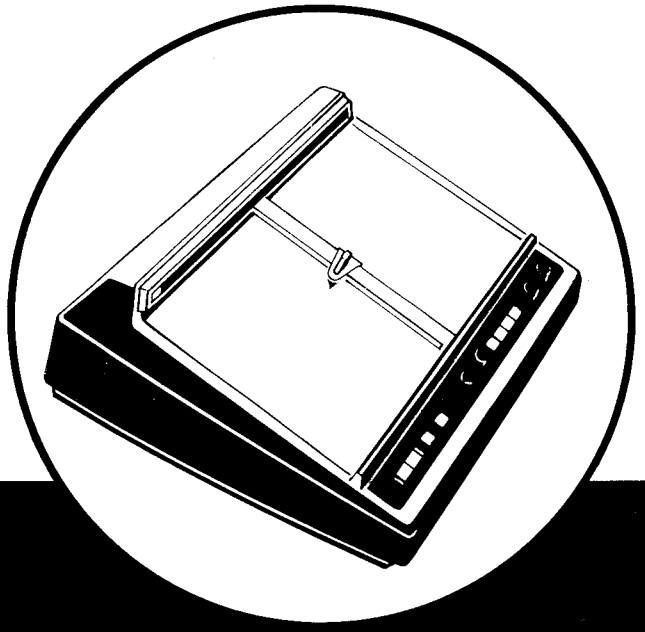

7210A
INTERFACE MANUAL

HEWLETT-PACKARD 7210A DIGITAL PLOTTER

HP 7210A
7210A INTERFACE

INTERFACE MANUAL

for

7210A DIGITAL PLOTTER

Note

This manual should be retained with computer system documentation.

07210-90002

Printed: JULY 1972

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual provides the information required to interface the Model 7210A Digital Plotter with an information source such as a digital computer.

1-3. GENERAL DESCRIPTION

1-4. The 7210A is an 11 x 17 inch (28 x 43,2 cm) Digital Plotter. Each pen position within the graph limits is uniquely defined by a positive integer between 0 and 9999. The operation of the Plotter is controlled by an external digital Information Source. The Information Source could be a computing device, a measuring instrument, or an information storage device which is capable of communicating with and controlling the Plotter. The Information Source defines coordinate points within the graph limits as well as defines the pen UP/DOWN status. The Plotter produces a graph comprised of straight line segments between the points defined by the "Source." The graph size is continuously variable from 0 x 0 to 10 x 15 inches (25,4 x 38,1 cm). The interfacing is TTL level compatible, and is extremely flexible.

1-5. OPERATIONAL CHARACTERISTICS

1-6. The Plotter's operation is divided into two separate types of maneuvers: a. Position maneuvers, in which a location for the pen on the graph surface (X-Y direction) is specified by the "Source." A straight line is drawn to that location during this operation. b. Pen maneuvers, in which the UP/DOWN position of the pen is specified by the "Source" and the pen status is changed accordingly. These maneuvers are controlled independent of each other. Either one can be performed only after the last specified maneuver is completed by the Plotter.

1-7. PANEL CONTROLS

1-8. The front panel controls (refer to Figure 1-1) operate as follows:

a. POWER

1. Turns primary power ON.

2. Presets logic circuits.

3. Forces Plotter into standby mode. Standby mode is the condition in which the pen is lifted, allowing the Plotter's arm to be moved freely.

4. Activates ready line (one of five output status lines, refer to paragraph 3-40. Its function is to indicate to Input Information Source that Plotter is powered).

b. CHART HOLD

Depressed

1. Activates electrostatic chart holddown.

2. Allows removal from standby mode (actual elimination of standby is accomplished by front panel LOWER LEFT or UPPER RIGHT controls or a position maneuver from Input Source).

Released

1. Deactivates electrostatic chart holddown.

2. Forces Plotter into standby mode.

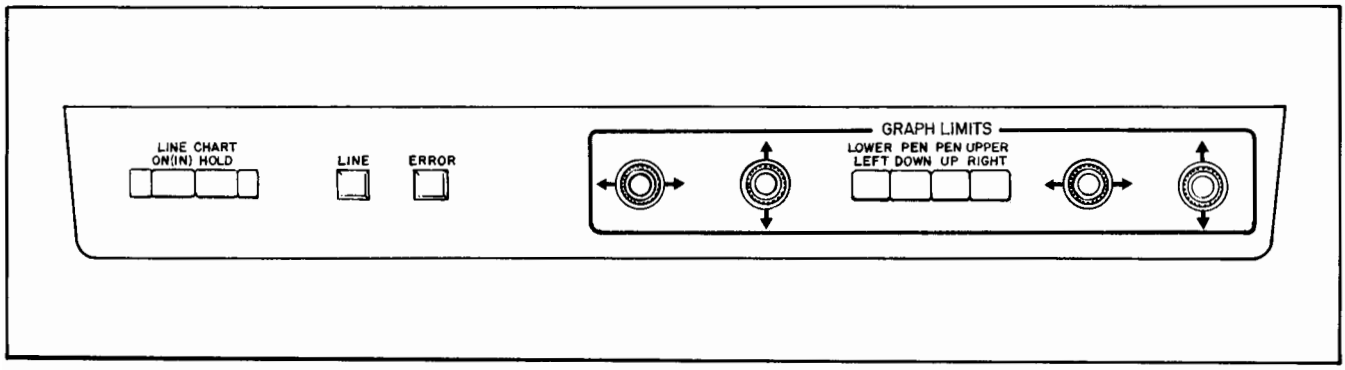


Figure 1-1. Control Panel

c. PEN DOWN

Lowers pen, overriding the source input pen information.

d. PEN UP

Lifts pen, overriding the source input pen information.

