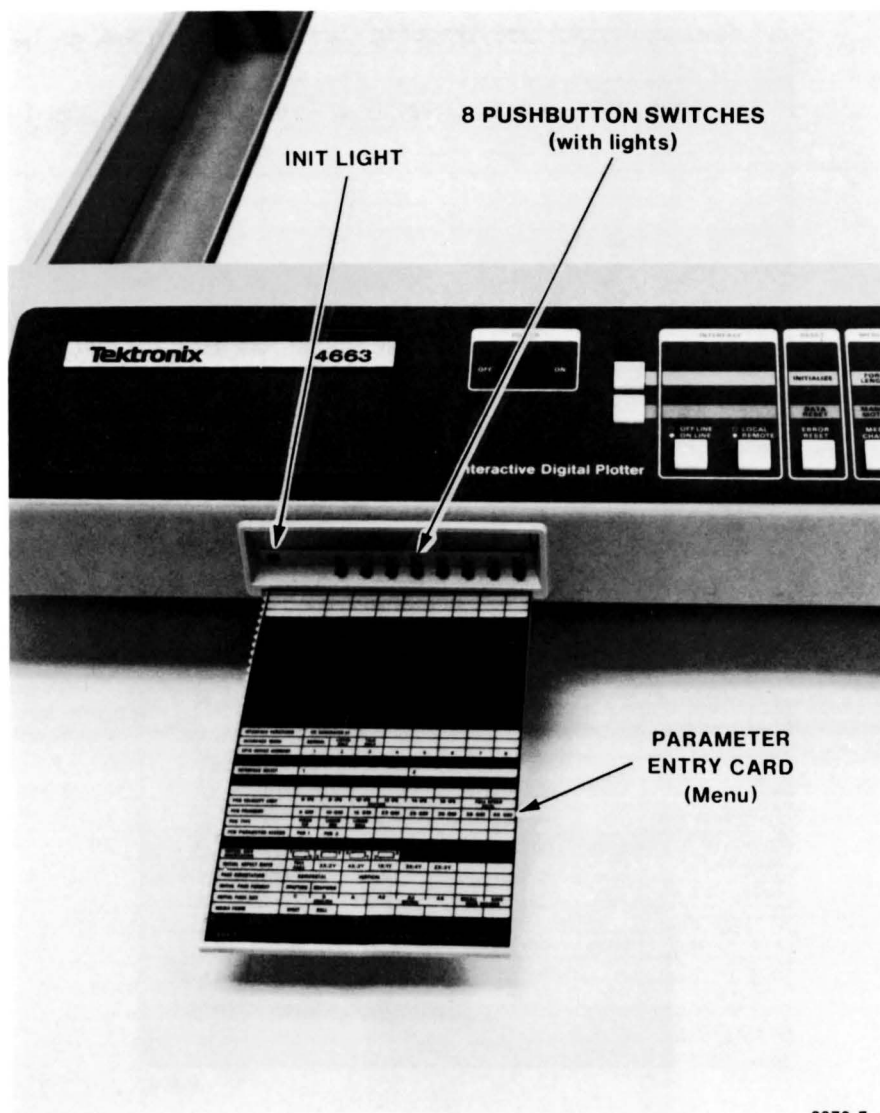
2670-7

Figure 2-10. Parameter Entry Module.

The Parameter Entry card line currently monitored by the Plotter is that one which is the topmost visible line (the first visible line outside of the Parameter Entry device). The card (shown in Figure 2-11), is laid out with nine vertical columns for each horizontal row. The leftmost column (and widest) is for the nomenclature of the line (operating parameter); the up to eight operating parameter choices occupy the remaining eight columns. Each of these parameter selection columns corresponds to one of the eight push-button switches, the one at the top of that particular column (see Figure 2-12). Notice that although any of the push-button switches can address any line choice under its corresponding column, the only line that can be addressed at any given time is the topmost visible line outside of the instrument. To access the other lines, the card must be moved in or out until the desired line is just visible.

NOMENCLATURE COLUMN / **8 COLUMNS OF OPERATING PARAMETER CHOICES**

EXECUTE SELF TEST	1	2	3	4	5	6	7	8
ERROR DATA	ERROR CODE	ERROR COUNT	1	2	3	4	5	6
				ERROR PARAMETERS				
OUTPUT TERMINTOR	CR	CR & EOT	NONE					
ATTENTION CHARACTER	ESC	!	^	SYN				
INTERFACE FUNCTIONS	AUTO MUTE	CR GENERATES LF		DEL IGNORE	CARRIER DETECT			
DC1/DC3 CONTROL	INPUT	OUTPUT						
COMMUNICATIONS CONTROL MODE	FULL DUPLEX	HARDWARE RECEIVE FLAGGING						
RECEIVE PARITY TRANSMIT PARITY	ODD ODD	EVEN EVEN	IGNORE LOGIC 0	IGNORE LOGIC 1				
CHARACTER FORMAT	7 DATA BITS/CHAR	8 DATA BITS/CHAR	1 STOP BITS	2 STOP BITS				
TRANSMIT BAUD RATE LIMIT	50	75	110	300	600	1200	FULL SPEED	
	50	75	134.5	150	1800	1X EXT	16X EXT	64X EXT
TRANSMIT BAUD RATE	110	300	600	1200	2400	4800	9600	
	50	75	134.5	150	1800	1X EXT	16X EXT	64X EXT
RECEIVE BAUD RATE	110	300	600	1200	2400	4800	9600	
SERIAL DEVICE ADDRESS	A	B	C	D	E	F	G	H
INTERFACE FUNCTIONS	CR GENERATES LF							
INTERFACE MODE	NORMAL	LISTEN ONLY	TALK ONLY					
GPIB DEVICE ADDRESS	1	2	3	4	5	6	7	8
INITIAL COMMAND/ RESPONSE FORMAT	1	2	3	4	5	6	7	8
INTERFACE SELECT	1				2			
ALPHA CHARACTER QUALITY	NORMAL	ENHANCED						
PEN VELOCITY LIMIT	6 IPS	8 IPS	10 IPS	12 IPS	14 IPS	16 IPS	FULL SPEED AXIAL	
PEN PRESSURE	5 GM	10 GM	15 GM	20 GM	25 GM	30 GM	35 GM	40 GM
PEN TYPE	FIBER TIP	LIQUID INK	LIQUID BALL					
PEN PARAMETER ACCESS	PEN 1	PEN 2						
LINE QUALITY	PREVIEW	NORMAL	1 ENHANCED 2					
INITIAL AXIS ORIENTATION	Y▢X	X▢Y	X▢Y	Y▢X	X▢Y	Y▢X	Y▢X	X▢Y
INITIAL ASPECT RATIO	FULL PAGE	3X:2Y	4X:3Y	1X:1Y	3X:4Y	2X:3Y		
PAGE ORIENTATION	HORIZONTAL		VERTICAL					
INITIAL PAGE FORMAT	DRAFTING	GRAPHING						
INITIAL PAGE SIZE	C	B ENGLISH	A	A2	A3 METRIC	A4	RECALL USER DEFINED	SAVE USER DEFINED
MEDIA FORM	SHEET	ROLL						
PARAMETER SETUP SELECT	SETUP 1	SETUP 2	SETUP 3	SETUP 4				
4663					**PARAMETER ENTRY CARD**			

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Figure 2-11. Parameter Entry Card (Menu).

Figure 2-12. Parameter Entry Pushbutton/Card Relationship.

Each pushbutton will select only the operating parameters in it's corresponding column. However, it must be remembered that the pushbutton wil choose only the parameter written on the top most visible line outside of the instrument. Moving the card in and out of the Parameter Entry module permits the pushbutton to choose any line.

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All of the choices for each operating parameter (nomenclature) reside on a single line, except for TRANSMIT and RECEIVE BAUD RATES which use two lines. Notice that only the lower (or first) line for each operating parameter is labeled with the nomenclature. The remaining BAUD RATE choices are listed on the line immediately above the line with nomenclature.

There are also several lines that have operating parameter choices that occupy more than one column. An example is PAGE ORIENTATION. The choices, "HORIZONTAL and VERTICAL," each occupy two columns. The operator may use either or both switches above the desired choice to enter that parameter.

The Plotter will not accept choices on blank lines or blank columns. If you attempt to make a choice in a blank line or column, the Plotter will sound the bell (speaker). The previous entry corresponding to a line will not be affected when a choice in a blank column is attempted.

The push-buttons contain lights which display the current (or previous) entry corresponding to that line. To read the current status of any line (for example INITIAL PAGE SIZE), the operator simply pulls the card out until the line ("INITIAL PAGE SIZE", in this case) is just visible. The currently chosen page size that is configured for the Plotter will be displayed by a light in the push-button located over the column with that parameter written.

An explanation of each operating parameter entry card line and its choices will be described in the following paragraphs.

Parameter Setup Select

The Parameter Setup Select line permits a rapid and convenient reconfiguration of the Plotter's operating parameters if equipped with Option 37 (additional parameter storage). All of the operating parameters for a particular mode of operation can be stored under SETUP, 1, 2, 3, or 4. Then, when that mode of operation is desired, only the corresponding SETUP switch need be pushed, instead of going through the entire parameter entry card and setting each line. Up to four different operating configurations can be stored in this manner. Without Option 37, all current parameters are stored as Setup 1.

In order to program (change any operating configuration) or operate in any of the four Setup modes, it is necessary first to press the corresponding SETUP switch (after pulling the card out to the first or bottom line). Then, any change to the desired operating parameter can be made by moving the card in or out and pressing the appropriate switches. The Plotter will continue to operate in that Setup mode until another SETUP switch is pressed (even after power-down situations).

Media Form

The Media Form line configures the Plotter to use either individual sheets of plotting paper or to plot on a portion of a long continuous roll of paper (if Option 36 is present). Then, when a page change is desired and the front panel MEDIA CHANGE button is pressed (or the host-supplied Page Change command is received — see Section 3), the Plotter will advance another portion of paper across the platen (in the case of ROLL mode) or move the pen out of the way and turn off the electrostatic paper hold-down (in the case of SHEET mode). The formlength advanced depends upon the Parameter Entry card selections — Initial Page Size, Format and Orientation.

If the Media Advance option (Option 36) is not present, and an attempt to select ROLL mode is made, the Plotter will simply ignore the command and remain in SHEET mode.

SHEET mode can be used with Option 36 installed, but the paper advance mechanism will be disabled.

Initial Page Size. The Initial Page Size line establishes the default page size (lower left and upper right corner locations) and the initial aspect ratio according to Table 1-6.

The SAVE USER DEFINED selection allows the operator to establish and save one set of unique lower left and upper right page coordinates manually via the joystick and the SET LOWER LEFT/SET UPPER RIGHT PAGE front panel switches. This set of coordinates then can be recalled later with RECALL USER DEFINED.

Initial Page Format. The Initial Page Format line permits plots to be made with margins conforming to either DRAFTING or GRAPHING standards as shown in Table 2-1. The DRAFTING margins are set according to the American National Standard drawing sheet size and format ANSI Y14.1-1975 for C, B and A sizes and according to the DIN 6781 standard for A2, A3, and A4 sizes. GRAPHING margins for C, B, and A sizes have wider margins along one side for binding purposes (such as three-hole punch) and are set to conform to most preprinted graph paper, such as K&E. The A2, A3, and A4 sizes have one wider margin according to DIN 6781 also.

Table 2-1

MARGIN DIMENSIONS

Page Format	Page Size	Margin Size (in HORIZONTAL orientation)
DRAFTING	C	.5 in sides and .75 in top and bottom
DRAFTING	B (paper is 11 x 17 in)	.62 in sides and .38 in top and bottom
DRAFTING	A	.25 in sides and .38 in top and bottom
DRAFTING	A2, A3, A4	10 mm margins all around
GRAPHING	C	1 in on left margin and .5 in on others
GRAPHING	B (paper is 11 x 16.5 in)	1 in on left margin and .5 in on others (plotting size is 10 x 15 in)
GRAPHING	A	1 in on top and .5 in on others
GRAPHING	A2, A3	20 mm on left margin and 10 mm on others
GRAPHING	A4	20 mm on top and 10 mm on others

Page Orientation

Page Orientation allows the operator to rotate the Page boundaries. Essentially, this gives the same result as if the paper was lifted and rotated 90 degrees (counterclockwise when going from HORIZONTAL to VERTICAL, and clockwise when going the other way) and repositioned at the HORIZONTAL lower-right corner. Every parameter of the Page will be rotated — axes, aspect ratios, and LOWER LEFT/UPPER RIGHT corners. After changing the Page Orientation, it is usually necessary to reselect the desired Initial Page Size again to establish the correct margins (see CAUTION below). It must also be remembered that if the new page boundary extends off the edge of the platen, the plot will be clipped at the platen edge. An example of this would be turning a horizontal C size plot to vertical mode. The top 5 inches (12.7 cm) of the plot will be clipped off. See Table 1-6 for Page Dimensions. This feature of Page Orientation might be used for better paper utilization in plot planning (see Figure 2-13).

> *{ **CAUTION** }*
>
> *The Page Orientation HORIZONTAL-VERTICAL conversions always pivot so that the actual lower-right corner remains fixed (even if left and right or top and bottom boundaries are interchanged, as might be the case when drawing mirror images for overhead slides). In order to correctly establish any of the six preformatted page sizes in a new VERTICAL or HORIZON-TAL orientation, it is necessary to press the desired Initial Page Size selection again (after the choosing fo either VERTICAL or HORIZONTAL). The following example explains this. Suppose the Plotter is set up for DRAFTING, B size, and HORIZONTAL (see Table 2-1). Choosing a VERTICAL page orientation still retains the new "lower left" corner at the original lower right position, .38 inches from the bottom and .62 inches from the right side arrow (i.e., these margins are now opposite of the standard). Reselecting the B size Initial Page Size now establishes the correct B size margins, with the lower left corner .62 inches from the bottom and .38 inches from the right side arrow. The same analogy applies when changing from VERTICAL to HORIZONTAL.*

Shaded portion may be clipped if the vertically
oriented Page/Viewport boundary is off the
edge of the platen.

Plot in Horizontal Mode

Same plot drawn in Vertical Mode and showing
its relationship to the Horizontal Plot.   2670-17
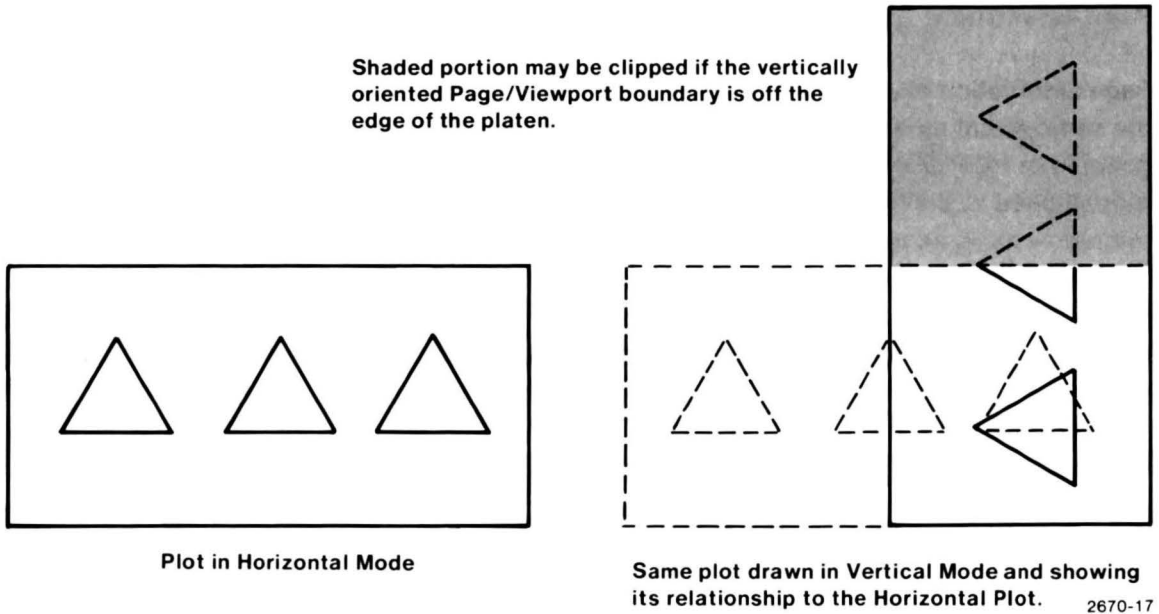
Figure 2-13. Page Orientation.

Initial Aspect Ratio

The Initial Aspect Ratio line permits the operator to specify the ratio of the X and Y
coordinate ranges. This results in plots with the specified coordinate ranges, which are
scaled equally in both axes, to fit in the current plotted page.

FULL PAGE permits the operator to plot on the entire initial page size for whichever page
size is chosen.

The remaining choices can be used to match the plots to various sources. This might
include Tektronix terminals which use an aspect ratio of 4X:3Y, or some B page size
drawings which use a 3X:2Y aspect ratio. Refer to Figure 2-14 for examples of the
viewport areas using different aspect ratios.

Full Page
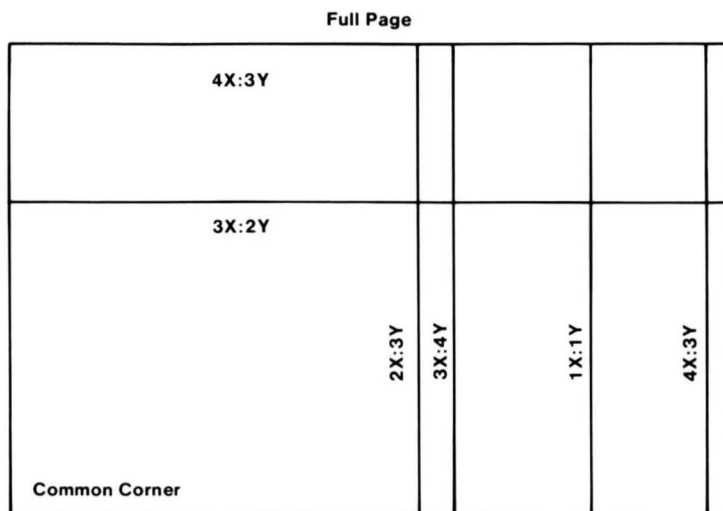
A. Initial Aspect Ratios for Horizontal C Size.
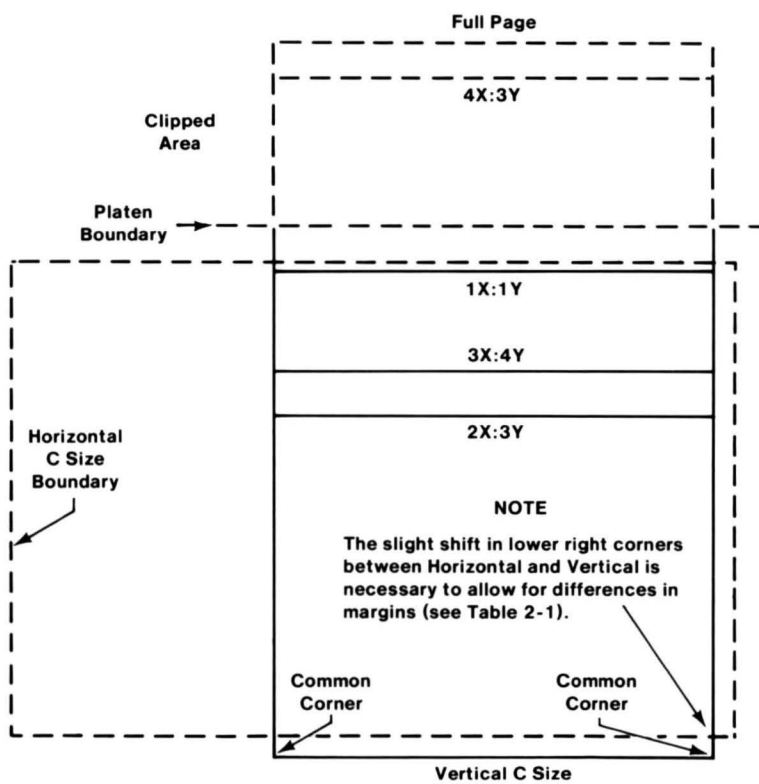
B. Initial Aspect Ratios for Vertical C Size.

2670-18

Figure 2-14. Initial Aspect Ratios.

@

Initial Axis Orientation. The Initial Axis Orientation allows the operator to arrange the axes of the desired plot. If the axis orientation as shown in the first Parameter Entry card column can be considered as "normal," then the second, third, and fourth columns simply progressively rotate the plot by 90 degrees clockwise. The last four columns permit selections where the X and Y axes are reversed. Figure 2-15 shows the selection of Axis Orientations available. Each number in a circle refers to the Parameter Entry card column which, if chosen, would orient the axes as shown. Both HORIZONTAL and VERTICAL modes are shown.

Changing the Axis Orientation does not have any effect on the existing page, viewport, or window sizes. However, any existing transformations, such as scaling or rotation, are reset to their default values.

Line Quality

The Line Quality line affects the acceleration (and deceleration) of the pen when it is drawing (moves are always accomplished at maximum acceleration). This will consequently affect the rate at which a plot is drawn. Notice that these four (4) choices (PREVIEW, NORMAL, ENHANCED 1, and ENHANCED 2) do not affect the terminal pen velocity, but only its acceleration (and deceleration) rate to that terminal pen speed. PREVIEW allows the operator to plot quickly (for quick overlooks). On the other hand, ENHANCED 2 causes the Plotter to plot much more slowly for very high quality archive copies. NORMAL is slower than PREVIEW and ENHANCED 1 is even slower, but faster than ENHANCED 2.

Pen Parameter Access

The Pen Parameter Access line allows the operator to program each of the two pens individually with three (3) parameters — Pen Type, Pen Pressure, and Pen Velocity Limit. Since the two pens can be of different types, it may be desirable to operate each pen differently due to the differing characteristics of inks, tips, etc. By choosing either PEN 1 or PEN 2 on this line, the Plotter is then programmed to accept changes (or reveal the existing configurations) in the next three (3) lines for the selected pen. Then the other pen should be chosen and the next three lines programmed for that pen.

CAUTION

Notice that this line does NOT choose the pen that will be used by the Plotter (that is done via the front panel controls or under the host program control), but rather permits the operator to change (or check) either of the two pen's selectable parameters.

Pen 1 is the pen closest to the front panel, while Pen 2 is the one closest to the back panel.
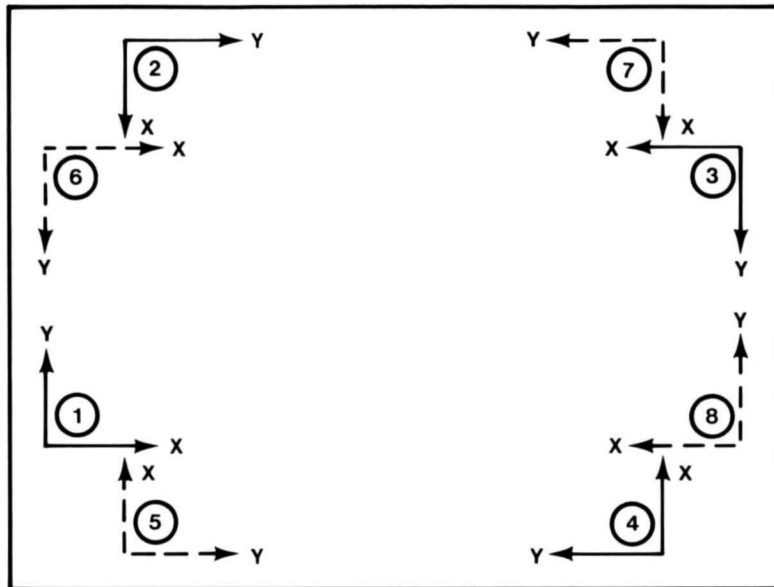
A. Axis Orientation in Horizontal Mode.

The circled number (X) refers to the Parameter Entry card column which, if chosen, would orient the axes as shown.

NOTE

The repositioning of the origin (0,0 location) is to keep the distances from the corresponding viewport axes the same. Positions are shown exaggerated for clarity.
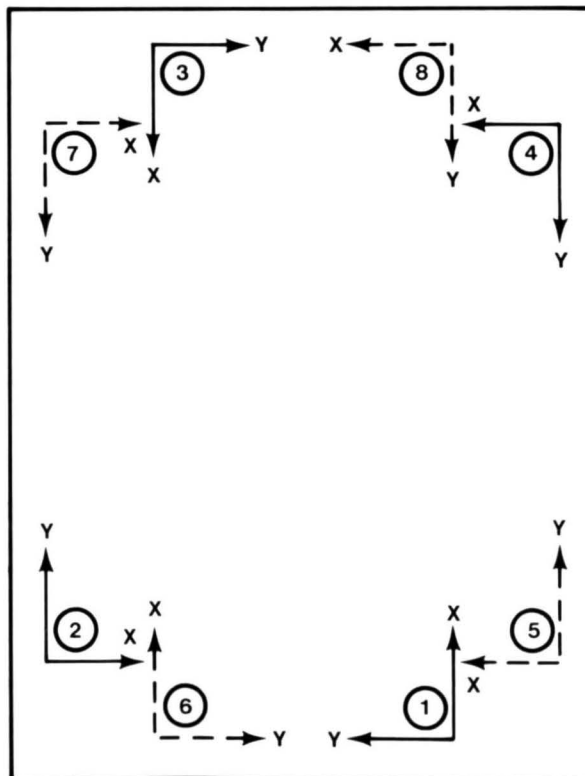
B. Axis Orientation in Vertical Mode.

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Figure 2-15. Axis Orientation.

Pen Type

The Pen Type line can be used by the operator to allow the Plotter to set default values for the next two parameter entry lines — Pen Pressure and Pen Velocity Limit — based upon the type(s) of pen(s) used. For example, if FIBER TIP is chosen, the Plotter will set the next two lines at 5 GRAMS (5 GM) of Pen Pressure and FULL SPEED AXIAL for Pen Velocity Limit. LIQUID INK has settings of 15 GM and 10 INCHES PER SECOND (10 IPS). Lastly, the LIQUID BALL uses default values of 40 GM and FULL SPEED AXIAL for the Pen Pressure and Pen Velocity Limit values, respectively.

Pen Type	Pen Pressure (default)	Pen Velocity Limit (default)
Fiber Tip	5 Grams	Full Speed Axial
Liquid Ink	15 Grams	10 IPS
Liquid Ball	40 Grams	Full Speed Axial

Notice that this line addresses the pen chosen in the previous line — the Pen Parameter Access line, and sets the downward force on the pen whenever that pen should become the active pen under host program control or via the front panel controls.

Pen Pressure

The Pen Pressure line allows the operator to select the downward pressure for the pen chosen by the parameter entry access line — Pen Parameter Access. This value will be used by the Plotter anytime that pen becomes the active pen under host program control or via the front panel controls. This value also becomes the coarse setting and can be further varied to ± 25% by adjusting the PEN CONTROL PRESSURE OVERRIDE control on the front panel (the fine adjustment) for that respective pen. An entry on this line will replace the default value that the Plotter previously set when an earlier entry was made to the Pen Type line (the next previous line).

Pen Velocity Limit

The Pen Velocity Limit is the maximum terminal speed (velocity) of the pen after acceleration from a start and prior to deceleration to a stop. This line allows the operator to preset the maximum terminal speed of the pen, and will replace the default value set by the Plotter if the operator has previously chosen one of the three Pen Types (two lines earlier). An entry on this line presets the terminal speed for the pen chosen by the Pen Parameter Access line (3 lines earlier). Should this pen become active (through host program control or via the front panel controls), this terminal speed will be used.

The first six (6) columns refer to the vector speed of the pen which is held constant for any drawing angle. The last two (2) columns (FULL SPEED AXIAL) establish a maximum velocity along either axis of 16 inches per second. This means that when FULL SPEED AXIAL is selected, the pen operates at a maximum terminal velocity of between 16 inches per second (drawing a line at 0 degrees, 90 degrees, 180 degrees, or 270 degrees) and 22 inches per second (drawing a line at 45 degrees, 135 degrees, 225 degrees, or 315 degrees).

Alpha Character Quality

The Alpha Character Quality selection permits the operator to emphasize either character smoothness or plotting speed for the printing of characters from the resident fonts. In the NORMAL mode, the Plotter uses a limited number of vectors to produce characters, where plotting speed may be more important than smoothness. In ENHANCED mode, the Plotter uses many more vectors, including curved line approximations, to produce smoother characters. Figure 2-16 shows a complete alphabet using both styles.

NORMAL ALPHANUMERIC CHARACTERS

ENHANCED ALPHANUMERIC CHARACTERS

2670-20

Figure 2-16. NORMAL and ENHANCED Character Styles.

Interface Select

The Interface Select line permits the operator to activate either the primary or secondary interface in the Plotter. Pressing the switch over the "1" column activates the interface that previously has been strapped as PRIMARY on the Interface Board. Likewise, pressing the switch over the "2" (fifth column), will activate the interface that has been previously strapped as SECONDARY on the Interface Board.

During the installation of the instrument, the customer should indicate, (in pencil) in the space beside column "1" which interface has been strapped on the Interface Board for PRIMARY. In a similar manner, the space beside "2" (in the fifth column) should indicate (in pencil) which interface, if any, that has been strapped on the Interface Circuit Board as SECONDARY.

Because of the different firmware requirements of each interface, changing to a different interface will cause the Plotter to undergo a complete power-up initialization sequence. During this reprogramming cycle, all present settings on the Parameter Entry Card will be retained. However, the VIEWPORT, PAGE, and MEDIA LENGTH dimensions will revert back (if the operator had previously altered these dimensions) to their initial values associated with the combination of present Parameter Entry Card selections concerning the page size and orientation.

It is important to note that if the Interface circuit board straps are later changed, that the notation (in pencil) on this card should then be changed to reflect this new strap arrangement.

NOTE

Whenever another Interface is selected, the Plotter undergoes a complete reprogramming (similar to an initial power-up). Since the Parameter Entry card is partially out at this time, it will be necessary to push it fully in momentarily to complete the initialization process of the Plotter (indicated by the turning off of the INIT light) before continuing.

Initial Command/Response Format

The Initial Command/Response Format allows the operator to provide the currently active interface with a detailed description of the format of the input commands to be interpreted and the format of any output data to be transmitted. This permits the Plotter to communicate with a large variety of equipment using various types of communication formats. The current Initial Command/Response Format will be saved, should another interface be activated, and then automatically restored when that interface becomes active again. The different formats are listed below. Refer to Section 6 for a detailed description of these formats.

Serial Interface (20/60 mA current loop, TTY, RS-232-C)

Format #1 — Unlabeled Binary Output

Format #2 — Unlabeled ASCII Output

Format #3 — Labeled Binary Output

Format #4 — Restricted Labeled Binary Output

Formats #5-8 are unused.

GPIB Interface

Format #1 — Full Command Set with EOI Output Terminator

Format #2 — Full Command Set with CR-LF Output Terminator

Format #3 — Tektronix Standard Format

Format #4 — Tektronix Standard Format

Format #5 — Restricted Command Set with EOI Output Terminator

Format #6 — Restricted Command Set with CR-LF Output Terminator

Formats #7-8 are unused.

GPIB Group

The next group of three lines (GPIB Device Address, Interface Mode, and Interface Functions) establish parameters and enable functions for the GPIB (General Purpose Interface Bus) interface. In order to make a selection on any of these three lines, the GPIB interface must be present and selected as the active interface (through a previous line — Interface Select. An attempt to make a selection without a GPIB interface or if it is inactive, will cause the Plotter to sound the speaker and ignore the command attempt.

GPIB Device Address

The GPIB Device Address line allows the operator to assign a number (from 1 to 8) as the Primary Address used to address the Plotter for talk and listen functions. This feature allows several devices, including the Plotter, to be connected to the GPIB bus and be selectively activated by a controller.

Interface Mode (GPIB)

The Interface Mode line permits the operator to choose the role of the Plotter in a GPIB instrumentation system. The design of the GPIB system allows devices to act as listeners and talkers. The addressing capability allows specific listeners and talkers to be activated and deactivated by a controller (such as a TEKTRONIX 4050 Series Graphic System or any other programmable GPIB controller). NORMAL permits the Plotter to act like either a talker or a listener, depending upon its immediate function under the control of a GPIB controller. LISTEN ONLY allows the Plotter to be manually configured as a listener in a GPIB communications system which does not have a controller to direct the talk-listen functions for instruments on the GPIB line. This could be used when transferring a plot directly from a GPIB tape unit which has been configured as a talker.

TALK ONLY allows the Plotter to be manually configured as a talker in a GPIB communications system which does not have a controller to direct the talk-listen functions for instruments on the GPIB line. This could be used when digitizing directly to a GPIB tape unit which has been configured as a listener.

Interface Functions

The Interface Function line allows the operator to enable or disable the CR (CARRIAGE RETURN) GENERATES LF (LINE FEED) function. If enabled, an ASCII CR in a print command will cause the Plotter to perform the carriage return motion and also generate an automatic line feed. If this function is disabled, an ASCII CR in a print command will cause the Plotter to perform only the carriage return motion.

Serial Interface Group

The next thirteen (13) lines establish parameters and usable functions for a serial interface. In order to make a selection on any of these lines, a serial interface must be present and selected as the active interface (via the Interface Select line). An attempt to make a selection without a serial interface or if the serial interface is inactive, will cause the Plotter to sound the bell and ignore the command attempt.

Serial Device Address

The Serial Device Address line allows any one of eight (8) device addresses (A through H in upper case) to be selected for the Plotter. This allows up to eight serial interface (such as RS-232-C) devices (including the Plotter) to be "chained together" in the same communications system and be selectively activated.

Receive Baud Rate

The Receive Baud Rate lines permit the operator to match the Plotter's received data transfer rate with that of the transmitting device. Because of the number of rates available, this function occupies two lines. However, only one data rate may be active at any instant (although the receive and transmit rates can be different). To check on the present received data rate setting, it may be necessary for the operator to move the card such as to address both of these lines in order to find the data transfer rate which has the lighted switch above (indicating the present setting). Received Data Transfer Rates available include 50, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 4800, and 9600 baud. In addition, there are three (3) multipliers (1x, 16x, and 64x), which may be selected when the receive clock is provided by an external modem.

Transmit Baud Rate

The Transmit Baud Rate lines permit the operator, in the same manner as for Receive Baud Rate (described above), to match the Plotter's transmit data transfer rate to that of the receiving device. The Receive and Transmit Baud Rates are separate functions which permit the Plotter to receive at one rate and transmit at another rate.

Transmit Baud Rate Limit

The Transmit Baud Rate Limit function permits the operator to slow the actual or effective output data transfer rate down to match the data handling capability of some host computers. There may be cases where, due to software considerations, the host may not be able to handle data as fast as the communications hardware can provide it. In this case, the Plotter operator can introduce a slight pause between individual ASCII characters, which will reduce the effective transmit baud rate and permit the host to keep up with the data transfer. Notice that the bits of the individual ASCII character will still be sent at the Transmit Baud Rate (chosen in the previous two lines) as required by the communications hardware, but the effective data transfer rate will be reduced because of this pause between individual ASCII characters. Approximately eight (8) microseconds is introduced between characters for the 1200 Transmit Baud Rate Limit, 16 microseconds for the 600 Baud Rate Limit, etc. FULL SPEED indicates that no pause is introduced between characters and data is sent at the Transmit Baud Rate setting (previous two lines).

Character Format

The Character Format line permits the operator to modify the communications parameters to match the hardware being used. The DATA BITS/CHAR selection does not include the Parity Bit in the bit count. For 7-bit ASCII data, the selection would be 7. Notice that there may be some interaction between Character Format selections and the Receive/Transmit Parity selections (next line). If the Receive Parity selection is IGNORE, a selection of 7 DATA BITS/CHAR will be ignored. The selection of 8 DATA BITS/CHAR and 2 STOP BITS will force the Plotter to select the Parity as IGNORE/LOGIC 1.

Receive Parity/Transmit Parity

The Receive and Transmit Parity line permits the operator to choose the type of parity check desired for characters being received and set the parity bit (most significant bit) in the characters being transmitted. The choices include the following: (1) check for ODD PARITY for receiving and setting of ODD PARITY for transmitting, (2) check for EVEN PARITY for receiving and setting of EVEN PARITY for transmitting, (3) IGNORE any parity bits for receiving and setting of the parity bit as a LOGIC 0 for transmitting, and (4) IGNORE any parity bits for receiving and setting of the parity bit as a LOGIC 1 for transmitting. If either active receive parity is selected, the Plotter will automatically select 1 STOP BIT, if 8 DATA BITS/CHAR is selected.

Communications Control Mode

The Communications Control Mode line permits the operator to select the hardware communications control protocol to be used over the serial interface between the Plotter and the host. If Column 1 (FULL DUPLEX) is selected, the Plotter-host interface system observes normal asynchronous full-duplex operation. In this mode, the DATA TERMINAL READY (DTR) control line is always asserted whenever the Plotter's power is on. The operator may also select HARDWARE RECEIVE FLAGGING when RECEIVING data from a host computer directly connected through the serial interface. This mode allows the Plotter to notify the host computer to stop sending continuous data when the available storage is becoming full. See Section 6 for further information on this function.

DC1/DC3 Control

The DC1/DC3 Control function permits the operator to use a "software" input flagging technique to control a continuous stream of data being transmitted between the Plotter and the host. In this mode, an ASCII DC3 (stop read) control character (CONTROL S) and an ASCII DC1 (start read) control character (CONTROL Q) are used to stop or start host transmissions or Plotter transmissions. Refer to Section 6 for further information concerning this function.

Interface Functions

The Interface Function line allows the operator to enable (or disable) some special operating functions concerning the serial interface. The AUTO MUTE function is used by the operator to prevent commands sent by a host to the Plotter from being displayed on the terminal's screen. This muting can be inhibited by NOT selecting this function and then all data from the host will pass through the Plotter's interface to the terminal, regardless of the Plotter's logical ON/OFF state. Notice that a portion of the Device On command will be sent on to the terminal before the AUTO MUTE function is activated even if AUTO MUTE was selected and the Plotter was logically off. Refer to the description of the Plotter On command (Section 6) for more information.

The CR GENERATES LF function allows the operator to enable or disable the CR (CARRIAGE RETURN) GENERATES LF (a LINE FEED) function. If this function is enabled, an ASCII CR in a print command will cause the Plotter to perform the carriage return motion and also generate an automatic line feed. If this function is disabled, an ASCII CR in a print command will cause the Plotter to perform only the carriage return motion.

The DEL IGNORE function allows ASCII DEL characters to be ignored when the 4663 communicates with host computers which use DEL for special system functions (such as padding). Note that as the DEL character is a low Y graphics character for implied packed binary graphics commands, an ESC ? character sequence must be used in place of the graphics DEL character when this function is selected.

The CARRIER DETECT function when selected monitors the DATA CARRIER DETECT (DCD) output from the modem when the front panel INTERFACE switches are set for ON-LINE REMOTE. If the carrier is lost, even momentarily, the REMOTE switch light will begin to blink.

Attention Character

The Attention Character line permits the operator to select the particular attention character that the Plotter will recognize as the beginning of an attention command. For TEKTRONIX 4010 Series Graphic Terminals, the attention (ATN in Section 3) character is ESC. However, the Parameter Entry card gives the operator a choice of ESC, !, ∧, or SYN.

Output Terminator

The Output Terminator line allows the operator to choose the output termination character sequence that is transmitted at the end of each transmission from the Plotter to the host. The choices are (1) a CR character, (2) a CR and an EOT (End of Transmission) character, or (3) no terminator (NONE) at all.

Error Data

The Error Data switches and lights permit the operator to access the contents of the internal firmware Error Data Table. If the operator presses the ERROR CODE switch (the switch over column 1), a binary code pattern indicating the type of error (if any) will be displayed by the eight lights. In the case that several errors have occurred since the last time that the Error Data Table was cleared, the display will indicate only the type of the first error occurring. Refer to Table A-1 in Appendix A for a description of the ERROR CODE light patterns. This description may include further instructions to press one of the ERROR PARAMETER switches (the six rightmost switches under columns 3 through 8). This may cause the lights to display further information concerning the error such as the location of the error address, the bit pattern of the error-causing character, or the faulty op-code of a command, etc.

The ERROR COUNT switch, when pressed, will cause the eight lights to display (in binary) the total number of errors recorded since the last time the Error Data Table was cleared.

However, even though the Plotter will record the total number of errors, only information about the first error will be available to the operator. Refer to Appendix A for more discussion of this function. See also the description of Identifying Errors later in this section.

NOTE

The first error will display its error code in the eight lights providing that the Parameter Entry card was previously pushed all the way in.

Execute Self-Test

The Plotter has internal self-testing features that perform three separate tests. One check occurs when the Plotter is powered up; it automatically performs internal checks on the RAM (buffers) and the ROM in which the controlling program (firmware) is stored. In addition, the pen location is initialized by moving it to the lower-right corner; the selected parameters (including interface) are then enabled. If an error is detected in this sequence, the Plotter will display the ERROR light (RESET switch) (see the ERROR DATA Parameter Entry Card entry discussed earlier).

The second self-test feature is activated by pressing the switch over column 1 and is not interruptable. It is designed to exercise the Plotter mechanism, including the motors and their drives, bearings, pulleys and cables, and the pen carriage. The test consists of a predetermined plot, shown in Figure 2-17, which may be examined to determine Plotter integrity. Notice that in this test, the right side of the center intersection (in the box) is drawn early in the plot. Then, finally after permitting the operator to briefly exercise the joystick, the Plotter completes this center intersection. The center "X" then can be examined to reveal any loss of positional accuracy during the plot and subsequent joystick operations.

The third self-test feature is a front panel lamp test and is activated by pressing the switch over column 2. All front panel switches should light (except those on the Parameter Entry and the POWER). To extinguish these lamps, simply press the switch over column 2 again.

Plot ends here after Joystick use. One
half of the intersection is drawn early in
the plot, while the remainder of the
intersection is drawn at the end to verify
repeatability.

Please exercise the joystick

2670-11
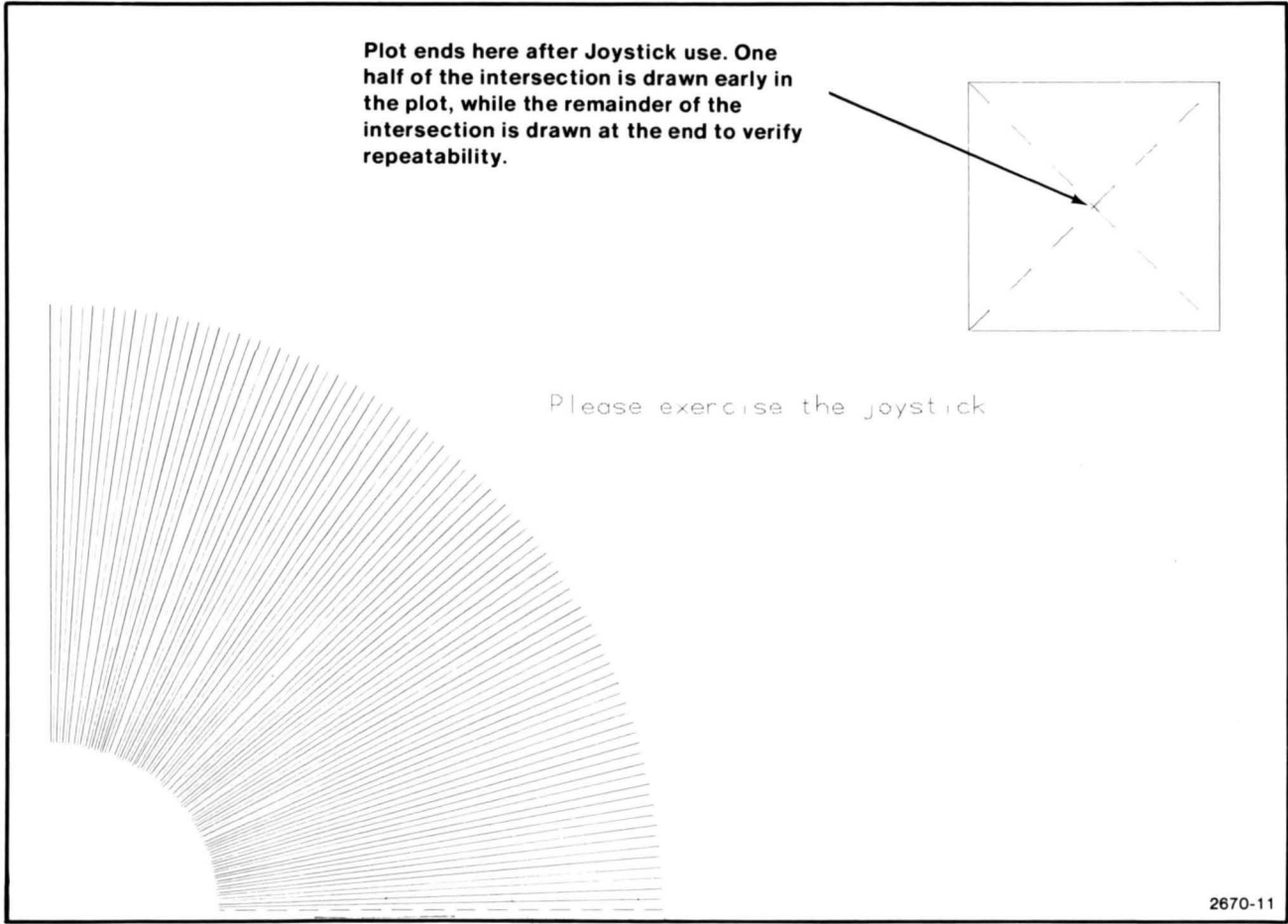
Figure 2-17. Test Pattern Produced by Self-Test Feature.

GENERAL OPERATING INSTRUCTIONS

Applying Power

After connecting the Plotter to an appropriate power source (see Installation — Section 7), rock the POWER switch to the right to apply power. Immediately, all eight (8) of the Parameter Entry switches will light, and after about 5 seconds, the pen carriage will move to the "Load" position. When the pen carriage reaches either the top or side boundary, it will move along that boundary until it reaches the upper right corner (load point) where it will stop. The eight Parameter Entry lights will go out at this time. This process initializes the internal circuitry to establish the plotting surface boundaries and the initial pen position. There is no special power indicator lamp, but there will be at least one switch lamp (usually one of the PEN SELECT lamps) on at all times while the Plotter is turned on. During the power-up initialization sequence, the Plotter automatically performs internal checks on the RAM storage and the ROMs in which the control firmware is stored. During this time all default parameter values are set to fixed values or values determined from current Parameter Entry card selections.

To complete the initialization process, it is a good idea to initialize the Parameter Entry card. The INIT Status LED (left side of the Parameter Entry) remains on at power-up (if the card is not fully pushed in) and indicates that the Parameter Entry card must be pushed fully in to synchronize and activate the Parameter Entry section. When the Parameter Entry card has been pushed in fully the INIT light will go out, indicating that the Parameter Entry has been initialized and is ready for entry or verification of operating parameters. If the Parameter Entry card is kept fully in, the initialization of the Parameter Entry is usually not necessary.

Typical Setup for General Plotting

For general plotting, the following setup of the operator controls will usually be satisfactory. Later on, as the operator becomes more familiar with some of the unique features of the Plotter, other variations of this setup may be used instead. If more information is requested on a particular switch, refer to its description earlier in this section.

Using A Serial Interface

1. POWER on.

2. INTERFACE switches to ON-LINE REMOTE (both switches on).

3. PEN 1 SELECT switch on.

4. Make the following selections on the Parameter Entry card:

   A. PARAMETER SETUP SELECT — SETUP 1

   B. MEDIA FORM — SHEET (unless Plotter is equipped with Media Advance option)

   C. INITIAL PAGE SIZE — C (or match desired paper size)

   D. INITIAL PAGE FORMAT — DRAFTING

   E. PAGE ORIENTATION — HORIZONTAL

   F. INITIAL ASPECT RATIO — FULL PAGE

   G. INITIAL AXIS ORIENTATION — Column 1

   H. LINE QUALITY — NORMAL

   I. PEN PARAMETER ACCESS, PEN TYPE, PEN PRESSURE, or PEN VELOCITY LIMIT — Used only when installing pens (refer to Installing Pens later in this section)

   J. ALPHA CHARACTER QUALITY — NORMAL

   K. INTERFACE SELECT — 1 (if the serial interface has been strapped as the primary interface)

   L. INITIAL COMMAND/RESPONSE FORMAT — 1 (a 4662 Emulation application would select 3)

   M. GPIB DEVICE ADDRESS — Not used with the serial interface

   N. INTERFACE MODE — Not used with the serial interface

   O. INTERFACE FUNCTIONS — Not used with the serial interface

P. SERIAL DEVICE ADDRESS — A (unless another device on the communications link has that address)

Q. RECEIVE BAUD RATE — Set to match host, modem, etc.

R. TRANSMIT BAUD RATE — Set to match host, modem, etc.

S. TRANSMIT BAUD RATE LIMIT — FULL SPEED

T. CHARACTER FORMAT — 8 BITS/CHAR and 1 STOP BIT or Set to match host, modem, etc.

U. RECEIVE/TRANSMIT PARITY — IGNORE/LOGIC 0 or Set to match host

V. COMMUNICATIONS CONTROL MODE — FULL DUPLEX

W. DC1/DC3 — Neither selected

X. INTERFACE FUNCTIONS — AUTO MUTE and CR GENERATES LF

Y. ATTENTION CHARACTER — ESC or Set to match host

Z. OUTPUT TERMINATOR — CR

5. Ignore the rest of the Parameter Entry card.

6. Be sure that the initial command to the Plotter is the Plotter On command (ATN ADD AE).

7. Remember that when the Plotter is powered down, it will remember all of the above Parameter Entry settings (Step 4). Therefore, the next time the Plotter is used, it will not be necessary to set (or reset) these selections, unless it is desired to change one or more of them.

Using the GPIB Interface

Use the same procedure as for the serial interface above except:

4K INTERFACE SELECT — 2 (unless the GPIB interface has been strapped as the primary interface).

4L INITIAL COMMAND/RESPONSE FORMAT — set to match type of controller.

4M GPIB DEVICE ADDRESS — 1 (unless another device on the communications link has that address).

4N INTERFACE MODE — NORMAL

4O INTERFACE FUNCTIONS — CR GENERATES LF

4P through 4Z Ignore. These lines pertain only to a serial interface. Ignore Steps 5 and 6.

If using a Tektronix 4050 Series terminal, use the DAB command structure (i.e., type PRINT @1,32:"DAB COMMAND and arguments" CR)

Loading Paper

Sheet Mode

If the Plotter is not operating in sheet mode (such as may be the case upon initial power-up), pull the Parameter Entry card out to MEDIA FORM and press the button located above the word SHEET (leftmost button).

Then push the MEDIA CHANGE switch (causing the light in that switch to blink). The pen carriage will move to the load position (upper right corner), and the electrostatic paper hold-down will be turned off. Remove any paper present on the platen, and position a new piece of paper on the plotting surface. The lower right corner of the paper should be aligned with the arrow on the lower paper guide. The bottom edge of the paper should lie evenly along the paper guide.

Press the MEDIA CHANGE switch again. This will turn the electrostatic paper hold-down back on.

If the PAUSE function is activated prior to the second pressing of MEDIA CHANGE, further plotting (but not the electrostatic paper hold-down) will be inhibited, until the PAUSE switch is pressed again. This allows the operator to smooth out the paper prior to plotting.

Roll Mode

If the Plotter is to operate in roll mode (only if the Media Advance Option 36 is present), pull the Parameter Entry card out to MEDIA FORM and press the button located above the word ROLL (second from the left button).

There are several other operating parameters that affect the paper advance media change that should be entered at this time. Some of these are INIT PAGE SIZE, INIT PAGE MARGIN, PAGE ORIENTATION and INIT ASPECT RATIO. Refer to the discussion on the Parameter Entry controls earlier in this section for details about each of these operating parameters.

Then push the MEDIA CHANGE switch. The pen carriage will move to the load point and the paper will advance across the platen and stop after moving the current form length.

If the PAUSE function is activated prior to when the paper stops advancing across the platen, further plotting will be inhibited until the PAUSE switch is pressed again. This allows the operator to smooth out the paper or alter the operating parameters prior to plotting.

Moving Paper to the Left/Right Using the Joystick

The operator may find it advantageous to use the joystick to reposition the paper to the right or left if employing roll mode. An example might be to position to the beginning of a preprinted form; or, after plotting a number of plots on a continuous roll of paper, the operator could shift all of the paper back to the left and then advance each plot through to the right, tearing off and separating each plot using the paper-tear bar.

To enable the joystick to control the paper advance motor, press SHIFT #1 and then the MEDIA switch (see Figure 2-18). Now the operator can move the joystick lever to the right to advance the paper to the right or move the joystick lever to the left to move the paper to the left.

1. Press SHIFT #1   2. Press MEDIA SWITCH

Joystick
(move to left to move paper to left, move to right to move paper to right)
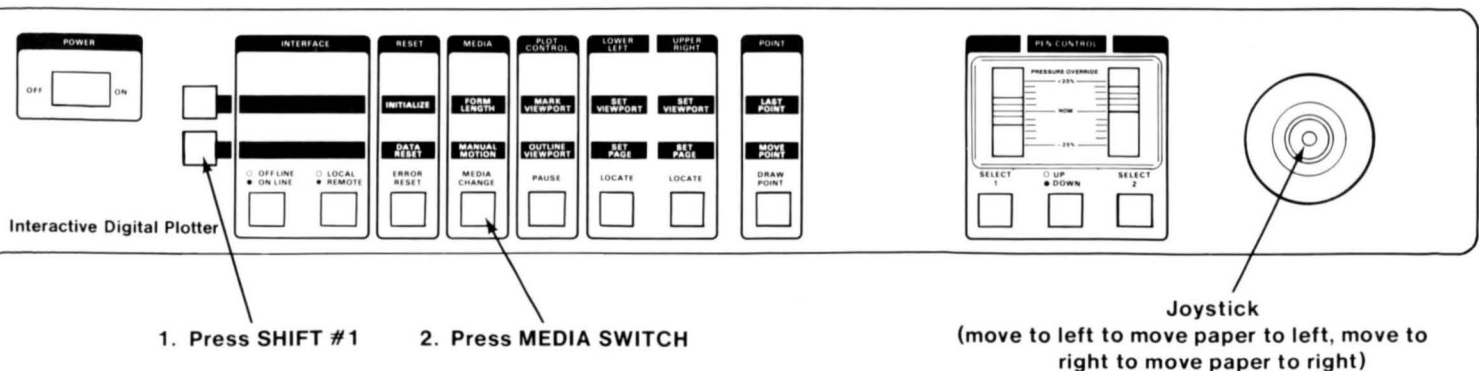
2670-21

Figure 2-18. Enabling the Joystick to Control the Paper Advance Motor.

It also must be remembered that the paper supply spool is not powered and paper moving to the left is not rewound onto the spool, except the first three inches or so. In addition, the paper is being pushed to the left across the platen since the paper drive mechanism is located on the right side. Therefore, some operator assistance may be required during left-going paper movements.

If it is desired to position the media to the left and continue plotting, the paper should first be moved 2-3 inches to the left past the desired position and the paper supply spool turned by hand to take up the slack. Then the paper can be moved to the right to the desired position. This will re-establish the supply-spool drag required to keep the paper flat on the platen surface.

Using the Paper-Tear Bar

A Paper-Tear Bar has been provided for use in separating plots when using roll paper. The Paper-Tear Bar is located on the right side of the Plotter (see Figure 2-19). To cut the paper, firmly lift the paper on the right side of the Paper-Tear Bar vertically against the Paper-Tear Bar. It may be helpful to press a hand down against the paper on the left side of the Paper-Tear Bar (holding it down against the platen) and adjacent to it while lifting the paper up.

Replacing the Paper Roll

The Plotter is designed to accept up to 3 inch (7.6 cm) diameter rolls of paper 18 inches (45.7 cm) wide using sprocket holes 1/2 inch (1.27 mm) apart, if the Plotter is equipped with Option 36.
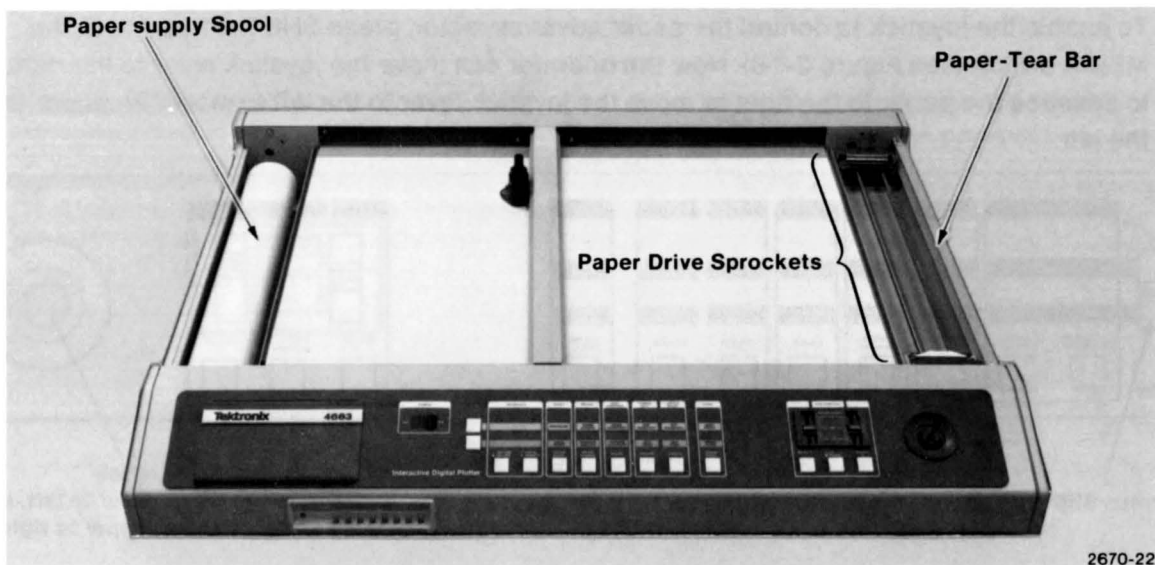
Figure 2-19. Paper Handling Mechanism.

