

The Intelligent Graphics

2647A

configuration and operation manual

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2647A

The Intelligent Graphics



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HEWLETT-PACKARD COMPANY
974 EAST ARQUES AVENUE
SUNNYVALE, CALIFORNIA, 94086

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This manual contains configuration and operation information for the HP 2647A Graphics Terminal. The following topics are covered:

- Preparing the terminal for use.
- Connecting the terminal to peripheral devices.
- Using the terminal to edit text and prepare terminal BASIC programs.
- Transferring data between the terminal and a computer.

In addition to this manual, you should also have the following manuals available for reference:

Terminal BASIC Manual, part number 02647-90005.

HP 2647A Intelligent Graphics User's Manual, part number 02647-90001.

HP 2647A Intelligent Graphics Quick Reference Guide, part number 02647-90006.

HP 2647A Intelligent Graphics Reference Manual, part number 02647-90002.

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INTRODUCTION

This section contains instructions for installing the HP 2647A Graphics Terminal, and connecting it to computers and peripheral devices. The following topics are covered:

1. Preparing the terminal for use.
2. Checking for correct line voltage.
3. Installing accessory Printed Circuit Assemblies (PCAs).
4. Selecting optional operating functions by setting switches on PCAs.
5. Connecting the terminal to modems, printers, plotters, other terminals, and computers.
6. Running the self-test to verify correct terminal operation.

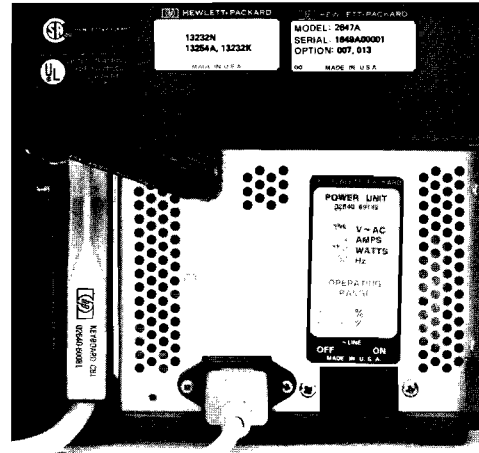


Figure 1-2. HP 2647A Back Panel

3. Set the ~ LINE Switch to OFF. The ~ LINE Switch is located under the rear hinged cover (see figure 1-2).

NOTE

To protect operating personnel, the Hewlett-Packard Company recommends that the terminal's frame be grounded. The terminal is equipped with a three-conductor cable, which, when connected to an appropriate power receptacle, grounds the frame of the terminal. To preserve this protection feature, do not operate the terminal from an ac power outlet with no ground connection.

PREPARING THE TERMINAL FOR USE

1. Place the terminal on any convenient surface, except plush or spongy surfaces that might restrict air flow through the bottom vents; do not use typewriter pads, for example.
2. Connect the keyboard to the terminal by lifting the terminal's rear hinged cover (two rotating latches hold it down) and connecting the keyboard cable hood connector to the printed circuit assembly (PCA). The PCA is notched three conductor strips down from the top to match the connector (see figure 1-1).

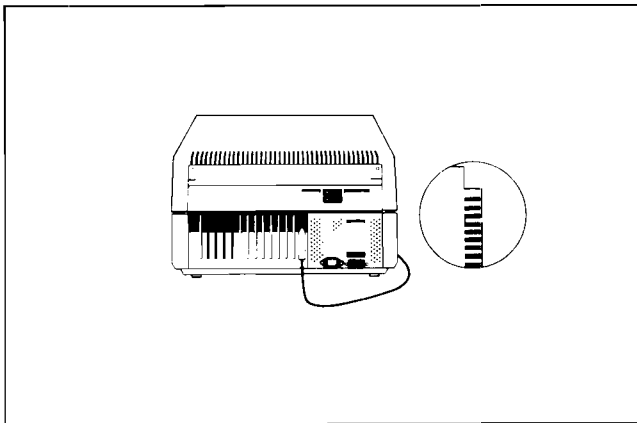


Figure 1-1. Keyboard Cable Connection

4. Connect the power cord to the terminal power connector (see figure 1-2).
5. **MAKE SURE THAT YOUR VOLTAGE MATCHES THE TERMINAL'S REQUIREMENTS** (either 115V or 230V, see the rear panel label). Plug the 3-prong power connector into your power outlet.
6. Set the **REMOTE** key to the up position (off-line operation).
7. Set the ~ LINE Switch, located at the back of the terminal, to ON. After 15 seconds the terminal will be ready. The display and graphics/alphanumeric memories will be clear, the message **TERMINAL READY** will be displayed, the alphanumeric cursor will be blinking, all programmable functions will be OFF, the terminal will be in ASCII mode, and the left and right tapes will be selected as the respective source and destination devices for data transfer operations.

8. If the **TERMINAL READY** message is displayed, perform the exercises shown in Section II of this manual.
9. If the **TERMINAL READY** message does not appear, press the **TEST** key (see page 1-47 for a description of the self-test function). If the **TEST** function does not work properly, set the **~LINE** Switch to **OFF** and repeat the steps starting at step 2. Open the terminal (see "Opening the Terminal" paragraph) and ensure that the printed circuit assemblies (PCAs) are properly seated into their connectors. If the self-test still does not give the correct results, do not attempt to use the terminal until the malfunction has been corrected by a qualified service representative.

Opening the Terminal

To gain access to the terminal's internal components, open the terminal as follows (also see figure 1-3):

1. Set **~LINE** Switch to **OFF** and disconnect power cord.

NOTE

The terminal top cover is unlocked by inserting access key (supplied with the terminal) into each of the keyways located on the right and left sides of top cover. No key rotation is required.

2. From front of terminal, insert access key into right keyway and unlock right side of terminal by slightly raising right side of top cover (figure 1-3, A and B).
3. While maintaining upward pressure to keep right side of terminal unlocked, insert access key into left keyway and raise top cover until both right and left sides of terminal are unlocked (figure 1-3C).
4. Carefully lift top cover until it latches in the half-open position (figure 1-3D).

NOTE

The half-open position provides adequate room for performing most service routines. If extensive repairs are to be made, however, or if components contained in the top cover are to be serviced, fully open top cover in accordance with step 5.

CAUTION

Top cover hinges are open hinge type. When fully opening terminals do not allow hinges to slip off hinge pins.

5. Firmly grasp top cover in one hand and release safety latch (see figure 1-4) by pressing it inboard with other hand. Then, using both hands, swing top cover up and over to a full open position (resting on its top).

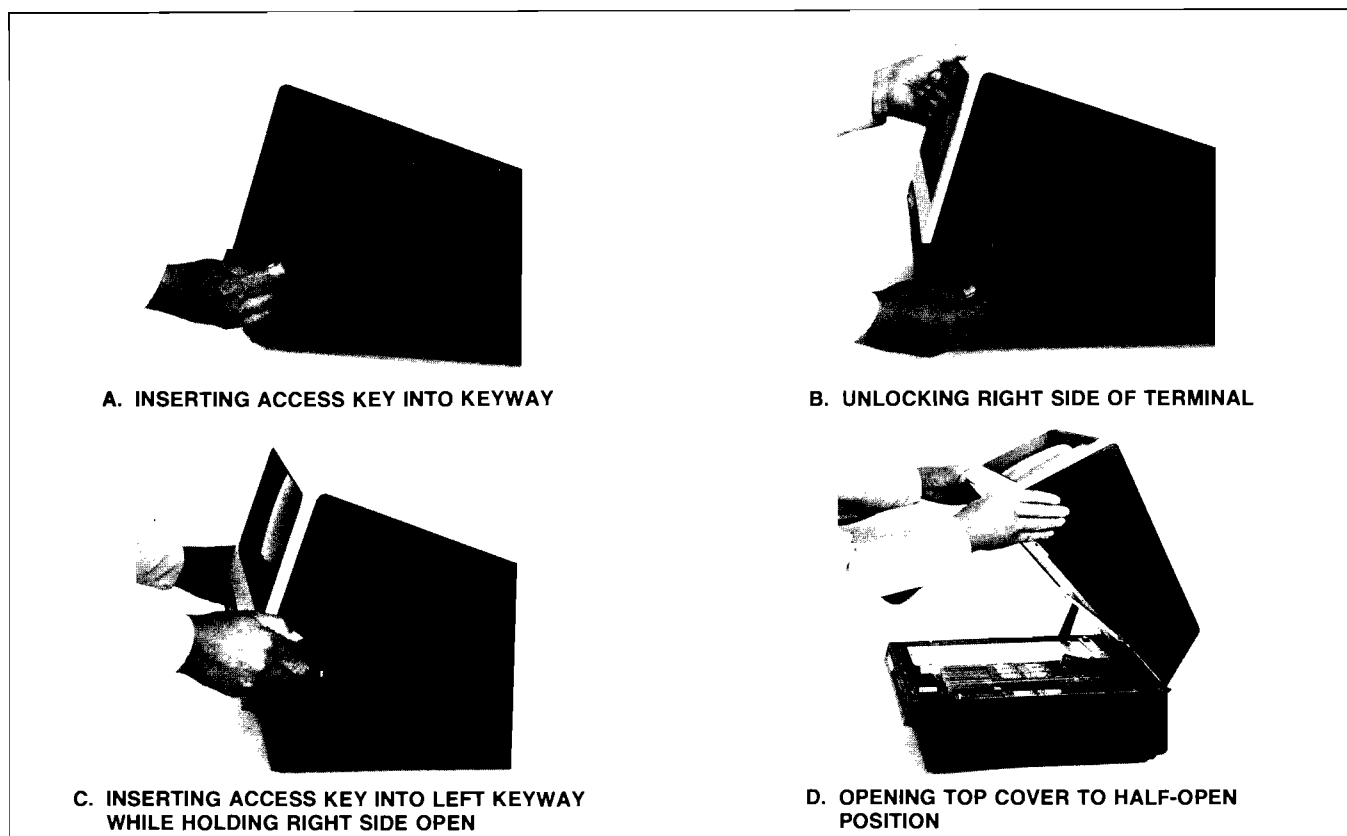
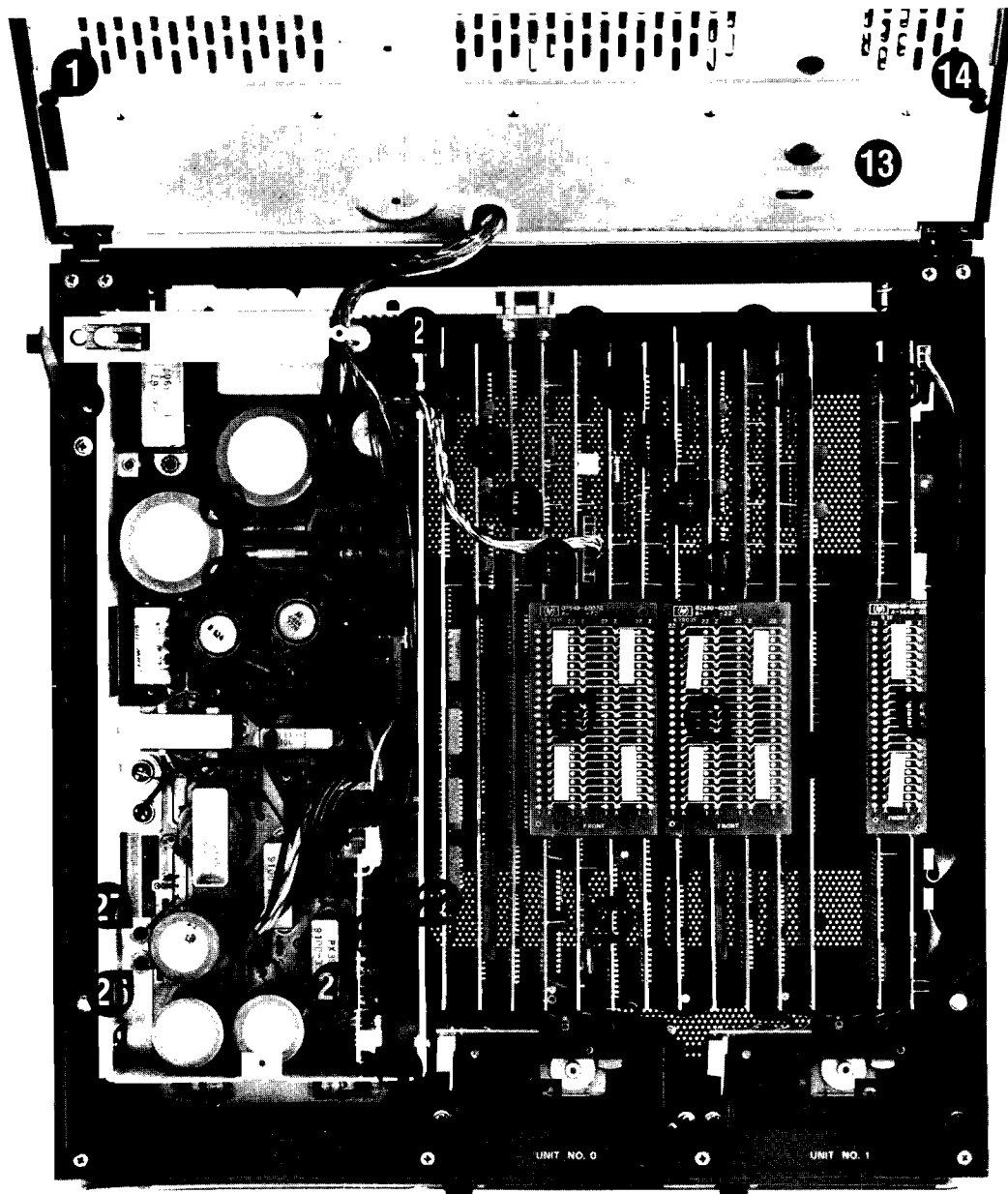


Figure 1-3. Opening the Terminal



- | | | |
|--------------------------------|---|-----------------------------|
| 1 SHIELD SNAP FASTENER | 11 32K UNIVERSAL MEMORY PCA (CON-
NECTED TO TOP PLANE CONNECTOR) | 21 CTU TRANSPORT ASSY'S |
| 2 KEYBOARD INTERFACE PCA | 12 ASYNCHRONOUS DATA COMM PCA | 22 -42V TEST POINT |
| 3 32K UNIVERSAL MEMORY PCA | 13 CRT SHIELD | 23 +12V TEST POINT |
| 4 GRAPHICS MICROCONTROLLER PCA | 14 SHIELD SNAP FASTENER | 24 +5V ADJUSTMENT |
| 5 GRAPHICS DISPLAY MEMORY PCA | 15 CTU INTERFACE PCA | 25 POWER SUPPLY CONTROL PCA |
| 6 GP DISPLAY TIMING PCA | 16 READ/WRITE PCA | 26 +12V TEST POINT |
| 7 DISPLAY MEMORY ACCESS PCA | 17 SPEED ADJUSTMENT | 27 +5V TEST POINT |
| 8 DISPLAY CONTROL PCA | 18 OPTION SLOT | 28 POWER SUPPLY FUSES |
| 9 CONTROL MEMORY PCA'S | 19 TOP PLANE CONNECTORS | 29 SAFETY LATCH |
| 10 PROCESSOR PCA | 20 CRYSTAL Y1 | |

Figure 1-4. Mainframe Bottom Part Locations



CONNECTING THE TERMINAL TO OTHER DEVICES

The HP 2647A can be used as the central device in a graphics work station environment, or it can be connected to printers, video interface devices, Hewlett-Packard computers, or computers manufactured by other companies. Table 1-1 lists peripheral devices and HP computers which are compatible with the HP 2647A. The table contains the following information:

1. Device name.

2. All accessories you will need to connect the HP 2647A to the device.

3. The function of the accessories and the page in this manual on which instructions are provided to connect the HP 2647A to the device.

Thus, to connect the HP 2647A to any of its peripheral devices, or to an HP computer, refer to table 1-1 for a list of the equipment you will need, then turn to the page specified in table 1-1 for information on connections.

Table 1-1. Connecting the HP 2647A to Peripheral Devices and Computers

DEVICE NAME	EQUIPMENT NEEDED	PAGE NUMBER
HP 250 Computer System	<p>HP 13260A Standard Asynchronous Communications Interface, consisting of:</p> <p>Interface PCA, part no. 02640-60086. ROM ICs, part no. 1818-0600. Baud Rate Label, part no. 7120-6388.</p> <p>To connect without modem:</p> <p>Cable HP 13232Y, part no. 02640-60218. Cable HP 45113A.</p> <p>With modem:</p> <p>Bell 103, 212, or equivalent. Cable HP 45111A. Cable HP 13232N, part no. 02640-60131 (U.S.), or Cable HP 13232M, part no. 5061-2409 (Europe).</p>	<p>Provides RS-232-C communications.</p> <p>See page 1-9 for connections.</p>
HP 300 Computer System	<p>HP 13260A Standard Asynchronous Communications Interface, consisting of:</p> <p>Interface PCA, part no. 02640-60086. ROM ICs, part no. 1818-0600. Baud Rate Label, part no. 7120-6388.</p> <p>To connect without modem:</p> <p>Cable HP 13232W, part no. 5061-2410. Cable HP 31390A.</p> <p>To connect with modem:</p> <p>Bell 103, 212, or equivalent. Cable HP 31390A. Cable HP 13232N, part no. 02640-60131 (U.S.), or Cable HP 13232M, part no. 5061-2409 (Europe).</p>	<p>Provides RS-232-C communications.</p> <p>See page 1-11 for connections.</p>
HP 1000 Computer System with HP 12531D Interface	<p>HP 13260A Standard Asynchronous Communications Interface, consisting of:</p> <p>Interface PCA, part no. 02640-60086. ROM ICs, part no. 1818-0600. Baud Rate Label, part no. 7120-6388.</p> <p>Cable HP 13232C, part no. 02640-60059. Cable HP 12531D, Option 001.</p> <p>To connect with modem:</p> <p>Bell 103, 212, or equivalent. Cable HP 12531D, Option 002. Cable HP 13232N, part no. 02640-60131 (U.S.), or Cable HP 13232M, part no. 5061-2409.</p>	<p>Provides RS-232-C communications.</p> <p>See page 1-12 for connections.</p>

Table 1-1. Connecting the HP 2647A to Peripheral Devices and Computers (Continued)

DEVICE NAME	EQUIPMENT NEEDED	PAGE NUMBER
HP 1000 Computer System with HP 12880A Interface	<p>HP 13260A Standard Asynchronous Communications Interface, consisting of:</p> <p>Interface PCA, part no. 02640-60086. ROM ICs, part no. 1818-0600. Baud Rate Label, part no. 7120-6388.</p> <p>Cable HP 13232C, part no. 02640-60059. Cable 12880-60003.</p>	<p>Provides RS-232-C communications.</p> <p>See page 1-13 for connections.</p>
HP 1000 Computer System with HP 12966A Interface	<p>HP 13260B Extended Asynchronous Communications Interface, consisting of:</p> <p>Interface PCA, part no. 02640-60143. ROM ICs, part no. 1818-0600. Baud Rate Label, part no. 7120-6388.</p> <p>To connect without modem:</p> <p>Cable HP 12966A, Option 001.</p> <p>To connect with modem:</p> <p>Bell 103, 212, or equivalent. Cable HP 12966A, Option 002. Cable HP 13232N, part no. 02640-60131 (U.S.), or Cable HP 13232M, part no. 5061-2409 (Europe).</p>	<p>Provides either standard RS-232-C or 20 mA current loop communications.</p> <p>Allows split speed and custom baud rates.</p> <p>See page 1-14 for connections.</p>
HP 2631A Printer	<p>HP 13238A Terminal Duplex Register, consisting of Terminal Duplex Register PCA, part no. 02640-60031.</p> <p>Cable HP 13232J.</p>	<p>Provides 8-bit parallel interface.</p> <p>See page 1-40 for connections.</p>
HP 2631G Graphics Printer	<p>HP 13296A Shared Peripheral Interface, consisting of:</p> <p>HP-IB Interface PCA, part no. 02640-60128. HP-IB Interface Adapter, part no. 02640-60215. Two-meter cable, part no. 8120-1834.</p>	<p>Provides interface to shared peripheral devices.</p> <p>See page 1-20 for connections.</p>
HP 2635A Printing Terminal	<p>HP 13250A Serial Printer Interface, consisting of Serial Printer Interface PCA, part no. 02640-60143.</p> <p>Cable HP 13232G, part no. 02640-60098.</p>	<p>Provides RS-232-C interface to serial printers.</p> <p>See page 1-45 for connections.</p>
HP 3000 Series I/II/III Computer System	<p>HP 13260A Standard Asynchronous Communications Interface, consisting of:</p> <p>Interface PCA, part no. 02640-60086. ROM ICs, part no. 1818-0600. Baud Rate Label, part no. 7120-6388.</p> <p>To connect without modem:</p> <p>Cable HP 13232Y, part no. 02640-60218. Cable HP 30062D.</p> <p>To connect with modem:</p> <p>Bell 103, 212, or equivalent. Cable HP 30062B. Cable HP 13232N, part no. 02640-60131 (U.S.) or Cable HP 13232M, part no. 5061-2409 (Europe).</p>	<p>Provides RS-232-C communications.</p> <p>See page 1-15 for connections.</p>
HP 3000 Series 30/Series 33 Computer System	<p>HP 13260A Standard Asynchronous Communications Interface, consisting of:</p> <p>Interface PCA, part no. 02640-60086. ROM ICs, part no. 1818-0600. Baud Rate Label, part no. 7120-6388.</p> <p>To connect without modem:</p> <p>Cable HP 13232Y, part no. 02640-60218. Cable HP 30062D.</p>	<p>Provides RS-232-C communications.</p> <p>See page 1-16 for connections.</p>

Table 1-1. Connecting the HP 2647A to Peripheral Devices and Computers (Continued)

DEVICE NAME	EQUIPMENT NEEDED	PAGE NUMBER
	<p>To connect with modem:</p> <p>Bell 103, 212, or equivalent. Cable HP 30062B. Cable HP 13232N, part no. 02640-60131 (U.S.), or Cable HP 13232M, part no. 5061-2409 (Europe).</p>	
<p>HP 7225A Plotter with HP 17601A Personality Module</p>	<p>HP 13296A Shared Peripheral Interface, consisting of:</p> <p>HP-IB Interface PCA, part no. 02640-60128. HP-IB Interface Adapter, part no. 02640-60215. Two-meter HP-IB cable, part no. 8120-1834.</p> <p>HP 17601A Personality Module (HP 7225A).</p>	<p>Provides interface to shared peripheral devices.</p> <p>See page 1-22 for connections.</p>
<p>HP 7245B Plotter/Printer</p>	<p>HP 13296A Shared Peripheral Interface, consisting of:</p> <p>HP-IB Interface PCA, part no. 02640-60128. HP-IB Interface Adapter, part no. 02640-60215. Two-meter HP-IB cable, part no. 8120-1834.</p>	<p>Provides interface to shared peripheral devices.</p> <p>See page 1-22 for connections.</p>
<p>HP 7310A Printer</p>	<p>When connected in shared peripheral interface configuration:</p> <p>HP 13296A Shared Peripheral Interface, consisting of:</p> <p>HP-IB Interface PCA, part no. 02640-60128. HP-IB Interface Adapter, part no. 02640-60215. Two-meter HP-IB cable, part no. 8120-1834.</p> <p>When connected in RS-232-C configuration:</p> <p>HP 13238A Terminal Duplex Register, consisting of Terminal Duplex Register PCA, part no. 02640-60031. Cable HP 13232J, part no. 02640-60116.</p>	<p>See page 1-22 for connections.</p> <p>Provides interface to shared peripheral devices.</p> <p>See page 1-40 for connections.</p> <p>Provides 8-bit parallel interface.</p>
<p>HP 9866B Printer</p>	<p>HP 13238A Terminal Duplex Register Interface, consisting of a Terminal Duplex Register PCA, part no. 02640-60031. Cable HP 13232S, part no. 02640-60135.</p>	<p>Provides 8-bit parallel interface to printers.</p> <p>See page 1-43 for connections.</p>
<p>HP 9871A Printer</p>	<p>HP 13238A Terminal Duplex Register Interface, consisting of a Terminal Duplex Register PCA, part no. 02640-60031. Cable HP 13232J, part no. 02640-60116.</p>	<p>Provides 8-bit parallel interface to printers.</p> <p>See page 1-44 for connections.</p>
<p>HP 9872B/9872S Plotter</p>	<p>HP 13296A Shared Peripheral Interface, consisting of:</p> <p>HP-IB Interface PCA, part no. 02640-60128 HP-IB Interface Adapter, part no. 02640-60215. Two-meter HP-IB cable, part no. 8120-1834.</p>	<p>Provides interface to shared peripheral devices.</p> <p>See page 1-22 for connections.</p>
<p>HP 9874A Digitizer</p>	<p>HP 13296A Shared Peripheral Interface, consisting of:</p> <p>HP-IB Interface PCA, part no. 02640-60128. HP-IB Interface Adapter, part no. 02640-60215. Two-meter HP-IB cable, part no. 8120-1834.</p>	<p>Provides interface to shared peripheral devices.</p> <p>See page 1-22 for connections.</p>
<p>HP 9876A Printer</p>	<p>HP 13296A Shared Peripheral Interface, consisting of:</p> <p>HP-IB Interface PCA, part no. 02640-60128. HP-IB Interface Adapter, part no. 02640-60215. Two-meter HP-IB cable, part no. 8120-1834.</p>	<p>Provides interface to shared peripheral devices.</p> <p>See page 1-23 for connections.</p>
<p>Video Hard-Copy Device</p>	<p>HP 13254A Video Interface, consisting of:</p> <p>Video Interface PCA, part no. 02640-60019. Sweep Extender Cable, part no. 02640-60122.</p>	<p>Links the terminal to a compatible video monitor or hard-copy device.</p> <p>See page 1-47 for connections.</p>

Table 1-1. Connecting the HP 2647A to Peripheral Devices and Computers (Continued)

DEVICE NAME	EQUIPMENT NEEDED	PAGE NUMBER
Video Monitor	HP 13254A Video Interface, consisting of: Video Interface PCA, part no. 02640-60019. Sweep Extender Cable, part no. 02640-60122.	Links the terminal to a compatible video monitor or hard-copy device. See page 1-47 for connections.
HP 13260A Standard Asynchronous Communications Interface	Standard Asynchronous Communications Interface, consisting of: Interface PCA, part no. 02640-60086. ROM ICs, part no. 1818-0600. Baud Rate Label, part no. 7120-6388.	Provides standard RS-232-C communications interface. See page 1-23 for connections.
HP 13260B Extended Communications Interface	Extended Asynchronous Communications Interface, consisting of: Interface PCA, part no. 02640-60143. ROM ICs, part no. 1818-0600. Baud Rate Label, part no. 7120-6388. Cable, part no. 02640-60083.	Provides either standard RS-232-C or 20 mA current loop communications. Allows split speed and custom baud rates. See page 1-30 for connections.
HP 13260C Asynchronous Multipoint Communications Interface	Asynchronous Multipoint Communications Interface, consisting of: Interface PCA, part no. 02640-60106. ROM ICs, part no. 1818-0614. ROM ICs, part no. 1818-0629. Baud Rate Label, part no. 7120-6386. Cable, part no. 02640-60083. Switch Cover, part no. 4040-1356.	Provides asynchronous multipoint communications. Allows several terminals to share the same communication line. See page 1-33 for connections.
HP 13260D Synchronous Multipoint Communications Interface	Synchronous Multipoint Communications Interface, consisting of: Interface PCA, part no. 02640-60107. ROM ICs, part no. 1818-0628. ROM ICs, part no. 1818-0629. Baud Rate Label, part no. 7120-6386. Cable, part no. 02640-60083. Switch Cover, part no. 4040-1356.	Provides synchronous multipoint communications. Allows several terminals to share the same communication line. See page 1-40 for connections.

IDENTIFYING AND INSTALLING ACCESSORIES

Your terminal is delivered with the options and accessories that you requested. The option number of the accessories originally furnished with your terminal is on the Identification Label located under the rear access cover.

If it should become necessary, you can identify the printed circuit assemblies (PCAs) installed in your terminal by opening the terminal to the half-open position and checking the part numbers on the PCAs. The part number is located on the top right side of the PCA (looking from the front of the terminal). The part numbers of the PCAs associated with all accessories are listed in table 1-1.

If at any time you should order additional accessories, instructions for installing such accessories in the terminal are contained in Section VII of the HP 2647A Reference Manual.

A list of accessories you will need to connect the HP 2647A to peripheral devices is contained in table 1-1. Ensure that

your terminal is equipped with the correct accessory before attempting to connect it to any peripheral device.

NOTE

After installing or removing accessories, you should adjust the +5 volt output of the terminal's power supply. See the paragraph "Power Supply Adjustment" in Section VII of the Reference Manual.

SELECTING OPTIONAL OPERATING FUNCTIONS

Printed circuit assemblies in the terminal are equipped with switches which can be used to alter some of the terminal's operating functions. Closing a switch connects traces on the PCA, this process is called "strapping" in the Reference Manual.

DATA COMMUNICATIONS CABLING

Sections V and VII of the Reference Manual contain information covering data communications. Part of that information is repeated here so that you can connect the terminal in any of several applications. For example, as shown in figure 1-5, the terminal can be hardwired to a computer (figure 1-5A), hardwired through other terminals to a computer (figure 1-5B), connected to a computer through a modem (figure 1-5C), or connected through other terminals to a modem and then to a computer (figure 1-5D).

INTERFACES

RS-232-C Compatibility

The Electronics Industries Association (EIA) has defined a number of standards for communications between data communications and data terminals equipment. Currently, RS-232-C is the most widely used of these standards. The HP 2647A terminal will operate on any RS-232-C compatible computer.

Current Loop Capability

In addition to handling any RS-232-C connection, the HP 2647A can be configured to provide an optional 20 mA current loop capability. Thus, the HP 2647A will operate on most computers because it is "Teletype compatible." This means that if your computer will operate a standard ASR-33 Teletype, you can also use an HP 2647A terminal. The current loop type of connection assumes that the terminal will operate in character mode.