e. LOWER LEFT

Depressed

1. Completes vector being drawn.

2. Maintains FLAG in "busy" condition.

3. Lifts pen.

4. Proceeds to lower left limit of plotting range (position of numerical 0000 in X and Y axis).

Released

1. Forces FLAG into "clear" condition.

2. Proceeds with pen up to next point specified by Input Source.

3. At end of move, forces pen into condition last specified by Input Source.

4. Continues normal operation.

f. UPPER RIGHT

Depressed

1. Completes vector being drawn.

2. Maintains FLAG in "busy" condition.

3. Lifts pen.

4. Proceeds to upper right limit of plotting range (position of numerical 9999 in each X and Y axis).

Released

1. Forces FLAG into "clear" condition.

2. Proceeds with pen up to next point specified by Input Source.

3. At end of move, forces pen into condition last specified by Input Source.

4. Continues normal operation.

g. POSITION Lower Left

One adjustment each for X and Y axis. Controls absolute pen position on chart corresponding to a zero numerical value in each axis (minimum possible input to each axis). The range of adjustment from lower left hand corner of chart is:

X Axis	10 inches (25,4 cm)
Y Axis	5 inches (12,7 cm)

h. SIZE Upper Right

One adjustment each for X and Y axis. Controls distance from position of zero numerical value to that of 9999. Range of adjustment is:

X Axis	0 - 15 inches (0 - 38,1 cm)
Y Axis	0 - 10 inches (0 - 25,4 cm)

1-9. The rear panel controls (refer to Figure 1-2) are:

a. Power Receptacle.

b. 100/115/200/230 volt selector switch (slide).

c. Fuse Receptacle.

d. Identification tag.

e. 50 Pin Connector (Winchester SRE-50S).

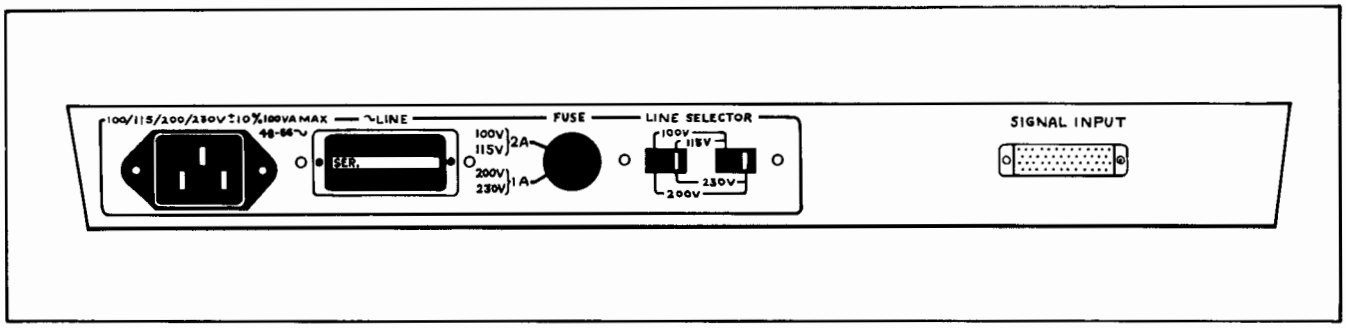


Figure 1-2. Rear Panel

SECTION II

7210A DIGITAL CAPABILITIES

2-1. INTRODUCTION

2-2. This section describes the general digital capabilities of the Model 7210A Digital Plotter.

2-3. GENERAL DESCRIPTION

2-4. In general, the Plotter performs one of two functions: position maneuvers or pen maneuvers.

2-5. The pen maneuvers (raise or lower) are given separate from the position maneuvers. Pen control is accomplished through Command Lines to the Plotter processor called SYC, MVR, and PNC (their operation is discussed in paragraph 3-14).

2-6. Position maneuvers are basically controlled by the same Command Lines; however, additional inputs and internal logic offer further flexibility.

2-7. INPUT DATA RANGE

2-8. The 7210A is a first quadrant Plotter. Locations on the platen correspond to positive integer values from 0 to 9999. The information input from the source must have the same magnitude range; however, in the Relative Mode (refer to paragraph 2-18), the input polarity may be positive or negative.

2-9. NUMERICAL CODE

2-10. The numerical position information is accepted in either binary or BCD 8421 codes. The binary information is handled in a 16-bit two's compliment form. The BCD information is handled in a 17-bit sign and magnitude form. The numerical code may be hard wired at the Plotter's input connector or selected by the input source. Furthermore, the code for each position maneuver in a graph may be either BCD or binary.

2-11. POSITION MODES

2-12. Position maneuvers may be performed in either of two modes: Absolute or Relative. Each mode offers some advantage over the other. The position modes may be hard wired at the Plotter's input connector or selected by the input source. Numerical inputs in either mode may come in BCD or binary.

2-13. ABSOLUTE MODE

2-14. Ease of understanding and programming is offered by this mode, since it proceeds exactly as hand generated graphs are constructed on a cartesian coordinate system. The plotting surface may be represented as shown in Figure 2-1.

2-15. The length of each axis is divided into 10,000 equally spaced points. Each point corresponds to integer values from 0 to 9999 as shown. Points within the plotting surface are described by ordered pairs of these X and Y values.

2-16. The numerical input from the Input Source (integer values from 0 to 9999) instructs the pen to locate a position using a cartesian coordinate system on the above plotting surface. Regardless of past or present pen position, the pen will follow a straight line path to any point on the plotting surface specified by the Input Source.

2-17. If the pen is commanded to proceed to Point C (at 7777, 3333) from Point A or B, the results are as shown. Hence, a graph may be generated by constructing straight lines between a set of points described by a list of ordered pairs; each succeeding point being the end point for the next line segment.

2-18. RELATIVE MODE

2-19. Numerical processing time and storage space may often be saved through use of Relative Mode plotting. In this mode, each new position is described relative to the last. Figure 2-2 illustrates operation in this mode.

2-20. With the pen at any Point A, the next pen position is described by the change or delta in the X axis (ΔX) and the delta in the Y axis (ΔY). Numerical inputs from the Input Source define the delta X and delta Y to be used. Delta X and delta Y may be positive or negative. The path to the next point is a straight line.

2-21. In the example shown, Point A is at 3000, 8000. For a ΔX and ΔY equal to 5000 and -4000 respectively, the Point B is 3000 + 5000, 8000 + (-4000) or 8000, 4000.