To replace the paper roll:

1. Turn the two (2) large screw fasteners on the left side panel of the Plotter 1/4 turn CCW (use a screwdriver or quarter) and allow the side panel to hinge down.

2. Facing the left side of the Plotter, firmly move (slide) the left paper roll shaft to the left (you are pushing against a spring — see Figure 2-20). Then lift the old paper roll core (left end first) with the two end paper roll bearings out of the Plotter.

3. Pull each of these paper roll bearing out of the old paper roll core and transfer them to the new roll of paper, making sure that the paper roll bearings are transferred to the corresponding ends of the new paper roll as they were on the old roll. The paper roll bearings are not interchangeable; the paper roll bearing with the cross-pin engages with a clock-spring/slip clutch mechanism (located at the right end of the paper roll and used to keep the paper under tension while plotting).

4. Insert the new roll of paper into the plastic shafts (slide the left shaft to the left to allow this insertion) such that the paper passes over the top of the roll (see insert in Figure 2-20). Make sure the cross-pin on the right shaft is fully engaged. The paper should now pass over the top of the roll and onto the platen.

5. Slide the paper across the platen under the Y-Axis arm (and pen carriage).

6. On the right side of the instrument (viewing from the front) are the paper drive sprockets and mechanism. Lift the covers over each sprocket drive (they hinge up) and guide the paper over the sprockets until the sprocket holes in the paper line up with the drive sprockets. Lower the covers over the sprocket drives.

7. Hinge up the left side panel of the Plotter and fasten by turning the screw fasteners 1/4 turn CW. Check to ensure that the paper lays flat against the platen and that it pulls freely across the platen with the paper advance mechanism (press MEDIA CHANGE).

Adjustment of the Paper Drive Mechanism to Accommodate Different Paper Roll Widths

When a new roll of paper has a different width, the paper drive mechanism can be adjusted to fit the new paper size. First, notice that if the paper is properly engaged in the front paper drive sprocket, the paper lays adjacent to and touches the entire length of the front paper guide. If this is the case, the front paper drive sprocket (one closest to the front panel) will not need to be adjusted any further (even later when using other paper widths). Only the rear sprocket will need to be adjusted to accommodate various widths of paper. Loosen slightly, but do not remove, the large knurled nut next to the rear sprocket drive (see Figure 2-21). This will allow the rear sprocket drive mechanism to slide back and forth across the left end of the Plotter (when viewing the front of the Plotter). Adjust this sprocket drive until both sets of sprockets are centered in the paper holes (check both edges of the paper). Be sure that both paper drive sprocket guide covers are lifted while checking this. Then, tighten the knurled nut and lower the paper drive sprocket guide covers.
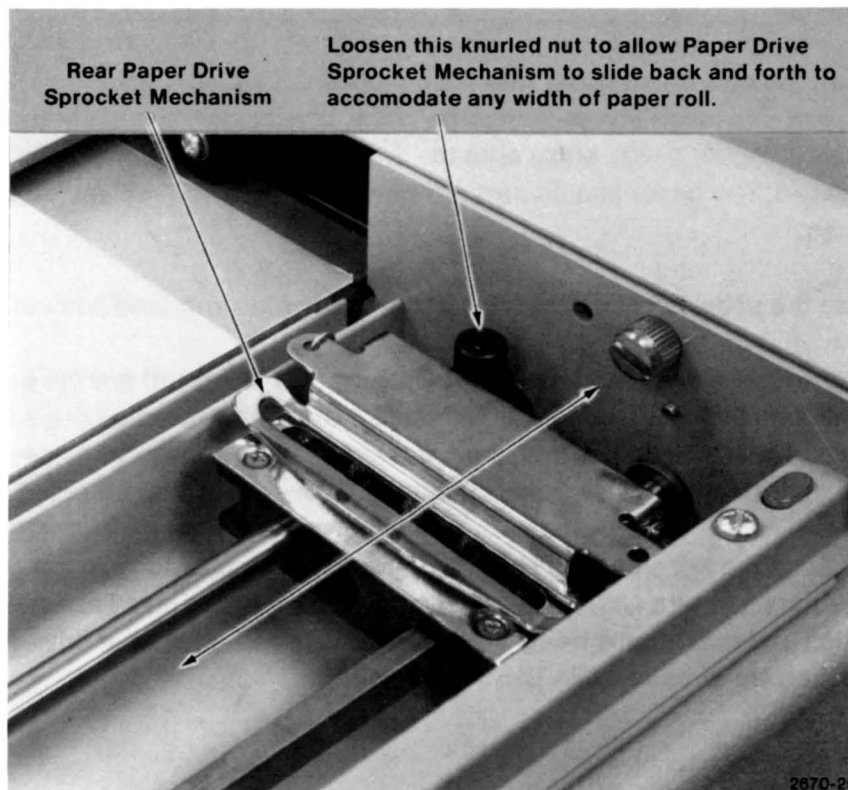
Figure 2-21. Adjustment to Accommodate Different Sizes of Roll Paper.

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Lateral Paper Drive Mechanism Adjustment

If there is a slight twist in the paper as it is being pulled across the platen (this is most easily noticed by feeling the tension of both edges of the paper as it comes off the roll), one sprocket drive mechanism is slightly ahead of the other. Figure 2-22 (diagramming the rear paper drive sprocket assembly) shows an adjustment screw (and a locking screw) which moves the rear paper drive sprocket assembly either forward (to the right when viewing the front of the Plotter) or backward (to the left when viewing the front of the Plotter). First, open the two end panels and the rear panel. Then, loosen the locking nut (do not remove) and slowly adjust the lateral paper drive mechanism adjustment screw until the tension on both edges of the paper (at the roll) are equal. Turning the adjustment screw CW moves the rear paper drive sprocket mechanism back (toward the left when viewing the front of the Plotter). Turning the adjustment screw CCW moves the rear paper drive sprocket mechanism forward (toward the right when viewing the front of the Plotter). Then, tighten the locking screw and replace the rear and end panels.

Figure 2-22. Paper Drive Sprocket Mechanism Lateral Adjustment Screw.

Installing Pens

To remove a pen, simply push the small button at the top of the pen holder (this retracts the rachet and allows the pen to turn freely). Carefully twist the pen (unscrew) CCW approximately 4 or 5 turns and lift it out.

To install another pen (with thread and tip dimensions equivalent to Statdhler-Mars), simply push the small button at the top of the pen holder (this retracts the rachet and allows the pen to turn freely) and carefully twist the pen CW approximately 4 or 5 turns until it seats.

CAUTION

Do not overtighten. Tighten reasonably firm with fingers only.

Once the pen is installed, the corresponding pen parameters must be set to the correct pressure and the maximum pen speed for that type of pen. The operator uses the PEN TYPE line on the Parameter Entry card to program the Plotter for the type of pen that is used in each pen location. The Plotter then uses this information to automatically establish an initial operating pressure and speed limit that is suitable for each pen. Later on, the operator may further adjust (or modify) these Plotter established settings, if desired, by selecting other values for the pen's pressure or speed. It must be remembered that to set (or change) the PEN TYPE, PRESSURE, or VELOCITY LIMIT for either pen, it is first necessary to identify the pen (PEN 1 or PEN 2) using the PEN PARAMETER ACCESS line on the Parameter Entry card. Once the proper pen is identified, its TYPE, PRESSURE, and VELOCITY LIMIT can be entered. Remember, however, that if the PEN TYPE is selected, a corresponding default PEN PRESSURE and VELOCITY LIMIT will be automatically set.

Then, if the PEN PRESSURE or VELOCITY LIMIT needs to be changed (or set) for the other pen, it will be necessary to access that pen, in a similar manner, using the PEN PARAMETER ACCESS line on the Parameter Entry card. The Parameter Entry card lines concerning PEN TYPE, PEN PRESSURE, and VELOCITY LIMIT then become applicable to the second pen.

Pen Height Adjustments

Liquid Ball/Fiber Tip Pens

The pen lifter (holder) is designed with sufficient travel to accommodate the slight variations in tip lengths for liquid ball and fiber tip pens. These pens are installed by simply twisting the pen CW approximately 4 or 5 turns until it seats (see Installing Pens above). There is no need for further height adjustments.

Liquid Ink Pens

Liquid Ink pens are sensitive to height and pressure settings. To install a Liquid Ink pen:

1. First turn the knurled locking nut on the pen body CCW several turns. This will move the nut up the body of the pen and temporarily out of the way.

2. Install the pen into the pen holder by turning it CW several times until it seats.

3. Turn (unscrew) the pen CCW 1-3 turns. The number of turns used in this may vary from pen to pen. You get a good idea of a reasonable adjustment by gently tapping the top of the pen and noticing that the pen does indeed rest above the paper between taps and that the pen travel is reasonable. It may be best to carry out this adjustment in several locations around the platen to ensure that platen unevenness does not affect this pen height.

4. Pull the Parameter Entry card out to Pen Type and select LIQUID INK for the corresponding pen location (see Pen Parameter Access line).

5. Press the PEN SELECT front panel switch corresponding to the pen holder containing the pen undergoing the test (remember Pen 1 is the pen closest to the front panel).

6. Press the OUTLINE VIEWPORT switch on the front panel. Verify that a solid line is drawn around the viewport.

7. Move the pen over the plotting paper using the joystick (with the pen up) and verify that the pen does not touch the paper. If the pen needs to be raised slightly, simply twist the pen CCW, and if the pen needs to be lowered slightly, twist the pen CW. The rachet action prevents the pen from twisting on its own.

8. When the pen is at the desired height, turn the knurled nut on the pen body CW until it rests lightly on the top of the pen holder. Do not overtighten.

Pen Pressure Adjustments

When a Pen Type has been chosen from the Parameter Entry card, the Plotter automatically chooses a default pen pressure. However, the operator can override this default pressure by simply choosing another pressure on the Pen Pressure line. In either case, this pressure is simply a "coarse" adjustment, and the operator can further modify this pressure by about ± 25% using the two front panel PEN PRESSURE OVERRIDE ADJUSTMENTS. To increase the pen pressure (to a maximum of + 25% more) adjust toward the + . To decrease the pen pressure (by a maximum of −25%) adjust toward the − . Notice that each pen has its own "fine" adjustment.

Line Quality

Note that PEN PRESSURE, PEN VELOCITY, and LINE QUALITY entries on the Parameter Entry Card and the operator PEN PRESSURE OVERRIDE ADJUSTMENT controls on the front panel will all affect the pen quality. It may require some experimenting with each of these variables to arrive at desired results. Remember that to change PEN PRESSURE or PEN VELOCITY, it is first necessary to access the proper pen, since it is possible to set up different forces and speeds for each pen. To access either pen and preset the pen force or speed values, pull the Parameter Entry Card out to the PEN PARAMETER ACCESS line. Press the switch over PEN 1, if the adjustments are to the pen closest to the front panel, or PEN 2, if the adjustments are to be made to the pen closest to the back panel (notice that the pen holders are also numbered). Thereafter, any entries made in the next three (3) lines — PEN TYPE, PEN PRESSURE, and PEN VELOCITY LIMIT — will be set up for that pen. Later, if adjustments are to be made for the other pen, it will have to be accessed through the PEN PARAMETER ACCESS line, in the same manner.

Any selection to PEN TYPE will cause the Plotter to automatically choose default corresponding values for PEN PRESSURE and PEN VELOCITY LIMIT (see "Pen Type" under Parameter Entry Switches and Indicators earlier in this section). However, the operator can then override these default settings, if desired, by addressing these two Parameter Entry lines separately and making another selection with the switches.

Pen/Crosshair Cursor Relationship

The 4663 Plotter has a pen carriage that holds two pens, permitting plots with two colors, textures, etc. However, only one of the pens may be active (moving or drawing) at any given time. Either pen can be selected from the front panel or by command from the host, and plots can be made using each pen on alternate moves. The pen carriage is constructed such that the two pens are located a slight distance apart from each other (approximately 1.1 in or 2.8 cm). See Figure 2-23 for a picture of this relationship. Notice that Pen 1 is the pen closest to the front panel. To avoid potential positioning problems, the crosshair cursor is the common point to reflect the position of the active pen, 1/2 second (or more) after the completion of the previous move. This means that if no more motion commands are processed by the Plotter, the pen will lift after 0.5 seconds (if not already up) and the pen carriage will move over slightly, such that the crosshair cursor is centered over the last position of the active pen. Then, when the next draw command is received (and processed) the pen carriage will move back again, so that the active pen is once again over the last position and the new move will begin from there. Therefore, all operations involving the locating positions on the plotting surface (except actual plotting), such as digitizing drawings or setting up page and viewport boundaries, require that the crosshair cursor be used for the current position instead of the actual pen.

NOTE

The current position for the next command is the spot under the center of the crosshair cursor, if the last move command was more than 0.5 seconds ago. When the joystick is active, such as for digitizing operations, the crosshair cursor is always in the current position (if the pen is up).

However, if it has been longer than 0.5 seconds since the Plotter has last received a motion command (and, therefore, the crosshair cursor is over the active pen position), and the next command is a move command (with no draw), the Plotter will eliminate the unnecessary move to position the pen over the last active spot prior to carrying out this next move command. It will, instead, simply make that move maintaining the active pen position under the crosshair cursor.
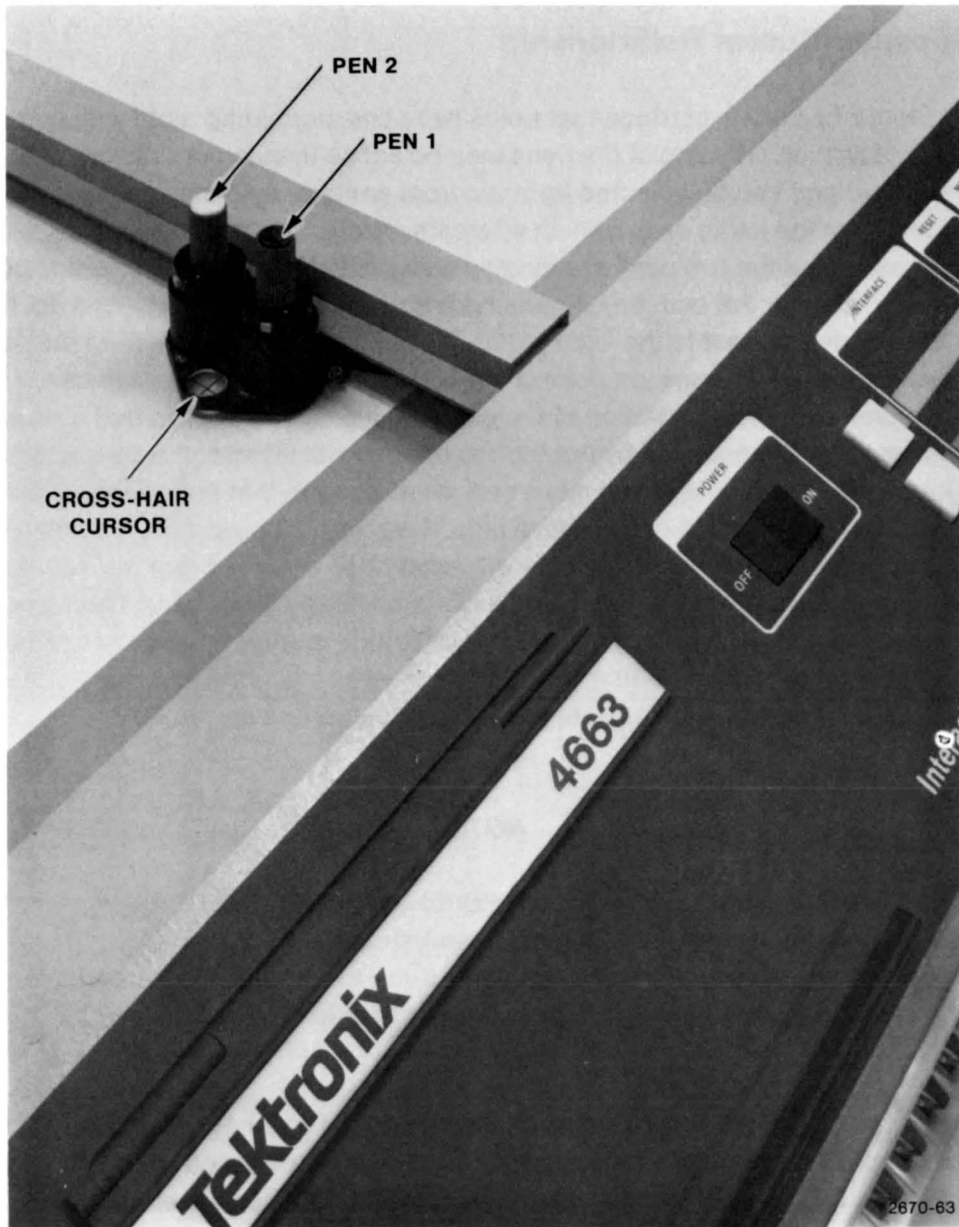
Figure 2-23. Pen Carriage.

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Manual Pen Positioning

The pen carriage cursor may be positioned to any point on the plotting surface using the joystick (POSITION CONTROL) located on the front panel (right side). The pen may even be moved manually by the joystick outside of the Page or Viewport boundaries in the case where the Page or Viewport boundaries have been reduced. This control can be used for digitizing operations, or in combination with other front panel switches (LOWER LEFT and UPPER RIGHT) and the Parameter Entry to redefine the plotting area size, orientation, and location.

The direction of pen motion corresponds to the direction in which the joystick control lever is tilted. The pen velocity is increased directly proportional to the displacement angle of the joystick control lever.

The joystick is always enabled, permitting the operator to use the joystick to manually move the pen carriage, 0.5 seconds after the last motion command has been processed by the Plotter and the pen carriage has moved to that last location.

Raising and Lowering the Pen

Pressing the PEN CONTROL UP-DOWN button changes the up-down state of the active pen. If the pen tip is touching the platen when the button is pressed, it will be lifted, and vice-versa. The button will light when the active pen is down.

When producing plots under program control, the Plotter automatically lifts and lowers the active pen to perform its MOVE, DRAW and PRINT operations. If no further commands are received within one-half second, the active pen will automatically lift from the paper and the pen carriage will move such that the crosshair cursor is centered over the last move point.

If the pen is lowered using the front panel UP/DOWN switch, it will be positioned to the active position and the automatic pen timeout will be inhibited so that the pen may be moved around the platen with the joystick. However, care should be exercised not to leave the pen down after completing any manual drawing which would allow the pen to "bleed" ink onto the paper.

Identifying Errors

If the Plotter encounters an error, it will attempt to make a reasonable assumption (or choice) and continue operating. If it can proceed after making a decision, the front panel ERROR/RESET switch will start blinking indicating that a nonfatal error was encountered. On the other hand, if the Plotter cannot continue operating with the erroneous information, the front panel ERROR/RESET light will be turned on steady and the Plotter will stop operation. In either case, the operator can determine the type of error(s) encountered as well as the number of errors encountered since the last time error information was requested. The eight parameter entry switch lights are used to indicate the error type. The operator can then refer to Appendix A to decode these lights and identify the error. If the Parameter Entry card was fully pushed in (normal recommended operating procedure) at the time the nonfatal error was encountered, the Parameter Entry switches will immediately show this code. The card does not need to be pulled out to the ERROR DATA line to identify the error. If, on the other hand, the Parameter Entry card had not been previously pushed fully in when the nonfatal error was encountered, the front panel ERROR/RESET light will start blinking (as usual), but the Parameter Entry switches will not display the error type code. The operator may, however, pull this card out to the ERROR DATA line and press the first switch (ERROR CODE) and display the error type code, which he can then decode using the table in Appendix A. Fatal errors, however, will always display the error type regardless of the position of the Parameter Entry card. If more than one error has been encountered (either fatal or nonfatal), only the error type code of the first error will be displayed.

The total number of errors encountered (since the previous request) will be displayed in binary when the operator presses the switch over ERROR COUNT (on the ERROR DATA Parameter Entry card line).

A nonfatal error indication (blinking light) can be cancelled by pressing the ERROR RESET function. This turns off the RESET light and clears the Parameter Entry error type code.

A fatal error condition (steady light) is reset by turning the power off and then on again (after correcting the cause of the error).

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Cleaning the Plotter Platen and Case

Occasional cleaning will preserve the appearance of the 4663. The frequency of cleaning will vary with the environment and use. The Plotter may be cleaned by using the following procedure:

1. Pull the Parameter Entry card out to the Media Form line and press the switch over SHEET (if it is not already lit).

2. Press the front panel MEDIA CHANGE switch; then turn the POWER switch off and disconnect the power cord. Remove any paper present on the platen.

3. Use a cloth lightly dampened in a mild detergent solution to wash the platen. Abrasive cleaners, such as scouring powder, must be avoided. Also, solvents containing alcohol should not be used to clean the platen because the alcohol breaks down the adhesive holding the paper alignment strips to the front and rear edges of the platen.

> **CAUTION**

> *Abrasive and strong chemical cleaners may scratch or even remove layers of the thin insulating film on the electrostatic platen. Alcohol will break down the adhesive holding the paper alignment strips on the platen.*

4. Remove soap residue from the platen with a moistened cloth, then dry with a clean, dry cloth.

5. The Plotter case may also be cleaned with a cloth lightly dampened with the same mild detergent solution.

6. Connect the power cord to the power source and, if necessary, change the Parameter Entry card's Media Form line back to ROLL mode. The Plotter may again be operated.

OPERATOR CONSIDERATIONS

Pressing of Any Front Panel Switch While Plotting

Typically the Plotter, while operating, buffers up to 10 motion commands ahead of that command currently being executed. This buffer is like a hopper; new commands are added to the top, and the Plotter executes commands coming out of the bottom. Pressing any front panel switch (except POWER, INTERFACE, and most of the Parameter Entry switches) causes the resulting motion command(s) to be loaded into the top of the hopper (buffer). The Plotter executes all of the previously buffered commands (moves, draws, etc.) before this latest command. Therefore, there may be some delay before the front panel switches take effect, even though the light in the switch will be activated immediately (when the command is created and stored in the buffer).

If a parameter concerning MEDIA FORM, PAGE SIZE or ORIENTATION, PEN FORCE or SPEED, or ALPHA or LINE QUALITY has been entered (changed) through the Parameter Entry card, the resulting commands are stored in the motion queue in the same manner.

However, Interface (RS-232 or GPIB) commands, such as baud rates, device addresses, parity, or special characters take effect as soon as the Parameter Entry switch is pressed. The front panel INTERFACE and POWER switches also have immediate responses.

Plotting Outside of Current Viewport

All plotting must be done within the currently defined Viewport boundaries. Any motion commands (MOVE or DRAW) that would exceed the Viewport boundaries are clipped at the Viewport boundary. The pen (or crosshair cursor, in a MOVE command) stops at the Viewport boundary. The Plotter's control firmware maintains the commanded pen locations outside the viewport, so that no motion information is lost, even though the physical pen motion is suppressed. Later, when subsequent motion commands call for motion within the Viewport, the pen (or crosshair cursor) moves to the Viewport boundary-plot intercept point and normal motion within the Viewport resumes. This same discussion applies to the page boundary, if the Page Clipping Limit is selected.

Roll Paper/Sheet Paper Margins

When plotting in ROLL MODE (set via the Parameter Entry card), the Plotter moves the upper and lower margin boundaries up 1/2″ (1.3 cm). This moves the plot up and allows the operator to remove the 1/2″ (1.3 cm) tear-off strip along both sides of the paper containing the sprocket holes. It is possible to plot in ROLL MODE when using sheet paper; in this case, the plots will be moved up by this same 1/2″ (1.3 cm).

NOTE

The electrostatic paper hold-down will not be operational during plots while in this configuration.

In a similar manner, but with opposite effects, the Plotter can be operated in sheet mode while using roll paper and in this case, the upper and lower margin boundaries will be moved down by 1/2″ (1.3 cm) to the normal boundaries.

NOTE

See Table 1-6 for dimensions for margin boundaries. The electrostatic paper hold-down will be used in this case. If the Option 36 Paper Advance mechanism is present and operated (after first switching back to ROLL MODE) without waiting a couple of minutes, the paper may tear because of the residual (but decreasing) electrostatic attraction to the platen.

Using the Joystick to Reposition Page/Viewport Boundaries

The Plotter initially establishes a page boundary whose size is based upon a combination of Parameter Entry selections (INITIAL PAGE SIZE, INITIAL PAGE FORMAT, etc.). This boundary is then positioned on the platen with lower right justification. At the same time, the initial viewport is made identical to the initial page. The operator may then reposition and/or alter the size of either the page or the viewport. The page may be repositioned using the joystick and the SET PAGE LOWER LEFT switch. To do this, use the joystick to position the crosshair cursor over the desired location of the lower left corner of the page, then activate the SET PAGE LOWER LEFT function. The Plotter, in this operation, simultaneously moves both the lower left and upper right corners of the page equally and places the lower left corner of the page under the crosshair cursor. It is not necessary (nor desirable) to also use the SET PAGE UPPER RIGHT function to establish the upper right corner of this page. Any time the SET PAGE LOWER LEFT function is activated (moving the lower left corner of a page), the upper right corner of that same current page automatically moves the same amount. This means that the current page size is always accurately maintained during repositioning. If you also use the SET PAGE UPPER RIGHT to reposition a page boundary, there is a substantial risk of inducing some error in the current page dimension.

If you want to establish a page size other than the selections on the Parameter Entry card (INITIAL PAGE SIZE), the joystick and both the SET PAGE LOWER LEFT and UPPER RIGHT switches are used. Since the SET PAGE LOWER LEFT function moves the upper right corner of the page in step with the lower left corner of the page, it is important that the lower left corner of the page be established first. Then the upper right corner of the page can be established. Also remember that any rescaling (as this operation really does) of the page will introduce a change in the X-Y aspect ratio. Afterward, any subsequent plotting will reflect this new aspect ratio. This induced distortion in scaling, however, may be eliminated by choosing the USER DEFINED — SAVE and RECALL selections on the INITIAL PAGE SIZE line of the Parameter Entry card.

In contrast to the SET PAGE function, the SET VIEWPORT LOWER LEFT and UPPER RIGHT functions work independently of each other. However, any rescaling of the viewport due to dimension alterations will be reflected in subsequent plots because of the change in the aspect ratio. Additionally, when positioning a viewport, remember that no portion of it may extend past the current page boundaries.

Successive Transform Commands

When the Plotter first powers-up, a default transform matrix is established which is then multiplied by each incoming motion command. This matrix also contains separate alphanumeric factors and is used by the Plotter to draw (or move) a vector or print a character. However, if you modify the plot (by sending one of the transform commands), the default transform matrix is multiplied by the matrix of the desired transform modification, creating a new active transform matrix. At this time the default transform matrix is discarded (unless saved with a Save Current Transform command prior to the modification). Then, if a further modification is requested, the present active transform (not the default transform matrix) will be multiplied by the next desired transform modification, creating a newer active transform matrix, which then is a combination of the default, and both of the subsequent modifications. Any further transform modification requests work in the same manner, each modifying the last created transform matrix. Consequently, it is possible to create an unwanted transform matrix unless some thought is given to the order in which the subsequent modification requests are sent. The Plotter establishes the transform matrix using the commands in the reverse order that they were received. This means that the last received command is the first one used to establish the transform matrix. Then, the next to the last received transform command is used and so on, until the first command received is used last.

Even though alphanumerics and graphics have their own modification commands, the modification of a graph parameter (such as skew, rotate, scale, etc.) will affect subsequent printing. The reverse is NOT true. Modifying alpha scale, alpha size, or alpha rotate (for example) will affect only subsequent alpha printing and not subsequent vectors.

Section 3

INTERFACE OPERATING COMMANDS

ABOUT THIS SECTION

This section consists of an explanation of the Plotter's coordinate and dimensioning system, as well as the description and formats for each of the host-driven Plotter operating commands. Both the serial and GPIB formats are given to aid the programmer.

INTRODUCTION

The 4663 Plotter can be operated from a host computer/terminal transmitting data over a variety of serial communications lines (RS-232-C, TTY, or 20/60 ma current loop) or the General Purpose Interface Bus (GPIB), using appropriate optional interfaces (see Table 1-1). Almost all of the operating commands described in this section can be used with any interface, and only the command format will be changed to meet the requirements of that interface. The Plotter also can modify its interface to enable it to receive (and send) different bit/byte formats from a variety of instruments (see the INIT COMMAND/DATA FORMAT line description of the Parameter Entry Card earlier).

Messages sent from the host computer system to the Plotter using a serial interface consist of commands, either explicit or implied, and any required command arguments (data). The explicit commands are in the form of attention commands. Such a command consists of several parts, in the following order: (1) a unique attention character (shown in this description as ATN), which always signals the beginning of a command; (2) an address character (ADD), which designates the device for which the command is intended; (3) a one or two character op-code which uniquely identifies the command; (4) any arguments (data) required. It must be remembered that all underlined portions of the command format (which is generally all of the command except the command op-code), requires that a unique character or data be substituted for that element. For example, ATN requires that either ESC (ESCAPE), !,∧, or SYN be transmitted for the Attention character (depending upon which character was chosen from the Parameter Entry card). Do not simply transmit ATN. In a similar manner, X,Y may require that an X-Y coordinate point (such as 50,25) or an X and Y dimension pair (such as 5 ADUs in the X direction and 10 ADUs in the Y direction) be transmitted. A guide for the use of the underlined variables in the command format is described in the description of the command. Most of the commands described in this section are explicit commands and use the following qualifier in the descriptions:

(delim)   Delimiter; a comma or a space

(term)   Data terminator for numeric ASCII data. May be another command
                 sequence or any non-numeric character except a delimiter, + , -, or E.

Although the delimiters are generally shown in the command formats between data elements, terminators are generally not shown and are understood to end a command.

The implied commands are of the form used by TEKTRONIX 4010 Series terminals using a serial interface. This command form (used in Graphic and Alpha modes only) provides an alternate way to specify print and move/draw commands. In addition, Alpha and Graph modes each have a sub-mode referred to as Last Character Escape (LCE), which permits non-related operations to be performed while remaining in that mode. The implied commands use certain control characters to transfer between these three modes (or sub-modes) as shown in Figure 3-1. In Alpha mode, all characters received are interpreted as print command arguments if a print command (US control character) has been received. If a GS character is received, the mode changes to Graph, and all subsequent characters are interpreted as Move/Draw arguments in HIY, LOY Format (described later). For additional information refer to Graphic Plot commands and Section 6.

Whenever an ATN character (such as ESC) is received, either Alpha or Graph LCE mode is activated. In these modes (and sub-modes), ATN commands are recognized and executed. At the completion of the command, the previous mode is reactivated.

If ATN commands are used exclusively for control of the Plotter, the Plotter will power-up in Alpha mode.

Arguments for either explicit or implied commands are simply ASCII characters. For implied PRINT commands, the attention character, US and GS, cannot be sent as arguments. Explicit commands may contain any ASCII characters.

Because of the different bit-byte formats for the different interfaces/systems, several variations of the command format may be shown. Each variation is given next to the corresponding selection from the Parameter Entry card's INIT COMMAND/DATA FORMAT line and is applicable to that interface. This is the Format # used in the following descriptions. For example, most RS-232 formats list Format #1, 2, 3, and 4. This means that the operator could select either 1, 2, 3, or 4 on the Parameter Entry card's INIT COMMAND/DATA FORMAT line (described later in this section), and then use the command format as shown.

In addition, there may be some supplementary information concerning a particular command specified in several other sections of this manual. This will be pointed out in the command's description.
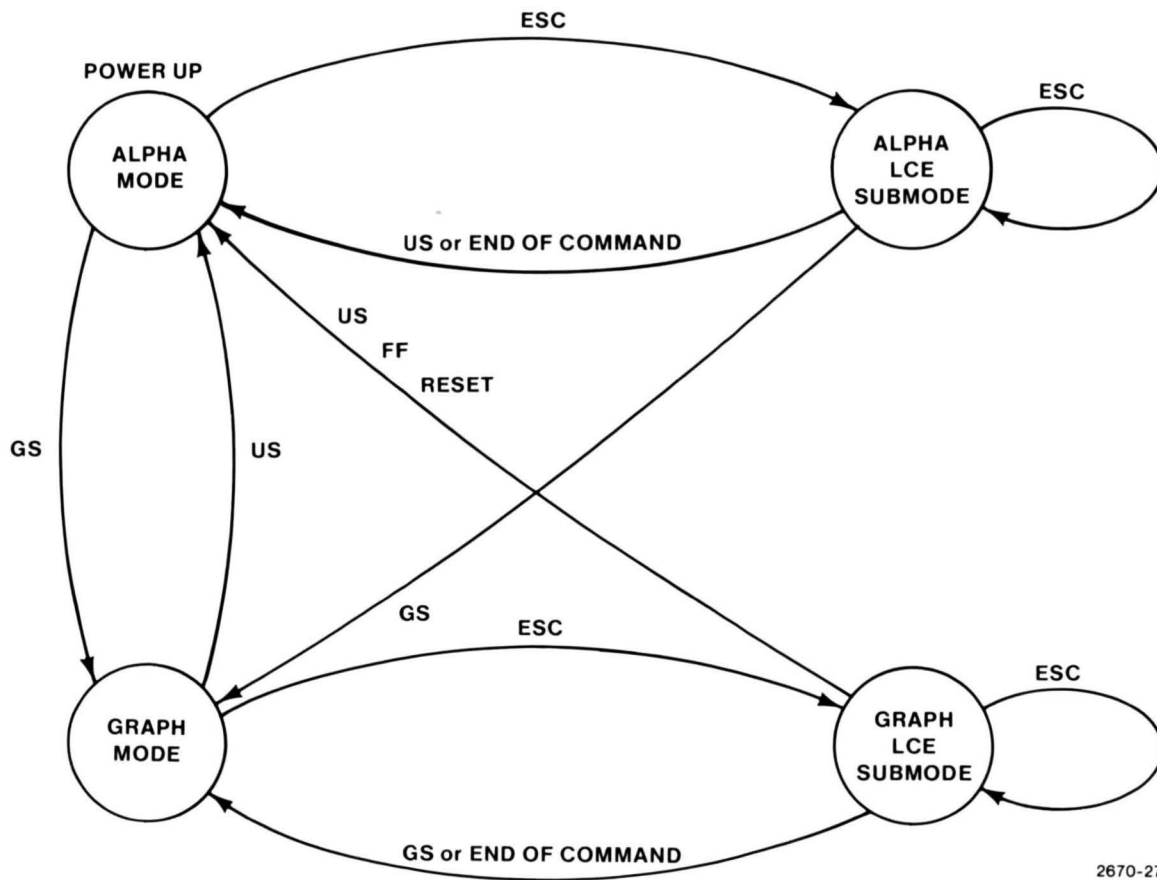
Figure 3-1. Implied Command/Mode Relationships.

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PLOTTER GRAPHICS

To understand Plotter Graphics, it is important that the operator become familiar with four terms. These are the Platen, Page, Viewport, and Window. Refer to Figure 3-2 for a relationship of these terms.

Platen   The platen is the physical plotting surface of the 4663 Interactive Digital Plotter. It has a usable plotting area of 23.5 inches (596.90 mm) horizontally by 17.33 inches (440.18 mm) vertically. This is the area to which both pens have access and is defined as the rectangular area whose bottom boundary is .2 inches (5.08 mm) above the bottom paper guide strip; whose top is .595 inches (15.11 mm) below the upper paper guide strip; whose right edge is .2 inches (5.08 mm) to the left of the arrow; and whose left edge is 23.7 inches (601.98 mm) to the left of the arrow.

Page   Normally, only a portion of the platen is used for plotting in order to conform to the size of the paper sheet being used. This portion is designated as the page, and can extend to (or in some cases beyond) the limits of the platen. The page is always rectangular and can be located by its lower left or upper right corners. Momentarily pressing the LOCATE LOWER LEFT and LOCATE UPPER RIGHT switches on the front panel will indicate this area. The initial page dimensions are determined by the MEDIA FORM, INITIAL PAGE SIZE, INITIAL PAGE FORMAT, and PAGE ORIENTATION selections on the Parameter Entry card. A variety of standard English and metric page sizes are available. In addition, a user-defined page size can be stored. The page can then be repositioned (or oriented) or even changed by using the joystick and the front panel switches — SET PAGE LOWER LEFT and SET PAGE UPPER RIGHT. The page can not be set by the host computer.
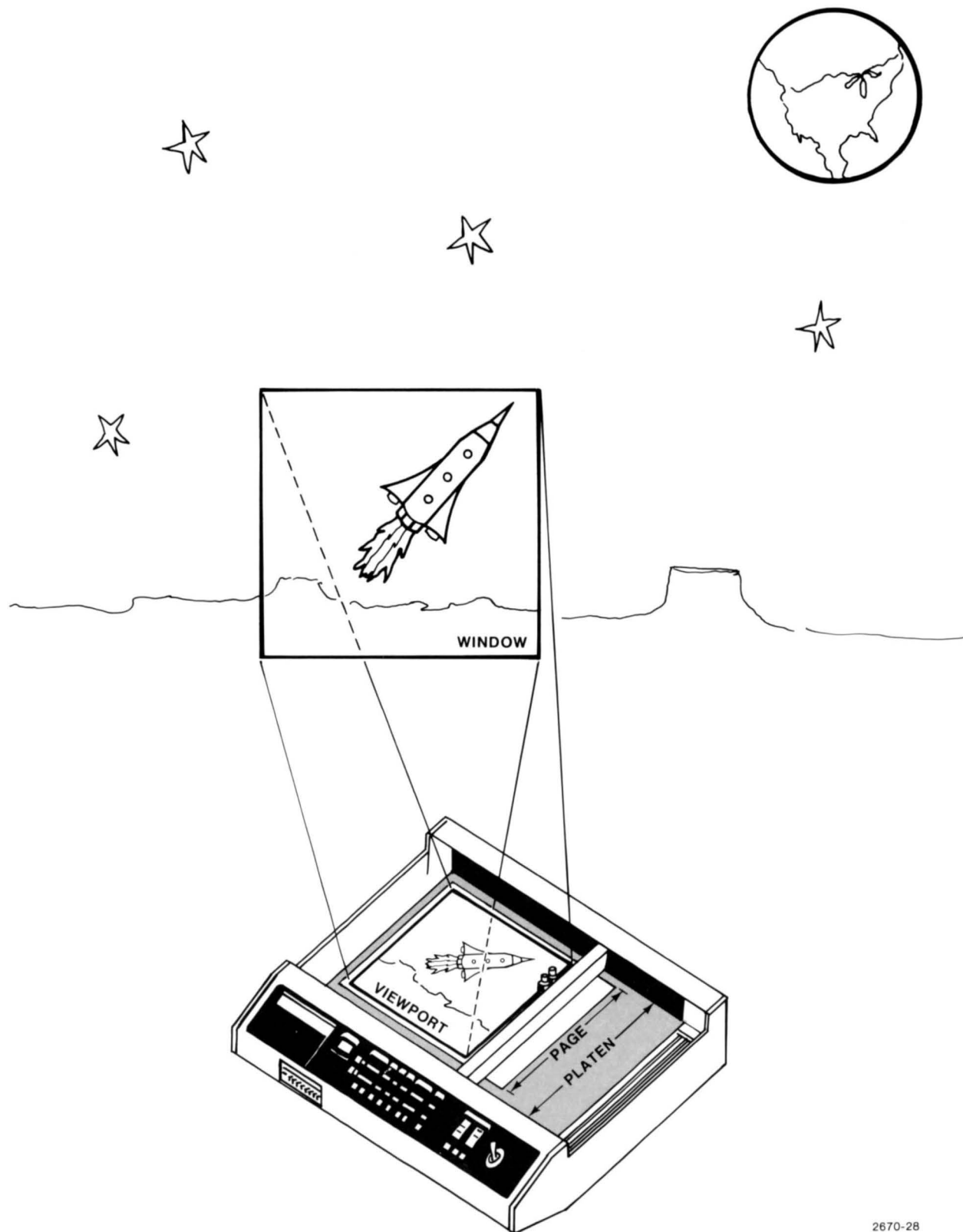
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Figure 3-2. Window/Viewport/Page/Platen Relationship.

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Viewport   When a plot is drawn on a piece of paper, it is not always desired to have the drawing totally fill the paper on which it is drawn. There are times when the space is needed around the edges for labeling or titling or when more than one drawing is to be drawn on a single piece of paper. The viewport, then, is the portion of the paper that is actually used for plotting. It is rectangular in shape (in default) and is always contained within the page boundaries. The viewport has the same relative horizontal and vertical position as the page. Therefore, if the orientation of the page is changed, the orientation of the viewport automatically follows in the same manner. The viewport's lower left and upper right corners can be located by holding down the front panel LOCATE LOWER LEFT and LOCATE UPPER RIGHT switches respectively until the bell sounds (approximately 2 seconds). In addition, the front panel MARK VIEWPORT function can be used to indicate the viewport boundary. The host can read the viewport boundaries with a Read Viewport command. The Plotter establishes the viewport based upon the INITIAL ASPECT RATIO selection on the Parameter Entry card. The FULL PAGE selection causes the viewport to have the same dimensions as the page boundary. With other selections of the INITIAL ASPECT RATIO, the Plotter establishes the largest viewport area possible within the current page boundary and then positions this viewport on the lower left corner of the page. Selecting a still different INITIAL ASPECT RATIO will result in another change in the viewport dimensions. In addition, the joystick and the front panel SET VIEWPORT LOWER LEFT and SET VIEWPORT UPPER RIGHT switches can be used to establish a viewport. Lastly, the host computer can establish the viewport with a Set Viewport command.

Window   The window is the rectangular portion of the world space that is to be drawn into the viewport area. The corners of the window are defined in "world units," the units of the world coordinate system — such as miles, meters, yards, feet, inches, etc. The boundaries of this window are then projected into the viewport's display area by the host using a Set Window command.

PLOTTING AND DIMENSION UNITS

All command arguments which involve a position or length (distance) on the plotting surface are specified using coordinate units. Examples might include the coordinates that the pen is to be moved to or the height of an alpha character. The operator may choose as his user coordinate unit any of three Device Units or the category of World Units (which can include units of the operator's own choosing). The three types of Device Units are:

Addressable Device Units (ADUs or Raster Units)

Graphic Device Units (GDUs)

Millimeters (mm)

Refer to Figure 3-3 for a diagram of the selection process for choosing coordinate units. Notice that the Plotter powers up in World Units. After that one of the Device Units can be selected. It is important to remember that the Plotter will automatically choose ADUs for a Device Unit if operating with a serial Interface, or GDUs if operating with a GPIB interface. The operator, however, may override this automatic selection and choose any Device Unit.

World Units

The default World Units, while operating with a serial interface, use the same range as if the ADU Device Unit were selected. This means that when operating through a serial interface, the default World Units range from 0 to 4096 on the longer viewport axis and from 0 to a proportionally smaller number on the other axis, depending upon the selected aspect ratio. On the other hand, the default World Units, while operating with a GPIB interface, use the same range as if the GDU Device Unit was selected. This means that when operating through the GPIB interface, the default World Units range from 0 to 100 on the shorter viewport axis and from 0 to a proportionally larger number on the other axis. In both cases, the default location of 0,0 is usually at the viewport lower left corner (depending upon the axis orientation). The operator may then choose a different coordinate range using any convenient world unit with a Set Window command. Some convenient units might include angstroms, inches, meters, yards, miles, light-years, etc. With this user-defined coordinate system, the Plotter is simply addressed with these coordinate numbers and it plots them properly in relation to the coordinate system. When World Units are selected, vectors are affected by all active transformations previously entered into the Plotter. This includes all of the Transformation commands (described later). Modification of the viewport or page does not affect the world unit values, nor does it change the window or axis orientation. However, the lengths of each unit will be proportionally different in the same way that the viewport/page dimensions have changed.

```
                        ┌──────────────┐
                        │   PLOTTER    │
                        │  POWER-UP    │
                        └──────┬───────┘
                               │
                               ▼
                                    WORLD UNITS
                               (subject to current Transforms)

                        ┌──────────────┐
                        │   SELECT     │        WORLD UNITS
                        │  GRAPHICS    │
                        │  COMMAND     │
                        │    UNIT      │
                        └──────┬───────┘
                               │
                               ▼
                          DEVICE UNIT CATEGORY
                       (not subject to current Transforms)

                        ┌──────────────┐        ADU
                        │   SELECT     │
                        │   DEVICE     │        GDU
                        │    UNIT      │
                        │  (see Note)  │         mm
                        └──────────────┘
```
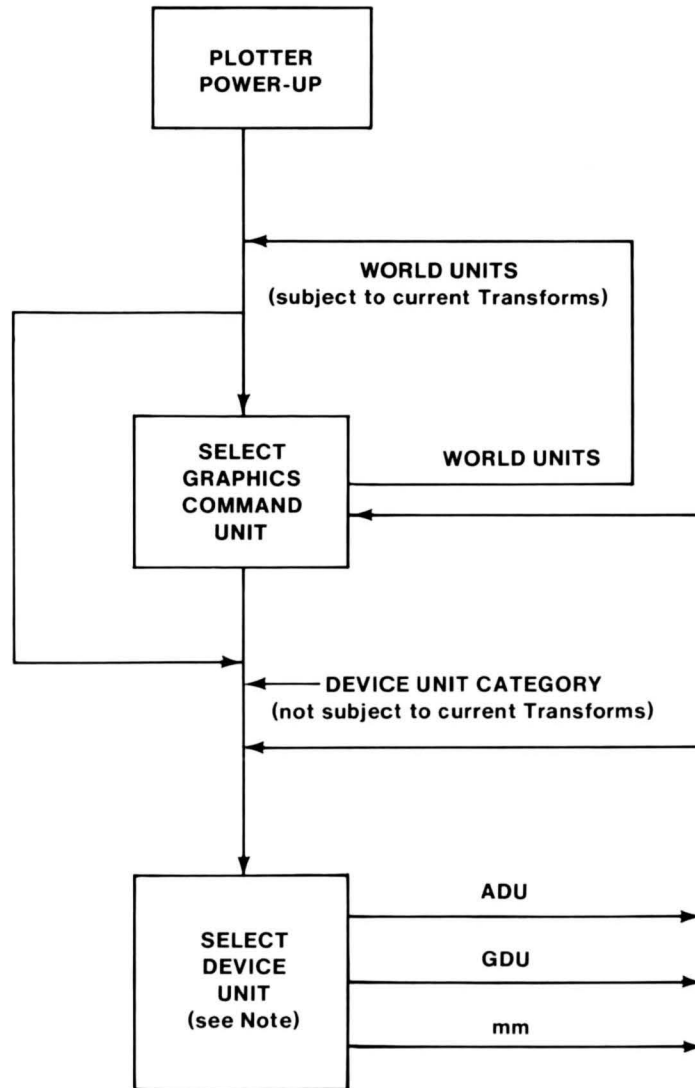
Note: If Device Unit is selected with the Select Graphics Unit command, the Plotter will automatically chose ADUs, if operating with a serial interface, or GDUs; if operating with a GPIB interface. The operator may, however, override this.

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Figure 3-3. Plotting Coordinate Unit Selection Process.

Device Units

The category of Device Units (selected with a Select Graphic Unit command) enables the operator to use any of three coordinate units (chosen with a Select Device Unit command). These are:

Addressable Device Unit (ADU or Raster Unit)

Graphic Device Unit (GDU)

Millimeter (mm)

Device Units apply to the page coordinate system and therefore can be used in establishing (or reading out) viewports. This means that all viewports are established with respect to the current page boundary (established by the Parameter Entry card). For each of the Device Units, the origin of the coordinate system (0,0 location) is the lower left corner of the page.

It must also be remembered that once a viewport is established that is different than the current page boundary, it (the viewport) establishes a complete coordinate system of its own and which is completely independent of the page coordinate system outside. The operator, therefore, can select a coordinate system inside the viewport that is different (even as to the type of units) than the page coordinate system outside (which can only be in one of the Device Units).

Referring to Figure 3-3, notice that Device Units are not subjected to any of the current transforms.

Addressable Device Units (ADUs or Raster Units)

The Addressable Device Unit is the default Device Unit selected by the Plotter when operating through a serial interface. These units provide a numeric addressable range of 0 to 4096 on the longest axis of the current viewport. The shorter axis will have a smaller range, depending upon the selected aspect ratio. Notice, however, that the actual physical size of these units will vary depending upon the size of the current viewport.

Graphic Device Units (GDUs)

The Graphic Device Unit is the default Device Unit selected by the Plotter when operating through the GPIB interface. These units provide a numeric addressable range of 0 to 100 on the shortest axis of the current viewport. The longer axis will have a larger range, depending upon the current aspect ratio. Like the ADU unit, the actual physical size of these units will vary depending upon the size of the current viewport.

Millimeters (mm)

Using Millimeters as user units means that the plots will always be measured in that unit regardless of the current viewport size and aspect ratio. The plot size and viewport will have to be chosen large enough to contain the desired plot.

Physical Lengths of Graphic Units (Page/Viewport Scaling)

For many graphing applications, it is useful to know the actual physical length of the current graphic unit. The following discussion will outline the scaling process for both page and viewport. Remember, 1"= 25.4 mm.

Page Scaling

The primary factor determining the length of a device unit in the page coordinate system is the length of the X or Y axis (i.e. the selected INITIAL PAGE SIZE). Other factors affecting this length are the selected INITIAL PAGE FORMAT and any modification of the page's lower left or upper right position with the front panel joystick. If the page has not been modified from the front panel, the physical size of the desired axis may be easily determined from Table 1-6 which lists axis dimensions.

For ADUs, 4096 units are located along the longest axis. Therefore, for a C size, Drafting selection, the page scaling is:

$$\frac{21 \text{ inches}}{4096 \text{ ADUs}} = .00513 \text{ inches per ADU or } 195.05 \text{ ADUs per inch}$$

or $$\frac{533.40 \text{ mm}}{4096 \text{ ADUs}} = .13022 \text{ mm per ADU or } 7.68 \text{ ADUs per mm}$$

For GDUs, 100 units are located along the shortest axis. Therefore, for the same selection, the page scaling is:

$$\frac{15.5 \text{ inches}}{100 \text{ GDUs}} = 0.155 \text{ inches per GDU or } 6.45 \text{ GDUs per inch}$$

or $$\frac{393.70 \text{ mm}}{100 \text{ GDUs}} = 3.937 \text{ mm per GDU or } .254 \text{ GDUs per mm}$$

For mm, the axis length is specified directly in mm. 1 inch = .03937 mm or 25.4 mm per inch.

Other page sizes can be calculated in a similar manner.

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Viewport Scaling

The scaling for the viewport is done in the same manner as for the page, after determining the length of the viewport axes. The viewport boundaries can be determined from a Read Viewport command. This gives the viewport boundaries in terms of the outside page coordinate system, which then can be converted into actual lengths of the viewport axes. The length of a viewport Device Unit then is calculated using the same procedure as for the page example shown earlier.

$$\text{Length of a viewport ADU} = \frac{\text{Length of viewport's longest axis}}{4096 \text{ ADUs}}$$

$$\text{Length of a viewport GDU} = \frac{\text{Length of viewport's shortest axis}}{100 \text{ GDUs}}$$

For example, a viewport whose longest axis runs from 100,50 to 3100,50 on the page coordinate system is 3000 page units long (ADUs in this case). The length of the viewport then is (3000 ADUs) x (.00513 inches/ADU) or 15.39 inches long (assuming the same example as in the page scaling discussion earlier). Then, the length of each viewport ADU $= \frac{15.39 \text{ inches}}{4096 \text{ ADUs}} = .00376$ inches per ADU or 266.15 ADUs per inch.

PLOTTER OPERATING COMMANDS

The operating commands for the 4663 Interactive Digital Plotter can be divided into seven (7) major groups:

Interface Commands

Device Commands

Graphic Plot (Graph) Commands

Transformation Commands

Alphanumeric (Alpha) Commands

Graphic Input (or Digitizing) Commands

Commands Associated with Plotter Options

NOTE

Attention Characters, Addresses, and Data or Argument elements in the following command statement formats are underlined. Refer to the description of the command under that format for the description of the character string that is to be substituted as part of the command.

NOTE

Throughout this manual, spaces are shown between adjacent characters. These are placed there for clarity in illustrating. However, in communicating with the Plotter, the host (or terminal) should not send any SPACE characters between characters unless requested by a SPACE (or SP). A SPACE may, however, be used in place of a comma for a delimiter.

Interface Commands

The following is a list of the interface commands, their descriptions and general format:

Device On

Device Off

Block Start

Block End

Set Turnaround Delay

Set Block Size

Set Bypass Cancel Character

Set Signature Character

Set Prompt String

Interface Parameter Reset

Data Reset

Select Command/Response Format

Device On

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> E

The Device On command is used to enable the Plotter to decode other commands and recognize data. If the Plotter is in the logical off state when the command is received from the host, the ATN ADD characters are passed on to the terminal (not muted). However, further characters are not sent on to the terminal (unless AUTO MUTE was not specified on the Parameter Entry card). The Device On command will also enable the Plotter to transmit if an output is pending and all other transmission requirements have been satisfied (such as prompt received or if turn-around delay time has elapsed). When this command is received, the Plotter's communication mode is set to continuous mode.

Device Off

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> F

The Device Off command causes the Plotter to ignore data and commands until turned on again with a Device On command. If the Plotter is in the logical on state when the command is received, the command code F (and possibly the command terminator, depending upon the current command format) is not sent on to the terminal, but any following characters will be unless AUTO MUTE was not specified on the Parameter Entry card. Device Off also disables any output transmission. However, any transmission currently in process will be allowed to finish.

Block Start

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> (

The Block Start command is used for Block mode transmission; it signals the beginning of a new block and starts the checksum accumulation with the character "(". The checksum includes all transmitted ASCII characters except NUL, SYN, and DEL (if DEL IGNORE is selected from the Parameter Entry card). This command sets the current communication mode to Block mode.

Block End

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u>) <u>CHECKSUM VALUE</u>

The Block End command signals the end of a Block mode block and initiates the block verification process. The block checksum will include the command characters up through the character ")". The checksum value is the value of the computed checksum for that block. That checksum value is an ASCII decimal number in the range 0-4095, representing the 12-bit checksum value. This checksum is computed by adding the binary equivalent of each ASCII character (see Appendix F). The accumulation begins with the "(" character in the Block Start command and ends with the ")" character in the Block End command. It includes all characters except NUL, SYN, and DEL (if DEL IGNORE has been previously selected on the Parameter Entry card). The checksum is then computed in a 12-bit accumulator using "end-around carry." (With "end-around carry," when the accumulated value exceeds 4095, 4096 is subtracted from the accumulator and 1 (the carry) is added. The final binary number is then converted to the ASCII decimal equivalent and transmitted as the checksum. Any difference between the checksum computed by the Plotter and the checksum transmitted by the host computer will generate a Block Checksum error. See Appendix A.)

An example of the checksum accumulation is shown below:

```
1 1 1 1 1 1 0 0 1 0 1 0        Current checksum value
        1 0 0 1 0 1 0          Next Character (J which is 74)
1←0 0 0 0 0 0 0 1 0 1 0 0
  └─────────────→ + 1          Overflow (carry)
  0 0 0 0 0 0 0 1 0 1 0 1      New Checksum Value
```
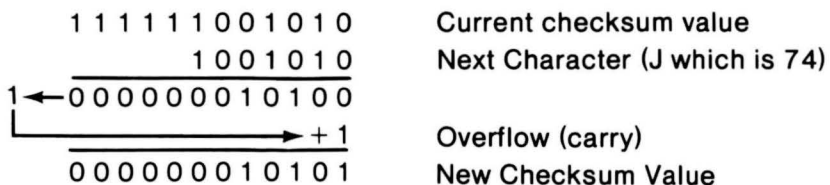
Following verification of the checksum value received, the Plotter transmits a positive (A) or negative (I) acknowledgement to the host. Negative acknowledgements are sent immediately, while positive acknowledgements are inhibited until the required storage space becomes available (see Plotter Communications, Section 6, and the Block Size command description).

Set Turnaround Delay

Serial Interface, Format #1, 2, 3, 4: ATN ADD G DELAYTIME

The Turnaround Delay command sets the turnaround and inter-output group delay time for the RS-232-C communications link. This time is specified in milliseconds (0 to 65535) with a resolution of 8 milliseconds. This delay prevents the Plotter from responding to a received character for the delay time specified. It also prevents the Plotter from sending a second output group within the delay time after transmitting the first group.

Set Block Size

Serial Interface, Format #1, 2, 3, 4: ATN ADD H BLOCKSIZE

The Block Size command sets the maximum number of characters (the number of bytes) in a block, excluding the Block Start and Block End Escape sequences that the host system will be transmitting (the actual block size may then be equal to or less than this value). The maximum usable value is equal to one third of the current free memory bytes value reported by the Read Status command, minus the memory requirements of commands currently scored in the input buffer. On the average, internal storage of commands requires approximately three times the number of command bytes received. Efficient block mode communications should use a block size of not more than one-half this value to allow one block's data to be plotting, while another block is being received. When the Plotter receives a Block End command requiring a checksum verification, it will not generate a positive checksum verification response until input buffer space is available for one new block. This helps to ensure that storage space will be available for that following block. The default BLOCKSIZE value is 0, which causes a positive block acknowledgement to be sent immediately regardless of the amount of storage space available.

Set Bypass Cancel Character

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> U <u>ASCII CHARACTER</u>

In Plotter output transmissions (Digitizing, etc.), characters transmitted by the Plotter may be echoed by the host computer system. These echoed characters will not be printed (they are ignored or suppressed) until after the Bypass Cancel Character is received. The default (power-up) value is a NUL character, indicating that no suppression is to take place. If this character is anything but NUL, all host transmitted characters will be recognized and printed automatically whenever transmission is by the Bypass Cancel character. This character is discarded by the Plotter.

Set Signature Character

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> S <u>ASCII CHARACTER</u>

The Signature Character command sets the Signature Character, which is prefixed to each block transmitted from the Plotter (if not NUL). This character allows the host system to differentiate between inputs from multiple devices. The default value of the character is NUL, which disables the Signature Character function.

