

HP PaintJet XL Color Graphics Printer Computer Information



**HEWLETT
PACKARD**

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Printing History

New editions are complete revisions of the manual. Change sheets, which may be issued between editions, contain additional information. The dates on the title page change only when a new edition is published. Minor corrections that do not affect the function of the product may be made at reprint without a change to the print date.

Many product updates and fixes do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one to one correspondence between product updates and manual revisions.

First Edition — November 1989

How to Use This Manual

This *Computer Information* manual contains all the information you should need to connect your printer to a computer and print text and graphics using a software package. The first three chapters contain the information needed to connect your printer to most computers and configure your software package. Chapter 4 gives information on using buffers, spoolers, and peripheral sharing devices. Chapters 5, 6, and 7 contain technical specifications for the Centronics, RS-232-C, and HP-IB interfaces—including cable schematics.

You don't need to read this manual from cover-to-cover! Follow the steps in Chapters 1 or 2 to connect your printer to the computer. Browse through Chapter 3 if you will be using a software package. Use Chapters 4 through 7 if you need further technical information. Here's what you'll find:

- Chapter 1** **Establishing a Computer Interconnection** gives you general instructions on connecting your printer to a computer with a Centronics, RS-232-C, or HP-IB interface.
- Chapter 2** **Connecting Your Printer to These Computers** gives you specific interconnection instructions for 17 popular computers.
- Chapter 3** **Using Software with Your Printer** explains what a printer driver is and how to get one. It also gives hints for specific applications and what to do if you don't have a PaintJet XL driver.
- Chapter 4** **Using Your Printer with Peripheral Sharing Devices, Buffers, and Spoolers** tells you about these popular devices including how to decide if you need one and which one to buy. It also includes lists of devices tested by Hewlett-Packard.
- Chapter 5** **Centronics Technical Information** includes pin assignments, handshake timing, and cable schematics.
- Chapter 6** **RS-232-C Technical Information** includes an overview of the RS-232-C interface. It describes handshaking and selecting a handshake as well as providing pin allocations and cable schematics.
- Chapter 7** **HP-IB Technical Information** explains normal and secondary command support. It also gives the supported bus commands and explains the addressing sequences.
- Appendix** Shows you the Roman8 and PC8 symbol sets.

Manual Terms and Conventions

Before reading this manual, you should understand the type styles and number representation used in the text.

BOLDFACE TYPE	Denotes buttons on the printer's control panel, such as Form Feed . Also denotes an ASCII control character, such as ESC , or an escape command, such as ESC&k3W .
Numbers—12 345	Numbers are typed using SI (International System of Units) standards. Numbers with more than four digits are placed in groups of three—separated by a space instead of a comma—counting both to the left and right of the decimal point (e.g., 54 321.123 45).
RS-232-C	A serial interface. All references to RS-232-C interface in this manual apply equally to RS-232-C and CCITT V.24 interfaces. The term RS-232-C is used for simplicity.

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Appendix

Establishing a Computer Interconnection

This chapter deals with generic configurations and interface conditions. This chapter outlines the steps necessary to establish communication between a computer and the printer. It describes the different ways equipment can be connected and discusses RS-232-C, Centronics, and HP-IB interface conditions.

Before You Begin

If you find your computer in the following list, skip to Chapter 2 and follow the interconnection instructions for your computer.

- Personal Computers (Compatible)
 - HP Vectra/Vectra ES/12
 - HP RS/20
 - IBM PC/PC-XT/AT
 - IBM PS/2
 - Olivetti M24

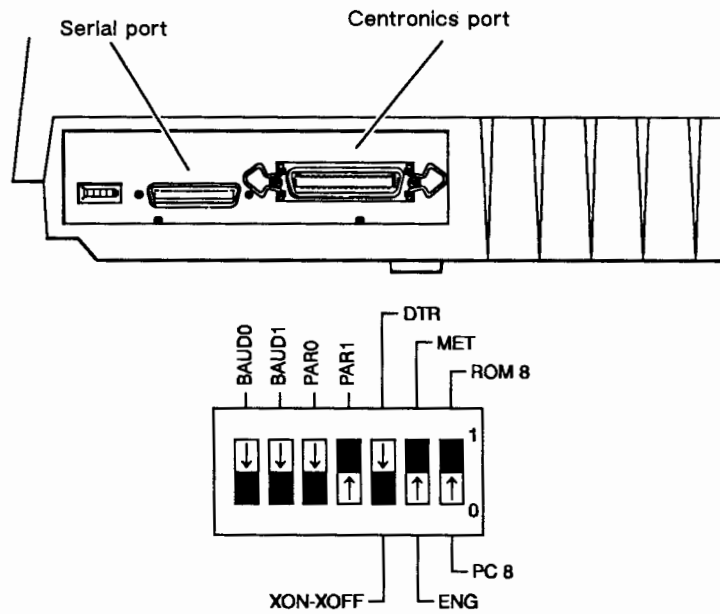
- Commodore Amiga
- Apple Macintosh
- Apple Macintosh Plus/SE/II
- HP 9000, Series 200 Technical Computer
- HP 9000, Series 300 Technical Computer
- HP 9000, Series 800 Technical Computer

If your computer isn't listed, and it supports an RS-232-C, Centronics, or HP-IB interface, follow the interface instructions in this chapter, depending on which interface you are using. Additional technical RS-232-C, Centronics, and HP-IB interface information (including cable schematics) is contained in Chapters 5, 6, and 7. Additionally, you can contact your HP Sales and Support Office to see if there is a *Set-Up Instruction* available for your particular computer.

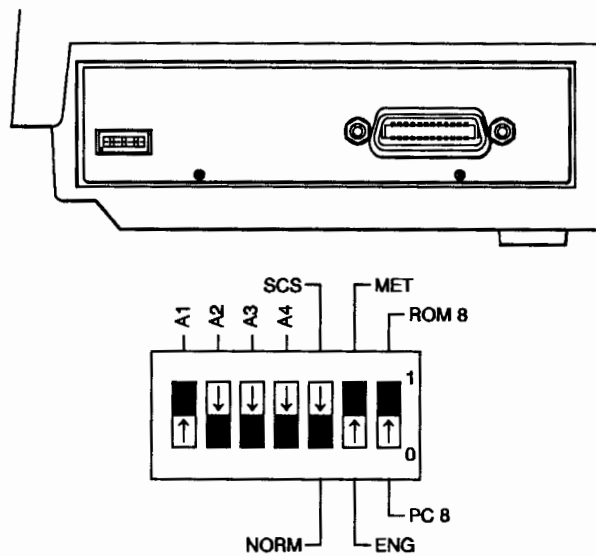
Identifying Your Interface

Use the following illustrations to help you identify your interface.

The Serial/Parallel PaintJet XL



The HP-IB PaintJet XL

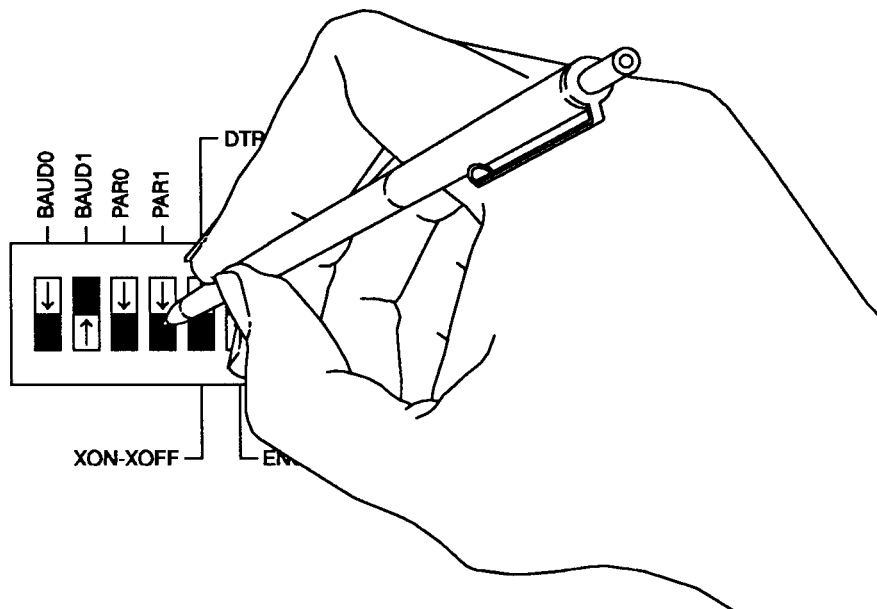


Setting the Rear-Panel Switches

This chapter describes how to use the switches to change your printer's settings. Once you set your printer's switches correctly, you will not need to reset them unless you change your computer/printer system so that it requires a different configuration. Use the same technique for both the serial/parallel interface switches and the HP-IB interface switches.

To change a switch setting, refer to the following steps and illustration.

1. Turn off the printer.
2. Push the switch to the desired position using a pencil or pen.



- The raised portion of the switch is shown in black.
 - The arrow indicates the direction to push the switch.
3. Turn on the printer. The new switch settings are now in effect.

NOTE: The printer reads the settings of the switches *only* when you turn it on. Be sure to turn it off then on when you change switch settings. ■

The rear-panel switches are described individually in the following sections.

Establishing a Symbol Set

Regardless of the interface you will be using, you must select either the Roman8 or PC8 symbol sets to be the default set for your printer.

The Roman8 symbol set includes the standard US ASCII set (printing characters are decimal codes 32–127) and the Roman Extensions, an 8-bit set of European characters and special symbols (decimal codes 160–255). Of the nonprinting control codes, only decimal codes 8, 10, 12, 13, 14, 15, and 27 are executed; the rest are ignored. Control codes and the symbol sets are presented in the appendix.