2-22. The range of the numbers input in the Relative Mode differs from that of the Absolute Mode in that input information may also be negative. The input range

is integer values from -9999 to +9999. Binary numbers are entered in two's compliment form (i.e., the sign information is in the last or most significant bit). BCD numbers are handled in sign and magnitude form and require a 17-bit input in each axis rather than the usual 16.

2-23. Binary numbers greater in magnitude than 9999 are possible in the 16-bit input (only 14 are required to represent 9999). In the event a number larger in magnitude than 9999 is received, the Plotter will resort to the Error Sequence described later. Furthermore, if the value of the accumulated pen position is requested to fall outside the range from 0 to 9999 in either axis, the Plotter will again resort to the Error Sequence.

2-24. This mode, although more complicated than the Absolute Mode, lends itself nicely to relative position information such as character generation. The character pattern may be output independent of offset and scaling used for the other data on a graph. In addition, incremental mode plotting techniques may be achieved by using the Relative mode and restricting the delta magnitude in both axes to a fixed integer.

2-25. ERROR SEQUENCE.

2-26. This sequence is a subroutine performed by the Plotter to indicate it has received some form of improper excitation. The possible errors that would force the Plotter to resort to this sequence are listed below:

a. Oversized Step in Absolute Mode input. This condition may occur when a number greater in magnitude than 9999 is entered to the Plotter in binary code (it is not possible in BCD code).

b. Accumulated position due to Relative Mode inputs lie outside the numerical positioning range. In the Relative Mode, the actual pen position must still remain within the numerical range of 0 to 9999. Position maneuvers are described in terms of relative moves in each axis, but the Plotter accumulates these inputs with present position to determine the next position. This mode would then allow the absolute position to sum to values outside the specified range.

c. Incorrect formatting of Source Input. As described later, information input to the Plotter is transmitted in multiple passes of a particular byte size. The Plotter uses the SYC (Synchronize) command line to determine which of the multiple passes it is receiving. If the Plotter finds these input passes out of sequence, it calls upon the Error Sequence.

2-27. Upon detection of these conditions, the Plotter resorts to an Error Sequence. This sequence makes it obvious an error was encountered, and at what point in a plot it occurred.

a. Remains at last properly-described position.

b. Lifts pen.

c. Lights ERROR indicator.

d. Indicates error on Format status line. (Output lines discussed later.)

e. Monitors input lines for next position input which contains no errors. Performs maneuver.

f. Indicates "correct" on Format status line.

g. Performs pen maneuver to conform with last specified pen command.

h. Continues normal operation.

2-28. OVERSCALE SEQUENCE.

2-29. This sequence is called upon when the numerical position is correct (within the range 0 to 9999), but the plotting surface has been located (through the front panel Graph Limits Controls) such that the pen position falls off the platen. Numerical information is not in error so the Error Sequence is not called upon; however, it is advantageous to avoid erroneous lines along the margins and wasted time plotting offscale. The overscale sequence prevents these problems in the following manner:

a. Upon encountering the edge of the platen, the Plotter:

1. Lifts pen.
2. Indicates "set" on clamp status line (output lines discussed later).
3. Lights ERROR indicator.
4. Continues to perform position maneuvers with pen up. At end of each maneuver, detects if pen has come on-scale (away from edge of platen).

b. Upon moving to a point away from the edge of the platen, the Plotter:

1. Allows time for pen to assume proper end point.
2. Indicates "clear" on clamp status line.
3. Clears ERROR indicator.
4. Performs pen maneuver to conform with last specified pen command.
5. Resumes normal operation.