Set Prompt String

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> R <u>ASCII CHARACTER STRING</u>

The Prompt String command establishes the prompt string (1 to 4 characters) that must be received from the host system before a Plotter transmission can be initiated. This string may appear anywhere within commands or data and is not included in block mode checksum calculations. However, the prompt string is only searched for whenever a Plotter output transmission is pending (i.e. a command requesting a Plotter output transmission has been received from the host computer). The default value of this string is NUL, which disables the Prompt function.

Interface Parameter Reset

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CR

The Interface Parameter Reset command resets the following programmable interface parameters:

Block Size = 0

Turnaround Delay = 0

Bypass Cancel Character = NUL

Signature Character = NUL

Prompt String = NUL

In addition, the Command/Response Format is reset to reflect the current Parameter Entry card selection (i.e. nullifies prior Select Command/Response Format commands).

Data Reset

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CD

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CD

The Data Reset command causes all commands currently stored in the Interface Input Buffer to be deleted. However, any commands which have already been read from the Interface Input Buffer (and are being processed by the Plotter) will be executed. Later commands are not affected.

Select Command/Response Format

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CC <u>CHOICE</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CC <u>CHOICE</u>

The Select Command/Response Format command conditions the Input Command Recognizer (in the Plotter's Communications Interface) to accept commands of that specified format. It also conditions the Output Formatter (also in the Plotter's Communications Interface) to transmit any output messages in that specified format. This command permits the host to accomplish the same action as an operator manually selecting one of the eight (8) choices (CHOICE) from the Parameter Entry card. (Refer to the description of the Parameter Entry card's INITIAL COMMAND/RESPONSE FORMAT line, located in Section 2.)

For a description of the Plotter's Command/Response formats, refer to the description of the Plotter's Communications (Section 6).

Device Commands

The following is a list of the Device commands. Their description and general format follows in subsequent paragraphs:

Device Reset

Read Status

Read Error

Identify

Device Reset

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> N <u>RESET NUMBER</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: N <u>RESET NUMBER</u>

The Device Reset command resets all programmable Plotter parameters, except those affecting the communications interface, to their power-up values. A choice of three degrees (levels) of reset can be chosen by inserting a value for RESET NUMBER of 0, 1, or 2. If no reset number is used, the Plotter assumes a number of 0 automatically.

A Reset Number of 0 accomplishes the following:

1. All transforms are deleted and the initial page orientation, window, and viewport parameters (determined from the Parameter Entry card) are established. Current lower left and upper right page coordinates, however, are not affected.

2. All alpha parameters are reset to their default values (equivalent to an Alpha Reset command).

3. Operator Digitize enable and Auto Macro Modes are canceled.

4. Any programmable macros or downloaded characters are deleted.

5. The pen carriage is moved to the load point position (upper right corner of the platen) and pen 1 is selected.

A Reset Number of 1 acts the same as 0, except for the following:

1. Downloaded character sets and programmable macros are saved (not deleted).

A Reset Number of 2 acts the same as 0, except for the following:

1. Downloaded character sets and programmable macros are saved (not deleted).

2. Current window and viewport parameters are saved (not reset).

In addition, the Device Reset command also causes the Local Parameter Modification and Local Position Modification bits in the System Status Word to be set.

Read Status

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> 0 <u>STATUS REGISTER</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: V <u>STATUS REGISTER</u>

The Read Status command causes the Plotter to respond with a one block message containing the contents of the desired status register. The Plotter contains four (4) defined status registers, each containing a pair of 16-bit status information words. These registers are numbered 0 to 3. The host can obtain status information from any register by specifying this STATUS REGISTER number (0 to 3) in the Read Status command. The information is encoded as follows:

    Block 1

        Data Value 1: Status Word 1

        Data Value 2: Status Word 2

        Block Type: 0, LAST

The information from each of the four Status Registers is as follows:

Specified Status Register	Status Information	
	Word 1	Word 2
0	Device Status	Current Available RAM
1	Max Available RAM	Installed Options
2	Current X Pos Coord	Current Y Pos Coordinate
3	Pen Status	Accumulated Plot Time

A detailed description of the Status Words is shown below (refer also to Appendix E for further information on Status/Identify coding and examples):

         @

Status Register 0

Device Status. The first status word from Status Register 0 whose bit structure is:

Bit Position	Flag Status
15 (MSB)	Out of Media
14	Local Position Modification
13	Local Parameter Modification
12	Local Data Reset
11	Unused
10	Roll Mode
9	Pause/Busy
8	X Mirrored
7	Y Mirrored
6	X Right ⎫
5	X Left ⎬ Virtual Position of the Current Clipping Limits
4	Y Above ⎪
3	Y Below ⎭
2	Communications Error
1	Command/Response Error
0 (LSB)	Internal Error

Where the following bits (if set) mean:

Bit 15   Out Of Media indicates that a length of roll media long enough to cover the platen is not present. This is set at power-up/Device Reset (if media type is ROLL), when ROLL MEDIA FORM is selected on the Parameter Entry card, or when an End of Media condition is encountered at the end of a roll-type media advance cycle. This is cleared only if media is present at the end of a roll type media advance cycle or if SHEET MEDIA FORM is selected on the Parameter Entry card.

NOTE

The Out Of Paper Sensor requires at least 2 sprocket holes to pass by before the Out of Media indicator is cleared. This implies a minimum form length of approximately 2 inches.

Bit 14   Local Position Modification indicates that a power-up, Device Reset command, joystick action, or one of the following front panel functions has occurred since the last Read Status command. Notice that all of these actions may result in a movement of the pen carriage.

         A.   Set Form Length

         B.   Manual Media Motion

         C.   Page Change

         D.   Set Page/Viewport Lower Left/Upper Right

         E.   Locate Page/Viewport Lower Left/Upper Right

         F.   INIT

This bit is cleared by the Read Status 0 command.

Bit 13   Local Parameter Modification indicates that a power-up, Device Reset command, Set Page/Viewport Lower Left/Upper Right, or Set Form Length Function has occurred since the last Read Status 0 command. This can be used to alert the host that some of the programmable device parameters may have been modified. This bit is cleared by the Read Status 0 command.

Bit 12   Local Data Reset indicates that a power-up or a front panel DATA
          RESET function has occurred since the last Read Status 0 command.
          This can alert the host that some host commands may have been
          deleted before being executed. This bit is cleared by the Read Status 0
          command.

Bit 10   Roll Mode indicates that the Plotter is operating in ROLL mode. This bit
          is not cleared unless SHEET mode is selected on the Parameter Entry
          card.

Bit 9   Pause/Busy indicates that one of the following front panel functions is
          active and that the processing of interface commands has been
          interrupted:

              A. PAUSE

              B. FORM LENGTH

              C. MANUAL MOTION

              D. MEDIA CHANGE

          This bit is cleared when that function is no longer active.

NOTE

*If there are no preceding unprocessed commands in the input
buffers, a Read Status command can be executed even when
a PAUSE/BUSY status exists.*

Bit 8   X Mirrored indicates that the Page's lower left X coordinate has been
          defined to the right of the upper right X coordinate. This bit is cleared
          whenever the Page's lower left X coordinate is located to the left of the
          upper right X coordinate.

Bit 7   Y Mirrored indicates that the Page's lower left Y coordinate has been
          defined above the upper right Y coordinate. This bit is cleared whenever
          the Page's lower left Y coordinate is located below the upper right Y
          coordinate.

Bit 3-6   X Right, X Left, Y Above, and Y Below indicate that the current pen position is outside of the current clipping limits (page or viewport) in a direction shown below:

X Left	Y Above	X Right
Y Above		Y Above
X Left	Clipping Area	X Right
X Left	Y Below	X Right
Y Below		Y Below

Right, Left, Above, and Below are defined with respect to a horizontally oriented platen surface. These directions are not affected by operator/host selected page/viewport orientations.

Bit 2   Communications Error indicates that a non-fatal communications error (such as a parity error) has occurred since the last Read Status 0 command. The error can then be identified with a Read Error command. This bit is cleared with the Read Status 0 command.

Bit 1   Command/Response Error indicates that a non-fatal error has occurred associated with an invalid command, argument, format, command usage, response format, response data value, or storage of commands or data since the last Read Status 0 command. The error can then be identified with a Read Error command. This bit is cleared with the Read Status 0 command.

Bit 0   Internal Error indicates that a non-fatal unexpected internal error has occurred since the last Read Status 0 command. This error can then be identified with a Read Error command. This bit is cleared with a Read Status 0 command.

Current Available Ram. This is the second status word from Status Register 0. This value indicates the current number of free RAM storage bytes after the storage of transforms, programmable macros, downloadable characters, or commands still in the input buffer (which may cause more storage to be allocated to the above categories as they are processed) have been satisfied (subtracted) from the installed RAM. The bit structure of this binary number is as follows:

Bit Position   15 (MSB), 14, ...1,0 (LSB)

Data Value   Current Available RAM
                                        (in Binary)

Status Register 1

Max Available Ram. This is the first status word from Status Register 1 and indicates, in a 16-bit binary number, the number of RAM storage bytes available to the user after the permanent system storage requirements have been satisfied (subtracted) from the installed RAM. Its bit structure is identical to the Current Available RAM status word just described.

Installed Options

This is the second status word from the Status Register 1 and indicates each available option with a 16-bit word whose bit structure is as follows:

Bit Position	Flag Status
15 (MSB)	
14	
.	
.	Unused
.	
.	
5	
4	Math Character Set
3	Downloadable Characters
2	Programmable Macros
1	Arc Generation
0	Media Advance

Status Register 2

Current X Pos Coord (Current X position coordinate). This is the first word of Status Register 2 and indicates the current pen position X axis in current units. The bit structure is defined below:

Bit position   15 (MSB), 14, ...1, 0 (LSB)

Data Value   X Position Coordinate
                                             (in binary)
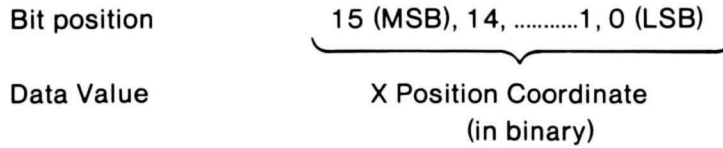
Current Y Pos Coord (current Y position coordinate). This is the second word of Status Register 2 and indicates the current pen position Y axis in current units. The bit structure is defined below:

Bit position   15 (MSB), 14, ...0, 1 (LSB)

Data Value   Y Position Coordinate
                                             (in binary)
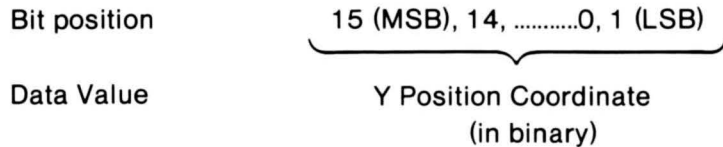
Status Register 3

Pen Status. The Pen Status word is the first word of Status Register 3 and indicates the current active pen and its up/down status. The bit structure is shown below:

Bit Position	Flag Status	
15 (MSB)		
14		
.		
.	Unused	
.		
.		
3		
2	Pen Number	0 = crosshair
1		1 = pen 1
		2 = pen 2
0	Pen Status	0 = up
		1 = down

Accumulated Plot Time. This is the second status word of Status Register 3 and indicates the approximate number of hours of actual pen carriage motion since the battery backup RAM was cleared (or lost power). The bit structure is defined below:
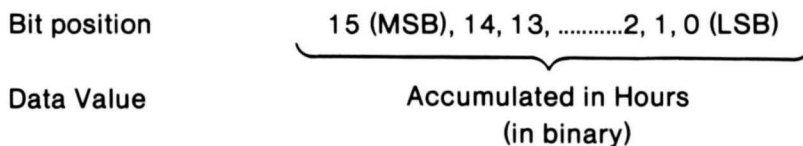
Bit position   15 (MSB), 14, 13, ...2, 1, 0 (LSB)

Data Value   Accumulated in Hours
                              (in binary)

Refer to the Plotter to Host Communications discussion (Section 6) for a description of the actual byte format transmitted.

Read Error

Serial Interface, Format #1, 2: <u>ATN</u> <u>ADD</u> CE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CE

The Read Error command causes the Plotter to respond with a two block message containing information identifying any current errors. The information is encoded as follows:

Block 1

Data Value 1, Byte 0:	Error Code — identifies the first error (refer to Appendix A for a listing of the error codes).
Byte 1:	Error Number — gives the total number of errors which have occurred since the last power-up and Read Error command.
Data Value 2, Byte 0:	Error Parameter 1, (the error parameters can provide additional information concerning the error — refer to Appendix A)
Byte 1:	Error Parameter 2
Block Type:	0

Block 2

Data Value 1, Byte 0:   Error Parameter 3

Byte 1:   Error Parameter 4

Data Value 2, Byte 0:   Error Parameter 5

Byte 1:   Error Parameter 6

Block Type: 0, LAST

This command turns off the front panel RESET light and the error code, number and error parameter lights. It also clears the three error type bits in the system status word (described earlier). If there are no current errors, the values returned will be 0.

Refer to the Plotter to Host Communications discussion (Section 6) for a description of the actual byte format transmitted.

Identify

Serial Interface, Format #1, 2, 3, 4: ATN ADD Q

GPIB Interface, Format #1, 2, 3, 4, 5, 6: I

The Identify command causes the Plotter to respond with a one-block message containing two 16-bit identification data words. The purpose of the Identify command is to provide a means for a host to determine the "identity" of a device present at a given address on a communications link. The encoding is as follows:

Block 1

Data Value 1: Ident Word 1

Data Value 2: Ident Word 2

Block Type: 0, LAST

The definition and descriptions of the Identify words are described below:

Identify Word 1

Bit Position	15 (MSB), 14, ...1,0 (LSB)
Data Value	Device Model Number (i.e. 4663)

Identify Word 1 is a binary number whose decimal equivalent is equal to 4663 and identifies the Plotter.

Identify Word 2

Bit Position	15 (MSB), 14,....9,8,7,6,...1, 0 (LSB)	
Data Value	Number of K bytes of RAM installed	Firmware release Number

Identify Word 2 indicates both the total RAM installed in K (thousands) of bytes and the version of the firmware installed in the Plotter. The total RAM also includes any RAM bytes which have failed the power-up RAM test and are now unavailable to the system. The Firmware Release Number is a unique number assigned to each version of the firmware installed in the Plotter.

Refer to Appendix E for a further discussion of the word coding of the Identify/Error/Status commands.

Refer to the Plotter to Host Communications discussion (Section 6) for a description of the actual byte format transmitted.

Graphic Plot (Graph) Commands

In general, plotting may be done anywhere on the platen. However, the operator may enter several parameters and commands to restrict plotting to certain areas of the platen or alter the plots in the viewport area. The first level of restriction is to define the plotting page. This is the rectangular area marked by momentarily pressing the LOCATE LOWER LEFT and LOCATE UPPER RIGHT switches. This area is normally based upon the size of the paper media used on and allows a margin conforming to Table 2-1. The second level of restriction of the plotting area is the viewport. The viewport is also a rectangular area defined by the SET VIEWPORT LOWER LEFT and UPPER RIGHT functions (set from the host or the front panel switches). The viewport is the actual area that the plot will be drawn in and is always located within the page boundaries. This area can be seen by holding down the LOCATE LOWER LEFT and LOCATE UPPER RIGHT switches until the bell sounds (approximately 2 seconds) and then releasing. The viewport area also contains the operator's chosen plotting unit coordinate system (the Window — see Plotting and Dimension Units earlier in this section). Further, the graphic commands from the host system can be operated on by the graphic transform capability in the Plotter's control firmware. This allows the motion commands (move and raise or lower the pen) to be translated, scaled, rotated, and/or skewed before being plotted. This transformation is accomplished by multiplying each motion command by a transform matrix containing the desired transform parameters (those chosen from the Parameter Entry card and any additional commands specified by the host system). As each additional command is received (note that these may be sent in any order, although the final results may be different using a different order), a new active transform matrix is created. The old transform matrix is saved, however (in fact, several transform matrices may be saved depending upon available RAM storage space). It must be noted that as each transform command is received, the current active transformation is modified, rather than replaced.

As pointed out earlier, Graph mode (and Alpha mode) allow the Plotter to draw by using either explicit or implied commands. The explicit commands (those beginning with an attention character) are each described individually later.

The implied commands, which are of the form used by TEKTRONIX 4010 Series terminals, uses coordinates on the plotting surface that are represented by binary numbers. The longest coordinate axis (either X or Y) of the viewport always has a range of 0 to 4095. However, the shortest axis coordinate range will be less (except in the case of a 1:1 aspect ratio) and will vary depending upon the aspect ratio chosen. The physical length of one coordinate unit on one axis is equal to the length of a coordinate unit on the other axis regardless of the aspect ratio chosen, unless the axes have been further scaled unequally. Figure 3-4 shows a diagram of the coordinate system using a 1:1 aspect ratio. Table D-1 is a coordinate conversion chart showing the ASCII character equivalences for each of the 4096 addressable points. Keep in mind that the X and Y axes may be interchanged in using the Plotter.
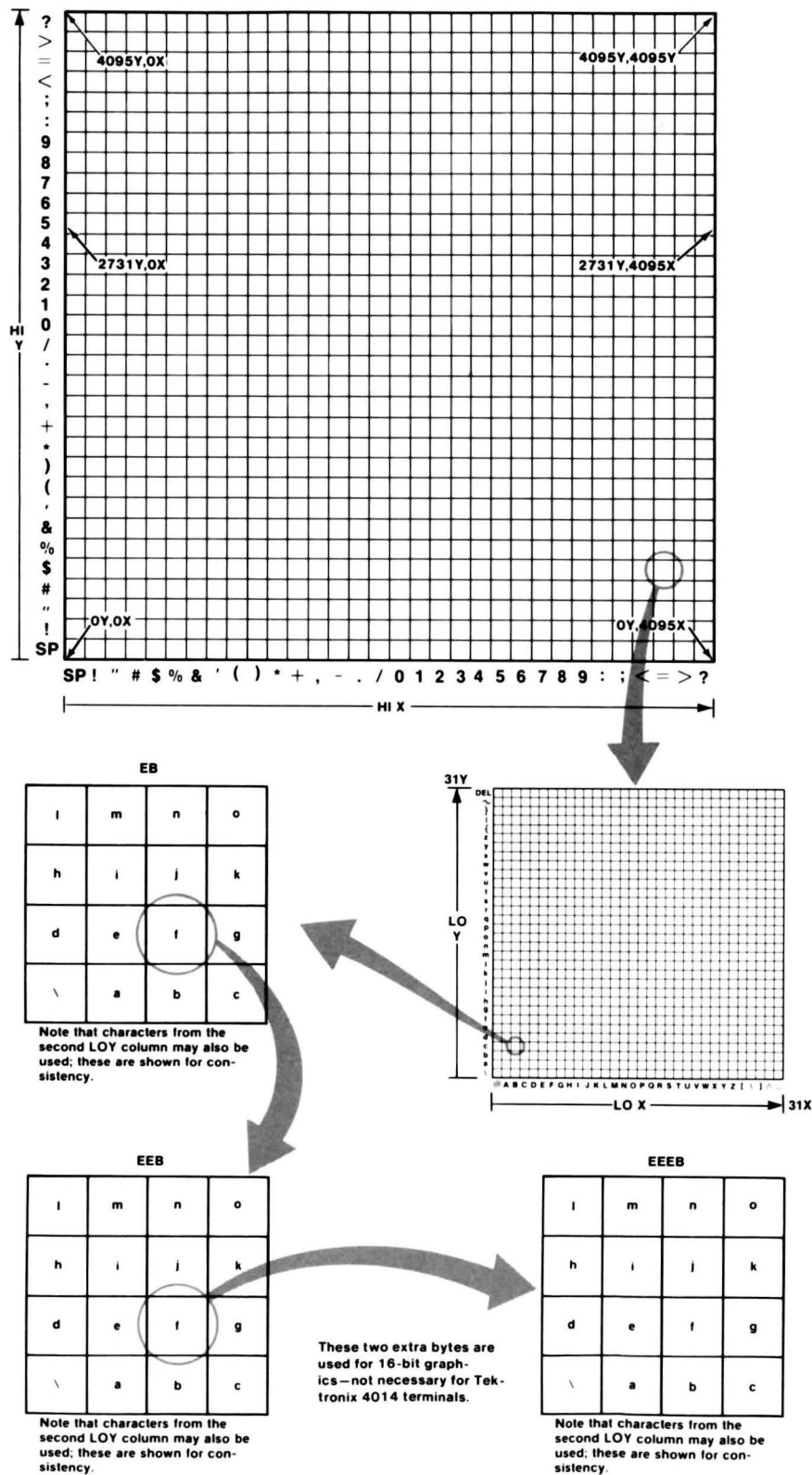
Figure 3-4. X-Y Coordinates (Showing the Increased Resolution Gained by the Extra Bytes).

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To operate in Graph mode (using implied commands), the ASCII GS control character (CONTROL SHIFT M) is sent to the Plotter. Then, the display points are sent to the Plotter in the form of coordinate messages. Each message consists of up to five data bytes. Two bytes provide the basic Y coordinate information and two bytes provide the basic X coordinate information. These bytes are called HIY, LOY, HIX, and LOX respectively. The fifth byte, EB is an extra byte which may or may not be used, depending on user resolution requirements. It provides an extra two bits of X data and an extra two bits of Y data for higher graphic resolution. These coordinate message bytes must be sent to the Plotter in the format:

HIY, (EB), LOY, HIX, LOX

These bytes are represented by ASCII characters which have the appropriate bit combination for that part of the coordinate. Refer to Appendix D and the Plotter Communications section for further information on data coding Implied Commands.

To MOVE (without drawing), the GS control character is sent followed by the coordinate bytes (GS HIY LOY HIX LOX). The pen lifts and moves to the specified coordinates. All subsequent coordinate pairs cause the Plotter to draw a vector (move with the pen down), unless that coordinate pair is preceded with a GS character. If the coordinates are out of the viewport boundary, the pen will stop at the viewport boundary until the Plotter receives the next coordinate pair that is located within the viewport area. At this time, the pen will make an extra move to the correct intercept point on the viewport boundary and then proceed to the specified coordinate location.

To DRAW (move with the pen down), a BEL control character (CONTROL G) is sent after the GS control character and before the coordinate bytes (GS BEL HIY LOY HIX LOX). This causes the Plotter to draw a vector from the current position to the new cordinate position. To draw another vector, all that is necessary is to send another coordinate pair (no GS or BEL character is necessary).

Refer to the Special Considerations description (for the particular interface used) for details concerning the data coding of graphic data.

The following is a list of the Plotter commands which set up and control graphic functions. Their description and general format follows in subsequent paragraphs.

Graphic Setup

Select Graphic Units

Select Device Units

Select Line Type

Set Dash Pattern

Set Dash Pattern Length

Select Pen

Select Coordinate Type

Change Page

Graphic Control

Move to Load Point

Move

Draw

Outline Viewport

Mark Viewport

Axis

Select Graphic Units

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BW <u>INCHOICE</u>, <u>OUTCHOICE</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BW <u>INCHOICE</u>, <u>OUTCHOICE</u>

The Select Graphic Units command selects the dimensional coordinate units that will be used in subsequent graphic or digitizing commands which require a graphic unit. The value INCHOICE specifies the type of graphic unit to be used in subsequent graphic operations caused by host computer commands, while the value OUTCHOICE specifies the type of graphic unit to be used in subsequent responses from the Plotter to the Host computer. If the value OUTCHOICE is omitted, the Plotter will automatically choose the same value specified by INCHOICE. The default selection is World Units for both input and output. The choices are:

    0 for World Units

    1 for Device Units

Refer to the Plotting and Dimension Unit description earlier in this section for a discussion on World and Device Units.

Select Device Units

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BV <u>CHOICE</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BV <u>CHOICE</u>

The Select Device Units command selects one of the three dimensional coordinate units (Device Units) to be used in subsequent graphic or digitizing operations. The Plotter will automatically choose, as default, ADUs if operating with a serial interface or GDUs if operating with the GPIB interface. The value of CHOICE is as follows:

    0 is for Addressable Device Units (ADUs or Raster Units)

    1 is for Graphic Device Units (GDUs)

    2 is for Millimeters (mm)

Refer to Plotting and Dimension Units (earlier in this section) for a description of these different units.

Select Line Type

Serial Interface, Format #1, 2, 3, 4: ATN ADD BL CHOICE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BL CHOICE

The Select Line Type command selects the type of line which will be used when drawing subsequent graphics commands by Draw, Arc, or Circle commands. (Alpha and Fixed Macro graphics always use a solid line type). The default line type is solid. The value of CHOICE specifies one of the following choices:

0   is for a solid line (the default selection).

1   is for a fixed length dash pattern (must also establish the dash pattern using the Set Dash Pattern and Set Dash Pattern length commands; refer to these descriptions immediately following). Using fixed dash lines, the dash pattern, whose length remains fixed, is repeated along each vector as often as necessary to cover the length of the vector. Any portion of the dash pattern not used in a vector, will be used for the first part of the next vector (i.e. the pattern bends around corners), unless that vector is a Move (no drawing). A Move restarts the dash pattern so that the pattern begins at the start of the next written (drawn) vector.

2   is for a variable length dash pattern (must also establish the dash pattern by using the Set Dash Pattern and Set Dash Pattern Length commands; refer to these descriptions immediately following). For variable dash lines, the dash pattern length is scaled down (if necessary), so that the smallest integral number of complete patterns, each with a length less than or equal to the established dash pattern length, will exactly cover the length of the vector (i.e. the pattern always ends at the end of the vector).

3   is for a single point at the end of the vector (i.e. point plot). The remainder of the vector will be blank (unwritten).

Set Dash Pattern

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BD <u>NUMBER STRING</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BD <u>NUMBER STRING</u>

The Set Dash Pattern command establishes an alternating pattern of up to 20 dots, dashes, or spaces whose actual length is established with the Set Dash Pattern Length command (next command described). This pattern then can be used by the Select Line Type command (described earlier) to draw dashed lines, arcs, or circles. The pattern is specified by a string (NUMBER STRING) of 1 to 20 dimensionless numbers (0 to 255) separated by commas. Each number represents a relative length of an element in the pattern. This means that the length of each element relative to the pattern is the numeric value of that number element divided by the sum of the numeric value of all of the number elements in the NUMBER STRING (see Figure 3-5). The pattern numbers are identified as alternating Draws and Moves (dots/dashes or spaces). The pattern always begins with a Draw. If the First Draw element is zero (0), the Draw is ignored and the dash pattern begins with a Move whose relative length is equal to the numeric value of the next number in the string. If a zero is assigned to a Draw element (other than the first element), that element will be printed as a dot. If a zero is assigned to a Move element, the two adjacent Draw moves will be joined together (see Figure 3-5C).

Set Dash Pattern Length

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BS <u>LENGTH</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BS LENGTH

The Set Dash Pattern Length command sets the total dash pattern (established with a Set Dash Pattern command, described earlier) to the specified LENGTH. The length is specified in the World Units defined along the X axis of the current window. The default pattern length is 0. Extremely short pattern lengths (including the default length) will produce a solid line.

Select Pen

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BP <u>CHOICE</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BP <u>CHOICE</u>

Examples of the Set Dash Pattern STRING might be as follows:

A. 2, 3

The pattern would appear as:
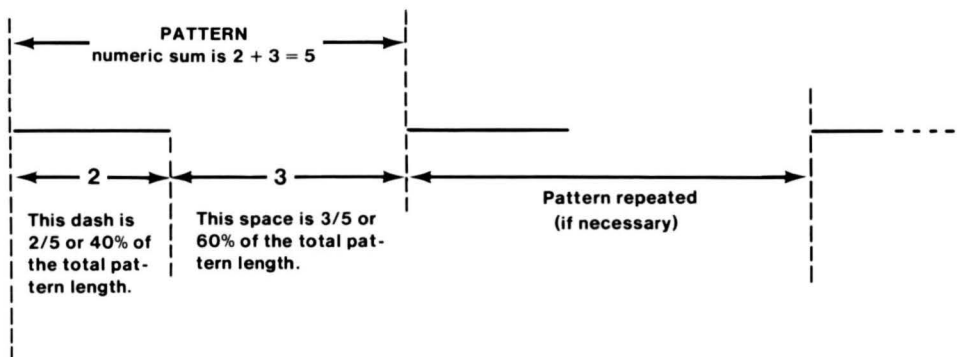
B. 2, 5, 0, 2, 1

The pattern would appear as:
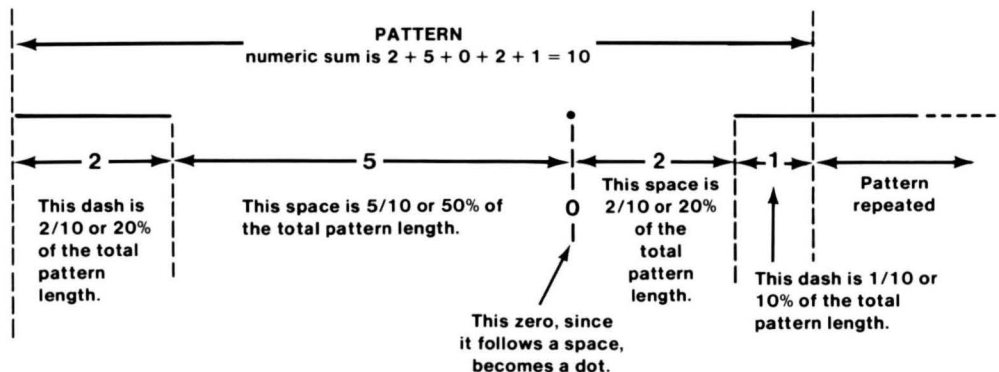
C. 0, 1, 2, 0, 2, 5

The pattern would appear as:
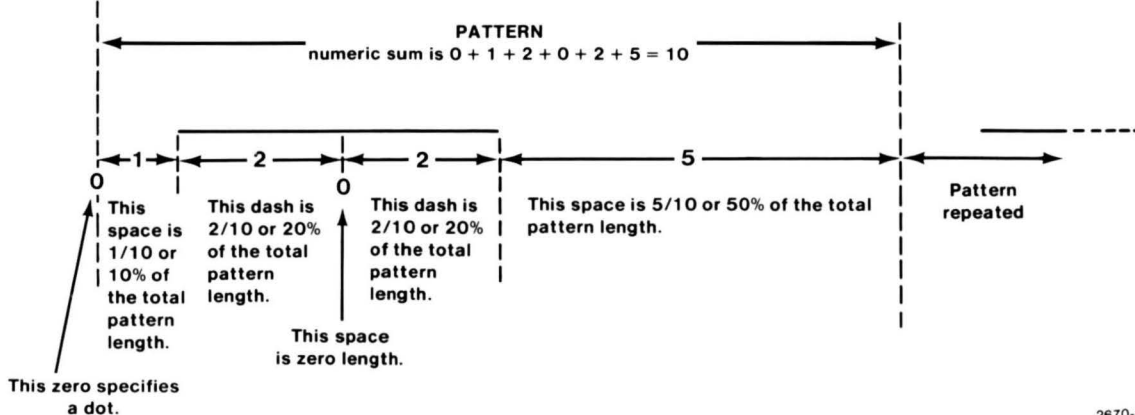
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Figure 3-5. Set Dash Pattern Examples.

The Select Pen command allows the host computer to select the active pen (or the crosshair cursor) for subsequent graphic operations. When the command is received, the newly selected pen remains in the "up" position until the next Draw command. The value of CHOICE specifies one of the following:

0 activates the crosshair cursor. The previous active pen will still be the selected pen, but is disabled while the crosshair is active (see NOTE below).

1 selects pen 1, which is the pen closest to the front panel of the Plotter. This is the active pen upon power-up (default).

2 selects pen 2.

NOTE

The selected pen retains its active state as long as graphic commands which cause pen carriage motion are received more often than approximately every 1/2 second. Otherwise, after that time-out period, the crosshair cursor becomes active and the pen carriage moves to the crosshair position. A subsequent Draw command will, however, reactivate the selected pen and deactivate the crosshair cursor. Notice that either the "active" pen or the crosshair cursor always remains at the current coordinate position.

Select Coordinate Type

Serial Interface, Format #1, 2, 3, 4: ATN ADD BO CHOICE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BO CHOICE

The Select Coordinate Type command selects either an absolute or a relative coordinate system for subsequent graphing operations. In an absolute coordinate system subsequent move or draws are interpreted with respect to the origin of the current coordinate system. On the other hand, in the relative coordinate system, each subsequent move or draw is interpreted with respect to the present (current) pen location.

NOTE

Only Move and Draw commands can be used with the relative coordinate system. All other graphic commands require absolute coordinates.

The CHOICE is as follows:

0 chooses the Absolute Coordinate System. The absolute coordinate system requires that graphic command (MOVE and DRAW) coordinates be made with respect to the origin of the current coordinate system. This is the default selection of the Plotter upon power-up.

1 chooses the Relative Coordinate System. The relative coordinate system requires that graphic command coordinates be made relative with respect to the present (current) pen location.

NOTE

Both coordinate systems use the currently defined dimension unit system.

Page Change

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BC

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BC

Without Option 36 (Media Advance)

The Page Change command permits the host computer to initiate the SHEET media change process. Refer to Loading Paper in Section 2 for details on the media change operation. The operator must press the front panel MEDIA CHANGE switch after changing paper to allow plotting to resume.

With Option 36 (Media Advance)

See Page Change command under Commands Associated With Plotter Options (later in this section).

Move to Load Point

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> Al

GPIB Interface, Format #1, 2, 3, 4, 5, 6: Al

The Move to Load Point command causes the Plotter's pen carriage to move to the extreme upper right corner of the platen (same spot that is used during media change operations). This position is normally outside of the page boundaries and, therefore, inaccessible through host-supplied Move and Draw commands. This position causes the LOWER LEFT and UPPER RIGHT switches to light indicating that the current pen position is outside the clipping limits and sets the appropriate offscale bits in the Status Word.

Move

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> X <u>X,Y</u> (<u>,X,Y</u>)

GPIB Interface, Format #1, 2, 3, 4, 5, 6: M <u>X,Y</u> (<u>,X,Y</u>)

The Move command causes the pen to move (with the pen up) to the specified coordinate(s). The coordinate pairs (X and Y in the Command) are interpreted with respect to the current graphic units and the current Coordinate Type (absolute or relative; refer to the Select Coordinate Type command and the Plotting And Dimension Units descriptions, both located earlier in this section). A series of consecutive moves will be processed as a single move to the last specified coordinate pair. All moves to points outside of the current clipping limits will be clipped and the pen will remain at the clipping limit intercept point. Subsequent moves outside the clipping limits will cause the appropriate off-scale bits to be set in the Device Status Word. While the pen is outside the clipping limits, both the LOWER LEFT and UPPER RIGHT switches will be lit.

Draw

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> Y <u>X</u>,<u>Y</u>(,<u>X</u>,<u>Y</u>)

GPIB Interface, Format #1, 2, 3, 4, 5, 6: D <u>X</u>,<u>Y</u>(,<u>X</u>,<u>Y</u>)

The Draw command causes the Plotter to draw (move with the pen down) with the currently selected pen to the specified coordinate(s). The coordinate pairs (X and Y in the command) are intepreted with respect to the current graphic units and the Coordinate Type (absolute or relative; refer to the Select Coordinate Type command and the Plotting And Dimension descriptions, both located earlier in this section). The type of line drawn depends upon the current line type (solid, dashed, etc.). Draws outside of the current clipping limits will be clipped, leaving the pen at the clipping limit intercept point. A command to Draw outside the viewport will cause the appropriate off-scale bits in the Device Status Word to be set and both of the LOWER LEFT and UPPER RIGHT switches to light.

Outline Viewport

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CB

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CB

The Outline Viewport command causes the Plotter to draw a solid line around the current viewport boundary. The pen then returns to its original position. This command operates in the same manner as pressing the front panel OUTLINE VIEWPORT function switch. If the viewport extends outside the current clipping limits, some of the outline will be clipped.

Mark Viewport

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CM

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CM

The Mark Viewport command causes the Plotter to mark the corners of the current viewport with small 90° corner brackets. The pen then returns to its original position. The actual size of the corner marks depends upon the size of the viewport or page, but does not change for any alteration of the window dimensions. This command, otherwise, operates in the same manner as pressing the front panel MARK VIEWPORT function switch. If the viewport extends outside of the current clipping limits, a portion of the corner marks may be clipped.

Axis

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CA <u>XSPACING</u>, <u>YSPACING</u>, <u>XORG</u>, <u>YORG</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CA <u>XSPACING</u>, <u>YSPACING</u>, <u>XORG</u>, <u>YORG</u>

The Axis command causes the Plotter to draw two orthogonal lines (axes) parallel to the current transform axes and extending the full length and width of the viewport. The two axes intersect at the XORG, YORG absolute coordinates specified in the command. In addition, small tic marks are drawn across each axis, beginning at the intersection of the axes, with a spacing defined by XSPACING (for the X axis) and YSPACING (for the Y axis). The actual size of the tic marks depends upon the size of the viewport or page, but does not change for any alteration of the window dimensions. The arguments in this command are in world units defined along the X axis of the current window.

Transformation Commands

Transformation commands are those commands which allow the operator to modify graphic or alpha commands from a host that may have a minimal graphics capability. The modification allows the motion commands to be translated, scaled, rotated, and/or skewed before being plotted. All of these modifications (transformations) can be accomplished by the control firmware within the Plotter and with no modifications (or effect on) to the host or its data. This transformation is accomplished by multiplying each incoming command by a transform matrix containing the desired modification parameters (such as rotation, scaling, etc.). A default matrix is automatically created (using the selections from the Parameter Entry card and default transform command conditions) at power-up and becomes the active transformation matrix. Then, as each modification to the plot is requested (by sending one of the commands described below), that active matrix is multiplied by a transform factor to create a new transform matrix containing the desired modification parameters. The old transform matrix will be discarded upon the creation of the newest matrix, unless a prior Save Current Transform command has been entered. Several old transform matrices may be saved in this manner — the limit being the amount of RAM storage space available. The new transform matrix will then be used on subsequent motion commands.

It must be remembered that these modification transformations (scale, rotate, skew, etc.) may be sent in any order. However, the final results may be different by using a different order of commands. It is important to remember that the Plotter establishes the transform matrix using the commands in the reverse order that they were received. This means that the last received command is the first one used to establish the transform matrix. Then, the next to the last received transform command is used, and so on, until the first command received is used last. The operator may wish to experiment with the order of the desired transform commands to achieve any desired effect.

The following is a list of the Plotter commands which set up and control the graphic transform functions. Their description and general format follows in subsequent paragraphs:

Save Current Transform

Restore Previous Transform

Set Origin To Current Position

Set Rotation To Last Angle

Set Scale

Set Translation

Set Skew

Set Rotation

Set Window

Set Viewport

Select Clipping Control

Read Viewport

Save Current Transform

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AX

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AX

The Save Current Transform command saves a copy of the current active transform matrix in RAM storage. Notice that this command only saves a copy of the current transform. That current transform still remains operational in the Plotter. A transform storage error is generated if there is insufficient RAM storage to save the current transform matrix.

NOTE

RAM storage is also used for programmable macro storage, downloadable alpha character storage, and interface command storage.

Restore Previous Transform

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AY

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AY

The Restore Previous Transform command replaces the current active transform matrix with the most recently saved transform matrix from the RAM storage. This portion of RAM storage then becomes available for other uses. If there are no transform matrices stored in RAM, a transform storage underflow error is generated and the current active transform matrix is retained.

Set Origin to Current Position

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AO

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AO

The Set Origin To The Current Position command moves the origin of the current coordinate system to the current active pen location (the crosshair cursor if the pen has timed-out — about 1/2 second after the last Draw). Then, all subsequent plotting will continue in the normal fashion and in relation to the new origin position.

NOTE

This is eqivalent to doing a Set Translation command to the current position.

Set Rotation to Last Angle

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AL

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AL

The Set Rotation To Last Angle command sets the origin to the current position and then rotates the axes of the current coordinate system to an angle equal to the angle of the last motion command (Move or Draw). If there have not been any non-zero length moves or draws since power-up Device Reset, the angle will be set to zero degrees. Notice that this command is equivalent to doing a Set Origin to Current Position followed by a Set Rotation command.

Set Scale

Serial Interface, Format #1, 2, 3, 4: ATN ADD AS XSCALE,YSCALE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AS XSCALE,YSCALE

The Set Scale command modifies the current active transform matrix X and Y scale factors by amounts equal to the XSCALE and YSCALE factors specified in the command. This means that all graphic values in the X direction are magnified by the dimensionless X scale value entered and all graphic values in the Y direction are magnified by the dimensionless Y scale value entered. Negative numbers reverse the corresponding axes to produce a mirror image plot. If zero is specified, a command argument error will be generated, and the actual scaling value used will be a very small positive value.

Set Translation

Serial Interface, Format #1, 2, 3, 4: ATN ADD AT XORG,YORG

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AT XORG,YORG

The Set Translation command moves the origin of the current coordinate system to the coordinates specified as XORG,YORG. These coordinates are defined as absolute coordinates in current graphic units with respect to the current coordinate system origin.

Set Skew

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AQ <u>XSKEW, YSKEW</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AQ <u>XSKEW,YSKEW</u>

The Set Skew command establishes a non-orthogonal (or non-perpendicular) coordinate axis system. The change in each axis angle is measured in degrees. A positive X skew (XSKEW in the command) is the angle (measured clockwise) between the former Y axis and the desired Y axis. In a similar manner, a positive Y skew (YSKEW in the command) is the angle (measured counter-clockwise) between the former X axis and the desired X axis (see Figure 3-6). Skew angles of 90 or 270 degrees are automatically set to 89.0 degrees.
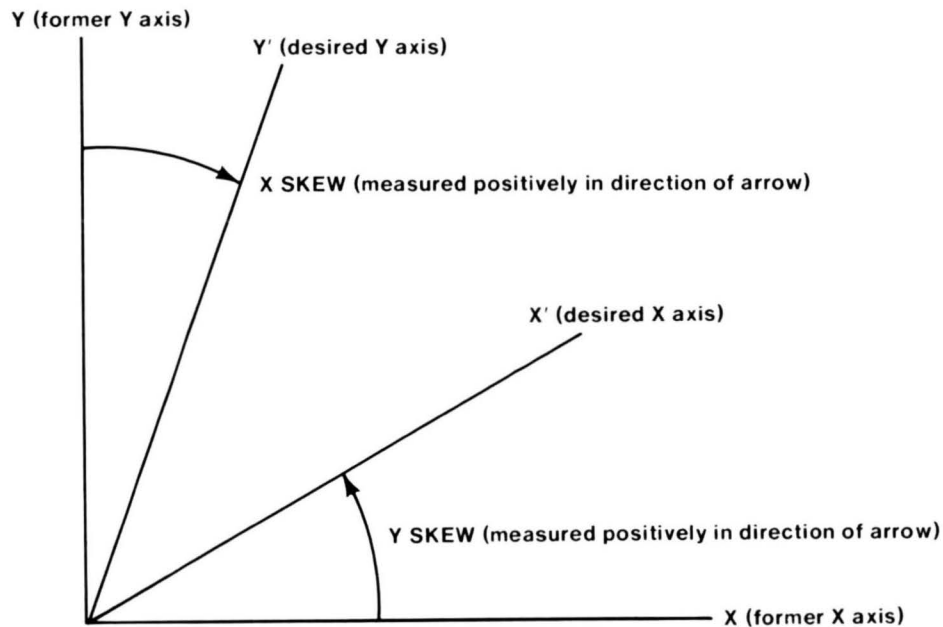
Figure 3-6. Measuring Skew Angles.

Set Rotation

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AR <u>ANGLE</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AR <u>ANGLE</u>

The Set Rotation command rotates the axes of the coordinate system by the specified rotation angle (ANGLE in the command). This angle is measured in degrees, starting from the current positive X axis. A positive angle is measured counter-clockwise around the current origin (see Figure 3-7).
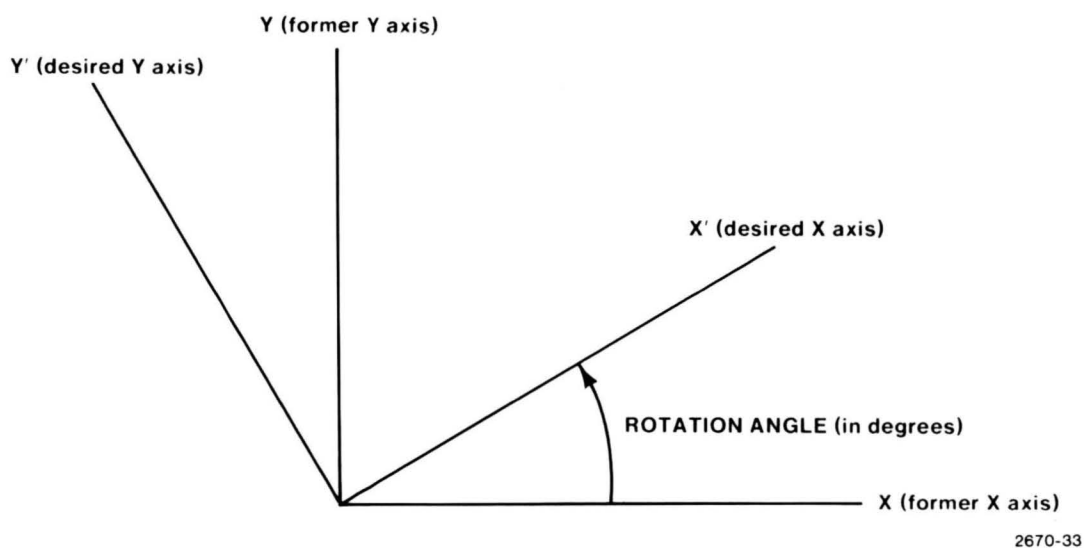
Figure 3-7. Rotation Angle.

Set Window

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AW <u>LLX,URX,LLY,URY</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AW <u>LLX,URX,LLY,URY</u>

The Set Window command specifies the portion of the world coordinate space that is displayed in the Plotter's viewport (see Figure 3-2). The window parameters are established in world units and define the values of the edges of the viewport. These are shown as LLX (Lower Left X coordinate), URX (Upper Right X coordinate), LLY (Lower Left Y coordinate), and URY (Upper Right Y coordinate) in the command.

An initial window is automatically established at power-up, after a DEVICE RESET (0 or 1) command, or by making a selection on one of the following Parameter Entry card lines:

Media Form

Initial Page Size

Initial Page Format

Initial Aspect Ratio

For a discussion of the initial (default) window coordinates, refer to the description of World Units earlier in this section.

If the operator uses the Set Window command, all prior (existing) translation, rotation, or skewing transforms are reset to 0, while any existing scaling transform is reset to 1. The new window coordinates then replace any existing coordinates (such as initial default). Unlike other transforms, the Window coordinates are not saved with a Save Current Transform command. Changing window coordinates does not affect either the page or viewport coordinates.

When establishing window coordinates, the upper right coordinate values (URX and URY) must both be greater than the corresponding lower left coordinate values (LLX and LLY). This means that no mirrored or zero length windows are allowed. Any such values will cause the Plotter to generate a window coordinate error and automatically establish a coordinate system where the URX and URY coordinates have a slightly larger value than the LL coordinate values.

Set Viewport

Serial Interface, Format #1, 2, 3, 4: ATN ADD AV LLX,URX,LLY,URY

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AV LLX,URX,LLY,URY

The Set Viewport command specifies the portion of the page to be used for plotting. The viewport coordinates are always expressed in the current Device Units and with respect to the page coordinate system. These coordinates are shown as LLX (Lower Left X coordinate), URX (Upper Right X coordinate), LLY (Lower Left Y coordinate), and URY (Upper Right Y coordinate) in the command.

An initial viewport is automatically established at power-up, after a DEVICE RESET (0 or 1) command, or by making a selection on one of the following Parameter Entry card lines:

Media Form

Initial Page Size

Initial Page Format

Initial Aspect Ratio

For additional information about the viewport and types of device units, refer to the description of Viewport and Device Units, both located earlier in this section.

If the operator uses the Set Viewport command, all prior (existing) translation, rotation, or skewing transforms are reset to 0, while any existing scaling transform is reset to 1. The new viewport coordinates then replace any existing viewport coordinates. Viewport coordinates are not saved with a Save Current Transform command. Changing viewport coordinates does not affect either the page or window coordinates. However, if unequal changes are made to the viewport (different X scaling than Y, for example), the resulting window may appear distorted.

When establishing viewport coordinates, no coordinate value may be specified outside of the page boundary. Any such attempt will cause the Plotter to generate a viewport setup error and modify that portion of the viewport coordinate to be the same as the closest page coordinate (i.e. that portion of the viewport will have the same boundary as the page). The new viewport will then be rescaled to contain the entire specified window coordinates (in ADUs, for example, the long axis will still range from 0 to 4095).

Another restriction is that neither of the upper right coordinates can be the same as the corresponding lower left coordinates. A viewport setup error will result and the viewport will be modified such that the upper right coordinate will be slightly larger than the lower left coordinates. However, one or both of the upper right coordinates may be made less than the corresponding lower left coordinate to generate a viewport that is mirrored about either axis.

Select Clipping Control

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AK <u>CHOICE</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AK <u>CHOICE</u>

The Select Clipping Control command selects the maximum clipping boundary limit for use with subsequent graphic operations. CHOICE in the command must be one of the following:

    0 sets the clipping boundary at the viewport boundary. This is the default clipping boundary for the Plotter.

    1 sets the clipping boundary at the page boundary.

The viewport boundary limits are always inside of (or equal to) the page boundary limits. Page clipping (1) might be used when labeling outside of a viewport, for example. In any situation where the page extends off the platen, motion will be clipped at the platen limits.

Read Viewport

Serial Interface, Format #1, 2: <u>ATN</u> <u>ADD</u> CV

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CV

The Read Viewport command causes the Plotter to send a two block message containing the current lower left and upper right coordinates of the current viewport (even if the viewport was established using the joystick and the SET VIEWPORT LL and UR front panel switches). The coordinates will be specified using the current Device Units and with respect to the current page coordinate system. The coding is as follows:

    Block 1

        Data Value 1: Lower Left X Coordinate

        Data Value 2: Upper Right X Coordinate

        Block Type: 0

Block 2

    Data Value 1: Lower Left X Coordinate

    Data Value 2: Upper Right Y Coordinate

    Block Type: 0, LAST

The 16-bit coordinate values are defined as follows:

Lower Left X Coordinate

    Bit Position   15 (MSB), 14, 13,..........2, 1, 0 (LSB)

    Data Value   Lower Left X Coordinate

Upper Right X Coordinate

    Bit Position   15 (MSB), 14, 13,..........2, 1, 0 (LSB)

    Data Value   Upper Right X Coordinate

Lower Left Y Coordinate

    Bit Position   15 (MSB), 14, 13,..........2, 1, 0 (LSB)

    Data Value   Lower Left Y Coordinate

Upper Right Y Coordinate

    Bit Position   15 (MSB), 14, 13..........2, 1, 0 (LSB)

    Data Value   Upper Right Y Coordinate

Note that this command is undefined for Serial Formats 3 and 4. Refer to the Plotter to Host Communications description in Section 6 for details of the actual byte format transmitted.

Alpha Mode Commands

The 4663 incorporates a means for printing text characters without requiring character generation support by the host computer system. A printing text character can be drawn using any of 9 unique resident fonts. The character can then be rotated, scaled (up or down), or slanted under program control. The text characters are normally drawn such that the lower left corner of an average uppercase character (such as "A") is at the current pen position (crosshair cursor, if the pen is inactive). After the text character is drawn, the pen is moved to the lower left corner of the next character. The most basic of the character size parameters are the two ratios relating the line space (distance between lines of text) and the height of an average printed uppercase character and the character space (distance between consecutive lower left corners of adjacent characters on a single horizontal line) to the width of an average uppercase printed character. This relationship is shown in Figure 3-8. In addition, the Plotter can print text so that the center of an average uppercase character is at the current pen position.

Upon Plotter power-up, unless a move command is executed, the text will begin in the "home" position (one character height down from the upper left corner of the viewport).

The following is a list of the Plotter commands which set up and control Alpha functions. Their description and general format follow in subsequent paragraphs:

Set Alpha Size   Print Character

Set Alpha Ratio   Print Centered Character

Set Alpha Dimension   Move to Home Position

Set Alpha Rotation   Character Move

Set Alpha Slant   Set Arc Smoothness

Set Alpha Scale

Set Tab Separation

Set Alpha Margin Separation

Select Alpha Spacing Control

Select Standard Alpha Font

Select Alternate Alpha Font

Reset Alpha Parameters
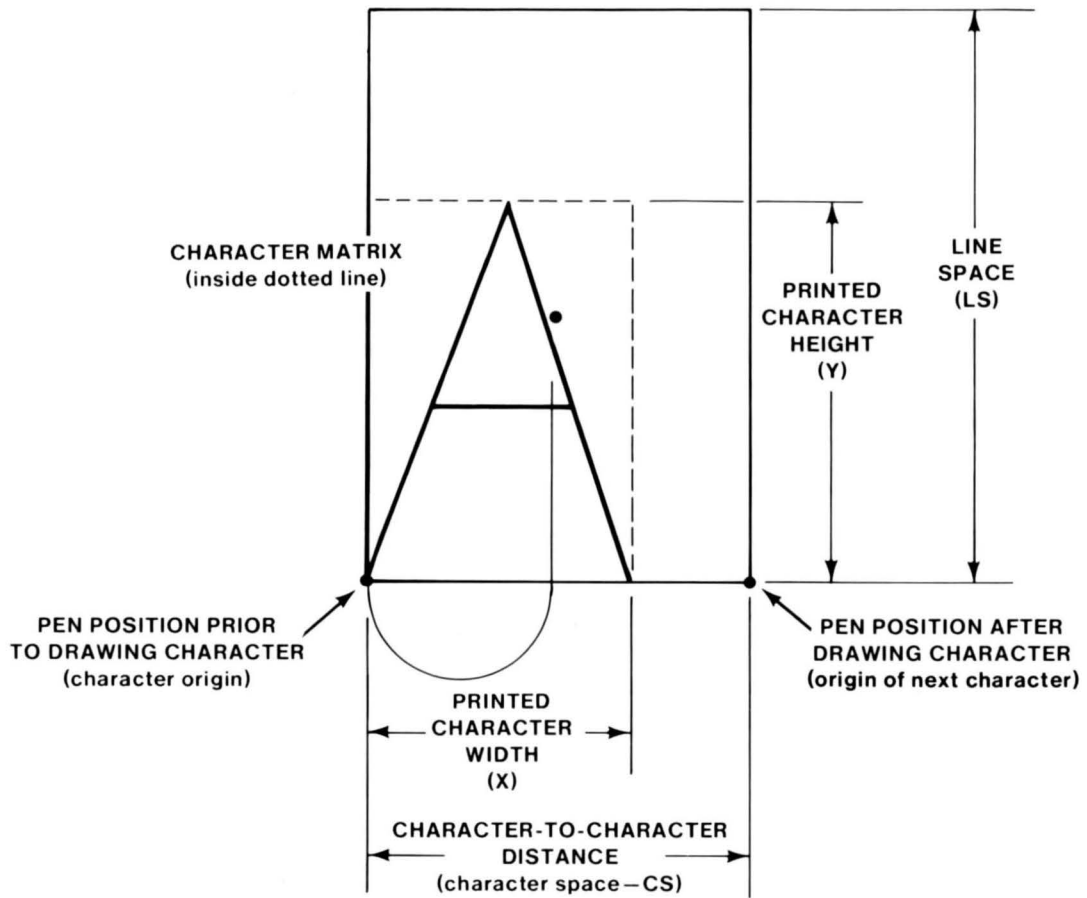
Notice that some characters (lower case) will extend below the origin by as much as 3/11 of the printed character height.

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Figure 3-8. Printed Character Dimension Relationships.

@

Set Alpha Size

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> <u>BZ</u> <u>WIDTH,HEIGHT</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BZ <u>WIDTH,HEIGHT</u>

The Set Alpha Size command sets the width and height of the average upper case letter (e.g. A) to the values specified by WIDTH and HEIGHT (see Figure 3-8). The specified units in this command are world units based upon the default window, even though the current window may have been subsequently changed (see the description of World Units early in this section for information on default windows). This means that the size of the printed character on the platen, as well as the numeric value for the width and height of a character, depends upon the selection made on the Parameter Entry card's INITIAL PAGE SIZE, INITIAL PAGE FORMAT, INITIAL ASPECT RATIO lines, while the physical size of a printed character only will change with any subsequent viewport modifications. (Exception: the numeric values for characters while using ADUs does not change.) Table 3-1 shows the relationship of character width, height, space, and line space for GDUs, ADUs, and millimeter units using different aspect ratios. This chart is based upon a C size DRAFTING selection. The other page sizes will have slightly different values. This is because the width and height of all characters are calculated as a fraction of the longest axis. When using ADUs, the longest axis is always 4096 units long. Therefore, all of the numeric values of the character sizes are the same — 37.333 and 53.777 ADUs. Notice, however, that actual plotted characters will vary in size as different aspect ratios are chosen, even though their numerical dimensions are identical. This is because the size of the viewport is a function of the aspect ratio. When using GDUs or mm, on the other hand, the longest axis is dependent upon the aspect ratio, whereas the shortest axis is always 100 GDUs long. Therefore, the GDU or mm numeric value for character sizes will change for each aspect ratio, page format, and page size (see Note below). Page orientation does not affect character dimensions. In addition, notice that these dimensions are valid only when using the default Alpha Ratios 3/2 and 18/11 (see Alpha Ratio command described immediately after this). Table 3-2 gives the fraction of the longest axis for each character width or height. These values can be multiplied by the longest axis value of the window desired to obtain the dimensions of a character. Appendix G gives a table of all the window lengths for all page sizes, formats, and aspect ratios. Be sure to use the window length in these calculations. For example, to find the width of an average uppercase character (in GDUs) with a FULL PAGE, C size, DRAFTING selection, multiply (referring to Table 3-2 and Appendix G) 0.007964 X 135.48 GDUs to obtain 1.079 GDUs. This particular value is also found in Table 3-1. Likewise, the sizes of characters printed on the other page sizes (B, A, A1, etc.) could be calculated.

Lower case characters like "g" and "p" may have portions that extend beyond the width-height range of the average uppercase character; narrow characters like "i" may not completely use the width-height range.