Character Mode Versus Block Mode Operation

Operating an HP 2647A terminal in character mode will allow you to connect to most computers, but it will not take full advantage of the terminal's capabilities. HP 2647A terminals are block mode terminals. This means that you don't have to communicate with the CPU a character at a time. Text can be manipulated, modified, and edited prior to transmission to the computer. Aside from the advantage of being able to work with the entire text, block mode is more efficient in using computer time and communications equipment. Also, addition of local mass

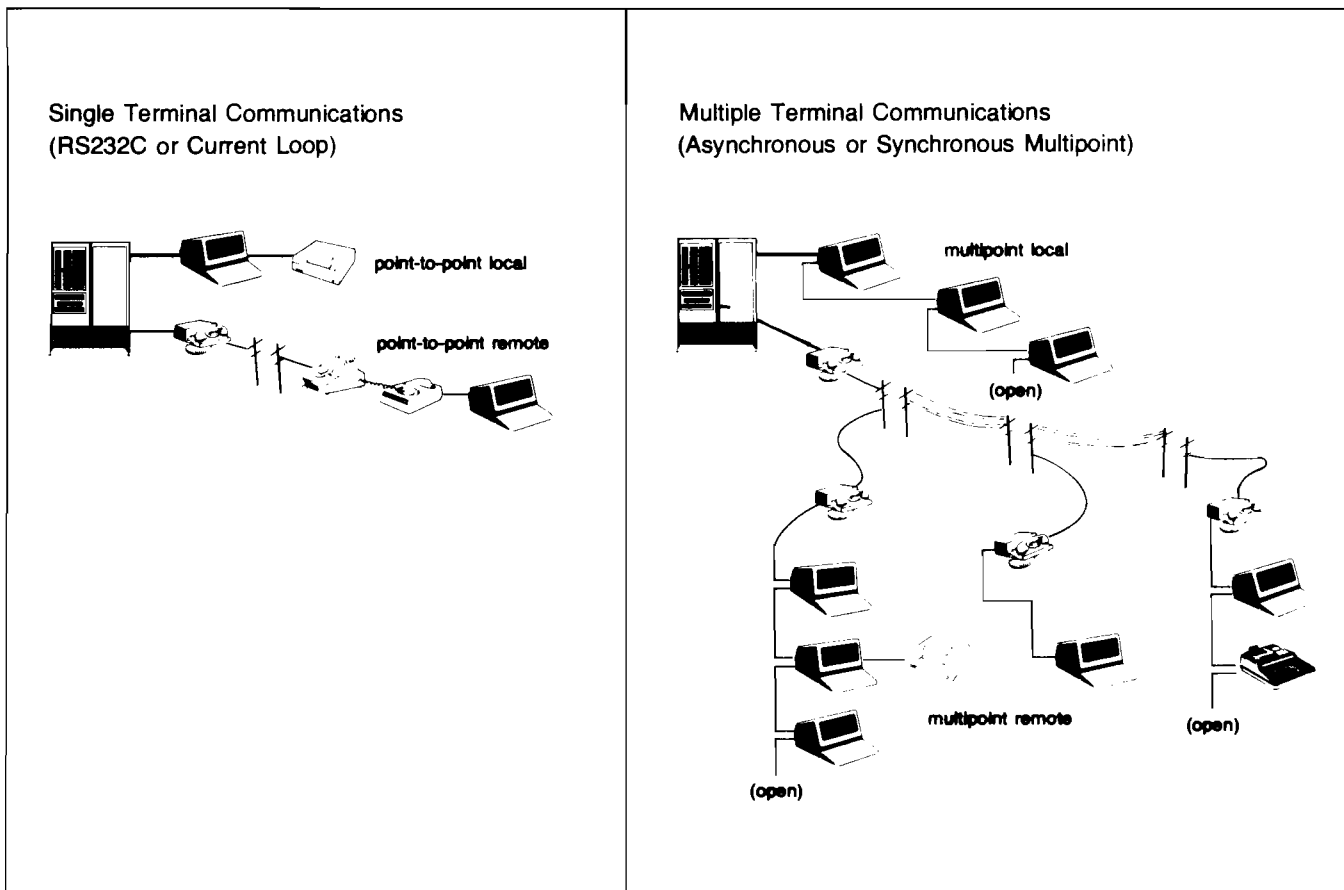


Figure 1-5. Terminal Network Configurations

storage requires block mode operation. Data movement from the tape cartridges to the computer is defined as a block transfer. Therefore, the CPU must support block mode operation to use the tape cartridges.

Handshake Protocol

The block mode protocol used by the HP 2647A terminal is ρ_1/ρ_2 . The terminal signals that data is ready for transmission by sending a ρ_2 . The CPU triggers the actual transmission by sending a ρ_1 . This protocol is supported on Hewlett-Packard computers. The terminal can also operate effectively with no protocol. Opening the G and H switches on the Keyboard Interface PCA (see Section VII, figure 7-2 in the Reference Manual) eliminates the use of protocol by the terminal. In this case, when the **ENTER** key is pressed in block mode operation, data is transmitted immediately and the enabling ρ_1 and ρ_2 are no longer required. Please note, however, that when the terminal is operating without protocol, it will send data whether or not the computer is ready to accept the data, and the terminal can overrun the computer's data communications buffer thus causing loss of data.

In operating without protocol, five factors should be considered:

1. Size of computer's data communications buffer.
2. Processing power of the computer.
3. Computer workload.
4. Data transmission speed.
5. Quantity of data transmitted.

NOTE

The HP 2647A terminal is a "Teletype-compatible" unit and cannot be used as an IBM 3270-type terminal. The HP 2647A can be used on IBM computers, however, if the following conditions are met:

1. The IBM computer must use the TSO operating system with one of the following communications software packages: BTAM, VTAM, DTAM, or CTAM.
2. The IBM computer must use a communications controller which provides an RS-232-C, point-to-point Teletype port.

CONNECTIONS BETWEEN THE HP 2647A AND COMPUTERS

The following paragraphs contain information on connecting the HP 2647A to Hewlett-Packard computers, to various types of peripheral devices (printers, plotters, etc.), and point-to-point communications cabling, multipoint communications cabling, and current loop communications cabling.

HP 250 Computer System

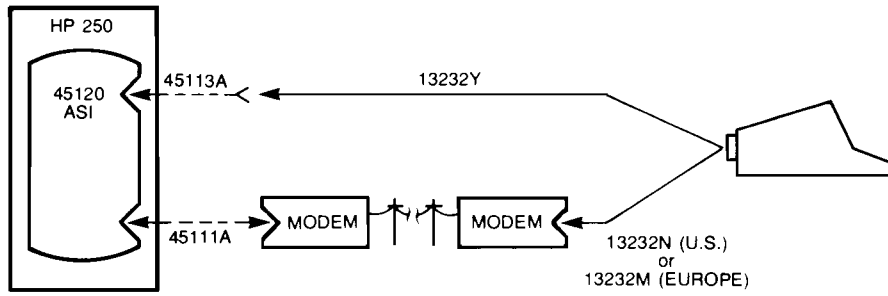
To connect the HP 2647A terminal to the HP 250 Computer System, refer to figure 1-6 and perform the following:

1. Ensure that an HP 45120 Asynchronous Serial Interface is installed in the computer.
2. Ensure that an HP 13260A Asynchronous Communications Interface (PCA part no. 02640-60086) is installed in the terminal.
3. Set all switches on the Keyboard Interface PCA (see figure 7-2 in the Reference Manual) to closed.
4. Set terminal keyboard switches as follows:

DUPLEX:	FULL
BAUD RATE:	Up to 9600 (see Section V, page 5-6, of the Reference Manual for operation at speeds above 1200 baud)
PARITY:	ODD
AUTO LF:	UP (OFF)
BLOCK MODE:	UP (OFF) or DOWN (ON)

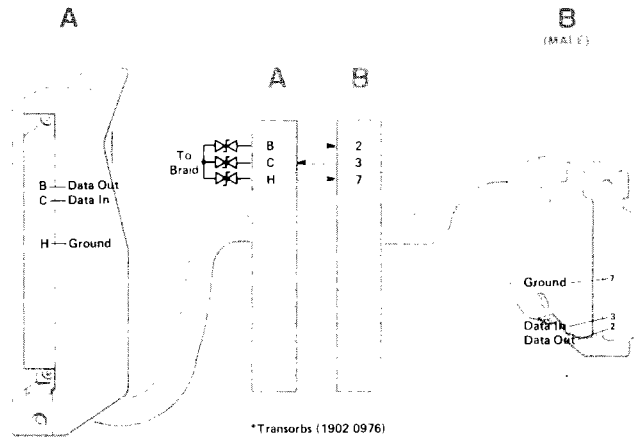
5. If the terminal is to be connected via a modem, use a Bell 103 or 212 or equivalent.
6. Connect the following cables (see figure 1-6):

Hardwired:	Cable HP 13232Y from terminal to cable HP 45113A to computer.
Modem:	Cable HP 13232N (U.S.) or HP 13232M (Europe) from terminal to modem; cable HP 45111A from modem to computer.



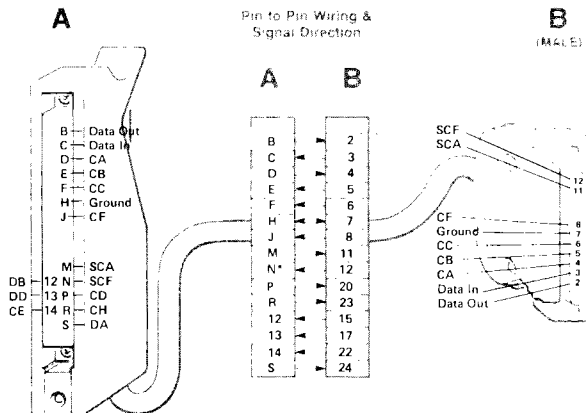
13232 Y

Cable 4.5 meters
Length 15 feet



13232 N

Cable 4.5 meters
Length 15 feet



13232 M

Cable 4.5 meters
Length 15 feet

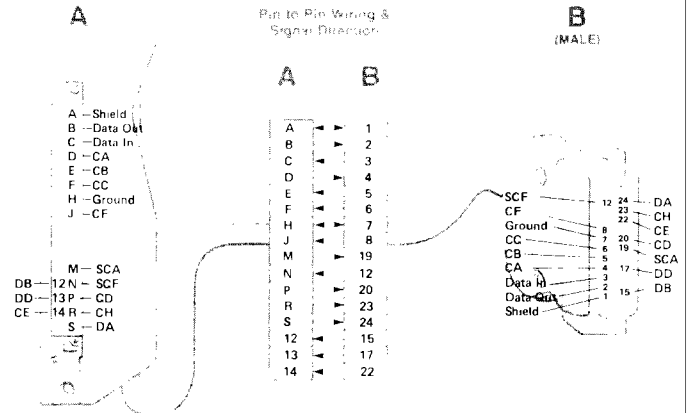


Figure 1-6. Connecting the Terminal to the HP 250 Computer System

HP 300 Computer System

To connect the HP 2647A terminal to the HP 300 Computer System, refer to figure 1-7 and perform the following:

1. Ensure that an HP 31264 Asynchronous Data Communications Interface is installed in the computer.
2. Ensure that an HP 13260A Asynchronous Communications Interface (PCA part no. 02640-60086) is installed in the terminal.
3. Set all switches on the Keyboard Interface PCA (see figure 7-2 in the Reference Manual) to closed.

4. Set terminal keyboard switches as follows:

- DUPLEX: FULL
- BAUD RATE: Up to 9600 (see Section V, page 5-6 of the Reference Manual for operation at speeds above 1200 baud)
- PARITY: NONE
- AUTO LF: UP (OFF)
- BLOCK MODE: UP (OFF) or DOWN (ON)

5. If the terminal is to be connected via a modem, use a Bell 103 or 212 or equivalent.

6. Connect the following cables (see figure 1-7):

- Hardwired: Cable HP 13232W from terminal to cable HP 31390A to computer.
- Modem: Cable HP 13232N (U.S.) or HP 13232M (Europe) from terminal to modem; cable HP 31390A from modem to computer.

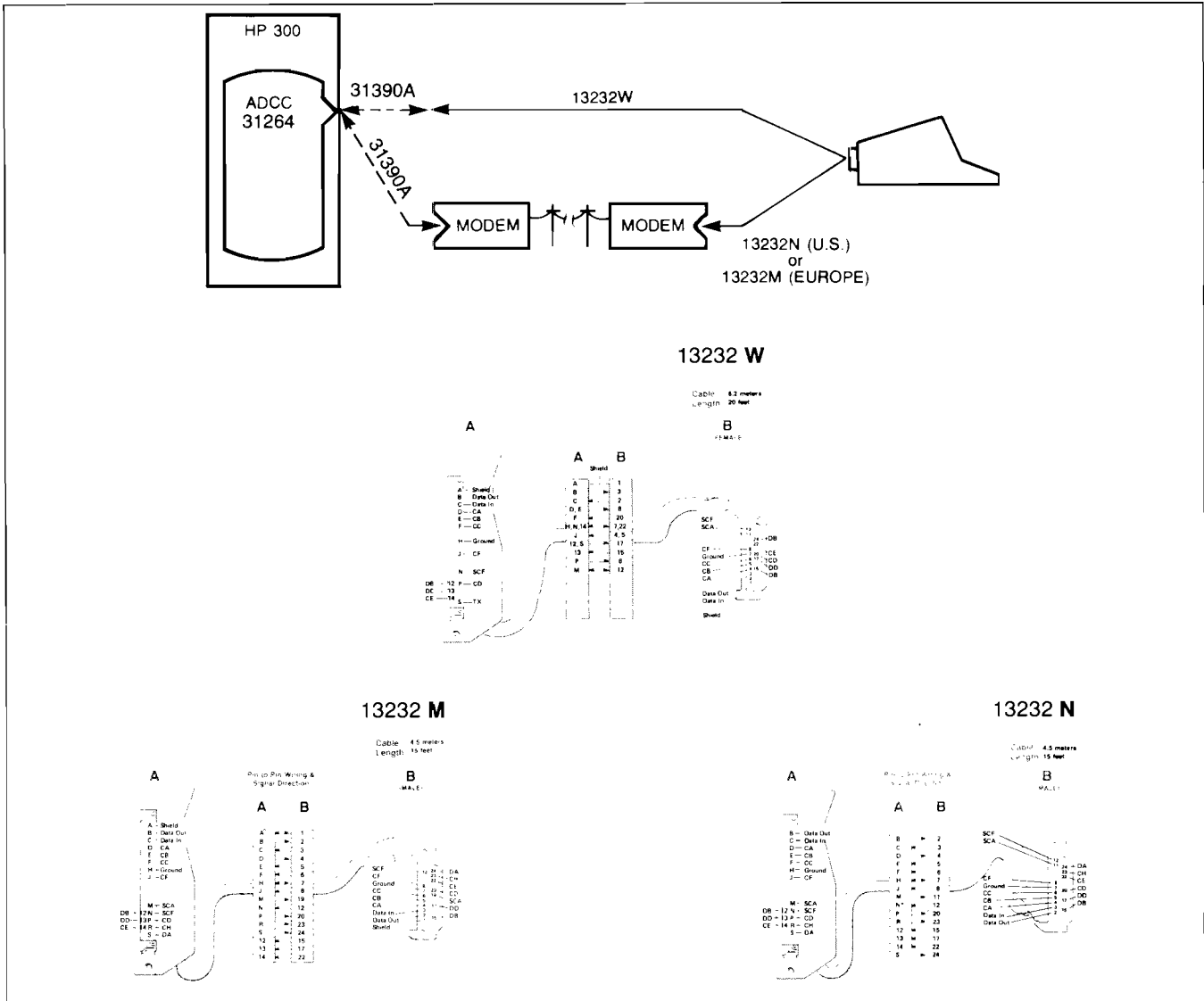


Figure 1-7. Connecting the Terminal to the HP 300 Computer System

HP 1000 Computer System with HP 12531D Interface

To connect the HP 2647A terminal to the HP 1000 Computer System using an HP 12531D interface, refer to figure 1-8 and proceed as follows:

1. Ensure that an HP 12531D Asynchronous Serial Interface is installed in the computer.
2. Ensure that an HP 13260A Asynchronous Communications Interface (PCA part no. 02640-60086) is installed in the terminal.
3. Set all switches on the Keyboard Interface PCA (see figure 7-2 in the Reference Manual) to closed.

4. Set terminal keyboard switches as follows:

- DUPLEX: FULL
- BAUD RATE: Up to 2400 (see Section V, page 5-6, of the Reference Manual for operation at speeds above 1200 baud)
- PARITY: NONE
- AUTO LF: UP (OFF)
- BLOCK MODE: UP (OFF)

5. If the terminal is to be connected via a modem, use a Bell 103 or 212 or equivalent.
6. Connect the following cables (see figure 1-8):

- Hardwired: Cable HP 13232C from the terminal to cable HP 12531D, Option 001, to computer.
- Modem: Cable HP 13232N (U.S.) or HP 13232M (Europe) from terminal to modem; cable HP 12531D, Option 002 from modem to computer.

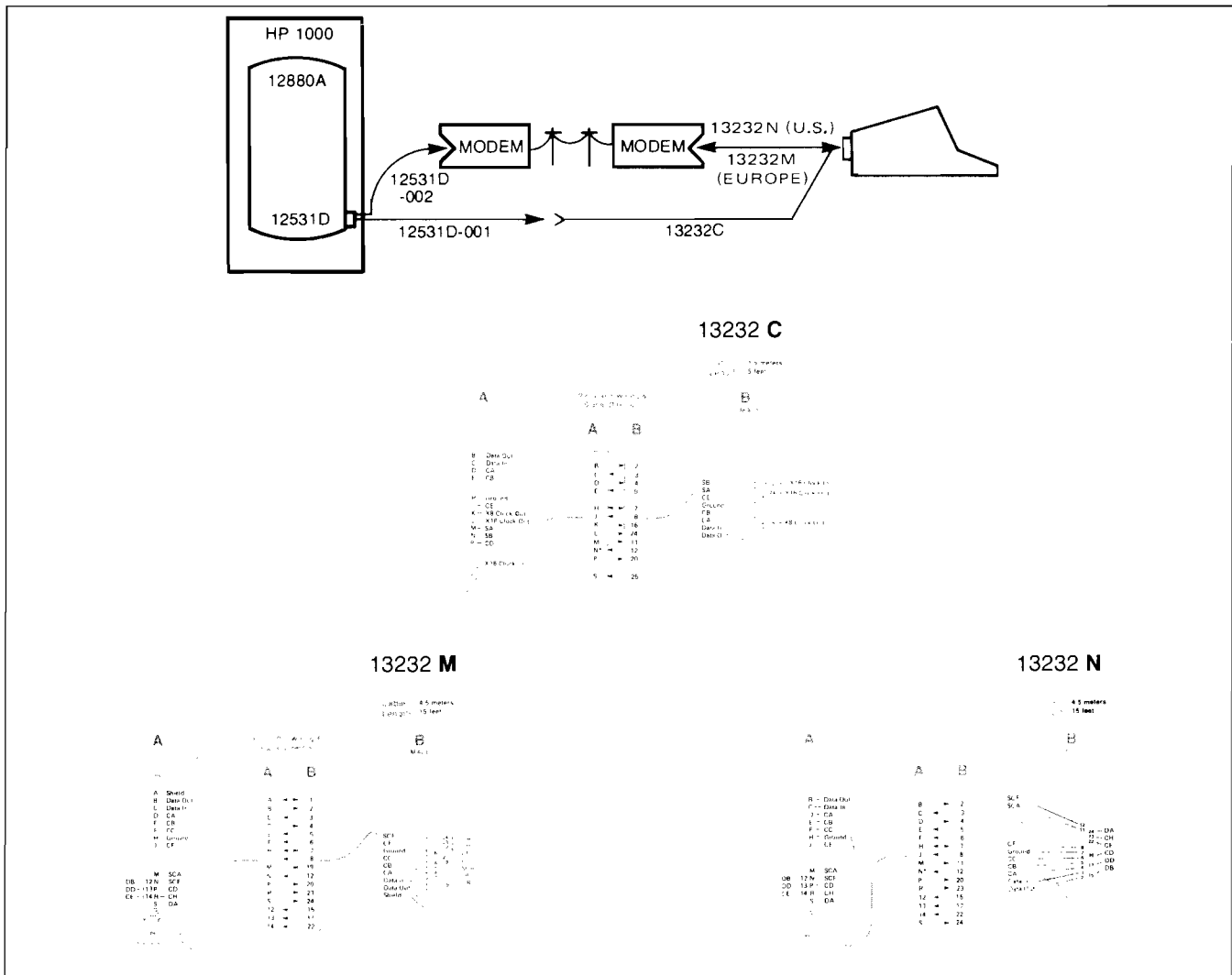


Figure 1-8. Connecting the Terminal to the HP 1000 Computer System with the HP 12531D Interface

HP 1000 Computer System with HP 12880A Interface

To connect the HP 2647A terminal to the HP 1000 Computer System using an HP 12880A interface, refer to figure 1-9 and perform the following:

1. Ensure that an HP 12880A Asynchronous Serial Interface is installed in the computer.
2. Ensure that an HP 13260A Asynchronous Communications Interface (PCA part no. 02640-60036) is installed in the terminal.
3. Set all switches on the Keyboard Interface PCA (see figure 7-2 in the Reference Manual) to closed.
4. Set terminal keyboard switches as follows:

DUPLEX:	FULL
BAUD RATE:	Up to 2400 (see Section V, page 5-6 of the Reference Manual for operation at speeds above 1200 baud)
PARITY:	NONE
AUTO LF:	UP (OFF)
BLOCK MODE:	UP (OFF)
5. A modem cannot be used with the HP 12880A.
6. Connect cable HP 13232C from terminal to cable part no. 12880-60003 to computer (see figure 1-9).

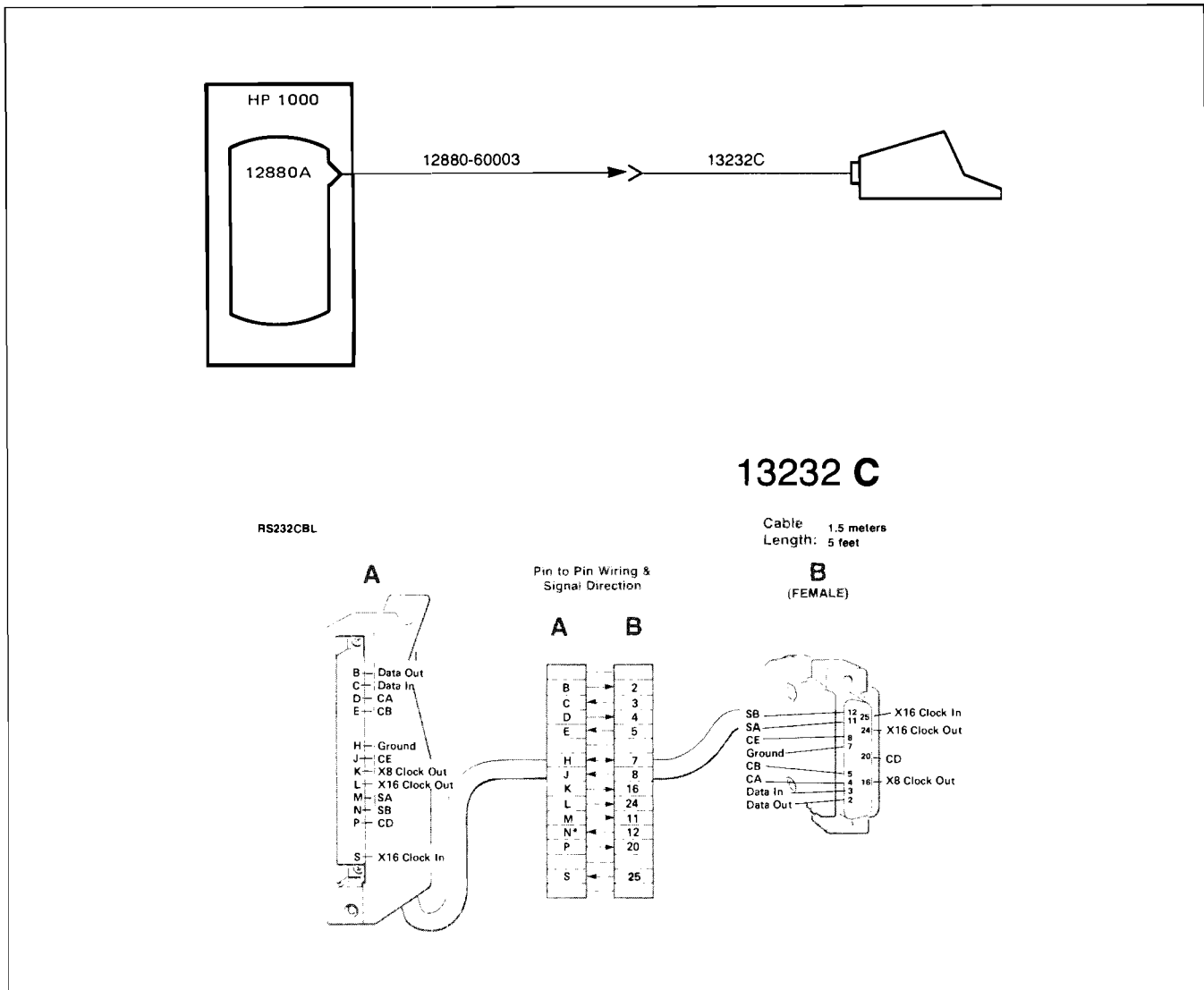


Figure 1-9. Connecting the Terminal to the HP 1000 Computer System with the HP 12880A Interface

HP 1000 Computer System with HP 12966A Interface

To connect the HP 2647A terminal to an HP 1000 Computer System using an HP 12966A interface, refer to figure 1-10 and perform the following:

1. Ensure that an HP 12966A Asynchronous Serial Interface is installed in the computer.
2. Ensure that an HP 13260B Extended Asynchronous Communications Interface (PCA part no. 02640-60143) is installed in the terminal.
3. Set all switches on the Keyboard Interface PCA (see figure 7-2 in the Reference Manual) to closed.
4. Set all switches except A9, A10, A11, and THE on the Extended Asynchronous Communications Interface PCA (see figure 7-2 in the Reference Manual) to open.

5. Set terminal keyboard switches as follows:

- DUPLEX: FULL
- BAUD RATE: Up to 9600 (see Section V, page 3-6, of the Reference Manual for operation at speeds above 1200 baud)
- PARITY: NONE
- AUTO LF: UP (OFF)
- BLOCK MODE: UP (OFF) or DOWN (ON)

6. If the terminal is to be connected via a modem, use a Bell 103 or 212 or equivalent.

7. Connect the following cables (see figure 1-10):

- Hardwired: Cable HP 12966A, Option 001 from terminal to computer.
- Modem: Cable HP 13232N (U.S.) or HP 13232M (Europe) from terminal to modem; cable HP 12966A, Option 002 from modem to computer.

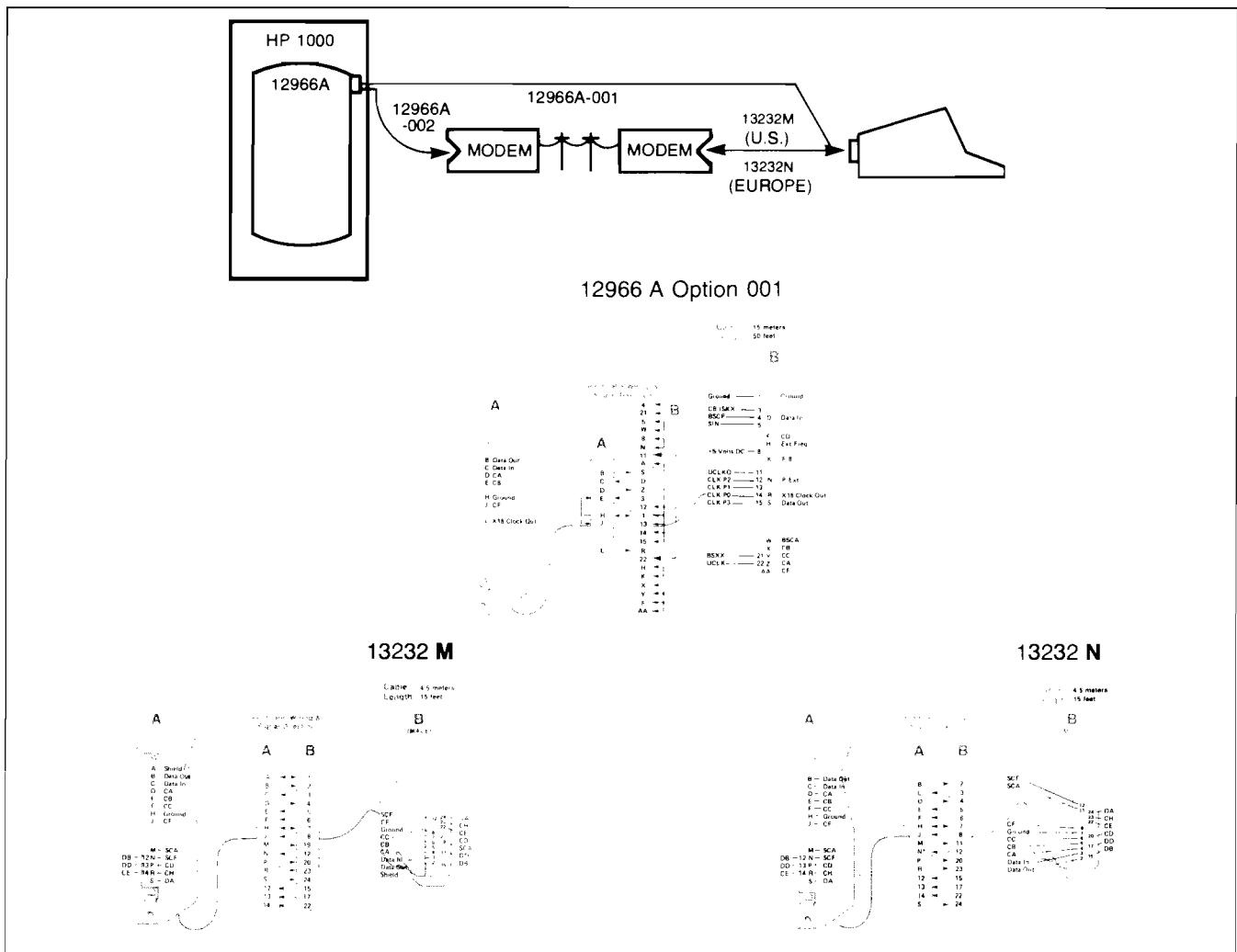


Figure 1-10. Connecting the Terminal to the HP 1000 Computer System with the HP 12966A Interface

HP 3000 Series I/II/III Computer System

To connect the HP 2647A terminal to an HP 3000 Series I, II, or III Computer System, refer to figure 1-11 and perform the following:

1. Ensure that an HP 30032B Asynchronous Terminal Controller is installed in the computer.
2. Ensure that an HP 13260A Asynchronous Communications Interface (PCA part no. 02640-60086) is installed in the terminal.
3. Set all switches on the Keyboard Interface PCA (see figure 7-2 in the Reference Manual) to closed.