The lower half of the PC-8 set is the same as the US ASCII set, except that decimal codes 1–32 have special printing characters. The upper half is an 8-bit set containing some European symbols and graphic symbols for mathematics and line drawing. It can be used with printing characters available on IBM personal computers, or when running software packages that support the PC-8 set.

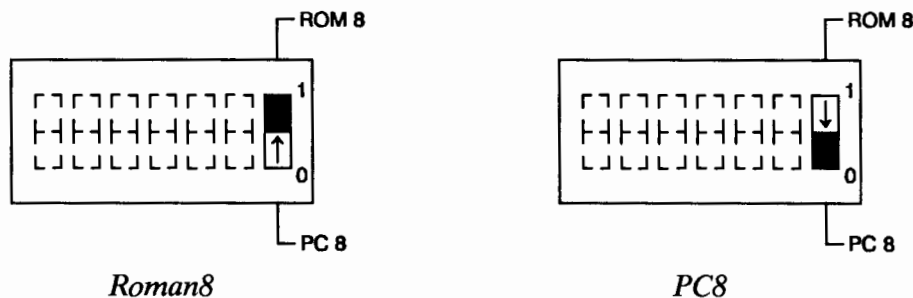
If you are going to use an RS-232-C interface and you will be accessing *any* of the symbols in the upper half of either symbol set (decimal codes 128–255), you *must* set parity to space (none). Otherwise, the special characters will not print.

Complete the following steps to set the symbol set.

1. Turn off the printer.
2. Use a pen or pencil to push the **ROM8/PC8** switch to the desired position.

Setting the **ROM8/PC8** switch *on* establishes the Roman8 symbol set.

Setting the **ROM8/PC8** switch *off* establishes the PC8 symbol set.



3. Read the following section to make sure your printer is set for the correct media size.

Selecting English or Metric Media Sizes

The PaintJet XL printer is designed to use both metric and English paper or transparency film in the following standard sizes:

- ANSI A and B
- ISO A4 and A3

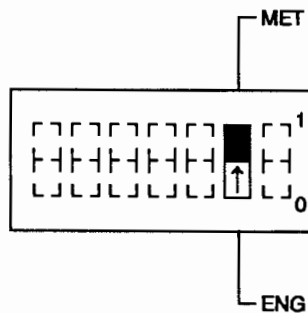
English (ANSI)	Metric (ISO)
A (8½ X 11 in.)	A4 (210 X 297 mm)
B (11 X 17 in.)	A3 (297 X 420 mm)

Complete the following steps to select the media sizes you will be using.

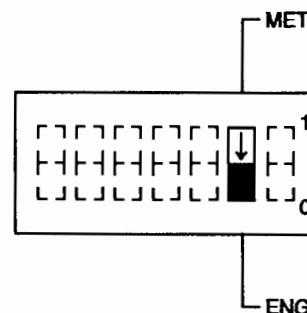
1. Turn off the printer.
2. Use a pen or pencil to push the **MET/ENG** switch to the desired position.

Setting the **MET/ENG** switch *on* establishes metric media sizes.

Setting the **MET/ENG** switch *off* establishes English media sizes.



Metric



English

3. If you need to set other switches, go on to those sections. Otherwise turn on the printer. The new switch settings are now in effect.

Setting Up a Centronics Interconnection

Use this section to help you establish a Centronics interconnection between the printer and your computer. Centronics is a type of *parallel* interfacing. This interface is the most widely used interface on personal computers because, unlike the RS-232-C serial interface, it usually does not require setup commands or special configurations on either the computer or printer.

Setting up the Centronics interface is the easiest of the interfaces. You simply

- Connect the equipment.
- Verify communication.

For Centronics pin allocations, cable schematics, and additional technical information, refer to Chapter 5.

Connecting the Equipment

Once you have decided how to configure your equipment, connect the printer to your computer.

With the printer, your computer, and all of its components turned off, connect one end of the Centronics cable to the computer's Centronics port and tighten the screws. (To select a Centronics cable appropriate for your computer, refer to Chapter 5.) Connect the other end of the cable to the printer's Centronics port. Latch the clips into place and turn your equipment on.

CAUTION

Many computer systems will have both Centronics and RS-232-C ports. These ports frequently appear identical. Make sure you plug your cable into the Centronics port (it should be labeled), or damage could occur to your printer.

NOTE: In some cases, you may need to install a Centronics (parallel) interface card in the computer. If this is the case, your computer documentation should provide details.■

Setting Up an RS-232-C Interconnection

Use this section to help you establish RS-232-C communication between the printer and your computer. RS-232-C is also known as *serial* interfacing.

The following steps outline the process to connect the printer to your computer.

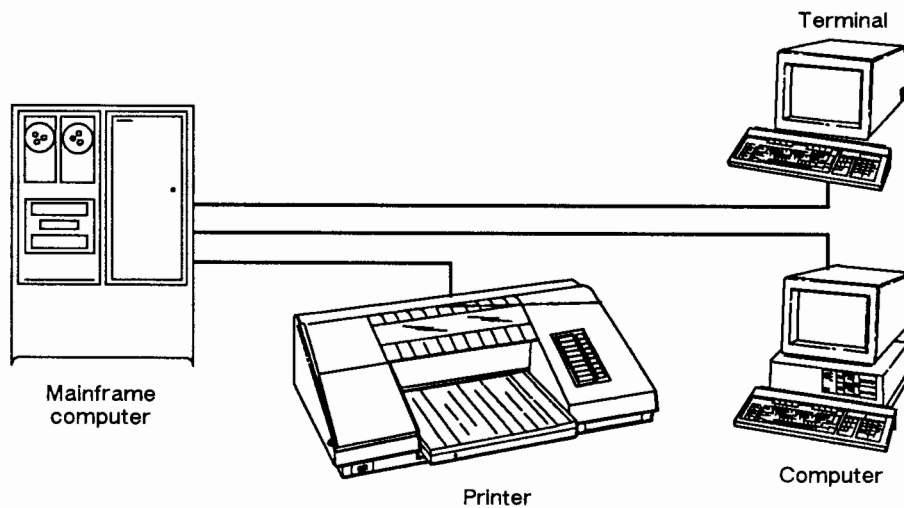
- Identify system configuration.
- Connect the equipment.
- Set serial interface conditions.
- Verify communication.

For RS-232-C pin allocations, cable schematics, and additional technical information, refer to Chapter 6.

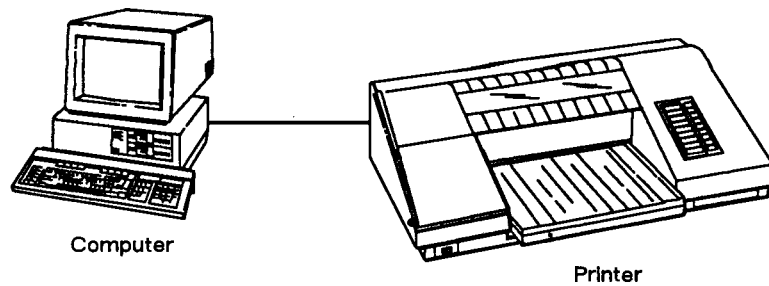
Identifying Your System Configuration

The term “system configuration” refers to the way the printer is connected to the computer and other equipment. The printer can only be operated in a standalone configuration.

In a standalone configuration, the printer is connected to the computer via a separate (not shared) interface cable. The following illustrations show this arrangement for mainframe computers and for personal computers or “smart” (programmable) terminals.



Standalone Configuration with Mainframe



Standalone Configuration with Personal Computer

Connecting the Equipment

Once you have decided how to configure your equipment, connect the printer to your computer.

With the printer, your computer, and all of its components turned off, connect one end of the RS-232-C cable to the computer's RS-232-C port. (To select an RS-232-C cable appropriate for your computer, refer to Chapter 6.) Connect the other end of the cable to the printer's RS-232-C port. Tighten the screws on both ends of the cable and turn your equipment on.

NOTE: In some cases, you may need to install an RS-232-C (serial) interface card in the computer. If this is the case, your computer documentation should provide details.■

Determining RS-232-C Interface Conditions

After correctly connecting your printer and computer, set the printer's rear-panel RS-232-C interface switches to tell it which configuration you are using. Additionally, you must set the printer's switches to match your computer's baud rate and parity. *To work together, your printer and computer must use the same settings.*

Check your system's documentation to find what baud rate and parity your computer uses. Write your computer's requirements in the "Computer Requirement" column of the following table. This should help you determine if you need to change printer settings. If you are using a software package, you may need to change settings according to the requirements of the software package.

RS-232-C Interface Condition Checklist

Condition	Printer's Factory-Set Default	Computer Requirement
baud rate	9600	_____
parity	space*	_____
handshake	Xon-Xoff	_____

* You can set parity to odd, even, mark and space. The factory-set default is space parity (no parity).

The following section explains how to use the printer's rear-panel switches to set your printer's interface conditions.

Setting the RS-232-C Interface Switches

The next four sections describe how to use the switches to change your printer's settings for baud rate, parity, and handshake. Once you set your printer's switches correctly, you will not need to reset them unless you change your computer/printer system so that it requires a different configuration.

The rear-panel switches are described individually in the following sections.

Setting the Baud Rate

USE: Use the two baud rate switches (**BAUD0** and **BAUD1**) to select the baud rate.