@

NOTE

Table 3-1 gives only the default character sizes with the assumption that ADUs were used with the Plotter operating with a serial interface and GDUs (or mm) were used with the Plotter operating with the GPIB interface. Another set of default character sizes will result if the Plotter was using ADUs and operating through the GPIB interface, or was using GDUs (or mm) and operating through the serial interface when an Alpha Reset command was received. In these cases, the default character sizes can be calculated simply by multiplying the values of Table 3-2 by the length of the longest axis.

Table 3-1

DEFAULT CHARACTER SIZE RELATIONSHIPS
(based upon C size, DRAFTING format)

ADU

Aspect Ratio	Character Width	Character Height [a]	Character Space	Line Space
FULL	37.333	53.777	56	88
3X:2Y	37.333	53.777	56	88
4X:3Y	37.333	53.777	56	88
1X:1Y	37.333	53.777	56	88
3X:4Y	37.333	53.777	56	88
2X:3Y	37.333	53.777	56	88

(a) Actual Character Width and Character Height values are 37 1/3 and 53 7/9 ADUs respectively.

Table 3-1 (cont)

DEFAULT CHARACTER SIZE RELATIONSHIPS
(based upon C size, DRAFTING format)

GDU

Aspect Ratio	Character Width	Character Height	Character Space	Line Space
FULL	1.079	1.554	1.619	2.543
3X:2Y	1.195	1.721	1.792	2.816
4X:3Y	1.044	1.504	1.566	2.461
1X:1Y	0.796	1.147	1.195	1.877
3X:4Y	1.044	1.504	1.566	2.461
2X:3Y	1.195	1.721	1.792	2.816

MM

Aspect Ratio	Character Width	Character Height	Character Space	Line Space
FULL	4.248	6.119	6.372	10.014
3X:2Y	4.248	6.119	6.372	10.014
4X:3Y	4.111	5.922	6.167	9.691
1X:1Y	3.l36	4.517	4.703	7.391
3X:4Y	3.136	4.517	4.703	7.391
2X:3Y	3.136	4.517	4.703	7.391

Table 3-2

DEFAULT ALPHA SIZE

Device Unit	Alpha Size	
	Width	**Height**
ADU	(7/768)L or .009114583L	(121/9216)L or .01312934026L
GDU or MM	(224/28125)L or .007964L	(968/84375)L or .01147259L

where L is the longer window axis length

Set Alpha Ratio

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> <u>BI</u> <u>XRATIO,YRATIO</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BI <u>XRATIO,YRATIO</u>

The Set Alpha Ratio command establishes the ratio of character spacing distance to character width and the ratio of line space to character height (see Figure 3-8) for the average uppercase character (e.g. "A") to the dimensionless values specified by XRATIO and YRATIO respectively. The default values for these parameters are 3/2 and 18/11 respectively, where:

$$XRATIO = \frac{Character\ Space}{Character\ Width}$$

$$YRATIO = \frac{Line\ Space}{Character\ Height}$$

The product of the width (or height) and the appropriate ratio is used to determine the character space (or line space) distance needed for some print operations, such as moving the pen to the next character position after printing a character or moving down to the next line.

A negative XRATIO will cause a reversal in direction for the advance to the next character action. For example, an XRATIO value of −1.5 will cause printed characters (with constant start-to-start spacing selected — see Select Alpha Spacing Control) to be printed normally, but in order from right to left. Similarly, a negative YRATIO value will reverse the direction of the linefeed.

Set Alpha Dimension

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> I <u>CHARSPACE</u>,<u>LINESPACE</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: S <u>CHARSPACE</u>,<u>LINESPACE</u>

The Set Alpha Dimension command sets the width and height of the average uppercase character (e.g. "A") which, for the current selections of Alpha Ratio, correspond to the character space distance and the line space distance specified by CHARSPACE and LINESPACE. This command is an alternate form of the Set Alpha Size command (described earlier).

Like the Set Alpha Size command, the specification units are world units relative to the initial window. Table 3-1 gives all of the default character space and linespace values for the default character size plotting on C size DRAFTING media using various aspect ratios. See the Set Alpha Size command description for further details.

Set Alpha Rotation

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> J ANGLE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: R ANGLE

The Set Alpha Rotation command is used to set the angle at which the next text characters will be printed. It also establishes the left margin as a line through the current pen position and perpendicular to the printing direction. The angle (ANGLE in the command) is measured in degrees counter-clockwise (CCW) from the positive X axis (see Figure 3-9). The default value is 0 degrees, and the default left alpha margin is the left side of the viewport.

This command applies only to the printing of text characters and does not affect graphic plotting.

The left margin established is used for carriage return actions and also the reference for right margin control (see Set Alpha Margin Separation later in this section).
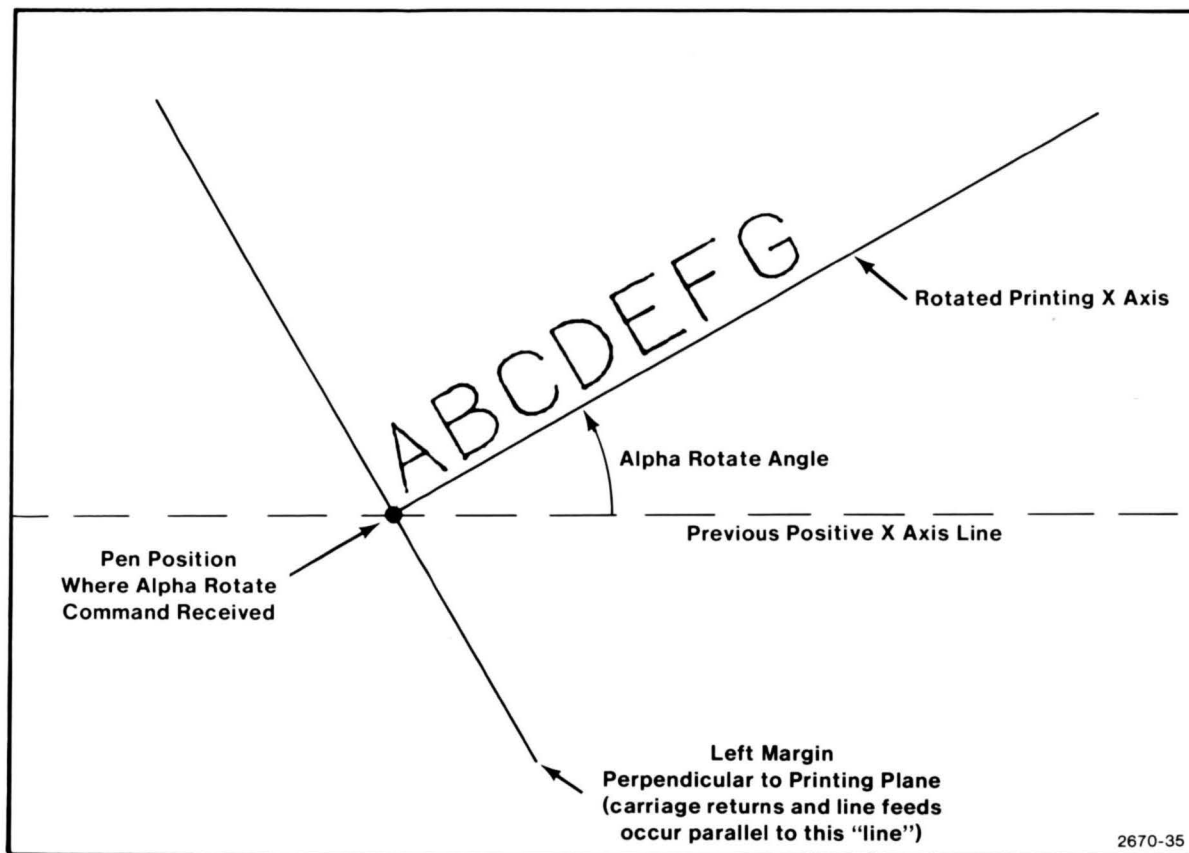
Figure 3-9. Alpha Rotation Showing the New Carriage Return/Line Feed References.

Set Alpha Slant

Serial Interface, Format #1, 2, 3, 4: ATN ADD BG ANGLE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BG ANGLE

The Set Alpha Slant command causes the Plotter to print text characters with a slanted appearance. The slant angle (ANGLE in the command) is measured in degrees in a clockwise direction from the positive unslanted Y-axis (vertical) of the character (see Figure 3-10). The default value is 0 degrees. The slant angle does not affect the height of the characters and remains in effect even if the characters are rotated (using a Set Alpha Rotation command — described earlier). In addition, line feed, vertical tabs, and character move operations are not affected and remain perpendicular to the text line (printing X-axis), regardless of the character slant angle. Slant angles of 90 or 270 degrees are automatically set to 89.9 degrees.

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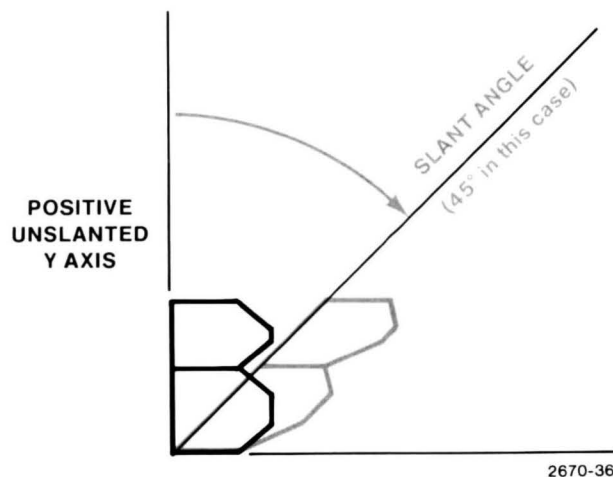
Figure 3-10. Slant Angle Showing the Letter B Slanted 45 Degrees.

Set Alpha Scale

Serial Interface, Format #1, 2, 3, 4: ATN ADD BH XSCALE,YSCALE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BH XSCALE,YSCALE

The Set Alpha Scale command sets the X and Y axis magnification factors to the dimensionless values specified by XSCALE and YSCALE. The XSCALE magnification factor applies to both the character width and the character space (see Figure 3-8), and the YSCALE magnification factor applies to both the character height and line space. The default values are 1,1.

@

Set Tab Separation

Serial Interface, Format #1, 2, 3, 4: ATN ADD BT NUMBER

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BT NUMBER

The Set Tab Separation command establishes tab stops at each NUMBER character spaces of the current size to the right of the left margin. This means that if NUMBER is 5, for example, tab stops will be established at character positions 5, 10, 15, 20, 25, 30, and so on across the platen. Subsequent changes in the current Alpha Size (or Alpha Dimension), Alpha Scale, and Alpha Ratio or any window specification will not affect the established tab stop locations. The default value of this parameter is 0, which disables the tab function and causes the horizontal tabs to be treated as spaces. The Plotter's pen is moved to the next tab stop location along the printing X-axis by sending an ASCII HT (HORIZONTAL TAB).

Set Alpha Margin Separation

Serial Interface, Format #1, 2, 3, 4: ATN ADD BR SPACES

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BR SPACES

The Set Alpha Margin Separation command activates the alpha right margin function and sets the number of character spaces (the absolute value of SPACES in the command) of the current size that separates the left and right alpha margins. This distance is equal to the current character space times the number of SPACES. Subsequent changes in the Alpha Size (or Alpha Dimension), Alpha Ratio, Alpha Scale, or any window specification will not affect the margin separation. Changes in the left margin location, such as when using Alpha Rotate, will also change the right margin location by an equal amount. Both margins are established perpendicular to the current Alpha Rotation angle (see Set Alpha Rotation Angle description, located earlier). The default value for SPACES is 0, which disables the alpha margin control function. If the alpha margin control function is active (separation greater than 0), all subsequent printing will occur between the two margins. This means that if the current pen position is left of the area between the margins and a print command for drawing a printable character is received, the Plotter will automatically move to the left margin before printing that character. In addition, if the next character to be printed would begin or extend past the right margin, an automatic carriage return and line feed will be generated before that character is printed.

Select Alpha Spacing Control

Serial Interface, Format #1, 2, 3, 4: ATN ADD AJ CHOICE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AJ CHOICE

The Select Alpha Spacing Control command specifies the type of spacing for printing text characters. If the value of CHOICE is 0, as in the normal or default mode, subsequent characters will be printed with a constant distance between the character origins (lower left corner of the printed character matrix; see Figure 3-11A). This spacing is defined by the current alpha ratio and alpha size. Since the characters are generally centered within this matrix, the actual spacing between adjacent characters will vary, depending upon the width of each character. Narrow characters will have wider spaces between them and vice-versa.

On the other hand, if the value of CHOICE is 1, subsequent characters will be printed such that there will be an equal (uniform) spacing between characters regardless of the width of each character (see Figure 3-11B). This spacing is defined with the alpha ratio and alpha size based upon the widest character (those entirely covering the width of the character matrix).

Select Standard Alpha Font

Serial Interface, Format #1, 2, 3, 4: ATN ADD T FONT #

GPIB Interface, Format #1, 2, 3, 4, 5, 6: F FONT #

The Select Standard Alpha Font command designates one of the 16 different printing character fonts, numbered 0 through 15, as the primary printing font. Font 0 is the default font and is shown in the upper portion of Figure 3-12. Fonts 0-6, 8 and 9, which are resident in the Plotter, differ only in the assignment of certain special characters, as shown in the lower portion of the figure. Fonts 7 and 10-15 may be optionally resident or may be downloaded from a host.

A. SPACING CONTROL CHOICE 0 (DEFAULT)
 1. Characters are centered in character matrix (shaded area)
 2. Character origins are equidistant apart (marked by small x)
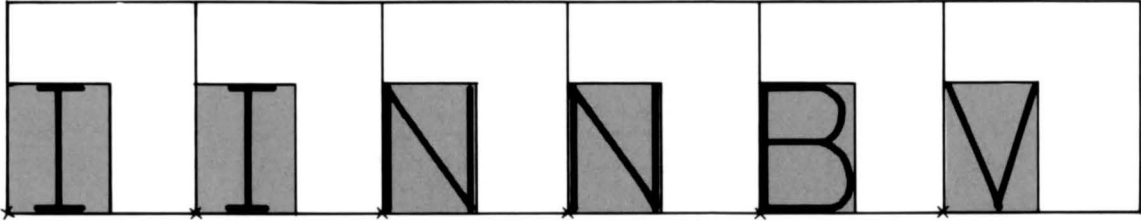
The result is that characters have unequal spacing — notice the spacing between adjacent 'Is' and 'Ns'

B. SPACING CONTROL CHOICE 1
 1. Character matrix width is reduced for thin characters (shaded area — compare letter 'I' and 'N')
 2. Character origins (marked by small x) are not equidistant apart — notice the distance between origins for 'Is' and 'Ns'
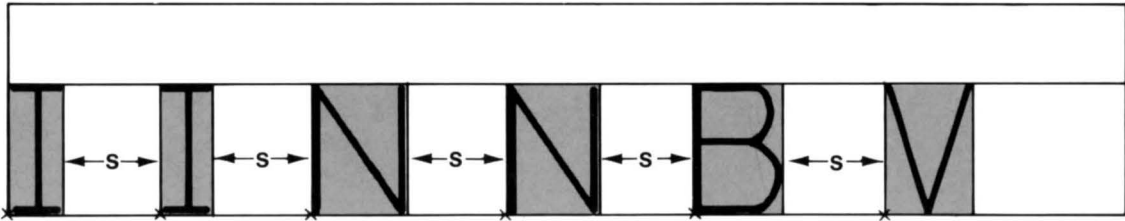
The result is that characters have equal spacing marked by S

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Figure 3-11. Spacing Control Effects.

```
! " # $ % & ' ( ) * + , - . /
0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O
P Q R S T U V W X Y Z [ \ ] ^ _
` a b c d e f g h i j k l m n o
p q r s t u v w x y z { | } ~
```

A. 4663 FONT 0 CHARACTER SET (NORMAL Alpha Quality).

```
0    # 0 @ [ \ ] ^ { | }
1    # 0 @ A O Å ^ a o å
2    £ 0 @ A O U ^ a o u
3    £ 0 @ [ \ ] ^ { | }
4    # 0 @ i Ñ ¿ ^ { | }
5    # 0 § [ \ ] ↑ ← ↙ →
6    # 0 @ [ \ ] ↑ { | }
7    SAME AS FONT 0
8    £ 0 @ [ \ ] ↑ { | }
9    # 0 @ Æ Ø Å ^ œ ø å
```

B. VARIATIONS IN FONTS 1-9 (compared to Font 0; remainder of characters are the same as those in Font 0).

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Figure 3-12. Alpha Font Character Variations.

The standard font chosen by this command is normally the active font unless the alternate font is activated (when the Plotter receives an ASCII SO, SHIFT OUT, control character). The standard font becomes active again when an ASCII SI (SHIFT IN) control character is received, the Plotter is powered-up, or when an Alpha Reset command is received. Notice, however, that the Alpha Reset command also changes the standard font selection to font #0.

Select Alternate Alpha Font

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BQ <u>FONT #</u>

GPIB Interface, Font #1, 2, 3, 4, 5, 6: BQ <u>FONT #</u>

The Select Alternate Alpha Font command designates one of the 16 different printing character fonts, numbered 0 through 15, to be the secondary (or alternate) font character set used by the Plotter. The default alternate font is the font #0.

The selection of an alternate font does not activate it. The alternate font, selected by this command, becomes active whenever an ASCII SO (SHIFT OUT) control character is received by the Plotter. Then, the alternate font becomes inactive and the standard font becomes active whenever an ASCII SI (SHIFT IN) control character is received, the Plotter is powered-up, or when an Alpha Reset command is received. Notice, however, that the Alpha Reset command also changes the alternate font selection to font #0.

Refer to the description of the Select Standard Alpha Font command (described earlier) for an explanation of the various fonts which may be selected.

Reset Alpha Parameter

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> V

GPIB Interface, Format #1, 2, 3, 4, 5 6: A

The Reset Alpha Parameter command resets all of the previously described alphanumeric parameters to their default values as follows:

Alpha Size	Alphanumeric character sizes are reset to the default sizes calculated from Table 3-2.
Alpha Ratio	3/2 and 18/11 (Character Space to Character Width and Line Space to Character Height ratios)
Alpha Scale	1,1
Alpha Rotation	0 degrees
Alpha Slant	0 degrees
Standard Font	0 (note also that the standard font becomes active, if not already)
Alternate Font	0
Alpha Margin Separation	0 (inactive)
Tab Separation	0 (Horizontal tab interpreted as a space)
Alpha Spacing Control	0 (Constant spacing between character origins)

This command also reestablishes the left alpha margin along the left edge of the viewport.

Print Character

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> P <u>STRING</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: P <u>STRING</u>

The Print command causes all of the 96 "printing" ASCII characters (ADE values 32-127, except DEL which is a nonprinting and nonadvancing character) contained in the STRING to be printed, using all of the current alpha parameters. For each character the current pen position is the character's origin (which for the average uppercase letter, e.g. "A," is the lower left corner). After each character is printed, the pen will be moved to the origin of the next character.

The print STRING must use either single or double quotes as delimiters, except as noted below. Either type of quotes can be used to delimit the string, but the closing delimiter must be the same as the opening. In addition, the right slash "/" can be used as a delimiter, in which case, the following number will be treated as the ADE equivalent and that character will be printed (or executed, in the case of ASCII control characters such as CARRIAGE RETURN, LINE FEED, BACKSPACE, SO, SI, etc.).

NOTE

Opening and closing delimiters are not required if the best character of the string is either an upper or lower case alpha character (not a number).

Examples of commands with STRINGs might be:

1. ESCAP"4663 INTERACTIVE DIGITAL PLOTTER"

2. ESCAP'4663 INTERACTIVE DIGITAL PLOTTER'

3. ESCAP'"4663 INTERACTIVE DIGITAL PLOTTER"'
    (here the double quotes will be printed because the STRING was delimited by the single quote).

4. ESCAP"ABC"/13"DEF" or ESCAP'ABC'/13'DEF'
    (here the /13 causes the Plotter to execute a CARRIAGE RETURN which, if CR GENERATES LF was also selected on the Parameter Entry card, would also generate a line feed).

5. ESCAPABCDEF123456
    (here the first character is an alpha character)

If implied commands are used, printing STRINGs might be as follows:

1. <US>ABCDEF

2. <US>ABC<ESC><FF>
   (here the ESC for ESCAPE precedes the ASCII control character FF)

The remaining 32 ASCII "control" characters (ADE values 0-31) are ignored, except for those listed below. These execute some action.

Character	Action
BEL (CONTROL G)	Rings the bell.
BS (CONTROL H)	Moves the pen position one space back (normally to the left).
HT (CONTROL I)	Moves the pen position to the next tab position to the right.
LF (CONTROL J)	Moves the pen position one line space down.
VT (CONTROL K)	Moves the pen position one line space up.
FF (CONTROL L)	Moves the pen position to the Alpha Home position (the height of an average uppercase character of current size down from the top left corner of the viewport boundary).
CR (CONTROL M)	Moves the pen to the current left margin (and generates a LF if CR GENERATES LF is selected on the Parameter Entry card).
SO (CONTROL N)	Causes the Plotter to activate the Alternate Font, which was previously selected using the Select Alternate Font command (see Select Alternate Font).
SI (CONTROL O)	Causes the Plotter to activate the Standard Font (see Select Standard Font).

Print Centered Character

Serial Interface, Format #1, 2, 3, 4: ATN ADD AP ASCII CHARACTER

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AP ASCII CHARACTER

The Print Centered Character command causes all of the 96 "printing" ASCII characters (ADE values 32-127) to be printed such that the center of an average uppercase character is at the current pen position (see Figure 3-13). The character will be printed using all current alpha parameters. The original pen position (which becomes the center of the printed character) will also be the final pen position. This means that the pen does not automatically advance to the origin of the next character after drawing a character. It will be necessary to send a Move command to advance to the next character, if desired. The Print Centered Character feature might be used in labeling a line, where the line passes through the 'center' of each character.
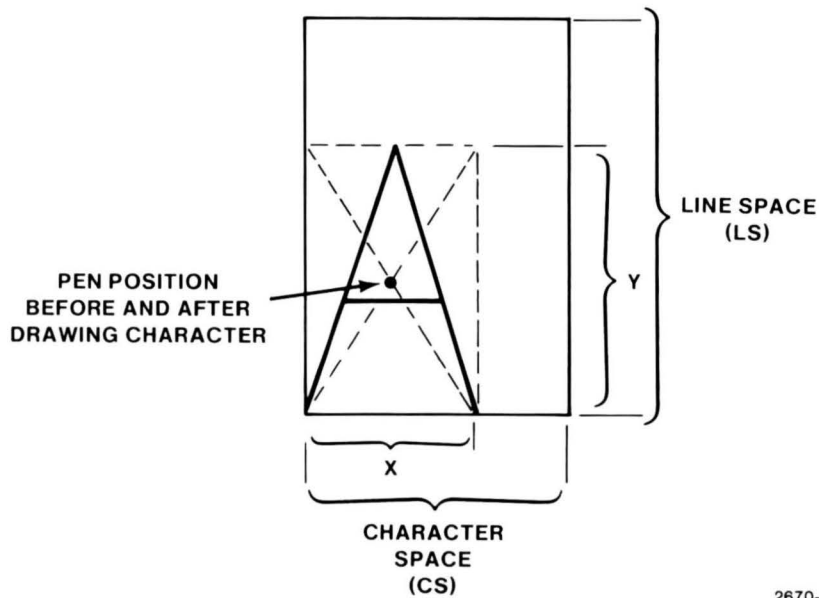
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Figure 3-13. Origin of Centered Character.

Move to Home

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AH

GPIB Interface, Format #1, 2, 3, 4, 5, 6: H

The Move To Home command causes the pen to move to the Alpha Home position (the height of an average uppercase character of current size, like "A," down from the top left corner of the viewport boundary). This is the same as "printing" FF (or CONTROL L).

Character Move

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AM <u>HSPACES</u>,<u>VSPACES</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AM <u>HSPACES</u>,<u>VSPACES</u>

The Character Move command causes the pen to move (without drawing) the number of character spaces (HSPACES) and/or vertical tabs (VSPACES) of current size (or fractions thereof) relative to the current pen position. Negative values will cause motion in terms of backspaces and linefeeds respectively. Fractions of a space are entered as decimal equivalents.

Set Arc Smoothness

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BA <u>VALUE</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BA <u>VALUE</u>

The Set Arc Smoothness command allows the operator to determine the smoothness (or granularity) of the curved lines used in printing text charcters. However, ENHANCED ALPHA QUALITY must be selected on the Parameter Entry card before the value set by this command is used in printing text characters (i.e., this function has no affect in NORMAL ALPHA QUALITY mode). The amount of smoothness of these arcs is indicated by VALUE which ranges from 0.0 to 1.0. A value of 0.0 indicates that the curved line is drawn by as many vectors as the Plotter can define — in other words, the smoothest curve possible. However, drawing these curves also may be time consuming. On the other hand, a value of 1.0 represents a very coarse broken line (angular) approximation of a curve. This curve may be convenient for previewing, since it can be drawn more quickly. It must be remembered that this scale from 0.0 to 1.0 is not linear (i.e., 0.5 is not necessarily half as coarse as 1.0). This function is designed to give approximately the same smoothness to curved lines regardless of the radius of the arc.

Digitizing Commands

The Digitizing (or Graphic Input) mode allows the Plotter to be used for digitizing operations and provides graphic data to the host. When digitizing, the Plotter's logic converts the present pen position into data bytes representing that location and transmits them to the host. The joystick can be used by the operator to position the pen prior to digitizing a coordinate point.

The following list of commands, which are then described, are used in the Digitizing mode:

Digitize

Operator Digitize

Prompt Light On

Prompt Light Off

Joystick Disable

Digitize

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> M

GPIB Interface, Format #1, 2, 3, 4, 5, 6: G

The Digitize command permits the host computer to interrogate the Plotter to obtain the present position of the pen (or the final projected pen position if several motion commands are buffered up in the motion queue and the pen is moving). The pen position may also be the position of the crosshair cursor if the pen is presently inactive (more than 0.5 seconds after the last motion command or if the crosshair has been selected). The Plotter responds with a one block message containing the projected pen coordinates of the currently selected pen. The coordinates are encoded as follows:

Block 1

Data Value 1:   Projected position X coordinate

Data Value 2:   Projected position Y coordinate

Block Type: 0, LAST (for pen up)

1, LAST (for pen down)

Notice that the block type is O, LAST depending upon whether the pen is up or down respectively.

The 16-bit coordinate values are defined as follows:

Projected X Coordinate

Bit Position   15 (MSB), 14, 13,..........2, 1, 0 (LSB)

Data Value   Projected X Coordinate

Projected Y Coordinate

Bit Position   15 (MSB), 14, 13,..........2, 1, 0 (LSB)

Data Value   Projected Y Coordinate

Refer to the description of the Plotter to Host description in Section 6 (Plotter Communications) for a discussion of the transmitted byte format.

If the current active output units are world units, the coordinates will be determined with respect to the current transform coordinate system origin. On the other hand, if the current active output unit is one of the Device Units, the coordinates will be reported with respect to the current page's origin. If an attempt is made to digitize a point that is outside of the current page while using any of the Device Units, the transmitted coordinates will be that of the nearest point on the page boundary.

Operator Digitize

Serial Interface, Format #1, 2, 3, 4: ATN ADD AG MAXIMUM POINTS

GPIB Interface, Format #1, 2, 3, 4, 5, 6: C MAXIMUM POINTS

The Operator Digitize command allows the operator to digitize a drawing using the front panel POINT functions and the joystick. The total number of input points must be equal to or less than the number specified as MAXIMUM POINTS. When this command is received, the POINT light is turned on steady (unless it is flashing in response to a prompt — described later, in which case, it will continue to flash), to indicate an Operator Digitize operation enabled. While the Operator Digitize mode is enabled, any POINT function (DRAW POINT, MOVE POINT, or LAST POINT) will generate a one block message containing the current coordinates of the currently selected pen (or the crosshair cursor, if the pen is not active). The coordinates are encoded as follows:

Block 1

Data Value 1:   Current Position X Coordinate

Data Value 2:   Current Position Y Coordinate

Block Type: 1 (for a DRAW POINT function)
                 0 (for a MOVE POINT function)
                 0, LAST (for a LAST POINT function)

Where the 16-bit coordinate values are defined as follows:

Projected X Coordinate

Bit Position   15 (MSB), 14, 13,..........2, 1, 0 (LSB)

Data Value   Projected X Coordinate

Projected Y Coordinate

Bit Position   15 (MSB), 14, 13,..........2, 1, 0 (LSB)

Data Value   Projected Y Coordinate

Refer to the description of the Plotter To Host description in Section 6 (Plotter Communications) for a discussion of the actual byte format transmitted.

If the current active output units are world units, the coordinates will be determined with respect to the current transform coordinate system origin. On the other hand, if the current active output unit is one of the Device Units, the coordinates will be reported with respect to the current page's origin. If an attempt is made to digitize a point that is outside of the current page while using any of the Device Units, the transmitted coordinates will be that of the current point on the page boundary.

The assignment of DRAW POINT, MOVE POINT, or LAST POINT information to the block type is dependent on the requirements of the specific application program. However, the normal use of these designations is to inform the host computer of the desired state of the pen at that coordinate (up or down). This information is not available automatically, as Operator Digitizing is usually done with the joystick and crosshair cursor. This means that the selected pen is always up. Normally the LAST POINT function is used after the pressing of either a DRAW POINT or MOVE POINT for the final coordinate point in the drawing and the coordinates in the LAST POINT message are discarded by the host. Alternatively, a host application program could assign the required MOVE or DRAW to the final digitized coordinate generated by the pressing of the LAST POINT function. The activation of the LAST POINT function causes a final one block message to be sent to the host, causing the Operator Digitize mode to be canceled and the POINT light to be turned off (unless it is flashing for a prompt). Subsequent POINT switch inputs will be ignored and will cause the bell to sound. If another Operator Digitize command is sent, while already operating in Operator Digitize mode, the new value of MAXIMUM POINTS will replace the current point count.

Unlike The Digitize command (described earlier), Operator Digitize uses the current pen position (or crosshair cursor) and not the projected pen position (consisting of points stored in the motion queue).

Operator Digitize can also be canceled by sending an Operator Digitize with MAXIMUM POINTS equal to 0 or by digitizing a number of coordinate points equal to MAXIMUM POINTS. In either case, a final one block message is generated with the block type set to 0, LAST. This informs the host that the final Operator Digitize message has been transmitted.

If an Operator Digitize command with a MAXIMUM POINTS equal to 0 is received when operating in any mode except Operator Digitize, the final one block message will be automatically generated anyway.

If another command which generates an output response is received while operating in Operator Digitize mode, the Operator Digitize mode will be canceled and an error will be indicated, but the automatic final one block message will not be generated.

Prompt Light On

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> K

GPIB Interface, Format #1, 2, 3, 4, 5, 6: T1

The Prompt Light On command causes the Plotter's front panel POINT switch light to blink. This action can be used to cue the operator to initiate some predefined action, such as changing paper, pens, operating configuration, etc.

Prompt Light Off

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> L

GPIB Interface, Format #1, 2, 3, 4, 5, 6: T0

The Prompt Light Off command causes the Plotter's front panel POINT switch light to stop blinking. Notice that the light may continue to be on steady if Operator Digitizing mode is currently enabled.

Joystick Axis Disable

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BJ <u>JOYSTICK AXIS</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BJ <u>JOYSTICK AXIS</u>

The Joystick Axis Disable command permits the host computer to disable either joystick axis or both of them. For example, this application might be used in certain digitizing operation, where only single axis values are desired, for example:

   If JOYSTICK AXIS is a 0, neither joystick axis
   is disabled (default condition).

   If JOYSTICK AXIS is a 1, the X axis is disabled.

   If JOYSTICK AXIS is a 2, the Y axis is disabled.

   If JOYSTICK AXIS is a 3, both axes are disabled.

Upon receipt of this command, the joystick is activated except for the designated axis. It must be pointed out that if for any reason the joystick should become deactivated (such as when the Plotter is executing any motion command —Move, Draw, etc. — or if a front panel function was activated which resulted in a pen movement — LOCATE, OUTLINE VIEWPORT, etc.) and then allowed to become active (0.5 second after the last motion command is executed), the effects of this command will be lost (i.e. both joystick axes will be fully active). It will be necessary to retransmit this command to disable a joystick axis after each joystick inactive period.

Commands Associated with Plotter Options

The following is a list of the Plotter commands which control the various performance options available. Their description and general format follows in subsequent paragraphs:

Option 31 Circular Arcs and Programmable Macros

  Draw Arc

  Draw Circle

  Set Arc Smoothness

  Begin Macro Definition

  End Macro Definition

  Expand Macro

  Delete Macro

  Read Macro Status

  Set Auto Macro

Option 32 Math Character Set and Downloadable Character

  Set Downloaded Character Size

  Begin Character Definition

  Set Character X-Extent

  Select Non-Advancing Character

  End Character Definition

  Delete Character Definition

  Delete Font Definition

Option 36 Media Advance

Advance Media

Read Formlength

Set Formlength

Page Change

Option 31 (Circular Arcs and Programmable Macros) Commands

Draw Arc (Requires Option 31)

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AA <u>X1,Y1,X2,Y2</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AA <u>X1,Y1,X2,Y2</u>

The Draw Arc command causes the Plotter to draw an arc which is defined by three points. The three points are: (1) the present pen location which also becomes the beginning of the arc; (2) an intermediate point along the arc and defined by the coordinates X1,Y1; and (3) the coordinate points of the end of the arc defined by X2,Y2 (see Figure 3-14). The coordinate points are expressed in current world units. The arc is approximated (composed) by the largest number of equal length internal chords (each of which subtend an angle of 45 degrees or less) which will satisfy the current arc smoothness specification (refer to the description of the Set Arc Smoothness command located later in this section). The direction of arc rotation is determined from the order of the three points on the arc. If the end point is the same as the present pen position, a complete circle is drawn.

For maximum precision, the intermediate points should be specified near the midpoint of the arc.

INTERMEDIATE COORDINATE
POINT (X1,Y1)

DESIRED ARC

EQUAL LENGTH CHORDS
DRAWN BY PLOTTER TO
APPROXIMATE DESIRED ARC.

RADIUS

MAXIMUM ANGLE
IS 45°

ARC CENTER

STARTING POINT FOR ARC
(PRESENT PEN POSITION)

END POINT FOR
FINAL PEN POSITION
(X2,Y2)
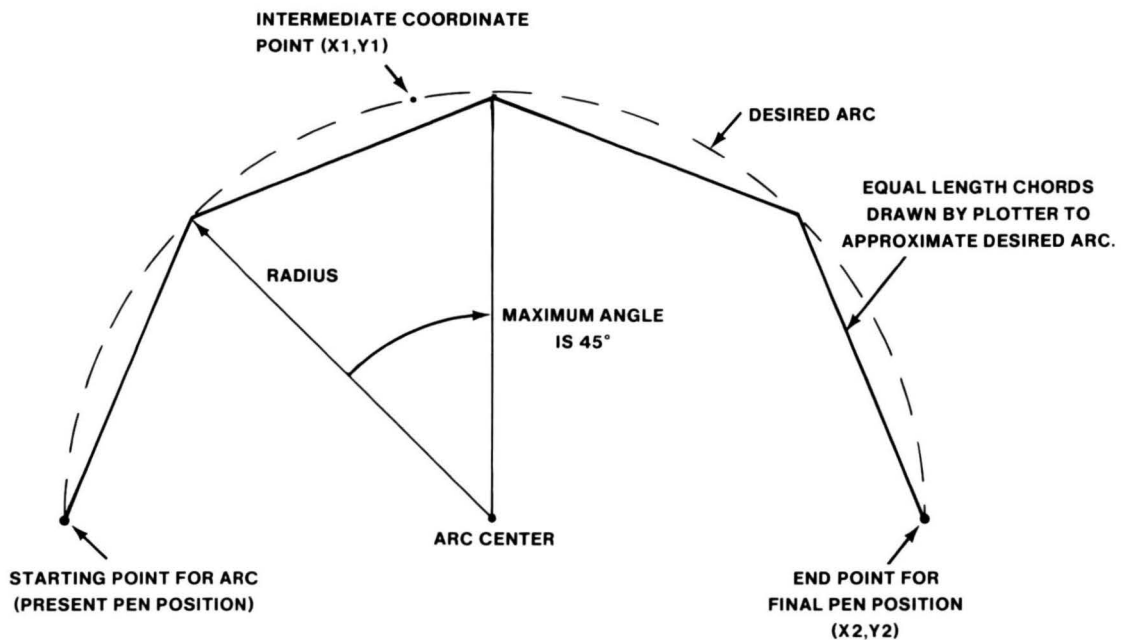
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Figure 3-14. Drawing Arcs.

Draw Circle (Requires Option 31)

Serial Interface, Format #1, 2, 3, 4: ATN ADD AC RADIUS

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AC RADIUS

The Draw Circle command causes the Plotter to draw a circle whose center is at the current pen position and whose radius length is specified by RADIUS. The circle is approximated by the largest number of equal length internal chords (each of which subtends an angle of 45 degrees or less) which will satisfy the current arc smoothness specification (refer to the command described next). The circle is drawn beginning at its positive X axis (which may or may not be parallel to the viewport X axis) and when completed, the pen returns to the center of the circle.

Set Arc Smoothness (Requires Option 31)

Serial Interface, Format #1, 2, 3, 4: ATN ADD BA VALUE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BA VALUE

@

The Set Arc Smoothness command allows the operator to determine the smoothness (or granularity) of a curved line, such as those used in printing alphanumerics or, if Option 31 is present, any circle or arc. The smoothness of any arc is indicated by a value from 0.0 to 1.0. A value of 0.0 indicates that a curved line is drawn by as many vectors (equal length internal chords) as the Plotter can define — in other words, the smoothest curve possible with the Plotter. However, drawing such a curve may be time consuming. On the other hand, a value of 1.0 represents a very coarse broken-line (angular) approximation of a curve consisting of equal length internal chords, each subtending an angle of 45 degrees or less. This curve may be convenient for previewing, since it can be drawn more quickly. It must be remembered that this scale from 0.0 to 1.0 is not linear (i.e., 0.5 is not necessarily half as coarse as 1.0). This function gives approximately the same smoothness of a curve regardless of the radius of the arc. Value of greater than 1.0 will result in circles of eight sides (octagon). The default value is 0.5.

Begin Macro Definition (Requires Option 31)

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BB <u>MACRO NUMBER</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BB <u>MACRO NUMBER</u>

The Begin Macro Definition command defines and saves a programmable macro, which can have any MACRO NUMBER (label) from 0 to 255. All subsequent commands (except for Interface commands which are executed immediately) are saved in the Plotter's system RAM until an End Macro Definition command (described later) is received, thereby forming the programmable macro. Since the system RAM is also allocated to transform storage, downloadable character set storage, and to the storage of Interface commands (on a first received, first executed basis), it is necessary that the operator keep in mind the available storage requirements. If insufficient RAM storage is available to complete a macro definition (storage), a macro storage overflow error is generated and the new macro is deleted. If there is a macro with the same MACRO NUMBER already in storage, the existing macro will be deleted prior to the storage of the new macro.

NOTE

Commands within a macro may expand (execute) another macro with a different MACRO NUMBER; however, circular definitions, where one macro expands another macro, which in turn expands another and so on, until the last macro expands the first (thereby forming an endless loop), are not permitted. In this case, a macro definition error will be generated when the macros are expanded and the offending Expand Macro command will be ignored. Also, commands which generate output messages must not be included in programmable macros. And, lastly, it should be noted that macros stored in RAM will be lost whenever the Plotter's power is recycled or if the Plotter receives a Device Reset (0) command.

End Macro Definition (Requires Option 31)

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BE

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BE

The End Macro Definition command terminates the storage of the macro commands for a given MACRO NUMBER. The stored macro is then ready for access.

Expand Macro (Requires Option 31)

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AE <u>MACRO NUMBER</u>,<u>MACRO NUMBER</u>,...

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AE <u>MACRO NUMBER</u>,<u>MACRO NUMBER</u>,...

The Expand Macro command causes all of the commands stored as a macro with the specified MACRO NUMBER(s) (ranging from 0 to 255) to be retrieved from RAM storage and executed. If the desired macro does not currently exist, an undefined macro error will be generated.

Delete Macro (Requires Option 31)

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> BK <u>MACRO NUMBER</u>,<u>MACRO NUMBER</u>,...

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BK <u>MACRO NUMBER</u>,<u>MACRO NUMBER</u>,...

The Delete Macro command clears the specified macro(s) (designated by MACRO NUMBER, MACRO NUMBER,...) from the RAM storage. If no MACRO NUMBER is used in the command, ALL macros will be cleared. The released RAM storage becomes available for other uses.

Read Macro Status (Requires Option 31)

Serial Interface, Format #1, 2: <u>ATN</u> <u>ADD</u> CS

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CS

The Read Macro Status command causes the Plotter to transmit an output message consisting of one block for each macro currently defined in RAM storage. Each macro is described by its macro number and its required storage size in bytes. These values are encoded in each block as follows:

Block 1

Data Value 1:   Macro Number

Data Value 2:   Storage Size

Block Type: 0 (for all but the last block)
0,LAST (for the last block)

Where the definition and description of the data words is as follows:

Macro Number

Bit Position   15 (MSB), 14,...........2, 1, 0 (LSB)

Data Value   Macro Number

Storage Size

Bit Position   15 (MSB), 14,...........2, 1, 0 (LSB)

Data Value   Storage Size

The number of macros currently defined is indicated by the number of blocks in the message. Notice that 0,LAST is the block type for the last block only. An unidentified command error will be generated if the programmable macro option (Option 31) is not installed in the Plotter when this command is received.

Refer to the Plotter to Host Description in Section 6 for a discussion of the actual transmitted byte format.

Set Auto Macro (Requires Option 31)

Serial Interface, Format #1, 2, 3, 4: ATN ADD BN MACRO NUMBER

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BN MACRO NUMBER

The Set Auto Macro command causes the macro designated by MACRO NUMBER (0 to 255) to be executed automatically at the end of each subsequent Draw, Arc, or Circle command. This might be used for such things as drawing arrowheads on dimensions or vectors. The Auto Macro mode is terminated by sending a Set Auto Macro command with no MACRO NUMBER, or by sending a Device Reset command. (Note, however, that a Device Reset (0) command will clear the entire RAM storage of all macros.) In addition, a Set Macro command must not be contained within a macro definition.

Option 32 (Math Character Set and Downloadable Character Set) Commands

Option 32 allows the host computer to temporarily override the resident alpha character fonts to print special math and greek characters, as well as special user-defined characters. When characters or fonts have been defined, they can be stored in the Plotter. For print operations, a priority system is used to select the characters as follows:

Priority	Character Recalled
1	Downloaded User-Defined
2	Characters stored in ROM located at the highest numbered optional PROM socket
3	Characters stored in ROM located at the lowest numbered optional PROM socket (Option 32)
4	Resident Fonts 1-6, 8 and 9
5	Resident Font 0

User-defined character definitions are downloaded by first using the Begin Character Definition command. (However, if the Set Download Character Size command is desired, it is sent first. It is not necessary to repeat this command for each following character since it defines the character size for the entire font.) This command is followed by a series of X-Extent, Move, Draw, Arc, Circle, and Non-Advance commands required to define the character. Then, the download is terminated by an End Character Definition command or another Begin Character Definition command.

The storage of downloadable characters also uses the same system RAM as macro storage, transform storage, input interface commands, and pending output responses. Downloadable character set storage requirements may be estimated as two bytes per character plus the number of bytes per command as follows:

Command	Storage Bytes	Remarks
X-Extent	2	If 'right' equal to XMIN + 48
	4	If 'right' not equal to XMIN + 48
Move	1	Low resolution
	3	High resolution
Draw	1	Low resolution
	3	High resolution
Arc	3	Low resolution
	5	High resolution
Circle	2	High resolution
Non-Advance	1	

Memory for storage of downloadable characters is assigned in small discrete blocks slightly larger than the charts described above.

Low resolution means that the X or Y coordinate value is one of the following integer values (X: 0, 8, 16, 24, 32, 40, or 48 and Y: −24, −16, −8, 0, 8, 16, 24, 32, 40, 48, 56, 64, 72, 80, 88, or 96). High resolution means that the coordinates can be any other integer value.

When individual character definitions are deleted or redefined, memory storage is not released. However, when an entire font is deleted, memory storage is released. If insufficient memory is available to complete a downloadable character definition, an error is generated and the character is deleted.

The Parameter Entry card line selection for Alpha Character Quality does not apply to downloaded characters. These characters are printed as defined. However, host-supplied Alpha commands affecting alpha parameters (such as rotation, slant, or scaling) will affect the downloaded characters when they are printed. Like other information stored in the system RAM, downloaded characters are lost on Device Reset 0 commands or power-down.

Set Downloaded Character Size

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> <u>CZ</u> <u>FONT#</u>,XMIN,XMAX,YMIN,YMAX

GPIB Interface, Format #1, 2, 3, 4, 5, 6: <u>CZ</u> <u>FONT#</u>,<u>XMIN</u>,<u>XMAX</u>,<u>YMIN</u>,<u>YMAX</u>

The Set Downloaded Character Size command sets the character width and height ranges for a typical uppercase letter in the user-defined character of a specified font. This origin and character size information is saved along with any character definitions. The default values are 0 (XMIN), 48 (XMAX), 0 (YMIN), and 88 (YMAX). Refer to Figure 3-15 for a diagram of these dimensions. Values for subsequent characters defining commands are rounded to integer values. Values for Moves, Draws, Arcs, and X-Extent are limited to a range of XMIN -64 to XMIN $+175$. Values for circles are limited to a range of -64 to $+175$.
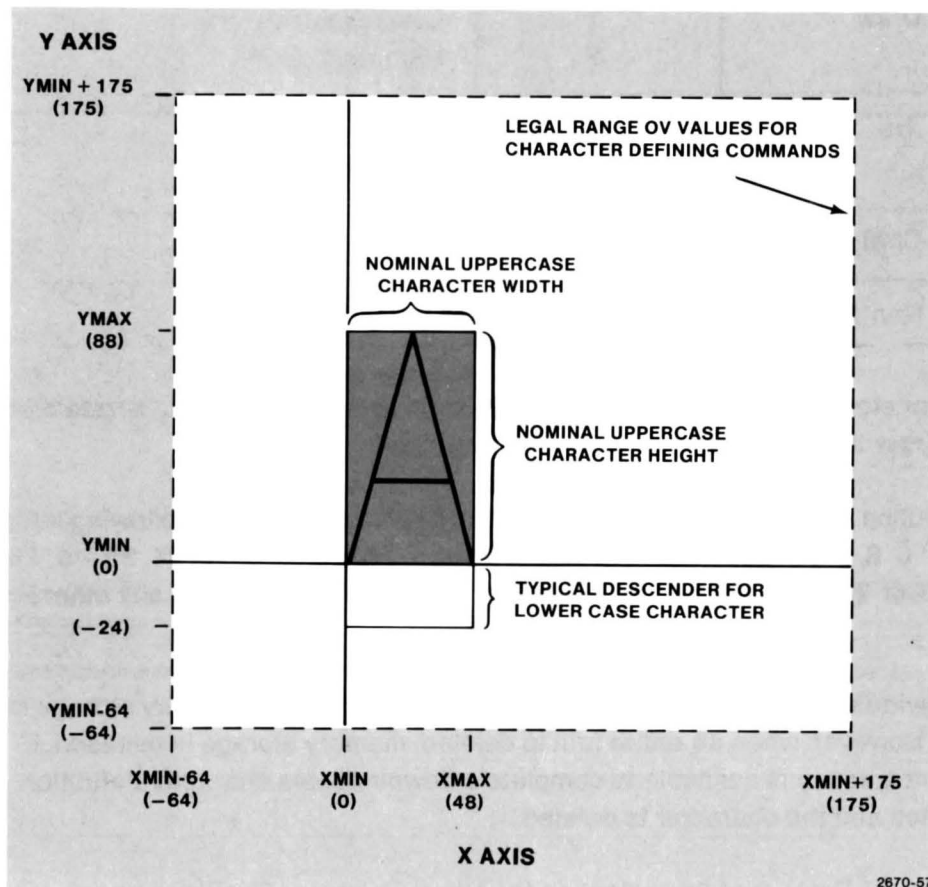
Figure 3-15. Numerical Value Ranges for Character Definition Commands.

@

Begin Character Definition

Serial Interface, Format #1, 2, 3, 4: ATN ADD CN FONT#, ASCII CHARACTER

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CN FONT#, ASCII CHARACTER

The Begin Character Definition defines the start of a character definition. This means that it can be used to terminate an earlier character definition as well as begin the current character definition. This command begins interpreting the following commands as character defining commands (until the next End Character Definition or Begin Character Definition command is received):

Set Character X-Extent
Move
Draw   in any combination
Draw Circle   necessary to
Draw Arc   describe character
Select Non-Advancing Character

Set Character X-Extent

Serial Interface, Format #1, 2, 3, 4: ATN ADD CT LEFT,RIGHT

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CT LEFT,RIGHT

The Set Character X-Extent command may be included at the beginning of a character definition to specify the LEFT and RIGHT values (edges) of the character used with Select Spacing Control 1.

Move (see standard Plotter commands)

Draw (see standard Plotter commands)

Draw Arc (see Option 31 commands)

Draw Circle (see Option 31 commands)

Select Non-Advancing Character

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CU

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CU

The Select Non-Advancing Character command can be included at the end of a character definition. This instructs the Plotter to move back to the original starting point of the character, rather than advancing to the next character's starting point.

End Character Definition

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CO

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CO

The End Character Definition command terminates a character definition. This command is optional if the next command is a Begin Character Definition command.

Delete Character Definition

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CP <u>FONT#,ASCII CHARACTER(S)</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CP <u>FONT#,ASCII CHARACTER(S)</u>

The Delete Character Definition command deletes the downloaded character definition for the specified character of the specified font.

Delete Font Definition

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> CQ <u>FONT#</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CQ <u>FONT#</u>

The Delete Font Definition command deletes all downloaded character definitions present for the specified font number, and releases system memory RAM for other uses. If no FONT# is specified, ALL fonts will be deleted.

4663 FONT 10 SET:

! " # $ % & ' ( ) * + , - . /
Ø 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B Ψ Δ E Φ Γ H I Ξ K Λ M N O
Π Q P Σ T Θ Ω W X Υ Z [\ ] ^ _
` α β ψ δ ε φ γ η ι ξ κ λ μ ν ο
π q ρ σ τ ϑ ω ς χ υ ζ { ∂ } ~

4663 FONT 11 SET:

· □ ○ △ + ◇ ⊠ ⋈ ⊕ ⊞ + ⊥ ‖ . ÷
° ∫ ∴ ∃ ⊂ ∪ ⊃ ∩ ∞ ∇ : ≠ ≤ ≡ ≥ ∝
² A B Ψ Δ E Φ Γ H I Ξ K Λ M N O
Π √ P Σ T Θ Ω W X Υ Z [±] ↑ _
⁻¹ α β ψ δ ε φ γ η ι ξ κ λ μ ν ο
π ρ σ τ ϑ ω ς χ υ ζ ℓ ∂ ↓ ~

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Figure 3-16. Option 32 Fonts.

Option 36 (Media Advance) Commands

Advance Media (Requires Option 36)

Serial Interface, Format #1, 2, 3, 4: <u>ATN</u> <u>ADD</u> AU <u>NUMBER OF INCREMENTS</u>

GPIB Interface, Format #1, 2, 3, 4, 5, 6: AU <u>NUMBER OF INCREMENTS</u>

The Advance Media command allows the host to advance the media (if the Plotter is equipped with Option 36) any amount in 1/64" (0.015625" or 4mm) increments. Notice that the command is given with the number of increments desired — not the desired length. During the media advance, the pen moves to the Load position and after the advance, plotting resumes. The media advance must be greater than approximately one inch (approximately 64 INCREMENTS) or the Plotter may indicate an Out of Media Status (Plotter's PAUSE light starts blinking). Negative advance values will be ignored. An undefined command error will be generated if Option 36 is not present, and an illegal media advance command error will be generated if the Parameter Entry card selection is SHEET rather than ROLL mode.

Read Formlength (Requires Option 36)

Serial Interface, Format #1, 2: <u>ATN</u> <u>ADD</u> CF

GPIB Interface, Format #1, 2, 3, 4, 5, 6: CF

The Read Formlength command causes the Plotter to respond with a one block message containing the form length parameter in 1/64" (0.015625" or 4mm) units. The message is encoded as follows:

    Block 1

        Data Value 1: Formlength

        Data Value 2: 0

        Block Type: 0,LAST

Where the Data Value word is defined as follows:

Formlength

Bit Position   15 (MSB), 14,..........2, 1, 0 (LSB

Data Value   Formlength

If the Media Advance option is not installed in the Plotter, an undefined command error will be generated.

Refer to the description of Plotter to Host in Section 6 for details of the transmitted byte format.

Set Formlength (Requires Option 36)

Serial Interface, Format#1, 2, 3, 4: ATN ADD BF NUMBER OF INCREMENTS

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BF NUMBER OF INCREMENTS

The Set Formlength command allows the host computer to establish a form length differing from the default selections on the Parameter Entry card (INITIAL PAGE SIZE). The unit used is 1/64″ (0.015625″ or 4mm) increments. Notice that the command uses the number of increments desired — not the length desired. The formlength must be greater than approximately one inch (approximately 64 INCREMENTS) or the Plotter may indicate an Out of Media status (PAUSE light starts blinking) when the media is advanced (either with the front panel MEDIA CHANGE switch or the host generated Page Change command, which is described next). An undefined command error is generated if Option 36 is not present in the Plotter.

Page Change (Requires Option 36 for a ROLL Mode Page Change)

Serial Interface, Format #1, 2, 3, 4: ATN ADD BC

GPIB Interface, Format #1, 2, 3, 4, 5, 6: BC

The Page Change command allows the host computer to advance the media the length specified by the current form length parameter (either the Parameter Entry card selection or a subsequent Set Formlength command, which is described immediately prior to this). This command is identical to pressing the front panel MEDIA CHANGE function while operating in ROLL mode (Parameter Entry card). Refer to the description of the front panel switches for more information. The Out of Media status is updated at the completion of the media advance cycle. If the status is Out of Media, the Plotter will not resume plotting and the PAUSE light will start blinking.

AN EXAMPLE PLOT WITH HOST SUPPLIED COMMANDS

Sections 4 and 5 of this manual consist of a series of commands an operator can issue to the Plotter from a terminal. These examples may not be exactly representative of the manner in which a host could send Plotter commands. For example, following each command, the terminal transmitted a CARRIAGE RETURN to terminate the command and to cause the Plotter to execute the command. A host sending a series of commands does not need to send a CARRIAGE RETURN after each command — the ATN character of the next command will cause the previous command to be executed (i.e., the ATN character of the next command acts as a command terminator).

NOTE

The following example is fairly short, and no attempt is necessary to establish block mode communications or any other measures to prevent Plotter input buffer overflow.

Figure 3-17 shows an example of a simple plot (A) made from a series of host-supplied commands (B). Notice that this is sent as one long string of commands, with no CARRIAGE RETURNS or LINE FEEDS, and only the last command uses a command terminator. An explanation of each command is included later. Notice that the ATN character has been chosen as "!". ESC could also have been chosen. The coordinates of the buildings and the fence are also included in Figure 3-18 as an aid to understanding the various Move and Draw commands, but are not really a part of the actual plot. Notice also that the coordinate units used inside the viewport, forming the window, are in world units of feet. This represents a common unit that might be used in many drawings of this type.