4. Set terminal keyboard switches as follows:

- DUPLEX: FULL
- BAUD RATE: Up to 2400 (see Section V, page 5-6 of the Reference Manual for operation at speeds above 1200 baud)
- PARITY: EVEN
- AUTO LF: UP (OFF)
- BLOCK MODE: UP (OFF) or DOWN (ON)

5. If the terminal is to be connected via a modem, use a Bell 103 or 212 or equivalent.
6. Connect the following cables (see figure 1-1):

- Hardwired: Cable HP 13232Y from terminal to cable HP 30062D to computer.
- Modem: Cable HP 13232N (U.S.) or HP 13232M (Europe) from terminal to modem; cable HP 30062B from modem to computer.

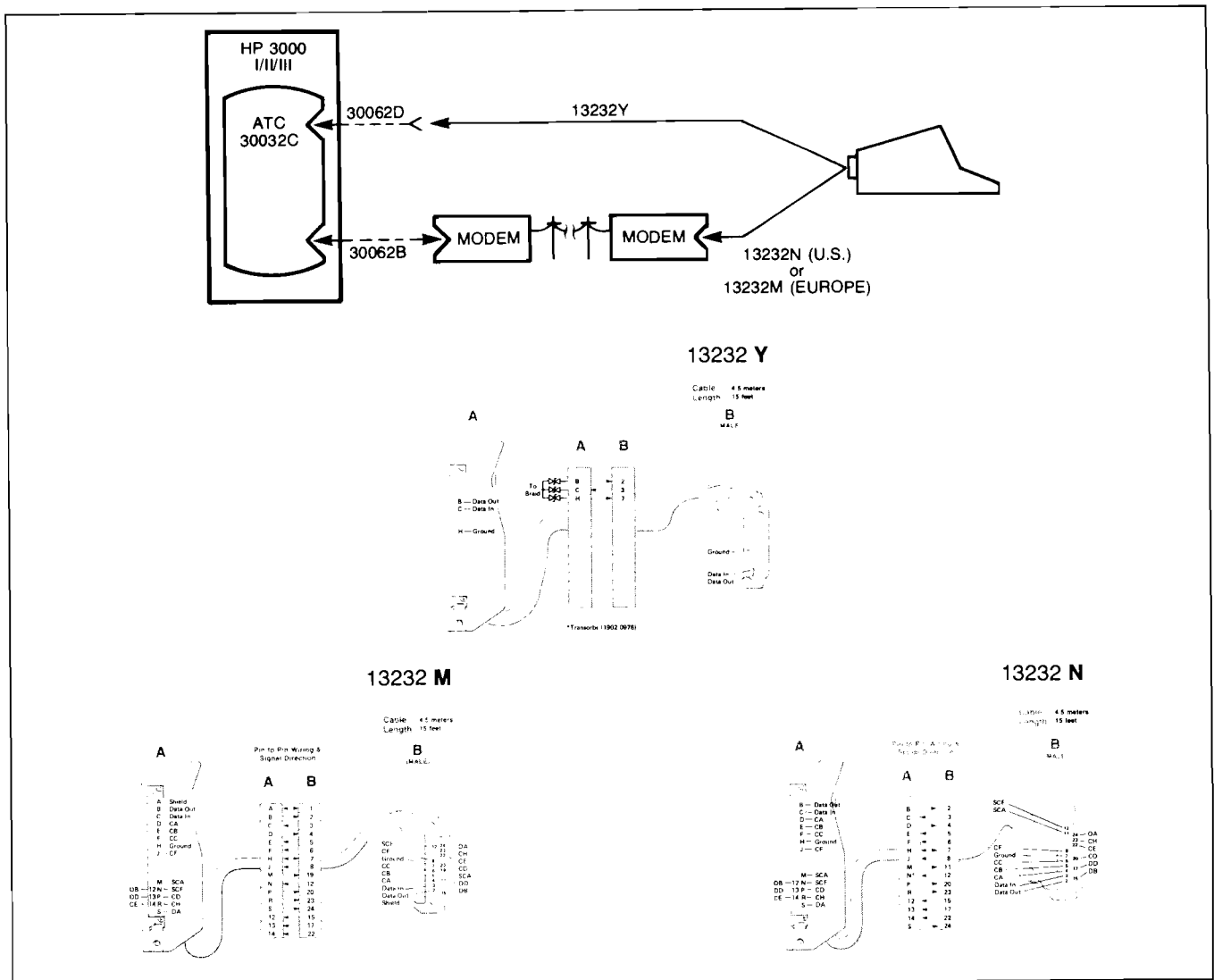


Figure 1-11. Connecting the Terminal to the HP 3000 Series I/II/III Computer System

HP 3000 Series 30/Series 33 Computer System

To connect the HP 2647A terminal to an HP 3000 Series 30/Series 33 Computer System, refer to figure 1-12 and perform the following:

1. Ensure that an HP 30018A Asynchronous Data Communications Controller is installed in the computer.
2. Ensure that an HP 13260A Asynchronous Communications Interface (PCA part no. 02640-60086) is installed in the terminal.
3. Set all switches on the Keyboard Interface PCA (see figure 7-2 in the Reference Manual) to closed.

4. Set terminal keyboard switches as follows:

- DUPLEX: FULL
- BAUD RATE: Up to 2400 (see Section V, page 5-6, of the Reference Manual for operation at speeds above 1200 baud)
- PARITY: NONE
- AUTO LF: UP (OFF)
- BLOCK MODE: UP (OFF) or DOWN (ON)

5. If the terminal is to be connected via a modem, use a Bell 103 or 212 or equivalent.
6. Connect the following cables (see figure 1-12):

- Hardwired: Cable HP 13232Y from terminal to cable HP 30062D to computer.
- Modem: Cable HP 13232N (U.S.) or HP 13232M (Europe) from terminal to modem; cable HP 30062B from modem to computer.

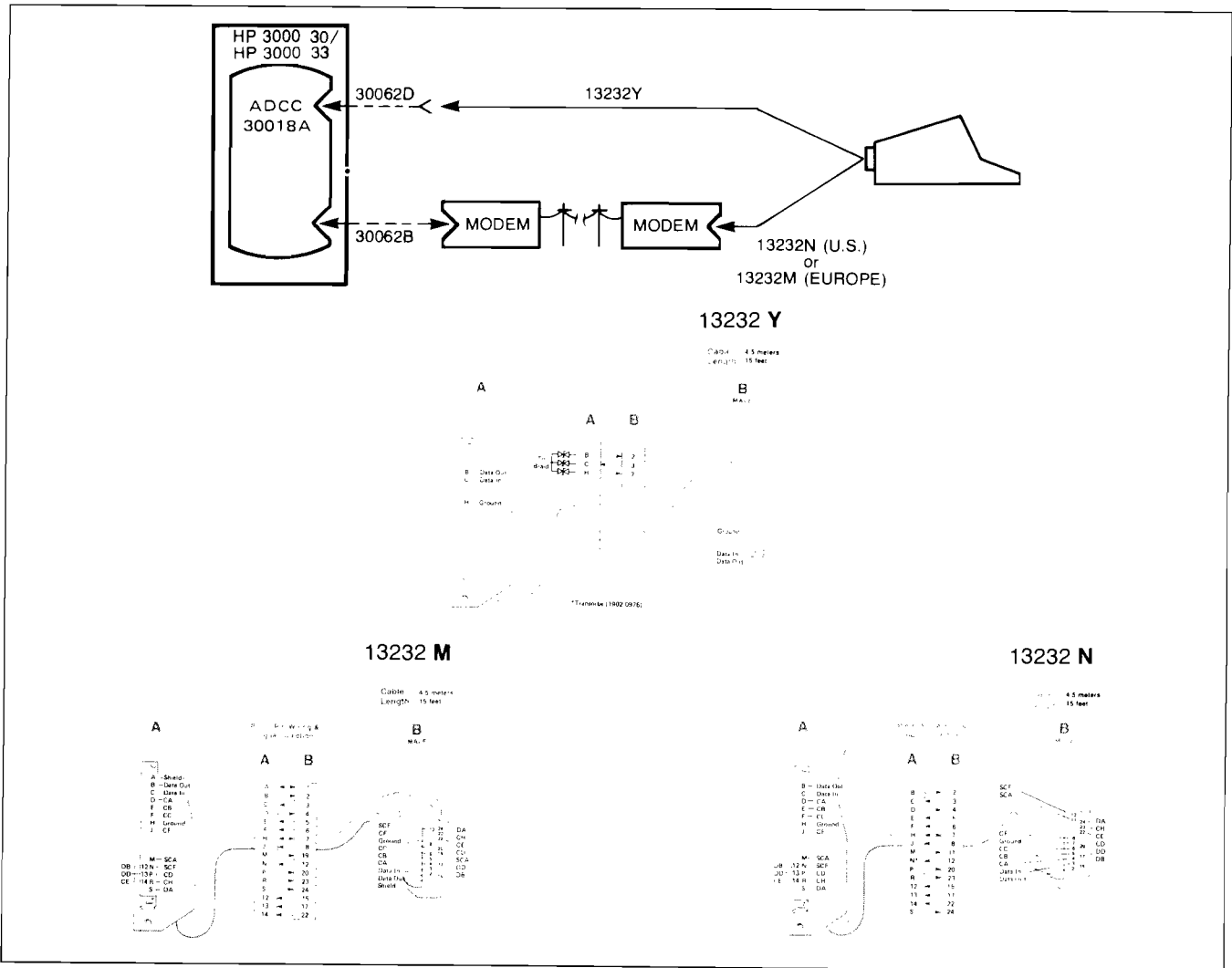


Figure 1-12. Connecting the Terminal to the HP 3000 Series 30/Series 33 Computer System

SHARED PERIPHERAL INTERFACE

The HP 13296A Shared Peripheral Interface accessory is used to connect shared peripheral devices to the HP 2647A terminal. The HP 13296A Shared Peripheral Interface consists of the following items:

1. HP-IB Interface PCA, part no. 02640-60128.
2. A standard 2-meter HP-IB interconnecting cable (figure 1-13). This cable has a double-sided male/female connector on both ends to allow stacked interconnection of multiple cables.

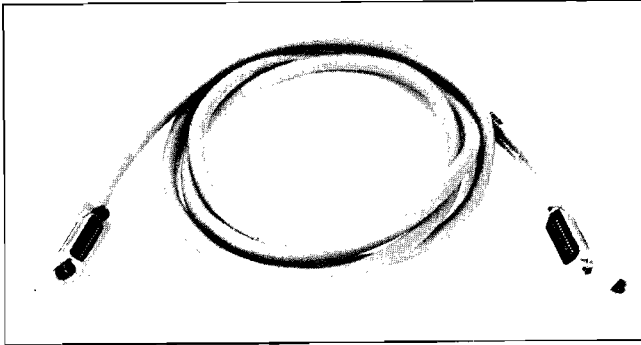


Figure 1-13. HP-IB Interconnecting Cable

3. HP-IB Interface Adapter, part no. 02640-60215 (figure 1-14). This item serves two purposes: First, it provides a means of connecting an HP-IB cable to the interface PCA. Second, it provides you with a means of increasing the maximum combined amount of interconnecting cable permitted in your HP-IB configuration.

HP-IB interconnecting cables are available in three lengths:

1. One meter (3.3 feet). HP 10631A HP-IB Cable, part no. 8120-1833.
2. Two meters (6.6 feet). HP 10631B HP-IB Cable, part no. 8120-1834.
3. Four meters (13.2 feet). HP 10631C HP-IB Cable, part no. 8120-1835.
4. One-half meter (1.6 feet). HP 10631D HP-IB Cable, part no. 8120-2237.

Each of the above cables has a double-sided male/female connector on both ends so that multiple cables can be stacked for parallel connections. To order any of the above three cables (the 2-meter cable is standard), contact the nearest Hewlett-Packard Sales and Service Office (a list of HP Sales and Service Offices is contained at the back of this manual).

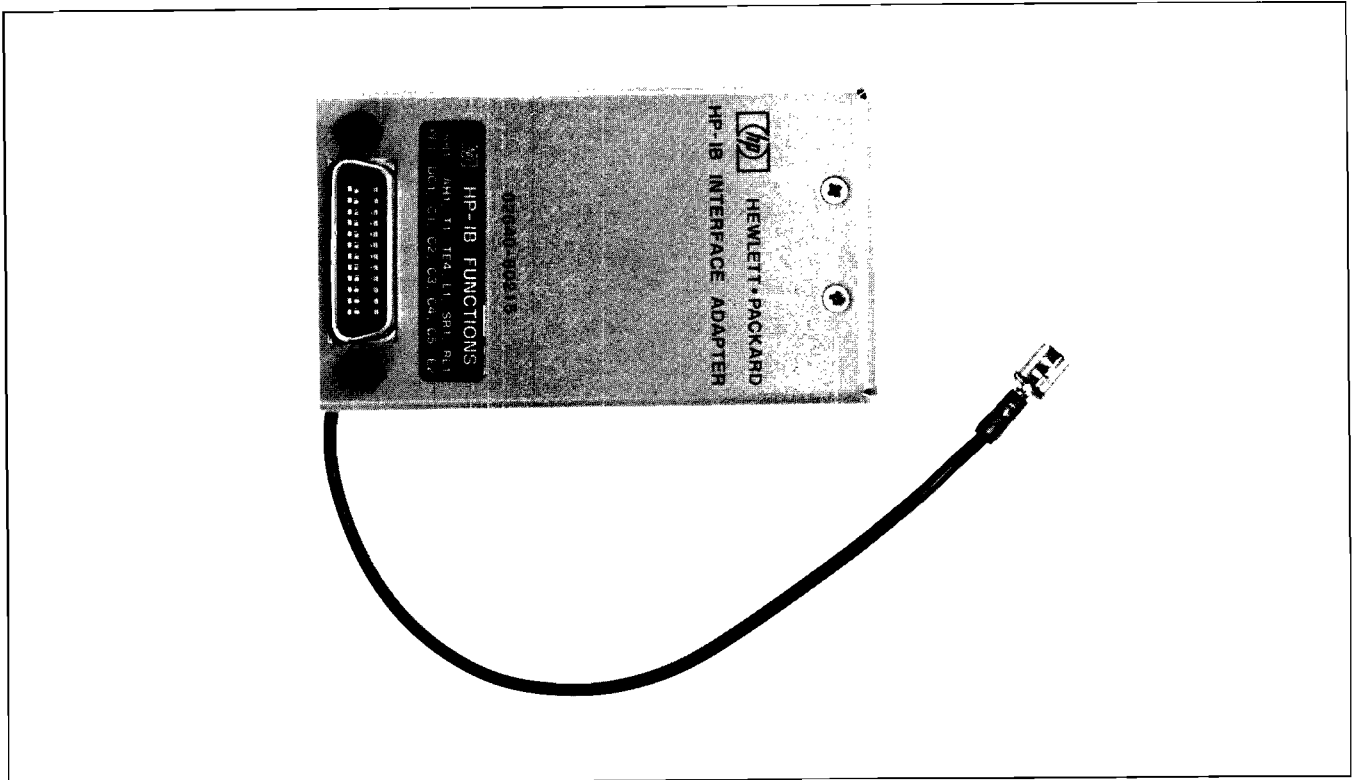


Figure 1-14. HP-IB Interface Adapter

Strapping the HP-IB Interface PCA, Part No. 02640-60128

Set the three switch banks on the HP-IB interface PCA as follows, depending on the number of terminals in the network.

ONE TERMINAL IN NETWORK

SWITCH BANK 1:			SWITCH BANK 2:			SWITCH BANK 3:		
1	-	Open	1	PL6	Closed	1	TA	Closed
2	-	Open	1	PL5	Open	2	LA	Open
3	A4	Closed	3	PL4	Open	3	B4	Open)
4	A11	Open	4	PL3	Open	4	B3	Open)
5	A10	Closed	5	PL2	Open	5	B2	Open)
6	A9	Closed	6	PL1	Open	6	B1	Closed)
7	ATN	Open	7	PL0	Open	7	B0	Open)
8	ATN2	Open	8	FC	Closed	8	SC	Open)

) ADDR = 29
) SYSCTL = Yes

TWO TERMINALS IN NETWORK

TERMINAL NO. 1			TERMINAL NO. 2		
Bank 1 (as above)			Bank 1 (as above)		
Bank 2 (as above)			Bank 2 (as above)		
BANK 3:			BANK 3:		
1	TA	Closed	1	TA	Closed
2	LA	Open	2	LA	Open
3	B4	Open)	3	B4	Open)
4	B3	Open)	4	B3	Open)
5	B2	Open)	5	B2	Open)
6	B1	Closed)	6	B1	Closed)
7	B0	Open)	7	B0	Closed)
8	SC	Closed)	8	SC	Open)

) ADDR = 29
) SYSCTL = No
) SYSCTL = Yes

In short, the only switches you ever need set are B4-B0 and SC. The rest should be left as indicated.

For multi-terminal configurations, you should start with address 29 and work your way down, sequentially, for example:

NO. TERMINALS	TERM No.	ADDRESS	SYSTEM CONTROLLER
1	1	29	Yes
2	1	29	No
	2	28	Yes
3	1	29	No
	2	28	No
	3	27	Yes

All peripheral devices must be strapped at addresses less than that of the system controller.

Shared peripherals must have an address between 0 and 7.

Installing the Shared Peripheral Interface PCA

Because of the HP-IB Interface Adapter, the shared peripheral interface PCA, part no. 02640-60128, should be installed in the second slot from the power supply enclosure. The datacomm PCA usually occupies this slot; this PCA can be moved to any vacant slot.

Cabling Considerations

A shared peripheral interface configuration is limited to a maximum combined amount of interconnecting cable that averages two meters of cable per device. The HP-IB Interface Adapter allows you to select 0 to 7 additional device loads (the HP 2647A terminal itself always counts as one device load). These simulated device loads make it appear as though the selected number of devices have actually been connected to the HP-IB configuration, thereby permitting you to use more meters of connecting cable. Additional cable availability obtained in this manner may be used anywhere within your HP-IB configuration. This adapter should be used for selecting device loads only when it is connected to the terminal that is functioning as the "System Controller" terminal. (If more than one terminal is connected in an HP-IB configuration, one of them must be configured as a System Controller.) The adapters for all other terminals should be set to "0."

The number of additional device loads is selected by moving the three IC chips (located inside the HP-IB Interface Adapter) back and forth between the upper and lower sockets. The upper sockets are inactive and the lower sockets are active. The lower left socket has the value "1", the lower middle socket has the value "2", and the lower right socket has the value "4." The number of additional device loads being simulated by the adapter is equal to the combined value of all the filled sockets in the lower row.

CAUTION

The three IC chips are not interchangeable. The IC chip for selecting one additional device load must always be in either the upper or lower "1 LOAD" socket, the IC chip for selecting two additional device loads must be in either the upper or lower "2 LOADS" socket, and the chip for selecting four additional device loads must be in the upper or lower "4 LOADS" socket. The part numbers of the three IC chips are:

- 1810-0408 (1 LOAD)
- 1810-1410 (2 LOADS)
- 1810-0409 (4 LOADS)

The IC chips must be installed in the sockets with the notched edge at the top. (An IC chip extractor tool is included with the HP-IB Interface Adapter.) The ground

cable from the adapter should be connected only to the terminal which is functioning as the System Controller terminal. It should be left unconnected on all other terminals in the configuration. The ground cable connects to the terminal at the ground plug adjacent to the power cord plug at the rear of the terminal.

To ensure proper operation for all cable lengths, it is recommended that you simulate seven loads on the adapter for all cable lengths.

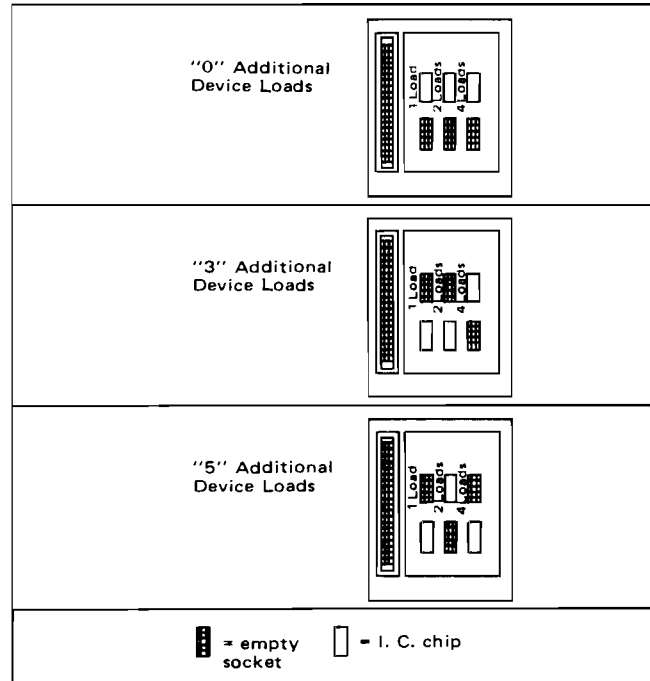


Figure 1-15. Selecting Additional Device Loads

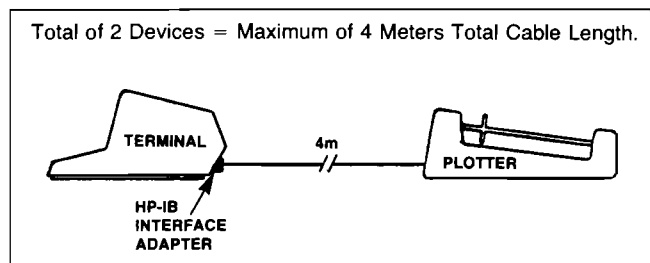


Figure 1-16. HP-IB Interface Adapter Set to "0" Loads

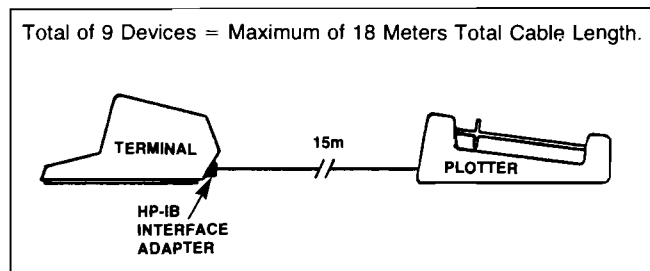


Figure 1-17. HP-IB Interface Adapter Set to "7" Loads

Operational Considerations

Any terminal in the configuration can be designated as the "System Controller." This is accomplished by setting switch SC on the terminal's HP-IB Interface PCA (part no. 02640-60128) to the "open" position. Only one terminal, however, should be assigned the System Controller role. An HP-IB configuration cannot function if it includes two or more System Controllers.

At any given time one of the terminals in the configuration is designated as the "Controller in Charge" (or CIC). Note that this is completely independent of the System Controller function. It merely means that the particular terminal is the one which most recently issued a command over the HP-IB. Whenever a terminal is currently the CIC, its LED above the **f4** key is lit.

If power is removed from the terminal which is currently designated as the CIC, the entire configuration becomes inoperative. To recover from such an event, you must do a hard reset (press **RESET TERMINAL** twice within 0.5 second) on the System Controller terminal (note that the terminal which was powered off need not be turned back on unless it also happens to be the System Controller terminal).

If power is removed from any terminal which is not currently designated as the CIC, the configuration is unaffected.

CAUTION

Doing a hard reset on the CIC halts any operation currently in progress. To resume operation, you must then do a hard reset on the System Controller terminal.

Doing a hard reset on the System Controller terminal reconfigures the HP-IB configuration.

Local HP-IB Testing

You can test the HP-IB interface of any terminal in the configuration locally at any time by pressing the following keys in the order shown below:

COMMAND NEXT NEXT NEXT TEST HP-IB RETURN

COMMAND **f1** **f1** **f1** **TEST** **HP-IB** **RETURN**

The test and its resulting messages are described in Section VII of the Reference Manual.

You can use the above test to determine if your terminal is the System Controller and/or currently the CIC (the message displays this information as well as the terminal's HP-IB device address).

Remote HP-IB Testing

When a configuration includes multiple terminals, you can test the cable connections by performing terminal loop-back tests. With this test, data is sent from one terminal to another and the data is then sent back for comparison. This test is initiated by pressing the following keys:

COMMAND NEXT NEXT NEXT TEST TERM#n RETURN

COMMAND **f1** **f1** **f1** **TEST** **TERM#n** **RETURN**

Where n is the address of the remote terminal with which the cable connection is to be tested.

This test and its resultant message are described in Section VII of the Reference Manual.

NOTE

DEVICES connected in a shared peripheral configuration must have a set of switches set to an address. Shared peripheral printers/plotters usually have addresses from 1 to 7. Setting an address switch to ON signifies a binary 1, OFF signifies a 0. For example, to set an address to 5, the switches would be as follows:

S ₁	S ₂	S ₃	S ₄	S ₅
ON	OFF	ON	OFF	OFF

Note that 2° is on the left.

Connecting the HP 2631G Graphics Printer

To connect the HP 2631G Graphics Printer to the HP 2647A Terminal, refer to figure 1-19 and perform the following:

1. Ensure that an HP-IB interface PCA (part no. 02640-60128) is installed in the terminal.
2. Connect the HP-IB interface adapter (part no. 02640-60215) to the HP-IB interface PCA.
3. Set the address switches (on the back of the printer) to the HP-IB interface bus address selected for the printer.
4. Connect the HP-IB cable (part no. 8120-1834) from the printer to the terminal, or from the printer to the next shared peripheral device.

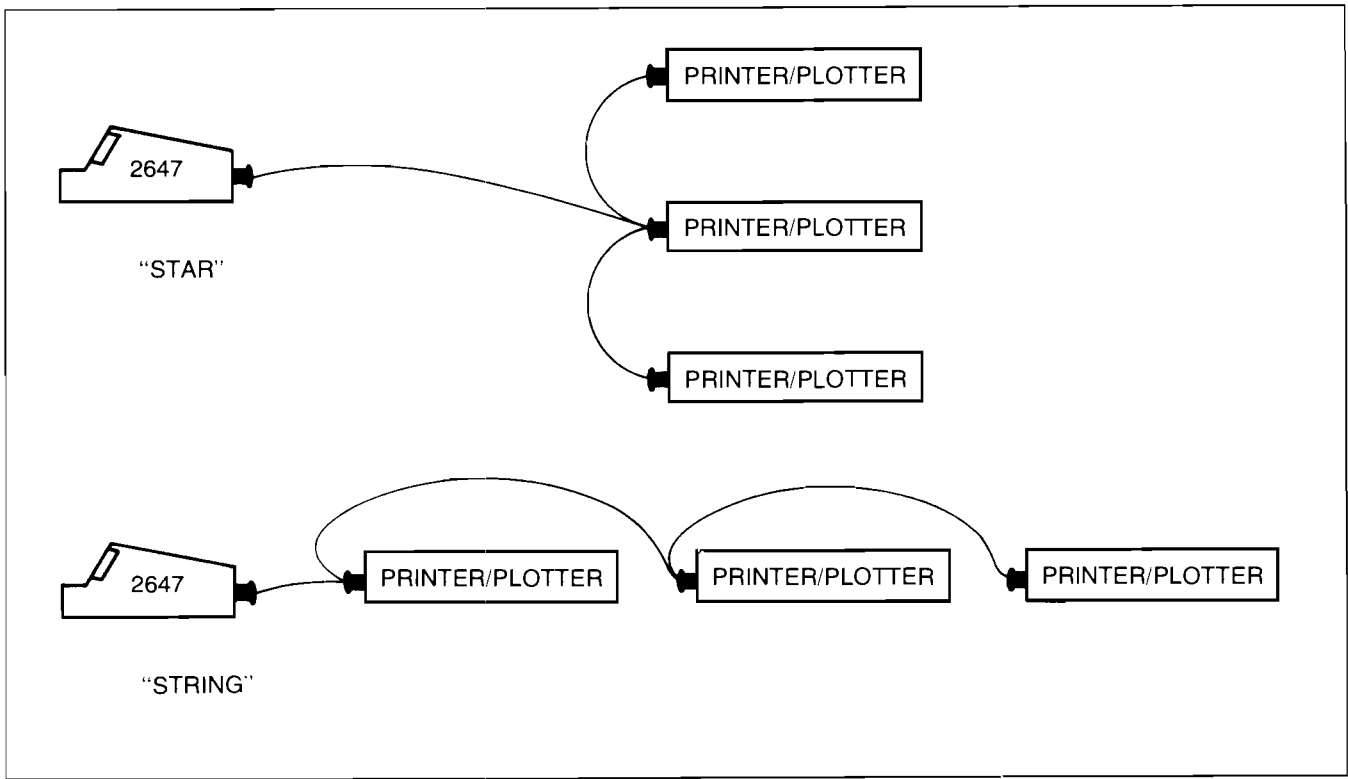


Figure 1-18. Shared Peripheral Interface Configurations

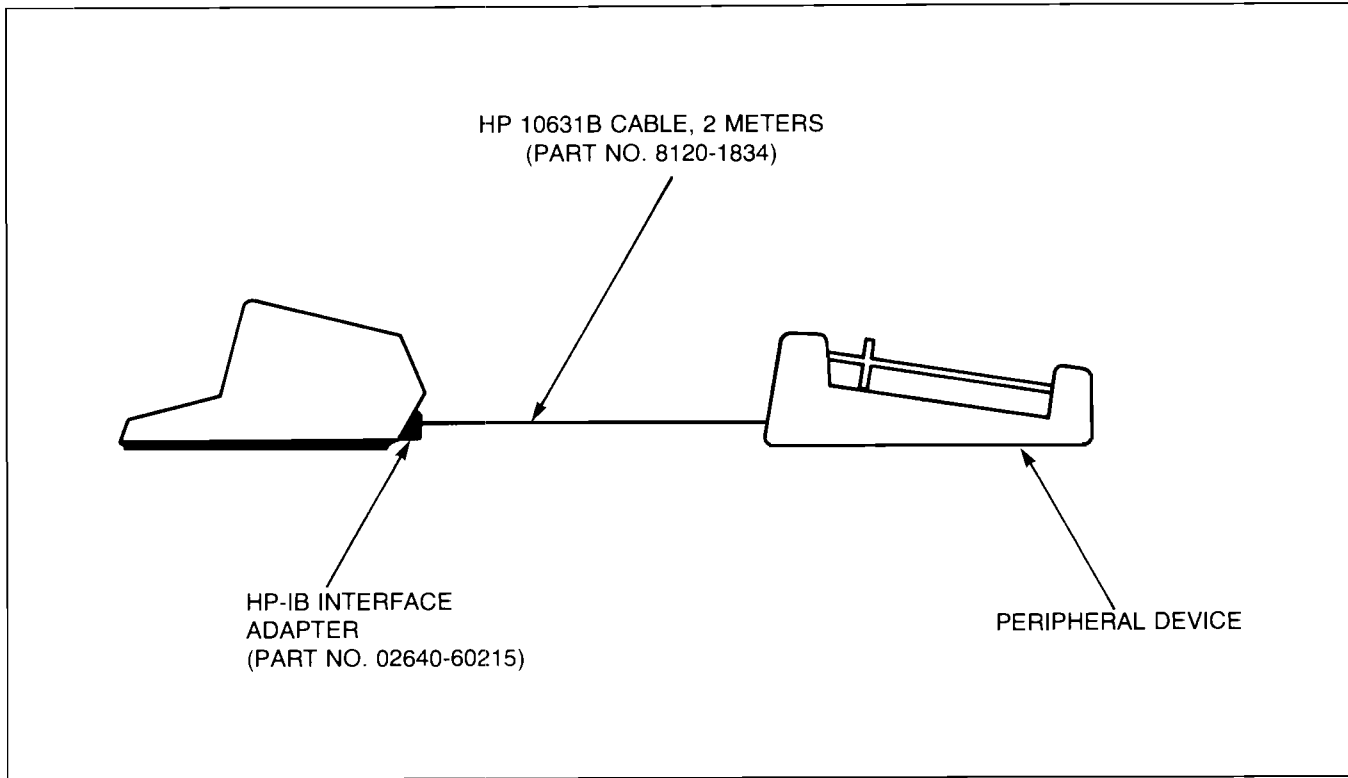


Figure 1-19. Connecting the HP 2647A to Shared Peripheral Interface Devices

Connecting the HP 7225A Plotter

To connect the HP 7225A Plotter to the HP 2647A, refer to figure 1-19 and perform the following:

1. Ensure that an HP-IB interface PCA (part no. 02640-60128) is installed in the terminal.
2. Connect the HP-IB interface adapter (part no. 02640-60215) to the interface PCA.
3. Ensure that the plotter contains an HP 17601A Personality Module.
4. Set the address switches (located on the back of the personality module) to the HP-IB interface bus address selected for the plotter.
5. Set the LISTEN ONLY/ADDRESSABLE switch (on the back panel of the personality module) to ADDRESSABLE.
6. Connect the HP-IB cable (part no. 8120-1834) from the plotter to the terminal, or to another peripheral device.