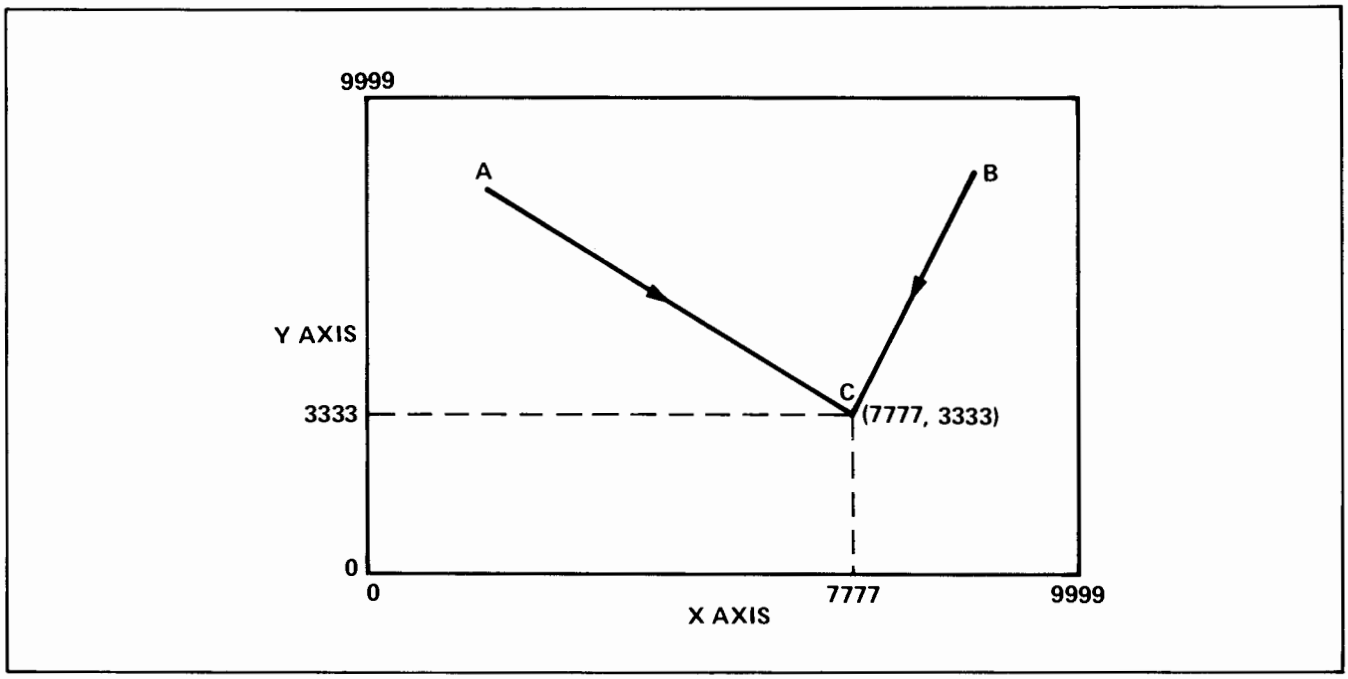


Figure 2-1. Absolute Mode Positioning

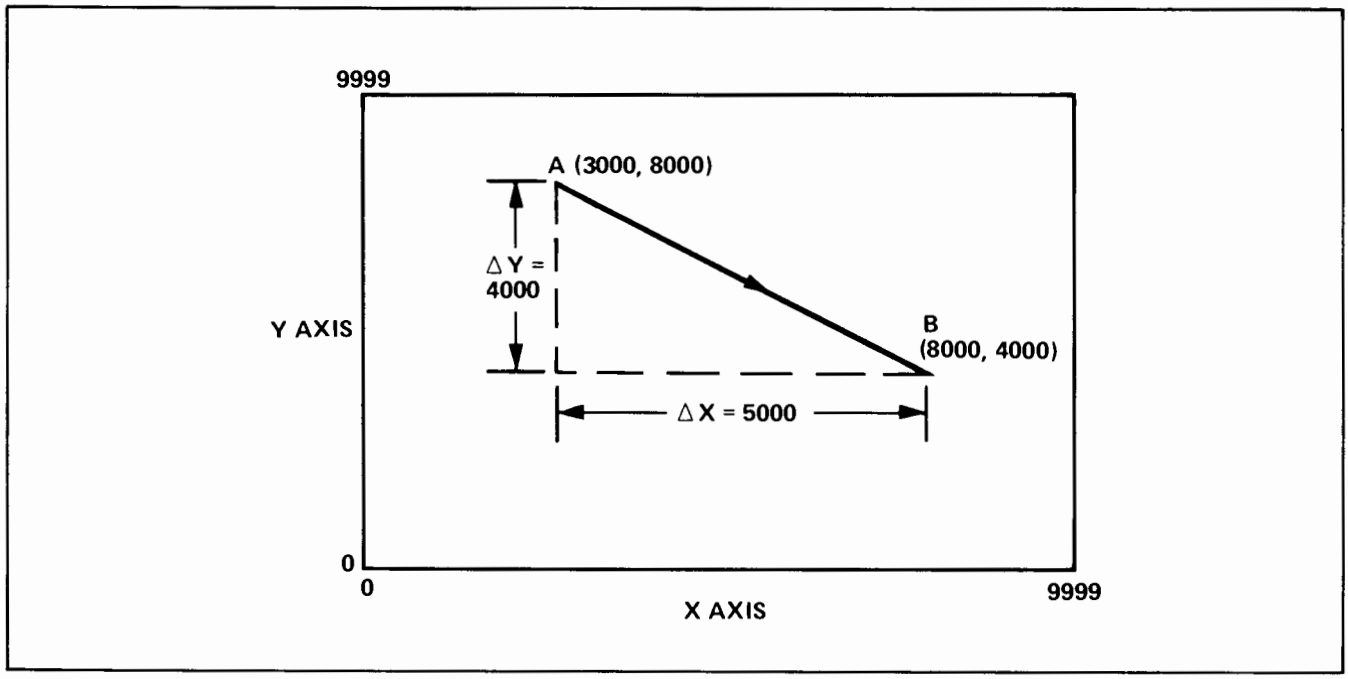


Figure 2-2. Relative Mode Positions

SECTION III

INTERFACE

3-1. INTRODUCTION

3-2. This section provides information required to interface the 7210A Digital Plotter. Included are complete input/output specifications for the Plotter.

3-3. INPUT INFORMATION SPECIFICATIONS

3-4. Information which controls the Plotter is placed on the Processor Control lines. The information given the Plotter by the Input Source arrives on lines called Source Control lines.

3-5. The Plotter performs two basic maneuvers: Pen maneuvers and Position maneuvers. Control of the maneuvers is accomplished by the following Processor Control lines:

a. Transfer Lines (2) . . . . . Input Information
b. Command Lines (7) . . . . . Input Information
c. Data Lines (8) . . . . . Input Information
d. Status Lines (5) . . . . . Output Information

These Control lines are all received in negative logic form (+5 Volts = Logical 0 = False). Furthermore, all input information is interpreted to be false or logical zero when the Control lines are open or disconnected.

3-6. The Plotter requires 7 bits of command information and 32 bits of data information. To input these bits over the Processor Control lines, the data is time multiplexed into 4 passes of 15-bit words (7 lines command, 8 lines data), or 8 passes of 8-bit words (4 command, 4 data). The relative timing of data and command information is shown in the Data Format section. Each pass requires a Flag-Control handshake to transfer its information.

3-7. TRANSFER LINES

3-8. The transfer Lines are called FLAG and CONTROL. The Input Source and the Plotter use these lines to continuously communicate the status of information being transferred and processed between them. No input line can pass its information to the Plotter without the proper use of the transfer lines. The meaning and use of these lines is defined below in true logic terms:

FLAG. A transfer line, originating at the Plotter, which informs the input device when the Plotter has completed all previous instructions and is READY for more information or is BUSY completing previous instructions.

CONTROL. A transfer line, originating at the input device, which informs the Plotter when the remaining input lines are settled out and contain valid information. The logical significance of this line at any given time is a function of the FLAG status. Control must be reset to zero or "wait" when FLAG goes busy.

3-9. Refer to Figure 3-1 for explanation of a transfer cycle.

3-10. Stage A–The Input Source (seeing the Plotter is ready) places new command and data information on the Source Control lines which arrives in some form on the Processor Control lines. When the information is settled and valid, State A is completed by placing CONTROL in a "read" condition. This signals the Plotter that information is propagating down the input lines. Total time in Stage A is T_a.