@
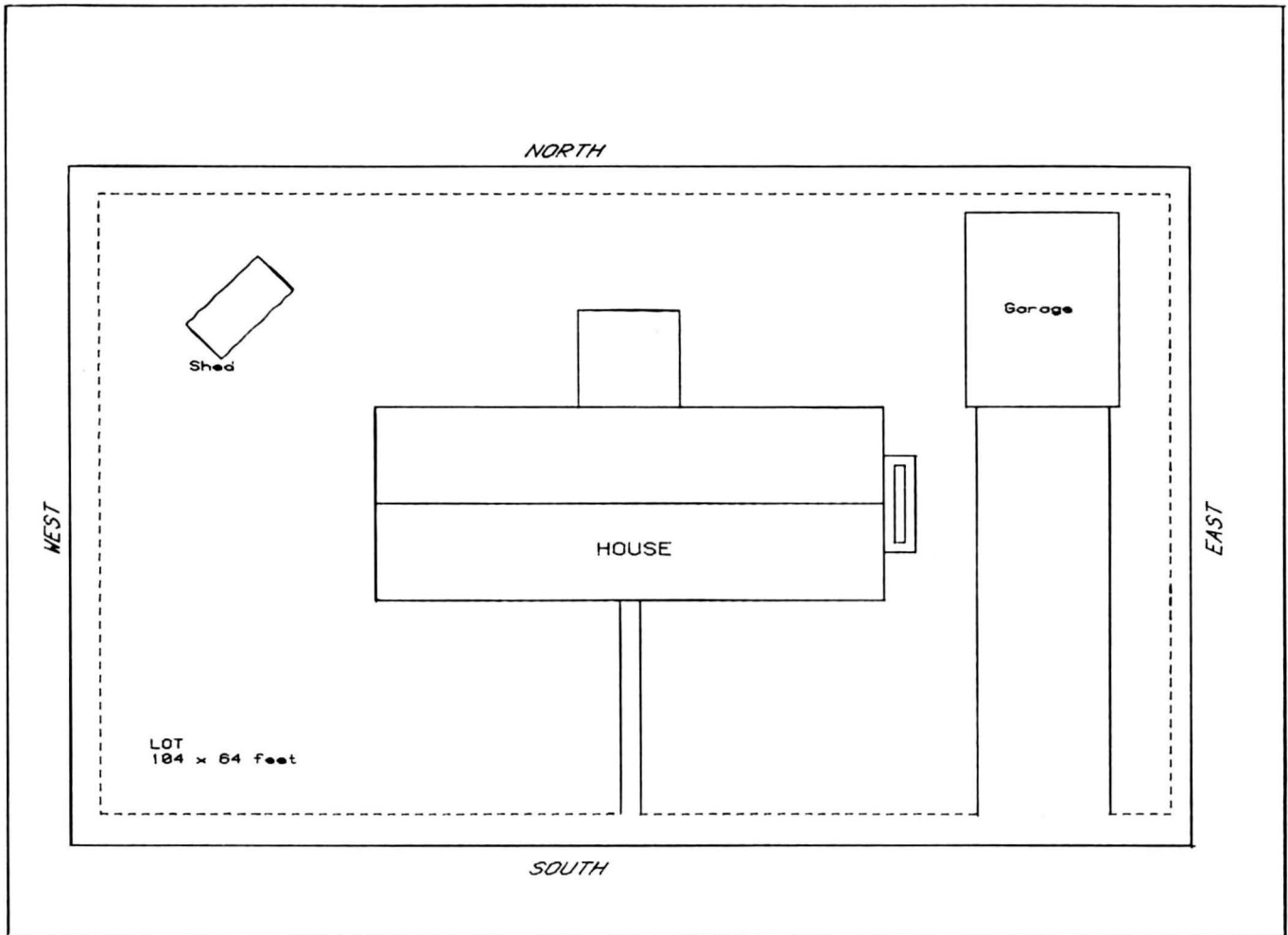
A. Drawing.

```
!AE!ACC1!AN0!AAV200,3800,300,2500!AAW0,110,0,70!AX30,25!AY80,25,80,45,30,45,30,2
5!AX50,45!AY50,55,60,55,60,45!AX30,35!AY80,35!AX80,30!AY83,30,83,40,80,40!AX81,?
1!AY82,31,82,39,81,39,81,31!AX15,50!AAX!AA0!AAR45!AY10,0,10,5,0,5,0,0!AAY!AX88,4
5!AAX!AA0!AY15,0,15,20,0,20,0,0!AAY!AX54,25!AY54,3!AX56,3!AY56,25!AX89,45!AY89,3
!AX102,3!AY102,45!AX3,3!ABD1,1!ABS50!ABL1!AY54,3!AX56,3!AY89,3!AX102,3!AY108,3,1
08,67,3,67,3,3!ABL0!AAK1!ABG30!AX45,71!ABF2!AP"NORTH"!AX45,-3!AP"SOUTH"!AX-1,30!
AJ90!AP"WEST"!AX113,30!AP"EAST"!AJ0!ABG0!AX12,49!ABH.75,.75!AP"Shed"!AX92,55!AP"
Garage"!AX8,10!AJ0!AP"LOT"/13"104 x 64 feet"!AV!AX52,30!APHOUSE!AAI;
```

B. Host Supplied Commands.

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Figure 3-17. Example Plot (With Host Commands).
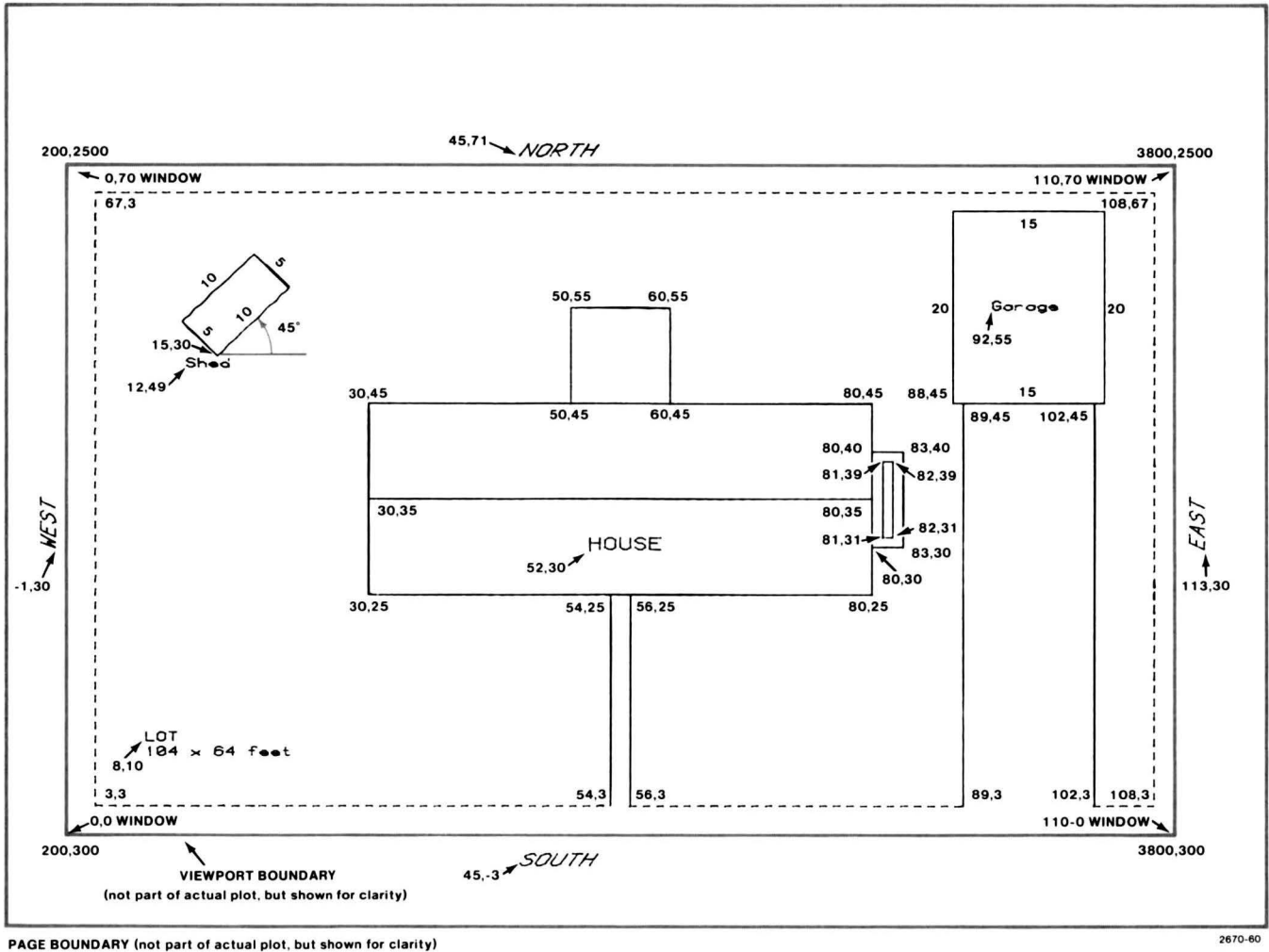
Figure 3-18. Example Plot (With Coordinates).

@

Command	Explanation
!AE	Turns on the Plotter's interface logic and permits the Plotter to interpret the following commands.
!ACC1	Selects the Plotter's Command/Response Format as 1. This could have been accomplished by selecting 1 on the Parameter Entry card's Select Command/Response Format line.
!AN0	Device reset with a degree (level) of 0.
!AAV200,3800,300,2500	Establishes a viewport just slightly smaller than the page boundary (which could be any choice — A,B,C, etc.). The viewport coordinates are shown in Figure 3-18.
!AAW0,110,0,70	Establishes the window. This means that the viewport will be measured in world units (feet in this case) ranging from 0,0 (lower left corner) to 110,70 (upper right corner).
!AX30,25	Move to SW corner of the house.
!AY80,25,80,45,30,45,30,25	Series of Draws forming the basic outline of the house.
!AX50,45	Move to rear of house where the west side of the porch joins.
!AY50,55,60,55,60,45	Series of draws forming the back porch.
!AX30,35	Move to center of west end of house.
!AY80,35	Draw the roof gable.
!AX80,30	Move to fireplace chimney.
!AY83,30,83,40,80,40 !AX81,31 !AY82,31,82,39,81,39,81,31	Series of Moves and Draws outlining the chimney.

Command	Explanation
!AX15,50	Move to south corner of shed.
!AAX	Saves a copy of the current transform in memory.
!AAO	Moves the viewport coordinate origin to the current pen position.
!AAR45	Rotates the coordinate axes 45 degrees CCW (effectively rotates the entire plot 45 degrees).
!AY10,0,10,5,0,5,0,0	Series of Draws forming the shed.
!AAY	Restores the previous transform from memory and deletes the rotated transform (moves the origin back to the lower left corner of the viewport).
!AX88,45	Move to SW corner of garage.
!AAX	Saves a copy of the current transform in memory.
!AAO	Moves the origin to the SW corner of the garage.
!AY15,0,15,20,0,20,0,0	Series of Draws forming the garage.
!AAY	Restores the previous transform from memory and deletes the transform with the relocated origin.
!AX54,25	Move to the front door of the house.
!AY54,3 !AX56,3 !AY56,25	Draws the front sidewalk to street.
!AX89,45	Moves to garage door.
!AX89,3 !AX102,3 !AY102,45	Draws driveway.
!AX3,3	Moves to SW corner fence post.

@

Command	Explanation
!ABD1,1	Set dash pattern with equal length dashes and spaces.
!ABS50	Sets dash pattern (one dash and one space equal to 50/4095 of the total length of the viewport's longest axis).
!ABL1	Chooses dash pattern line type.
!AY54,3	
!AX56,3	Draws fence (with dashed lines).
!AY89,3	
!AX102,3	
!AY108,3,108,67,3,67,3,3	
!ABL0	Changes back to solid lines.
!AAK1	Establishes clipping limit as page boundary (allows drawing outside of viewport).
!ABG30	Slants subsequent alpha characters 30 degrees.
!AX45,71	Moves to north center of back of lot.
!ABP2	Changes to pen 2.
!AP"NORTH"	Prints the word "NORTH" (with no quotes).
!AX45,−3	Similarly prints "SOUTH" on front edge of lot.
!AP"SOUTH"	
!AX-1,30	Moves to west edge of lot.
!AJ90	Rotates the printing axis 90 degrees CCW.
!AP"WEST"	
!AX113,30	Prints "WEST" and "EAST" in respective places.
!AP"EAST"	

Command	Explanation
!AJ0	Rotates the printing axis back to horizontal.
!ABG0	Deletes the alpha slant.
!AX12,49	Moves to south of shed.
!ABH.75,.75	Scales subsequent alpha characters by 75% both in width and height.
!AP"Shed"	Prints "Shed".
!AX92,55	Moves to within the garage.
!AP"Garage"	Prints "Garage".
!AX8,10	Moves to SW corner of the lot.
!AJ0	Establishes the left printing margin at this pen location.
!AP"LOT"/13"104 x 64 feet"	Prints: LOT

104 X 64 feet

(Notice the CARRIAGE RETURN — ADE value of 13; Plotter must also have selected CR GENERATES LF on the Parameter Entry card.)

!AV	Resets all alpha parameters back to default.
!AX52,30	Moves to within the boundaries of the house.
!APHOUSE	Prints "HOUSE". (Since the text begins with an upper case alpha character, no quotes are necessary.)
!AAI;	Moves the pen to the "load position." The semicolon terminates this command since no other commands follow.

@

Section 4

FIRST TIME OPERATION THROUGH
THE SERIAL INTERFACE (PART 2)

This sequence of operations may be used to familiarize the first-time operator with the various functions of the Plotter, or it could be used as a general Plotter checkout procedure. Before this sequence is performed, the operator should complete the First Time Operation (Part 1). If a first-time operator's procedure is desired for a GPIB interface, refer to First Time Operation Through The GPIB Interface (Part 3).

These procedures are intended to provide familiarity with many of the various command sequences through first-hand experience. This will give the first-time operator some idea of the actions the Plotter will take in response to these commands. The familiarization procedures do not cover every possible command or sequence of commands, but rather provide a general overview of Plotter operation.

It may be helpful to refer to the description of each command encountered in this sequence. These descriptions are located in Section 3.

CR stands for Carriage Return (or RETURN). ESC (ESCAPE) may be CONTROL SHIFT K on some terminals. "Type ESC A V CR" means "press the ESCAPE KEY (or the sequence of keys which generate an ESCAPE character for that terminal), then press the A key, then the V key, and finally press the RETURN key."

NOTE

Throughout this manual, spaces are shown between adjacent characters. These are placed there for clarity in illustrating. However, in communicating with the Plotter, the host (or terminal) should not send any SPACE characters between characters unless requested by a SPACE (or SP).

1. Turn off the Plotter (if not already off).

2. Attach an ASCII terminal, such as a TEKTRONIX 4010 Series, 4006-1, or equivalent, to the serial port on the rear panel marked TERMINAL (refer to the Installation section).

3. Turn on both the Plotter and the terminal, and initialize the terminal if necessary (after a few seconds press PAGE on the Tektronix terminal to erase the screen). All familiarization commands should be issued from the terminal keyboard.

4. Set the following Plotter front panel switches (others should be off or ignored):

   A.   INTERFACE switches to ON-LINE LOCAL.

   B.   Select either PEN 1 or PEN 2 with the appropriate SELECT switch.

5. Set the Parameter Entry card switches as follows (other lines can be ignored):

   A.   PARAMETER SETUP SELECT — SETUP 1.

   B.   MEDIA FORM — set to SHEET unless the Plotter has the Media Advance Option, in which case set to ROLL.

   C.   INITIAL PAGE SIZE — set according to paper size used. If using standard roll paper, set at "C."

   D.   INITIAL PAGE MARGIN — DRAFTING.

   E.   PAGE ORIENTATION — HORIZONTAL.

   F.   INITIAL ASPECT RATIO — FULL PAGE.

   G.   INITIAL AXIS ORIENTATION — Leftmost Column.

   H.   LINE QUALITY — PREVIEW.

   I.   Next four lines (PEN PARAMETER ACCESS, PEN TYPE, PEN PRESSURE, and PEN VELOCITY LIMIT) should be set up for the type of pen used (refer to the Installing Pens description located in Section 2).

   J.   ALPHA CHARACTER QUALITY — NORMAL.

   K.   INTERFACE SELECT — Select the Serial Interface (if the Plotter initializes itself at this point, it will be necessary to momentarily push the Parameter Entry card fully in to turn off the INIT light before resuming).

   L.   INITIAL COMMAND/DATA FORMAT — 1.

        Then skip the next 3 lines.

   M.   SERIAL DEVICE ADDRESS — A.

   N.   TRANSMIT and RECEIVE BAUD RATE — set to match terminal.

O.   TRANSMIT BAUD RATE LIMIT — FULL SPEED.

P.   CHARACTER FORMAT — 8 BITS/CHAR and 1 STOP BITS.

Q.   RECEIVE PARITY/TRANSMIT PARITY — 3.

R.   COMMUNICATIONS CONTROL MODE — FULL DUPLEX

Ignore the next line.

S.   INTERFACE FUNCTIONS — CR GENERATES LF.

T.   ATTENTION CHARACTER — ESC.

U.   OUTPUT TERMINATOR — NONE.

Then push the Parameter Entry card back into the Plotter.

6. Issue the Plotter On command (type ESC A E CR). This command causes the Plotter to execute subsequent commands.

7. Type the following text and note that the characters (upper and lowercase) are printed starting in the HOME position (upper left corner) as transmitted (except upper case only with TEKTRONIX 4010 Terminal):

    4663 Interactive Digital Plotter CR

8. Repeat the text transmission.

9. To move the pen to a different location, transmit a Move command (type ESC A X 2050, 1500 CR). The pen carriage should move to the center of the paper (platen).

10. To draw a vector from this point to the upper right corner, transmit a Draw command (type ESC A Y 4000, 3000 CR). The Plotter should draw a diagonal line to near the upper right corner.

11. Transmit a Set Dash Pattern command. (Type ESC A BD 2,3 CR). This will establish a dash pattern similar to Figure 3-5A.

12. Establish the dash pattern length using the Set Dash Pattern Length command (type ESC A BS 100 CR). This means that for a vector 100 ADUs long, there will be a 40 ADU long dash.

13. To cause the Plotter to draw the dashed pattern line on the next vector, transmit a Select Line Type command with a dash line selection (type ESC A BL 2 CR).

14. Type ESC A Y 4000, 100 CR. The Plotter will draw a dashed line down the right edge.

15. To reset the Plotter back to drawing solid line vectors, type ESC A BL 0 CR.

16. Transmit a Move command to move the pen to near the left edge and down from the top (type ESC AX 0, 2000 CR).

17. Type any uppercase alphabetic character two or three times. The Plotter should print those characters. Do not type a RETURN.

18. The size of the alphanumeric printing can be changed by transmitting an Alpha Size command (type ESC A BZ 70, 100 CR).

19. Then type the same alphabetic key in the same manner as in Step 17 above. Do not type a RETURN. The printed characters should be approximately twice as large as those printed in Step 17.

20. Set the Alpha Parameters back to default (type ESC A V CR).

21. Type one or two alphabetic characters and confirm that the printed characters are the same size as those printed in Steps 7, 8, or 17.

22. The Alpha Ratio command affects the character-to-character distance (based upon the character width) and the line-to-line spacing (based upon the character height). Type ESC A BI 2.6,3.2 CR.

23. Once again type two or three alphabetic characters (as in Steps 17 and 19). The Plotter should print characters of the default size, but which are printed approximately twice as far apart.

24. Press RETURN and continue to type three or four of the same alphabetic characters. Notice that the line-to-line spacing is approximately twice that noticed in Steps 7 and 8.

25. To go back to the original character size, transmit a Reset Alpha Parameter command (type ESC A V CR).

26. Type two or three alphabetic characters (with no RETURN as in Steps 17, 19, and 21) and verify that they are the default size (compare to Step 7).

27. To alter the X and Y scaling factors, transmit a Set Scale command (type ESC A BH 1.5, 2 CR).

28. Type two or three alphabetic characters (with no RETURN) and notice that the characters are printed such that their width is 50% wider (multiplied by 1.5) and their height is 100% higher (multiplied by 2).

29. To go back to the default scaling factors, transmit another Set Scale command with magnification factors of 1,1 (type ESC A BH 1,1 CR).

30. Type two or three alphabetic characters (with no RETURN) to verify that the characters are being printed in their default size.

31. To cause the Plotter to write with the other pen, transmit a Select Pen command (type ESC A BP 2 CR). The PEN SELECT 1 light should go off and the PEN SELECT 2 light should come on.

32. To write at an angle other than horizontal (for example 45°), transmit a Set Rotate command (type ESC A J 45 CR).

33. Type three or four alphabetic charcters (with no RETURN) and notice that they are being printed along a line diagonal (45° angle) across the paper.

34. A right margin can be established, even when printing along this angle, by transmitting a Set Right Margin command (type ESC A BR 10 CR).

35. Continue to type about 25 alphabetic characters (with no RETURNs) and notice that when the 10th character has been typed, the Plotter automatically executes a CARRIAGE RETURN and a LINE FEED and starts printing on the next line. Also notice that both margins (left and right) are perpendicular to the printing axis (which in this case is at a 45° angle).

36. The printed characters can also be slanted by transmitting a Set Slant command (type ESC A BG 45 CR).

37. Type three or four more alphabetic characters (with no RETURN) and notice that these characters, although printed along the 45° angle printing axis, are further slanted to the right 45° also.

38. To reset the Alpha parameters, type ESC A V CR.

39. To select one of the other resident fonts, transmit a Select Standard Font command (type ESC A T 2 CR).

40. Then type as many of the following characters, shown as Font 0, as your terminal permits and notice that the printed characters should appear like those of the second line following (Font 2):

Font 0   #   0   @   [\   ]   ∧   { | }

Font 2   £   0   @   Ä   Ö   Ü   ∧   ä   ö   ü

41. Type the ASCII character BEL (CONTROL G on some terminals). Notice that the speaker sounds.

42. If the pen is not along the left margin, type the ASCII character BS (CONTROL H on some terminals). Notice that the pen carriage moved one character space back.

43. Type the ASCII character LF (CONTROL J on some terminals). Notice that the pen carriage moved one line space down.

44. To move a given number of character spaces in any direction, type a Character Move command (type ESC A AM 2, −1 CR). The pen carriage should move two character spaces to the right and down one line space.

45. To cause the Plotter to print with equal spacing between the characters, transmit an Alpha Spacing Control command (type ESC A AJ 1 CR).

46. Type a few characters (with no RETURN) and notice that the spacing between the characters is different from that previously typed.

47. To reset all of the alpha parameters back to their default values, type ESC A V CR (as in Steps 20 and 25).

48. Type a few characters (with no RETURN) to verify that the Plotter is printing default sized characters along a horizontal printing axis.

49. To move the pen, transmit a Move command (type ESC A X 0,0 CR).

50. To illustrate some of the Transform commands, we will first draw a square box and then modify it with some of the transform commands. To draw the box, transmit the following Move and Draw commands:

ESC A Y 500, 0 CR (this will set up a reference line to the box)

ESC A Y 1000, 0 CR

ESC A Y 1000, 500 CR

ESC A Y 500, 500 CR

ESC A Y 500, 0 CR

A box with 500 ADU sides should be drawn with its lower left corner 500 ADUs to the right of the viewport origin.

51. Before altering the default transform matrix, it is necessary to save a copy of it in RAM storage. If this is not done, each subsequent transform modification will modify the existing transform matrix creating an effect that may be unpredictable. Also, it may be nearly impossible to recreate the default without resetting the instrument. To save the present (default) transform, transmit a Save Current Transform (type ESC A AX CR).

52. To change the X-Y scaling factors for subsequent graphing, transmit a Set Scale command (type ESC A AS 2,3 CR).

53. Now, retransmit the commands in Steps 49 and 50 above. Notice that this box is twice as wide and three times as high as the first box and is displaced to the immediate right of the first box. The lower left corner of both boxes is 500, 0, but 500 on the X axis after rescaling (when drawing the second box) begins twice as far out from the origin as when drawing the first box.

54. To restore the default transform matrix and delete this scaled transform matrix, transmit a Restore Previous Transform command (type ESC A AY CR). This command also clears the RAM storage where the default transform matrix was previously stored.

55. Now, it is again necessary to save a copy of this present (default) transform matrix (type ESC A AX CR).

56. To rotate the axes of the viewport 40°, transmit a Set Rotation command (type ESC A AR 40 CR).

57. Then retransmit the commands in Steps 49 and 50 above. Notice that the box is redrawn in reference to an axis coordinate system that is rotated conterclockwise by 40°.

58. To restore the default transform matrix again and delete this rotated transform matrix, type ESC A AY CR.

59. To set the viewport (not using the front panel controls or the Parameter Entry card), transmit a Set Viewport command (type ESC A AV 2500, 4000, 100, 1500 CR).

60. To outline this new viewport, transmit a Outline Viewport command (type ESC A CB CR). You can also press the OUTLINE VIEWPORT front panel switch to accomplish the same thing.

61. Then retransmit the commands in Steps 49 and 50 above. Notice that a smaller version of the box appears in the viewport outline. Although the new viewport is now smaller than the default, all 4096 addressable points along the default viewport X axis are still available in this new viewport. Likewise, the 3023 Y axis addressable points are still available in the new viewport.

62. To delete the new viewport transform matrix, pull the Parameter Entry card out to the Initial Page Size line and press the switch over the size initially set up in Step 5 earlier.

NOTE

Even though that switch's light will still be on, you must press this switch at this time. The default viewport then becomes the same as the page size.

63. To turn the PROMPT light on (the POINT switch light), transmit a Prompt Light On command (type ESC A K CR). The POINT switch light should start blinking.

64. To turn the PROMPT light off, transmit a Prompt Light Off command (type ESC A L CR).

65. The X axis of the joystick can be disabled by transmitting a Joystick Disable command and specifying an X axis disable (type ESC A BJ 1 CR).

66. Move the front panel joystick around and notice that the joystick only causes the pen to move along the Y axis. This command could be used, for example, to digitize the Y coordinates of a graph at known X axis locations.

67. Both axes of the joystick are again enabled anytime the host repositions the pen or another Joystick Disable command is given, specifying that neither axis be disabled (type ESC A BJ 0 CR).

68. Leave the pen positioned somewhere near the center of the default viewport. Remember that the Plotter is now operating with the default viewport and the small viewport created in Steps 59-61 has been deleted with Step 62.

69. Pull the Parameter Entry card out to the INITIAL COMMAND/RESPONSE FORMAT line and press the switch above 2 (the second switch from the left).

70. The terminal will print the Plotter's pen coordinates in ADUs (0-4095 in the X axis and 0-3023 in the Y axis) if an Immediate GIN command is transmitted (type ESC A M CR). Notice that the numbers are in scientific notation.

71. Move the pen with the joystick and transmit another Immediate GIN command (type ESC A M CR). The new pen coordinates should be printed on the terminal screen.

This completes the familiarization procedure (Part 2) for the Serial Interface commands. If the operator desires to familiarize himself with the operating commands using the GPIB interface, proceed to First Time Operation Through The GPIB Interface (Part 3), which is located in Section 5.

Section 5

FIRST TIME OPERATION THROUGH THE GPIB INTERFACE (PART 3)

This section contains a sequence of operations which may be used to familiarize an operator with the various functions of the Plotter using the GPIB interface. These procedures may also be used as a general Plotter checkout procedure. A detailed description of the communications protocol and formats required for operation of the GPIB interface is covered under Plotter Communications (Section 6).

Before this sequence is performed, the operator should complete the First Time Operation (Part 1). If a first-time operator procedure is desired for a serial interface, refer to the First Time Operation Through The Serial Interface (Part 2).

These procedures are intended to provide familiarity with many of the various command sequences through first-hand experience. This will give the first-time operator some idea of the actions the Plotter will take in response to these commands. The familiarization procedures do not cover every possible command or sequence of commands, but rather provide a general overview of Plotter operation.

It may be helpful to refer to the description of each command encountered in this sequence. These descriptions are located earlier in this section.

For Hewlett Packard terminals, the operator should select 2, 4, or 6 on the INITIAL COMMAND/RESPONSE FORMAT Parameter Entry card line. TEKTRONIX 4050 Series terminals, on the other hand, use 1, 3, or 5.

The following procedure will use a TEKTRONIX 4050 Series terminal; it is assumed that it is already connected and powered up. If another terminal is used, the operator should refer to that terminal's manual for transmitting the following address and DAB command sequences.

As much as possible, DAB commands will be used in this procedure. The operator must be aware, however, that in many cases, MSA commands could be used, and in some cases, they may even be faster to enter.

1. Turn on the power to the 4663 Plotter and wait for it to initialize.

2. Pull the Parameter Entry card out slowly one line at a time and make the following line selections, unless already active (light is on above that selection):

   PARAMETER SETUP SELECT — SETUP 1

   MEDIA FORM — Use SHEET unless the Plotter is equipped with Media Advance Option 36. Load the paper at this time.

   INITIAL PAGE SIZE — C

   INITIAL PAGE FORMAT — DRAFTING

   PAGE ORIENTATION — HORIZONTAL

   INITIAL ASPECT RATIO — FULL PAGE

   INITIAL AXIS ORIENTATION — Column 1

   LINE QUALITY — PREVIEW

   Next four lines (PEN PARAMETER ACCESS, PEN TYPE, PEN PRESSURE, and PEN SPEED LIMIT) should be set up for the type(s) of pens used (refer to Installing Pens description located in Section 2).

   ALPHA CHARACTER QUALITY — NORMAL

   INTERFACE SELECT — Select the GPIB Interface. The Plotter will reinitialize. Then push the Parameter Entry card fully in momentarily (to turn off the INIT light) before continuing.

   INITIAL COMMAND/RESPONSE FORMAT — Column 1 unless the terminal is a Hewlett Packard; then use Column 2.

   GPIB DEVICE ADDRESS — 1

   INTERFACE MODE — NORMAL

   INTERFACE FUNCTIONS — CR GENERATES LF

   The remainder of the Parameter Entry card may be ignored for now.

NOTE

In the following procedure, CR stands for CARRIAGE RETURN or RETURN keyboard key.

NOTE

In the following procedure, CTRL stands for the CONTROL key on the terminal keyboard used to activate an ASCII control character. Type PRINT @ 1,32: "PCTRL H" CR means enter PRINT @ 1,32: "P from the keyboard, then while holding the keyboard CONTROL key down, press the uppercase H key, and finally finish with" and CARRIAGE RETURN.

3. Set the INTERFACE function switches to ON-LINE REMOTE (both INTERFACE lights on).

4. Enter the following sequences from the terminal keyboard to cause the pen carriage to move to the HOME position (near the upper-left corner of the platen):

    PRINT @ 1,32:"AH" CR

5. Type the following sequence from the keyboard:

    PRINT @ 1:"4663 Interactive Digital Plotter" CR

The alphanumeric text within the quotes should be printed, followed by a carriage return and line feed.

6. Type the following sequence from the keyboard (Device Identify command):

    PRINT @ 1,32:"I" CR

    INPUT @ 1,32:A,B,C CR

    PRINT A, B, C CR

The terminal screen should print:

| 4663 | A number whose integer after dividing by 256 equals the number of Kbytes of RAM available. | 2 (which is the the end of block messasge) |

7. Type the following sequence from the keyboard (Read Viewport command):

    PRINT@1,32:"CV" CR

    INPUT@1,32:X1, X2 CR

    INPUT@1,32 Y1, Y2 CR

    PRINT X1, X2, Y1, Y2 CR

The terminal will print:

    0   135.484   0   100

This sequence gives the boundaries of the Plotters viewport. The result gives the lower left X coordinate (0), the upper right X coordinate (135.484), the lower left Y coordinate (0), and the upper right Y coordinate (100). Therefore, the Plotter's viewport ranges from 0 to 135.484 on the horizontal X axis and from 0 to 100 on the vertical Y axis.

8. Type the following sequence from the keyboard:

    PRINT@ 1,32:"M0,0" CR

The pen carriage should move to the lower-left corner of the platen.

9. Enter the following commands:

    PRINT@1,32:"D0,100" CR

    PRINT@1,32:"D130,100:" CR

    PRINT@1,32:"D130,0" CR

    PRINT@1,32:"D0,0" CR

A box should be drawn.

10. Type the Set Dash Pattern command (type PRINT@1,32:"BD2,3" CR). This will establish a dash pattern similar to Figure 3-5A.

11. Establish the dash pattern length using the Set Dash Pattern Length command (type PRINT@1,32:"BS10"CR). This means that for a vector 10 GDUs long, there will be a 4 GDU long dash and a space 6 GDUs long.

12. To draw the dashed pattern line on the next vector, transmit a Select Line Type command with a dash line selection (type PRINT@1,32:"BL2" CR).

13. Type PRINT@1,32:"D130,100" CR. The Plotter will draw a dashed line diagonally across the platen to the upper right corner.

14. To reset the Plotter back to drawing solid line vectors, type: PRINT@1,32:"BL0" CR

15. Move the pen carriage near the left margin slightly down from the top (type PRINT@1,32:"M0,80" CR).

16. Print any upper case character (such as R) several times (type PRINT@1,32: "PRRRR" CR).

17. The size of the alphanumeric printing can be changed by transmitting an Alpha Size command (type PRINT@1,32:"BZ3,5" CR).

18. Repeat Step 16. The printed characters should be approximately three times as large as those printed in Step 16.

19. To set the Alpha Parameters back to default, type PRINT@1,32:"A" CR.

20. The Alpha Ratio command affects the character-to-character distance (based upon the character width) and the line-to-line spacing (based upon the character height). Type PRINT@1,32:"B12,6,3.3" CR.

21. Once again type two or three alphabetic characters (as in steps 16 and 18). The Plotter should print characters of the default size, but which are printed approximately twice as far apart.

22. Again transmit two or three alphabetic characters (as in Step 21 above). Notice that the line-to-line spacing is approximately twice that as noticed in Steps 16 and 18.

23. To go back to the original (default) character size, transmit a Reset Alpha Parameter command (type PRINT@1,32:"A" CR).

24. Transmit two or three alphabetic characters and verify that they are printed in the default size and spacing (repeat Step 16 and compare).

NOTE

If the pen carriage reaches the bottom of the paper in the remaining sequence, the operator can simply change media (refer to instructions on Loading Paper earlier in this section), and continue with these procedures.

25. To alter the X and Y scaling factors, transmit a Set Scale command (type PRINT@1,32:"BH1.5,2" CR).

26. Transmit 2 or 3 alphabetic characters. The characters are printed 1.5 times wider and twice as high.

27. To go back to the default scaling factors, transmit another Set Scale command with magnification factors or 1,1 (type PRINT@1,32:"BH1,1" CR).

28. Repeat step 26.

29. To cause the Plotter to write with the other pen, transmit a Select Pen command (type PRINT@1,32:"BP2" CR). The PEN SELECT 1 light should go off and the PEN SELECT 2 light should turn on.

30. To write at an angle other than horizontal (for example 45 degrees), transmit a Set Rotate command (type PRINT@1,32:"R45" CR).

31. Type PRINT@1,32:"PRRRR" CR. Notice that the characters are being printed along a line diagonal (45 degree angle) across the paper.

32. A right margin can be established, even when printing along this angle by transmitting a Set Right Margin command (type PRINT@1,32:"BR10" CR).

33. Type about 25 alphabetic characters in a row with a PRINT@1,32: "PXXXXXXXXXXXXXXXXXXXXXXXXX" CR. Notice that when the tenth and twentieth characters have been typed, the plotter automatically executes a CARRIAGE RETURN and a LINE FEED and starts printing on the next line. Also notice that both margins (left and right) are perpendicular to the printing axis (which in this case is at a 45° angle).

34. The printed characters can also be slanted by transmitting a Set Slant command (type PRINT@1,32:"BG45" CR). The 45 is the angle of the character slant.

35. Type several more characters with a PRINT@1,32:"PXXXXX" CR.

36. To reset the Alpha Parameters, type PRINT@1,32:"A" CR.

37. To select another of the resident fonts, transmit a Select Standard Font command (type PRINT@1,32:"F2" CR).

Font 0   # 0 @ [\ ] ∧ { | }

Font 2   £ 0 @ Ä Ö Ü ∧ ä ö ü

(type PRINT@1,32:"#0 @ [\ ] ∧ { | }

38. Then type as many of the following characters, shown as Font 0, as your terminal permits and notice that the printed characters appear like those of the second line (Font 2):

Font 0   # 0 @ [\ ] ∧ { | }

Font 2   £ 0 @ Ä Ö Ü ∧ ä ö ü

(type PRINT @ 1,32:"P # 0 @ [\ ] ∧ { | }"CR

39. Transmit the ASCII character BEL (CONTROL G on some terminals) by typing PRINT@1,32:"PCTRL G" CR. Notice that the speaker sounds.

40. To move a given number of character spaces in any direction, type a Character Move command (type PRINT@1,32:"AM3,2" CR). The pen carriage should move three character spaces to the right and up two lines.

41. To transmit an ASCII BS (backspace), which may be a CONTROL H on some terminals, type PRINT@1,32:"PCTRL H" CR. Notice that the pen carriage moved one character space back (to the left).

42. Transmit the ASCII character LF (CONTROL J on some terminals) by typing PRINT@1,32:"PCTRL J" CR. Notice that the pen carriage moved one space down.

43. To cause the Plotter to print with equal spacing between the characters, transmit an Alpha Spacing Control command (type PRINT@1,32:"AJ1" CR).

44. Type a few characters (type PRINT@1,32:"PXXXX" CR) and notice that the spacing between the characters is different than those typed in previous steps.

45. To reset all of the Alpha Parameters back to their default values, type PRINT@1,32:"A" CR.

46. To move the pen, transmit a Move command (type PRINT@1,32:"M0,0" CR).

47. To illustrate some of the Transform commands, we will first draw a square box and then modify it with some of the transform commands. To draw the box, transmit the following Draw commands:

 PRINT@1,32:"D25,0" CR (this will set up a
 reference line to the box)

 PRINT@1,32:"D50,0" CR

 PRINT@1,32:"D50,25" CR

 PRINT@1,32:"D25,25" CR

 PRINT@1,32:"D25,0" CR

 A box with 25 GDU sides should be drawn with its lower left corner 25 GDUs to the right of the origin.

48. Before altering the default transform matrix, it is necessary to save a copy of it in RAM storage. If this is not done, each subsequent transform modification will modify the existing transform matrix, creating an effect that may appear to be unpredictable (it really isn't) and it may be difficult to recreate the default transforms without careful analysis or resetting the instrument. To save the present (default) transform, transmit a Save Current Transform command (type PRINT@1,32:"AX" CR).

49. To change the X-Y scaling factors for subsequent graphing, transmit a Set Scale command (type PRINT@1,32:"AS2,3" CR).

50. Now, retransmit the commands in Steps 46 and 47 above. Notice that this box is twice as wide and three times as high as the first box and is displaced to the immediate right of the first box. The lower left corner of both boxes is 25,0, but 25 on the X axis after rescaling (when drawing the second box) begins twice as far out from the origin as when drawing the first box.

51. To restore the default transform matrix and delete this scaled transform matrix, transmit a Restore Previous Transform command (type PRINT@1,32:"AY" CR). This command also clears the RAM storage of the default transform matrix previously stored.

52. Now it is again necessary to save a copy of this present (default) transform matrix (type PRINT@1,32:"AX" CR).

53. To rotate the axes of the viewport 40°, transmit a Set Rotation command (type PRINT@1,32:"AR40" CR).

54. Then retransmit the commands in Steps 46 and 47 above. Notice that the box is redrawn in reference to an axis coordinate system that was rotated counter-clockwise by 40 degrees.

55. To restore the default transform matrix again and delete this rotated transform matrix, type PRINT@1,32:"AY" CR.

56. To set the viewport (not using the front panel controls or the Parameter Entry card), transmit a Set Viewport command (type PRINT@1,32:"AV75,120,15,85" CR).

57. To outline this new viewport, transmit an Outline Viewport command (type PRINT@1,32:"CB" CR). You can also press the OUTLINE VIEWPORT front panel switch to accomplish the same thing.

58. Retransmit the commands in Steps 46 and 47 above. Notice that a smaller version of the box appears in the viewport outline. Although the new viewport is now smaller than the default, all 100 addressable points (in GDUs) along the shortest axis are still available in this viewport.

59. To delete the new viewport transform matrix, pull the Parameter Entry card out to the INITIAL PAGE SIZE line and press the size initially set up in Step 2 above.

NOTE

Even though that switch's light is still on, you must press this switch at this time to cause the default viewport to be reestablished. The default viewport then becomes the same as the page size (if using a FULL PAGE Initial Aspect Ratio).

60. To turn the PROMPT light on (the POINT switch light), transmit a Prompt Light On command (type PRINT@1,32:"T1" CR). The POINT switch light should start blinking.

61. To turn the PROMPT light off, transmit a Prompt Light Off command (type PRINT@1,32:"T0" CR).

62. The X axis of the joystick can be disabled by transmitting a Joystick Disable command and specifying an X axis disable (type PRINT@1,32:"BJ1" CR).

63. Move the front panel joystick around and notice that the joystick only causes the pen to move along the Y axis. The command could be used, for example, to digitize the Y coordinates of a graph at known X axis locations.

64. Both axes of the joystick are again enabled anytime the host repositions the pen or by transmitting another Joystick Disable command and specifying that neither axis be disabled (type PRINT@1,32:"BJ0" CR).

65. Leave the pen positioned somewhere near the center of the default viewport. Remember that the Plotter is now operating with the default viewport, and the small viewport created in Steps 56-58 has been deleted with Step 59.

66. The terminal will print the coordinates of the crosshair cursor in GDUs, if an immediate GIN command is processed. Type the following sequence:

    PRINT@1,32:"G" CR

    INPUT@1,32:X,Y,Z CR

    PRINT X,Y,Z

    The screen will print three numbers in scientific notation E format giving the X and Y coordinates and a 2 if the Plotter's pen is up or a 3 if the pen is down.

67. Move the pen carriage with the joystick and transmit the same sequence as in the step above. The new pen coordinates should be printed on the screen.

68. Change paper.

This completes the familiarization procedure (Part 3) for the GPIB Interface commands. If you want to familiarize yourself with the operating commands using a serial interface, proceed to First Time Operation Through the Serial Interface (Part 2), which is located in Section 4.

Section 6

PLOTTER COMMUNICATIONS

ABOUT THIS SECTION

This section describes the details and requirements for communications between the Plotter and a host computer. Included in this section is a description of the communications protocol and formats required while using either the serial interface or the optional GPIB interface. It must be understood that while the standard Plotter is equipped with an RS-232-C interface, the serial descriptions included in this section can be assumed to be representative of any optional serial interface (TTY or 20/60 mA current loop).

SERIAL INTERFACE

General Communications Characteristics

The Plotter incorporates hardware and internal firmware together to provide interfacing with a wide variety of communications equipment. This ranges from remote communications, wherein the Plotter communicates to a host via a modem, to communications with a local minicomputer via hardwired lines. In general, the Plotter will support flagged and full duplex hardware-type control protocols. The Plotter can also support software full duplex or software half duplex (using prompts) control protocols. In addition, the serial interface will accept commands and data in several different formats, including Packed Binary format (used by TEKTRONIX 4010 Series and 4006 Computer Display Terminals) and an expanded ASCII decimal format.

Interface Connection

The serial interface uses two connectors. One is labeled MODEM or HOST (for connection to a modem or local host computer), and the other is labeled TERMINAL (for a connection to a terminal). The two connections then provide a "loop through" capability to allow the Plotter (and other peripheral devices) to be "chained" together between the data terminal and either the modem or the host computer. Communications data routing through the Plotter is controlled by the front panel INTERFACE switches (refer to the description of these switches in Section 2). The connector labeled TERMINAL is wired to appear as an active modem, while the connector labeled MODEM is wired to appear as an active terminal. This means that all of the pins in each connector are wired identically except for RECEIVE DATA (RDATA) and TRANSMIT DATA (TDATA) which are reversed. This arrangement allows the Plotter to be used alone with a modem (or host computer) or alone with a terminal. However, TTY has some other differences — see Appendix B. In addition, the following RS-232-C communication control lines are pulled active (high) when the power is on:

REQUEST TO SEND

CLEAR TO SEND

DATA TERMINAL READY

DATA CARRIER DETECT

DATA SET READY

PROTECTIVE GROUND is tied to the chassis and may be connected to logic (or SIGNAL COMMON) through an optional resistor or strap. Appendix B shows diagrams of the serial interface connectors available.

Host to Plotter Communications

Section 3 describes the 4663 Plotter commands. These commands can be separated into two general groups. The first group contains the interface commands. These commands are executed as soon as they are received by the Plotter. The second group contains all other commands (Transform, Alpha, Graph, GIN, and Device). These commands are converted into an internal form and stored in the Plotter's input buffer. They are then retrieved from the input buffer and processed on a first-in first-out basis. The host, therefore, must be aware of the command storage requirements and transmit accordingly to keep from exceeding the available buffer storage.

Generally, the storage requirements for each command is as follows. Each control or parameter setting command, alpha character or print command argument character, graphic move, draw, arc, or circle command becomes an internal command. Each of these internal commands requires two bytes of storage, plus one byte for a character argument or plus five bytes for each numeric argument.

This means that the range of storage requirements for a command can be from 2 to 22 bytes. The average alpha command may be around 3 bytes, while the average graphic command may be approximately 12 bytes.

The Plotter's RAM storage can be used to store transform matrices, programmable macros, and downloadable character sets as well as being used as an input buffer.

Several means can be employed to control the host's input to the Plotter. These include:

Continuous Mode at a low data transfer rate

Hardware Flagging

Software Flagging (DC1/DC3 Control)

Block Mode

Continuous Mode using a low data transfer rate to prevent input buffer overflow is perhaps the least desirable transfer means, since the time to execute commands is quite variable. This time depends upon many factors, including the combinations of the front panel control settings. In this mode, an attempt is made to transmit commands no faster than the Plotter is able to execute them. Unless any of the other three modes are chosen, the Plotter is automatically initialized to continous mode after being activated by a Device On command.

If the Plotter is directly connected to a host, a hardware flagged mode of operation can be used to control the host's input to the Plotter. Operating in this mode, the Plotter will activate the DATA READY RS-232-C Interface control line when at least 172 bytes of storage are available and will deactivate this line when the storage is within 136 bytes of being full.

Software flagging means that an ASCII DC3 (STOP READ) control character is sent to the host computer to stop the host's transmission when the storage is within 136 bytes of being full. Later, when the stored commands have been processed so that more than 172 bytes can be stored, an ASCII DC1 (START READ) control character is sent to the host computer to restart the data transmission.

Perhaps the best method to send data to the Plotter is with Block Mode. In this mode, the host sends a block of Plotter commands, preceded by a Block Start command and followed by a Block End command (with or without a checksum value). The host then pauses to acknowledge input from the Plotter. If the checksum was good and when there is room in the input buffer for another block, the Plotter responds with a positive Block Acknowledge ("A"); another block may then be sent. If the checksum is bad, the block is discarded and a negative Block Acknowledge ("I") is sent immediately. At this time the front panel ERROR light is turned on (including the Parameter Entry lights), and the Plotter's bell is rung (unless there has been a prior error that has not been cleared). The host then retransmits the "bad" block; if it is accepted, the positive Block Acknowledge response is sent as usual when there is room for another block. Notice that the error lights stay on, however. If the block checksum is omitted from the Block End command or is 0, the positive Block Acknowledge response is sent as soon as sufficient storage is available without checking the checksum. Additionally, if after the positive acknowledge is sent, the processing of commands already in the buffer requires additional storage, there may be insufficient storage remaining for the next block. If this occurs, the next block will be discarded and the interface will again wait for sufficient storage before sending a negative Block Acknowledge to the host computer, causing the host computer to retransmit the discarded block. If the checksums are specified in the Block End command, the checksum is computed and compared with the Block End message. If the checksums do not agree, the block is discarded and a negative Block Acknowledge is sent to the host computer to retransmit the block.

Block mode is entered by a Block Start command and is terminated by a Device On or Device Off command to reestablish continuous mode. Activation of the front panel INIT function will also terminate block mode.

> **CAUTION**
>
> *Care must be exercised when transmitting Interface commands which set communication control parameters within blocks. These commands are executed immediately and will apply to the processing of the current block even if that block is discarded because of an error.*

Since Block Mode communication causes output to be sent to the host, all communication parameters should be sent to the Plotter in Continuous Mode before Block Mode is initiated. These include Prompt Character, Turnaround Delay, Bypass Cancel Character and Block Size. This will ensure that all transmissions to the host will be sent in the form expected by the host (including a negative Block Acknowledge sent in response to the first block of a Block Mode transmission that contains an error). The use of these parameters governing transmission to the host are described in the Plotter-to-Host Transmission description.

Between a Block End command and the next Block Start command, only the Plotter Off command and the Reset or Plotter On commands (used to change to Continuous Mode) or a Prompt character are acted upon. All other commands above are ignored.

Implied and Explicit Commands

All messages sent from the host computer to the Plotter consist of either implied or explicit commands. The following paragraphs describe each.

Implied Commands (General). The implied commands are of the form used by TEKTRONIX 4010 Series terminals. This command form provides an efficient subset of commands, which can be used to request a Print, Move, Draw, Arc, or Circle. The implied commands use the concept of Alpha, Graph, and Last Character Escape (LCE) modes as shown in Figure 6-1. In Alpha mode, which is the default mode at power-up or after an ASCII US character has been received, all characters received are interpreted as Print command arguments as if a Print command has been received. On the other hand, if an ASCII GS character is received, the mode changes to Graph and any following characters are interpreted as Move/Draw command arguments in HIY, LOY, HIX, LOX format (described later). The first argument set received after entering Graph mode is assumed to be a Move command argument unless it is preceded by an ASCII BEL character. All subsequent argument sets are then assumed to be Draw command arguments. If Option 31 is present and operating in Graph mode, the receipt of S1 and S0 characters will cause any subsequent arguments to be interpreted as mid/end point and radius values for arcs and circles respectively.

Whenever the current Attention (ATN) character (chosen from the Parameter Entry card) is received, either Alpha or Graph LCE mode is activated. In these modes, attention commands (explicit commands described later) are recognized and executed. However, at the completion of the command, the previous Alpha or Graph mode is reactivated.

Implied Graph Commands. Arguments for implied Move/Draw commands are sent coded in a packed binary format as a series of bytes. This coding scheme allows 16-bit coordinates of 10, 12, 14, or 16-bit resolution to be transmitted. Different TEKTRONIX 4010 Series terminals use different resolutions: 4010, 4012, and 4013 use 10 bits, while the 4014 and 4015 use 12 bits. However, each of these terminals will accept greater resolution (greater number of bits), even though they might not use them. The Plotter assumes 4014 (12-bit) resolution which interprets the 16-bit maximum coordinate as follows:
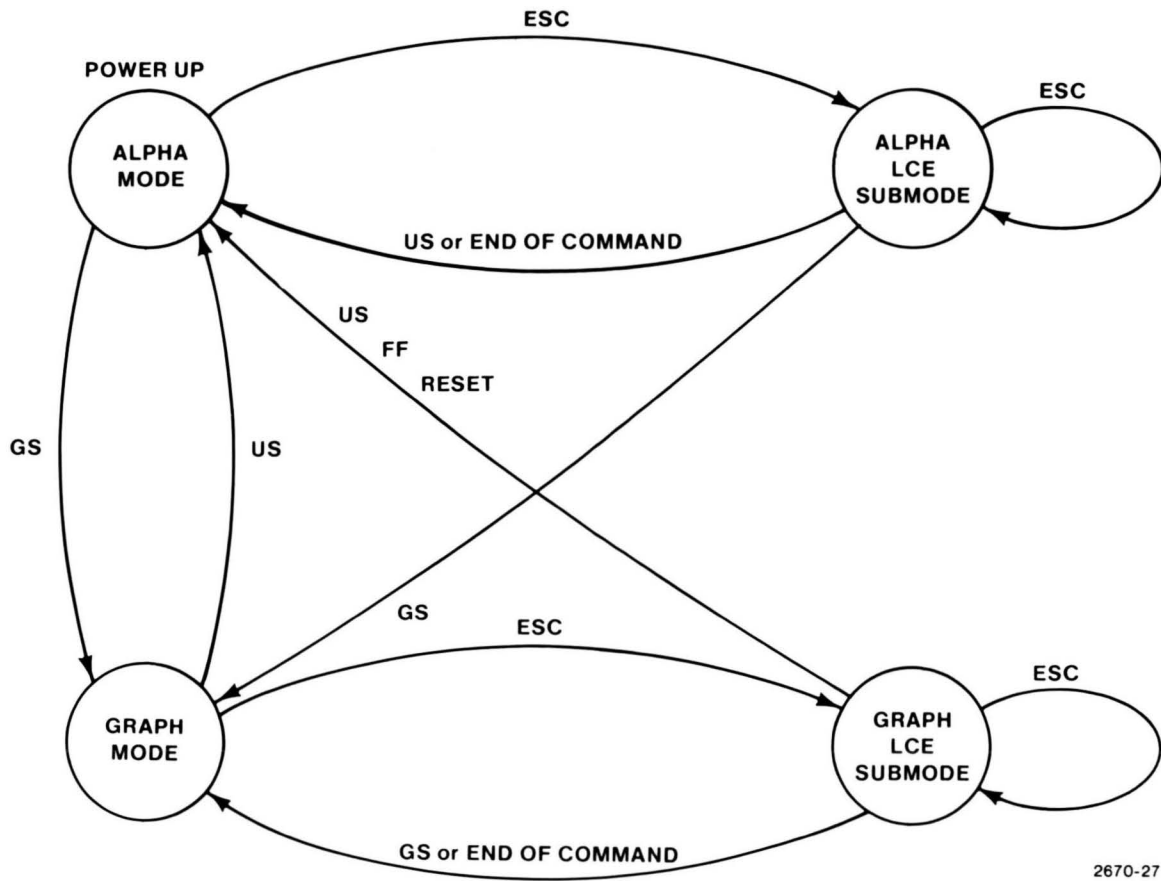
Figure 6-1. Implied Command Processing Modes.

Integer Bits   Fractional Bits

15 14 13 12 11 10 9 8 7 6 5 . 3 2 1 0

Implied binary point
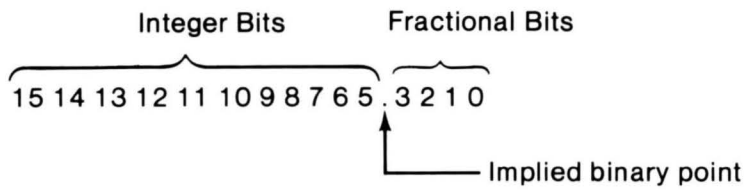
This means that the packed binary coding scheme allows coordinates to range from 0 to 4095 (in ADUs) with a resolution determined by the number of fractional bits transmitted as shown below:

Fractional Bits	Coordinate Bits	Resolution
0	10	4
1	12	1
2	14	.25
3	16	.0625

The data coding for a 16-bit X-Y coordinate pair is defined in Table 6-1. All seven bytes are required (in the order shown) to specify a 16-bit coordinate pair with maximum resolution. However, if less resolution is required or if some bits do not change, some of the bytes do not need to be sent. For example, with 10-bit data, only the HIY, LOY, HIX, and LOX bytes need to be sent. Notice that by dropping the low order bits, the resolution is decreased.

As these coordinate bytes are received, they are entered into a graph memory which is then referenced to assemble the resulting Move/Draw command. This graph memory allows complete coordinates to be specified with fewer bytes when some of the bytes have not changed from the last command. Parameters affecting shortened commands are shown in Table 6-2.

Table 6-1

PACKED BINARY COORDINATE CODING DEFINITION

Byte Number	Byte Name	7-Bit ASCII Character						
		Fixed Bits		Data Bits				
		6	5	4	3	2	1	0
1	High Order Y (HIY)	0	1	Y15	Y14	Y13	Y12	Y11
				5 most significant bits of Y				
2	Extra3 Byte (EEEB)	1	1	a Unused	Y01 Y00 2 lowest bits of Y		X01 X00 2 lowest bits of X	
3	Extra2 Byte (EEB)	1	1	a Unused	Y03 YO2 2 lower bits of Y		X03 X02 2 lower bits of X	
4	Extra1 Byte (EB)	1	1	a Unused	Y05 Y04 2 low bits of Y		X05 X04 2 low bits of X	
5	Low Order Y (LOY)	1	1	Y10	Y09	Y08	Y07	Y06
				5 intermediate bits of Y				
6	High Order X (HIX)	0	1	X15	X14	X13	X12	X11
				5 most significant bits of X				
7	Low Order X (LOX)	1	0	X10	X09	X08	X07	X06
				5 intermediate bits of X				

[a] Do not care

Table 6-2

INSTRUCTIONS FOR OPTIMIZED BINARY COORDINATE CODING

Bytes Desired To Be Changed	Bytes Which Must Be Sent						
	HIY	EEEB	EEB	EB	LOY	HIX	LOX
HIY	X						X
EEEB		X	X	X	X		X
EEB			X	X	X		X
EB				X	X		X
LOY					X		X
HIX					X	X	X
LOX							X

None of the extra bytes (EEEB, EEB, and EB) need to be sent if they are not required for the desired resolution. However, if any of the extra bytes are sent, an LOY byte must always be sent (even if this byte did not change). The extra bytes are included in the sequence in the following manner:

HIY, EEEB, EEB, EB, LOY, HIX, LOX

Figure 6-2 shows how the data bytes are related to graphing coordinates and the ranges of the data bytes in plotting. Appendix D gives a comprehensive table of the ASCII characters corresponding to various coordinate locations, and examples.
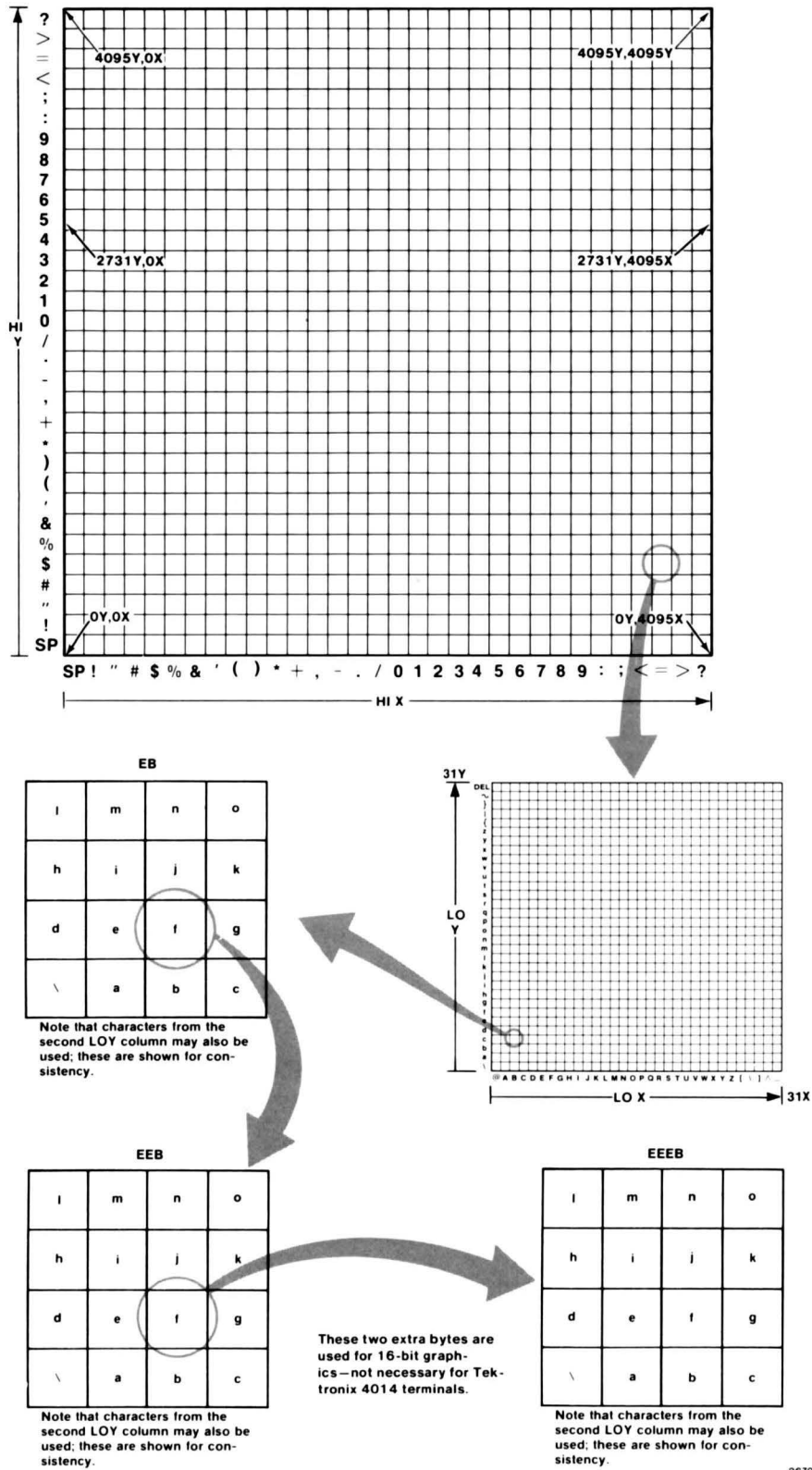
Figure 6-2. X-Y Coordinates (Showing the Increased Resolution Gained by the Extra Bytes).