Connecting the HP 7245B Plotter/Printer

To connect the HP 7245B Plotter/Printer to the HP 2647A, refer to figure 1-19 and perform the following:

1. Ensure that an HP-IB interface PCA (part no. 02640-60143) is installed in the terminal.
2. Connect the HP-IB interface adapter (part no. 02640-60215) to the interface PCA.
3. Set the address switches (located on the back of the plotter) to the HP-IB interface bus address selected for the plotter. The address selected corresponds to the plotter address (L) and the printer is automatically set as the next higher address (L+1). Do not use address 30 because addressing the printer (L+1) would request address 31 which is not a valid address.
4. Set the ADDRESS/LISTEN ONLY/L+1 switch (on the back panel of the plotter) to ADDRESS.
5. Set the back panel switches listed below as follows:

ERROR BEEP	- OFF
6 L/I - 8 LPI	- 8 LPI
SI/SO - 8 BIT	- 8 BIT
ENG - METRIC	- DEPENDING ON UNITS YOU ARE USING
SCALED - 9872	- 9872

6. Connect the HP-IB cable (part no. 8120-1834) from the plotter to the terminal, or to another peripheral device.

Connecting the HP 7310A Printer

To connect the HP 7310A Printer to the HP 2647A, refer to figure 1-19 and perform the following:

1. Ensure that an HP-IB interface PCA (part no. 02640-60128) is installed in the terminal.
2. Connect the HP-IB interface adapter (part no. 02640-60215) to the interface PCA.
3. Set the back panel switches listed below as follows:

HP-IB Switches:

S1 - S5	- To the HP-IB interface bus address selected for the HP 7310A.
CR	- ON
SRO	- OFF
LISTEN ONLY	- OFF

All FUNCTION switches except ENH RESET to the left. Set ENH RESET to the right.

4. Connect the HP-IB cable (part no. 8120-1834) from the printer to the terminal, or to another peripheral device.

Connecting the HP 9872B/9872S Plotter

To connect the HP 9872B/9872S Plotter to the HP 2647A, refer to figure 1-19 and perform the following:

1. Ensure that an HP-IB interface PCA (part no. 02640-60128) is installed in the terminal.
2. Connect the HP-IB interface adapter (part no. 02640-60215) to the interface PCA.
3. Set the address switches (located on the back of the plotter) to the HP-IB interface bus address selected for the plotter.
4. Set the LISTEN ONLY switch (on the back of the plotter) to 0 (OFF).
5. Connect the HP-IB cable (part no. 8120-1834) from the plotter to the terminal, or to another peripheral device.

Connecting the HP 9874A Digitizer

To connect the HP 9874A Digitizer to the HP 2647A, refer to figure 1-19 and perform the following:

1. Ensure that an HP-IB interface adapter (part no. 02640-60128) is installed in the terminal.
2. Connect the HP-IB interface adapter (part no. 02640-60215) to the interface PCA.

- Set the address switches (located on the back of the digitizer) to the HP-IB interface bus address selected for the digitizer.
- Connect the HP-IB cable (part no. 8120-1834) from the digitizer to the terminal, or to another peripheral device.

- Connect the HP-IB cable (part no. 8120-1834) from the printer to the terminal, or to another peripheral device.

Connecting the HP 9876A Printer

To connect the HP 9876A Printer to the HP 2647A, refer to figure 1-19 and perform the following:

- Ensure that an HP-IB interface adapter (part no. 02640-60128) is installed in the terminal.
- Connect the HP-IB interface adapter (part no. 02640-60215) to the interface PCA.
- Set the switches listed below (located on the back of the printer) as follows:

- | | |
|---------------|--|
| A1 - A5 | - To the HP-IB interface bus address selected for the printer. |
| SRQ | - OFF |
| 8 BIT ASCII | - OFF |
| LISTEN ALWAYS | - ON |

STANDARD POINT-TO-POINT DATA COMMUNICATIONS CABLING

For standard (i.e., not through a modem) point-to-point data communications cabling, refer to figure 1-20 and perform the following:

- Ensure that an HP 13260A Asynchronous Communications Interface (PCA part no. 02640-60086) is installed in the terminal.
- Perform the steps listed in figure 1-21 and table 1-2.
- Connect an HP 13232C cable to the Asynchronous Communications Interface PCA (part no. 02640-60086). Fabricate an RS-232-C cable to connect from the HP 13232C cable to your computer. Refer to figure 1-20 for the cabling information and to table 1-3 for information on fabricating your own cable.

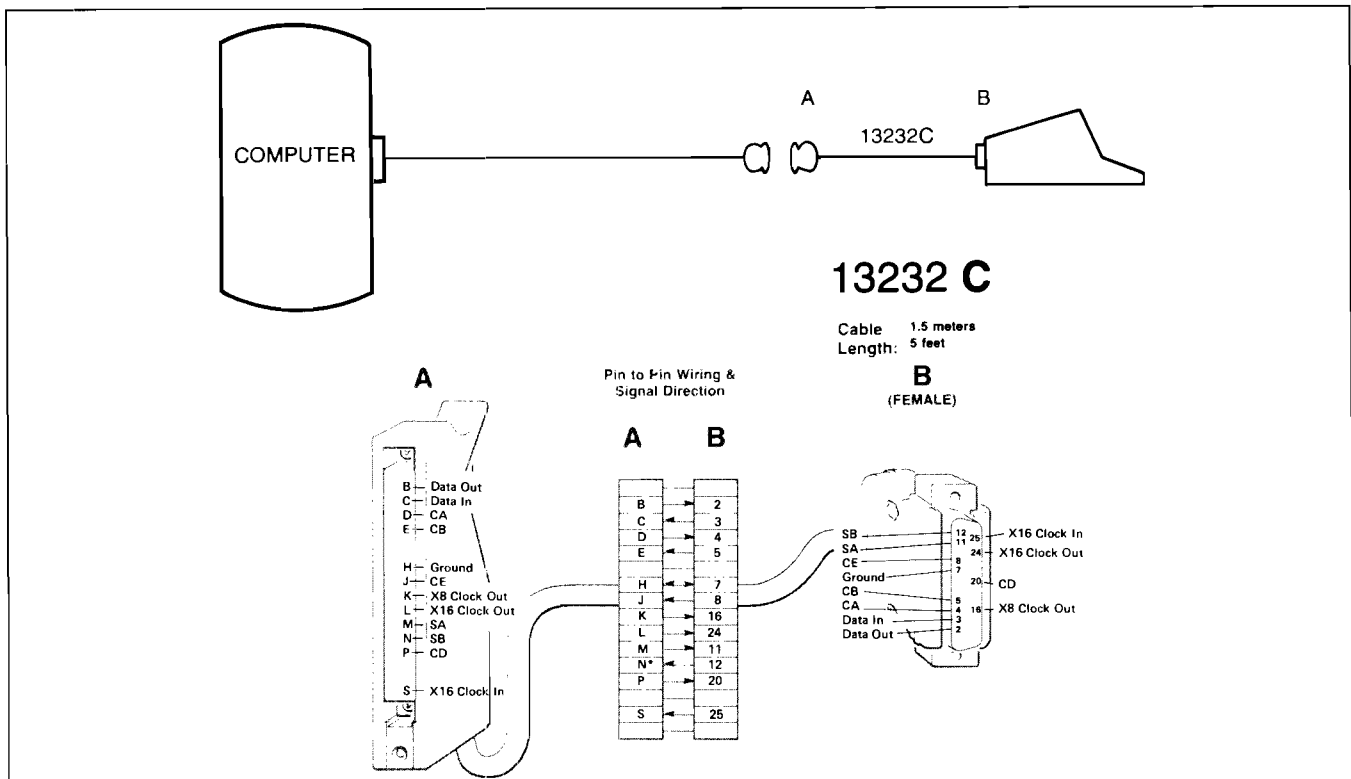


Figure 1-20. Point-to-Point Data Communications Cabling

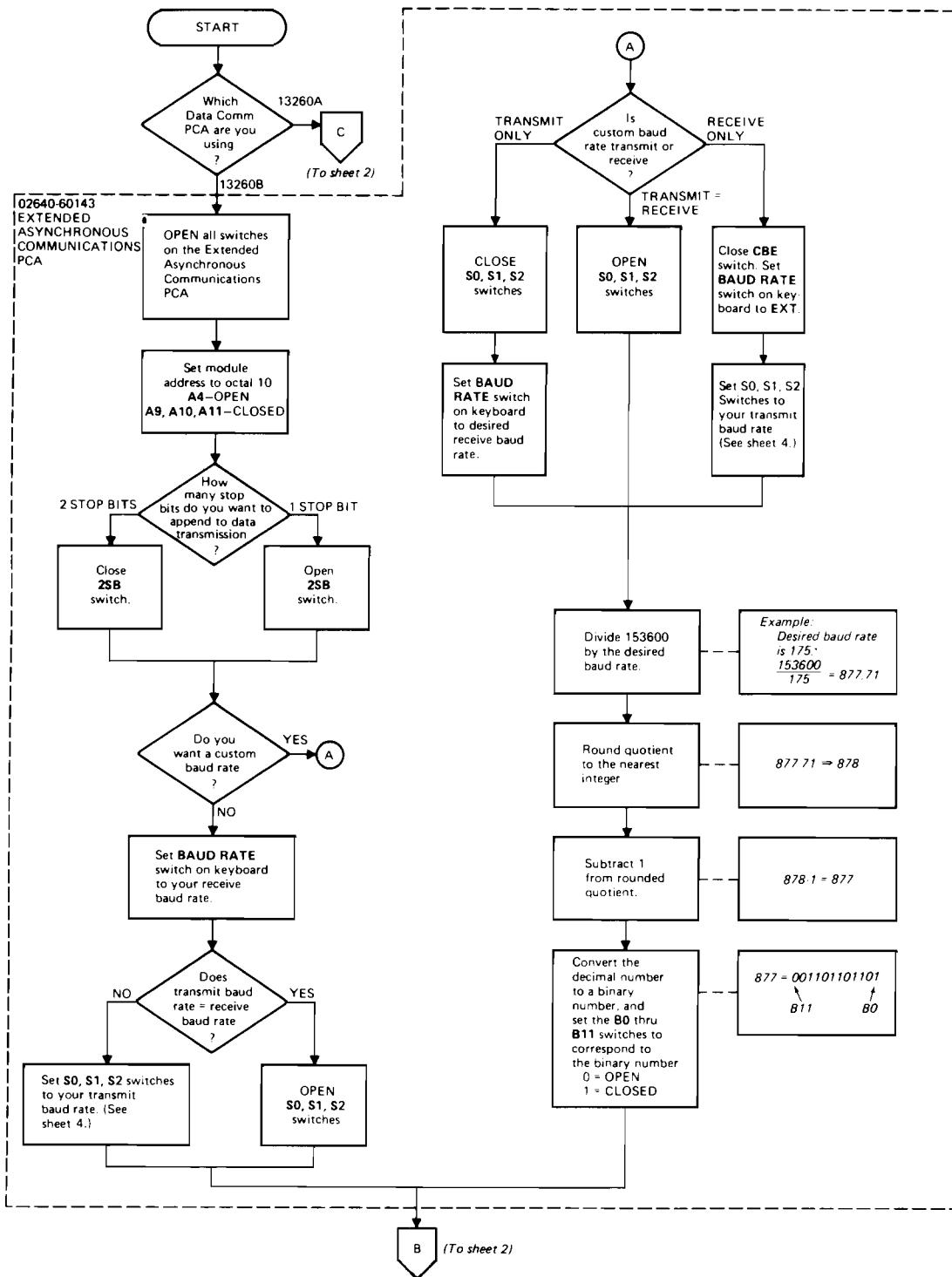


Figure 1-21. Point-to-Point Data Communications Configuration Flowchart (Sheet 1 of 4)

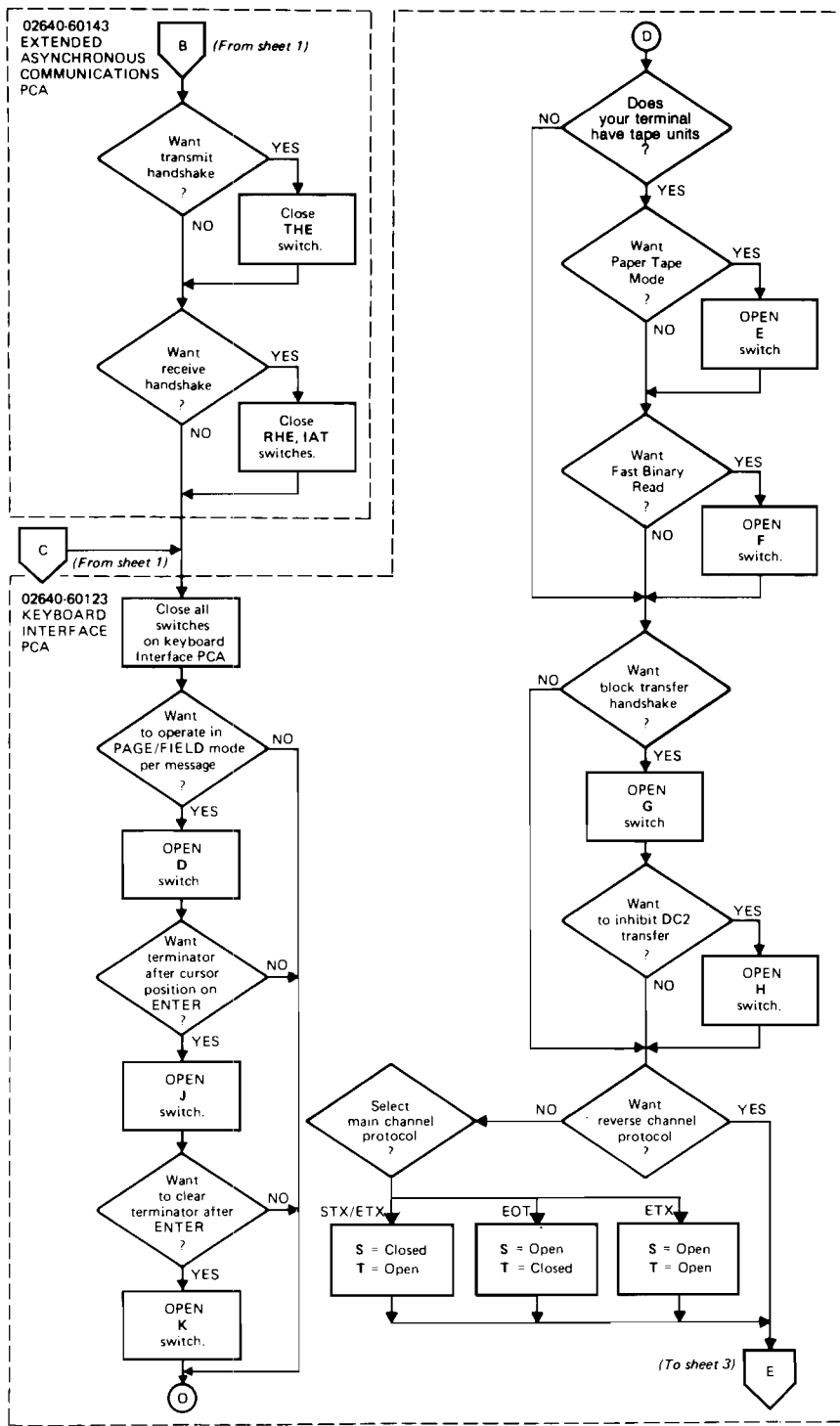


Figure 1-21. Point-to-Point Data Communications Configuration Flowchart (Sheet 2 of 4)

02640-60123
KEYBOARD
INTERFACE
PCA

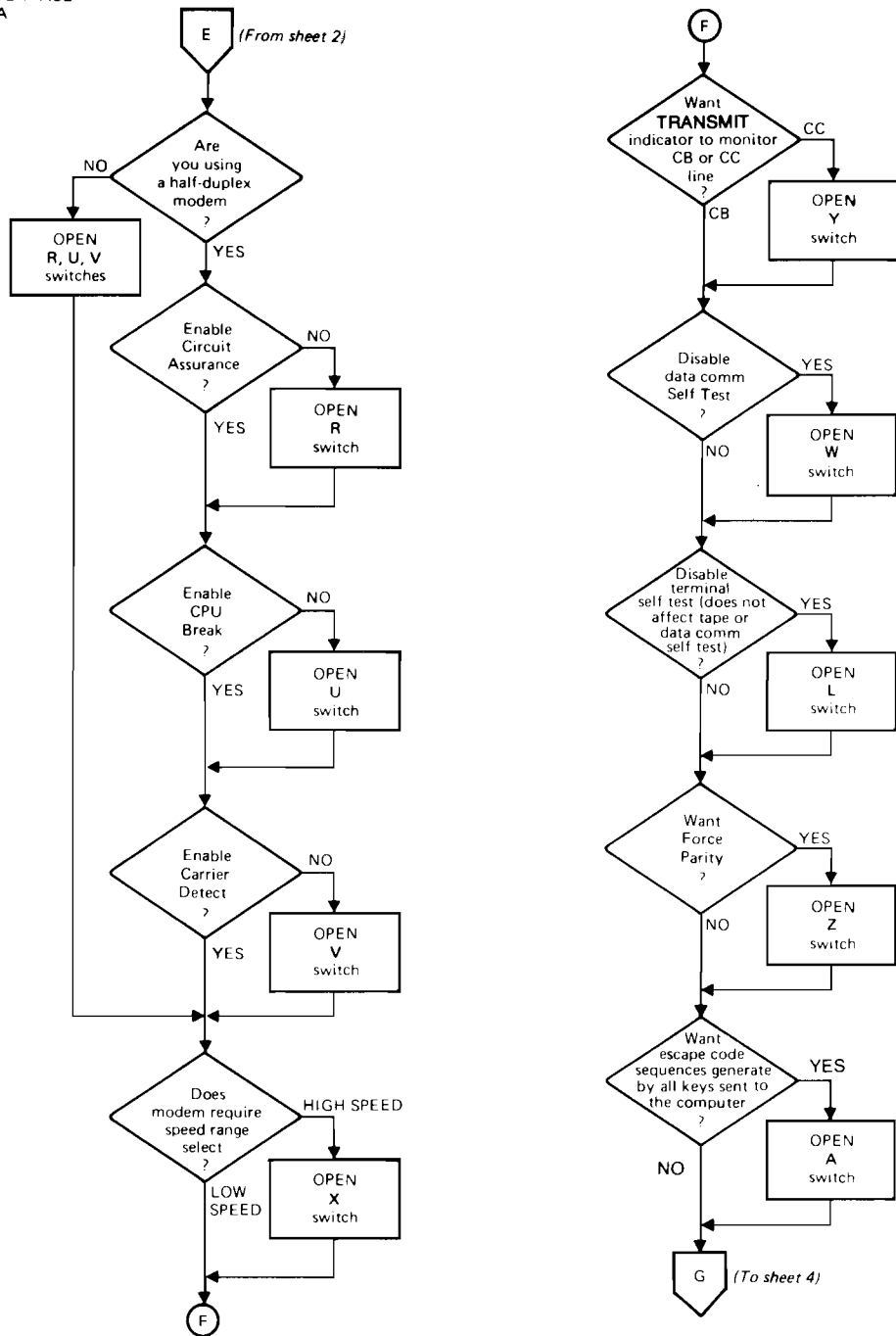
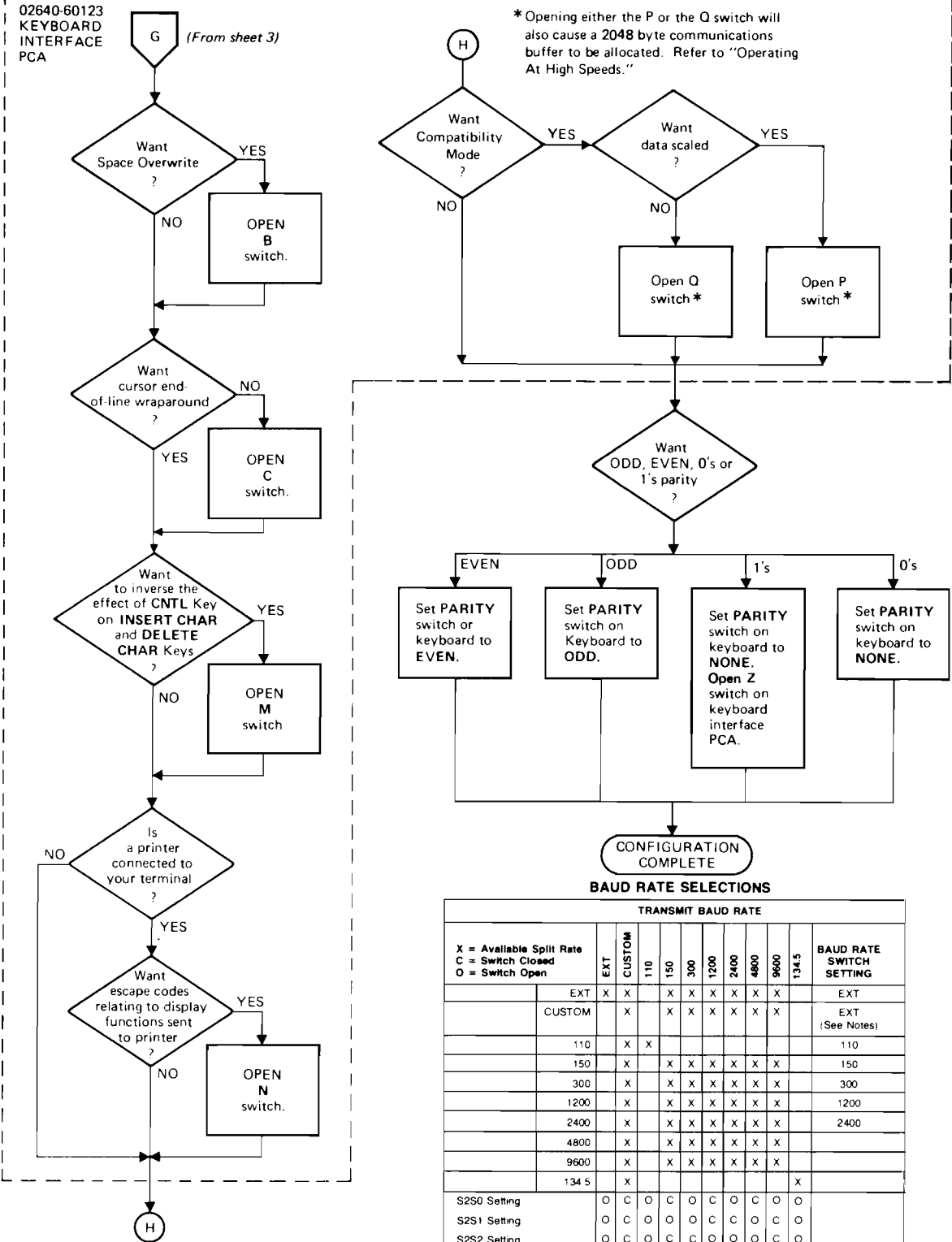


Figure 1-21. Point-to-Point Data Communications Configuration Flowchart (Sheet 3 of 4)



* Opening either the P or the Q switch will also cause a 2048 byte communications buffer to be allocated. Refer to "Operating At High Speeds."

BAUD RATE SELECTIONS

		TRANSMIT BAUD RATE										
		EXT	CUSTOM	110	150	300	1200	2400	4800	9600	134.5	BAUD RATE SWITCH SETTING
	EXT	X	X	X	X	X	X	X	X	X		EXT
	CUSTOM		X	X	X	X	X	X	X	X		EXT (See Notes)
	110		X	X								110
	150		X	X	X	X	X	X	X			150
	300		X	X	X	X	X	X	X			300
	1200		X	X	X	X	X	X	X			1200
	2400		X	X	X	X	X	X	X			2400
	4800		X	X	X	X	X	X	X			
	9600		X	X	X	X	X	X	X			
	134.5		X								X	
S2S0 Setting		O	C	O	C	O	C	O	C	O	O	
S2S1 Setting		O	C	O	C	O	C	O	C	O	O	
S2S2 Setting		O	C	O	C	O	C	O	C	O	O	

NOTES

The S2CBE switch must be set to its closed position for custom receive baud rates and keyboard BAUD RATE switch must be set to EXT
When switches S2S0, S2S1, and S2S2 are all set to their open positions, the transmit baud rate will equal the receive baud rate

Figure 1-21. Point-to-Point Data Communications Configuration Flowchart (Sheet 4 of 4)

Table 1-2. Keyboard Interface PCA Strapping Options for Point-to-Point

STRAP	STRAPPING OPTION	NORMAL OPERATION (SWITCH CLOSED)	OPERATION WITH STRAPPING OPTION (SWITCH OPEN)
A	Function Key Transmission	The escape code sequence generated by the major function keys (such as, ROLL UP, ROLL DOWN, etc.) are executed locally, but not transmitted to the computer.	The escape code sequences generated by all keys are transmitted to the computer. If operating in half duplex, the function is also executed locally.
B	Space Overwrite (SPOW) Latch Enable	Spaces typed will overwrite existing characters.	When the SPOW latch is off, overwriting occurs as normal. When the SPOW latch is on, spaces cause the cursor to move forward but not overwrite any existing characters. The SPOW latch is turned on by a Carriage Return, and off by a Line Feed, Home or Tab.
C	Cursor End-of-Line Wraparound	At the end of each line, a local Carriage Return and Line Feed are generated; the cursor moves to the beginning of the next line.	A Carriage Return and Line Feed are not generated at the end of each line. The cursor remains in and overwrites column 80.
D	Line/Page	The terminal is set to transfer a line at a time in Block Mode.	Entire pages of information are transferred in Block Mode.
E	Paper Tape Mode	When the READ key is pressed with AUTO LF key latched down, each tape record begins with an LF and is terminated by a CR .	Each tape record is terminated by CR .
F	Fast Binary Read	The transmission rate is determined by the BAUD RATE switch on the keyboard.	When an LF (Fast Binary Read) is issued by the computer, the baud rate is switched automatically to 9600 baud (if the terminal is equipped with cartridge tape units).
G	Block Transfer Handshake	In Block Mode, all data transfers to the computer are sent upon receipt of a DC1 from the computer.	All Block Mode transfers (i.e., cursor sense, terminal and device status, device I/O responses, display memory, and function keys) are preceded by a DC2. The terminal sends the DC2 upon receipt of a DC1 from the computer. After the CPU receives the DC2 from the terminal, another DC1 is required to trigger transmission of data from the terminal.
H	Inhibit DC2	During Block Mode Handshake transfers, the terminal sends a DC2 in response to a DC1 prior to sending data. (See Block Transfer Handshake strapping above.)	A DC1 from the computer is not required to trigger data transfers to the computer. Also, the DC2 from the terminal is not sent during Block Mode Transfer handshakes. (See Block Transfer Handshake strapping above.) Additionally, when the ENTER key is pressed in Block Mode the cursor will be placed in the first column before transmission occurs if operating in Line/Field Mode (switch D closed) or Home'd if operating in Page Mode (switch D open.) Opening both switches G and H eliminate the terminal's use of the Handshake protocol entirely.
J	Auto Terminate	No effect.	When in BLOCK mode and the ENTER key is pressed, places a non-displaying terminator before the cursor position.
K	Clear Terminator	No effect	Clear terminator caused by Strapping Option J or LF .
L	Self Test Inhibit	No effect.	Self Test function is inhibited. Pressing TEST key or issuing LF z displays the NO TEST message. TAPE TEST and DATA COMM SELF TEST functions are not affected.
M	INSERT and DELETE CHAR with wrap (Reverse Sense)	No effect.	Reverses effect of CNTL key on INSERT CHAR and DELETE CHAR keys (i.e., when key is pressed, line wrap around is in effect without having to press CNTL key. When either key is pressed while pressing CNTL, normal insert character and delete character functions are in effect.)