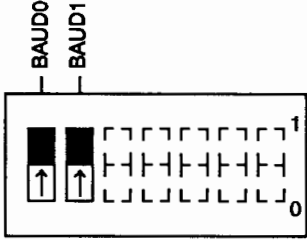
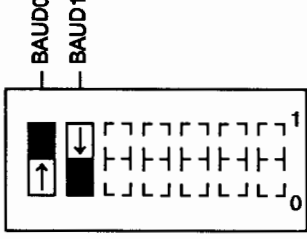
DEFAULT: 9600

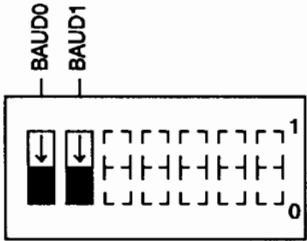
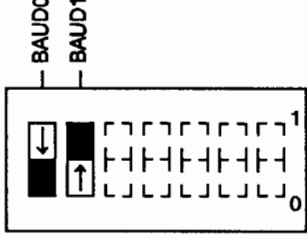
OPTIONS: 1200, 4800, 9600, and 19 200

Complete the following steps to set the baud rate.

1. Turn off the printer.
2. Push switches **BAUD0** and **BAUD1** to the desired position using a pen or pencil.

The combined settings of the two baud rate switches set the baud rate. The printer sends 1 stop bit for all of these baud rates. Your computer and printer do not have to use the same number of stop bits. The following table shows how to set the switches for the available baud rates.

Baud Rate	Switch Settings
1200	 The diagram shows two switches labeled BAUD0 and BAUD1. Both switches are in the up position, indicated by upward-pointing arrows. To the right of the switches is a grid of 16 small squares, with a '1' at the top right and a '0' at the bottom right, representing a 1-stop-bit configuration.
4800	 The diagram shows two switches labeled BAUD0 and BAUD1. BAUD0 is in the up position (upward arrow), and BAUD1 is in the down position (downward arrow). To the right is a grid of 16 small squares, with a '1' at the top right and a '0' at the bottom right, representing a 1-stop-bit configuration.

Baud Rate	Switch Settings
9600	 <p>The diagram shows two switches labeled BAUD0 and BAUD1. Both switches are in the 'down' position, indicated by a downward-pointing arrow. To the right of the switches is a grid of 16 small rectangular switches, with a '1' at the top right and a '0' at the bottom right.</p>
19 200	 <p>The diagram shows two switches labeled BAUD0 and BAUD1. The BAUD0 switch is in the 'down' position (downward arrow), and the BAUD1 switch is in the 'up' position (upward arrow). To the right of the switches is a grid of 16 small rectangular switches, with a '1' at the top right and a '0' at the bottom right.</p>

3. If you need to set other switches, go on to those sections. Otherwise, turn on the printer. The new switch settings are now in effect.



Setting the Parity

USE: Use the **PAR0** and **PAR1** switches to turn parity checking on or off.

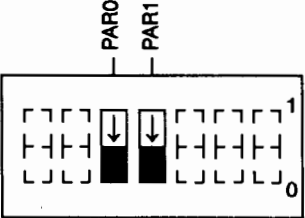
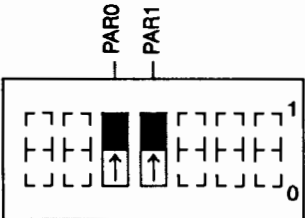
DEFAULT: Space (Off, parity bit 0)

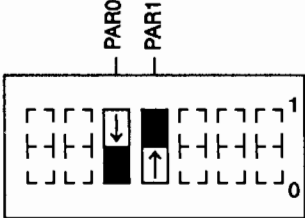
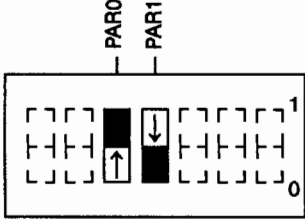
OPTIONS: Space (0), Mark (1), Odd, Even

EXPLANATION: Complete the following steps to set parity.

1. Turn off the printer.
2. Push the **PAR0** and **PAR1** switches to the desired positions using a pen or pencil.

The combined settings of the two parity switches set the parity. If you will be using any of the higher bits from the symbol sets, you must set parity to Space (off). The following table shows how to set the switches for parity.

Parity	Switch Settings
Space (bit 8 transmitted as 0)	 

Parity	Switch Settings
Even	
Odd	

3. Turn on the printer. The new switch settings are now in effect.

NOTE: If your software uses 8-bit character sets (e.g., ISO sets), it will require NO (space) parity as the 8th bit must be available for data.■

Establishing a Handshake

USE: Use the **XON-XOFF/DTR** switch to set your handshake.

DEFAULT: Xon-Xoff

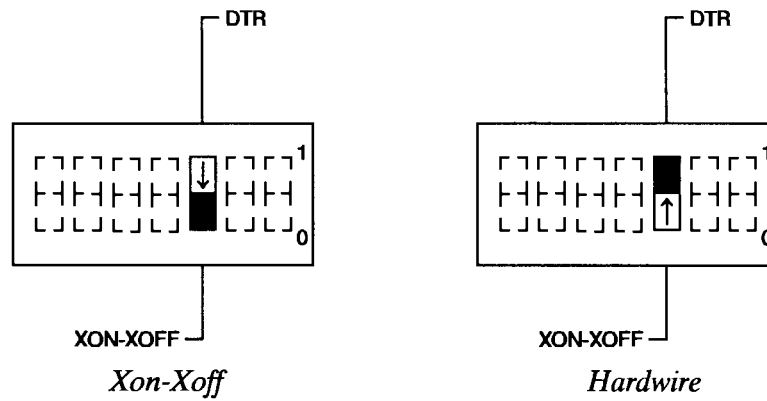
OPTIONS: Xon-Xoff and Hardwire (DTR)

EXPLANATION: Complete the following steps to establish your handshake.

1. Turn off the printer.
2. Push the **XON-XOFF/DTR** switch to the desired position using a pen or pencil.

Setting the **XON-XOFF/DTR** switch *off* establishes an Xon-Xoff handshake.

Setting the **XON-XOFF/DTR** switch *on* establishes a hardwire handshake.



3. Turn on the printer. The new switch settings are now in effect.

Setting Up an HP-IB (IEEE-488) Interconnection

The Hewlett-Packard Interface Bus (HP-IB) is an interface system consisting of one or more HP-IB cables linking computers and peripheral devices. The HP-IB is a parallel interface, also known as IEEE-488. Unlike the Centronics parallel interface, the HP-IB interface allows two-way communication. For more detailed information about how the HP-IB interface works, refer to Chapter 7.

Use this section to help you establish an HP-IB interconnection between the printer and your computer. Setting up the HP-IB interface is quite simple. You must

- Connect the equipment.
- Set the address.
- Verify communication.

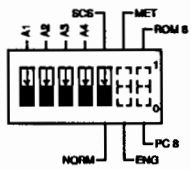
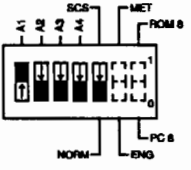
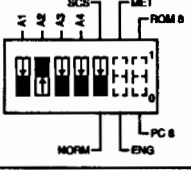
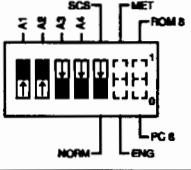
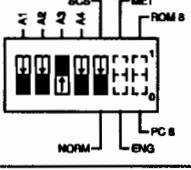
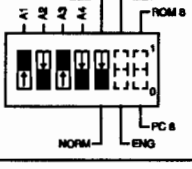
Connecting the Equipment

Once you have decided how to configure your equipment, connect the printer to your computer.

With the printer, your computer, and all of its components turned off, connect one end of the HP-IB cable to the printer and the other end to the computer. Tighten the screws and turn your equipment on.

Selecting an HP-IB Address

If you are using more than one HP-IB peripheral with your computer, each must have a separate HP-IB address. Most systems use address 01 for printers—this is the printer's default address setting. To use an address other than 01, Use the rear-panel HP-IB interface switches to set the address. Refer to the following table.

Address Codes		Address Settings	Address Characters	
Decimal	Octal		Listen	Talk
0	0		SP	@
1	1		!	A
2	2		“	B
3	3		#	C
4	4		\$	D
5	5		%	E

Address Codes		Address Settings	Address Characters	
Decimal	Octal		Listen	Talk
6	6		&	F
7	7		%	E
15	17		/	O

NOTE: The **SCS/NORM** switch must remain set to **NORM (0)** unless you are using Secondary Command Support (SCS). Refer to Chapter 7 for more information on SCS. ■

If you select listen-only (address 15), the printer listens to all data transmitted on the interface. This mode is useful in a system that has no controller but, instead, has a dedicated talker (such as a magnetic tape driver or other mass storage unit) transmitting information to the printer. Refer to Chapter 7 for more information about listen-only mode.

If your computer system uses languages such as BASIC, FORTRAN, or COBOL, with high-level input/output (I/O) statements, the addressing procedure is taken care of by the computer's internal operating system—all you need to do is select an address.

If, however, your computer uses low-level I/O statements, you must directly control the addressing. If your computer system fits this description, refer to *HP-IB Addressing Protocol*, in Chapter 7, for details.

Verifying Communication

Load print cartridges and media. Then follow the instructions below.

Setting the Mode Command

Place the Mode command(s) appropriate for your interface into your AUTOEXEC.BAT file. Consult your DOS documentation if you need assistance.

From the DOS prompt enter the following commands (substitute COM2 for COM1 if necessary):

```
MODE COM1:9600,N,8,1,P  ENTER
```

```
MODE LPT1:=COM1      ENTER
```

The first command sets the serial port to 9600 baud, no parity, 8 data bits, 1 stop bit, and continuous retry on all timeouts. The second command directs the primary printer communication to the first serial port.

Testing Communications Without BASIC

At the DOS prompt, type these two lines:

```
COPY CON:PJXLTEST          ENTER (The prompt will not show up.)  
PaintJet XL Communication OK!  ENTER (The prompt will not show up.)
```

then press **CTRL-Z** (simultaneously) ENTER (The prompt will not show up.)

The computer will display "1 File(s) copied".

Next, at the prompt type:

```
PRINT PJXLTEST  ENTER
```

The computer will prompt: Name of list device [prn:]:

Press **ENTER** to accept PRN.