Explicit (Attention) Commands. Explicit (or Attention) commands are commands which are initiated by an ATN character and followed by an address, the command op-code, and any necessary data (arguments) required. Almost all of the commands described in Section 3 are explicit commands. The ATN character is a designated character whose only function is to indicate the beginning of a command. This character must be selected from the Parameter Entry card (ATTENTION CHARACTER line). Choices are ESC, !,∧, or SYN. Thereafter, the programmer merely substitutes this character for the underlined ATN designation in the command format description in Section 3. After the ATN character, the programmer transmits the logical address for the Plotter (SERIAL DEVICE ADDRESS). Choices include the upper case characters A, B, C, D, E, F, G, and H. The programmer merely substitutes the chosen character for the underlined ADD designation in the command format descriptions in Section 3.

The command op-code identifies the desired command and may be of a single or double character form.

A special command delimiter is required to terminate the command (or series of commands) when no further commands are expected for some period of time or when it is desired to execute the command just after it is received. Command delimiters are semicolon (;) or carriage return (CR).

Normally the command delimiter is not processed further after terminating the command. However, for formats 3 and 4 there are no special command delimiters, and all delimiters are processed. But if such a delimiter is desired, an ASCII SOH character may be used because this character is ignored in subsequent command processing.

Normally, in a sequence of commands, the consecutive commands (and their arguments) are separated by using characters (delimiters) whose normal function is to separate arguments. The normal delimiter used for this purpose is either a space (SP) or comma. However, some commands (and these are noted in the command descriptions in Section 3) accept multiple groups of arguments. With these commands, multiple argument sets may be sent after the op-code to give the effect of multiple commands. For example:

$$\underline{ATN} \ \underline{ADD} \ YX0, \ Y0, \ X1, \ Y1, \ X2, \ Y2, \ldots \ldots Xn, \ Yn$$

will cause a line to be drawn to each of the specified coordinate points in succession. In this case, a space or comma can not be used to separate the last argument of one of these commands from the op-code of the next command, since the Plotter would be expecting another argument and not the op-code of a command. For this type of command, a different command terminator must be used (or the ATN character for the next command).

For commands requiring an argument, it is possible to omit a portion of the argument (NUL argument), but these "no specified arguments" must be either preceded or followed by an argument delimiter (SP or comma). The omitted argument then is assumed to be the default value of that parameter (in many cases 0). For example, D,100 would be interpreted as a draw to an X-Y coordinate location of 0,100. Similarly, D100, would be interpreted as a draw to an X-Y coordinate location of 100,0.

Plotter to Host Communications

Transmissions from the Plotter to the host are in response to commands requesting data. A complete response to a specific host computer command is called a message and is composed of control and/or data blocks. The output blocks are packed into output groups which vary from one block up to as many blocks as necessary to give a total number of characters of 64 or less (max size of the output buffer). Each output group is initiated with a signature character (specified with a previous command) and terminated by the previously selected OUTPUT TERMINATOR (Parameter Entry card). An output group may contain one or more messages, or a message may be divided into several output groups.

The assembling of the blocks into an output transmission and the initiation of the output transmission may be controlled to some extent by the transmission parameter commands. These are described following the discussion of the two types of blocks used in Plotter to Host communications.

Control Block

Control blocks are used for control functions where no data values are required. The only control block responses transmitted by the Plotter are the negative and positive Block Acknowledge characters (I and A) used in Block mode communications (see Host to Plotter Communications earlier in this section). These blocks are always one character in length and are encoded as shown below, regardless of the selection of the INITIAL COMMAND/RESPONSE FORMAT (Parameter Entry card).

    Bit Position   6 5 4   3   2 1 0

    Bit Value   1 0 C0 C1 0 0 1

The control bits (C0 and C1) are encoded as either:

0   0   Positive Block Acknowledge (ACK) giving the ASCII character A

0   1   Negative Block Acknowledge (NAK) giving the ASCII character I

Data Block

The data block format is used by the Plotter when responding to all other commands. This response, which can range from 7 to 32 characters in length (depending upon the data values and the current INITIAL COMMAND/RESPONSE FORMAT selection), consists of two data values along with a tag value (which could be used to specify a type attribute of the two data values).

Following is a description of the data blocks for each INITIAL COMMAND/RESPONSE FORMAT. This description can be used along with the description of the output data encoded for a particular command (see Interface Commands Section 3) to determine the actual byte format transmitted.

Format 1 — Unlabeled Binary Output

The Packed Binary format, which is shown in Figure 6-3, consists of seven consecutive ASCII characters. These are encoded as shown from two 16-bit numbers and three bits of tag information. The coding (defined more formally in Figure 6-4) uses only the ASCII characters SPACE to UNDERLINE (32 to 95) to permit communications by most host computer systems.
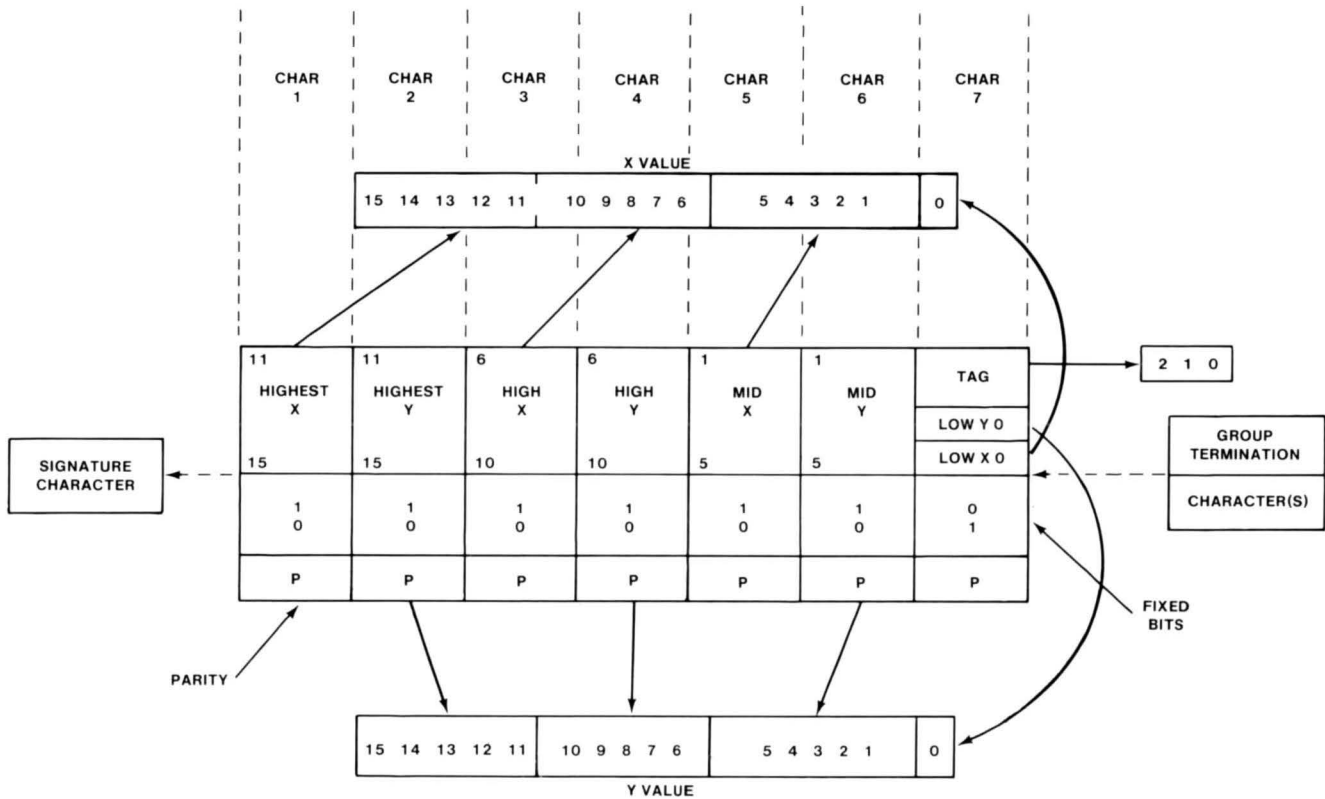
Figure 6-3. Packed Binary Response Block Format.

BYTE NUMBER	BYTE NAME	7-BIT ASCII CHARACTER						
		FIXED BITS		DATA BITS				
		6	5	4	3	2	1	0
1	HIGHEST X	0	1	X15	X14 5 MSB OF DATA VALUE 1	X13	X12	X11
2	HIGHEST Y	0	1	Y15	Y14 5 MSB OF DATA VALUE 2	Y13	Y12	Y11
3	HIGH X	0	1	X10	X9 5 INTERMEDIATE BITS OF DATA VALUE 1	X8	X7	X6
4	HIGH Y	0	1	Y10	Y9 5 INTERMEDIATE BITS OF DATA VALUE 2	Y8	Y7	Y6
5	INTERMEDIATE X	0	1	X5	X4 NEXT 5 INTERMEDIATE BITS OF DATA VALUE 1	X3	X2	X1
6	INTERMEDIATE Y	0	1	Y5	Y4 NEXT 5 INTERMEDIATE BITS OF DATA VALUE 2	Y3	Y2	Y1
7	LOX, LOY, CONTROL	1	1	X0	Y0	T2 TAG BITS (VALUE)	T1	T0

LSB OF DATA VALUE 1

LSB OF DATA VALUE 2

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Figure 6-4. Packed Binary Response Format.

The Tag Bit Value element of the block may have the numeric values shown below:

Tag Value (Binary)	Meaning
000	Not used
001	Control Block (see Control Block description earlier)
010	Type 0 Block
011	Type 1 Block
100	Last Type 0 Block
101	Last Type 1 Block
110	Not Used
111	Not Used

The last block designation allows command responses consisting of a variable number of blocks to be terminated. The interpretation of the Type 0/Type 1 designation depends upon the requirements of the generating command. For example, in digitizing blocks, Type 0 usually designates a MOVE, and Type 1 usually designates a DRAW. To understand fully the block data values, it is necessary to know what response data was requested by the host computer. This information is included in the descriptions of the commands (in Section 3).

Format 2 — Unlabeled ASCII Output

The ASCII format consists of the two data values and the tag value, all expressed as ASCII decimal numbers separated by commas as shown below:

Number, Number, Number

Tag Value

Y Data Value

X Data Value

When this format is used, a signature character (and an output group terminator) should be defined to properly delimit the numbers. The format of the numbers will depend upon the current user units selected. If World Units are currently being used, the numbers (including the tag value) will be expressed in the E Floating Point format shown below:

$$\left(\begin{array}{c} - \\ or \\ SP \end{array}\right) \text{X.XXXXXE} \pm \text{XX}$$

The format is similar to scientific notation. In addition, the sign of the mantissa will be a SPACE if the number is positive or a minus if negative. There will be from zero to five places to the right of the decimal point and the exponent (a power of 10) always is preceded by a + or − (and both of the exponent digits are always used).

If the current user units are Device Units (ADUs, GDUs, or Millimeters), the output numbers will be in fixed point format with a fixed width shown below:

$$\left(\begin{array}{c} - \\ or \\ SP \end{array}\right) \text{XXXXX.XXX}$$

The sign will be a SPACE if the number is positive or a minus if negative. Leading and trailing SPACES are generated to maintain the field width at ten characters and to maintain the location of the decimal point in the field. The tag bit value for this format is interpreted as shown below:

0 (decimal)	Type 0 Block
1	Type 1 Block
2	LAST Type 0 Block
3	LAST Type 1 Block

Format 3 — Labeled Binary Output

This packed binary output format is the same as for Format 1, except for the interpretation of the tag bits which are shown below:

Tag Value (Binary)	Meaning
000	Digitized Block — Pen Up
001	Control Block
010	Status Block
011	Size Block
100	Digitized Block — Pen Down
101	
110	Not Used
111	

The meaning of the block data (Digitized, Status, etc.) is determined by referring to the tag values. However, the indicated response types are the only ones which may be requested in this format. For Digitized responses, the coordinate value bits 3, 2, 1, and 0 of both data values (coordinates) are set to 0. This results in 12-bit resolution graphics.

Format 4 — Restricted Labeled Binary Output

This packed binary format and the tag value interpretation is the same as for Format 3. The only difference in the format is that bit 0 of the X coordinate value for Digitizing blocks is always set to 1 to avoid encoding an @ character in the output. The @ character may be a problem for some host computers which use to activate the delete last character function.

Signature Character

A unique Signature Character may be prefixed to each output block. This allows the host system to identify the source of an input transmission when there is more than one device on the communication link capable of transmitting. It must be remembered that each block of the output message will be prefixed with the signature character previously chosen by the Set Signature Character command (see Section 3), or by a default NUL character.

Bypass Cancel Character (Echoed Character Suppression)

Many host systems use a computer echo system in which all characters transmitted from a device will be automatically echoed back to that device. Such a system may cause undesirable action by the Plotter. This may be prevented by setting the Bypass Cancel Character (see Section 3) to some character other than NUL, enabling the Plotter's Bypass Mode. Bypass Mode is then activated each time a Plotter-to-Host transmission is initiated. All incoming data is then discarded by the Plotter until the Bypass Cancel Character is received. The Bypass Cancel Character is also discarded and subsequent data is acted upon in the normal manner. By using specific settings for the Plotter Output terminator (see Parameter Entry card), Bypass Mode may be automatically entered and exited during normal Plotter-to-Host transmission. For example, if the host were to echo CR-LF when a CR is received, the Plotter Output Terminator may be set to CR and the Bypass Cancel Character set to LF. Then Bypass Mode would be cancelled when the Plotter received the echo of the last character associated with transmission to the host.

If AUTO MUTE is selected, the discarded data will also be blocked from other devices further down the communication link (such as a terminal).

Turn-Around Delay

Some host systems cannot support simultaneous transmission and reception of data (even over a hardware full-duplex communication link). To operate in such a system, the Turn-Around Delay may be set by a command (see Section 3) to a value greater than the time it takes to receive a character at the current baud rate plus the time required for the host communications hardware to be reconfigured for reception. The Turn-Around delay will prevent the Plotter from initiating a transmission as long as data is being received from the host. However, once the Plotter starts to transmit, it will continue even if the host begins to transmit also.

Prompt String

Some host systems can only accept input at certain times, even though their communication hardware supports full-duplex operation. The host normally indicates that it is available for input by transmitting a Prompt Character (or String), which can be any character or string other than NUL.

The receipt of the Prompt Character String, when one is set (by a command — see Section 3) is used to enable Plotter transmission. Once transmission to the host ceases, it cannot be initiated again until the Prompt Character is received. The Prompt String may be located at any point in the receive string, but it is only scanned for when the Plotter has an output pending. A single prompt string will enable the transmission of one output group (consisting of up to 72 characters or bytes). Therefore, several prompts may be necessary to transfer a complete output message (or several command responses) to the host computer.

GPIB INTERFACE

General Information About GPIB

The General Purpose Interface Bus (GPIB) interface is an optional interface that allows the Plotter to be operated as part of an instrumentation system (an implementation of the IEEE-488 interface bus). The design of the interface allows three different types of devices: listeners, talkers, and controllers. The addressing capability of the GPIB allows specific listeners and talkers to be activated and deactivated independently; the controller designates which devices are active to listen (receive) and to talk (transmit). A controller may be a TEKTRONIX 4050 Series Graphic System or any other programmable controller with a GPIB interface. If an active controller is present, the Plotter is placed in NORMAL mode (refer to the INTERFACE MODE Parameter Entry card line). In NORMAL mode, the controller can assign the Plotter to be either a listener or a talker.

The LISTEN ONLY and TALK ONLY modes are meant to be used in a system where there is no active controller. The GPIB system then consists of one device set to the TALK ONLY mode and the other device(s) would be set to the LISTEN ONLY mode. The conversation on the bus is then in only one direction, with the TALK ONLY device sending commands and data to the LISTEN ONLY device(s). The Plotter can be selected to operate in either of these modes. It must be remembered that while the Plotter is operating in LISTEN ONLY mode, it can not transmit any data or response to a received command. The TALK ONLY mode is used to enable the operator to perform offline digitizing operations (GIN). When TALK ONLY is selected, the POINT switch is enabled, allowing the operator to choose any of the 3 functions associated with that switch — DRAW POINT, MOVE POINT, and LAST POINT (refer to the description of the Plotter Communications for details on the formats and uses of the coordinates transmitted in this mode).

Operation of the Plotter (in NORMAL mode) using GPIB follows a basic signal sequence. To enable the Plotter to receive a command, the controller must first designate the Plotter as a listener by asserting the ATN bus line and then handshaking a Listen Address (MLA). This decimal value of the MLA must be the same as the operator has previously selected on the Parameter Entry card's GPIB DEVICE ADDRESS line. The controller may then address either itself or another device as a talker, then release the ATN line. The Plotter can then accept commands and/or data from the talker. After the command transfer is finished, the controller can deactivate the bus by asserting ATN and sending Untalk (UNT) and Unlisten (UNL).

In a similar manner, the controller can enable the Plotter to transmit a response to a received command. The controller first addresses the Plotter as a talker, then addresses itself or another device as a listener. The Plotter then may transmit data to the listener.

If more than one command requiring a response is sent to the Plotter before the Plotter is made a talker, the output responses will be internally buffered up to the limit of the available memory. Then when the Plotter is addressed to talk, it will send the responses in the same order that it received the commands.

The Interface Clear (IFC) bus control line is used to set all devices on the bus to a known quiescent state. The assertion of IFC by a controller will cause the GPIB interface to clear addresses to itself, and to clear the Service Request status.

When operating in Command/Response formats 1-4, Interface Clear has no other effect on the operation of the Plotter. When operating in formats 5 and 6 (4662 Compatibility mode), the receipt of Interface Clear will cause the Plotter to clear its buffer and reset the command parser.

The 4051 sends IFC when an INIT statement is executed.

Device Clear is a GPIB bus message which, when received by the Plotter, will cause the Plotter to:

1.   Terminate the execution of any command the instrument might have received.

2.   Clear the input and output buffers.

3.   Clear SRQ, if asserted, and clear the RQS (Request Service) bit in Serial Poll Status Byte.

The Device Clear message can be sent to the 4663 from a TEKTRONIX 4050 Series controller via the BASIC statement 'WBYTE @ 20:'.

If it is desired to reset only selected devices on the GPIB bus, a Selected Device Clear can be sent by the controller. The Selected Device Clear has the same effect as Device Clear, but it only acts on chosen GPIB devices. The Selected Device Clear message can be sent to the 4663 from a TEKTRONIX 4050 Series controller with a BASIC statement 'WBYTE @ 32 + (Plotter address), 4:'.

When a Serial Poll is performed, the Controller sends the Serial Poll Enable (SPE) command to all devices on the GPIB bus. This command informs each device that a Serial Poll is about to be performed. The Controller then addresses each device, one at a time, to be a Talker. That addressed device then transmits a Serial Poll Status Byte to the Controller, which, in turn, examines this byte to determine whether the Polled device is requesting service. If the device is not requesting service, the Controller "Untalks" it and addresses another device.

The Plotter currently implements only the Request Service status bit as required by the IEEE-488 standard. The two possible responses by the Plotter are (1) a hexadecimal value of 40 is returned if the Plotter is requesting service (this # indicates that a digitized point is available to be transmitted) or (2) 00 is returned if the Plotter is not requesting service.

Digitizing may be performed in three ways. Two of these can be accomplished by transmitting either a Digitize command or a Read Status Word 2. In either case, the Plotter will respond by sending the coordinates (and pen status) of the crosshair cursor. The third method can be accomplished by transmitting an Operator Digitize command. Then the pressing of any of the three POINT switch functions will cause the Plotter to buffer a coordinate triplet and transmit a Service Request message (SRQ). The SRQ message informs the controller that the operator has digitized a point, and the controller may then fetch the coordinates by addressing the Plotter to talk and listening to the coordinate data.

When the GPIB interface is selected, the Plotter selects Graphic Display Units (GDUs) as the default device units (refer to the description of Plotting and Dimension Units located in Section 3).

As was mentioned earlier, each device on the GPIB bus is assigned a device number, called a Primary Address. In the case of the Plotter, the Primary Address is selected by the GPIB DEVICE ADDRESS line on the Parameter Entry card. This same Primary Address is used as either a Listen Address (MLA) or a Talk Address (MTA), depending upon how the controller desires the Plotter to operate. To address the Plotter, the controller first sends this Primary Address over the GPIB, then follows with a command to tell the Plotter which programmable function it is to perform. The command that defines the programmable function may take one of two forms, depending upon requirements of the controller and the system. It may be a command data byte (DAB) or it may be a secondary address (MSA). The DAB is a single character or pair of characters that may be used to cause some operation to occur. Each command description earlier in this section includes the DAB characters for the GPIB interface. In most cases this will be the primary means of instructing the Plotter. The MSA can also be used as a command. Whenever MSA secondary addresses are used as commands, they always follow the Primary Address (MLA or MTA). It must be remembered that there is a limited number of these secondary addresses as shown in Appendix C. The Plotter will accept either DAB or secondary address commands. However, it will not accept both simultaneously. If the operator (or the system) elects to transmit DAB commands, the MSA commands must then be eliminated (and vice-versa). However, if a TEKTRONIX 4050 Series terminal is used, the appropriate MSA command, ranging from 1 to 31, is automatically inserted after the Primary Address for commands such as PRINT, DRAW, MOVE, INPUT, GIN, etc. It will be necessary to suppress these MSA commands when using DAB commands. The TEKTRONIX 4050 Series terminals will permit the operator to insert any desired MSA command. The operator can therefore use a code of 32 for the MSA command. Since 32 is not a valid MSA code, it will suppress the automatic insertion of the MSA associated with the initial key word used — such as PRINT, DRAW, MOVE, etc.

For examples of these command formats, we will examine some DRAW commands.

The DAB command for DRAW is D followed by a pair of X-Y coordinates for the vector end point. The MSA command is 20 (Appendix C) followed by the X-Y coordinates. Therefore, from a TEKTRONIX 4050 Series terminal, the command would appear as follows:

PRINT@1,32:D X coordinate, Y coordinate

Notice that the 32 is used to suppress the MSA of 12 that the 4050 Series terminal would have otherwise inserted for the initial key word — PRINT.

Another form for this command from a 4050 Series terminal using a MSA command, could be:

PRINT@1,20: X coordinate, Y coordinate

In this case, the terminal will accept the operator-induced MSA command of 20 (for DRAW) in place of the 12 it would have otherwise inserted for the initial key word — PRINT.

It should be also noted that another MSA command using a variation of the DRAW command could be sent from a 4050 Series terminal as:

DRAW@1: X coordinate, Y coordinate

Notice that the operator has purposely left out the MSA command of 20, since the terminal will automatically insert this, making the command appear as:

DRAW@1,20: X coordinate, Y coordinate.

GPIB Command Formats

The GPIB interface will accept commands in a variety of formats selectable through the Parameter Entry card's INITIAL COMMAND/RESPONSE FORMAT line.

Format 1 — Full Command Set with EOI as the Output Terminator

This format accepts all of the commands listed in this manual, as well as those intended for the TEKTRONIX 4662 Plotter. The Plotter output is terminated by the assertion of EOI with the last byte of the message. Print commands are terminated by ETX or EOI.

Format 2 — Full Command Set with <CR> <LF> as the Output Terminator

This format is the same as Format 1, except that all Plotter outputs are terminated with <CR> and then a <LF> concurrent with EOI.

Format 3 — Tektronix Standard Format with EOI as the Output Terminator

Format 3 is the same as Format 1, except that the Print statement uses either single or double quotes to delimit a string. Either character can delimit the string, but the closing delimiter must be the same as the opening delimiter, as shown in Figure 6-5.

2670-43
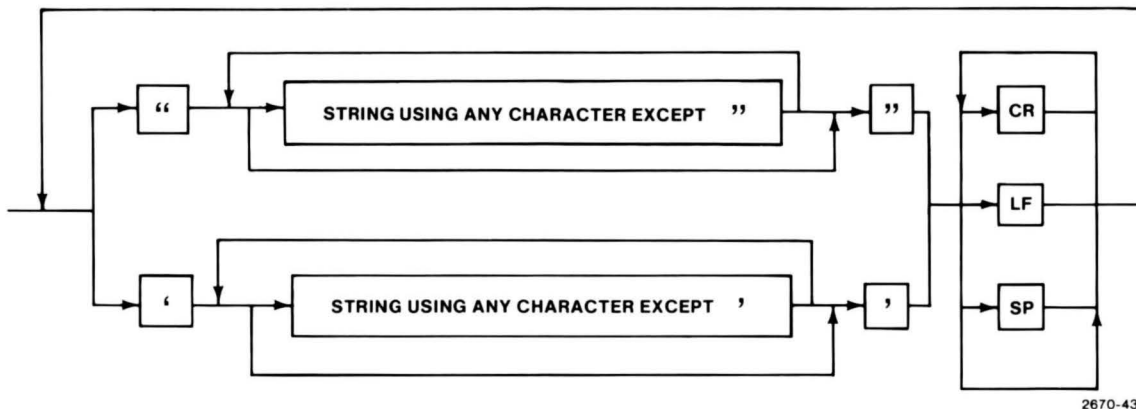
Figure 6-5. Formats 3 and 4 String Delimiters.

Format 4 — Tektronix Standard Format with <CR> <LF> as the Output Terminator

This format is the same as Format 2, except that the string is delimited in the same manner as Format 3.

Format 5 — 4662 Compatible Command Set with EOI Output Terminator

This format configures the 4663 Plotter the same as the TEKTRONIX 4662 Plotter. The 4663 Plotter will transmit in the same manner as the 4662 for all commands which the 4662 handles. All other responses are the same as for Formats 1-4. The output is terminated with the assertion of EOI with the last byte of the message.

Format 6 — Restricted Command Set With <CR> <LF> Output Terminator

This format is the same as Format 5, except that the outputs are terminated with <CR> and then a <LF> concurrent with EOI.

GPIB Digitizing

The Plotter can transmit the position of the pen or crosshair to any device on the GPIB bus. This process is known as Digitizing. The Plotter can digitize by two different methods depending on the selection of the INITIAL COMMAND/RESPONSE FORMAT Parameter Entry line. If the operator selects any of the first four formats (1-4), the host computer must send the Operator Digitize command to the Plotter, along with the maximum number of points to be digitized. When this command is sent to the Plotter, the POINT light turns on steady, indicating that the Plotter is enabled to buffer coordinate points. When the user presses either the MOVE or DRAW POINT switch, the Plotter holds the SRQ line true on the bus, indicating that a point can be received by a listener. The Plotter will release the SRQ line if, after the point is transmitted, it finds that no more points remain in the buffer. If more points remain in the buffer, the Plotter will continue to assert the SRQ line. Later, when the user sends a LAST point, or when the allotted number of points have been sent, a LAST POINT response is generated. This is indicated by the third data value (coordinate) being a two (2). Receipt of the LAST POINT message can indicate to the listening device that no more points are coming and some other task may now be performed.

The second digitizing method is selected when operating in Formats 5 or 6. In this mode the 4663 Plotter performs digitizing in a manner identical to the 4662 Plotter. In this method, coordinate points may be buffered at any time; i.e., an Operator Digitize command does not have to be sent to enable the digitizing operation. If a point is entered before the receipt of an Operator Digitize command, the Plotter will assert SRQ. SRQ is then released if the Plotter transmitted the last point in the buffer. If an Operator Digitize command is received before a coordinate point is buffered, the Plotter is "armed" to send the point without asserting SRQ. This method allows the transmitting of digitized points to a device which cannot handle the SRQ assertion.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE
FOR USE BY QUALIFIED PERSONNEL ONLY. TO
AVOID PERSONAL INJURY, DO NOT PERFORM ANY
SERVICING OTHER THAN THAT CONTAINED IN
OPERATING INSTRUCTIONS UNLESS YOU ARE
QUALIFIED TO DO SO.

Section 7

INSTALLATION

ABOUT THIS SECTION

This section provides the information necessary for installing and connecting the 4663 Interactive Digital Plotter into a system.

PLACEMENT OF THE PLOTTER

The Plotter can be placed on any flat surface, such as a table or desk, that is at least 38″ x 30″ (97 cm x 77 cm) in size. For servicing, access should be available to all four (4) sides, and an additional 6″ (16 cm) of space will be needed for each side or end panel to fold down.

LINE VOLTAGE SELECTION

CAUTION

The 4663 is intended to operate on a single phase power source which has one of its current-carrying conductors (grounding) connected to Safety Earth (ground potential). Operation from other power sources which have both current-carrying conductors live with respect to ground (such as phase-to-phase on a multi-phase system or across the legs of a 117-234 volt single-phase three-wire system) is not recommended, since only the line conductor has over-current (fuse) protection within the instrument.

The Plotter is designed to operate on a 115 or 230 volt nominal line voltage source with a frequency of 48 to 440 Hz. In addition, either of two voltage ranges for the 115 or 230 Vac may be selected. The ac power connector is a three-wire polarized plug with one lead connected directly to the instrument frame to provide electric shock protection. Connect this plug only to a three-wire outlet which has a safety ground. If the unit is connected to any other power source, the Plotter frame must be connected to a safety ground system. The connector configuration and color coding is shown in Figure 7-1. The power cord is to be replaced only with another of the same polarity.

Power Cord Conductor Identification		
Conductor	**Color**	**Alternate Color**
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow
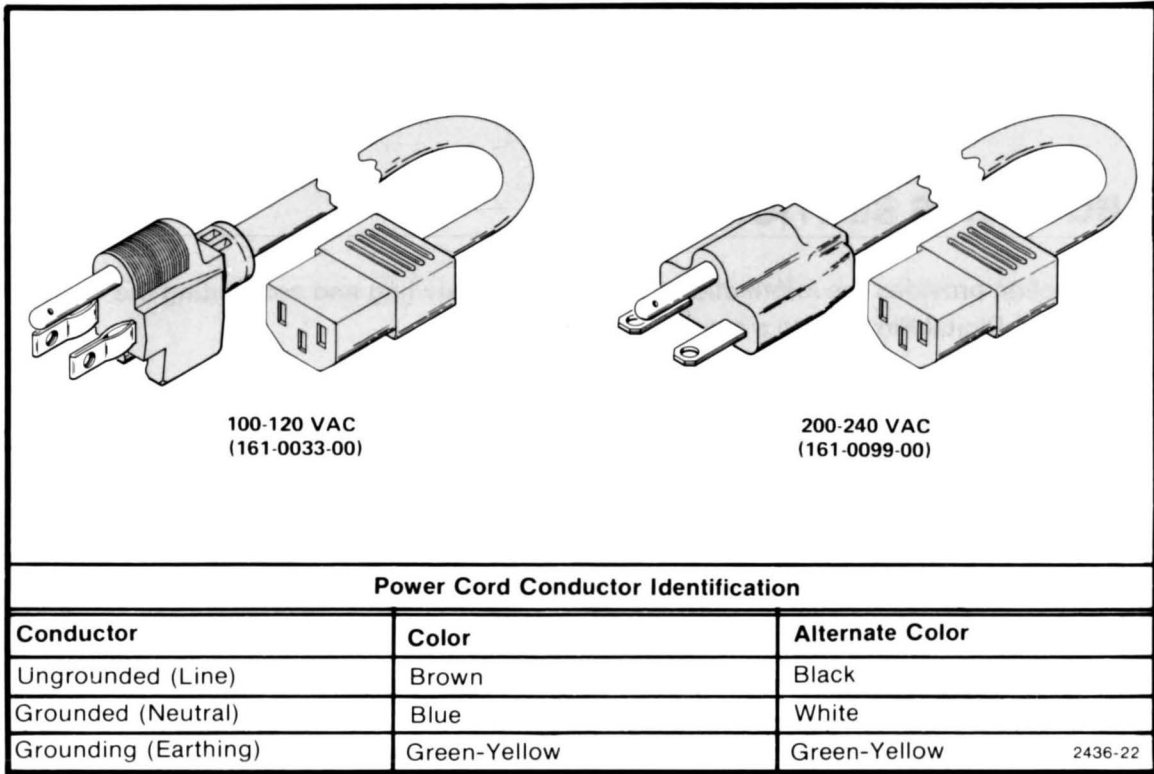
Figure 7-1. USA Standard Power Cord Sets.

The appropriate line voltage is selected with a switch on the power supply within the Plotter. To select line voltages, proceed as follows:

1. Turn off the power to the Plotter and disconnect the power cord.

WARNING

It is important to remove the power cord because some power supply circuits remain energized from the input line, even though the front panel power switch is turned to "off."

2. Turn (using a nickel, a quarter, or a large screwdriver) all four of the large quarter-turn latches 1/4 turn CCW. There are two of these latches on each end panel (see Figure 7-2). When both latches have been opened on either end panel, that panel may be lowered on its hinge. Then repeat for the other end panel.
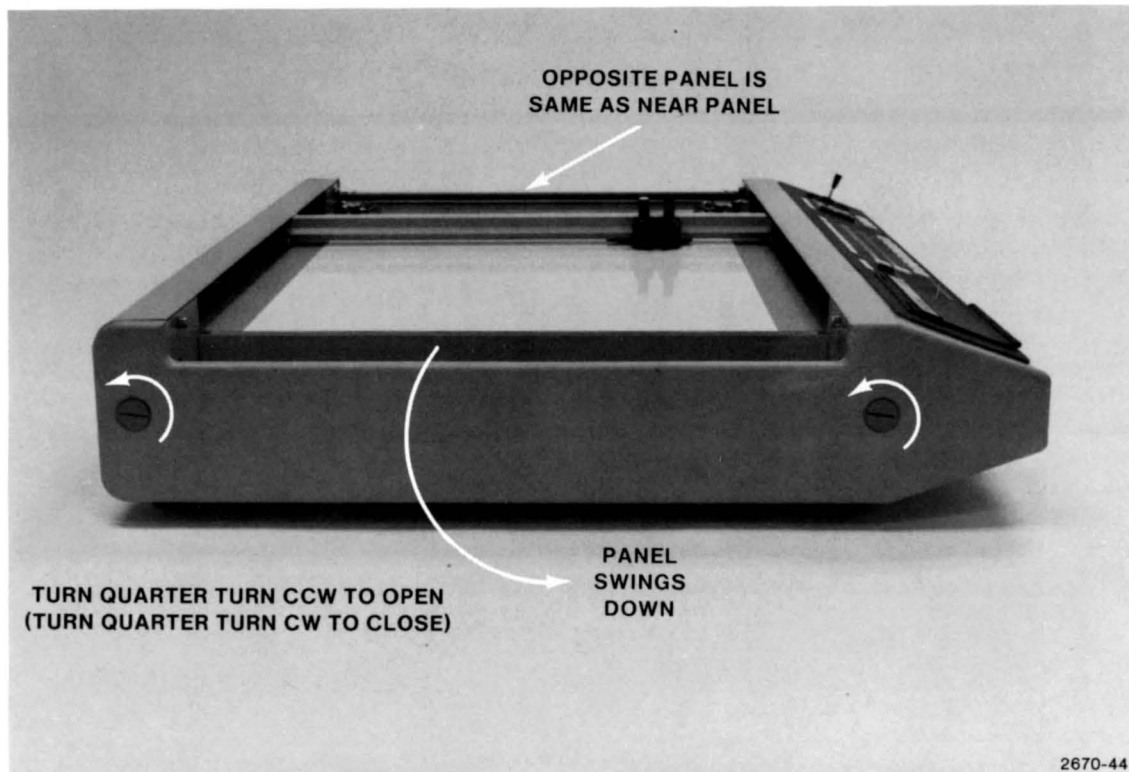
Figure 7-2. Side Panel Quarter-Turn Latches.

3. When both end panels have been lowered, the front and back panels can be lowered on their hinges. To do this, unscrew each of the four knurled thumb-screws that hold the front and back panels in place. These are located near the top of the instrument, near each corner, and face in toward the center of the instrument (see Figure 7-3).
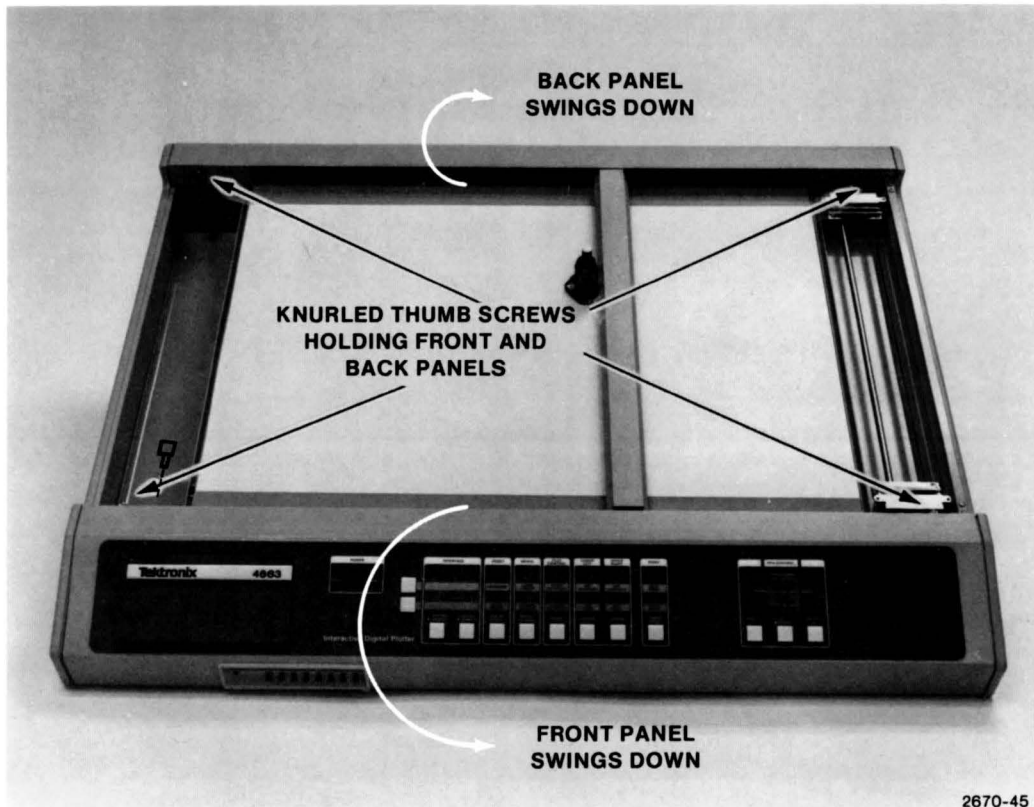
Figure 7-3. Front and Back Panel Thumb-screw Locations.

4. Unscrew the eight (8) nuts on studs holding the pen drive mechanism assembly down to the Plotter base (see Figure 7-4 for the location of these nuts).
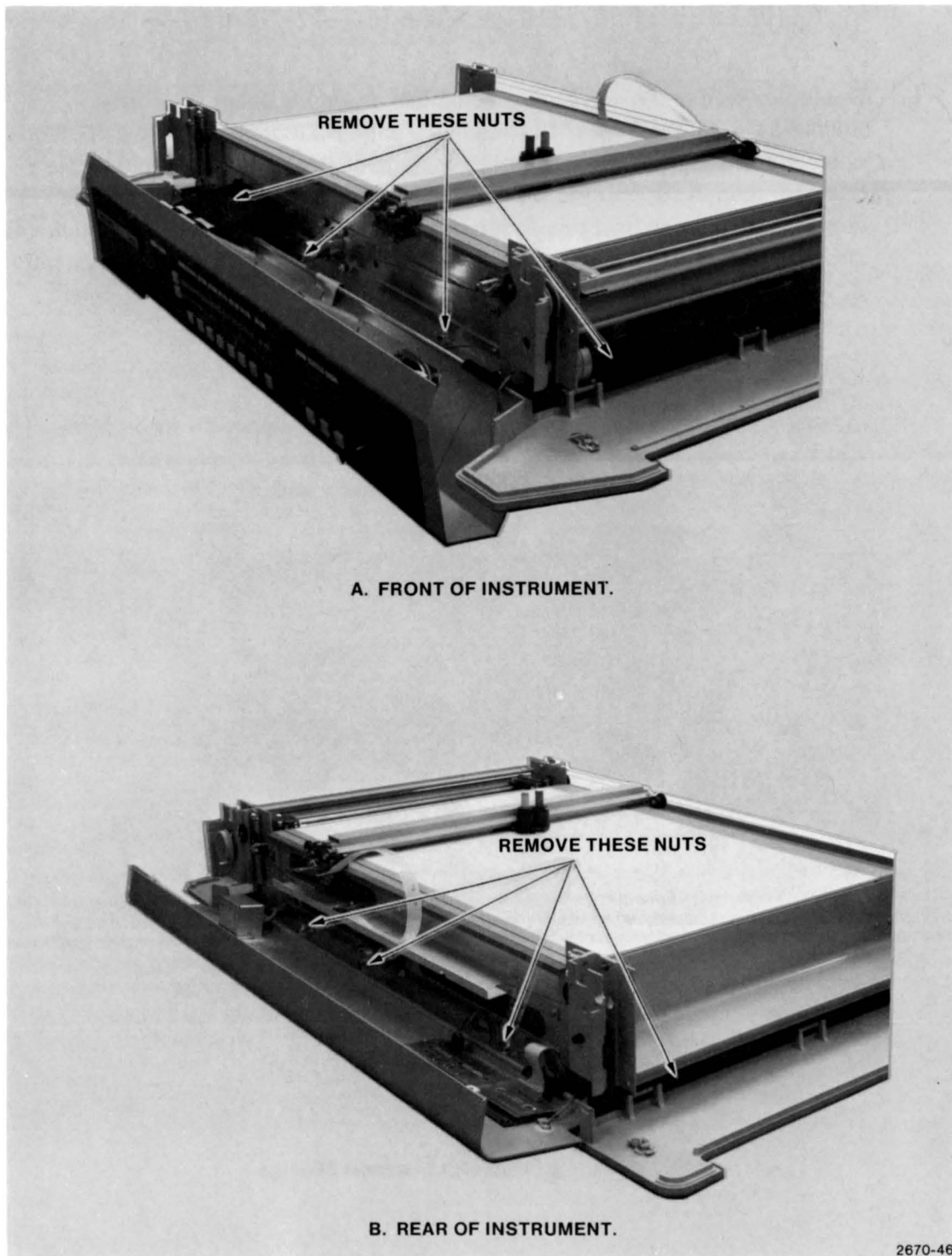
Figure 7-4. Nuts Holding Pen Drive Mechanism Assembly.

NOTE

Before tilting up the pen drive mechanism, make sure the rear panel has been opened and that panel has been swung down and out of the way.

5. Grasp the front of the pen drive mechanism assembly under the corner brackets and lift the front of the assembly only. Tilt it back to about a 45 degree angle. Care must be exercised not to damage or stretch the pen drive cable in this operation. A support rod is provided (stored along the right side of the circuit card cage) to hold this assembly up for access to the Plotter's electrical circuitry. Insert the free end of the support rod into a hole located approximately 3″ (7.5 cm) to the right of the front cable capstan (see Figure 7-5 for details).

2670-47
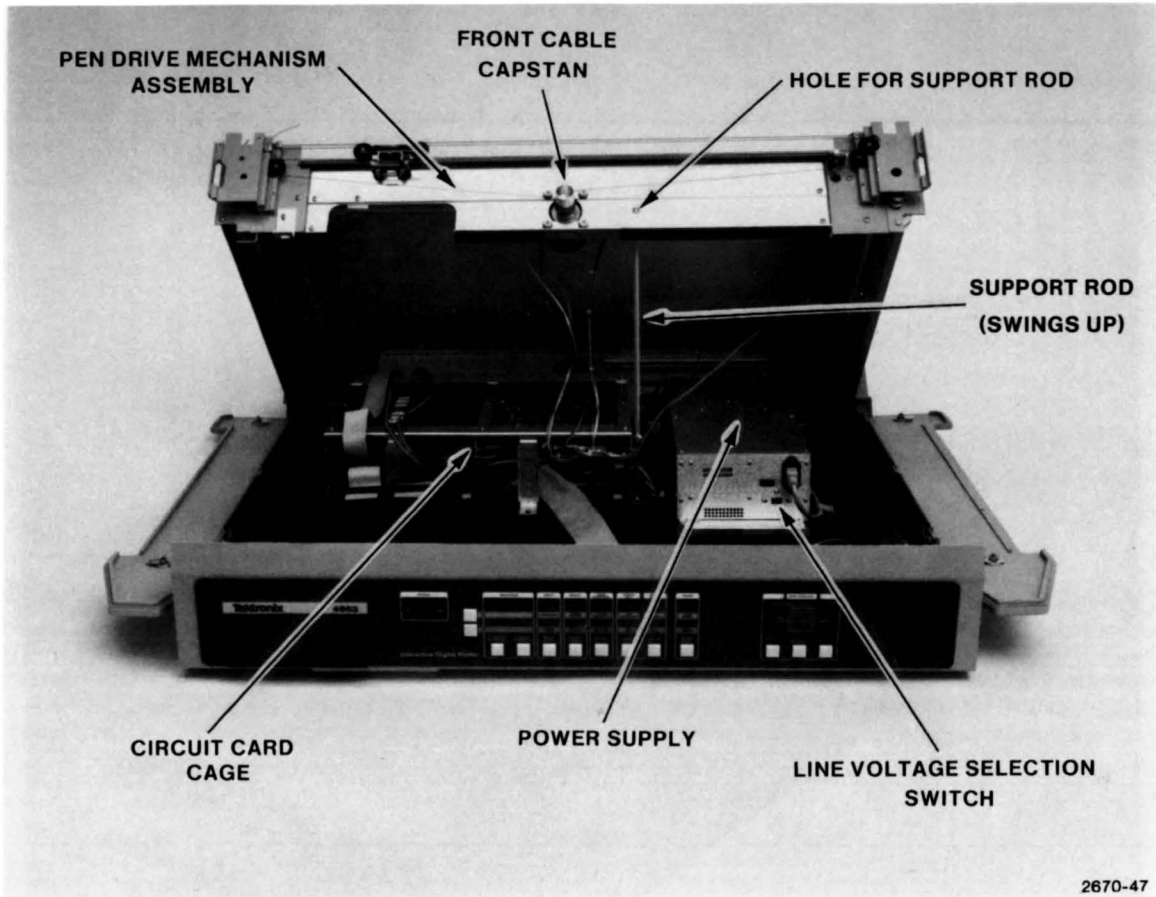
Figure 7-5. Access to Plotter's Electrical Circuitry.

6. The line voltage selection switch is located on the front of the power supply (see Figure 7-5).

WARNING

Make sure the line cord is unplugged before continuing.

Use a small screwdriver to slide the switch either to the left or right until the intended input line voltage value appears on the switch (115 or 230 volts).

7. To return the Plotter to operation, reverse the procedure for gaining access to the Plotter's electrical circuitry. When lowering the pen drive mechanism assembly, make sure cables from the front panel pass between the felt pads on the underside of the pen drive mechanism assembly. Do not pinch these cables under the felt pads.

CAUTION

Before closing the rear panel, it may be helpful to manually move the Y-axis arm to the far left side of the instrument (when viewed from the front). This will minimize the possibility of damaging the flexible cable to the Y-axis arm (at the rear of the instrument).

8. It is necessary to change the line fuse to match the new selected line voltage (fuse is on the rear panel).

   For the 90-125 volt range, the line fuse is a 5 A (fast-blo).

   For the 180-240 volt range, the line fuse is a 2.5 A (fast-blo).

9. Change the rear panel line voltage indicator to indicate the new voltage selection.

CONNECTING THE PLOTTER TO A HOST COMPUTER THROUGH A SERIAL INTERFACE

If the Plotter is equipped with a serial interface (RS-232-C, TTY, or 20/60 ma current loop), this procedure provides the information necessary to connect the Plotter to a host computer.

The Plotter's serial interfaces have two connection ports on the rear panel. One is for a terminal and the other is for a modem or host computer. This arrangement allows the Plotter to be "chained" to other serial interface devices. The connector labeled TERMINAL is wired to appear as an active modem, while the connector labeled MODEM (or HOST) is wired to appear as an active terminal. This arrangement allows the Plotter to be used alone with either a modem or a terminal.

Simply connect the serial interface cable from a terminal to the Plotter connector labeled TERMINAL, or connect the serial interface cable from a modem (or computer) into the Plotter connector labeled MODEM (see Figure 7-6).

Before the Plotter can communicate, it is necessary to activate the serial interface. After turning on the power, and allowing the Plotter to initialize (approximately 5 seconds), pull the Parameter Entry card out to the INTERFACE SELECT line and select the serial interface (INIT light must be off — see Applying Power in Section 2).

Before operating a newly connected serial interface, it may be helpful to proceed with Step 4 and following of the First Time Operation Through The Serial Interface (Part 2) procedure (located in Section 4). However, with a modem or host computer connected, set the INTERFACE switches to ON-LINE REMOTE.

Lastly, set the appropriate Parameter Entry card selections to match the system configuration — ADDRESS, BAUD RATES, ATTENTION CHARACTER, etc.

THIS CABLE WOULD BE
CUT AT THIS POINT TO
ADD ANOTHER PLOTTER

TERMINAL

SECOND
PLOTTER

CONNECTOR LABELED
TERMINAL

MODEM

CONNECTOR LABELED
MODEM

PLOTTER

MODEM
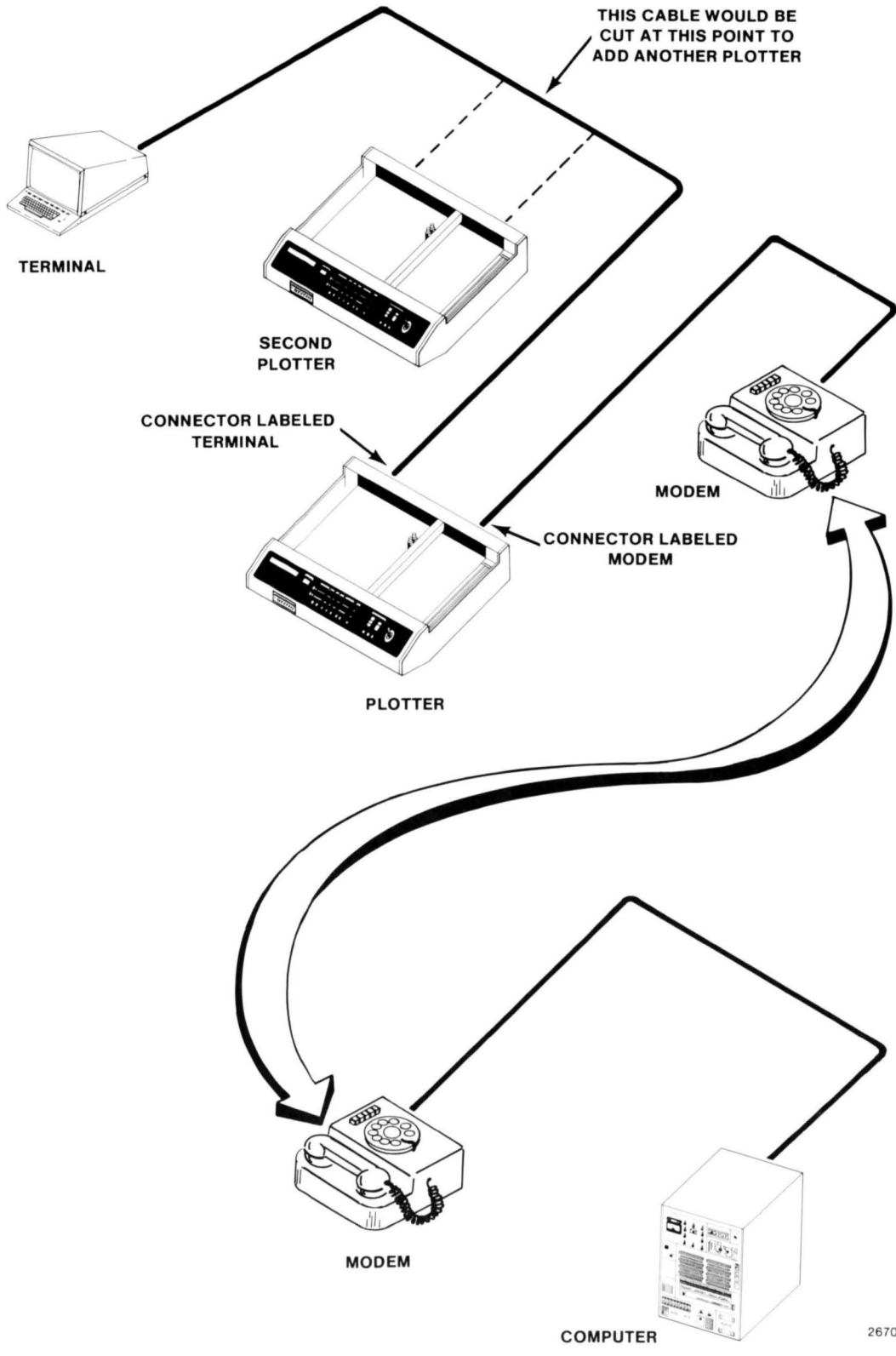
COMPUTER

2670-48

Figure 7-6. Serial Interface Connections.

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CONNECTING THE PLOTTER TO A HOST COMPUTER THROUGH A GPIB INTERFACE

If the Plotter is equipped with a GPIB interface, this procedure provides the information necessary to connect the Plotter to a host (controller).

The standard GPIB Interconnecting cable allows devices to be linked together sequentially or branched out from a central controller, as shown in Figure 7-7. Connect the Plotter GPIB cable between the Plotter and the controller (or other GPIB device) as shown in Figure 7-7. A 4051 Graphic System is shown as a controller in the example.

2670-64
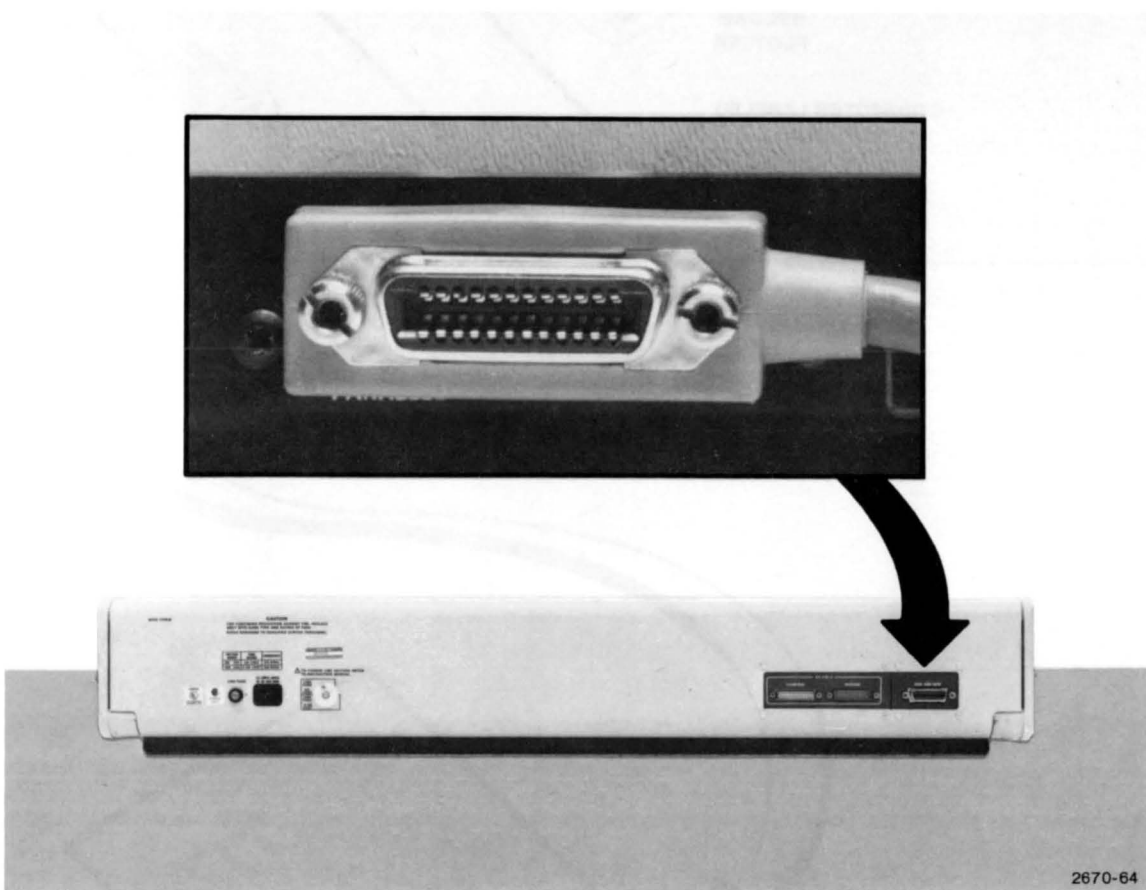
Figure 7-7. Installing the Plotter into a GPIB system.

@

Before the Plotter can communicate, it is necessary to activate the GPIB interface. After turning on the Plotter's power, and allowing the Plotter to initialize (approximately 5 seconds), pull the Parameter Entry card out to the INTERFACE SELECT line and select the GPIB interface. The Plotter will repeat the initialization process. It will then be necessary to push the Parameter Entry card fully in to turn off the INIT light. Then, set the appropriate Parameter Entry card selections to match the system configuration — ADDRESS, FORMAT, MODE, etc.

Before operating a newly connected GPIB interface, it may be helpful to proceed with the First Time Operation Through The GPIB Interface (Part 3) procedure (located in Section 5).