Table 1-2. Keyboard Interface PCA Strapping Options for Point-to-Point (Continued)

STRAP	STRAPPING OPTION	NORMAL OPERATION (SWITCH CLOSED)	OPERATION WITH STRAPPING OPTION (SWITCH OPEN)
N	Escape Code Transfer to Printer	No effect.	Escape codes relating to the display (e.g., display enhancements, alternate character sets, format mode, fields, etc.) are sent to printer if it is selected as a destination device.
P,Q	Compatibility Mode	These switches set the terminal to be compatible with Tektronix control commands when initialized (power on or full reset).	
		P-closed, Q-closed	Normal operation
		P-closed, Q-open	Unscaled Compatibility Mode and 2048 byte data comm buffer.
		P-open, Q-closed	Scaled Compatibility Mode and 2048 byte data comm buffer.
		P-open, Q-open	2048 byte data comm buffer.
R	Circuit Assurance	The transition from receive state to transmit state occurs after both CB (106) (Clear to Send) and SB (122) (Secondary Receive Data) go on within 2.6 seconds. Otherwise, the terminal returns to the receive state.	The transition from receive state to transmit state occurs after CB (106) (Clear to Send) goes on.
S,T	Main Channel Protocol	Reverse Channel protocol (both switches closed).	S-closed, T-open: Main channel with STX/ETX as Start of Data and End of Data. S-open, T-closed: Main channel with EOT as End of Data. S-open, T-open: Main channel with ETX as End of Data.
U	CPU Break	The CPU can interrupt the terminal while it is in the transmit state. The CPU initiates an ON to OFF transition of the SB(122) (Secondary Receive Data) line. The terminal responds by turning off CA (106) (Request to Send) and going to the receive state.	The terminal ignores all transitions on the SB (122) (Secondary Receive Data) line from the modem in the transmit state.
V	Carrier Detect	When the terminal is in the receive state, an ON to OFF transition of CF (109) (Carrier Detect) line from the modem causes the terminal to go into the transmit state. Transitions of CF have no effect while the terminal is in the transmit state.	Transitions of CF (109) (Carrier Detect) line have no effect on the terminal.
W	Data Comm Self Test Enable	Enables DATA COMM SELF TEST from either the keyboard or escape sequence.	Disables DATA COMM SELF TEST. If self test is attempted (by either the keyboard or escape sequence), the test will be aborted and ERROR 0 will appear on the display.
X	Data Speed Select	Holds data speed signal low (CH (111) = 0).	Sets data speed signal high (CH (111) = 1).
Y	Transmit LED	The TRANSMIT light on the keyboard is turned on when CB (106) (Clear to Send) line from the modem is high. It is turned off when the CB (106) line goes low.	The TRANSMIT light on the keyboard is turned on when the CC (107) (Data Set Ready) line from the modem is high and the 13260B Extended Asynchronous Communications Interface PCA is used. It is turned off when the CC line goes low.
Z	Parity	The PARITY switch on the terminal keyboard is affected as follows:	
		<p>No Parity: Send 8 bits and receive 8 bits. Force bit 8 to zero. Check for parity error.</p> <p>Odd Parity: Send 7 data bits + odd parity. Receive 7 data bits + odd parity. Check for parity error.</p> <p>Even Parity: Send 7 data bits + even parity. Receive 7 data bits + even parity. Check for parity error.</p>	<p>No Parity: Send 8 bits and receive 8 bits. Force bit 8 to one on send. No check for parity error.</p> <p>Odd Parity: Send 7 bits + odd parity. Receive 7 bits. No check for parity error.</p> <p>Even Parity: Send 7 data bits + even parity. Receive 7 data bits. No check for parity error.</p>

POINT-TO-POINT COMMUNICATIONS CABLING THROUGH A MODEM

To connect the terminal to a computer through a modem, refer to figure 1-22 and perform the following:

1. Ensure that an HP 13260B Extended Asynchronous Communications Interface (PCA part no. 02640-60143) is installed in the terminal.

2. Perform the steps listed in figure 1-21 and table 1-2.

3. Connect cable HP 13232N (U.S.) or HP 13232M (Europe) from the Extended Asynchronous Communications Interface PCA (part no. 02640)60143) to the modem. Connect an appropriate RS-232-C cable from the modem to your computer. Refer to figure 1-22 for the cabling information and to table 1-3 for information on fabricating your own cable.

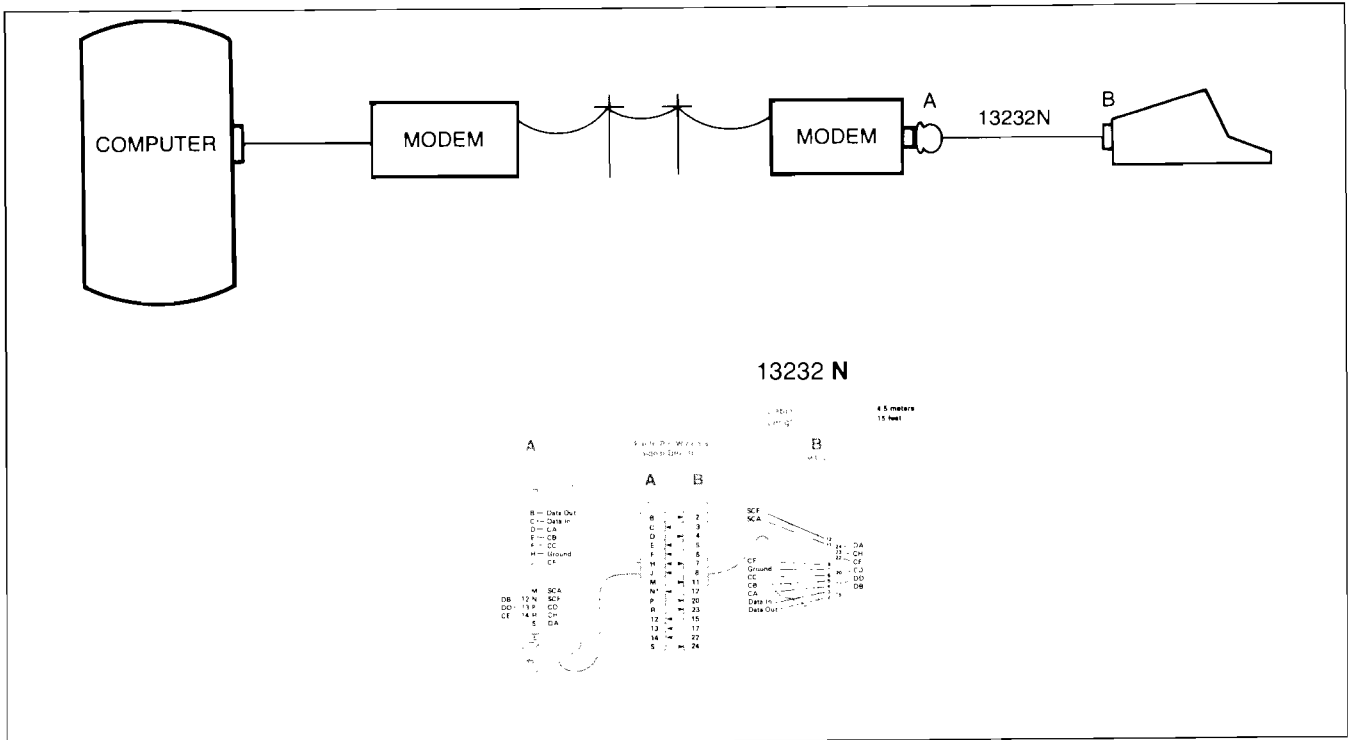


Figure 1-22. Point-to-Point Data Communications through a Modem

Table 1-3. Fabricating a Data Communications Cable

ITEM	HP PART NO.	DESCRIPTION	ALTERNATE SOURCE
RS232 Connector Kit	5061-2405	Includes male and female RS232 Connectors (1 each)	
264X PCA Hood Connector Kit	5061-1340		
262X Connector Kit	5061-2412	Includes one 50-pin male connector	Connector only: Amphenol 57-30500
Multipoint Connector Kit	5061-2401	Includes one male and one female connector	
Connector Cable ¹	8120-1903	15 conductor, non-shielded	U.L. Style 2560
	8120-1930	18 conductor, non-shielded	U.L. Style 2560
	8120-1950	12 conductor, shielded	U.L. Style 2560
	8120-2398	16 conductor, shielded	U.L. Style 2560
Multipoint Cable ²	8120-2305		Brand Rex POSS4P22: U.L. Style 2448

Note: All connectors include contacts.

¹26 AWG (or greater) low voltage computer cable

²22 AWG. 4 twisted pairs, overall shield, 75 ohm differential mode characteristic impedance.

CURRENT LOOP CABLING

Standard RS-232-C interfacing uses voltage levels to represent marks and spaces on an interfacing line. Current loop interfacing, on the other hand, uses the presence or absence of current to represent marks and spaces. When the current represents a mark, there is always an absence of current on the line except when a mark is being transmitted. When the current represents a space, there is always current on the line except when a mark is being transmitted (that is, a mark is represented by an interruption of the current).

As shown in figure 1-23, the device on each end of a current loop interface has both a transmitter and a receiver. The transmitter manipulates the current (opens and closes the current loop) to generate marks and spaces; the receiver monitors the state of the current loop to determine if data is being received.

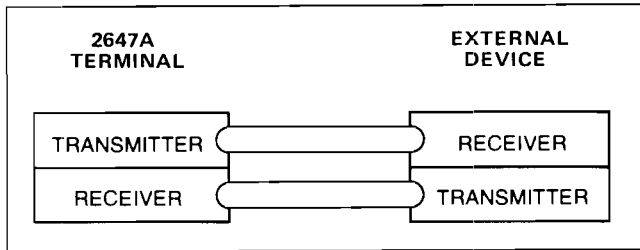


Figure 1-23. Current Loop Interface

There are two types of transmitters and two types of receivers:

A sourcing transmitter supplies the current for the loop.

A sinking transmitter does not supply the current for the loop.

A non-floating, or active, receiver supplies the current for the current loop.

A floating, or passive, receiver does not supply the current for the loop.

NOTE

The term "floating" means that the passive receiver can handle a range of voltage levels, and can thus "float" up or down in its ability to accommodate a variety of device transmitters.

Schematic representations of these four types of transmitters and receivers are shown in figure 1-24. The specifications for each type are shown in table 1-4.

If one device has a sourcing transmitter, the other must have a passive receiver. Conversely, if one device has a sinking transmitter, the other must have an active receiver.

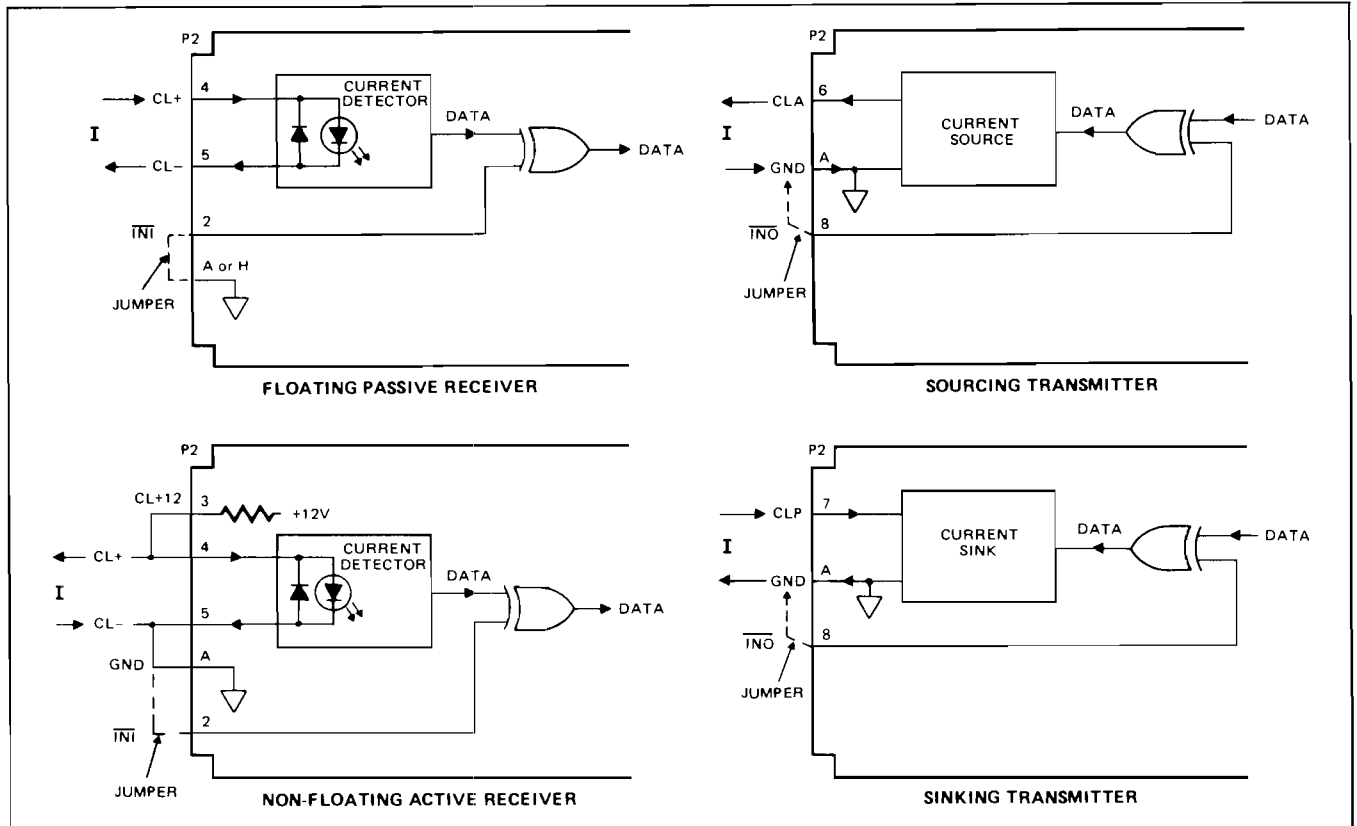


Figure 1-24. Current Loop Configurations

Table 1-4. Current Loop Specifications

FLOATING PASSIVE RECEIVER		
Loop Current:	15 mA (min); 25 mA (max)	Loop current is interpreted as a MARK if INI (Invert Input) is open; if INI is grounded, loop current is interpreted as a SPACE.
No Loop Current:	0 mA (min); 5 mA (max)	
Voltage Drop (Loop Current Flowing):	1.4V (min); 1.8V (max)	
NON-FLOATING ACTIVE RECEIVER		
Loop Current:	20 mA (min); 25 mA (max)	Loop current is interpreted as a SPACE if INI (Invert Input) is open; if INI is grounded, loop current is interpreted as a MARK.
No Loop Current:	0 mA (min); 10 mA (max)	
Voltage Drop (Loop Current Flowing):	1.4V (min); 1.8V (max)	
SOURCING TRANSMITTER		
Loop Current:	17 mA (min); 25 mA (max)	A MARK is transmitted as loop current if INO (Invert Output) is open; a SPACE is transmitted as loop current if INO is grounded.
No Loop Current:	0 mA (min); 0.01 mA (max)	
Receiver Voltage:	+7.5V to -12V	
SINKING TRANSMITTER		
Loop current:	25 mA (min); 35 mA (max)	A MARK is transmitted as loop current if INO (Invert Output) is open; a SPACE is transmitted as loop current if INO is grounded.
No Loop Current:	0 mA (min); 0.01 mA (max)	
Receiver Voltage:	+15V to -7.5V	

The characteristics of an HP 13260B current loop are determined by the manner in which the interface cable is wired to the hood connector. Hewlett-Packard offers a current loop interface cable assembly (HP 13232F) that defines the following characteristics:

1. Current = mark (for both transmitting and receiving).

1. The HP 13260B is a sourcing transmitter and a floating passive receiver.

You can alter these characteristics by rewiring the hood connector (the end that connects to the PCA) of the HP 13232F connector as follows:

1. Normally, a mark is transmitted as current in the line. If you want current to represent a space, ground INO by connecting a jumper between pins 8 and A or between pins 8 and H.

2. Normally, a mark is received as current in the line. If you want current to represent a space, ground INI by connecting a jumper between pins 2 and A or between pins 2 and H.

3. Normally, the HP 13260B receiver is configured as a floating passive receiver. The current path is into CL+ (pin 4) and out of CL- (pin 5). Note that if a Teletype is

to be used as a transmitter, TTYIN (pin 12) should be used as the input instead of CL+. If a non-floating active receiver is desired, connect CL+ to CL+12 by connecting a jumper between pins 3 and 4 and ground CL- by connecting a jumper between pins 5 and A or between pins 5 and H. The current path is from +12 volts into CL+ and out of CL- to ground.

4. Normally, the HP 13260B transmitter is configured as a sourcing transmitter. The current path is from +12 volts, out of CLA (pin 6), and into the receiver. The return path is ground. To convert the HP 13260B transmitter to a sinking transmitter, disconnect the wire from CLA (pin 6) and connect it to CLP (pin 7). Now the current path is from the receiver, to CLP (pin 7), and to -12 volts. The return path is still ground.

To connect the terminal in a current-loop configuration, refer to figure 1-25 and perform the following:

1. Ensure that an HP 13260B Extended Asynchronous Communications Interface (PCA part no. 02640-60143) is installed in the terminal.

2. Perform the steps listed in figure 1-21 and table 1-2.

3. Connect an HP 13232F cable from the terminal to the current loop interface device. Refer to figure 1-25.

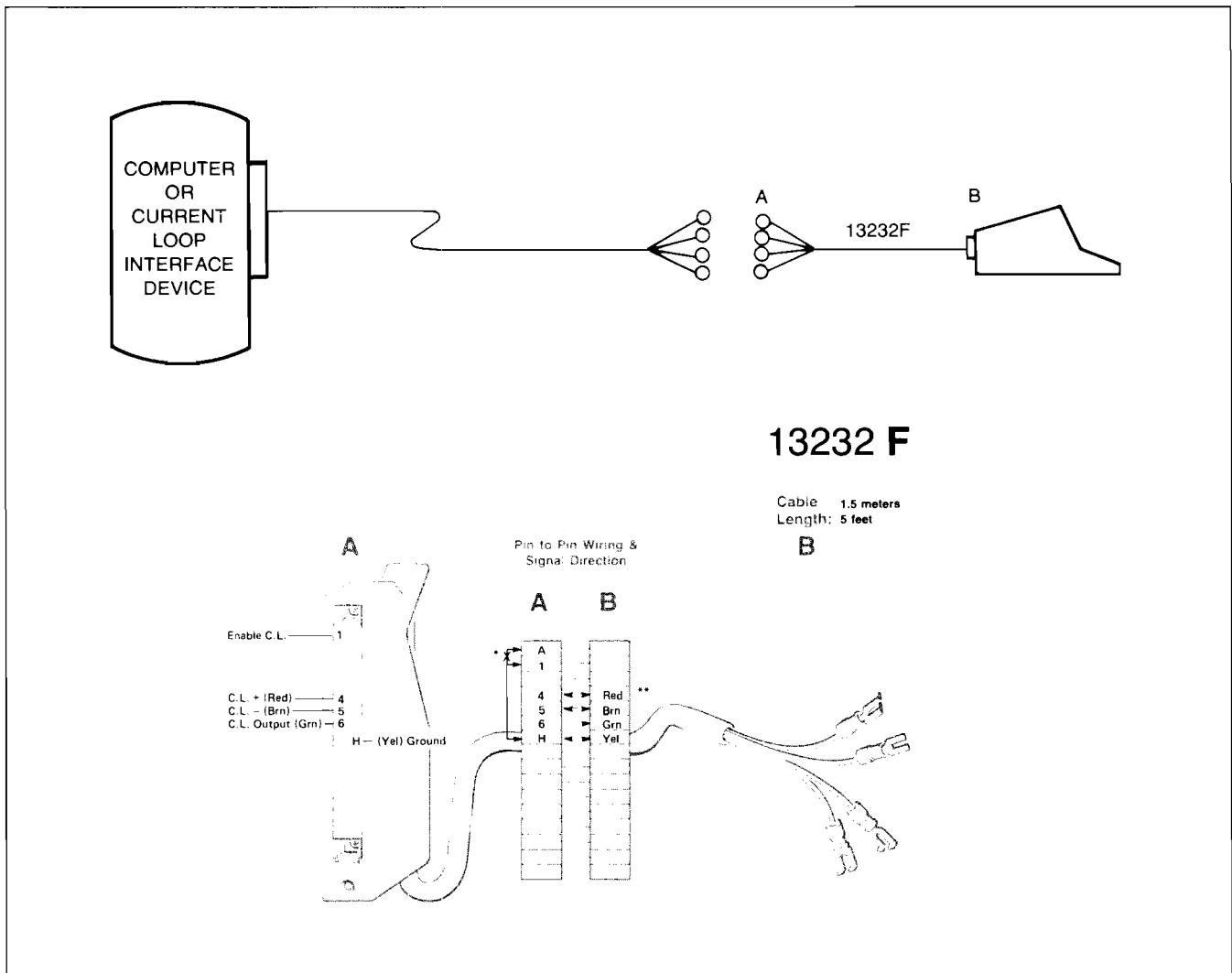


Figure 1-25. Connecting the Terminal in a Current Loop Configuration

MULTIPOINT COMMUNICATIONS

The HP 2647A terminal is capable of operating in a polled multipoint environment. This means that one or more terminals can share the same communications line. The terminal can be used in networks using asynchronous or synchronous communications. (Operation is similar to IBM Bisynchronous communications.)

Multipoint operation requires the following:

1. All communications must follow a strict protocol.
2. Each terminal must have an address that is unique within the communications line.
3. Data must be transmitted in blocks.
4. All data transfers must be initiated by the computer.

5. All terminals on the same communications line must use the same code (ASCII or EBCDIC) and the same parity.

Refer to Section V, page 5-34, of the Reference Manual for a complete discussion of multipoint protocol.

Asynchronous Multipoint Cabling

For asynchronous multipoint cabling, refer to figure 1-26 and perform the following:

1. Ensure that an HP 13260C Asynchronous Multipoint Communications Interface (PCA part no. 02640-60106) is installed in the terminal.
2. Configure the terminal as shown in figure 1-27 and table 1-5.
3. Connect the terminal(s) as shown in figure 1-26.

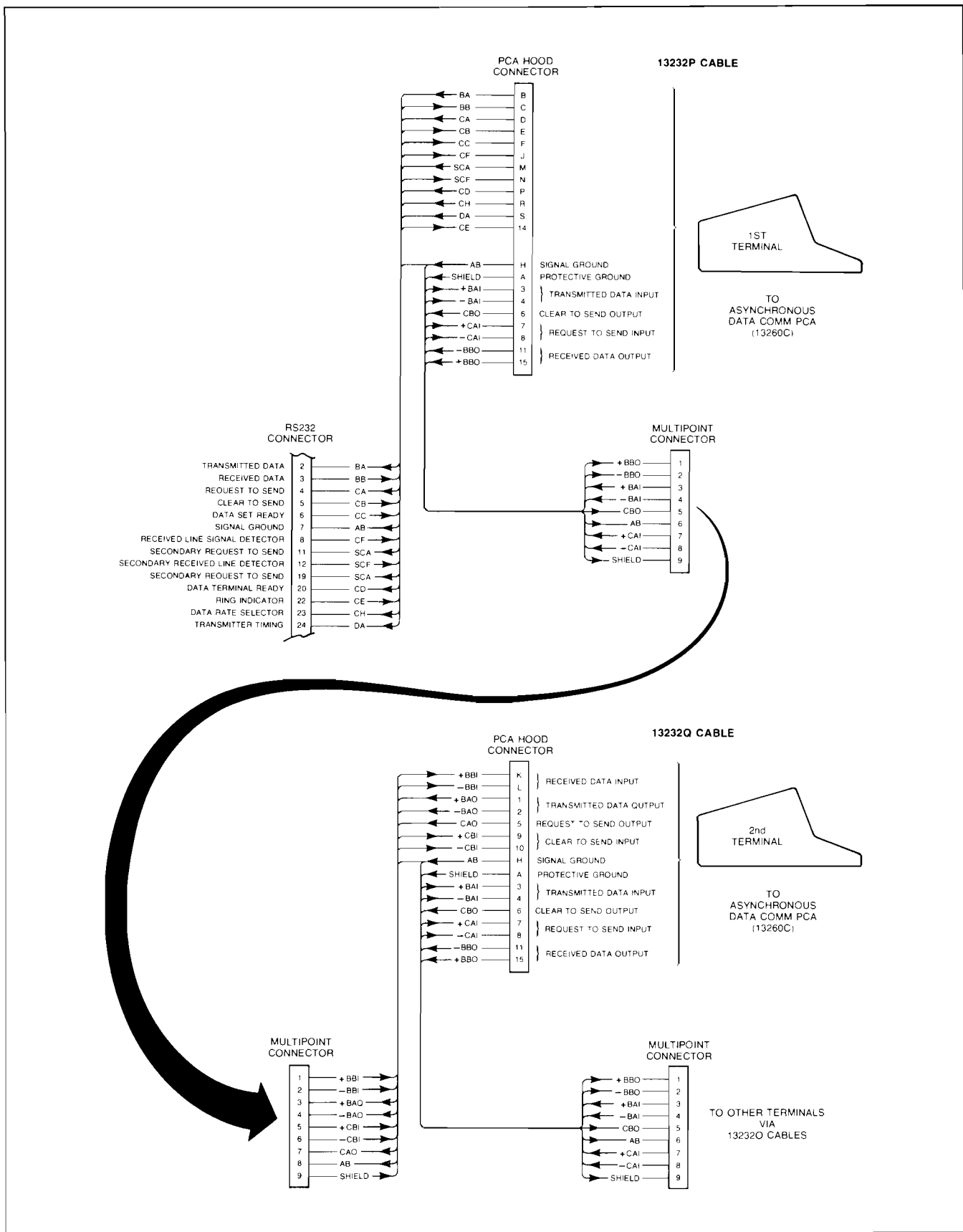


Figure 1-26. Asynchronous Multipoint Cabling

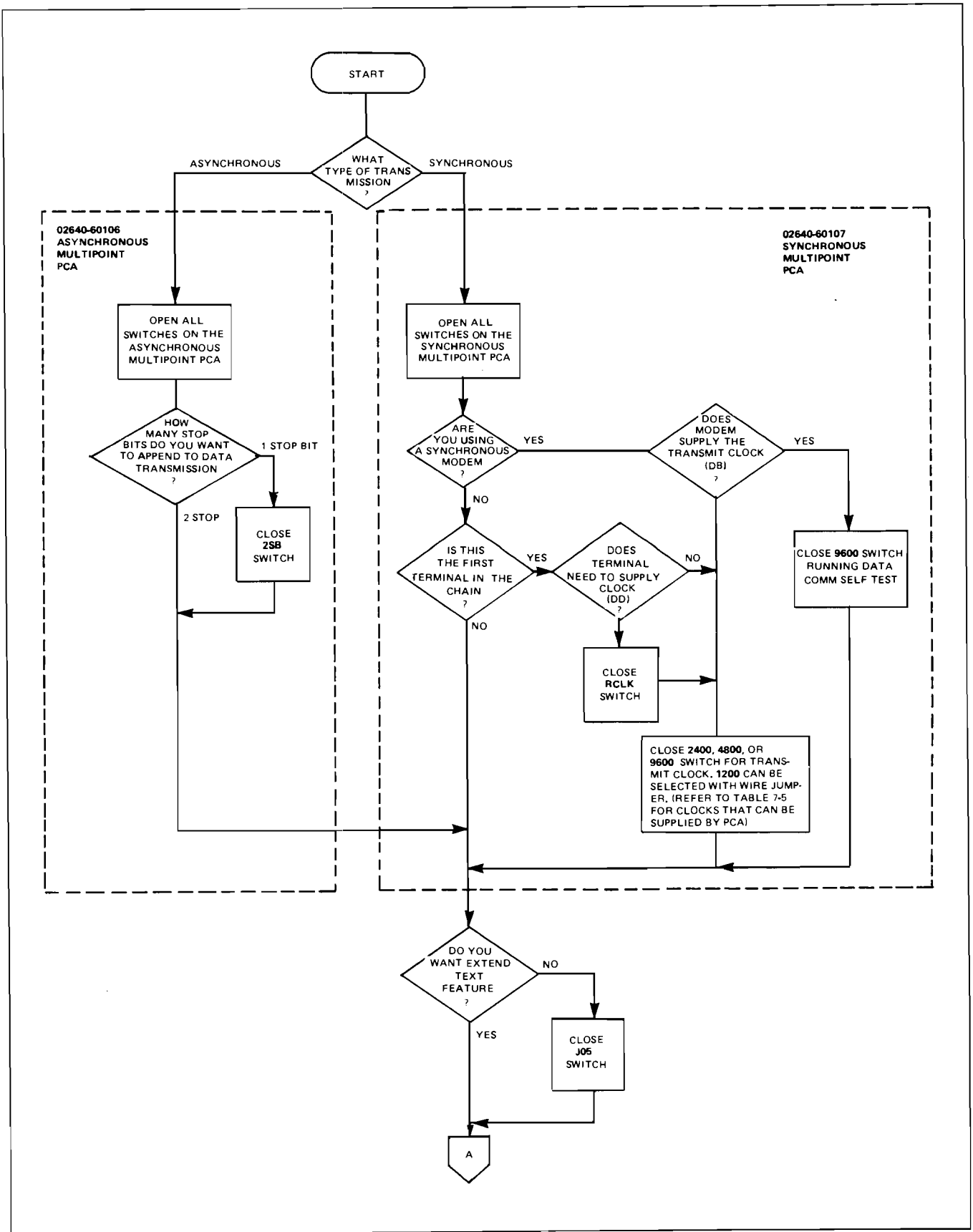


Figure 1-27. Multipoint Data Communications Configuration (Sheet 1 of 4)