The PaintJet XL will print:

```
PaintJet XL Communication OK!
```

Testing Communications With BASIC

Enter and run the following BASIC program. (If you need help entering and running the program, refer to your computer documentation.)

```
10 LPRINT CHR$(27)+"E"           'resets the printer
20 LPRINT "COMMUNICATION OK"
30 LPRINT CHR$(13)               'carriage return
40 LPRINT CHR$(12)               'form feed
50 END
```

Your printer should print COMMUNICATION OK.

Connecting Your Printer to These Computers

Your printer will work with most computers. However, regardless of the computer you use, you must first establish a symbol set and select a media size. This chapter tells you first how to establish the symbol set and select a media size, then connect it to one of the computers in the following list. If your computer is not in this list, refer to Chapter 1.

Personal Computers (Compatible)

- Compaq Deskpro
- HP Vectra/Vectra ES/12
- HP Vectra RS/20
- IBM PC/PC-XT/AT
- IBM PS/2
- Olivetti M24

Commodore Amiga

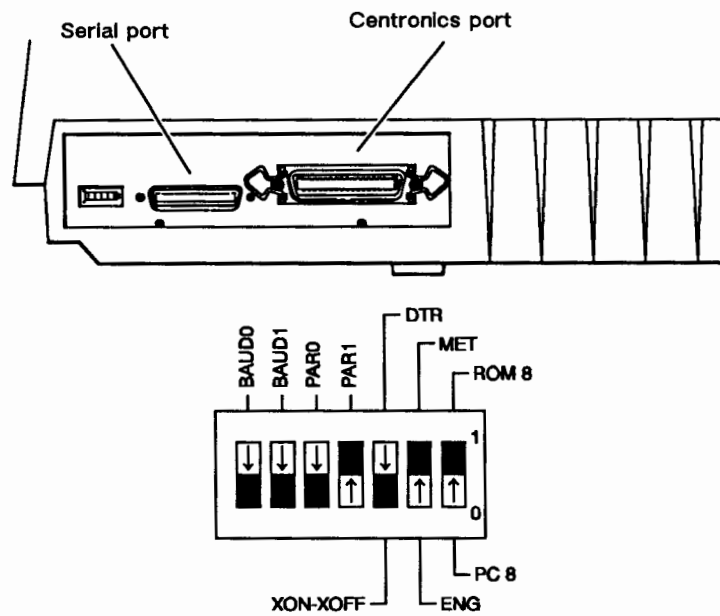
- Apple Macintosh
- Apple Macintosh Plus/SE/II
- HP 9000, Series 200 Technical Computer
- HP 9000, Series 300 Technical Computer
- HP 9000, Series 800 Technical Computer

Refer to Appendix C of the User's Guide for cable ordering information. Additional technical RS-232-C, Centronics, and HP-IB interface information (including cable schematics) is contained in Chapters 5, 6, and 7.

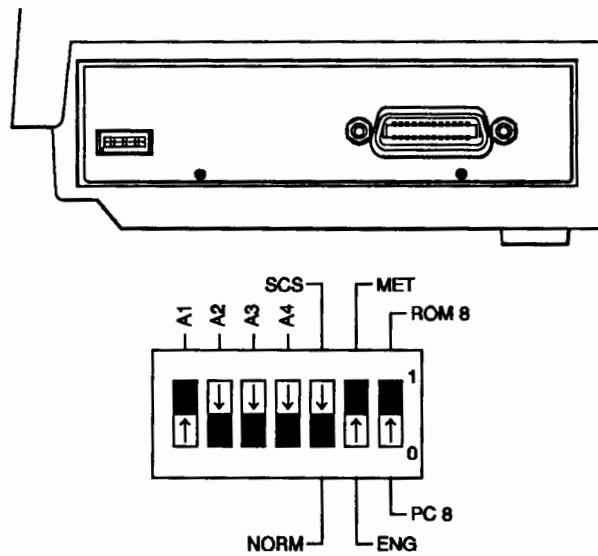
Identifying Your Interface

Use the following illustrations to help you identify your interface.

The Serial/Parallel PaintJet XL



The HP-IB PaintJet XL



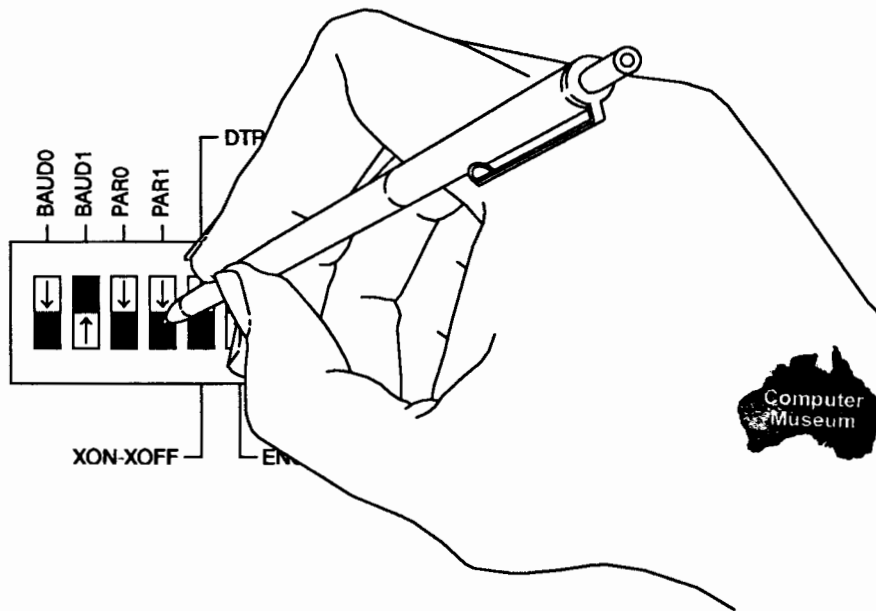
Setting the Rear-Panel Switches

The following section describes how to change the printer's rear-panel interface switches. Use the same technique for both the serial/parallel interface switches and the HP-IB interface switches.

This section tells you *how* change the settings; for a full description of each option, refer to Chapter 1.

To change a switch setting, refer to the following steps and illustration.

1. Turn off the printer.
2. Push the switch to the desired position using a pencil or pen.



- The raised portion of the switch is shown in black.
- The arrow indicates the direction to push the switch.

3. Turn on the printer. The new switch settings are now in effect.

NOTE: The printer reads the settings of the switches *only* when you turn it on. Be sure to turn it off then on when you change switch settings.■

Establishing a Symbol Set

Regardless of the interface you will be using, you must select either the Roman8 or PC8 symbol sets to be the default set for your printer.

The Roman8 symbol set includes the standard US ASCII set (printing characters are decimal codes 32–127) and the Roman Extensions, an 8-bit set of European characters and special symbols (decimal codes 160–255). Of the nonprinting control codes, only decimal codes 8, 10, 12, 13, 14, 15, and 27 are executed; the rest are ignored. Control codes and the symbol sets are presented in the appendix.

The lower half of the PC-8 set is the same as the US ASCII set, except that decimal codes 1–32 have special printing characters. The upper half is an 8-bit set containing some European symbols and graphic symbols for mathematics and line drawing. It can be used with printing characters available on IBM personal computers, or when running software packages that support the PC-8 set.

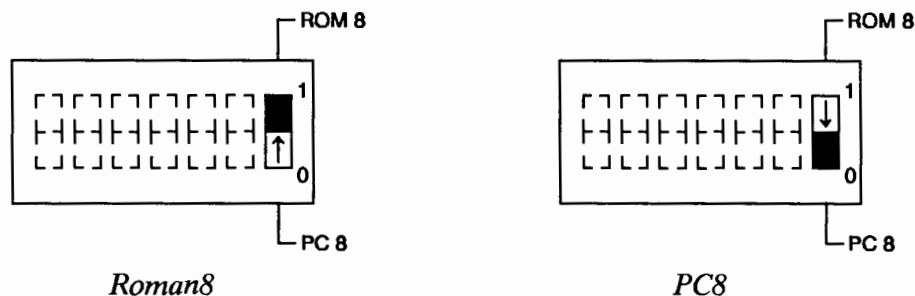
If you are going to use an RS-232-C interface and you will be accessing *any* of the symbols in the upper half of either symbol set (decimal codes 128–255), you *must* set parity to space (none). Otherwise, the special characters will not print.

Complete the following steps to set the symbol set.

1. Turn off the printer.
2. Use a pen or pencil to push the **ROM8/PC8** switch to the desired position.

Setting the **ROM8/PC8** switch *on* establishes the Roman8 symbol set.

Setting the **ROM8/PC8** switch *off* establishes the PC8 symbol set.



3. Read the following section to make sure your printer is set for the correct media size.

Selecting English or Metric Media Sizes

The PaintJet XL printer is designed to use both metric and English paper or transparency film in the following standard sizes:

- ANSI A and B
- ISO A4 and A3

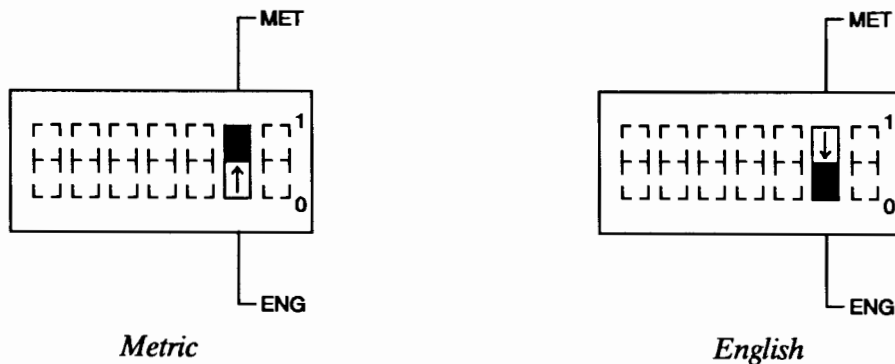
English (ANSI)	Metric (ISO)
A (8½ X 11 in.)	A4 (210 X 297 mm)
B (11 X 17 in.)	A3 (297 X 420 mm)

Complete the following steps to select the media sizes you will be using.