Appendix A

ERROR TYPES

The following table shows the Parameter Entry switch display for each error type (refer to identifying Errors in Section 2 for further information on error displays).

● = Light is ON

Fatal Errors Parameter Entry Display	Hex Eq	Dec Eq	Cause of Error
○ ○ ○ ○ ○ ○ ○ ●	01	1	Insufficient RAM
○ ○ ○ ○ ○ ○ ● ○	02	2	RAM check error
○ ○ ○ ○ ○ ○ ● ●	03	3	ROM check error
○ ○ ○ ○ ○ ● ○ ○	04	4	Undefined common subroutine
○ ○ ○ ○ ○ ● ○ ●	05	5	Command dispatch error
○ ○ ○ ○ ○ ● ● ○	06	6	Software interrupt
○ ○ ○ ○ ○ ● ● ●	07	7	Non-maskable interrupt
○ ○ ○ ○ ● ○ ○ ○	08	8	Non-existent memory reference
○ ○ ○ ○ ● ○ ○ ●	09	9	Unable to create a buffer (insuf RAM)
○ ○ ○ ○ ● ○ ● ○	OA	10	Unexpected system error
○ ○ ○ ○ ● ○ ● ●	OB	11	No service routine for level
○ ○ ○ ○ ● ● ○ ○	OC	12	No self interrupt routine for level
○ ○ ○ ○ ● ● ○ ●	OD	13	MSync address not in first 256 bytes of ROM

Fatal Errors Parameter Entry Display	Hex Eq	Dec Eq	Cause of Error
○ ○ ○ ○ ● ● ● ○	OE	14	No routine for specified system command
○ ○ ○ ○ ● ● ● ●	OF	15	ROM in wrong socket
○ ○ ○ ● ○ ○ ○ ○	10	16	Motion buffer overrun

Non-Fatal Errors Parameter Entry Display	Hex Eq	Dec Eq	Cause of Error
○ ○ ○ ○ ○ ○ ○ ●	01	1	Data overrun
○ ○ ○ ○ ○ ○ ● ○	02	2	Framing error
○ ○ ○ ○ ○ ○ ● ●	03	3	Parity error
○ ○ ○ ○ ○ ● ○ ○	04	4	Input buffer full error
○ ○ ○ ○ ○ ● ○ ●	05	5	Output attempt when message is in progress
○ ○ ○ ○ ○ ● ● ○	06	6	ODBuffer full
○ ○ ○ ○ ○ ● ● ●	07	7	OBuffer full
○ ○ ○ ○ ● ○ ○ ○	08	8	Block size exceeds input buffer size
○ ○ ○ ○ ● ○ ○ ●	09	9	Block checksum error
○ ○ ○ ○ ● ○ ● ○	OA	10	GPIB — Illegal secondary address
○ ○ ○ ○ ● ○ ● ●	OB	11	GPIB — Talked with no listener on line
○ ○ ○ ○ ● ● ○ ○	OC	12	GPIB — Unable to complete message transmission
○ ● ○ ○ ○ ○ ○ ○	40	64	Integer argument exceeds 16-bit value

Fatal Errors Parameter Entry Display	Hex Eq	Dec Eq	Cause of Error
O ● O O O O O ●	41	65	Illegal paper advance command
O ● O O O O ● O	42	66	Illegal macro command usage
O ● O O O O ● ●	43	67	Macro called itself
O ● O O O ● O O	44	68	Integer outside legal range
O ● O O O ● O ●	45	69	Too many entries or string too long (dash pattern)
O ● O O O ● ● O	46	70	Unidentified interface attention sequence error
O ● O O O ● ● ●	47	71	Unidentified interface command error
O ● O O ● O O O	48	72	Invalid command for selected output format
O ● O O ● O O ●	49	73	Scale = 0
O ● O O ● O ● O	4A	74	Viewport of 0 length or outside page boundary
O ● O O ● O ● ●	4B	75	Window less than or equal to 0
O ● O O ● ● O O	4C	76	Page upper right on top of lower left position
O ● O O ● ● O ●	4D	77	Argument type error (interface)
O ● O O ● ● ● O	4E	78	Command decoding error (interface)
O ● O O ● ● ● ●	4F	79	Output value range error

Fatal Errors Parameter Entry Display	Hex Eq	Dec Eq	Cause of Error
● ○ ○ ○ ○ ○ ○ ○	80	128	Invalid switch entry (Parameter Entry)
● ○ ○ ○ ○ ○ ○ ●	81	129	Battery backup RAM checksum error
● ○ ○ ○ ○ ○ ● ○	82	130	Transform stack underflow or overflow
● ○ ○ ○ ○ ○ ● ●	83	131	Transform cannot produce virtual Digitizing data because of transform values
● ○ ○ ○ ○ ● ○ ○	84	132	RAM verify error — block not used
● ○ ○ ○ ○ ● ○ ●	85	133	Insufficient memory for buffer allocation
● ○ ○ ○ ○ ● ● ○	86	134	Cannot find specified macro
● ○ ○ ○ ○ ● ● ●	87	135	Illegal alpha table command byte
● ○ ○ ○ ● ○ ○ ○	88	136	Not assigned
● ○ ○ ○ ● ○ ○ ●	89	137	Illegal Monitor usage (RESTAT)
● ○ ○ ○ ● ○ ● ○	8A	138	Output processing routine missing
● ○ ○ ○ ● ○ ● ●	8B	139	Number greater than 99999.999 in fixed ASCII conversion
● ○ ○ ○ ● ● ○ ○	8C	140	Too many PROM alpha tables in system
● ○ ○ ○ ● ● ○ ●	8D	141	Selected interface hardware or ROM not present

Appendix B

SERIAL INTERFACE CONNECTORS

PIN/SIGNAL DESCRIPTIONS

PIN NUMBER (EITHER JACK)	DESCRIPTION
1	CABLE SHIELD
2	TDATA
3	RDATA
4	REQUEST TO SEND
5	CLEAR TO SEND
6	DATA SET READY
7	SIGNAL GND
8	CARRIER DETECT
11	SEC RTS
12	SEC CARRIER DETECT
15	TCLK
17	RCLK
19	SEC RTS
20	DATA TERMINAL READY
22	RING DETECTOR

2670-49
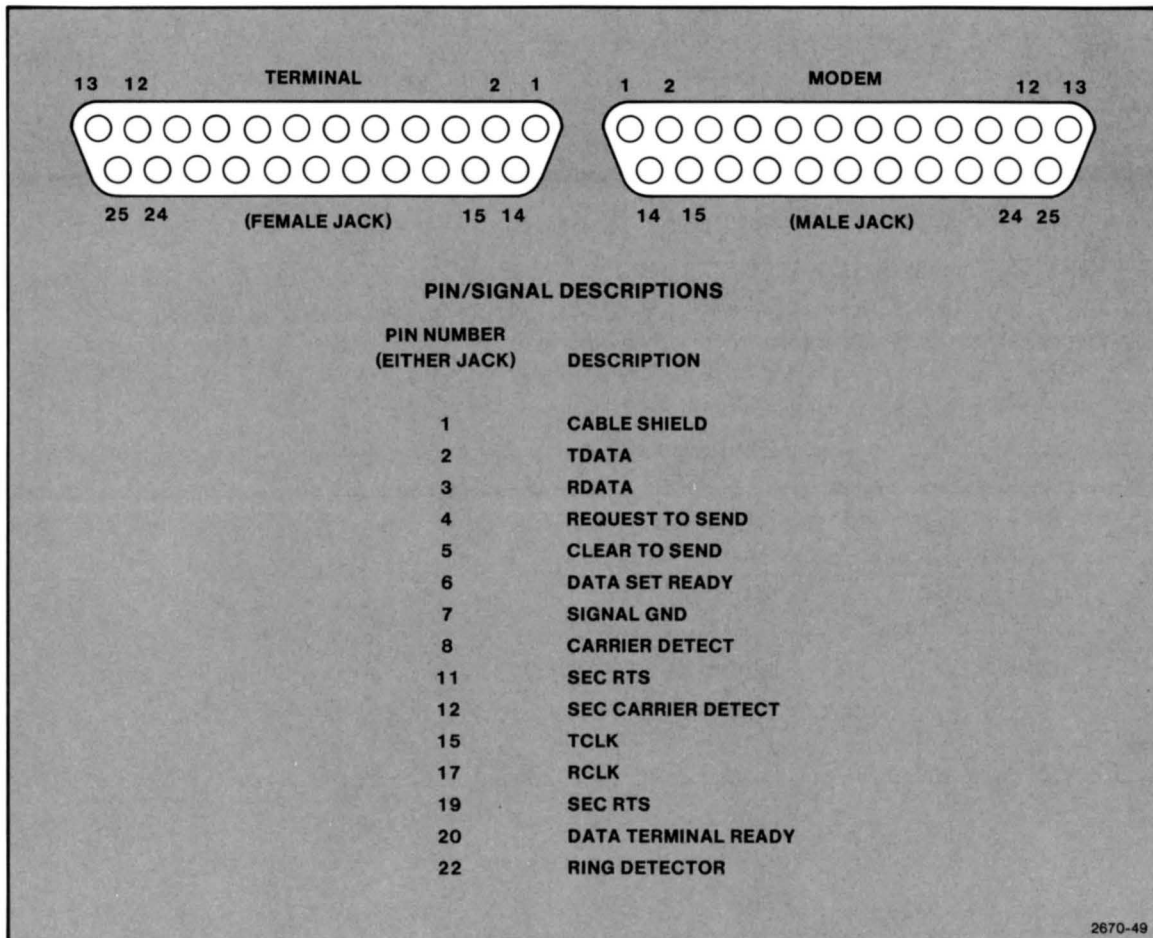
Figure B-1. RS-232-C

PIN/SIGNAL DESCRIPTIONS

Pin # (either jack)	Description
1	CABLE SHIELD
2	TDATA
3	RDATA
4	REQUEST TO SEND
5	CLEAR TO SEND
6	DATA SET READY
7	SIGNAL GND
8	CARRIER DETECT
11	SEC RTS
12	SEC CARRIER DETECT
15	TCLK
17	RCLK
19	SEC RTS
20	DATA TERMINAL READY
22	RING DETECTOR

HOST			TERMINAL		
13 12		2 1	1 2		12 13
25 24	(FEMALE JACK)	15 14	14 15	(MALE JACK)	24 25

PIN #	DESCRIPTION	PIN #	DESCRIPTION
1	FRAME GND	1	FRAME GND
2	TDATA	2	TDATA
3	RDATA	3	RDATA
4	TTY RELAY	4	TTY RELAY
5	READ TAPE-0	5	READ TAPE-0
6	CTS POS BUSS	6	CTS POS BUSS
7	GND	7	GND
8	(VARIES WITH HOST)	8	(VARIES WITH HOST)
9	SCHAR-0	9	NC
10	LINE-1	10	NC
11	RELAY RETURN -15 VOLTS	11	RELAY RETURN -15 VOLTS
12	CTS NEG BUSS	12	CTS NEG BUSS
13	PBAUDSH-1	13	NC
14	CLEAR TO SEND-1	14	NC
15	INTERFACE CLK	15	INTERFACE CLK
16	CLOCK	16	NC
17	(VARIES WITH HOST)	17	(VARIES WITH HOST)
18	NC	18	NC
19	PCLEAR TO SEND-0	19	NC
20	(VARIES WITH HOST)	20	(VARIES WITH HOST)
21	(VARIES WITH HOST)	21	(VARIES WITH HOST)
22	PSTOP-0	22	NC
23	NC	23	NC
24	NC	24	NC
25	(VARIES WITH HOST)	25	(VARIES WITH HOST)

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Figure B-2. Option 2 (TTY Interface).

TERMINAL

① ②
③ ④
⑤ ⑥

(FEMALE)

HOST

② ①
④ ③
⑤ ⑥

(MALE)

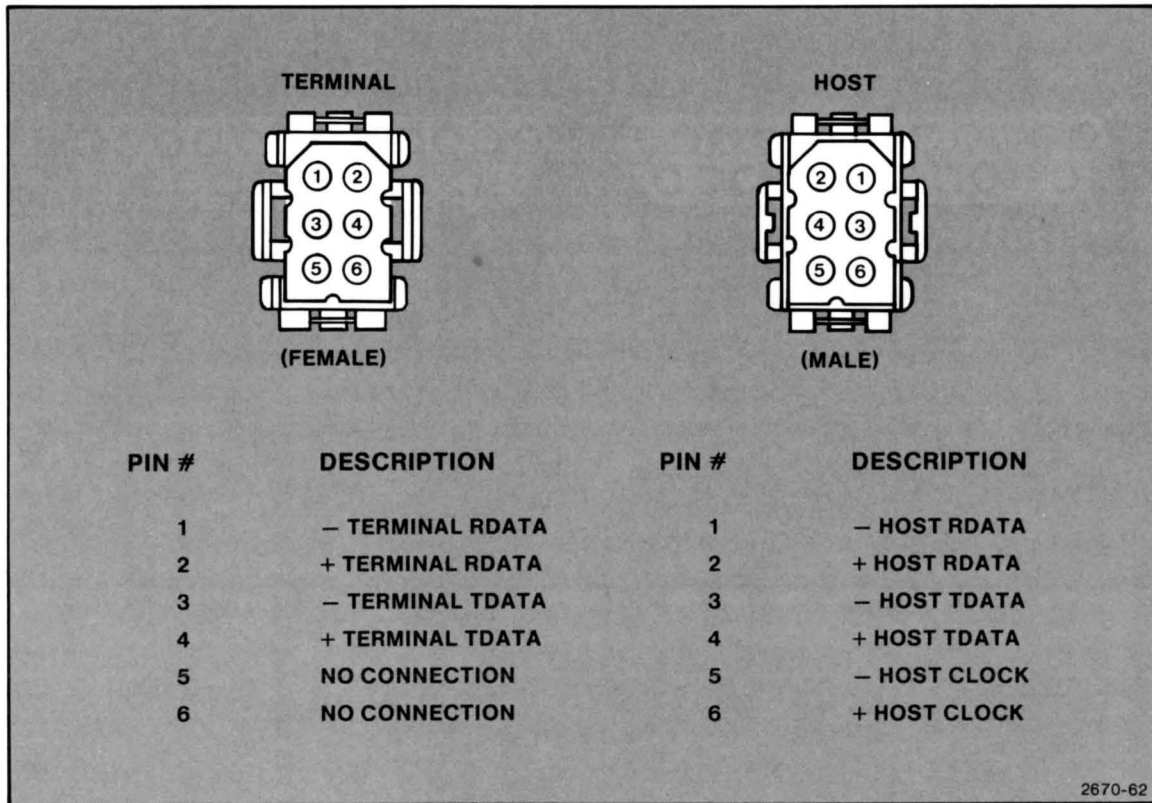| PIN #	DESCRIPTION	PIN #	DESCRIPTION
1	− TERMINAL RDATA	1	− HOST RDATA
2	+ TERMINAL RDATA	2	+ HOST RDATA
3	− TERMINAL TDATA	3	− HOST TDATA
4	+ TERMINAL TDATA	4	+ HOST TDATA
5	NO CONNECTION	5	− HOST CLOCK
6	NO CONNECTION	6	+ HOST CLOCK

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Figure B-3. Option 3 (20/60 mA Current Loop Interface).

Appendix C

GPIB SECONDARY ADDRESS COMMANDS

The description of GPIB (refer to First Time Operation Through The GPIB Interface — Part 3) gives two forms of commands which can be sent to the Plotter when using a GPIB interface. The descriptions of the commands in Section 3 and the examples all use the DAB format. However, the second form uses a system of Secondary Address commands (MSA). The 4050 Series Graphic System uses this method of sending commands. The MSA command (listed in Table C-1) must be sent immediately following the Primary Address of the Plotter. The 4050 Series Graphic System uses the Secondary Address command scheme in a manner which is invisible to the user. In this the 4050 Series terminal automatically transmits these MSA commands corresponding to a BASIC keyword. Table C-1 lists these BASIC keywords and the associated MSA command.

Table C-1

MSA COMMANDS (USING TEKTRONIX 4050 SERIES KEYWORDS)

Command	MSA
PRINT	12
INPUT	13
LIST	19
DRAW	20
MOVE	21
PAGE	22
HOME	23
GIN	24

In addition, there are other MSA commands that the 4050 Series terminals do not have keywords for, but which are still recognized by the Plotter. These include:

Command	MSA
Read Status Word	0
Alpha Reset	7
Set Status Word	16
Alpha Scale	17
Alpha Font	18
Alpha Rotate	25
Prompt Light	26
Operator Digitize	27

Appendix D

COORDINATE CONVERSION CHART

The following chart is designed for use with 10 and 12-bit graphing:

10-Bit Graphic With A TEKTRONIX 4010, 4012, or 4013
Terminal

Simply use the chart without the interpolation insert. Find the desired X or Y coordinate in the body of the chart; follow that column to the bottom of the chart to find the decimal value or the ASCII character which represents the HIY or HIX byte; go to the right in the row containing the coordinate value to find the LOY byte, or go to the left to find the LOX byte. With 10-bit graphing, it is not possible to use coordinate values between those shown on the chart. Arrange the characters in the sequence:

HIY, LOY, HIX, LOX

Example: 100Y, 480X would be SP, y, #, X in ASCII code.

12-bit Graphing With A TEKTRONIX 4014 or 4015 Terminal

This requires the interpolation insert chart and the main coordinate chart following. Simply find the largest coordinate value in the chart that is equal to or less than the desired coordinate value using the main coordinate chart below; follow that column to the bottom of the chart to find the decimal value or the ASCII character which represents the HIY or HIX byte; go to the right in the row containing that largest coordinate value equal to or less than the desired coordinate value to find the LOY byte, or go to the left to find the LOX byte. Then subtract this largest coordinate value in the chart that is equal to or less than the desired coordinate value. Repeat for the other coordinate value. Note both of these remainders and their respective axes. Notice that these values will always range from 0 to 3. Apply both of these remainders to the interpolation insert chart (using the X remainder across the top and the Y remainder down the left side) to determine the extra byte (EB) character in the sequence:

HIY, EB, LOY, HIX, LOX

Example: 31Y, 841X would be SP, a, g, &, R in ASCII code.

INTERPOLATION INSERT CHART
FOR THE EB BYTE

X Remainder

	0	1	2	3
0	l	m	n	0
1	h	i	j	k
2	d	e	f	g
3	\	a	b	c

(Y Remainder is the vertical axis label, rows labeled 0, 1, 2, 3)

Refer to the description of Implied Commands in the Plotter Communications (Section 6) for further information.

Table D-1

COORDINATE CONVERSION CHART

Low Order X		X or Y Coordinate								Low Order Y	
ASCII	DEC.									DEC.	ASCII
@	64	0	128	256	384	512	640	768	896	96	'
A	65	4	132	260	388	516	644	772	900	97	a
B	66	8	136	264	392	520	648	776	904	98	b
C	67	12	140	268	396	524	652	780	908	99	c
D	68	16	144	272	400	528	656	784	912	100	d
E	69	20	148	276	404	532	660	788	916	101	e
F	70	24	152	280	408	536	664	792	920	102	f
G	71	28	156	284	412	540	668	796	924	103	g
H	72	32	160	288	416	544	672	800	928	104	h
I	73	36	164	292	420	548	676	804	932	105	i
J	74	40	168	296	424	552	680	808	936	106	j
K	75	44	172	300	428	556	684	812	940	107	k
L	76	48	176	304	432	560	688	816	944	108	l
M	77	52	180	308	436	564	692	820	948	109	m
N	78	56	184	312	440	568	696	824	952	110	n
O	79	60	188	316	444	572	700	828	956	111	o
P	80	64	192	320	448	576	704	832	960	112	p
Q	81	68	196	324	452	580	708	836	964	113	q
R	82	72	200	328	456	584	712	840	968	114	r
S	83	76	204	332	460	588	716	844	972	115	s
T	84	80	208	336	464	592	720	848	976	116	t
U	85	84	212	340	468	596	724	852	980	117	u
V	86	88	216	344	472	600	728	856	984	118	v
W	87	92	220	348	476	604	732	860	988	119	w
X	88	96	224	352	480	608	736	864	992	120	x
Y	89	100	228	356	484	612	740	868	996	121	y
Z	90	104	232	360	488	616	744	872	1000	122	z
[	91	108	236	364	492	620	748	876	1004	123	{
\	92	112	240	368	496	624	752	880	1008	124	:
]	93	116	244	372	500	628	756	884	1012	125	}
∧	94	120	248	376	504	632	760	888	1016	126	~
–	95	124	252	380	508	636	764	892	1020	127	RUBOUT (DEL)

DEC. ⟶	32	33	34	35	36	37	38	39
ASCII ⟶	sp	!	"	#	$	%	&	'

High Order X & Y

Table D-1 (cont)

COORDINATE CONVERSION CHART

Low Order X						X or Y Coordinate				Low Order Y	
ASCII	DEC.									DEC.	ASCII
@	64	1024	1152	1280	1408	1536	1664	1792	1920	96	'
A	65	1028	1156	1284	1412	1540	1668	1796	1924	97	a
B	66	1032	1160	1288	1416	1544	1672	1800	1928	98	b
C	67	1036	1164	1292	1420	1548	1676	1804	1932	99	c
D	68	1040	1168	1296	1424	1552	1680	1808	1936	100	d
E	69	1044	1172	1300	1428	1556	1684	1812	1940	101	e
F	70	1048	1176	1304	1432	1560	1688	1816	1944	102	f
G	71	1052	1180	1308	1436	1564	1692	1820	1948	103	g
H	72	1056	1184	1312	1440	1568	1696	1824	1952	104	h
I	73	1060	1188	1316	1444	1572	1700	1828	1956	105	i
J	74	1064	1192	1320	1448	1576	1704	1832	1960	106	j
K	75	1068	1196	1324	1452	1580	1708	1836	1964	107	k
L	76	1072	1200	1328	1456	1584	1712	1840	1968	108	l
M	77	1076	1204	1332	1460	1588	1716	1844	1972	109	m
N	78	1080	1208	1336	1464	1592	1720	1848	1976	110	n
O	79	1084	1212	1340	1468	1596	1724	1852	1980	111	o
P	80	1088	1216	1344	1472	1600	1728	1856	1984	112	p
Q	81	1092	1220	1348	1476	1604	1732	1860	1988	113	q
R	82	1096	1224	1352	1480	1608	1736	1864	1992	114	r
S	83	1100	1228	1356	1484	1612	1740	1868	1996	115	s
T	84	1104	1232	1360	1488	1616	1744	1872	2000	116	t
U	85	1108	1236	1364	1492	1620	1748	1876	2004	117	u
V	86	1112	1240	1368	1496	1624	1752	1880	2008	118	v
W	87	1116	1244	1372	1500	1628	1756	1884	2012	119	w
X	88	1120	1248	1376	1504	1632	1760	1888	2016	120	x
Y	89	1124	1252	1380	1508	1636	1764	1892	2020	121	y
Z	90	1128	1256	1384	1512	1640	1768	1896	2024	122	z
[	91	1132	1260	1388	1516	1644	1772	1900	2028	123	{
\	92	1136	1264	1392	1520	1648	1776	1904	2032	124	:
]	93	1140	1268	1396	1524	1652	1780	1908	2036	125	}
∧	94	1144	1272	1400	1528	1656	1784	1912	2040	126	~
—	95	1148	1276	1404	1532	1660	1788	1916	2044	127	RUBOUT (DEL)

DEC. ⟶	40	41	42	43	44	45	46	47
ASCII ⟶	(	)	*	+	,	—	.	/

High Order X & Y

@

Table D-1 (cont)

COORDINATE CONVERSION CHART

Low Order X		X or Y Coordinate								Low Order Y	
ASCII	**DEC.**									**DEC.**	**ASCII**
@	64	2048	2176	2304	2432	2560	2688	2816	2944	96	'
A	65	2052	2180	2308	2436	2564	2692	2820	2948	97	a
B	66	2056	2184	2312	2440	2568	2696	2824	2952	98	b
C	67	2060	2188	2316	2444	2572	2700	2828	2956	99	c
D	68	2064	2192	2320	2448	2576	2704	2832	2960	100	d
E	69	2068	2196	2324	2452	2580	2708	2836	2964	101	e
F	70	2072	2200	2328	2456	2584	2712	2840	2968	102	f
G	71	2076	2204	2332	2460	2588	2716	2844	2972	103	g
H	72	2080	2208	2336	2464	2592	2720	2848	2976	104	h
I	73	2084	2212	2340	2468	2596	2724	2852	2980	105	i
J	74	2088	2216	2344	2472	2600	2728	2856	2984	106	j
K	75	2092	2220	2348	2476	2604	2732	2860	2988	107	k
L	76	2096	2224	2352	2480	2608	2736	2864	2992	108	l
M	77	2100	2228	2356	2484	2612	2740	2868	2996	109	m
N	78	2104	2232	2360	2488	2616	2744	2872	3000	110	n
O	79	2108	2236	2364	2492	2620	2748	2876	3004	111	o
P	80	2112	2240	2368	2496	2624	2752	2880	3008	112	p
Q	81	2116	2244	2372	2500	2628	2756	2884	3012	113	q
R	82	2120	2248	2376	2504	2632	2760	2888	3016	114	r
S	83	2124	2252	2380	2508	2636	2764	2892	3020	115	s
T	84	2128	2256	2384	2512	2640	2768	2896	3024	116	t
U	85	2132	2260	2388	2516	2644	2772	2900	3028	117	u
V	86	2136	2264	2392	2520	2648	2776	2904	3032	118	v
W	87	2140	2268	2396	2524	2652	2780	2908	3036	119	w
X	88	2144	2272	2400	2528	2656	2784	2912	3040	120	x
Y	89	2148	2276	2404	2532	2660	2788	2916	3044	121	y
Z	90	2152	2280	2408	2536	2664	2792	2920	3048	122	z
[	91	2156	2284	2412	2540	2668	2796	2924	3052	123	{
\	92	2160	2288	2416	2544	2672	2800	2928	3056	124	:
]	93	2164	2292	2420	2548	2676	2804	2932	3060	125	}
∧	94	2168	2296	2424	2552	2680	2808	2936	3064	126	~
—	95	2172	2300	2428	2556	2684	2812	2940	3068	127	RUBOUT (DEL)
DEC. ⟶		48	49	50	51	52	53	54	55		
ASCII ⟶		0	1	2	3	4	5	6	7		

High Order X & Y

Table D-1 (cont)

COORDINATE CONVERSION CHART

Low Order X										Low Order Y	
ASCII	**DEC.**				X or Y Coordinate					**DEC.**	**ASCII**
@	64	3072	3200	3328	3456	3584	3712	3840	3968	96	`
A	65	3076	3204	3332	3460	3588	3716	3844	3972	97	a
B	66	3080	3208	3336	3464	3592	3720	3848	3976	98	b
C	67	3084	3212	3340	3468	3596	3724	3852	3980	99	c
D	68	3088	3216	3344	3472	3600	3728	3856	3984	100	d
E	69	3092	3220	3348	3476	3604	3732	3860	3988	101	e
F	70	3096	3224	3352	3480	3608	3736	3864	3992	102	f
G	71	3100	3228	3356	3484	3612	3740	3868	3996	103	g
H	72	3104	3232	3360	3488	3616	3744	3872	4000	104	h
I	73	3108	3236	3364	3492	3620	3748	3876	4004	105	i
J	74	3112	3240	3368	3496	3624	3752	3880	4008	106	j
K	75	3116	3244	3372	3500	3628	3756	3884	4012	107	k
L	76	3120	3248	3376	3504	3632	3760	3888	4016	108	l
M	77	3124	3252	3380	3508	3636	3764	3892	4020	109	m
N	78	3128	3256	3384	3512	3640	3768	3896	4024	110	n
O	79	3132	3260	3388	3516	3644	3772	3900	4028	111	o
P	80	3136	3264	3392	3520	3648	3776	3904	4032	112	p
Q	81	3140	3268	3396	3524	3652	3780	3908	4036	113	q
R	82	3144	3272	3400	3528	3656	3784	3912	4040	114	r
S	83	3148	3276	3404	3532	3660	3788	3916	4044	115	s
T	84	3152	3280	3408	3536	3664	3792	3920	4048	116	t
U	85	3156	3284	3412	3540	3668	3796	3924	4052	117	u
V	86	3160	3288	3416	3544	3672	3800	3928	4056	118	v
W	87	3164	3292	3420	3548	3676	3804	3932	4060	119	w
X	88	3168	3296	3424	3552	3680	3808	3936	4064	120	x
Y	89	3172	3300	3428	3556	3684	3812	3940	4068	121	y
Z	90	3176	3304	3432	3560	3688	3816	3944	4072	122	z
[	91	3180	3308	3436	3564	3692	3820	3948	4076	123	{
\	92	3184	3312	3440	3568	3696	3824	3952	4080	124	:
]	93	3188	3316	3444	3572	3700	3828	3956	4084	125	}
∧	94	3192	3320	3448	3576	3704	3832	3960	4088	126	~
—	95	3196	3324	3452	3580	3708	3836	3964	4092	127	RUBOUT (DEL)

DEC. ⟶		56	57	58	59	60	61	62	63
ASCII ⟶		8	9	:	;	<	=	>	?

High Order X & Y

Appendix E

IDENTIFY/STATUS WORD DECODING

The information contained in Identify or Status words is specified either in terms of binary numbers of binary flags (bits). The binary flags occupy their specified locations and indicate their status as a 0 or 1. The numbers are always expressed in binary and are always right justified (pushed to the right as much as possible) in the indicated portion of the word. The most significant bit in a word is labeled 15 and the least significant bit is labeled 0.

When an Identify/Status word is transmitted, the current flag or numeric values within the word are treated together as a 16-bit binary integer. This integer is encoded for output transmission as described in Section 6 (Plotter Communications). When the transmitted value is received by the host computer, the transmitted bytes are reconverted into a 16-bit binary number. Then the individual flags and numbers may be recovered from the word as shown in the following example:

Identify Word 2 would appear as shown below for 8K of installed RAM and firmware version 1:

Bit Position	15 (MSB), 14, 13, 12, 11, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, 0 (LSB)
Binary Value	0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1
Octal Value	004001
Hex Value	0801
Decimal Value	02049

The desired groups of bits may be extracted by appropriate masking and shifting operations. Once the binary number is obtained, it can be converted to decimal for further use.

Appendix F

ASCII CODE CHART

B7 B6 B5				Ø Ø Ø	Ø Ø 1	Ø 1 Ø	Ø 1 1	1 Ø Ø	1 Ø 1	1 1 Ø	1 1 1
BITS				CONTROL		HIGH X & Y GRAPHIC INPUT		LOW X		LOW Y	
B4	B3	B2	B1								
Ø	Ø	Ø	Ø	NUL 0	DLE 16	SP 32	0 48	@ 64	P 80	\ 96	p 112
Ø	Ø	Ø	1	SOH 1	DC1 17	! 33	1 49	A 65	Q 81	a 97	q 113
Ø	Ø	1	Ø	STX 2	DC2 18	" 34	2 50	B 66	R 82	b 98	r 114
Ø	Ø	1	1	ETX 3	DC3 19	# 35	3 51	C 67	S 83	c 99	s 115
Ø	1	Ø	Ø	EOT 4	DC4 20	$ 36	4 52	D 68	T 84	d 100	t 116
Ø	1	Ø	1	ENQ 5	NAK 21	% 37	5 53	E 69	U 85	e 101	u 117
Ø	1	1	Ø	ACK 6	SYN 22	& 38	6 54	F 70	V 86	f 102	v 118
Ø	1	1	1	BEL 7	ETB 23	' 39	7 55	G 71	W 87	g 103	w 119
1	Ø	Ø	Ø	BS 8	CAN 24	(40	8 56	H 72	X 88	h 104	x 120
1	Ø	Ø	1	HT 9	EM 25	) 41	9 57	I 73	Y 89	i 105	y 121
1	Ø	1	Ø	LF 10	SUB 26	* 42	: 58	J 74	Z 90	j 106	z 122
1	Ø	1	1	VT 11	ESC 27	+ 43	; 59	K 75	[91	k 107	{ 123
1	1	Ø	Ø	FF 12	FS 28	, 44	< 60	L 76	\ 92	l 108		124
1	1	Ø	1	CR 13	GS 29	- 45	= 61	M 77	] 93	m 109	} 125
1	1	1	Ø	SO 14	RS 30	. 46	> 62	N 78	∧ 94	n 110	~ 126
1	1	1	1	SI 15	US 31	/ 47	? 63	O 79	_ 95	o 111	RUBOUT (DEL) 127

2670-50

Appendix G

DEFAULT PAGE, VIEWPORT AND WINDOW COORDINATES

MAXIMUM X AND Y COORDINATES FOR GIVEN ASPECT RATIOS (MINIMUM = Ø,Ø)

INITIAL ASPECT RATIO

INITIAL PAGE SIZE AND PAGE FORMAT			FULL PAGE Page/Viewport/Window	3X:2Y Viewport	3X:2Y Window	4X:3Y (4096/3124) Viewport	4X:3Y Window	1X:1Y Viewport	1X:1Y Window	3X:4Y (3124/4096) Viewport	3X:4Y Window	2X:3Y Viewport	2X:3Y Window
A-DRAFTING 10.5" x 7.74"	ADU	X	4096	4096	4096	3958.77	4096	3019.34	4096	2302.83	3124	2012.89	2730.67
		Y	3019.23	2730.67	2730.67	3019.34	3124	3019.34	4096	3019.34	4096	3019.34	4096
	GDU	X	135.66	135.66	150	131.11	131.11	100	100	76.27	100	66.67	100
		Y	100	90.44	100	100	100	100	100	100	131.11	100	150
	MM	X	266.7	266.7	266.7	257.8	257.8	196.6	196.6	149.9	149.9	131.1	131.1
		Y	196.6	177.8	177.8	196.6	196.6	196.6	196.6	196.6	196.6	196.6	196.6
A-GRAPHING 10" x 7"	ADU	X	4096	4096	4096	3759.30	4096	2867.20	4096	2186.80	3124	1911.47	2730.67
		Y	2867.20	2730.67	2730.67	2867.20	3124	2867.20	4096	2867.20	4096	2867.20	4096
	GDU	X	142.86	142.86	150	131.11	131.11	100	100	76.27	100	66.67	100
		Y	100	95.24	100	100	100	100	100	100	131.11	100	150
	MM	X	254.0	254.0	254.0	233.1	233.1	177.8	177.8	135.6	135.6	118.5	118.5
		Y	177.8	169.3	169.3	177.8	177.8	177.8	177.8	177.8	177.8	177.8	177.8
B-DRAFTING 15.76" x 12.24"	ADU	X	4096	3992.04	4096	3489.41	4096	2661.36	4096	2092.81	3124	1774.24	2730.67
		Y	2661.36	2661.36	2730.67	2661.36	3124	2661.36	4096	2661.36	4096	2661.36	4096
	GDU	X	153.91	150	150	131.11	131.11	100	100	76.27	100	66.67	100
		Y	100	100	100	100	100	100	100	100	131.11	100	150
	MM	X	400.3	390.1	390.1	341.0	341.0	260.1	260.1	198.4	198.4	173.4	173.4
		Y	260.1	260.1	260.1	260.1	260.1	260.1	260.1	260.1	260.1	260.1	260.1
B-GRAPHING 15" x 10"	ADU	X	4096	4096	4096	2580.29	4096	2732.67	4096	2082.67	3124	1820.44	2730.67
		Y	2730.67	2730.67	2730.67	2730.67	3124	2730.67	4096	2730.67	4096	2730.67	4096
	GDU	X	150	150	150	131.11	131.11	100	100	76.27	100	66.67	100
		Y	100	100	100	100	100	100	100	100	131.11	100	150
	MM	X	381.0	381.0	381.0	233.0	233.0	254.0	254.0	193.7	193.7	169.3	169.3
		Y	254.0	254.0	254.0	254.0	254.0	254.0	254.0	254.0	254.0	254.0	254.0

MAXIMUM X AND Y COORDINATES FOR GIVEN ASPECT RATIOS

INITIAL ASPECT RATIO (MINIMUM = 0,0)

INITIAL PAGE SIZE AND PAGE FORMAT			FULL PAGE Page Viewport Window	3X:2Y Viewport	3X:2Y Window	4X:3Y (4096/3124) Viewport	4X:3Y Window	1X:1Y Viewport	1X:1Y Window	3X:4Y (3124/4096) Viewport	3X:4Y Window	2X:3Y Viewport	2X:3Y Window
C-DRAFTING 21" x 15.5"	ADU	X	4096	4096	4096	3963.89	4096	3124	4096	2305.81	3124	2015.49	2730.67
		Y	3023.24	2730.67	2730.67	3023.24	3124	3124	4096	3023.24	4096	3023.24	4096
	GDU	X	135.48	135.48	150	131.11	131.11	100	100	76.27	100	66.67	100
		Y	100	90.32	100	100	100	100	100	100	131.11	100	150
	MM	X	533.4	533.4	533.4	516.2	516.2	393.7	393.7	300.0	300.0	262.5	262.5
		Y	393.7	355.6	355.6	393.7	393.7	393.7	393.7	393.7	393.7	393.7	393.7
C-GRAPHING 20.5" x 16"	ADU	X	4096	4096	4096	4096	4096	3196.88	4096	2438.24	3124	2131.25	2730.67
		Y	3196.88	2730.67	2732.67	3124	3124	3196.88	4096	3196.88	4096	3196.88	4096
	GDU	X	128.3	128.3	150	128.13	131.11	100	100	76.27	100	66.67	100
		Y	100	85.42	100	97.72	100	100	100	100	131.11	100	150
	MM	X	520.7	520.7	520.7	520.7	520.7	406.4	406.4	310.0	310.0	270.9	270.9
		Y	406.4	347.1	397.1	347.1	347.1	406.4	406.4	406.4	406.4	406.4	406.4
A2-DRAFTING 22.60" x 15.75"	ADU	X	4096	4096	4096	3742.46	4096	2854.36	4096	2177.00	3124	1902.90	2370.67
		Y	2854.36	2730.67	2730.67	2854.36	3124	2854.36	4096	2854.36	4096	2854.36	4096
	GDU	X	143.50	143.50	150	131.11	131.11	100	100	76.27	200	66.67	100
		Y	100	95.67	100	100	100	100	100	100	131.11	100	150
	MM	X	574.0	574.0	574.0	524.5	524.5	400.0	400.0	305.1	305.1	266.7	266.7
		Y	400.0	382.67	382.67	400.0	400.0	400.0	400.0	400.0	400.0	400.0	400.0
A2-GRAPHING 22.20" x 15.75"	ADU	X	4096	4096	4096	3808.81	4096	2904.96	4096	2215.50	3124	1936.64	2730.67
		Y	2904.96	2730.67	2730.67	2904.96	3124	2904.96	4096	2904.96	4096	2904.96	4096
	GDU	X	141.00	141.00	150	131.11	131.11	100	100	76.27	100	66.67	100
		Y	100	94.00	100	100	100	100	100	100	131.11	100	150
	MM	X	564.0	564.0	564.0	524.5	524.5	400.0	400.0	305.1	305.1	266.7	266.7
		Y	400.0	376.0	376.0	400.0	400.0	400.0	400.0	400.0	400.0	400.0	400.0

MAXIMUM X AND Y COORDINATES FOR GIVEN ASPECT RATIOS (MINIMUM = Ø,Ø)

INITIAL ASPECT RATIO

INITIAL PAGE SIZE AND PAGE FORMAT		FULL PAGE Page Viewport Window	3X:2Y Viewport	3X:2Y Window	4X:3Y (4096/3124) Viewport	4X:3Y Window	1X:1Y Viewport	1X:1Y Window	3X:4Y (3124/4096) Viewport	3X:4Y Window	2X:3Y Viewport	2X:3Y Window
A3-DRAFTING 15.75" x 10.91"												
ADU	X	4096	4096	4096	3719.02	4096	2836.48	4096	2163.37	3124	1890.99	2730.67
	Y	2836.98	2730.67	2730.67	2836.48	3124	2836.48	4096	2836.48	4096	2836.48	4096
GDU	X	144.40	144.40	150	131.11	131.11	100	100	76.27	100	66.67	100
	Y	100	96.27	100	100	100	100	100	100	131.11	100	150
MM	X	400.0	400.0	400.0	363.2	363.2	277.0	277.0	211.3	211.3	184.7	184.7
	Y	277.0	266.67	266.67	277.0	277.0	277.0	277.0	277.0	277.0	277.0	277.0
A3-GRAPHING 15.35" x 10.91												
ADU	X	4096	4096	4096	3814.38	4096	2909.21	4096	2218.84	3124	1939.47	2730.67
	Y	2909.21	2730.67	2730.67	2909.21	3124	2909.21	4096	2909.21	4096	2909.21	4906
GDU	X	140.79	140.79	150	131.11	131.11	100	100	76.27	100	66.67	100
	Y	100	93.86	100	100	100	100	100	100	131.11	100	150
MM	X	390.0	390.0	390.0	363.2	363.2	277.0	277.0	211.3	211.3	184.7	184.7
	Y	277.0	260.0	260.0	277.0	277.0	277.0	277.0	277.0	277.0	277.0	277.0
A4-DRAFTING 10.91" x 7.48"												
ADU	X	4096	4096	4096	3863.69	4096	2809.53	4096	2142.82	3124	1873.02	2730.67
	Y	2809.53	2730.67	2730.67	2809.53	3124	2809.53	4096	2809.53	4096	2809.53	4096
GDU	X	145.79	145.79	150	131.11	131.11	100	100	76.27	200	66.67	100
	Y	100	97.19	100	100	100	100	100	100	131.11	100	150
MM	X	277.0	277.0	277.0	249.1	249.1	190.0	190.0	144.9	144.9	126.7	126.7
	Y	190.0	184.7	184.7	190.0	190.0	190.0	190.0	190.0	190.0	190.0	190.0
A4-GRAPHING												
ADU	X	4096	4096	4096	3586.75	4096	2735.60	4096	2086.43	3124	1823.73	2730.67
	Y	2735.60	2730.59	2730.67	2735.60	3124	2735.60	4096	2735.60	4096	2735.60	4096
GDU	X	149.73	149.73	150	131.11	131.11	100	100	76.27	100	66.67	100
	Y	100	99.82	100	100	100	100	100	100	131.11	100	150
MM	X	277.0	277.0	277.0	242.6	242.6	185.0	185.0	141.1	141.1	123.3	123.3
	Y	185.0	184.7	184.7	185.0	185.0	185.0	185.0	185.0	185.0	185.0	185.0

Appendix H

4663 OPTION 30 INSTALLATION
AND OPERATION

Option 30, which connects the 4663 to the 4081 Graphic System, consists of an interface card and cable. This appendix describes how to connect the 4663 Plotter with the 4081 Graphic System and discusses ways to output graphics or alphanumerics to the Plotter from the 4081.

OPTION 30 SOFTWARE SUPPORT

4081 software support for the 4663 Plotter transfers alphanumeric characters and graphic data to the 4663. Essentially the software support for the 4663 Plotter allows the 4663 to do the same things as the TEKTRONIX 4662 Interactive Digital Plotter, with a few additions. These additions include:

    drawing dashed lines, both relative and absolute
    plotting with pen 1 or pen 2
    advancing or changing the media

When the Plotter is in SHEET mode, the media advance or change option pauses to allow a new sheet of paper to be placed on the platen. If the Plotter is in ROLL mode (with Option 36 in the 4663), the media advance or change option automatically advances the media the length defined by the Parameter Entry card selection, INITIAL PAGE SIZE.

AVAILABILITY OF OPTION 30 SOFTWARE SUPPORT

As of May, 1979, the 4081 software support for the 4663 Option 30 hardware (which supports dashed lines, pen selection, and change of paper) is available from your systems analyst.

The VER 4 LEV 03 software release will include the software support for the Option 30 hardware. Specifically, the software support will be included on the cartridge tape:

PLOT 80 Programming Support Sysgen
P/N 020-0375-03 or higher

OPTION 30 HARDWARE

The Option 30 hardware and its installation procedure is described starting on page page H-16.

SYSGEN CONSIDERATIONS

When creating an operating system to support a Plotter, the following SYSGEN (system generation) question must be answered with a 1.

Number of plotters(Def= 0)

The next question:

4663 (C Size) Plotter(Def= NO)?

when answered YES includes in the operating system the additional support needed by the 4663 to draw dashed lines, change or advance the media and plot with either pen 1 or pen 2. The default NO response results in an operating system which supports a 4662 (B size plotter) or a 4663 without dashed lines, media advance or 2 pens.

The file SPL.RIP must be on the system device if the operating system is to support the PLOT GOS utility program. This file may be copied from GOS.LIB on the PLOT 80 Programming Support SYSGEN tape cartridge or from the SYSGEN USR device.

4663 AND 4662 HARDWARE AND OPERATING SYSTEMS

The TEKTRONIX 4662 Interactive Digital Plotter is a B size plotter which can be driven by the 4081. The interface card which drives the 4662 Plotter will also drive the 4663 Interactive Digital Plotter.

An operating system which is generated using VER 4 LEV 02 (also VER 4 LEV 00 and 01) software will drive both the 4662 and the 4663 Plotters. However, dashed lines, page advance and the selection of pen 1 and pen 2 on the 4663 are not supported.

An operating system which is generated using VER 4 LEV 03 software with the sysgen question:

4663 (C Size) Plotter(Def= NO)?

answered yes, will support ONLY the 4663 Plotter; the operating system WILL NOT support the 4662 Plotter. If this question is answered no, the operating system will support the 4662 and the 4663, but dashed lines, selection of pens and page advance or change on the 4663 will not be supported. Note that only one plotter may be attached to the 4081 at any one time.

PROGRAMMED OPERATION OF THE 4663 FROM THE 4081

The 4663 Plotter may be run from the 4081 under the control of an assembly language program or a FORTRAN program using either the Run Time Library (RTL) or the Distributed Graphics Library (DGL). It is also possible to output PDB files using GFM. The PLOT GOS utility program outputs PLT files directly to the 4663. PLT files may also be output to the Plotter using the COPY utility program, for example:
COPY PL:= filename.PLT;B

4663 INITIALIZATION

Using the Parameter Entry card on the lower left side of the 4663 front panel, check, and set as necessary, the following parameter values.

PARAMETER	SELECTION
SETUP SELECT	SETUP 1
MEDIA FORM	User may select; however, roll mode requires 4663 Option 36, media advance
INITIAL PAGE SIZE	Dependent on page size
INITIAL PAGE FORMAT	DRAFTING
PAGE ORIENTATION	HORIZONTAL
INITIAL ASPECT RATIO	FULL PAGE
INITIAL AXIS ORIENTATION	Y $\llcorner\!\!\to$ X
LINE QUALITY	User may select quality desired
PEN PARAMETER ACCESS	Depends on pen used
PEN TYPE	Depends on pen used
PEN PRESSURE	Depends on pen used
PEN VELOCITY LIMIT	FULL SPEED AXIAL
ALPHA CHARACTER QUALITY	User may select quality desired
INTERFACE SELECT	1
INITIAL COMMAND/ RESPONSE FORMAT	3
GPIB DEVICE ADDRESS	Not Applicable
INTERFACE MODE	Not Applicable
INTERFACE FUNCTIONS	Not Applicable
SERIAL DEVICE ADDRESS	A
RECEIVE BAUD RATE	1200
TRANSMIT BAUD RATE	1200

TRANSMIT BAUD	FULL
RATE LIMIT	SPEED
CHARACTER FORMAT	8 DATA BITS/CHAR, 1 STOP BIT
RECEIVE PARITY	IGNORE
TRANSMIT PARITY	LOGIC 0
COMMUNICATIONS CONTROL MODE	FULL DUPLEX
DC1/DC3 CONTROL	Turn off
INTERFACE FUNCTIONS	CR GENERATES LF
ATTENTION CHARACTER	ESC
OUTPUT TERMINATOR	CR

When column 3 is specified as the INITIAL COMMAND/RESPONSE FORMAT parameter, the DRAW POINT light on the control panel of the 4663 turns on.

The switches labelled OFF LINE/ON LINE and LOCAL/REMOTE on the front panel of the 4663 should both be lit.

An illustration of the 4663 Parameter Entry card follows. The required parameter settings for operation with the 4081 are shaded.

EXECUTE SELF TEST	1	2	3	4	5	6	7	8
ERROR DATA	ERROR CODE	ERROR COUNT	1	2	3	4	5	6
				ERROR PARAMETERS				
OUTPUT TERMINTOR	CR	CR & EOT	NONE					
ATTENTION CHARACTER	ESC	!	^	SYN				
INTERFACE FUNCTIONS	AUTO MUTE	CR GENERATES LF		DEL IGNORE	CARRIER DETECT			
DC1/DC3 CONTROL	INPUT	OUTPUT						
COMMUNICATIONS CONTROL MODE	FULL DUPLEX	HARDWARE RECEIVE FLAGGING						
RECEIVE PARITY TRANSMIT PARITY	ODD ODD	EVEN EVEN	IGNORE LOGIC O	IGNORE LOGIC 1				
CHARACTER FORMAT	7	8	1	2				
	DATA BITS/CHAR		STOP BITS					
TRANSMIT BAUD RATE LIMIT	50	75	110	300	600	1200	FULL SPEED	
	50	75	134.5	150	1800	1X EXT	16X EXT	64X EXT
TRANSMIT BAUD RATE	110	300	600	1200	2400	4800	9600	
	50	75	134.5	150	1800	1X EXT	16X EXT	64X EXT
RECEIVE BAUD RATE	110	300	600	1200	2400	4800	9600	
SERIAL DEVICE ADDRESS	A	B	C	D	E	F	G	H
INTERFACE FUNCTIONS	CR GENERATES LF							
INTERFACE MODE	NORMAL	LISTEN ONLY	TALK ONLY					
GPIB DEVICE ADDRESS	1	2	3	4	5	6	7	8
INITIAL COMMAND/ RESPONSE FORMAT	1	2	3	4	5	6	7	8
INTERFACE SELECT	1				2			
ALPHA CHARACTER QUALITY	NORMAL	ENHANCED						
PEN VELOCITY LIMIT	6 IPS	8 IPS	10 IPS	12 IPS	14 IPS	16 IPS	FULL SPEED	
			VECTOR				AXIAL	
PEN PRESSURE	5 GM	10 GM	15 GM	20 GM	25 GM	30 GM	35 GM	40 GM
PEN TYPE	FIBER TIP	LIQUID INK	LIQUID BALL					
PEN PARAMETER ACCESS	PEN 1	PEN 2						
LINE QUALITY	PREVIEW	NORMAL	1	2				
			ENHANCED					
INITIAL AXIS ORIENTATION								
INITIAL ASPECT RATIO	FULL PAGE	3X:2Y	4X:3Y	1X:1Y	3X:4Y	2X:3Y		
PAGE ORIENTATION	HORIZONTAL		VERTICAL					
INITIAL PAGE FORMAT	DRAFTING	GRAPHING						
INITIAL PAGE SIZE	C	B	A	A2	A3	A4	RECALL	SAVE
		ENGLISH		METRIC			USER DEFINED	
MEDIA FORM	SHEET	ROLL						
PARAMETER SETUP SELECT	SETUP 1	SETUP 2	SETUP 3	SETUP 4				

4663   **PARAMETER ENTRY CARD**

2670-51

INITIALIZING THE 4081

Load an operating system which was created to support a 4663 Plotter.

OPERATING THE 4663 WITH THE 4081

The 4663 can plot alphanumeric or graphic data transmitted by the 4081 and can transmit coordinates to the 4081 from the Plotter's joystick (GIN).

ASSEMBLY LANGUAGE

Output to the Plotter may be programmed from assembly language using SVC1 or SVC15. SVC15 (Graphic Transform Package) uses many of the same op codes as SVC 1. The second byte (byte 1) of an SVC15 command must identify the logical unit (assigned by SVC4 assign instruction) to which the command refers.

Programming for the Plotter Using SVC1

SVC1 (Device Independent I/O) is used to transfer a block of data between the 4081 and peripheral devices. The function byte within the parameter block controls the type of operation performed by SVC1.

The function byte has the following format:

BIT NUMBER

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

- ALWAYS 0
- ALWAYS 0
- ALWAYS 0
- 1 = WAIT
  0 = PROCEED
- 0 = ASCII
  1 = BINARY
- 1 = WRITE
- 1 = READ
- DATA TRANSFER (ALWAYS 0)
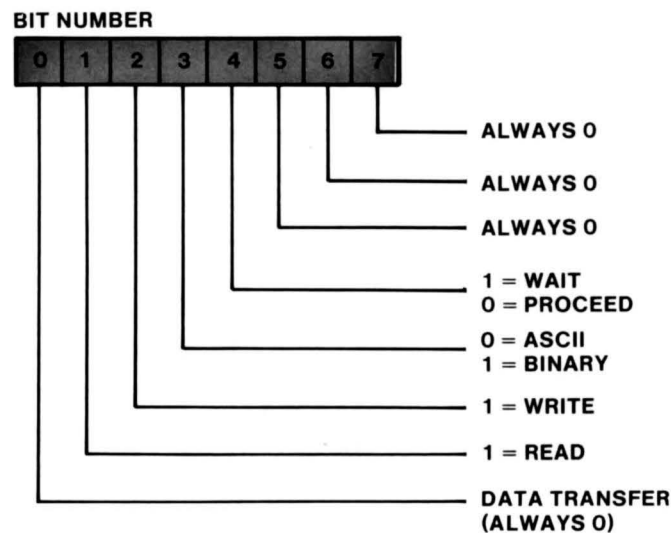
2670-52

@

Write

When transferring data to the Plotter, Bit 2 of the function byte must be set. Bit 3 of the function byte determines whether data is sent as ASCII characters or as binary graphic data. If bit 3 is not set, the contents of the buffer are plotted as ASCII characters. If bit 3 of the function byte is set, graphic commands and data are transmitted.

The ASCII characters which are accepted by the Plotter include the 95 ASCII printing characters plus BEL, BS, CR, FF, HT, LF, and VT control characters.

Table H-1 lists the ASCII character functions. ASCII control characters which are not listed are ignored by the 4663 Plotter.

Table H-2 lists the SVC 1 op codes which are recognized by the Plotter as graphic commands (bit 3 of the function byte is set). Arguments needed by the graphic command are placed in the SVC 1 buffer after the op code. SVC1 op codes which are not included in Table H-2 are ignored by the Plotter.

Table H-1

ASCII CHARACTERS

Characters	Function
ASCII Printing Characters	All ASCII printing characters are drawn on the plotting surface unless they are part of a command sequence.
BEL	Rings the bell on the Plotter.
BS (Back Space)	Causes the pen carriage to move back one currently defined character space.
CR (Carriage Return)	Causes the pen carriage to move back to the currently-defined left margin on the present line.
FF (Form Feed)	Causes the pen to move to the HOME position, one character line-space below the upper-left corner of the currently defined page.
HT (Horizontal Tab)	Causes the pen carriage to move ahead one currently-defined character space on the present line. Same movement results from a SPACE character.

Table H-1 (cont)

ASCII CHARACTERS

Characters	Function
LF (Line Feed)	Moves the pen carriage down one currently-defined line space.
SI (Shift In)	Causes the Plotter to activate the Standard Font.
SO (Shift Out)	Causes the Plotter to activate the Alternate Font.
VT (Vertical Tab)	Causes the pen carriage to move up one currently-defined line space.
SPACE	The SPACE character causes the pen carriage to move ahead one currently-defined character space on the present line.

Table H-2

SVC1 OP CODES AND PARAMETER BLOCK

Function	Result	Opcode LU	Arguments	
NO-OP	No action	0		
END OF BUFFER	Stop process'g op codes	6		
DIRECT POINT	Point to desired location	E	Virt X	Virt Y
DIRECT DASH	Dash to desired location	F	Virt X	Virt Y
DIRECT MOVE	Move to desired location	10	Virt X	Virt Y
DIRECT DRAW	Draw to desired location	11	Virt X	Virt Y
INTENSITY	Selects pen	12	1,3 for pen 1; 2,4 for pen 2	

@

Table H-2 (cont)

SVC1 OP CODES AND PARAMETER BLOCK

Function	Result	Opcode	LU	Arguments	
DASHTYPE	Sets 12 position rotating dash pattern	13	Obj #	Dashtype	
CHARACTER SIZE	Set Plotter character size to n where n= 1 to 10	16		Character size	
MAKE COPY	See note	1F			
ERASE	Moves pen to "Load" position, turns on DRAW POINT light and rings bell. Load paper, and press DRAW POINT button to continue operation.	20			
RELATIVE POINT	Point relative to present location	22		Virt X	Virt Y
RELATIVE DASH	Dash relative to present location	23		Virt X	Virt Y
RELATIVE MOVE	Move relative to present location	24		Virt X	Virt Y
RELATIVE DRAW	Draw relative to present location	25		Virt X	Virt Y

NOTE

If the media advance option (Option 36) is installed in the 4663 and ROLL mode is in effect, SVC 1 op code 1F moves the pen to the load position, turns on both LOCATE Lights and advances the media the defined length. Plotting then continues; the user does not need to do anything.

If SHEET mode is in effect or if the paper advance option is not installed in the 4663, SVC 1 op code 1F moves the pen to the load position, turns on both LOCATE Lights, blinks the MEDIA CHANGE light and turns off the electrostatic hold down. The user may change the paper. To continue plotting, press the MEDIA CHANGE button.