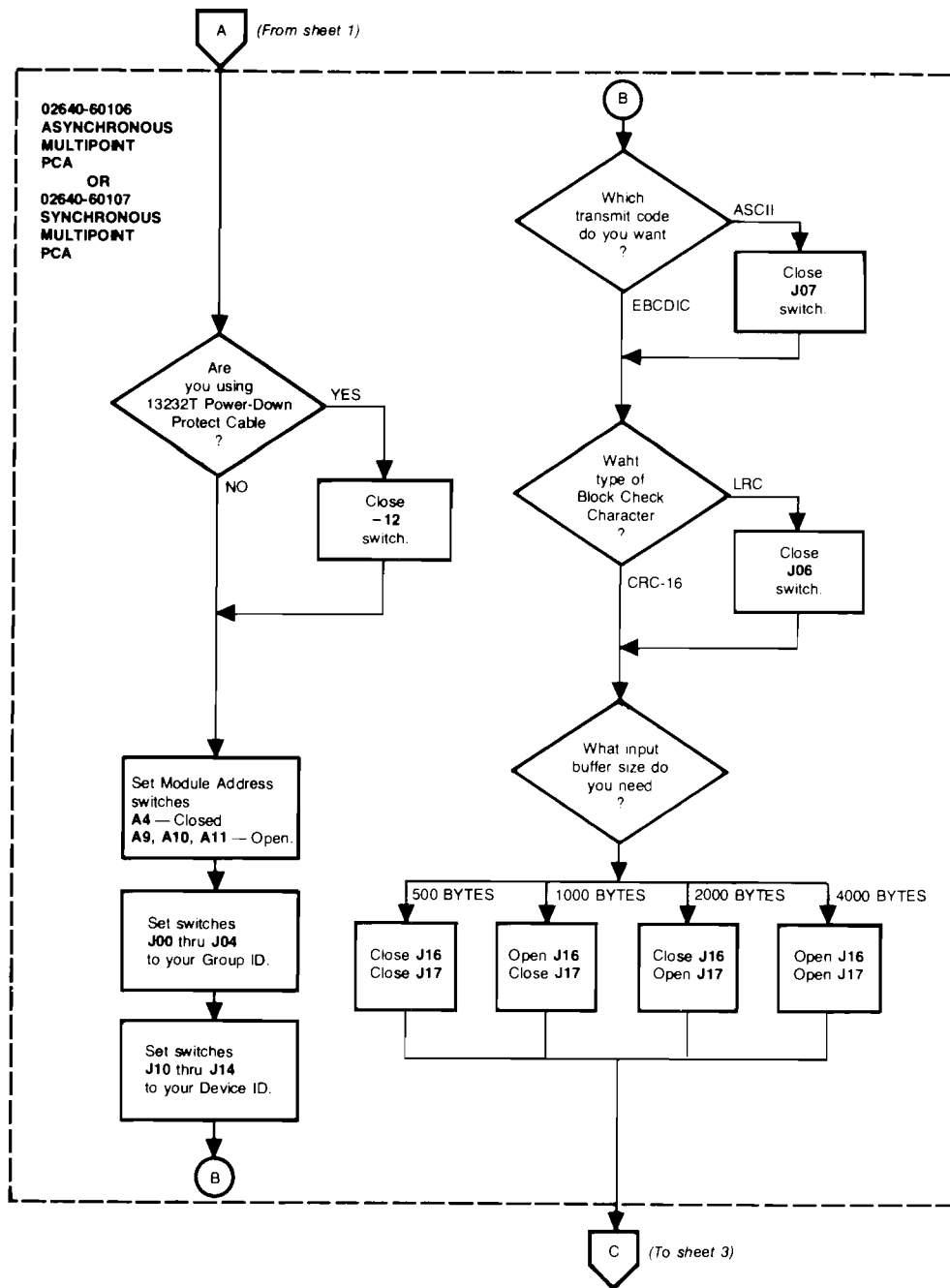


Figure 1-27. Multipoint Data Communications Configuration (Sheet 2 of 4)

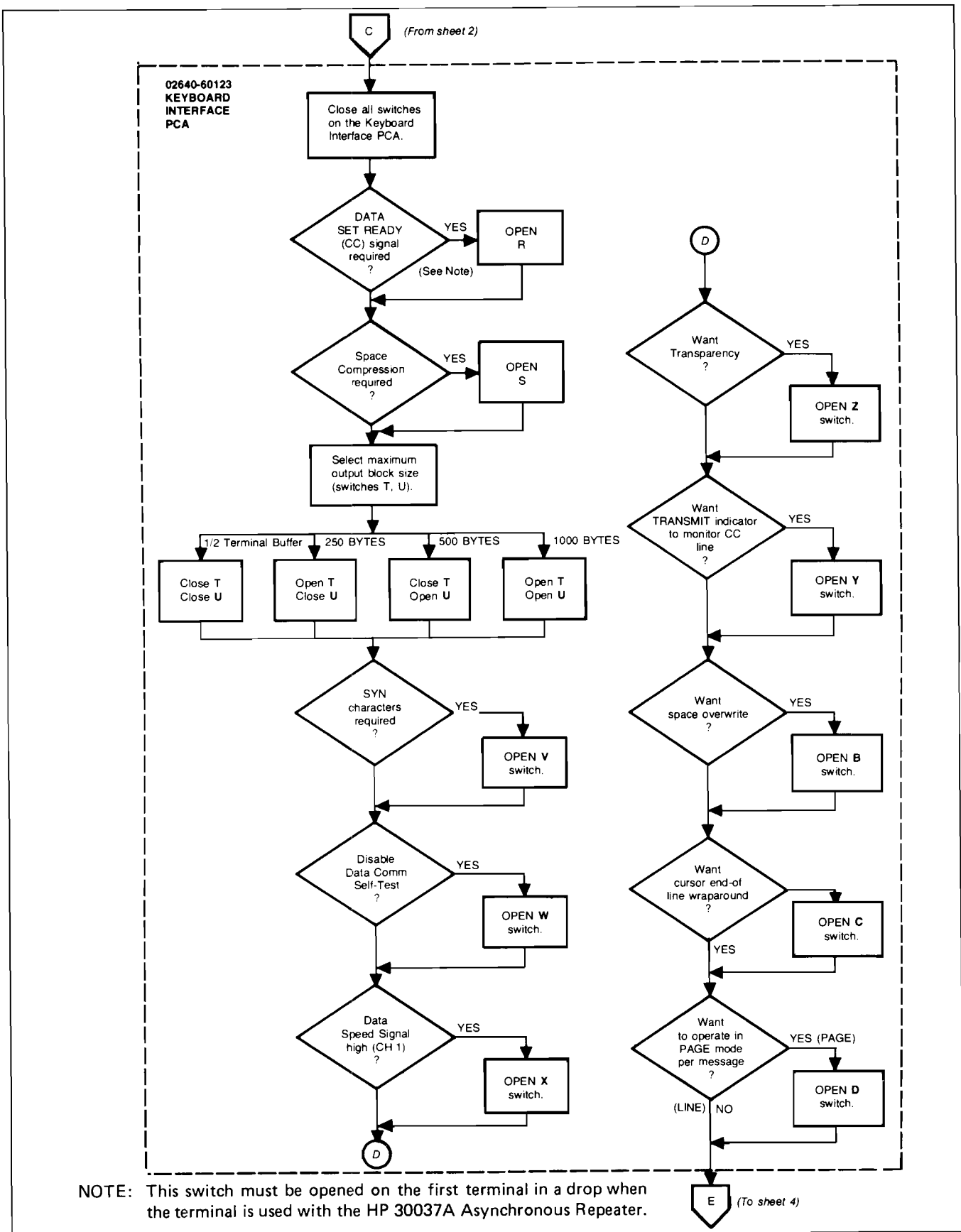


Figure 1-27. Multipoint Data Communications Configuration (Sheet 3 of 4)

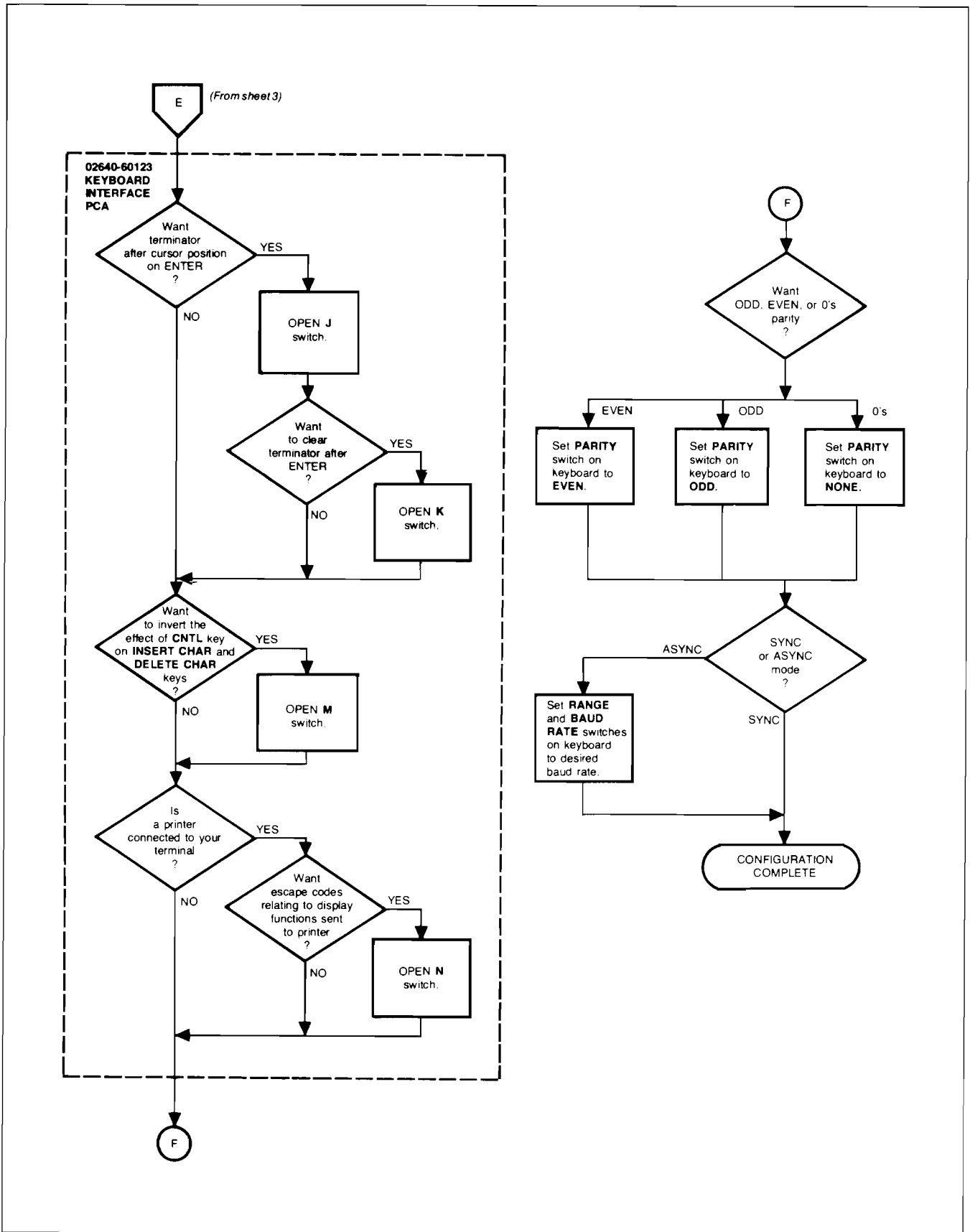


Figure 1-27. Multipoint Data Communications Configuration (Sheet 4 of 4)

Table 1-5. Keyboard Interface Straps for Block Operation Using HP 13260C or HP 13260D Communications Accessory

STRAP	STRAPPING OPTION	NORMAL OPERATION (SWITCH CLOSED)	OPERATION WITH STRAPPING OPTION (SWITCH OPEN)
A	Function Key Transmission	The escape code sequence generated by the major function keys (such as, ROLL UP, ROLL DOWN, etc.) are executed locally, but not transmitted to the computer.	(Same as switch closed.)
B	Space Overwrite (SPOW) Latch Enable	Spaces typed will overwrite existing characters.	When the SPOW latch is off, overwriting occurs as normal. When the SPOW latch is on, spaces cause the cursor to forward but not overwrite any existing characters. The SPOW latch is turned on by a Carriage Return, and turned off by a Line Feed, Home, or Tab.
C	Cursor End-of-Line Wrap Around	At the end of each line, a local Carriage Return and Line Feed are generated; the cursor moves to the beginning of the next line.	A Carriage Return and Line Feed are not generated at the end of each line. The cursor remains in and overwrites column 80.
D	Line/Page	The terminal is set to transfer a line at a time from display memory, an unprotected field in format mode, or a record from the tape cartridge.	Transfers the entire contents of display memory (a "page"), all unprotected fields in format mode, or a file from the tape cartridge.
E	Paper Tape Mode	When the READ key is pressed with the AUTO LF down, each tape record begins with an LF if the AUTO LF key is down and is ended with a CR.	Each tape record is terminated by CR(LF).
F	(Not Used)		
G	Block Transfer Handshake	No effect.	No effect.
H	Inhibit DC2	No effect.	No effect.
J	Auto Terminate	No effect.	When the ENTER key is pressed a non-displaying terminator is placed after cursor position.
K	Clear Terminator	No effect.	Clear terminator caused by strapping option J above.
L	Self Test Inhibit	No effect.	Self Test function is inhibited. Pressing TEST key or issuing ESC z has no effect. TAPE TEST and DATA COMM SELF TEST functions are not affected.
M	Reverse Sense of INSERT and DELETE CHAR with Wrap.	No effect.	Reverses control function of INSERT CHAR and DELETE CHAR keys (i.e., when key is pressed, line wrap around is in effect without having to press CNTL key. When either key is pressed while pressing CNTL, normal insert character and delete character functions are in effect.)
N	Escape Code Transfer To Printer	No effect.	Escape codes relating to the display (e.g., display enhancements, alternate character sets, format mode, fields, etc.) are sent to printer if it is selected as a destination device.
P,Q	Compatibility Mode	These switches set the terminal to be compatible with Tektronix control commands when initialized (power on or full reset). Refer to Section III for additional information on Compatibility Mode. P-closed, Q-closed Normal operation P-closed, Q-open Unscaled Compatibility Mode P-open, Q-closed Scaled Compatibility Mode P-open, Q-open Normal operation	
R	Data Set Ready	No effect.	Provides an internal Data Set Ready (CC) signal to the terminal. (Used in applications with the HP 30037A Asynchronous Repeater, and the Group Poll feature.)

Table 1-5. Keyboard Interface Straps for Block Operation Using HP 13260C or HP 13260D Communications Accessory (Continued)

STRAP	STRAPPING OPTION	NORMAL OPERATION (SWITCH CLOSED)	OPERATION WITH STRAPPING OPTION (SWITCH OPEN)
S	Space Compression	Space characters are sent normally.	Space characters are compressed.
T,U	Output Block Size	T U	BLOCK SIZE (BYTES)
		C C	1/2 Data Comm Buffer (refer to switches J16, J17 on multipoint PCA). 250 max 500 max 1000 max
		O C C O O O	
		C = closed, O = open	
V	Synch Characters	Asynchronous operation without SYN characters.	SYN characters are inserted during Asynchronous operation.
W	Data Comm Self Test	Enables DATA COMM SELF TEST from either the keyboard or escape sequence.	Disables DATA COMM SELF TEST. If self test is attempted (by either the keyboard or escape sequence), the test will be aborted and ERROR 0 will appear on the display.
X	Data Speed Select	Holds data speed signal low (CH = off).	Sets data speed signal high (CH = on).
Y	Transmit Indicator	Lights TRANSMIT indicator on keyboard when terminal is communicating with the computer.	Lights TRANSMIT indicator on keyboard when Data Set Ready (CC) is on, and it goes out when CC goes off.
Z	Transparency	No effect.	Causes all data sent from the terminal to be transparent.

Synchronous Multipoint Cabling

For synchronous multipoint cabling, refer to figure 1-28 and perform the following:

1. Ensure that an HP 13260D Synchronous Multipoint Communications Interface (PCA part no. 02640-60107) is installed in the terminal.
2. Configure the terminal as shown in figure 1-27 and table 1-5.
3. Connect the terminal(s) as shown in figure 1-28.

CONNECTING THE TERMINAL USING THE HP 13238A TERMINAL DUPLEX REGISTER INTERFACE

The HP 13238A Terminal Duplex Register Interface, consisting of a Terminal Duplex Register PCA, part no. 02640-60031, provides 8-bit parallel interface to printers such as the HP 2631A Printer, the HP 7310A (Option 052 or 240) Graphics Printer, the HP 9866B Printer, and the HP 9871A Printer.

Connecting the HP 2631A Printer or HP 7310A (Option 052 or 240) Graphics Printer

To connect the HP 2631A Printer or the HP 7310A (Option 052 or 240) Graphics Printer to the terminal, refer to figure 1-29 and perform the following:

1. Configure jumpers on the Terminal Duplex Register PCA, part no. 02640-60031, as shown in figure 1-30.
2. Install the Terminal Duplex Register PCA in the terminal in the first vacant backplane assembly connector adjacent to existing PCAs.
3. Connect cable HP 13232J from the terminal to the printer.
4. On the HP 7310A Graphics Printer, set all rear panel interface switches to the left.

NOTE

When using the Terminal Duplex Register PCA, the HP 7310A Graphics Printer can produce forms and text but no graphics.

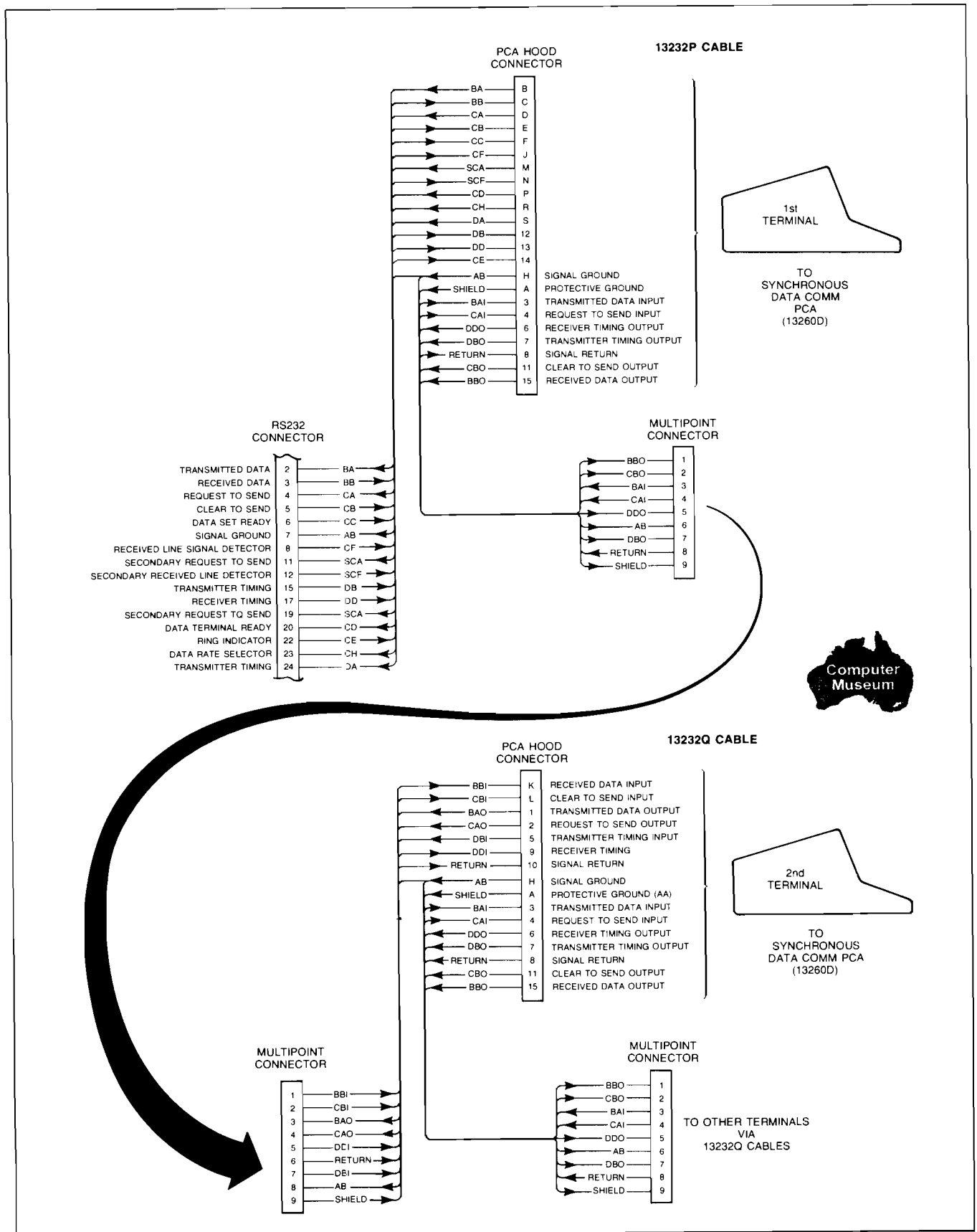


Figure 1-28. Synchronous Multipoint Cabling

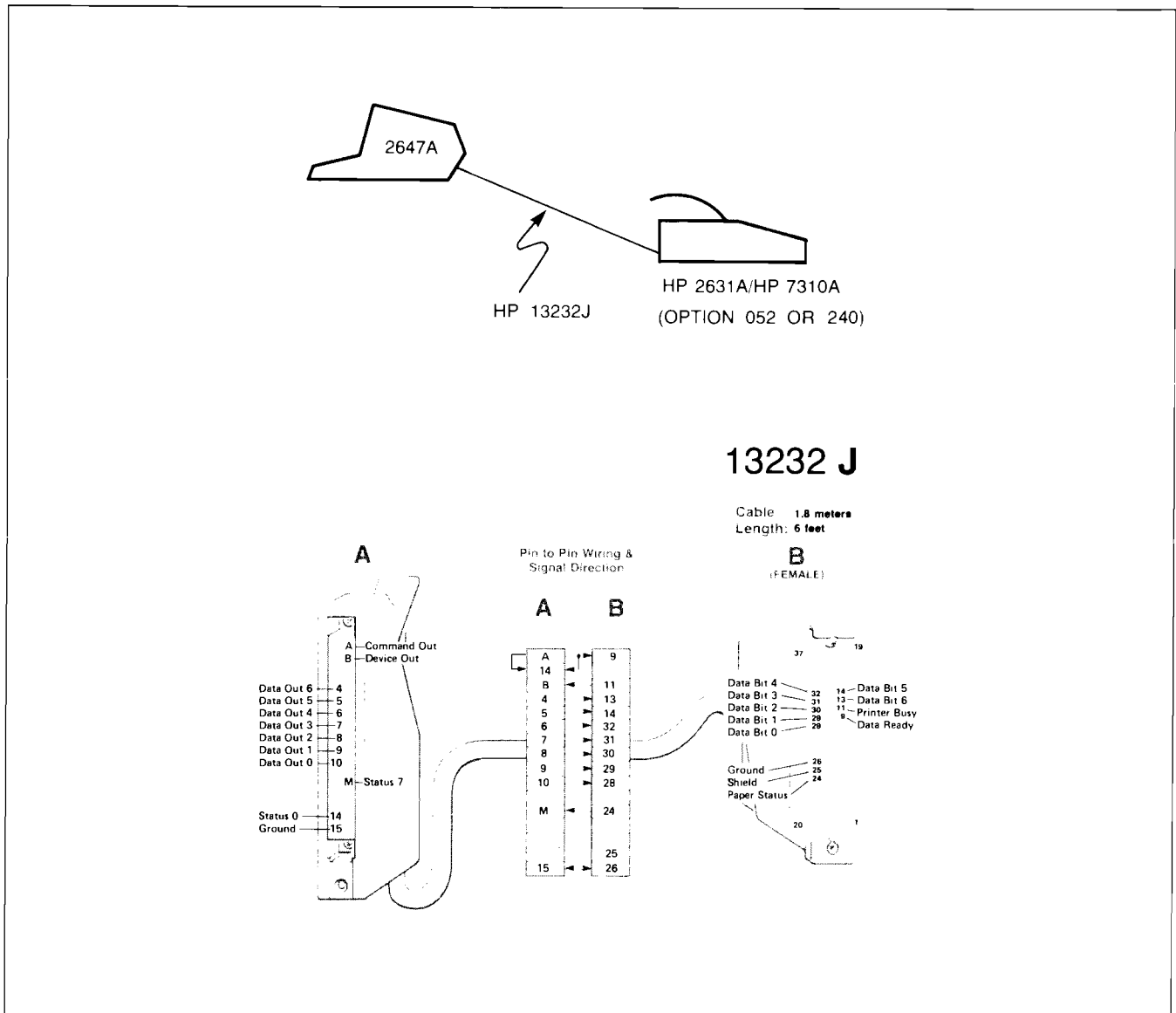


Figure 1-29. Connecting the HP 2631A Printer

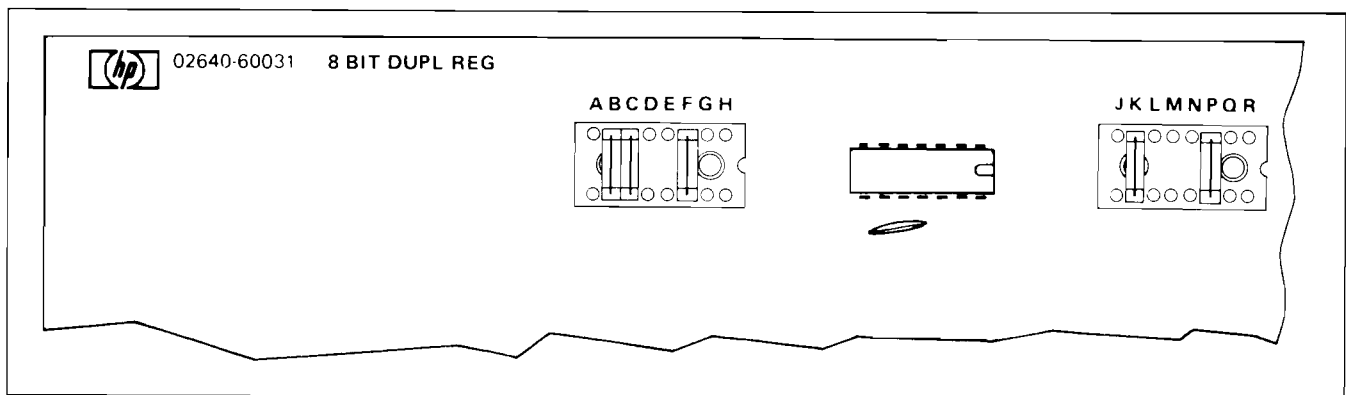


Figure 1-30. Terminal Duplex Register PCA Jumper Configuration

Connecting the HP 9866B Printer

To connect the HP 9866B printer to the HP 2647A, refer to figure 1-31 and perform the following:

1. Configure jumpers on the Terminal Duplex Register PCA, part no. 02640-60031, as shown in figure 1-30.
2. Install the Terminal Duplex Register PCA in the terminal in the first vacant backplane assembly connector adjacent to existing PCAs.
3. Connect cable HP 13232S from the terminal to the printer.

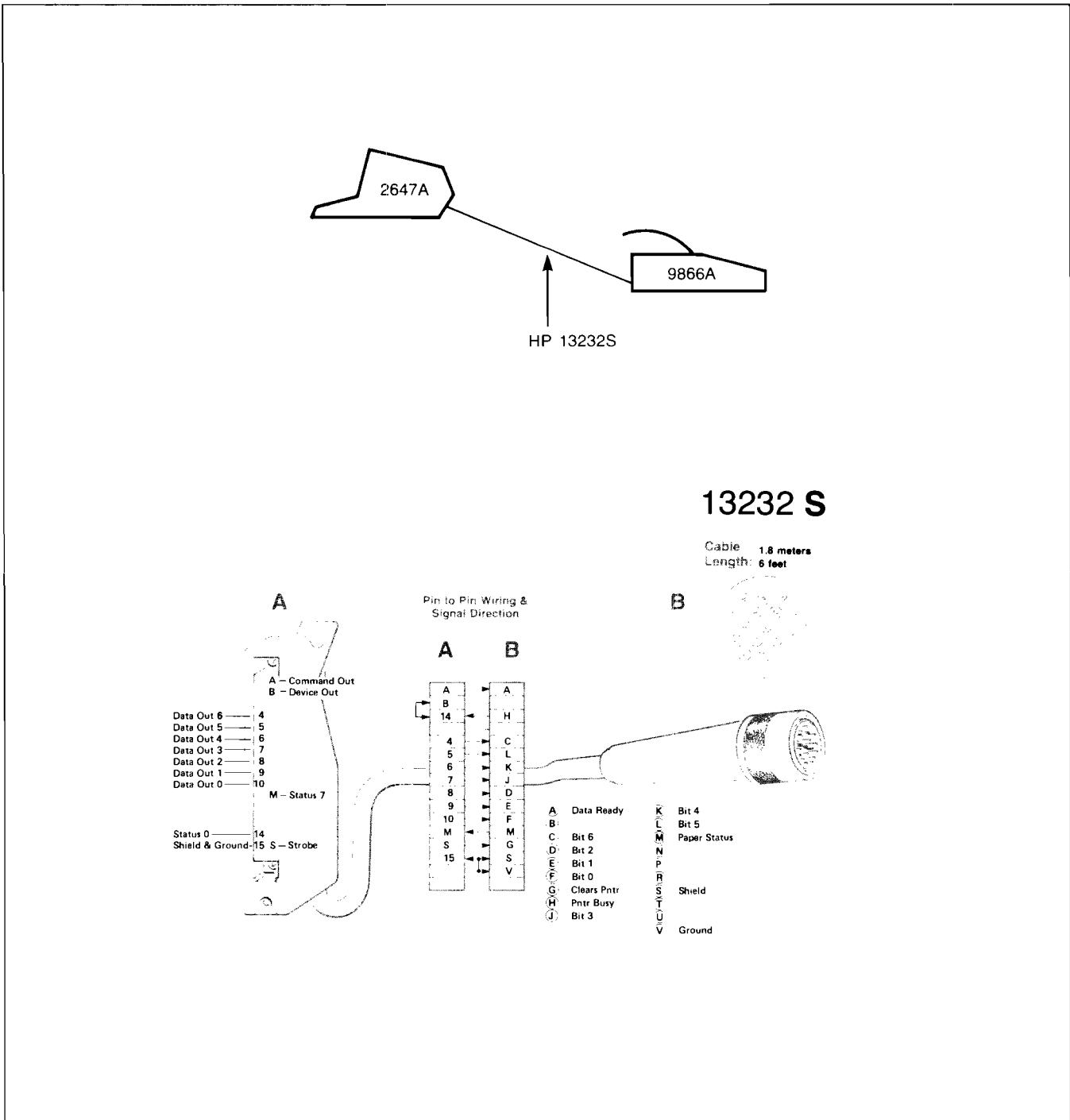


Figure 1-31. Connecting the HP 9866B Printer

Connecting the HP 9871A Printer

To connect the HP 9871A printer to the HP 2647A, refer to figure 1-32 and perform the following:

1. Configure jumpers on the Terminal Duplex Register PCA, part no. 02640-60031, as shown in figure 1-30.
2. Install the Terminal Duplex Register PCA in the terminal in the first vacant backplane assembly connector adjacent to existing PCAs.
3. Connect cable HP 13232J from the terminal to the printer.