1. Turn off the printer.
2. Use a pen or pencil to push the **MET/ENG** switch to the desired position.

Setting the **MET/ENG** switch *on* establishes metric media sizes.

Setting the **MET/ENG** switch *off* establishes English media sizes.



3. If you need to set other switches, go on to those sections. Otherwise turn on the printer. The new switch settings are now in effect.

Using the Interconnection Instructions

Before turning to the specific instructions for your computer, you must establish a symbol set and select a media size. Follow those instructions earlier in this chapter before continuing.

The following instructions are designed to help you get your printer and computer connected and communicating as soon as possible. Be aware that the listed computer and printer equipment includes the *minimum* necessary to establish communication.

Note that using an interface cable other than the one listed may prevent communication. If you desire to make your own cable refer to the schematics in the appropriate technical information chapter for your interface.

Please verify that your computer and printer work individually before attempting to connect them.

If you'll be using graphics software, check your software documentation (or software supplier) for specific computer hardware and memory requirements. When you install your software, you may have to "configure" the software. After your computer and printer are communicating, refer to Chapter 3 for information on configuring your software.

Personal Computers (Compatibles using RS-232-C Interface)

These instructions tell you how to connect your HP PaintJet XL printer to the following compatible computers.

- Compaq DeskPro
- HP Vectra/ES/12 Personal Computers
- HP Vectra RS/20
- IBM PC/PC-XT/AT Computer
- IBM PS/2

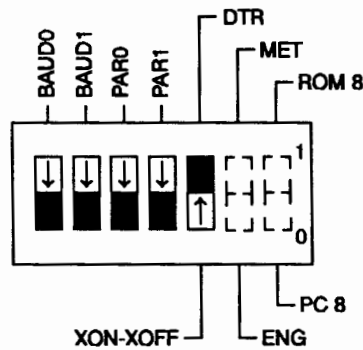
Computer	Cable
HP Vectra, ES/12, or RS/20 with HP 24540A or HP 24541A card using the 9-pin connector	HP 24542G
with the 24541A card using the 25-pin connector	HP 17255M or HP 13242G
IBM PC, PC-XT, or PS/2 using the 25-pin connector	HP 17255D
IBM AT or PS/2; COMPAQ 286 or 386 using the 9-pin connector	HP 24542G

Interconnection Instructions

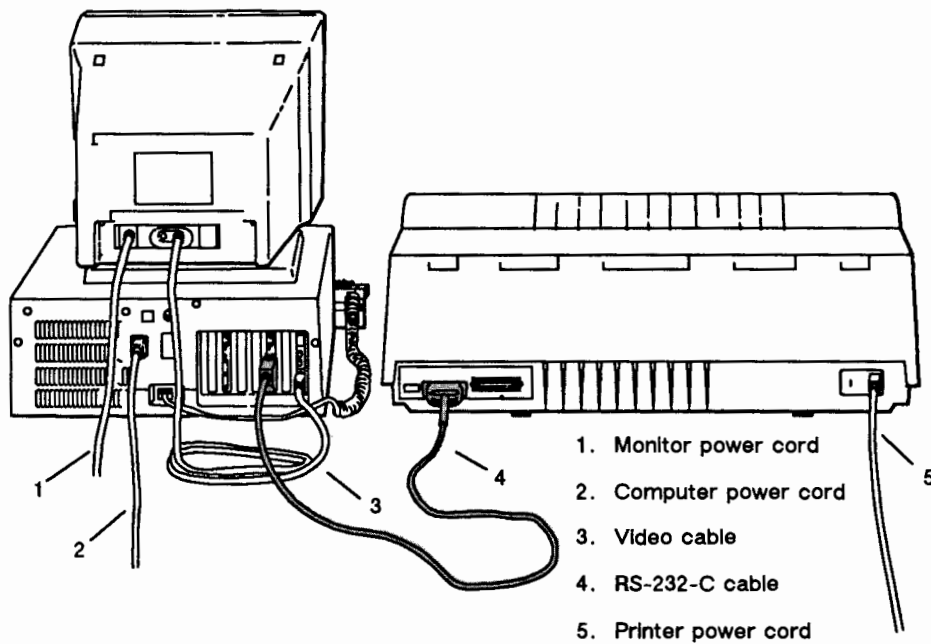
1. Turn off your printer and computer equipment.
2. If necessary, install the serial interface card. (Refer to your computer documentation for details.) If you have already installed a serial card, go to step 3.

NOTE: If you have more than one serial port installed, you will need to know whether you're connecting the printer to COM1 or COM2 (most software will not run on COM3). You will need this information for testing communications and for configuring your software. If you are using COM2, be sure to substitute COM2 for COM1 in the instructions. ■

- Set the printer's rear-panel switches to 9600 baud, parity checking off, and hardware handshake. Refer to the following illustration.



- Connect the printer to the computer. The following illustration shows an HP Vectra PC.



The printer has a 25-pin connector. If you have a 25-pin connector on the serial card on your computer, you can use either the HP 17255M or 13242G cable, attaching one end to the computer and the other to the printer. If you have a 9-pin connector on the serial card on your computer, you can use the HP 24542G cable, attaching the 9-pin connector to the computer and the 25-pin connector to the printer.

Verifying Communication

Load pens and media. Then follow the instructions below.

Setting the Mode Command

Place the Mode command(s) appropriate for your interface into your AUTOEXEC.BAT file. Consult your DOS documentation if you need assistance.

From the DOS prompt enter the following commands (substitute COM2 for COM1 if necessary):

MODE COM1:9600,N,8,1,P **ENTER**

MODE LPT1:=COM1 **ENTER**

The first command sets the serial port to 9600 baud, no parity, 8 data bits, 1 stop bit, and continuous retry on all timeouts. The second command directs the primary printer communication to the first serial port.

Testing Communications Without BASIC

At the DOS prompt, type these two lines:

COPY CON:PJXLTEST **ENTER** (The prompt will not show up.)
PaintJet XL Communication OK! **ENTER** (The prompt will not show up.)

then press **CTRL-Z** (simultaneously) **ENTER** (The prompt will not show up.)

The computer will display "1 File(s) copied".

Next, at the prompt type:

PRINT PJXLTEST **ENTER**

The computer will prompt: Name of list device [prn:]:

Press **ENTER** to accept PRN.

The PaintJet XL will print:

PaintJet XL Communication OK!

Testing Communications With BASIC

Enter and run the following BASIC program. (If you need help entering and running the program, refer to your computer documentation.)

```
10 LPRINT CHR$(27)+"E"           'resets the printer
20 LPRINT "COMMUNICATION OK"
30 LPRINT CHR$(13)               'carriage return
40 LPRINT CHR$(12)               'form feed
50 END
```

Your printer should print COMMUNICATION OK.

Personal Computers

(Compatibles using Centronics (parallel) Interface)

2

These instructions tell you how to connect your HP PaintJet XL printer to the following compatible computers.

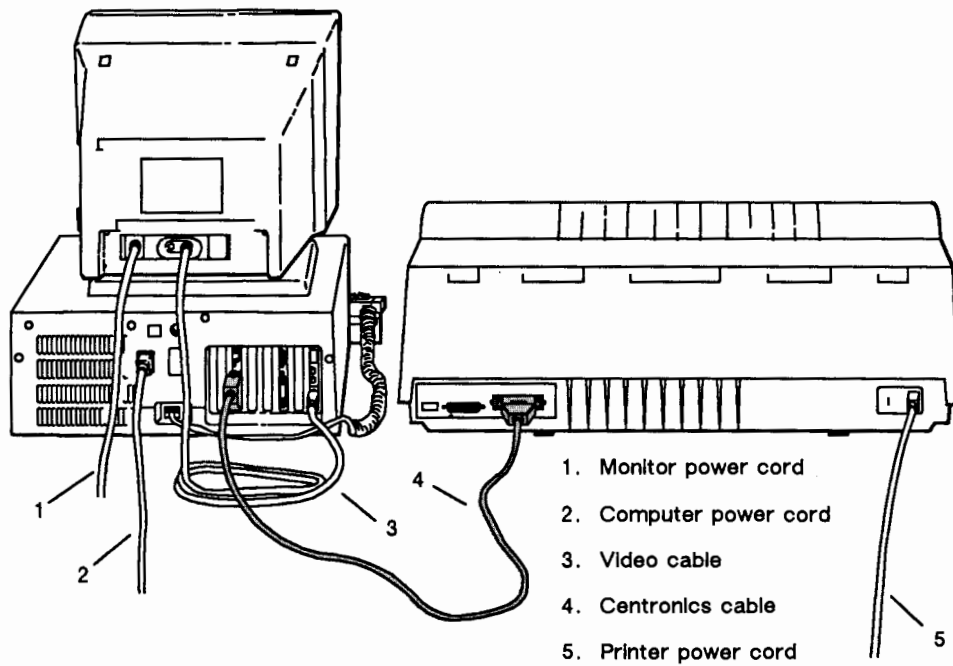
- Compaq DeskPro
- HP Vectra/ES/12 Personal Computers
- HP Vectra RS/20
- IBM PC/PC-XT/AT Computer
- IBM PS/2
- Olivetti M24

Computer	Cable
HP Vectra, ES/12, or RS/20 IBM PC, PC-XT, or PS/2 COMPAQ 286 or 386 Olivetti M24	HP 92219K

Interconnection Instructions

1. Turn off your printer and computer equipment.
2. If necessary, install the Centronics interface card. (Refer to your computer documentation for details.) If you have already installed a Centronics card, go to step 3.