Read

The Read (Graphic Input) function allows the Plotter to return pen coordinates to the 4081. Only Locator Mode, which reads a single point at a time, can be used. A cursor is selected by setting bit 5 of the function byte and specifying the object number of the cursor in the last halfword of the SVC1 parameter block. If the cursor definition halfword is zero, the standard crosshair cursor is specified. When a cursor is specified, the initial GIN position is the cursor's setpoint. When no cursor is specified, the initial X,Y GIN location is 0,0. However, if bit 7 is set, the third and fourth halfword of the SVC1 parameter block define the initial X,Y position. The function byte for a read operation is as follows:


```
0 1 2 3 4 5 6 7
```

0=DEFAULT INITIAL POSITION
1=PARAMETER BLOCK DEFINES
    INITIAL POSITION

1 = NO DEFAULT TERMINATOR
0 = USE DEFAULT TERMINATOR

1 = CURSOR
0 = NO CURSOR

1 = WAIT
0 = PROCEED

LOCATOR (ALWAYS 1)

ALWAYS 0

READ (ALWAYS 1)

COMMAND (ALWAYS 0)
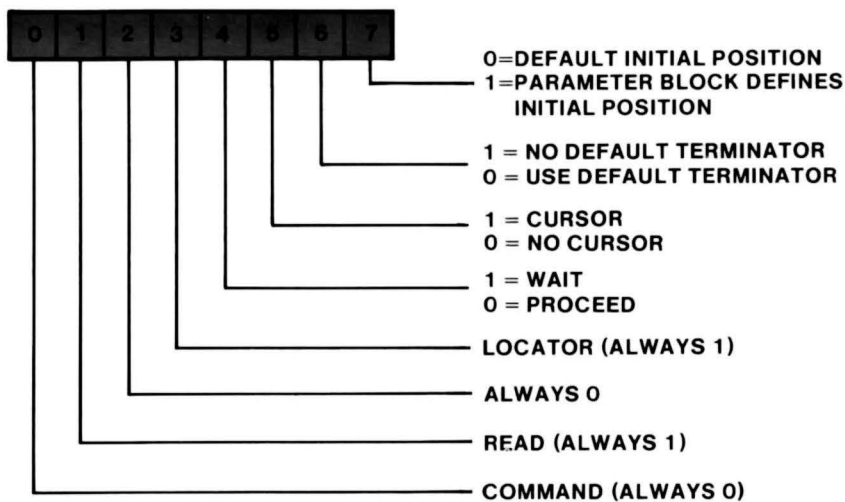
2670-53

@

A read operation involving the Plotter blinks the DRAW POINT light on the Plotter control panel. Use the joystick to position the pen over the desired point and then press the DRAW POINT button. When the coordinates are accepted, the DRAW POINT button stops blinking. During this operation, if a cursor is specified by bit 5 of the read function byte, the cursor does not follow the pen as the pen is positioned over the desired spot. The cursor jumps from its initial position to the pen position when the DRAW POINT button is pressed.

Command

When bit 1 of the function byte is set, a command is sent to the Plotter. The function byte is:
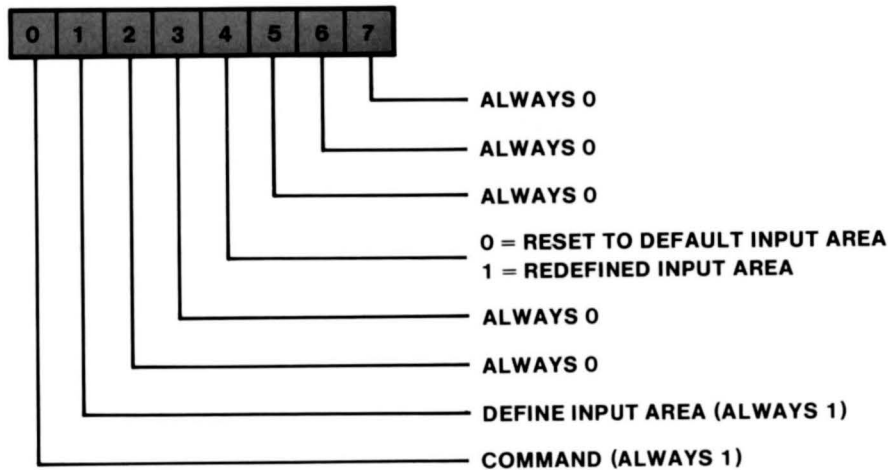
2670-54

When bit 1 and bit 4 of the function byte are both set, the plotting area of the Plotter may be redefined from its keyboard. With both bits set, the DRAW POINT light on the 4663 blinks to request user response. Using the joystick, position the pen at the lower-left corner of the desired plot area and push the DRAW POINT button. Reposition the pen to the upper-right corner of the desired plotting area and press the DRAW POINT button again. The DRAW POINT button stops blinking when the coordinates of the two points are received.

If bit 4 of the command function byte is zero, the command resets the plotting area to the default size, which is 15.5 inches (39.4 cm) by 21 inches (53.3 cm).

Redefining the plotting area using SVC1 has the same effect as using the Plotter's SET VIEWPORT LOWER LEFT and SET VIEWPORT UPPER RIGHT buttons to define the plotting area.

For additional information on SVC1 (Device Independent I/O), see the PLOT 80 GOS Programmer's Reference Manual.

Programming for the Plotter Using SVC15

SVC15 uses may of the same op codes as does SVC1. Table H-3 is a listing of the SVC15 op codes recognized by the Plotter. The second byte of an SVC15 parameter block must identify the logical unit (assigned by an SVC4 assign instruction) to which the command refers. SVC15 op codes which are not included in Table H-3 are ignored by the Plotter.

Table H-3

SVC15 OP CODES AND PARAMETER BLOCKS

Function	Result	Opcode	LU	Arguments	
DUMP	Transmit buffer	0	LU		
S2V	Converts screen coordinates to virtual coordinates	1	LU	Scrn X Virt X	Scrn Y Virt Y
V2S	Converts virtual coordinates to screen coordinates	2	LU	Virt X Scrn X	Virt Y Scrn Y
SW CHAR	Transmits vectors forming specified char	3	LU	0 Char	
END OF BUFFER	Stop process'g op codes	6			

Table H-3 (cont)

SVC15 OP CODES AND PARAMETER BLOCKS

Function	Result	Opcode	LU	Arguments	
ATTACH	Attach graphic control block to specified LU	C	LU	Address of GCB	
DIRECT POINT	Point to desired location	E	LU	Virt X	Virt Y
DIRECT DASH	Dash to desired location	F	LU	Virt X	Virt Y
DIRECT MOVE	Move to desired location	10	LU	Virt X	Virt Y
DIRECT DRAW	Draw to desired location	11	LU	Virt X	Virt Y
INTENSITY	Selects pen	12	LU	1,3 for pen 1; 2,4 for pen 2	
DASHTYPE	Sets 12 position rotating dash pattern	13	LU	Obj #	Dash-type
CHARACTER SIZE	Set Plotter character size to n where n= 1 to 10	16	LU	Character size	
SW CHAR STRING	Transmits addressed buffer of characters to Plotter	17	LU	Addr of 1st char	Addr of last char
MAKE COPY	See note	1F	LU		

Table H-3 (cont)

SVC15 OP CODES AND PARAMETER BLOCKS

Function	Result	Opcode	LU	Arguments	
ERASE	Moves pen to "Load" position, turns on DRAW POINT light and rings bell. Load paper and press DRAW POINT button to continue.	20	LU		
RELATIVE POINT	Point relative to present location	22	LU	Virt X	Virt Y
RELATIVE DASH	Dash relative to present location	23	LU	Virt X	Virt Y
RELATIVE MOVE	Move relative to present location	24	LU	Virt X	Virt Y
RELATIVE DRAW	Draw relative to present location	25	LU	Virt X	Virt Y

NOTE

If the media advance option (Option 36) is installed in the 4663 and ROLL mode is in effect, SVC 1 op code 1F moves the pen to the load position, turns on both LOCATE Lights and advances the media the defined length. Plotting then continues; the user does not need to do anything.

If SHEET mode is in effect or if the media advance option is not installed in the 4663, SVC 1 op code 1F moves the pen to the load position, turns on both LOCATE Lights, blinks the MEDIA CHANGE light and turns off the electrostatic paper hold-down. The user may change the paper. To continue plotting, press the MEDIA CHANGE button.

REFRESH AND THE 4663

When a refreshed object (RTL) or segment (DGL) is defined within a FORTRAN program, this graphic code is immediately sent to the 4663 and plotted. When this object or segment is later posted or fixed, it will not be plotted on the 4663.

For example, a program may:

    CALL OPEN(1)
    Call graphic commands...MOVE....DRAW
    CALL CLOSE

The Plotter ignores the commands CALL OPEN and CALL CLOSE. It simply sees the graphic commands and plots them. Later calls to:

    CALL POST(1)
or
    CALL FIX(1)

are ignored by the Plotter. The graphic segment is not plotted.

Within GFM when the Plotter is defined as the display device with the command:

USE DISPLAY PL0:

GFM graphic commands such as rotate, translate and scale cause the currently defined segment to be plotted.

INSTALLATION PROCEDURE

Installing the 4081 interface card and connecting the 4663 Plotter consists of:

- verifying switch and strap settings
- placing the interface card in a free slot in the 4081 card cabinet
- connecting the cable between the interface card and the Plotter.

If a Plotter (either 4662 or 4663) is ordered at the same time as the 4081, the interface card is installed in the card cabinet of the 4081. Simply connect the cable to the Plotter.

If a 4663 Plotter and Option 30 were ordered after the 4081 was ordered, the following should be done:

I. CHECK THE INTERFACE STRAPS

The straps on the 4081 interface card were set by manufacturing. Table H-4 lists the required settings of the 4081 interface card straps should you wish to check them.

Table H-4

INTERFACE CARD STRAP SETTINGS

Strap	Setting
EXT CLOCK SOURCE	INT
RS-232	C
CTS INT	Connected
EOC BUSY	NONFLAG
MODEM RATE SELECT	ALL ELSE
CTS STAT	NONFLAG
TBUSY	Not connected
TRANSMIT IMO	15
RECEIVE IMO	15
ADDRESS	X'30' (0011 00XX)
CBUSY	NONFLAG
SPLIT RATE DIVISOR	DIVIDE BY 8

SPLIT RATE DIVISOR may be labelled TBAUD.

Figure H-1 illustrates most of the strap settings for the Plotter Interface Card.
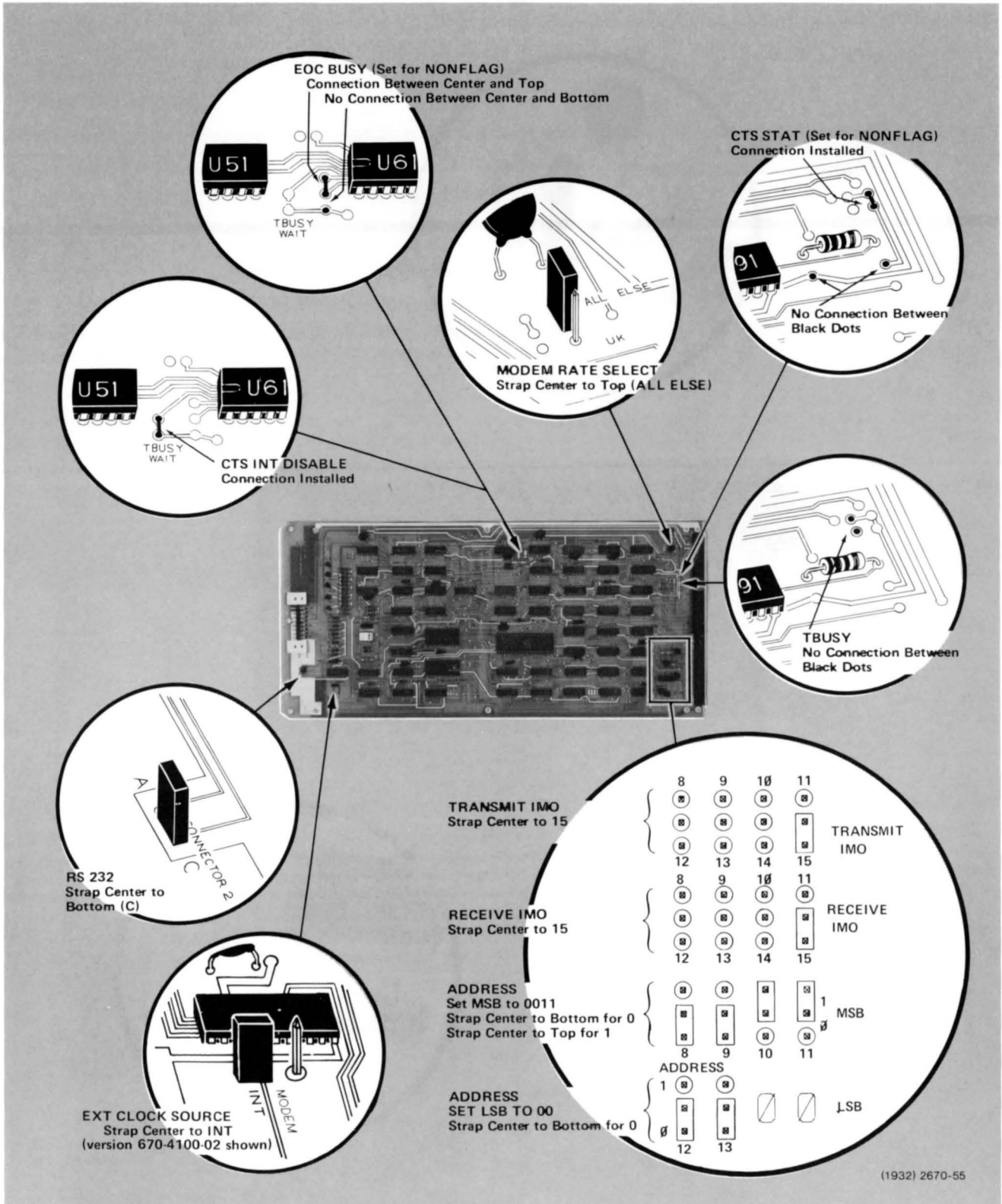
Figure H-1. Strap Settings for Plotter Interface Card.

Figure H-2 illustrates the settings of the CBUSY and SPLIT RATE DIVISOR strap options.

C BUSY (Set for NONFLAG)
Connection Between Center and Top

ALL ELSE

UK

No Connection Between Center and Bottom

CBUSY
FLAG

SPLIT RATE DIVISOR (Factory Set for ÷8)

SPLIT RATE DIVISOR
1/2/4/8/16

To set for another level (÷2, ÷4, or ÷16)
CUT top half of ÷8 run.
CONNECT selected Split Rate Divisor to
feed-through hole directly below.

SPLIT RATE DIVISOR
1/2/4/8/16

Example for ÷16 only.
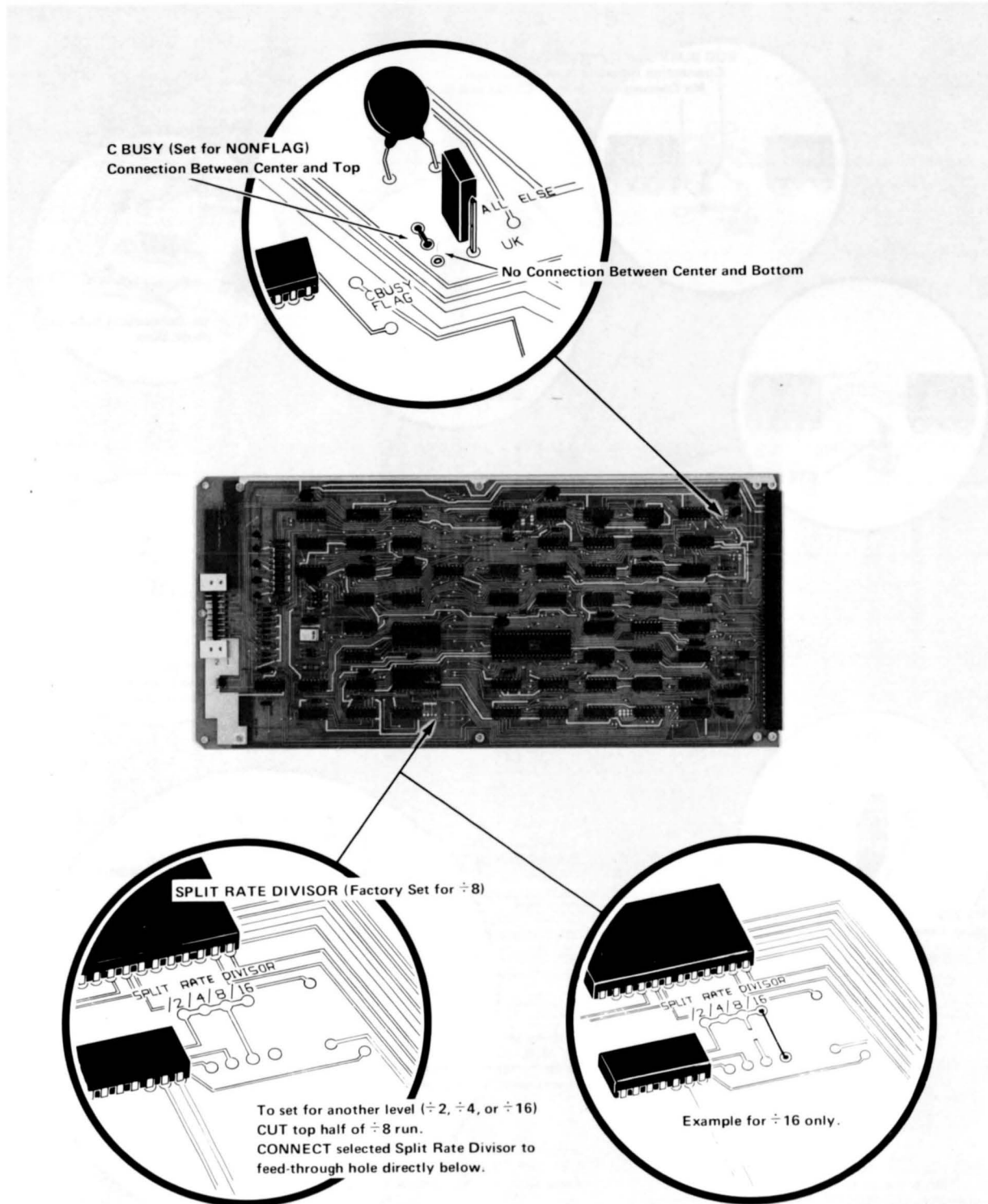
2116 (2670-56)

Figure H-2. CBUSY and SPLIT RATE DIVISOR Strap Options.

II. INSTALL THE INTERFACE CARD INTO THE 4081 CARD CABINET

CAUTION

To prevent circuit card damage, turn the 4081 system off before removing or installing circuit cards.

1. Remove the four screws on the front of the circuit card cabinet. Take off the cover, and set it aside. Remove the 4081 card cabinets's rear cover by turning each of the four fasteners 1/4 turn counterclockwise.

2. Select any unused slot in the main or secondary backplanes except the three upper-right slots in the secondary backplane (J1001,J1101, and J1201). Slide the circuit card in the selected slot. The connecting pins at the back of the board must be fully engaged. When the pins are fully engaged, the front edge of the circuit card is even with the other cards.

3. Working from the rear of the card cabinet, thread the smaller end of the interconnect cable (wires visible) over the circuit card rack toward the front on the 4081. Attach this end of the cable to the Plotter Interface Card's male connector.

4. At the rear of the card cabinet, attach the bared portion of the interface cable to chassis ground with the metal clamp provided.

5. On the rear of the backplane, remove the RACKO-TACKO strap for the slot in which the Plotter Interface Card was placed.

6. Replace the front and rear covers of the card cabinet.

III. CONNECT THE SECOND END OF THE CABLE

Plug the second (larger) end of the interconnect cable into the 4663 Plotter connector labelled RS-232-C MODEM on the back of the Plotter. Tighten the two screws. Plug in the Plotter. The Plotter may be plugged into the 4081's system power bus located at the rear of the 4081 behind the cartridge tape unit or into a power outlet. If the 4663 is plugged into the 4081, the 4663's power switch may be left on so the 4663 will turn on and off when the 4081 is turned on and off. The 4663 may also be plugged into a wall socket and turned on and off independently of the 4081.

Appendix I

COMMAND SUMMARY

SERIAL INTERFACE

Interface Commands

Device On	ATN ADD E
Device Off	ATN ADD F
Block Start	ATN ADD (
Set Turnaround Delay	ATN ADD G DELAY TIME (milliseconds)
Block End	ATN ADD) CHECKSUM VALUE
Set Block Size	ATN ADD H BLOCKSIZE (bytes)
Set Bypass Cancel Character	ATN ADD U ASCII CHARACTER
Set Signature Character	ATN ADD S ASCII CHARACTER
Set Prompt String	ATN ADD R ASCII CHARACTER STRING
Interface Parameter Reset	ATN ADD CR
Data Reset	ATN ADD CD
Select Command/Response Format	ATN ADD CC CHOICE

Device Commands

Device Reset	ATN ADD N RESET NUMBER (0-2)
Read Status	ATN ADD O STATUS REGISTER (0-3)
Read Error	ATN ADD CE
Identify	ATN ADD Q

Graphic Commands

Select Graphic Units	ATN ADD BW INCHOICE,OUTCHOICE (0,1)
Select Device Units	ATN ADD BV CHOICE (0-2)
Select Line Type	ATN ADD BL CHOICE (0-3)
Set Dash Pattern	ATN ADD BD NUMBER STRING
Set Dash Pattern Length	ATN ADD BS LENGTH (world units)
Select Pen	ATN ADD BP CHOICE (0-2)
Select Coordinate Type	ATN ADD BO CHOICE (0-1)
Page Change	ATN ADD BC
Move To Load Point	ATN ADD AI
Move	ATN ADD X X,Y(,X,Y)
DRAW	ATN ADD Y X,Y(,X,Y)
OUTLINE VIEWPORT	ATN ADD CB
MARK VIEWPORT	ATN ADD CM
AXIS	ATN ADD CA XSPACING,YSPACING,XORG,YORG

Transformation Commands

Save Current Transform	ATN ADD AX
Restore Previous Transform	ATN ADD AY
Set Origin To Current Position	ATN ADD AO
Set Rotation To Last Angle	ATN ADD AL
Set Scale	ATN ADD AS XSCALE,YSCALE (multiplier)
Set Translation	ATN ADD AT XORG,YORG
Set Skew	ATN ADD AQ XSKEW,YSKEW (degrees)
Set Rotation	ATN ADD AR ANGLE (degrees)
Set Window	ATN ADD AW LLX,URX,LLY,URY (world units)
Set Viewport	ATN ADD AV LLX,URX,LLY,URY (device units)
Select Clipping Control	ATN ADD AK CHOICE (0-1)
Read Viewport	ATN ADD CV

Alpha Commands

Set Alpha Size	ATN ADD BZ WIDTH, HEIGHT (world units based upon default window)
Set Alpha Ratio	ATN ADD BI XRATIO,YRATIO
Set Alpha Dimension	ATN ADD I CHARSPACE,LINESPACE
Set Alpha Rotation	ATN ADD J ANGLE (degrees)
Set Alpha Slant	ATN ADD BG ANGLE (degrees)
Set Alpha Scale	ATN ADD BH XSCALE,YSCALE (multiplier)
Set Tab Separation	ATN ADD BT NUMBER (multiple spaces)
Set Alpha Margin Separation	ATN ADD BR SPACES
Select Alpha Spacing Control	ATN ADD AJ CHOICE (0-1)
Select Standard Alpha Font	ATN ADD T FONT # (0-15)
Select Alternate Alpha Font	ATN ADD BQ FONT # (0-15)
Reset Alpha Parameters	ATN ADD V
Print Character	ATN ADD P STRING
Print Centered Character	ATN ADD AP ASCII CHARACTER
Move To Home	ATN ADD AH
Character Move	ATN ADD AM HSPACES,YSPACES
Set Arc Smoothness	ATN ADD BA VALUE (0.0-1.0)

Digitizing Commands

Digitize   ATN ADD M

Operator Digitize   ATN ADD AG MAXIMUM POINTS

Prompt Light On   ATN ADD K

Prompt Light Off   ATN ADD L

Joystick Axis Disable   ATN ADD BJ JOYSTICK AXIS (0-3)

Commands Associated with Plotter Options

Option 31

Draw Arc   ATN ADD AA X1,Y1,X2,Y2

Draw Circle   ATN ADD AC RADIUS

Set Arc Smoothness   ATN ADD BA VALUE (0.0-1.0)

Begin Macro Definition   ATN ADD BB MACRO NUMBER

End Macro Definition   ATN ADD BE

Expand Macro   ATN ADD AE MACRO NUMBER, MACRO NUMBER,...

Delete Macro   ATN ADD BK MARCO NUMBER, MACRO NUMBER,...

Read Macro Status   ATN ADD CN

Set Auto Macro   ATN ADD BN MACRO NUMBER

Option 32

Set Downloaded Character Size	ATN ADD CZ FONT #,XMIN,XMAX,YMIN,YMAX
Begin Character Definition	ATN ADD CN FONT #,ASCII CHARACTER
Set Character X-Extent	ATN ADD CT LEFT,RIGHT
Select Non-Advancing Character	ATN ADD CU
End Character Definition	ATN ADD CO
Delete Character Definition	ATN ADD CP FONT #,ASCII CHARACTER(S)
Delete Font Definition	ATN ADD CQ FONT #

Option 36

Advance Media	ATN ADD AU NUMBER OF INCREMENTS (1/64")
Read Formlength	ATN ADD CF
Set Formlength	ATN ADD BF NUMBER OF INCREMENTS (1/64")
Page Change	ATN ADD BC

GPIB INTERFACE COMMAND SUMMARY
IN 4051 BASIC FORMAT

The normal operating format when using the Tektronix 4051 is Format #1. The following notation is: D is the GPIB device number to which the Plotter is set. R1, R2, R3,... are command dependent numeric responses.

Interface Commands

Select Command/Response Format   PRINT@ D,32:"CC",<u>CHOICE</u>

Device Commands

Device Reset   PRINT@ D,32:"N"

Read Status   PRINT@ D,32:"V",<u>STATUS REGISTER</u> (0-3)

Read Error   PRINT@ D,32:"CE"

       INPUT@ D,32:R1,R2,R3

       INPUT@ D,32:R4, R5, R6

Identify   PRINT@ D,32:"I"

       INPUT@ D,32:R1,R2,R3

Graphic Commands

Select Graphic Units		PRINT@D,32:"BW",<u>INCHOICE</u>,<u>OUTCHOICE</u> (0-1)
Select Device Units		PRINT@D,32:"BV",<u>CHOICE</u> (0-2)
Select Line Type		PRINT@D,32:"BL",<u>CHOICE</u> (0-3)
Set Dash Pattern		PRINT@D32:"BD",<u>NUMBER STRING</u>
Set Dash Pattern Length		PRINT@D,32:"BS",<u>LENGTH</u> (world units)
Select Pen		PRINT@D,32:"BP",<u>CHOICE</u> (0-2)
Select Coordinate Type		PRINT@D,32:"BO",<u>CHOICE</u> (0-1)
Page Change		PRINT@D,32:"BC"
Move To Load Point		PRINT@D,32:"AI"
Move		PRINT@D,32:"M",<u>X</u>,<u>Y</u>(,<u>X</u>,<u>Y</u>)
	OR	MOVE@D:<u>X</u>,<u>Y</u>
	OR	PRINT@D,21:<u>X</u>,<u>Y</u>
Draw		PRINT@D,32:"D",<u>X</u>,<u>Y</u>
	OR	DRAW@D:<u>X</u>,<u>Y</u>
	OR	PRINT@D,20:<u>X</u>,<u>Y</u>
Outline Viewport		PRINT@D,32:"CB"
Mark Viewport		PRINT@D:32:"CM"
Axis		PRINT@D,32:"CA",<u>XSPACING</u>,<u>YSPACING</u>,<u>XORG</u>,<u>YORG</u>

Transformation Commands

Save Current Transform   PRINT@D,32:"AX"

Restore Previous Transform   PRINT@D,32:"AY"

Set Origin To Current Position   PRINT@D,32:"AO"

Set Rotation To Last Angle   PRINT@D,32:"AL"

Set Scale   PRINT@D,32:"AS",XSCALE,YSCALE (multiplier)

Set Translation   PRINT@D,32:"AT",XORG,YORG

Set Skew   PRINT@D,32:"AQ",XSKEW,YSKEW (degrees)

Set Rotation   PRINT@D,32:"AR",ANGLE (degrees)

Set Window   PRINT@D,32:"AW",LLX,UR,LLY,URY (world units)

Set Viewport   PRINT@D,32:"AV",LLX,UR,LLY,URY (device units)

Clipping Control   PRINT@D,32:"AK",CHOICE (0-1)

Read Viewport   PRINT@D,32:"CV"

                                                     INPUT@D,32:R1,R2,R3

                                                     INPUT@D,32:R4,R5,R6

Alpha Commands

Set Alpha Size	PRINT@D,32:"BZ",WIDTH,HEIGHT (world units based upon default window)
Set Alpha Ratio	PRINT@D,32:"BI",XRATIO,YRATIO
Set Alpha Dimension	PRINT@D,32:"S",CHARSPACE,LINESPACE
Set Alpha Rotation	PRINT@D,32:"R",ANGLE (degrees)
Set Alpha Slant	PRINT@D,32:"BG",ANGLE (degrees)
Set Alpha Scale	PRINT@D,32:"BH",XSCALE,YSCALE (multiplier)
Set Tab Separation	PRINT@D,32:"BT",NUMBER (multiple spaces)
Set Alpha Margin Separation	PRINT@D,32:"BR",SPACES
Select Alpha Spacing Control	PRINT@D,32:"AJ",CHOICE (0-1)
Select Standard Alpha Font	PRINT@D,32:"F",FONT # (0-15)
Select Alternate Alpha Font	PRINT@D,32:"BQ",FONT # (0-15)
Reset Alpha Parameters	PRINT@D,32:"A"
Print Character	PRINT@D:"TEXT STRING"
Print Centered Character	PRINT@D,32:"AP CHARACTER"
Move To Home	PRINT@D,32:"H"
Character Move	PRINT@D,32:"AM",HSPACES,YSPACES
Set Arc Smoothness	PRINT@D,32:"BA",VALUE (0.0-1.0)

Digitizing Commands

Digitize		PRINT@ D,32:"G"
		INPUT@ D,32:R1,R2,R3
	OR	GIN @ D:X,Y
Operator Digitize		PRINT@ D,32:"AG",<u>MAXIMUM POINTS</u>
Prompt Light On		PRINT@ D,32: "T",1
Prompt Light Off		PRINT@ D,32:"T",0
Joystick Axis Disable		PRINT@ D,32:"BJ",<u>JOYSTICK AXIS</u> (0-3)

Commands Associated With Plotter Options

Option 31

Draw Arc	PRINT@ D,32:"AA",<u>X1</u>,<u>Y1</u>,<u>X2</u>,<u>Y2</u>
Draw Circle	PRINT@ D,32:"AC",<u>RADIUS</u>
Set Arc Smoothness	PRINT@ D,32:"BA",<u>VALUE</u> (0.0-1.0)
Begin Macro Definition	PRINT@ D,32:"BB",<u>MACRO NUMBER</u>
End Macro Definition	PRINT@ D,32:"BE"
Expand Macro	PRINT@ D,32:"AE",<u>MACRO NUMBER</u>
Delete Macro	PRINT@ D,32:"BK",<u>MACRO NUMBER</u>
Read Macro Status	PRINT@ D,32:"CS"
	INPUT@ D,32:R1,R2,R3
	INPUT@ D,32:R4,R5,R6 (if necessary)
Set Auto Macro	PRINT@ D,32:"BN",<u>MACRO NUMBER</u>

Option 32

Set Downloaded Character Size	PRINT@D,32:"CZ",FONT #,XMIN,XMAX,YMIN,YMAX
Begin Character Definition	PRINT@D,32:"CN",FONT #,ASCII CHARACTER
Set Character X-Extent	PRINT@D,32:"CT",LEFT,RIGHT
Select Non-Advancing Character	PRINT@D,32:"CU"
End Character Definition	PRINT@D,32:"CO"
Delete Character Definition	PRINT@D,32:"CP",FONT #,ASCII CHARACTER(S)
Delete Font Definition	PRINT@D,32:"CQ",FONT #

Option 36

Advance Media	PRINT@D,32:"AU",NUMBER OF INCREMENTS (1/64")
Read Formlength	PRINT@D,32:"CF"
	INPUT@D,32:R1,R2,R3
Set Formlength	PRINT@D,32:"BF",NUMBER OF INCREMENTS (1/64")
Page Change	PRINT@D,32:"BC"

Appendix J

GPIB RESPONSES (PLOTTER TO HOST)

The 4663 normally returns three values in a message block. The response may be generated as a result of a command sent to the plotter, or by a user pressing a POINT function. The number of message blocks generated by a command (or Point Switch function) may vary.

The third value, henceforth called the tag, informs the controller when the last message block has been received. This allows the controller to begin another action, such as displaying the information or performing some computation on it.

When the tag is greater than 1, it indicates that the current response is the last. Tag values of 0 or 1 indicate that another response is forthcoming.

The two plotter functions which generate a variable number of responses are Read Macro Status and Operator Digitize. These functions return descriptions of the currently defined macros and digitized points, respectively. The tag value indication of the last response for each of these functions.

Immediate Digitize

Returns X coor, Y coor, {2.E+ 00 for pen up,
3.E+ 00 for pen down}

For formats 5 and 6:

Returns X coor, Y coor, {0.E+ 00 for pen up,
1.E+ 00 for pen down}

Read Status

Returns Status Word 1, Status Word 2, 2.E+ 00

For formats 5 and 6:

Returns Status Word N.

Identify

Returns 4.663E+ 03, Number of K bytes of RAM installed times 256 + Firmware Release Number, 2.E+ 00

For formats 5 and 6:

Returns 1.35E+ 02, 1.E+ 02, 0.E+ 00

Read Viewport

Returns two blocks of information.

1st Block: Lower Left X, Lower Left Y, 0.E+ 00
2nd Block: Upper Right X, Upper Right Y, 2.E+ 00

Read Form Length

Returns Form Length, 0.E+ 00, 2.E+ 00

Read Error

Returns two blocks of information:

1st Block: Error Code times 256 + Error Count, Error parameter 1 times 256 + Error parameter 2, 0.E+ 00

2nd Block: Error parameter 3 times 256 + Error parameter 4, Error parameter 5 times 256 + Error parameter 6, 0.E+ 00

Read Macro Status

Returns a variable number of blocks of the form:

Macro Number, Macro Storage Size, {0.E+ 00 if not last response, 2.E+ 00 if last response).

Operator Digitize

Returns a variable number of blocks of the form:

X coor, Y coor, {0.E+ 00 for Move Point,
1.E+ 00 for Draw Point, 2.E+ 00 for Last Point).

Appendix K

OPTION 32 FONT TABLES

SP 32	Ø 0 48	@ @ 64	Π P 80	` 96	π p 112
! ! 33	1 1 49	A A 65	Q Q 81	α a 97	q q 113
" ▪ 34	2 2 50	B B 66	P R 82	β b 98	ρ r 114
# # 35	3 3 51	ψ C 67	Σ S 83	ψ c 99	σ s 115
$ $ 36	4 4 52	Δ D 68	T T 84	δ d 100	τ t 116
% % 37	5 5 53	E E 69	Θ U 85	ε e 101	ϑ u 117
& & 38	6 6 54	Φ F 70	Ω V 86	φ f 102	ω v 118
′ ′ 39	7 7 55	Γ G 71	W W 87	γ g 103	ς w 119
((40	8 8 56	H H 72	X X 88	η h 104	χ x 120
)) 41	9 9 57	I I 73	ϒ Y 89	ι i 105	υ y 121
* * 42	: : 58	≡ J 74	Z Z 90	ξ j 106	ζ z 122
+ + 43	; ; 59	K K 75	[[91	κ k 107	{ { 123
, , 44	< < 60	Λ L 76	\ \ 92	λ l 108	∂	124
− − 45	= = 61	M M 77	]] 93	μ m 109	} } 125
. . 46	> > 62	N N 78	^ ^ 94	ν n 110	~ ~ 126
/ / 47	? ? 63	O O 79	— 95	o o 111	DEL 127

FONT 10

2670-65

SP 32	○ 0 48	² @ 64	∏ P 80	⁻¹ ` 96	π p 112
. ! 33	∫ 1 49	A A 65	√ Q 81	α a 97	⁻ q 113
□ ▪ 34	∴ 2 50	B B 66	P R 82	β b 98	ρ r 114
○ ≢ 35	∃ 3 51	ψ C 67	Σ S 83	ψ c 99	σ s 115
△ $ 36	⊂ 4 52	Δ D 68	T T 84	δ d 100	τ t 116
+ % 37	∪ 5 53	E E 69	Θ U 85	ε e 101	ϑ u 117
◇ & 38	⊃ 6 54	φ F 70	Ω V 86	φ f 102	ω v 118
⊠ ' 39	∩ 7 55	Γ G 71	W W 87	γ g 103	ς w 119
¤ (40	∞ 8 56	H H 72	X X 88	η h 104	χ x 120
⊕) 41	∇ 9 57	I I 73	ϒ Y 89	ι i 105	υ y 121
⊞ * 42	∶ : 58	⊒ J 74	Z Z 90	ξ j 106	ζ z 122
+ + 43	≠ ; 59	K K 75	[[91	κ k 107	ℓ { 123
⊥ , 44	≤ < 60	∧ L 76	± \ 92	λ l 108	∂ l 124
‖ − 45	≡ = 61	M M 77	]] 93	μ m 109	↓ } 125
. 46	≥ > 62	N N 78	↑ ^ 94	ν n 110	~ ~ 126
÷ / 47	∝ ? 63	O O 79	− _ 95	O o 111	DEL 127

FONT 11

2670-66

FIGURE 2-20

1. Turn ¼ turn counterclockwise to open (turn ¼ turn clockwise to close).

Paper Roll Bearings

3. Transfer the Paper Roll bearings to the new roll of paper. Note the orientation of the new roll (the paper roll bearings are not interchangeable).

Paper Roll Core (lift out left end first)

2. Push left Paper Roll Shaft to Left (against spring), freeing Paper Roll Core.

4. To insert new roll of paper, engage the right paper roll bearing cross-pin with the paper tension mechanism and then engage the left end (pushing the left paper roll shaft to the left as in #2).

Paper Tension Mechanism (with right paper roll bearing and cross-pin)

Paper Drive Sprockets

5. Pull paper across platen and under Y-Axis Arm. Notice that the paper pulls from the top of the roll. Pull the paper just past the paper drive sprockets.

2670-23

Figure 2-20. Paper Roll Replacement.

Paper Drive Sprocket Guide Cover

Paper Drive Sprocket Engaged in Paper Holes

6. Flip open the Paper Drive Sprocket Guide covers on both sides and position the paper such that the sprocket drive engages in the paper holes on each side of the paper.

7. Close the Paper Drive Sprocket Guide covers over the paper and be sure the sprocket drive still engages the paper holes on both sides of the paper.

2670-24

INDEX

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MANUAL CHANGE INFORMATION

PRODUCT _____ 4663 Operator's _____   CHANGE REFERENCE ___ C1/879 ___

MANUAL PART NO. __ 070-2670-00 _____   DATE _____ 8-20-79 ___

EFF ALL SN

TEXT ADDITION

Page 2-23, end of paragraph entitled Lower Left/Upper Right

ADD:

    Whenever the pen is outside of the current clipping limit (default is
viewport), these switches will light. For example, at power-up, the pen
moves to the load point, which is outside of the viewport; therefore,
the lights are turned on. The same is true if the clipping limit is
changed to page. Also, in either case, the plot will be clipped at the
clipping limit.

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MANUAL CHANGE INFORMATION

PRODUCT ___4663 Operator's___ CHANGE REFERENCE ___C2/979___

MANUAL PART NO. ___070-2670-00___ DATE ___9-7-79___

EFF ALL SN

TEXT ADDITION

Page vii, the next line below Appendix K OPTION 32 FONT TABLES

ADD: INDEX

PRODUCT ____4663 INTERACTIVE DIGITAL PLOTTER____   CHANGE REFERENCE __C3/1079__

MANUAL PART NO. __070-2670-00__   DATE __10-2-79__

EFF ALL SN

<div align="center">TEXT CHANGES</div>

Page 1-3, Table 1-1, Optional Replacement Points

   CHANGE TEK PART NUMBER TO READ:

   PL5 (dia=.02", .5mm)   214-2706-01
   PL8 (dia=.03", .8mm)   214-2706-02

Page 1-4, Table 1-1, Optional Ink Reservoir (6 per pkg)

   ADD TEK PART NUMBER:

   016-0649-00

Page 1-4, Table 1-1, Optional Ink

   REMOVE TEK PART NUMBER:

   016-0648-00

PRODUCT _____ 4663 INTERACTIVE DIGITAL PLOTTER _____   CHANGE REFERENCE _C4/180_

MANUAL PART NO. _070-2670-00_ _____   DATE _____ 1-16-80 _____

EFF ALL SN

TEXT CHANGES

Page 1-3, Standard Accessories
  ADD:
      Sheet Paper (17" x 22", 100 sheets/box)   006-3150-00

Page 1-5, Optional Accessories
  CHANGE TEK PART NUMBER AS FOLLOWS:
      Sheet Paper (17" x 22", 100 sheets/box)   006-3150-00

Page I-10, Print Character
  ADD:
      or PRINT D,32:"PTEXT STRING"

Tektronix
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MANUAL CHANGE INFORMATION

PRODUCT _____ 4663 INTERACTIVE DIGITAL PLOTTER _____   CHANGE REFERENCE __C5/480__

MANUAL PART NO. __070-2670-00__   DATE __4-28-80__

EFF ALL SN:

TEXT CHANGES

REPLACE THE FOLLOWING PAGES:

Pages 1-3, 1-4, 1-7, 1-8, 1-9, 1-0, 2-57, 2-58, 2-59, 2-60

ADD THE FOLLOWING NEW PAGES:

2-59-a, 2-59-b, L-1

Make note in the Index of your manual the addition of

Appendix L LIQUID INK PEN PARTS

The area of change is marked by a
"change bar" in the margin.

Table 1-1

ACCESSORIES AND OPTIONS

Accessories		Tektronix Part Number
Standard	Power Cord	161-0066-00
	Pens, Fiber Tip (for paper)	
	Red (3 each)	016-0415-00
	Black (3 each)	016-0414-00
	Blue (3 each)	016-0416-00
	Green (3 each)	016-0417-00
	RS-232-C Interface Cable	012-0829-00
	Operator's Manual	070-2670-00
	Reference Guide	070-2828-00
	Sheet Paper 17" x 22", 100 sheets/box	006-3150-00
Optional	Wet Ink Pen Assembly	
	with PL3 point (dia= .01" .3mm)	016-0444-01
	PL5 point (dia= .02", .5mm)	016-0442-02
	PL8 point (dia= .03", .8mm)	016-0443-01
	Replacement points	
	PL3 (dia= .01", .3mm)	214-2706-01
	PL5 (dia= .02", .5mm)	214-2706-02
(continued)	PL8 (dia= .03", .8mm)	214-2706-02

Table 1-1 (cont)

ACCESSORIES AND OPTIONS

Accessories		Tektronix Part Number
Optional (Continued)	Pen Replacement Part Kit	006-2968-00
	Contains: 1 cap	
	1 body section	
	1 barrel	
	1 locking nut	
	6 ink reservoirs	
	Ink Reservoir (6 per pkg)	016-0649-00
	Ink	
	For Film (3/4 oz. Squeeze bottle)	
	Black (each)	016-0427-00
	Red (each)	016-0426-00
	Green (each)	016-0424-00
	Blue (each)	016-0425-00
	Brown (each)	016-0423-00
	For Paper (3/4 oz. Squeeze Bottle)	
	Black (each)	016-0428-00
	Ball Point Pens:	
	Black (3 each)	016-0419-00
	Red (3 each)	016-0419-01
	Green (3 each)	016-0419-02
(continued)	Blue (3 each)	016-0419-03

Table 1-2

PHYSICAL CHARACTERISTICS

Weight:	Approximately 80 lbs (36.4 Kg)	
Outside Dimensions:	Length	38.0" (96.5 cm)
	Width	30.1" (76.5 cm)
	Height	6.8" (17.3 cm)

Table 1-3

POWER REQUIREMENTS

Input Power @ 115 Vac	3.5 A maximum; 2.4 A typical
Line Voltage, Strap Selectable Limits	
110 Volts	90 to 130 Volts
220 Volts	180 to 250 Volts
Line Frequency	48 to 440 Hz

Table 1-4

ENVIRONMENTAL SPECIFICATIONS

Temperature	
Non-Operating	-55 to + 75° C (-67 to 167° F)
Operating	0 to 40° C (32 to 104° F)
Altitude	
Non-operating	To 50,000 feet (15240 m)
Operating	To 15,000 feet (4572 m)
Vibration	
(Non-operating)	Up to 40 Hz @ .010 inch (.03 cm) total displacement.
Shock	
(Non-operating)	To 30 Gs, 1/2 sine, 11 ms duration.
Transportation	Meets National Safe Transit Committee type of test when packaged as shipped by factory. Test procedure 1A, Category II with a 12″ drcp.
Humidity	Mil-T-28800B per test conditions 810 B at 50.71, procedure IV (5 day operating and non-operating, 90 to 95% Relative Humidity).

Table 1-5

PERFORMANCE SPECIFICATIONS

Default Paper Size	A Size — 8 1/2 x 11 in (216 x 279 mm)
	B Size — 11 x 17 in (279 x 432 mm)
	C Size — 17 x 22 in (432 x 559 mm)
	A4 Size — 8.3 x 11.7 in (210 x 297 mm)
	A3 Size — 11.7 x 16.5 in (297 x 420 mm)
	A2 Size — 16.5 x 23.4 in (420 x 594 mm)
	Roll — 200 ft roll, 18 in wide with 1/2 in tear-off strips on each side.
Paper Control (Sheets)	Electrostatic Hold-Down
(Roll)	Mechanical Hold-Down used with Option 36
Paper Drive Speed (Option 36)	$\geq$4.5 ips (11.4 cm/s)
Paper Drive Resolution (Option 36)	0.016 in (0.4 mm)
Plotting Area	Y Axis $\leq$17.25 in (438 mm) X Axis $\leq$23.5 in (597 mm)
Plotting Speed	16.47 in per second along either axis, 23.3 ips at a 45° angle
Acceleration	600 ips^2 in PREVIEW, 400 ips^2 in NORMAL, 300 ips^2 in ENHANCED 1, and 240 ips^2 in EN-HANCED 2
Point Plotting Rate	30 Points/s (max)
Plotting Accuracy	0.15% of Vector Length $\pm$0.0025 in
Repeatability	Will return to any previously Plotted Point to within $\pm$0.0025 in (0.0635 mm)

Table 1-5 (cont)

PERFORMANCE SPECIFICATIONS

Resolution (Addressable)	0.001 in (0.0254 mm)
Pen Pressure	Coarse Pressure Selected ± 25%
Pen Height (Up)	0.058 in ±0.013 (1.47 ±0.33 mm)
Linearity	
Geometry	Mean vector shall not deviate more than ±0.015 in from a straight line between two points.
Line Aberrations	Short term non-linearity shall not deviate more than ±0.003 in from mean vector.
Orthogonality	±0.015 in (0.38mm) across the plotting surface.

Table 1-6

PAGE SIZES (FULL PAGE ASPECT RATIO)

Margin	Orientation	Page Size & Media Dimensions	Measurements (width x height)		Refer to Figure Number
			(ENGLISH-inch)	(METRIC-mm)	
Drafting	Horizontal	C 22 x 17	21.00 x 15.5	533.4 x 393.7	1-2
Drafting	Horizontal	B 17 x 11	15.76 x 10.24	400.3 x 260.1	1-2
Drafting	Horizontal	A 11 x 8.5	10.50 x 7.74	266.7 x 196.6	1-2
Drafting	Horizontal	A2 594 x 420 mm	22.72 x 15.75	574.0 x 400.0	1-3
Drafting	Horizontal	A3 420 x 297 mm	15.75 x 10.91	400.0 x 277.0	1-3
Drafting	Horizontal	A4 297 x 210 mm	10.91 x 7.48	277.0 x 190.0	1-3

Lateral Paper Drive Mechanism Adjustment

If there is a slight twist in the paper as it is being pulled across the platen (this is most easily noticed by feeling the tension of both edges of the paper as it comes off the roll), one sprocket drive mechanism is slightly ahead of the other. Figure 2-22 (diagramming the rear paper drive sprocket assembly) shows an adjustment screw (and a locking screw) which moves the rear paper drive sprocket assembly either forward (to the right when viewing the front of the Plotter) or backward (to the left when viewing the front of the Plotter). First, open the two end panels and the rear panel. Then, loosen the locking nut (do not remove) and slowly adjust the lateral paper drive mechanism adjustment screw until the tension on both edges of the paper (at the roll) are equal. Turning the adjustment screw CW moves the rear paper drive sprocket mechanism back (toward the left when viewing the front of the Plotter). Turning the adjustment screw CCW moves the rear paper drive sprocket mechanism forward (toward the right when viewing the front of the Plotter). Then, tighten the locking screw and replace the rear and end panels.
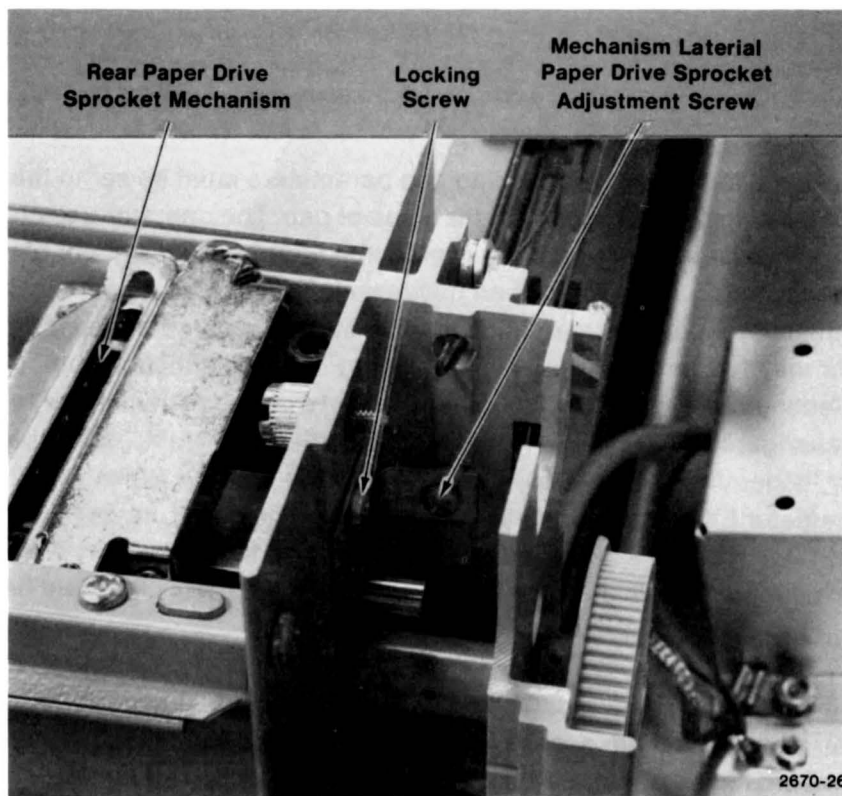

Figure 2-22. Paper Drive Sprocket Mechanism Lateral Adjustment Screw.

Installing Pens

Liquid Ball/Fiber Tip Pens

To install, a pen must have a thread and tip dimension equivalent to Statdhler-Mars. The operator simply pushes the small button at the top of the Plotter's pen holder (this retracts the rachet and allows the pen to turn freely) and carefully twist the pen CW approximately four or five turns until it seats.

CAUTION

Do not overtighten. Tighten reasonably firm with fingers only.

Once the pen is installed, the corresponding pen parameters must be set to the correct pressure and the maximum pen speed for that type of pen. The operator uses the PEN TYPE line on the Parameter Entry card to program the Plotter for the type of pen that is used in each pen location. The Plotter then uses this information to automatically establish an initial operating pressure and speed limit that is suitable for each pen. Later on, the operator may further adjust (or modify) these Plotter established settings, if desired, by selecting other values for the pen's pressure or speed. It must be remembered that to set (or change) the PEN TYPE, PRESSURE, or VELOCITY LIMIT for either pen, it is first necessary to identify the pen (PEN 1 or PEN 2) using the PEN PARAMETER ACCESS line on the Parameter Entry card. Once the proper pen is identified, its TYPE, PRESSURE, and VELOCITY LIMIT can be entered. Remember, however, that if the PEN TYPE is selected, a corresponding default PEN PRESSURE and VELOCITY LIMIT will be automatically set.

Then, if the PEN PRESSURE or VELOCITY LIMIT needs to be changed (or set) for the other pen, it will be necessary to access that pen, in a similar manner, using the PEN PARAMETER ACCESS line on the Parameter Entry card. The Parameter Entry card lines concerning PEN TYPE, PEN PRESSURE, and VELOCITY LIMIT then become applicable to the second pen.

To remove a pen, simply push the small button at the top of the pen holder (this retracts the rachet and allows the pen to turn freely) and carefully twist the pen CCW (unscrew) approximately four or five turns and lift it out.

Pen Height Adjustments

Liquid Ball/Fiber Tip Pens

The pen lifter (holder) is designed with sufficient travel to accommodate the slight variations in tip lengths for liquid ball and fiber tip pens. These pens are installed by simply twisting the pen CW approximately four or five turns until it seats (see Installing Pens above). There is no need for further height adjustments.

Liquid Ink Pen Installation and Adjustment

Pen Assembly

1. Screw the pen point into the pen body. Use a small wrench.

2. Screw the positioning ring approximately six to eight turns (see Appendix L) onto the pen body. This ring is threaded onto the top of the pen body (end opposite the pen point) and the cup side of the ring faces the pen point.

3. Fill the ink reservoir with ink up to just below the collar. Insert the ink reservoir into the pen body.

CAUTION

Be sure the ink reservoir remains upright until the completion of the next step.

4. Slide the locking ring over the ink reservoir, such that it is oriented thread-end first (threads are inside ring). Tighten over threads on top of pen body until finger tight.

NOTE

When locking ring is mounted, it should not be touching the positioning ring mounted in Step 1. If so, thread the positioning ring further onto the pen body until the locking ring can be firmly tightened (finger tight).

5. Install the pen into the pen holder by turning it CW several times until it seats.

Installation On Plotter

1. Place a piece of paper on the platen, near the center.

2. Move the pen carriage to the approximate center of the platen (over the paper installed in the previous step).

3. Install the pen into the pen holder by turning it CW several times until it just touches the paper. By gently tapping the top of the pen periodically while screwing it into the pen holder, it will become evident when the pen is touching the paper.

NOTE

If the pen has been previously installed on the Plotter and the positioning ring has not been moved, simply screw the pen into the pen holder (touching only the locking ring and the ink reservoir—see Appendix L) until the positioning ring lightly touches the top of the pen holder. The pen will be automatically at the proper height. Steps 4, 5, and 6 following can be ignored.

4. To position the pen to the correct height, unscrew the pen CCW one and three-quarter (1 ¾) turns. Be sure this adjustment is done near the center of the platen.

5. Move the pen over the plotting paper using the joystick (with pen up) and verify that the pen does not touch the paper. If the pen needs to be raised slightly, simply twist the pen CCW, and if the pen needs to be lowered slightly, twist the pen CW. The rachet action of the pen holder (the clicking sound) prevents the pen from twisting on its own.

6. When the pen is at the desired height, turn the knurled positioning ring on the pen body CW until it rests lightly on the top of the pen holder. Do not overtighten. This ring will help to prevent line aberrations and, more importantly (if this ring is not moved during future removals and installations), it will serve as a height guage (guide) when pen is installed again.

Pen Removal

1. To remove the pen, unscrew CCW touching only the locking ring and ink reservoir. Do NOT unscrew pen by turning the positioning ring.

Ink Refill

1. After the pen has been removed from the Plotter, it may be refilled with ink. To do this, unscrew the locking ring from the pen body and slide the ink reservoir out of the pen body. Then, do steps 3 and 4 of the Pen Assembly instructions (above). To install the pen back into the Plotter, follow the instructions of Installation On Plotter (above).

Pen Care

Liquid Ball and Fiber Tip pens should be removed from the Plotter after use and the cap placed over the tip to prevent the ink from drying while storing.

Liquid Ink pens should be removed from the Plotter, disassembled, cleaned with water (preferably in an ultrasonic cleaner), and dried before storing. Pen should be thoroughly dry before refilling with ink for use.

Pen Pressure Adjustments

When a Pen Type has been chosen from the Parameter Entry card, the Plotter automatically chooses a default pen pressure. However, the operator can override this default pressure by simply choosing another pressure on the Pen Pressure line. In either case, this pressure is simply a "coarse" adjustment, and the operator can further modify this pressure by about ±25% using the two front panel PEN PRESSURE OVERRIDE ADJUSTMENTS. To increase the pen pressure (to a maximum of + 25% more) adjust toward the + . To decrease the pen pressure (by a maximum of −25%) adjust toward the − . Notice that each pen has its own "fine" adjustment.

Line Quality

Note that PEN PRESSURE, PEN VELOCITY, and LINE QUALITY entries on the Parameter Entry Card and the operator PEN PRESSURE OVERRIDE ADJUSTMENT controls on the front panel will all affect the pen quality. It may require some experimenting with each of these variables to arrive at desired results. Remember that to change PEN PRESSURE or PEN VELOCITY, it is first necessary to access the proper pen, since it is possible to set up different forces and speeds for each pen. To access either pen and preset the pen force or speed values, pull the Parameter Entry Card out to the PEN PARAMETER ACCESS line. Press the switch over PEN 1, if the adjustments are to the pen closest to the front panel, or PEN 2, if the adjustments are to be made to the pen closest to the back panel (notice that the pen holders are also numbered). Thereafter, any entries made in the next three (3) lines — PEN TYPE, PEN PRESSURE, and PEN VELOCITY LIMIT — will be set up for that pen. Later, if adjustments are to be made for the other pen, it will have to be accessed through the PEN PARAMETER ACCESS line, in the same manner.

Any selection to PEN TYPE will cause the Plotter to automatically choose default corresponding values for PEN PRESSURE and PEN VELOCITY LIMIT (see "Pen Type" under Parameter Entry Switches and Indicators earlier in this section). However, the operator can then override these default settings, if desired, by addressing these two Parameter Entry lines separately and making another selection with the switches.

Appendix L

LIQUID INK PEN PARTS

APPENDIX L

LIQUID INK PEN PARTS
(SEE PEN HEIGHT ADJUSTMENTS)

LOCKING RING

INK RESERVOIR

PEN BODY

POSITIONING RING

POINT