3-11. Stage B–After some time, T_b (comprised of propagation delays and plotter logic cycle times) the FLAG responds, changing to a "Busy" condition. The input device then places CONTROL in a "Wait" condition some time T_c after FLAG goes "Busy." After some propagation time T_d the Plotter recognizes CONTROL is in the "Wait" condition, completing Stage B. Since information has propagated over the transfer lines three times, the Processor Control lines are stable and ready to be read in Stage C.

3-12. Stage C–The Plotter scans the input lines and performs the prescribed task. All inputs have been monitored and may be destroyed after 500 µs. After some total time T_e, the task is complete and the FLAG is placed in a "Ready" condition. This initiates another Stage A.

3-13. The actual time specifications are shown in Table 3-1.

TABLE 3-1. TRANSFER CYCLE TIMING

Time Period	Min.	Nominal	Max.
T_a	0	–	Unlimited
T_b	1.2 µs	–	52 µs
T_c	0	–	Unlimited
T_d	6 µs	14.5 µs	22 µs
T_e	1 ms	–	3 sec

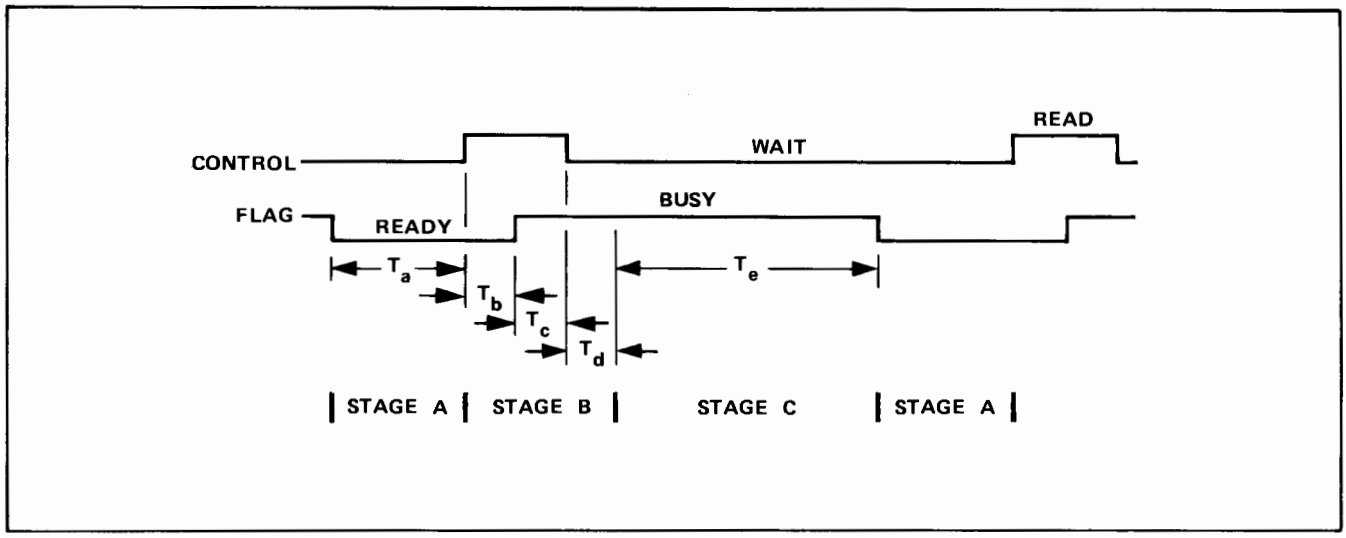


Figure 3-1. Transfer Cycle

3-14. COMMAND LINES

3-15. Control of the overall plotting operation is accomplished through these lines. There are a total of 7 lines all controllable by the Input Source.

3-16. SYC–Synchronize (Trailing/Lead = ∅/1).

Function–Synchronize the first pass of information transmitted on the Processor Control lines with the information received as the first pass by the Plotter.

True–Accompanying information on input lines is the leading, or first pass of a pen or position maneuver transmission.

False–Accompanying information on input lines is a trailing pass of position maneuver information.

3-17. When the Plotter recognizes its read cycle is out of phase with the incoming information (not the same pass), it will resort to the Error Sequence. Through monitoring the SYC line, the Plotter determines when the next correct transmission of a position maneuver is to begin; hence, only one data point would be lost if the Plotter and input device should drop out of phase.

3-18. SYC information is monitored in all passes of pen or position maneuvers. If this line becomes open, SYC will indicate "trailing." Consequently, an attempt to execute an input cycle would force the Plotter into the Error Sequence.

3-19. MVR–Maneuver (Position/Pen = ∅/1).

Function–Specify which type of maneuver is to be performed, pen or position. This allows proper interpretation of the accompanying and following data.

True–Pen Maneuver.

False–Position Maneuver.

3-20. Only one pass of data is necessary to complete a pen maneuver. After the FLAG–CONTROL handshake, SYC is checked for a "lead" indication. If MVR is now found to indicate "pen," the only other input line examined will be PNC, for pen instructions. The Plotter is then finished with the input data and expects the first pass of a new instruction.

3-21. Four or eight passes of data are required for position maneuvers. The format in which the data is taken is discussed under Data Format. MVR information is monitored in the first pass of a pen or position maneuver. If this line becomes open, MVR will indicate "position."

3-22. PNC–Pen Command (UP/DOWN = ∅/1).

Function–Specify the pen status when the maneuver (MVR) is pen.

True–Pen Down.

False–Pen Up.

3-23. PNC information is monitored in the first pass of a pen maneuver. If this line becomes open, PNC will indicate pen "UP."

3-24. CDE–Code (BCD/Binary = ∅/1).

Function–Specify which code, BCD or Binary, is to be used to input numerical data.

True–Binary Code.

False–BCD 8421 Code.

3-25. CDE information is monitored during the first pass of a position maneuver. If this line becomes open, CDE will indicate "BCD."

3-26. MDE–Mode (Absolute/Relative = Ø/1).

Function–Specify which position mode, Absolute or Relative is to be used to determine the next pen location.

True–Relative Mode.

False–Absolute Mode.

3-27. MDE information is monitored during the last pass of a position maneuver. If this line becomes open MDE will indicate "Absolute."

3-28. DXS–Delta X Sign (+/- = Ø/1).