3. Connect the printer to the computer. The following illustration shows an HP Vectra PC.



CAUTION

Many computer systems will have both Centronics and RS-232-C ports. These ports frequently appear identical. Make sure you plug your cable into the Centronics port (it should be labeled), or damage could occur to your printer.

Verifying Communication

Load pens and media. Then follow the instructions below.

Setting the Mode Command

Place the Mode command(s) appropriate for your interface into your AUTOEXEC.BAT file. Consult your DOS documentation if you need assistance.

From the DOS prompt enter the following command (substitute LPT2 for LPT1 if necessary):

```
MODE LPT1: , , P      ENTER
```

This command sets the parallel interface to continuous retry on all timeouts.

Testing Communications Without BASIC

At the DOS prompt, type these two lines:

```
COPY CON:PJXLTEST      ENTER (The prompt will not show up.)  
PaintJet XL Communication OK!  ENTER (The prompt will not show up.)
```

then press **CTRL-Z** (simultaneously) ENTER (The prompt will not show up.)

The computer will display "1 File(s) copied".

Next, at the prompt type:

```
PRINT PJXLTEST      ENTER
```

The computer will prompt: Name of list device [prn:]:

Press **ENTER** to accept PRN.

The PaintJet XL will print:

```
PaintJet XL Communication OK!
```

Testing Communications With BASIC

Enter and run the following BASIC program. (If you need help entering and running the program, refer to your computer documentation.)

```
10 LPRINT CHR$(27)+"E"           'resets the printer
20 LPRINT "COMMUNICATION OK"
30 LPRINT CHR$(13)               'carriage return
40 LPRINT CHR$(12)               'form feed
50 END
```

Your printer should print COMMUNICATION OK.

Apple Macintosh Computer (RS-232-C Interface)

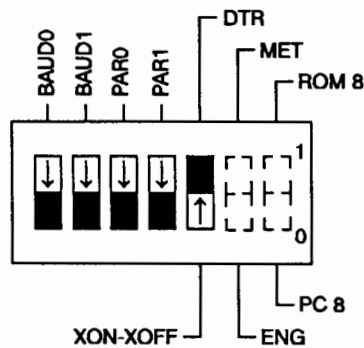
2

Computer	Cable
Apple Macintosh	HP 92219M

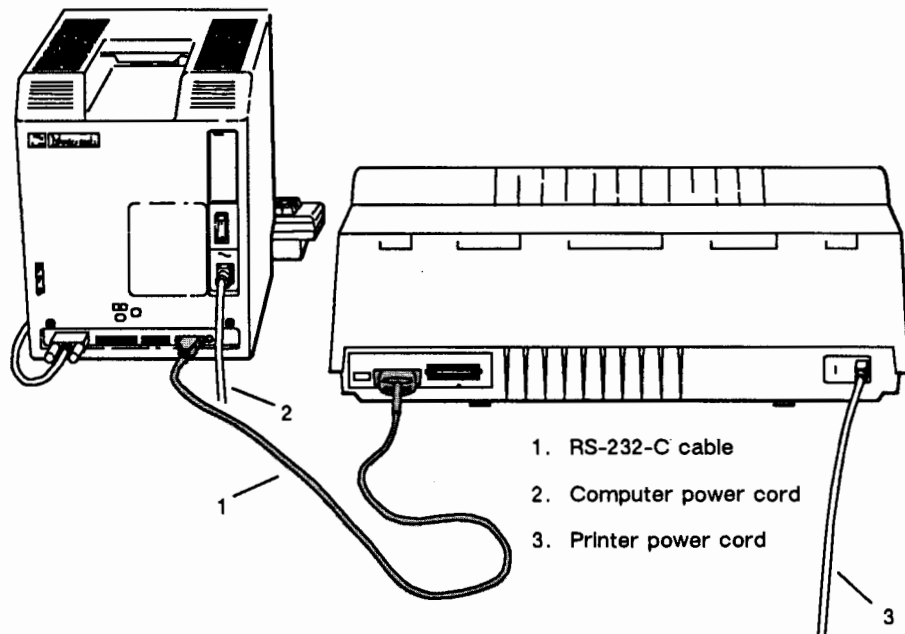
NOTE: Unless you are using BASIC, a PaintJet Series driver is required to run the Macintosh with the PaintJet XL. Check with your computer dealer for the PaintJet drivers that are available.■

Interconnection Instructions

1. Turn off your printer and computer equipment.
2. Set the printer's rear-panel switches to 9600 baud, parity checking off, and Xon-Xoff handshake. Refer to the following illustration.



3. Connect the printer to the computer using the RS-232-C cable. The small end of the cable connects to the computer's printer port. Refer to the following illustration.



4. Configure your computer system as follows. (Refer to your computer documentation if you have difficulty with this step.)
 - a. Insert the System Disk (or System Tools disk if purchased after 1 January 1986) in the disk drive and turn on the computer.
 - b. Select the "apple" icon from the menu bar, then select **CHOOSE PRINTER** from the "apple" icon menu.
 - c. Under **PORT**, choose the Printer icon, then select **OK** to exit the system disk menu.
 - d. Select **FILE** from the menu bar, then select **EJECT** from the file menu.

Verifying Communication

Load pens and media. Then enter and run the following BASIC program. (If you need help entering and running the program, refer to your computer documentation.)

1. Insert BASIC 2.0 or higher into the disk drive.
2. Select **FILE** from the menu bar, then select **OPEN** from the file menu. If prompted to do so, correct the date and time and press **ENTER**.
3. Choose the Microsoft® BASIC icon in the window.
4. Select **FILE** from the menu bar, and **OPEN** from the file menu. You should have a window, headed by LIST on your screen.
5. Enter the following BASIC program.

```
10 LPRINT CHR$(27)+"E"           'resets the printer
20 LPRINT "COMMUNICATION OK"
30 LPRINT CHR$(13)               'carriage return
40 LPRINT CHR$(12)               'form feed
50 END
```

6. Select **RUN** from the menu bar, and select **START** from the run menu. The printer should print COMMUNICATION OK.

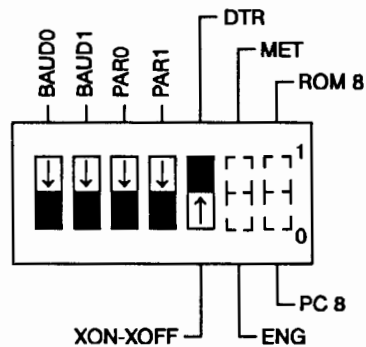
Apple Macintosh Plus/SE/II Computers (RS-232-C Interface)

Computer	Cable
Apple Macintosh Plus/SE/II Microsoft BASIC 2.0 or higher	HP 17302A

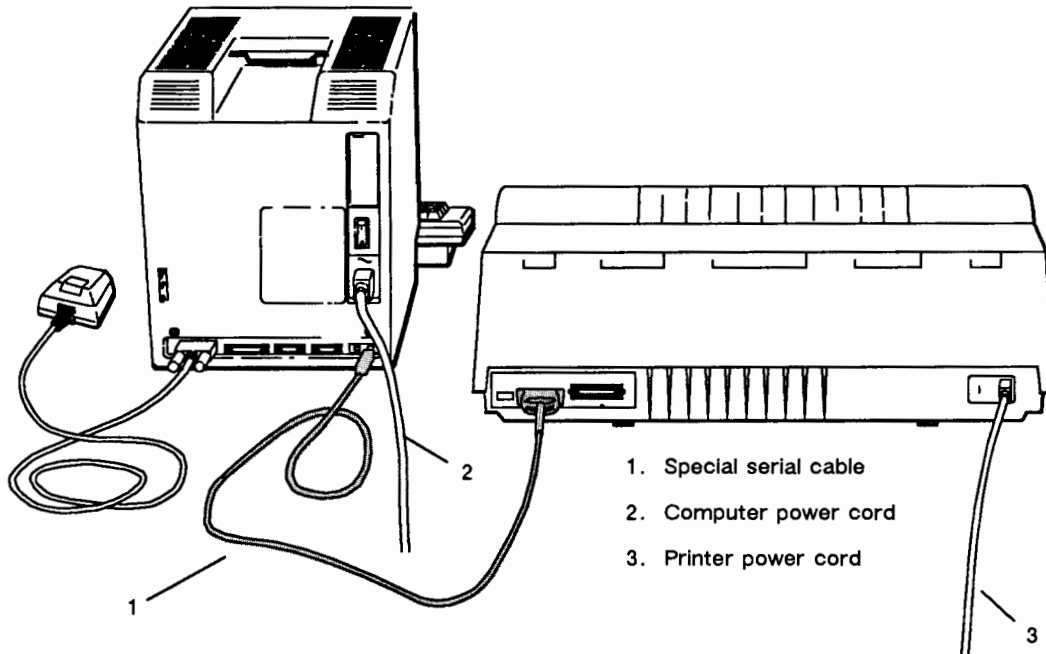
NOTE: Unless you are using BASIC, a PaintJet Series driver is required to run the Macintosh Plus, SE, or II computers with the PaintJet XL. Hewlett-Packard sells the *HP PaintJet Printer Interface Kit for Macintosh[™] Computers*. This kit contains the HP 17302A interface cable, disks containing the printer driver plus PaintJet fonts, and the user's guide for the interface kit. ■

Interconnection Instructions

1. Turn off your printer and computer equipment.
2. Set the printer's rear-panel switches to 9600 baud, parity checking off, and Xon-Xoff handshake. Refer to the following illustration.



- 3. Connect the printer to the computer using the RS-232-C cable. The round end of the cable attaches to the computer's printer port and the other end to the printer. Refer to the following illustration. (This illustration is of a Macintosh Plus; the Macintosh II and SE are similar.)