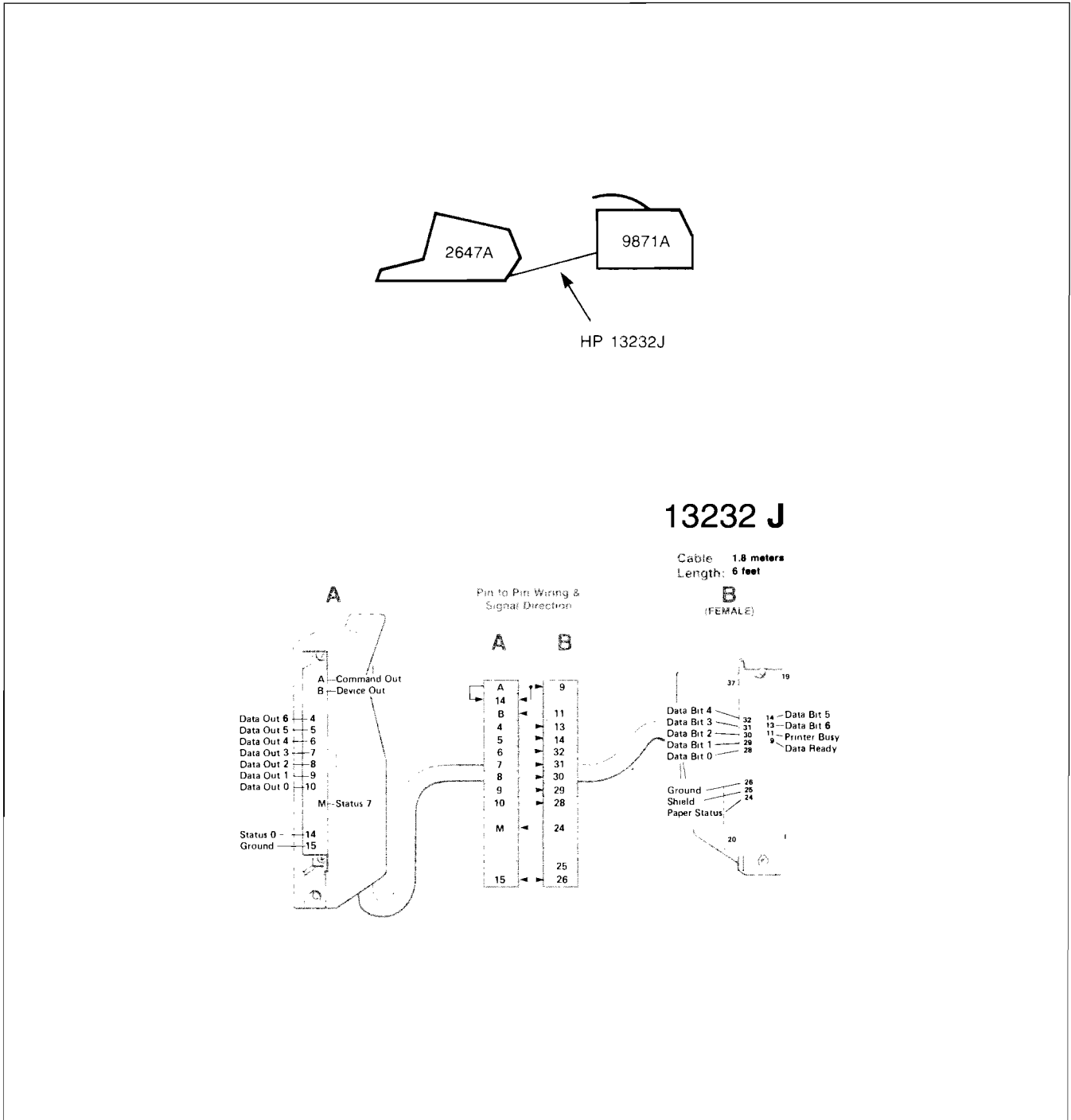


Figure 1-32. Connecting the HP 9871A Printer

CONNECTING THE TERMINAL USING THE HP 13250A SERIAL PRINTER INTERFACE

The HP 13250A Serial Printer Interface, consisting of a serial printer interface PCA, part no. 02640-60143, and an HP 13232G cable, provides an RS-232-C interface from the HP 2647A terminal to serial printers such as the HP 2635A Printing terminal.

Connecting the HP 2635A Printing Terminal

Before connecting the HP 2635A printing terminal to the HP 2647A, refer to figure 1-33 and table 1-6 for the locations and functions of the Serial Printer Interface PCA (part no. 02640-60143) switches.

Table 1-6. Serial Printer Interface PCA (part no. 02640-60143) Switch Functions

SWITCH GROUP	FUNCTION PERFORMED
S2 S1 S0	Selects "Transmit" Baud Rate
CBE	Specifies that a Custom "Receive" Baud Rate is Being Supplied
B11 B10 B9 B8 B7 B6 B5 B4 B3 B2 B1 B0	Selects Custom Baud Rate
A4 A11 A10 A9	Selects PCA's Octal Address
1AT RHE	Selects Receive Handshake Capability
2SB	Selects Number of Stop Bits
THE	Selects Transmit Handshake Capability

The communication options used with the HP 2635A are as follows:

PARITY AT PRINTER AND INTERFACE:	NONE
MAXIMUM BAUD RATE AT PRINTER AND INTERFACE:	2400
HARDWARE HANDSHAKE PROTOCOL:	See table 1-8
NUMBER OF STOP BITS:	2
FULL OR HALF DUPLEX:	FULL

PARITY SELECTION. Set parity as shown above on the HP 2635A and HP 2647A keyboards.

BAUD RATE SELECTION. The baud rates selectable on the HP 2635A are EXT, 110, 150, 300, 1200, and 2400. Set the desired baud rate on the HP 2635A and on the HP 2647A keyboard, then set switches S0, S1, and S2 on the serial printer interface PCA as shown in table 1-7.

Table 1-7. Baud Rates

BAUD RATE	S2	S1	S0
110	Open	Open	Open
150	Closed	Open	Closed
300	Closed	Open	Open
1200	Open	Closed	Closed
2400	Open	Closed	Open

HANDSHAKE PROTOCOL SELECTION. Set switches THE and RHE as shown in table 1-8 for the desired handshake capability.

Table 1-8. Handshake Protocol Selection

TYPE OF HANDSHAKE	THE	RHE
Transmit Only	Closed	Open
Receive Only	Open	Closed
Both	Closed	Closed

STOP BIT SELECTION. Set switch 2SB to OPEN for one stop bit, CLOSED for two stop bits.

After all switches have been set correctly, refer to figure 1-34 and connect the HP 2635A to the HP 2647A as follows:

1. Install the Serial Printer Interface PCA in the terminal in the first vacant backplane assembly connector adjacent to existing PCAs.
2. Connect cable HP 13232G from the HP 2635A to the HP 2647A terminal.

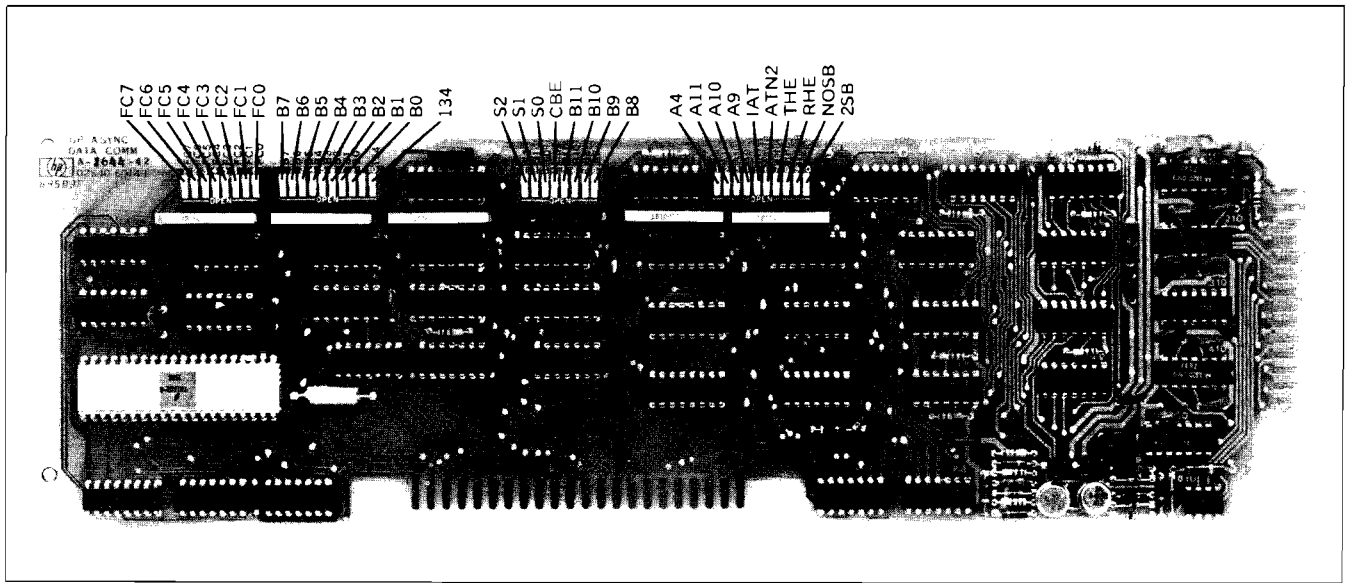


Figure 1-33. Serial Printer Interface PCA (part no. 02640-60143) Switch Locations

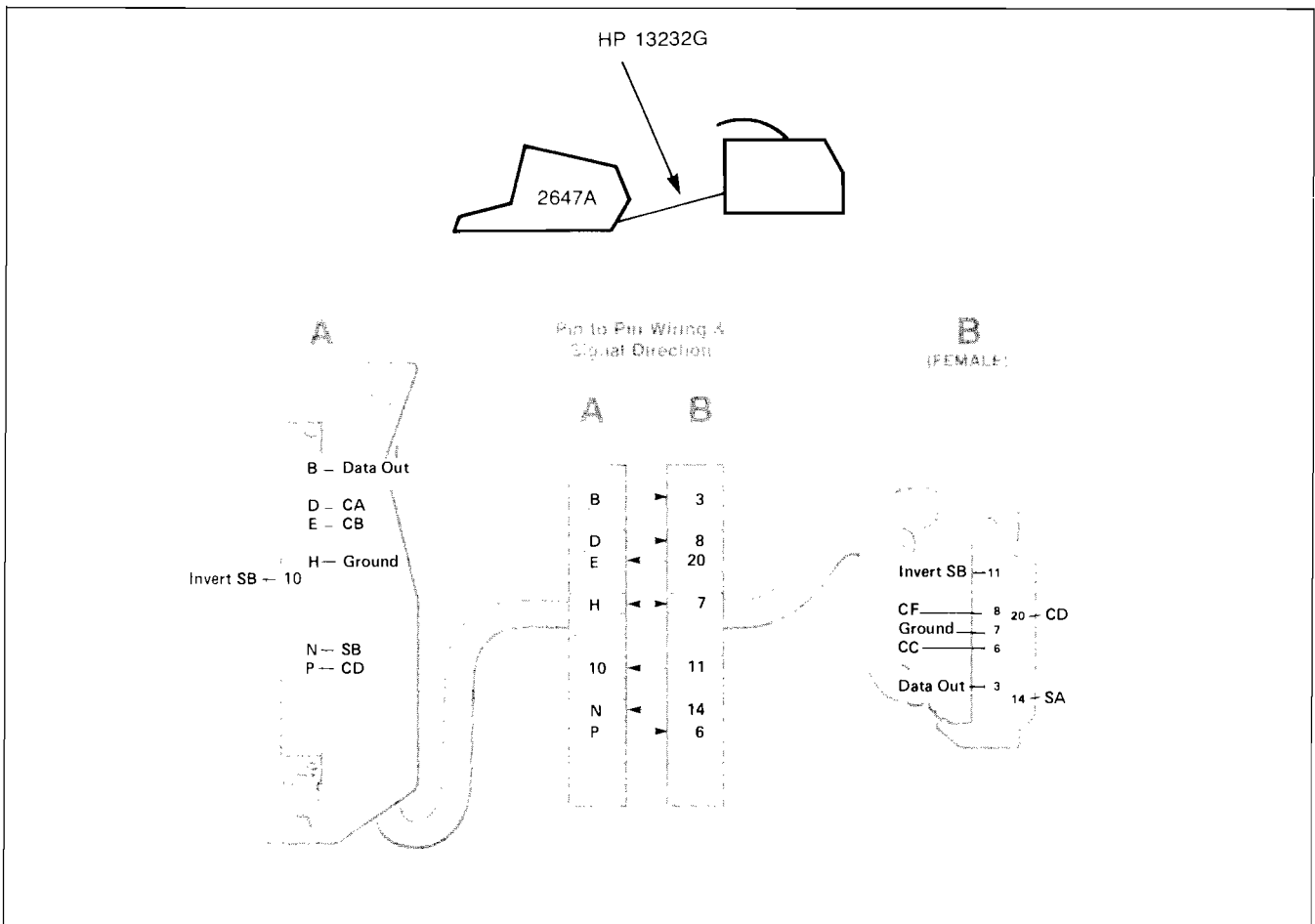


Figure 1-34. Connecting Peripheral Devices to the Serial Printer Interface PCA (part no. 02640-60143)

CONNECTING THE TERMINAL TO VIDEO INTERFACE DEVICES

The HP 13254A Video Interface provides an interface from the terminal to a compatible video monitor or hard copy device. The video interface consists of a Video Interface PCA, part no. 02640-60019, and a sweep extender cable, part no. 02640-60122. The PCA requires one option slot. Detailed installation and operating information is contained in the HP 13254A Accessory Manual, part no. 13254-90001.

SELF-TEST

The terminal is capable of testing itself. The self-test should be performed if a malfunction is suspected. Several types of self-test are possible with the HP 2647A, as follows:

1. Terminal self-test. This test checks the terminal except for the cartridge tape units (if installed) and the data communications. This test is explained in the following paragraphs.
2. Cartridge tape unit self-test. This test is explained in Section VII of the Reference Manual.
3. Data communications self-test. See Section VII of the Reference Manual.
4. HP-IB self-test, which tests the PHI IC chip. See Section VII of the Reference Manual.
5. Terminal-to-terminal loop back test. This function tests the communication capabilities between two terminals in an HP 13296A Shared Peripheral Interface configuration. See Section VII of the Reference Manual.

Terminal Self-Test

Pressing TEST checks the terminal, except for the cartridge tape units (if installed) and the data communications. The following events occur when the TEST key is pressed (also see the flowchart in figure 1-35):

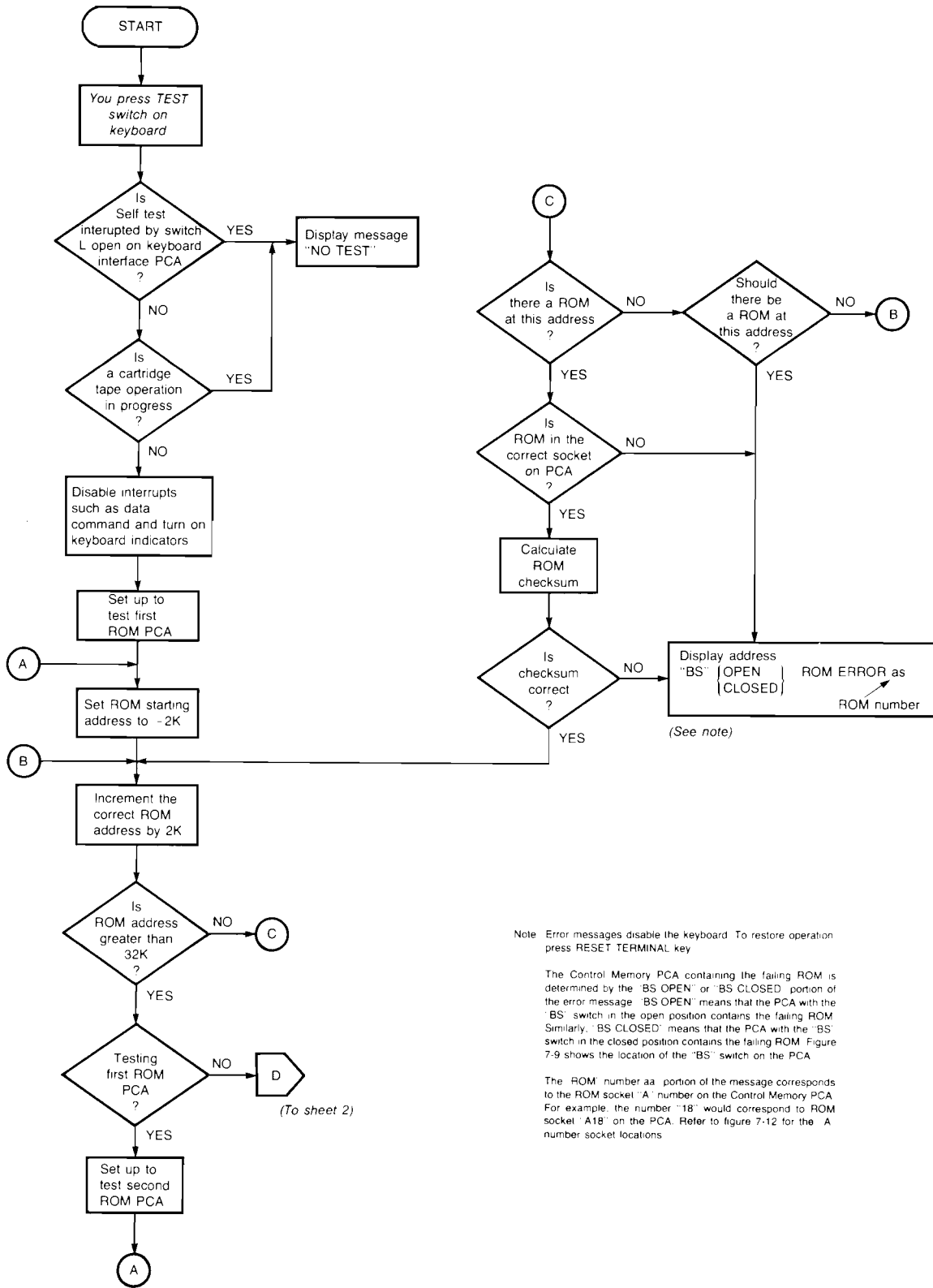
NOTE

The test pattern cannot be recorded because of embedded Record Separators (RS).

1. The light-emitting diodes on the keyboard light up briefly as an indication that the power supply and microprocessor board are functioning.
2. A checksum test is performed on the read-only memory (ROM). This verifies that the firmware is working properly. An error here causes a ROM ERROR message to be displayed (see flowchart, figure 1-35). Note that this checksum test also is performed as part of the power-on sequence.
3. A RAM TEST appears on the display while a checkerboard test is performed on the random access memory. An error here causes a RAM ERROR message to be displayed (see flowchart, figure 1-35).
4. A graphics test is performed. This test checks both the vector generating function as well as the graphics memory. This is done by drawing a series of vertical and horizontal lines. If the graphics memory test fails, a message indicating the defective graphics memory component is displayed (see flowchart, figure 1-35).
5. The bell is beeped indicating success up to this point. If the **TEST** key is held down to cause the self-test to be repeated, the bell beeps only for the first self-test.
6. The entire character set contained in the terminal is displayed.
7. If the BASIC Interpreter was active at the time the **TEST** key was pressed, BASIC performs its checksum routine.
8. A line of characters, **●ABCDEFGHIJKLMNO**, is displayed. If the Display Enhancement option is installed, then Underline, Half-Bright, and Blinking will be displayed with Inverse Video in all of the possible Display Enhancement combinations by this line of characters.
9. The 14 bytes of status information are displayed. (See the "Status" paragraph in Section VI of the Reference Manual for an explanation of the status bytes.)

Generally, if the terminal beeps and the display shows patterns similar to those illustrated in figure 1-36, the terminal is functioning properly. Only those character sets actually present in the terminal will be displayed in the test pattern, thus the actual test pattern displayed will be dependent on which features are present in each terminal.

RESET TERMINAL must be pressed to resume operation if any error occurred. However, the terminal's operation will not be reliable if the Self-Test failed.



Note Error messages disable the keyboard. To restore operation press RESET TERMINAL key.

The Control Memory PCA containing the failing ROM is determined by the "BS OPEN" or "BS CLOSED" portion of the error message. "BS OPEN" means that the PCA with the "BS" switch in the open position contains the failing ROM. Similarly, "BS CLOSED" means that the PCA with the "BS" switch in the closed position contains the failing ROM. Figure 7-9 shows the location of the "BS" switch on the PCA.

The ROM number aa portion of the message corresponds to the ROM socket "A" number on the Control Memory PCA. For example, the number "18" would correspond to ROM socket "A18" on the PCA. Refer to figure 7-12 for the "A" number socket locations.

Figure 1-35. Terminal Self-Test Flowchart (Sheet 1 of 3)

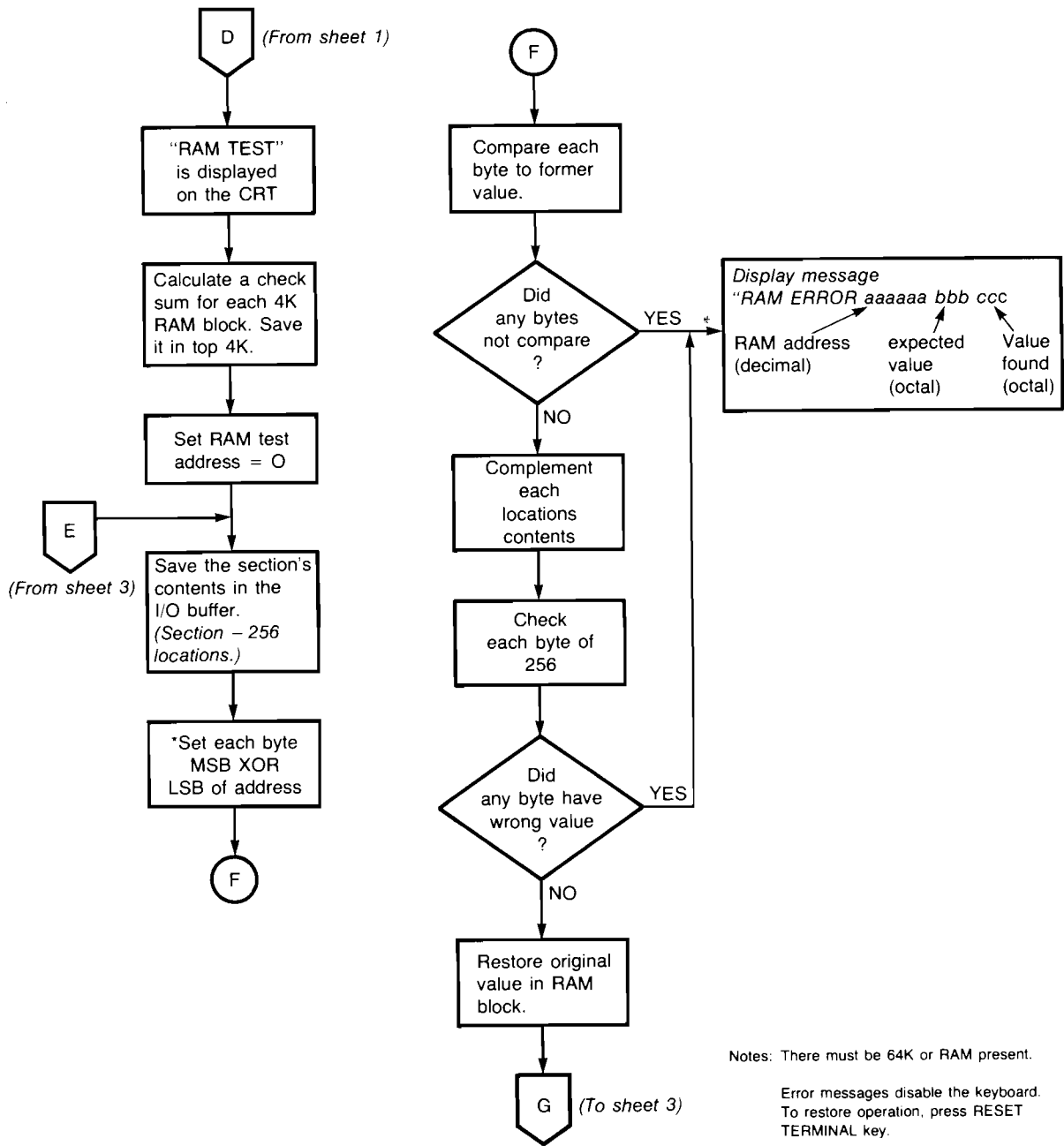


Figure 1-35. Terminal Self-Test Flowchart (Sheet 2 of 3)

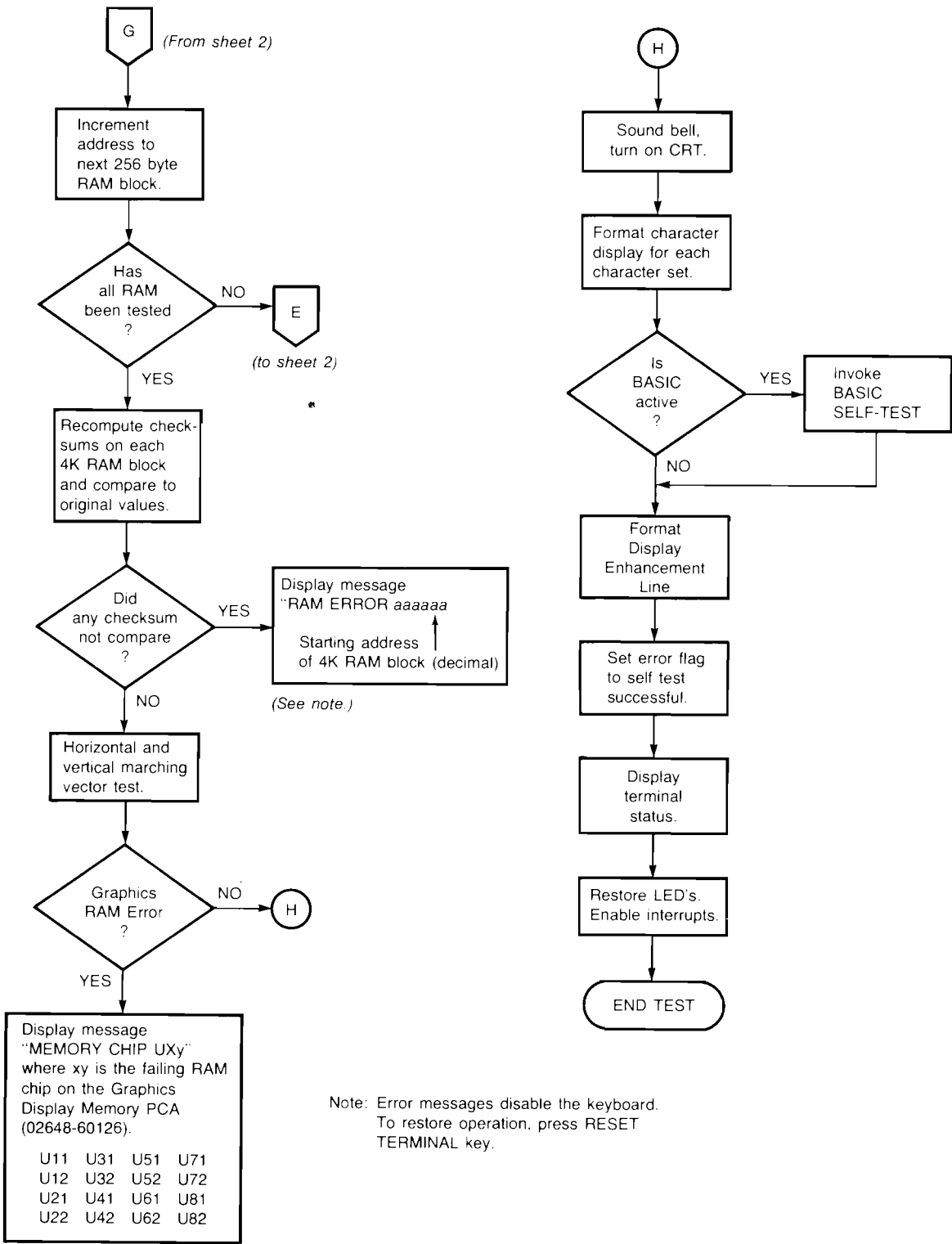


Figure 1-35. Terminal Self-Test Flowchart (Sheet 3 of 3)

```

%&^& ^&^&^&^& ^&^&^&^&^& ^&^&^&^&^& ^&^&^& !''# $%&'()*+ ,-. /0123 456789:; <=>?
@ABC DEFGHIJK LMNOPQRS TUVWXYZI \]^_`abc defghijk lmnopqrs tuvwxyz{ |}~■
@ABCDEFGHIJKLMNO 900-020 4=100000

```

A. Test Pattern for the standard terminal.

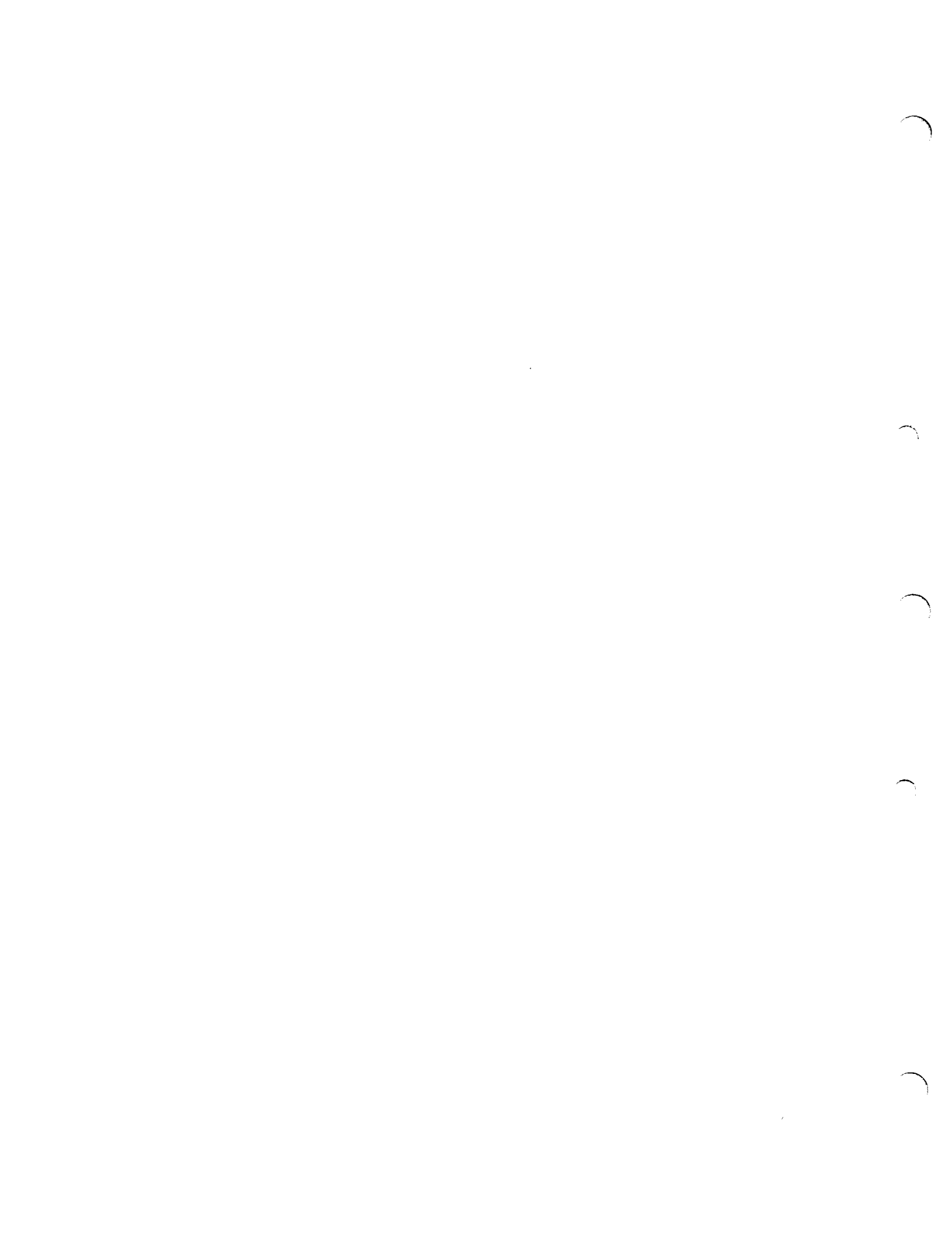
```

<<+ '123456 7890,1.1 11.11.11.1 1.1<<+ 123456 7890,1.1 11.11.11.1 1.1<<+
|4| || U-]m m+|]r| r|h|d |m-π|4| || U-]m m+|]r| r|h|d |m-π|4| || U-]m m+|]r| r|h|d |m-π|
π α β ψ ϕ ε δ λ η ι θ κ ω μ ν ρ π γ θ σ τ ξ Δ δ χ υ ζ ι →T+ι π α β ψ ϕ ε δ λ η ι θ κ ω μ ν ρ π γ θ σ τ ξ Δ δ χ υ ζ ι →T+ι
%&^& ^&^&^&^& ^&^&^&^&^& ^&^&^&^&^& ^&^&^& !''# $%&'()*+ ,-. /0123 456789:; <=>?
@ABC DEFGHIJK LMNOPQRS TUVWXYZI \]^_`abc defghijk lmnopqrs tuvwxyz{ |}~■
@ABCDEFGHIJKLMNO 900-020 4=100000

```

B. Test Pattern for terminals containing Display Enhancements, Math Symbol Set, and Line Drawing Set.

Figure 1-36. Terminal Self-Test Patterns



Operating the Terminal

SECTION

II

INTRODUCTION

This section provides information on operating the HP 2647A terminal. Included are instructions on running some simple exercises, loading and running the Terminal BASIC, and writing simple programs in BASIC which will demonstrate how to transfer data between the terminal (running in BASIC) and a computer running in another language (FORTRAN in the example).