Function–Specify the numerical polarity of the X data for a position maneuver while in Relative mode and BCD code.

True–Negative quantity.

False–Positive quantity.

3-29. DXS is effectively an extra or 17th bit necessary to carry the sign information of a 16-bit BCD coded number in a Sign and Magnitude form. Since in Absolute mode only positive integers are necessary, DXS is only used while in Relative mode with BCD code. DXS information is monitored during the last pass of a position maneuver. If the line becomes open, DXS will indicate "+."

3-30. DYS–Delta Y Sign (+/- = Ø/1).

Function–Specify the numerical polarity of the Y data for a position maneuver while in Relative mode and BCD code.

True–Negative quantity.

False–Positive quantity.

3-31. DYS is effectively an extra or 17th bit necessary to carry the sign information of a 16-bit BCD coded number in a Sign and Magnitude form. Since in absolute mode only positive integers are necessary, DYS is only used while in Relative mode with BCD code.

3-32. DYS information is monitored during the last pass of a position maneuver. If this line becomes open, DYS will indicate "+."

3-33. Some command lines may be hard-wired to simplify driver requirements. For example, in Binary code DXS and DYS are not used, therefore they may be hard-wired to either 1 or Ø. If a driver operates in Binary code, only the CDE line may be hard-wired to logical 1. To achieve a logical Ø, leave the input open, for a logical 1, ground the input.

3-34. DATA LINES

3-35. Numerical inputs specifying pen location are entered through these lines.

3-36. The information input through these lines is considered negative logic (+5 Volts = Logical 0 = False). A 16-bit numerical input for each axis is:

$$X_{15}X_{14} \longrightarrow X_1X_0$$

$$Y_{15}Y_{14} \longrightarrow Y_1Y_0$$

3-37. The above thirty-two bits of information may be segmented in one of two ways as shown in Table 3-2.

TABLE 3-2. DATA INPUT CONFIGURATION

1. Four passes of 8-bit words.	
1st pass	$X_{15} - X_8$
2nd pass	$X_7 - X_0$
3rd pass	$Y_{15} - Y_8$
4th pass	$Y_7 - Y_0$
2. Eight passes of 4-bit words.	
1st pass	$X_{15} - X_{12}$
2nd pass	$X_{11} - X_8$
3rd pass	$X_7 - X_4$
4th pass	$X_3 - X_0$
5th pass	$Y_{15} - Y_{12}$
6th pass	$Y_{11} - Y_8$
7th pass	$Y_7 - Y_4$
8th pass	$Y_3 - Y_0$

3-38. To accept 4-bit data words, the following changes must be made:

At Output Connector:
1. Hard wire CDE to logical 1 (grounded).
2. Hard wire DXS to logical 0 (open).
3. Hard wire DYS to logical 0 (open).
4. Connect source bit Ø to data bits Ø and 4.
5. Connect source bit 1 to data bits 1 and 5.
6. Connect source bit 2 to data bits 2 and 6.
7. Connect source bit 3 to data bits 3 and 7.

At Interface Board:
8. Move the jumper on the interface board A1 from 8BW to 4BW.

3-39. The Data lines, like all the Processor Control lines may be interconnected with the Source Control lines as necessary. These connections are discussed in para. 3-59.

3-40. STATUS LINES

3-41. Continuous information about certain conditions existing inside the Plotter is output over these lines for monitoring by the Input Source. None of these are essential to plotter operation, but may enhance an overall computer-plotter system.

3-42. There are five Status Lines. The Plotter is capable of monitoring each condition and executing various maneuvers designed to keep the overall operation of the Plotter smooth and predictable. However, additional responses to status indications may be performed by the Input Source.

3-43. All information transmitted on the Status Lines is in negative logic form (+5 Volts = Logical 0 = False). All Status Lines are asynchronous.

3-44. The mnemonic, title, and function of each Status Line is described below in positive logic form.

3-45. RDY – Ready (Not Ready/Ready = Ø/1).

Function – Indicate to the input device when the power in Plotter is up and it is ready to run.

True – Ready.

False – Not Ready.

3-46. If the Plotter is not plugged in, or not turned on, RDY will indicate "Not Ready." The Digital Information Source could sense this status and output a diagnostic or otherwise indicate the problem.

3-47. SBY–Stand-by (Clear/Muted = Ø/1).

Function–Indicates when the Plotter is in a standby condition due to a "power up" cycle or an inactivated chart hold switch.

True–Positioning muted (logic still active).

False–Positioning not muted.

3-48. The purpose of the stand-by condition is to enhance the convenience and predictability of the Plotter while initially turning power on and, later, while loading and unloading chart paper.

3-49. There are two events which cause the Plotter to enter stand-by:

a. Initial "power on" of instrument.

b. The Chart Hold function released to the up position (releasing the chart paper).

3-50. Clearing the stand-by condition is a two-step process. First, activate the Chart Hold function by depressing the front panel switch. Secondly, complete one of the following:

a. Depress front panel control "Lower Left."

b. Depress front panel control "Upper Right."

c. Input necessary digital information to define a position maneuver from the input source.

3-51. If the Digital Information Source attempts plotting while Chart Hold remains released, the stand-by condition will not allow pen motion, but will continue to accept data at an accelerated rate. This allows quick execution of plotting programs for debugging purposes.

3-52. CLP–Clamp (Clear/Set = Ø/1).

Function–Indicate when the plotter positioning performance is reduced.

True–Clamp Set.

False–Clamp Clear.

3-53. The Clamp condition is encountered in three cases:

a. The Plotter is initially "powered on." The low performance positioning allows smooth controlled motion while correcting initial errors between actual pen position and the first specified input location after the stand-by condition has been removed. After reaching the first location, the clamp condition is cleared after a 1.2 second delay, allowing full positioning performance.

b. The Chart Hold is activated and the Plotter is commanded to locate a point. Again low performance positioning allows smooth controlled motion while correcting initial errors between actual pen position and the specified input location. After reaching the first location, the Clamp condition is cleared after a 1.2 second delay.

c. Overscale. A numerical position in the proper range (0 to 9999) may fall offscale if the graph limits (controlled through front panel "Position" and "Size" adjustments) are aligned partially off the platen. The low performance allows smooth controlled motion while correcting initial errors encountered when returning to a point on-scale. After reaching a point on-scale, the Clamp condition is "clear" after a 1.2 second delay.