- 4. Configure your computer system as follows. (Refer to your computer documentation if you have difficulty with this step.)
 - a. Insert the System Disk (or System Tools disk if purchased after 1 January 1986) in the disk drive and turn on the computer.
 - b. Select the “apple” icon from the menu bar, then select **CHOOSE PRINTER** from the “apple” icon menu.
 - c. Under **PORT**, choose the Printer icon, then select **OK** to exit the system disk menu.
 - d. Select **FILE** from the menu bar, then select **EJECT** from the file menu.

Verifying Communication

Load pens and media. Then enter and run the following BASIC program. (If you need help entering and running the program, refer to your computer documentation.).

1. Insert BASIC 2.0 or higher into the disk drive.
2. Select **FILE** from the menu bar, then select **OPEN** from the file menu. If prompted to do so, correct the date and time and press **ENTER**.
3. Choose the Microsoft® BASIC icon in the window.
4. Select **FILE** from the menu bar, and **OPEN** from the file menu. You should have a window, headed by LIST on your screen.
5. Enter the following BASIC program.

```
10 LPRINT CHR$(27)+"E"           'resets the printer
20 LPRINT "COMMUNICATION OK"
30 LPRINT CHR$(13)               'carriage return
40 LPRINT CHR$(12)               'form feed
50 END
```

6. Select **RUN** from the menu bar, and select **START** from the run menu. The printer should print COMMUNICATION OK.

Commodore Amiga (Centronics (parallel) Interface)

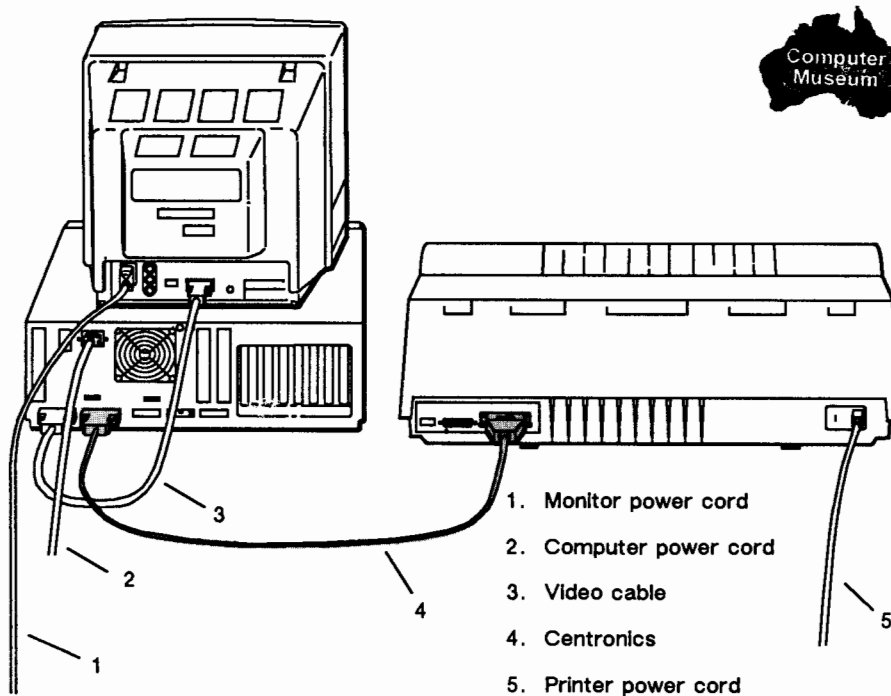
2

Computer	Cable
Amiga 500 and 2000 Amiga 1000	HP 92219K A1000/Parallel*

* See your Amiga deal to obtain this cable.

Interconnection Instructions

1. Turn off your printer and computer equipment.
2. If necessary, install the Centronics interface card. (Refer to your computer documentation for details.) If you have already installed a Centronics card, go to step 3.
3. Connect the printer to the computer. The following illustration shows an Amiga 2000.



4. Install the HP PaintJet driver by double-clicking on the *Install Printer* utility in the Workbench 1.3 Utilities drawer. (The HP PaintJet driver is included on the Workbench 1.3 Extras disk.) Refer to Commodore's Workbench 1.3 documentation for detailed instructions.
5. Double-click on the *Printer* icon in the Workbench Preferences drawer. From the Printer main menu, select the **HP-PaintJet** printer and the **Parallel** interface.
6. From the *Graphic 1* menu, be certain that **Color** is selected.
7. Save your Printer settings and return to the Workbench.

Verifying Communication

From Workbench, open the System drawer, then double click on the *Graphic Dump* icon.

The computer will wait for 10 seconds, and then send a screen dump to the printer.

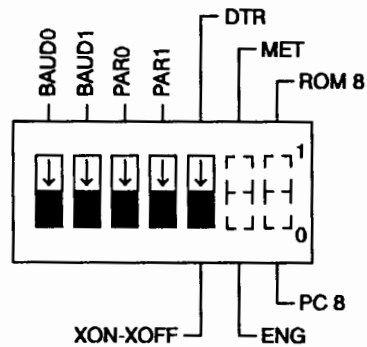
Commodore Amiga (RS-232-C Interface)

2

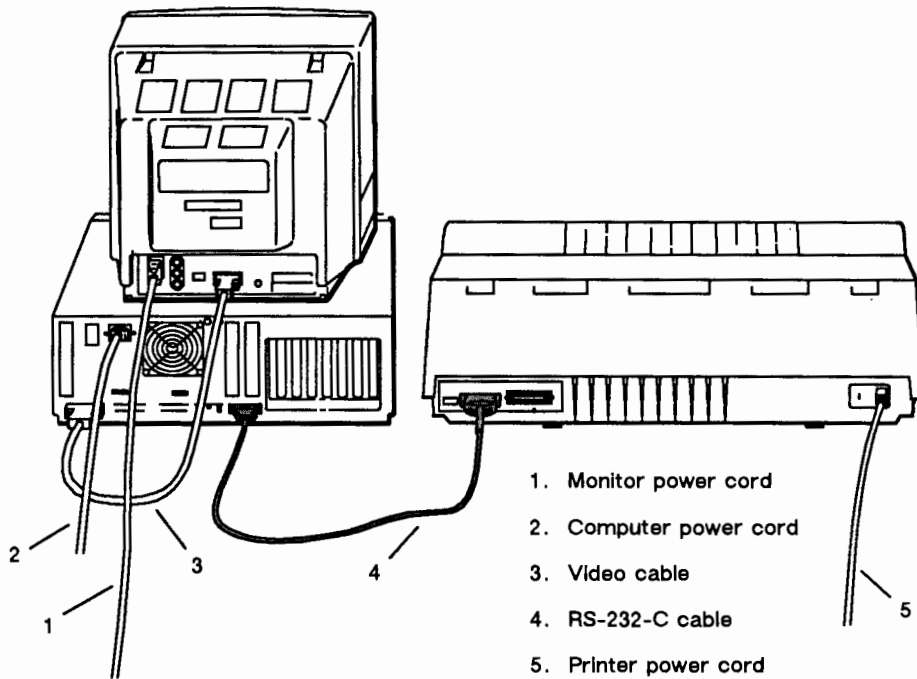
Computer	Cable
Amiga 500 and 2000 Amiga 1000	HP 17255D HP 17255M (or 13242G)

Interconnection Instructions

1. Turn off your printer and computer equipment.
2. If necessary, install the serial interface card. (Refer to your computer documentation for details.) If you have already installed a serial card, go to step 3.
3. Set the printer's rear-panel switches to 9600 baud, parity checking off, and Xon-Xoff handshake. Refer to the following illustration.



4. Connect the printer to the computer. The following illustration shows an Amiga 2000.



5. Install the HP PaintJet driver by double-clicking on the *Install Printer* utility in the Workbench 1.3 Utilities drawer. (The HP PaintJet driver is included on the Workbench 1.3 Extras disk.) Refer to Commodore's Workbench 1.3 documentation for detailed instructions.
6. Double-click on the *Printer* icon in the Workbench Preferences drawer. From the Printer main menu, select the **HP-PaintJet** printer and the **Serial** interface.
7. From the *Graphic 1* menu, be certain that **Color** is selected.
8. Save your Printer settings and return to the Preferences drawer.
9. Set the Amiga's serial port settings as follows:
 - a. Double click on the *Serial* icon in the Preferences drawer.

b. Select the following settings.

Baud Rate:	9600	Buffer Size:	512 (may be adjusted as needed)
Read Bits:	8	Write Bits:	8
Stop Bits:	1	Parity:	None
Handshaking:	xOn/xOff		

2

c. Save your settings and return to the Workbench.

Verifying Communication

From Workbench, open the System drawer, then double click on the *Graphic Dump* icon.

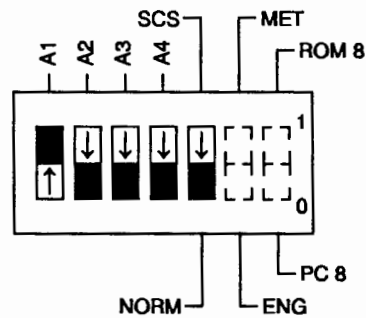
The computer will wait for 10 seconds, and then send a screen dump to the printer.