EXERCISES

To type data into the terminal and edit it, proceed as follows:

1. Type the following:

```
Alexander Hamelton_
```

(Notice that the alphanumeric cursor moves across the screen as you type. This tells you where the next character will appear when you press the next key.)

2. Correct the spelling in the above display.

a. Move the cursor under the **e** (using the **←**, **→**, **↑**, and **↓** keys in the display group).

- b. Type **i**. The result will be:

```
+
Alexander Hamilton
```

Draw a box around the text entered above.

1. Press the **□** key, and move the graphics cursor (using the **←**, **↑**, **→**, and **↓** keys on the graphics key pad) to the top-left portion of the text area.

```
Alexander Hamilton
```

2. Hold the **SHIFT** key down and press the **MOVE** key. (This effectively moves the "pen" to present position of the cursor.

3. Hold the **SHIFT** key down, then press the **ROLL** key. Move the cursor to the top-right portion of the text area.

```
+
Alexander Hamilton
```

4. Press **SHIFT** **DRAW** keys to draw a line from the previous point.
5. Move the graphics cursor to the bottom-right portion of the text area, then press the **SHIFT** **DRAW** keys.

```
Alexander Hamilton
```

6. Move the cursor to the bottom-left portion of the text area, then press **SHIFT** **DRAW** keys.

```
+
Alexander Hamilton
```

7. Move the cursor to the top-left portion of the text area (the starting point), then press **SHIFT** **DRAW** keys to complete the box. You may move the cursor away from the text area, then press **SHIFT** **MOVE** keys to move the "rubber band line" starting point, or press **SHIFT** **ROLL** to turn off "rubber band line."

```
Alexander Hamilton
```

8. By pressing the **ROLL UP** and **ROLL DOWN** keys, you can see how the alphanumeric display memory is independent of the graphics display memory.

Further editing can be accomplished using the **INSERT LINE**, **DELETE LINE**, **INSERT CHAR**, **DELETE CHAR** keys. Experiment with these keys until you feel comfortable using them. (See Section III of the *HP 2647A User's Manual*, part no. 02647-90001.)

USING TERMINAL BASIC

Loading the BASIC Interpreter

To load the BASIC interpreter, proceed as follows:

1. Insert the TERMINAL BASIC/MULTIPLLOT tape cartridge in the left tape slot.
2. With the **REMOVE** key up, press the **HEAD** key. The display shown below will appear on the screen.

```
BASIC/MULTIPLLOT
(c) HEWLETT-PACKARD CO 1978
02647-13301
Rev B-1901-42
```

* If BASIC is not loaded press "f8" key.

* Select MULTIPLLOT "f1"-"f6", or restore normal operation "f7".

* MULTIPLLOT performs a "Remove STD", removing CALL and PRINT USING

```
-----MULTIPLLOT-----|-----BASIC-----|
f1 f2 f3 f4 f5 f6 f7 f8
PIE BAR LINEAR LDG/LDG Y-LDG X-LDG restore
```

- After the terminal "beeps", press the **f8** key. This loads the BASIC interpreter into the terminal (it takes approximately 3 minutes). After loading, the BASIC interpreter will display the amount of workspace available, followed by the prompt character ">".

Entering BASIC

If BASIC is already loaded into the terminal, you can call the BASIC Interpreter as follows:

- Set the **REMOTE** key to the UP position.
- Press the **COMMAND** key.
- Type BASIC **RETURN**. The terminal will display a message similar to the following:

```
HP TERMINAL BASIC REV. C-1914-42
6974 BYTES DISPLAY MEMORY
10822 BYTES WORK SPACE
>
```

The ">" character is a prompt.

Exiting BASIC

To exit the BASIC Interpreter, enter (after the ">" prompt):

```
>EXIT RETURN
```

Using BASIC in Computational Mode

Terminal BASIC can be used for direct computation without the need for a program. Numeric operations can be performed by entering a "?" followed by the numeric expression.

In addition, entering any valid BASIC language expression, or most statements (such as LET or PRINT), without a statement number will cause the operation to be executed as soon as the **RETURN** key is pressed.

Example: Calculate $(2*(4+2)^3)$

```
>?2*(4+2)^3 RETURN
>432
```

Example: Set $X=3$, $Y=-8*X$, and print the absolute value of $X*Y$.

```
>LET X=3 RETURN
>LET Y=-8*X RETURN
>PRINT ABS(X*Y) RETURN
>72
```

Entering a Program from the Keyboard

The following paragraphs tell you how to enter BASIC programs from the terminal keyboard. It is assumed that you are familiar with the BASIC programming language. If you are not familiar with programming in BASIC, refer to the *Learning Time-Shared BASIC Manual*, part no. 22687-90009.

Descriptions of commands and statements that are unique to terminal BASIC are presented in the *Terminal BASIC Language Manual*, part no. 02647-90005, and are not repeated here.

The terminal should be set for local operation (**REMOTE** key UP) during program generation. Otherwise, if the terminal is connected to a computer, keyboard input will be sent to the computer as well as the BASIC interpreter.

BASIC does not process input until the **RETURN** key is pressed. When the **RETURN** key is pressed, the line containing the cursor is read by the Interpreter. This allows you to edit the line using the cursor keys and the terminal editing functions (INSERT and DELETE) before sending the line to the Interpreter.

If a BASIC statement is entered without a line number, it will be executed immediately (refer to the paragraph "Using BASIC in Computational Mode").

To enter a program from the keyboard, proceed as follows:

- If you are not already in the BASIC Interpreter, call it as described in the paragraph "Entering BASIC."
- Type SCR **RETURN**. This clears any existing statements from the work space.
- Enter a program from the keyboard. For example,

```
>10 REM Plot SIN(X)/X
>20 PLOT
>30 LOCATE (100,180,50,100)
>40 SCALE (0,50,-1,1)
>50 FXD (2,2)
>60 LGRID (5,.2,0,0,2,2)
>70 FOR X=.01 TO 40 STEP .1
>80 PLOT (X,SIN(X)/X)
>90 NEXT X
>100 END
```

- Type RUN **RETURN**

Editing a Program

Programs may be edited by using the **INSERT CHAR** and **DELETE CHAR** keys. (The statement is not read by the interpreter until the **RETURN** key is pressed.)

For example, change the step size in the following statement to .4.

```
70 FOR X=.01 TO 40 STEP .1
```

1. Move the alphanumeric cursor to the line containing the statement.
2. Move the cursor under step size (.1), as follows:
70 FOR X=.01 TO 40 STEP .1
3. Overstrike the "1" with a "4". The edited line now should be
70 FOR X=.01 TO 40 STEP .4
4. Press the **RETURN** key. This will cause the edited line to be entered, replacing the original line 70, into the interpreter.

Saving a Program on Cartridge Tape

You can save, on cartridge tape, the program entered into the BASIC interpreter in the preceding paragraph as follows:

1. Load a tape cartridge into the right or left tape slot.
2. Record the program on the cartridge by typing
SAVE "R" **RETURN** (if the tape is in the right tape slot)
or
SAVE "L" **RETURN** (if the tape is in the left tape slot)

Note that the "R" can be omitted if the tape is in the right slot; the right tape slot is the default slot for saving a program on tape.

3. Type MARK FILE header on R/L tape or REWIND R/L tape. For example, if the tape is in the left slot:

COMMAND MARK L TAPE **RETURN**

COMMAND **f6** **f5** **RETURN**

OR

COMMAND REWIND L TAPE **RETURN**

COMMAND **f5** **f6** **RETURN**

Entering a Program from Cartridge Tape

To enter a program from cartridge tape into the BASIC Interpreter, proceed as follows:

1. Enter the BASIC Interpreter.
2. Type SCR **RETURN**. This clears any existing programs from the BASIC workspace.

3. Insert the tape containing a program into the right or left tape slot.
4. Load the program into the BASIC Interpreter by entering

GET "R" **RETURN** (if the tape is in the right tape slot)

or

GET "L" **RETURN** (if the tape is in the left tape slot)

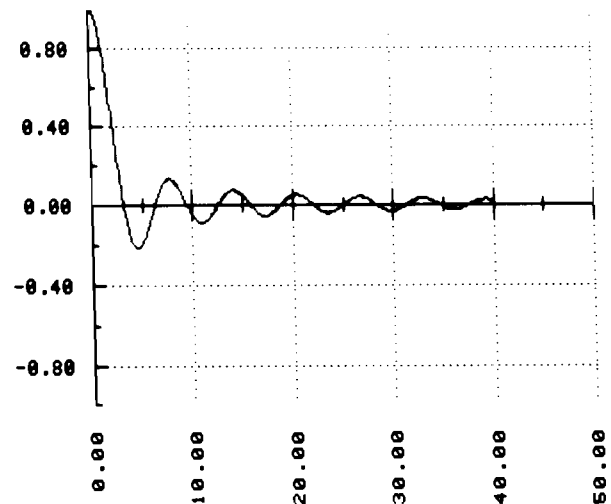
For example, use the tape saved from the paragraph "Saving a Program on Cartridge Tape." To run this program, enter the BASIC interpreter as outlined in steps 1 and 2 above, and perform the following:

1. Insert the tape in the left tape slot.
2. Type GET "L" **RETURN**
3. Type LIST **RETURN**. The BASIC interpreter will list the program.

```
>10 REM PLOT SIN(X)/X
>20 PLOT R
>30 LOCATE (100,180,50,100)
>40 SCALE (0,50,-1,1)
>50 FXD (2,2)
>60 LGRID (5,.2,0,0,2,2)
>70 FOR X=.01 TO 40 STEP .1
>80 PLOT (X,SIN(X)/X)
>90 NEXT X
>100 END
```

4. Type RUN **RETURN**

The program will execute and give the following display:



Loading a Program from a Computer

The following two examples demonstrate how to load a program into the BASIC Interpreter from a computer to which the terminal is connected. The computer used in the example was a Hewlett-Packard HP 3000.

1. Log onto the computer

```
:HELLO HAL.MPUBS
```

The computer prints the following message:

```
HP3000 / MPE III B.00.02. WED, JAN 2, 1980, 3:12 PM
*****LUKE*****
```

2. Enter the computer's BASIC interpreter.

```
:BASIC
```

The BASIC Interpreter prints the following message and a ">" prompt:

```
HP32101B.00.10(4WD) BASIC (C)HEWLETT-PACKARD CO 1978
>
```

3. Enter the following simple program:

```
>10 PRINT "THIS IS A TEST"
>20 PRINT "TO DEMONSTRATE LOADING A PROGRAM FROM A COMPUTER"
>30 PRINT "INTO THE HP 2647A BASIC INTERPRETER"
```

4. Set the **REMOTE** key to the UP position (local mode).

5. Press the **COMMAND** key.

6. Type BASIC **RETURN**. The terminal's BASIC Interpreter prints the following message and a ">" prompt:

```
HP TERMINAL BASIC -- REV. C-1914-42
6943 BYTES DISPLAY MEMORY
10822 BYTES WORK SPACE
>
```

7. Position the alphanumeric cursor opposite the "10" in statement 10 that you typed while in the computer's BASIC Interpreter.

8. Press **RETURN** three times (for statements 10, 20, and 30).

9. Type LIST **RETURN**. The HP 2647A Interpreter will print the program:

```
10 PRINT "THIS IS A TEST"
20 PRINT "TO DEMONSTRATE LOADING A PROGRAM FROM A COMPUTER"
30 PRINT "INTO THE HP 2647A BASIC INTERPRETER"
```

10. Type RUN **RETURN**. The BASIC Interpreter will execute the program.

```
THIS IS A TEST
TO DEMONSTRATE LOADING A PROGRAM FROM A COMPUTER
INTO THE HP 2647A BASIC INTERPRETER
```

11. You can save the program on cartridge tape by inserting a tape in the right tape slot and typing SAVE **RETURN**

12. Type EXIT **RETURN**. This exits the terminal's BASIC Interpreter.

13. Press the **REMOTE** key. This returns you to the computer's BASIC Interpreter.

14. Type EXIT **RETURN**. This exits the computer's BASIC Interpreter.

```
>EXIT
```

```
END OF SUBSYSTEM
```

15. Log off.

```
:BYE
```

```
CPU=4. CONNECT=16. WED, JAN 2, 1980, 3:28 PM
```

An alternate method is as follows:

1. Set the **REMOTE** key to the UP position (local mode).
2. Perform a soft terminal reset and exit BASIC if it is active.

To do this, press

```
RESET TERMINAL
```

then type:

```
>EXIT RETURN
```

Terminal will display **TERMINAL READY**

3. Set **REMOTE** key down. (On-line)
4. Log onto the computer and access the computer's BASIC Interpreter.

5. Enter the following program to the computer:

```
10 Print "10 PLOTR"
20 Print "20 LOCATE (50,150,25,75)"
30 Print "30 SCALE (-10,10,-10,10)"
40 Print "40 FRAME"
50 Print "50 LGRID (1,1,0,0,2,2)"
60 Print "60 END"
70 Print "RUN"
```

6. Type RUN (do not press **RETURN** at this time).

7. Set **REMOTE** key up.

8. Press **COMMAND** key.

9. Type BASIC **RETURN**.

10. Type SCR **RETURN**.

11. Set **REMOTE** key down.

12. Press **RETURN**. This will complete the "RUN" in step 5.

The terminal will list the program, then execute it. Note that BASIC commands will execute immediately if printed to the terminal while it is in BASIC command mode, even though the **REMOTE** key is down and a computer is being accessed (as in the above example).

The computer does not have to be in BASIC as long as the format of the lines to be printed is in terminal BASIC. For example, the preceding program can be entered into the SPL/3000 (Systems Programming Language for the HP 3000 Computer System) compiler, then listed to the terminal and executed by the terminal's BASIC interpreter. Figure 2-1 contains an example.

Controlling the Terminal Programmatically

The HP 2647A terminal can be controlled using "escape codes." For example, perform the following:

1. Press, then release, the **ESC** key.

2. Type `,cDI W#7 RETURN`. The soft keys window will be displayed.

3. Press, then release, the **END** key.

4. Type `,cCLD W#7 RETURN`. The soft keys display will turn off.

The above, and other, terminal functions can be controlled by calling the escape sequences programmatically, either from a program running on a host computer or from a terminal BASIC program being run by the terminal's BASIC Interpreter.

```

:SPLGD SPL1
PAGE 0001  HP32100A.07.02 [4W] (C) HEWLETT-PACKARD COMPANY 1978

00001000  00000 0  *CONTROL USLINIT
00002000  00000 0  BEGIN
00003000  00000 1
00004000  00000 1      ARRAY MESSAGE(0:79);
00005000  00000 1
00006000  00000 1      INTRINSIC PRINT;
00007000  0000  1
00008000  00000 1      MOVE MESSAGE:=""10 PLOTR";
00009000  00011 1      PRINT(MESSAGE, -11,0);
00010000  00015 1      MOVE MESSAGE:=""20 LOCATE(50,150,25,75)";
00011000  00036 1      PRINT(MESSAGE, -23,0);
00012000  00042 1      MOVE MESSAGE:=""30 SCALE(-10,10,-10,10)";
00013000  00063 1      PRINT(MESSAGE, -24,0);
00014000  00067 1      MOVE MESSAGE:=""40 FRAME";
00015000  00100 1      PRINT(MESSAGE, -8,0);
00016000  00104 1      MOVE MESSAGE:=""50 LGRID(1,1,0,0,2,2)";
00017000  00124 1      PRINT(MESSAGE, -21,0);
00018000  00130 1      MOVE MESSAGE:=""60 END";
00019000  00140 1      PRINT(MESSAGE, -6,0);
00020000  00144 1      MOVE MESSAGE:=""RUN";
00021000  00153 1      PRINT(MESSAGE, -3,0);
00022000  00157 1
00023000  00157 1  END.
      PRIMARY DB STORAGE=X001;    SECONDARY DB STORAGE=X00120
      NO. ERRORS=0000;            NO. WARNINGS=0000
      PROCESSOR TIME=0:00:01;     ELAPSED TIME=0:00:10

END OF COMPILE

END OF PREPARE

10 PLOTR
20 LOCATE(50,150,25,75)
30 SCALE(-10,10,-10,10)
40 FRAME
50 LGRID(1,1,0,0,2,2)
60 END
RUN

```

Figure 2-1. Loading a Program from the SPL/3000 Compiler

NOTE

An uppercase character terminates an escape sequence. If the escape sequence is not terminated with an uppercase character, the terminal will hang up and you will have to execute a "soft reset" (press **RESET** key) or another escape sequence (terminated with an uppercase character) to regain control of the terminal.

For example, perform the following:

1. Press, then release the **ESC** key.
2. Type `*dr`

The alphanumeric cursor will turn off. If you enter

ESC `*dq`

the cursor will reappear but you cannot now control the terminal until you perform another escape sequence ending with an uppercase character, or perform a soft reset.

The escape function can be invoked by specifying its ASCII code in the program. Then by calling the complete escape sequence for a particular function, the terminal can be made to perform the function.

In terminal BASIC, the function `CHR$(27)` is used to specify the escape code. The function `CHR$(X)` returns the string character whose ASCII (numerical) value is `X`. For example, the ASCII code for `ESC` is decimal 27. Thus, to specify `ESC` with `CHR$(X)`, you would use `CHR$(27)`.

For example, consider the previous example using the `ESC` key (turning the soft keys window on and off). To duplicate this same function in a BASIC program, perform the following:

1. Press the **COMMAND** key.
2. Type `BASIC` **RETURN**. This accesses the BASIC Interpreter.
3. Enter:

```
>10 A$= CHR$(27)&" ,cDI W#7" RETURN
>20 PRINT A$
>RUN RETURN
```

The softkeys window should be displayed.

The statement

```
10 A$= CHR$(27)&" ,cDI W#7"
```

assigns the complete escape sequence to the character variable `A$`. That is, 27 is the ASCII code for `ESC`, the `&`

tells the statement that there is more to follow, and `" ,cDI W#7"` is a string containing the rest of the escape sequence (the complete escape sequence to turn the soft key window display on is: `ESC ,cDI W#7`).

4. The complete escape sequence to turn the soft keys window display off is: `ESC ,cCLO W#7`
5. Enter this programmatically:

```
>SCR RETURN (This clears the BASIC workspace)
>10 PRINT CHR$(27)&" ,cCLO W#7" RETURN
>RUN RETURN
```

The soft keys window should go off.

6. Refer to Section II of the Reference Manual and try several escape sequences to control various aspects of terminal operation.
7. Figure 2-2 contains a program that displays a chess board. This program should provide several examples for experimentation.

Note that in the program shown in figure 2-2, some lines contain several statements, separated by a `"\"`. This is valid, and allows you to compress lengthy programs into fewer lines.

The statement

```
10 PLOTTR \GCLR
```

turns on the terminal graphics function (`PLOTTR`), `GCLR` clears the graphics display before the program executes.

The statement

```
60 A$=CHR$(27)&"*m"
```

sets up an escape sequence that defines the graphics mode. Refer to page 3-6 of the HP 2647A Reference Manual for a discussion of graphics mode parameters.

Once the escape sequence is set up in statement 60, any of the following parameters may be appended to cause the terminal to perform some graphics function:

- a select drawing mode
- b select line type
- c define line pattern
- d define area pattern
- e area fill, absolute
- f area fill, relocatable
- j set relocatable origin
- k set relocatable origin to pen position
- l set relocatable origin to cursor position
- m set graphics text size
- n set graphics text direction
- o turn on character slant
- p turn off character slant
- q set text origin
- r set graphics defaults
- z NOP

```

10 PLOTR \GCLR
20 DIM P$(16)\P$(1)="WR"\P$(2)="WN"\P$(3)="WB"\P$(4)="WQ"
30 P$(5)="WK"\P$(6)="WB"\P$(7)="WN"\P$(8)="WR"
40 P$(9)="BR"\P$(10)="BN"\P$(11)="BB"\P$(12)="BQ"\P$(13)="BK"
50 P$(14)="BB"\P$(15)="BN"\P$(16)="BR"
60 A$=CHR$(27)&"*m"\B$="E"\C$="WP"
70 LOCATE (0,200,0,100)\SCALE (0,719,0,359)
80 I1=280\I2=520\J=20
90 FOR N=1 TO 7 STEP 2
100 FOR I=I1 TO I2 STEP 80
110 PRINT A$;I;J;I+40;J+40;"e"
120 NEXT I
130 J=J+80
140 NEXT N
150 I1=240\I2=480\J=60
160 FOR N=2 TO 8 STEP 2
170 FOR I=I1 TO I2 STEP 80
180 PRINT A$;I;J;I+40;J+40;"e"
190 NEXT I
200 J=J+80
210 NEXT N
220 PRINT B$
230 LOCATE (240*10/36,562*10/36,20*10/36,341*10/36)
240 FRAME
250 PRINT A$&"3A"
260 FOR J=72 TO 272 STEP 200
270 FOR I=256 TO 536 STEP 40
280 MOVE (I,J)
290 PRINT #0;C$;
300 NEXT I
310 C$="BP"
320 NEXT J
330 K=1
340 FOR I=256 TO 536 STEP 40
350 J=32
360 MOVE (I,J)
370 PRINT #0;P$(K)
380 K=K+1
390 NEXT I
400 K=9
410 FOR I=256 TO 536 STEP 40
420 J=312
430 MOVE (I,J)
440 PRINT #0;P$(K)
450 K=K+1
460 NEXT I

```

Figure 2-2. Terminal BASIC Program Example

The statement

```
70 LOCATE (0,200,0,100)\SCALE (0,719,0,359)
```

defines the plotter space in units of 0 to 719 for the X axis, and 0 to 359 for the Y axis (that is, the whole screen is defined as the graphics area).

The statement

```
130 PRINT A$;I;J;I+40;J+40;"e"
```

fills in an area of 40 by 40 units, starting at I=280, J=20. Note that the parameter appended to the escape sequence

(contained in A\$) is lower case "e". This is done so that the escape sequence is not terminated until the complete FOR - NEXT loop is completed. The statement

```
260 PRINT B$
```

terminates the escape sequence once the entire chess board pattern has been printed (B\$ contains an uppercase "E").

The statement

```
290 PRINT A$&"3A"
```

appends the parameters 3A onto the escape sequence defined in A\$. The parameters 3A set the "complement"

graphics mode so that the characters depicting the chess pieces will be printed on the shaded and non-shaded areas alike. Note that uppercase A is used to terminate the sequence once the characters are printed.

Passing Data Between the Terminal and a Computer

A program running in the terminal's BASIC Interpreter can enable direct data communications between the terminal and a host computer. The handshake protocol used by the terminal is D_1/D_2 . The terminal signals that it is ready to transfer data by sending a D_2 to the computer. The computer triggers the actual transmission by sending a D_1 . The program shown in figure 2-3 is a simple FORTRAN program named DC1TEST, which has been compiled and prepared on an HP 3000 Computer System.

```

$CONTROL USLINIT
100 FORMAT(2X,"Compute the square and cube of a number")
200 FORMAT("0")
WRITE(6,100)
10 WRITE(6,200)
ACCEPT X
IF (X .EQ. 0)GOTO 20
SQ=X**2
CB=X**3
DISPLAY "The square of ",X," is ",SQ
DISPLAY "The cube of ",X," is ",CB
GOTO 10
20 STOP
END

```

Figure 2-3. FORTRAN Program Example

The program shown in figure 2-4 is a terminal BASIC program which will send data to and receive data from the FORTRAN program.

```

10 DIM A$(80)
20 REM Define control commands *****
30 Eof$=CHR$(27)&"&CHR$(13)
40 Eon$=CHR$(27)&"&CHR$(13)
50 Rmote$=CHR$(27)&"&k1R"
60 Loc1$=CHR$(27)&"&k0R"
70 REM Put terminal in remote for assign *****
80 PRINT CHR$(27)&"&k0A"
90 PRINT Rmote$;
100 ASSIGN "DA" TO #1
110 REM Log on CPU *****
120 PRINT #1;CHR$(13);\ GOSUB 360
130 PRINT #1;"HELLO HAL.MPUBS"&CHR$(13);
140 GOSUB 360
150 REM Turn off echo *****
160 PRINT #1;Eof$;\ GOSUB 360
170 REM Run test program on CPU *****
180 PRINT #1;"RUN DC1TEST"&CHR$(13);
190 READ #1;A$\ PRINT A$
200 GOSUB 360
210 REM Get keyboard input *****
220 PRINT Loc1$;\ INPUT J\ PRINT Rmote$;
230 REM Send input to CPU *****
240 PRINT #1;J;CHR$(13);
250 IF J=0 THEN 410
260 REM Get squared number from CPU *****
270 READ #1;A$
280 REM Print answer *****
290 PRINT A$
300 REM Get cubed number from CPU *****
310 READ #1;A$
320 REM Print answer *****
330 PRINT A$
340 GOTO 200
350 REM Wait for DC1 character *****
360 GETDCM ON \D$=""
370 IF GETDCM(D$)=0 OR D$<>CHR$(17) THEN 370
380 GETDCM OFF \ PRINT CHR$(17);
390 RETURN
400 REM Cleanup *****
410 GOSUB 360
420 REM Restore echo *****
430 PRINT #1;Eon$;\ GOSUB 360
440 REM Log off CPU *****
450 PRINT #1;"BYE"&CHR$(13);\ PRINT Loc1$
460 END

```

Figure 2-4. Data Communications Program Example

In figure 2-4, the statements

```
30 Eof$=CHR$(27)&"&"&CHR$(13)
40 Eon$=CHR$(27)&"&"&CHR$(13)
```

turn the ECHO off and on (on the HP 3000, E ; turns ECHO off, E : turns ECHO on). $\text{CHR}\$(13)$ causes a carriage return.

The statements

```
50 Rmote$=CHR$(27)&"&k1R"
60 Loc1$=CHR$(27)&"&k0R"
```

contain escape sequences that switch the terminal from REMOTE to LOCAL mode. (E & k1R sets the REMOTE key ON, E & k0R sets the REMOTE key OFF. See page 2-13 in the HP 2647A Reference Manual.)

Similarly, the statement

```
80 PRINT CHR$(27)&"&k0A"
```

switches the  key off.

The statement

```
100 ASSIGN "DA" TO #1
```

assigns the file name DA to file number 1. The name DA is a reserved word meaning "Data Comm" and thus has significance to the terminal.

The statement

```
120 PRINT #1;CHR$(13);\ GOSUB 360
```

sends a carriage return character to the computer, then passes control to subroutine 360 to enable direct data communications with the computer. (Note that the semi-colon following $\text{CHR}\$(13)$ suppresses a line feed, the semi-colon after #1 merely separates the file number from the variable list to be printed.)

The statement

```
360 GETDCM ON \D)=""
```

turns on the GETDCM function and assigns a null to the character variable D\$. The GETDCM function is used to enable direct data communications input, thus bypassing the normal P_1/P_2 handshake protocol. Statement

```
370 IF GETDCM(D$)=0 OR D$<>CHR$(17) THEN 370
```

is a loop, that is, the terminal is in a wait mode until the variable D\$ contains the decimal value 17 (ASCII code for Device Control 1). In other words, the program is handling the P_1 character transfer instead of allowing the terminal's Data Communications firmware to perform this function, thus effectively bypassing the normal P_1/P_2 mode.

Once the P_1 is received, GETDCM is turned off and the statement

```
PRINT CHR$(17);
```

passes the DC1 from the program to the terminal ("prints" it to the terminal).

The statements

```
130 PRINT #1;"HELLO HAL.MPUBS"&CHR$(13);
140 GOSUB 360
```

send the log-on message to the computer, then return to subroutine 360 to again wait for a P_1 from the computer.

The rest of the program operates in essentially the same manner; that is, it gets the computer's attention, then waits for a P_1 giving the program permission to send data.

It should be understood that the programs contained in figures 2-3 and 2-4 are merely simple examples to illustrate the principles of data communications programming. The actual techniques involved will depend on the type of computer you are using, whether or not you are using full duplex, the protocol used by the host computer, and other factors.



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