3-54. Pen–Pen (UP/DOWN = Ø/1).

Function–Indicate instantaneous pen status.

True–Pen Down.

False–Pen Up.

3-55. FMT – Format (Correct/Error = Ø /1).

Function – Indicates the format status of the information on the Processor Control lines.

True – An error has been detected and a complete correct format has not been received since the error.

False – Format correct.

3-56. This line indicates to the Input Source that the Plotter has detected one of three formatting errors, and is, or has undergone the Error Sequence. (The Input Source may wish to further convey this information to the operator.) The three possible formatting errors are those specified in the Error Sequence.

3-57. DATA FORMAT

3-58. All information received by the Plotter on the Processor Control lines is time multiplexed in on 15 lines (7 command and 8 data lines). Some input sequences are shown in Table 3-3. Since not all command lines are read in each pass, an "*" is placed in each bit position which will not be read (Don't Care condition). A detailed description of an 8-bit data word transmission is presented in Appendix A.

3-59. INTERFACE

3-60. LOGIC LEVELS

3-61. All information on the Source Control lines uses TTL logic levels. The signal common for all logic levels is at the same potential as earth ground. All lines contain information in a negative logic form:

$$\frac{+Vcc}{GND} = \frac{Logical\ Ø}{Logical\ 1} = \frac{False}{True}$$

3-62. TRANSMITTERS AND RECEIVERS

3-63. All input Source Control lines are connected to a receiver configuration as shown in Figure 3-2.

3-64. The input line drives a pull-up resistive divider and one standard TTL input load. This input loading is actually that of an 8-bit multiplexer. Input lines may be left open to achieve a logical zero, or grounded for logical 1.

3-65. All output Source Control lines are driven as shown in Figure 3-3.

3-66. The output line has a limiting resistor in series with the output of a TTL gate. The gate shown is actually the Q output of a flip-flop. The gate load factor drive capability is 10; however, one load may already be present at the output for internal use.

3-67. INTERFACE BOARD

3-68. This board provides the ability to change the input/output form of this instrument. The four bit word jumper is on this board. The jumper goes to 4BW or 8BW. All information from the Input Source passes through the interface board. All outputs from the Plotter (status lines and flag) are available at two pins on the rear connector. One comes through the interface board, and one bypasses it. For rear panel connector pin connections, refer to Table 3-4. Since all information passes through this board, the input characteristics of the Plotter can be changed by changing this board. Contact the local HP Sales Office if you have a special problem.

TABLE 3-3. INPUT SEQUENCES

EXAMPLES

a. 16 BIT Computer, 8 BIT Data Word, Position.

PASS	SYC	MVR	PNC	CDE	MDE	DXS	DYS	DATA
1	1	0	*	1/0	*	*	*	X_{15} - X_8
2	0	*	*	*	*	*	*	X_7 - X_0
3	0	*	*	*	*	*	*	Y_{15} - Y_8
4	0	*	*	*	1/0	1/0	1/0	Y_7 - Y_0

*Indicates "Don't Care"

TABLE 3-3. INPUT SEQUENCES (Continued)

EXAMPLES

b. 8 BIT Computer, 4 BIT Word, Position.

PASS	SYC	MVR	PNC	MDE	DATA
1	1	0	*	*	X_{15} - X_{12}
2	0	*	*	*	X_{11} - X_{8}
3	0	*	*	*	X_{7} - X_{4}
4	0	*	*	*	X_{3} - X_{0}
5	0	*	*	*	Y_{15} - Y_{12}
6	0	*	*	*	Y_{11} - Y_{8}
7	0	*	*	*	Y_{7} - Y_{4}
8	0	*	*	1/0	Y_{3} - Y_{0}

Make the following changes:

At Output Connector:
1. Hard wire CDE to logical 1 (grounded). ①
2. Hard wire DXS to logical 0 (open). ①
3. Hard wire DYS to logical 0 (open). ①
4. Connect source bit Ø to data bits Ø and 4.
5. Connect source bit 1 to data bits 1 and 5.
6. Connect source bit 2 to data bits 2 and 6.
7. Connect source bit 3 to data bits 3 and 7.

At Interface Board:
8. Move the jumper on the interface board A1 from 8BW to 4BW.

① Command lines may also be connected as shown in paragraph d.

c. 16 BIT Computer, 8 BIT Data Word, Pen.

PASS	SYC	MVR	PNC	CDE	MDE	DXS	DYS	DATA
1	1	1	1/0	*	*	*	*	*

*Indicates "Don't Care"

TABLE 3-3. INPUT SEQUENCES (Continued)

EXAMPLES

d. 12 BIT Computer, 8 BIT Data Word, Position.

PASS	SYC	MVR/DXS	PNC/DYS	CDE/MDE	DATA
1	1	MVR	PNC	CDE	$X_{15} - X_{0}$
2	0	*	*	*	$X_{7} - X_{0}$
3	0	*	*	*	$Y_{15} - Y_{8}$
4	0	DXS	DYS	MDE	$Y_{7} - Y_{0}$

MVE shorted to DXS
PNC shorted to DYS
CDE shorted to MDE

In the above example the seven commands are condensed into four lines by time-multiplexing. This complicates the driver slightly, but it gives the Plotter the flexibility to run on a 12-bit computer with 8-bit data words, or an 8-bit computer with 4-bit data words, without hard-wiring any command lines.

*Indicates "Don't Care"

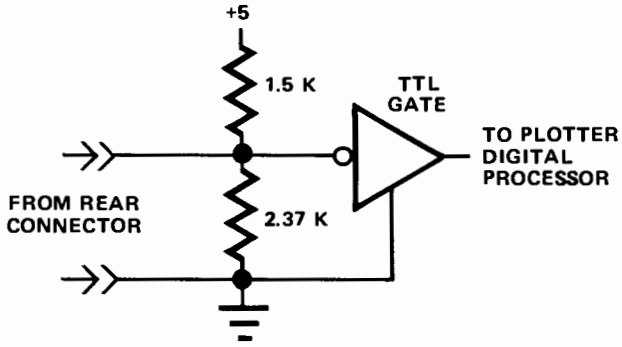


Figure 3-2. Source Control Line Input Characteristics

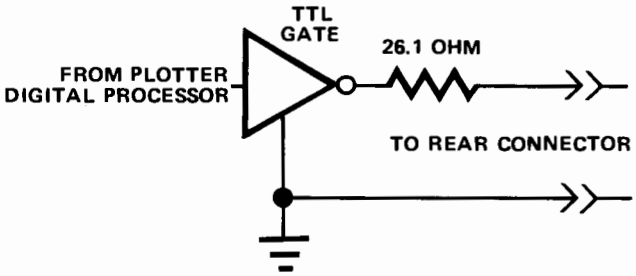


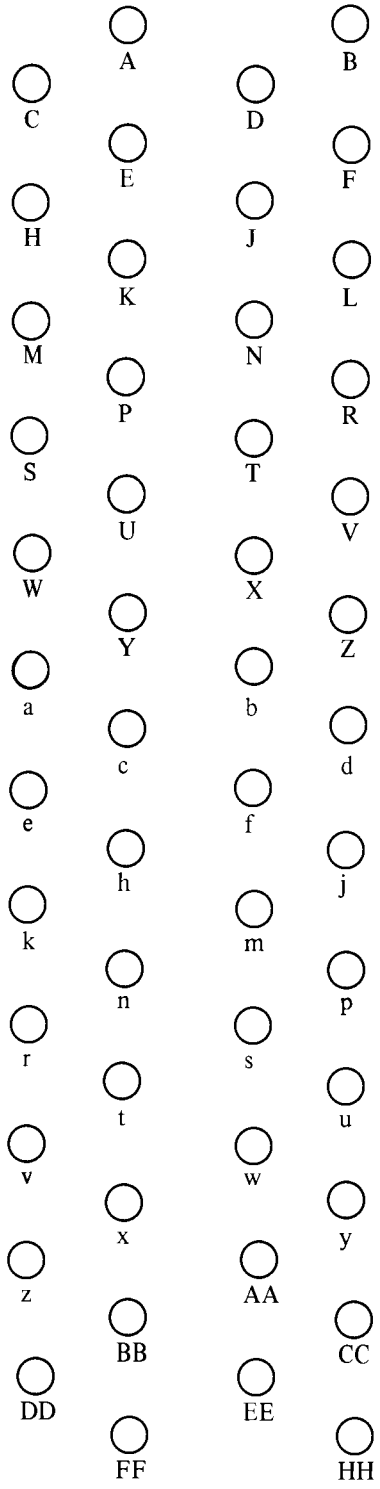
Figure 3-3. Source Control Line Output Characteristics

TABLE 3-4. PIN CONNECTIONS, REAR CONNECTOR

PLOTTER CONNECTOR PIN	FUNCTION
A	Data Bit 0
B	Data Bit 1
C	Data Bit 2
D	Data Bit 3
E	Data Bit 4
F	Data Bit 5
H	Data Bit 6
J	Data Bit 7
K	N/L
L	N/L
M	Clamp (CLP)
N	Standby (SBY)
P	Pen (PEN)
R	Ready (RDY)
S	Mode (MDE)
T	Format (FMT)
U	Delta X Sign (DXS)
V	Delta Y Sign (DYS)
W	Maneuver (MVR)
X	Code (CDE)
Y	SYNC (SYC)
Z	Pen Command (PNC)
a	N/L
b	N/L
c (1)	Standby (SBY) (1)
d (1)	Ready (RDY) (1)
e (1)	Format (FMT) (1)
f (1)	Clamp (CLP) (1)
h	N/L
j (1)	Pen (PEN) (1)
k	N/L
l	N/L
n	N/L
p	N/L
r	N/L
s	N/L
t	N/L
u	N/L
v	N/L
w	N/L
x	Flag (FLG)
y	N/L
z	N/L
AA	N/L
BB (1)	Flag (FLG) (1)
CC	Control (CTL)
DD	N/L
EE	N/L
FF	Ground
HH	Ground

(1) Signals on these pins bypass Interface Board.

TABLE 3-5. CONNECTOR PINS



Pins as viewed from rear of cable connector.

APPENDIX A

TABLE A-1. TIME SEQUENCE OF PASS TRANSMISSIONS FOR AN 8 BIT DATA WORD

PLOTTER ACTION	COMPUTER ACTION
PEN MANEUVER	
Flag = 1 (Ready)	
	Pen maneuver information placed in output register.
	Control = 1 (Read)
Flat = Ø (Busy)	
	Control = Ø (Wait)
Processes information	Output register held (500 us)
Executes pen maneuver ↑ 40 ms ↓	New information may be placed in output register.
POSITION MANEUVER	
Flag = 1 (Ready)	First pass information present in output register.
	Control = 1 (Read)
Flag = Ø (Busy)	
	Control = Ø (Wait)
Processes first pass	Output register held
Flag = 1 (Ready)	
	Second pass placed in output register
	Control = 1 (Read)
Flag = Ø (Busy)	
	Control = Ø (Wait)
Processes second pass	Output register held
Flag = 1 (Ready)	
	Third pass placed in output register
	Control = 1 (Read)
Flag = Ø (Busy)	
	Control = Ø (Wait)

TABLE A-1. TIME SEQUENCE OF PASS TRANSMISSIONS FOR AN 8 BIT DATA WORD (Continued)

PLOTTER ACTION	COMPUTER ACTION
Processes third pass	Output register held
Flag = 1 (Ready)	
	Fourth pass placed in output register.
	Control = 1 (Read)
Flag = Ø (Busy)	
	Control = Ø (Wait)
Processes fourth pass	Output register held (500 us)
Executes position maneuver 40 ms ↕ 3 sec	New information may be placed in output register.
Flag = 1 (Ready)	

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07210-90002

PRINTED IN U.S.A.