HP 9000 Series 200 Technical Computer (HP-IB Interface)

Computer	Cable
HP Model 216, 226, or 236 computer	HP 10833A, B, C, or D

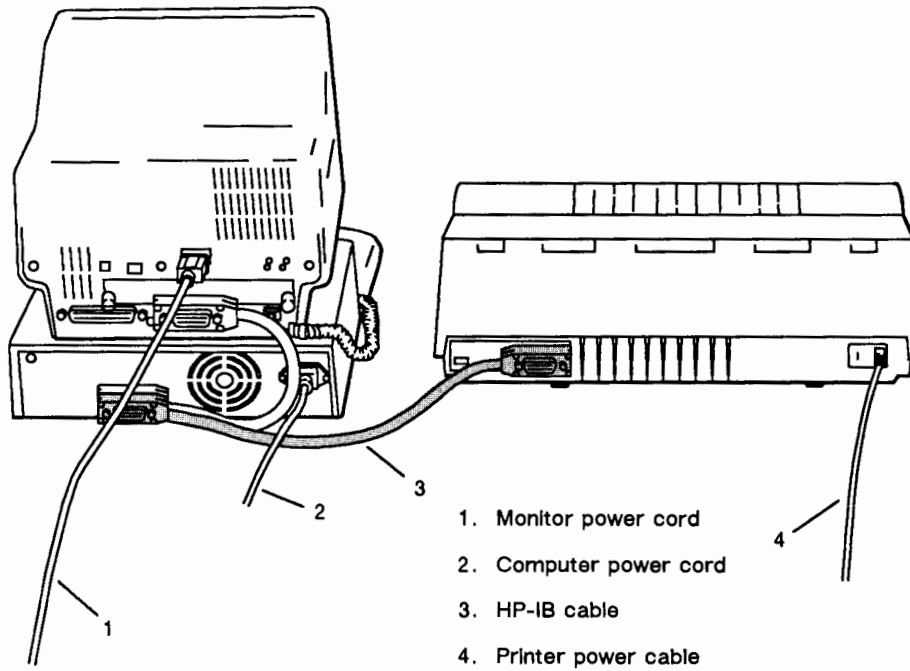
Interconnection Instructions

1. Turn off your printer and computer equipment.
2. Set the printer's rear-panel HP-IB switches to address 01, as shown in the following illustration.



3. Connect the printer to the computer using the HP-IB cable. Either end of the cable can be connected to the printer or computer. The following illustration shows an HP Model 216 connected to the printer.

2



Verifying Communication

Load pens and media. Enter and run the following BASIC program. (If you need help entering and running the program, refer to your computer documentation.)

```
10 PRINTER IS 701           !sends output to address 1
20 PRINT CHR$(27)&"E"       !resets the printer
30 PRINT "COMMUNICATION OK"
40 PRINT CHR$(13)           !carriage return
50 PRINT CHR$(12)           !form feed
60 END
```

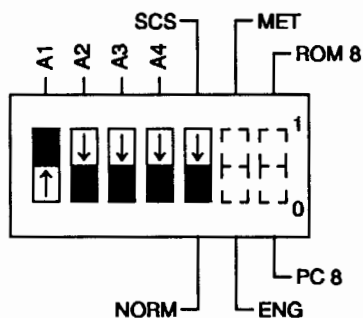
Your printer should print COMMUNICATION OK.

HP 9000 Series 300 Technical Computer (HP-IB Interface)

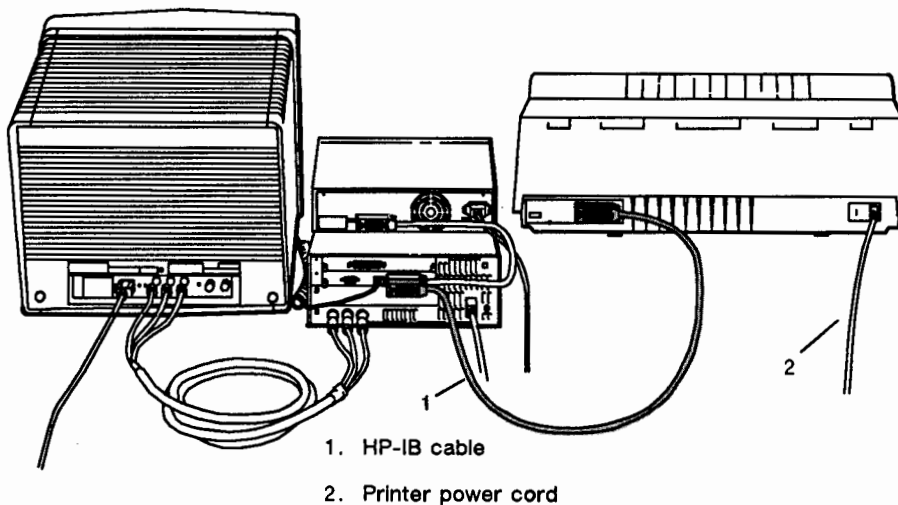
Computer	Cable
HP Model 310 or 320 computer	HP 10833A, B, C, or D

Interconnection Instructions

1. Turn off your printer and computer equipment.
2. Set the printer's rear-panel HP-IB switches to address 01. Refer to the following illustration.



3. Connect the printer to the computer using the HP-IB cable. Either end of the cable can be connected to the printer or computer. The following illustration shows an HP Model 320 connected to the printer.



Verifying Communication

Load pens and media. Enter and run the following BASIC program. (If you need help entering and running the program, refer to your computer documentation.)

```
10 PRINTER IS 701           !sends output to address 1
20 PRINT CHR$(27) & "E"     !resets the printer
30 PRINT "COMMUNICATION OK"
40 PRINT CHR$(13)          !carriage return
50 PRINT CHR$(12)          !form feed
60 END
```

Your printer should print COMMUNICATION OK.

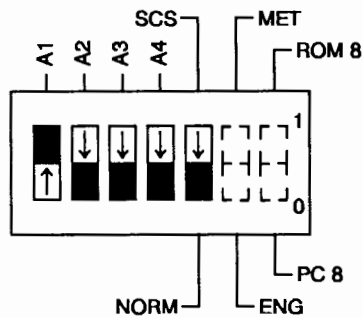
HP 9000 Series 800 Technical Computer (HP-IB Interface)

2

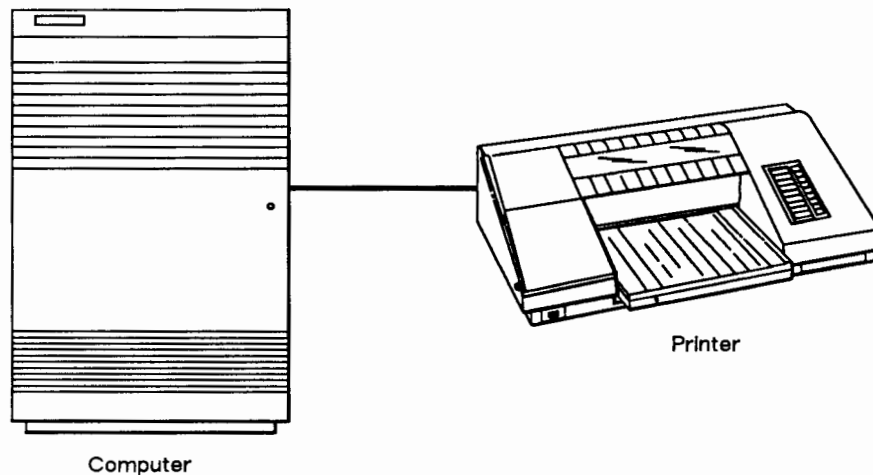
Computer	Cable
HP 9000 Series 800 computer	HP 10833A, B, C, or D

Interconnection Instructions

1. Turn off your printer and computer equipment.
2. Set the printer's rear-panel HP-IB switches to address 01. Refer to the following illustration.



3. Connect the printer to the computer using the HP-IB cable. Either end of the cable can be connected to the printer or computer.



Verifying Communication

Load pens and media. Enter and run the following BASIC program. (If you need help entering and running the program, refer to your computer documentation.)

```
10 PRINTER IS 701           !sends output to address 1
20 PRINT CHR$(27) & "E"     !resets the printer
30 PRINT "COMMUNICATION OK"
40 PRINT CHR$(13)          !carriage return
50 PRINT CHR$(12)          !form feed
60 END
```

Your printer should print COMMUNICATION OK.

Using Software with Your Printer

This chapter provides important information on using graphics software packages or programs to create color graphics on your printer. Be sure to read it before attempting to use your graphics software package. This appendix discusses the following topics.

- Before using your software.
- Using graphics software packages.
- Understanding printer drivers.
- Printing files.
- Setting margins with software.
- Matching screen colors to print colors.
- Importing color graphics.
- Printing on transparency film.
- Writing your own graphics programs.

Before You Begin

Before using a software package, check the following.

- Is your printer in good working condition? If the self-test works, it is a good indication that the printer is working correctly.
- Is your computer system working correctly?
- Are your printer and computer communicating effectively? If the test program (described in Chapters 1 and 2) runs, communication is established.
- Does your software package support your printer and computer? (Your software documentation should tell you this.)

When you are sure the components of your computer system are working properly, and that communication has been established between the computer and printer, you are ready to use your software package.

Using Graphics Software Packages

Your software documentation is your best source of information about how your software works and the features it supports. Sections of this chapter give you key words to look for in your application's manual for more information.

Many software packages require you to configure the software so that it knows what type of printer you are using, how the printer interface switches are set, and where the printer is attached to your computer. This configuration is usually done by typing or selecting answers on your computer in response to questions asked by the software. If your software asks you configuration questions, answer them carefully to avoid computer/printer communication problems. Read your software documentation when installing and configuring the software to avoid potential problems.

If your software documentation recommends specific printer settings, use them—even if they differ from the settings recommended for your computer in Chapter 2. If your software lists possible choices *without* making a recommendation, use the settings recommended in Chapters 1 and 2.

Using the Optional Cartridges

Using the font cartridge provides you with access to twenty fonts and character sets. You may need to select the printer driver that specifically supports the font cartridge. Your software documentation should tell you if this is possible.

If you have purchased the HP-GL/2 Language cartridge, you have access to the same fonts as with the font cartridge, plus you can use driver's written to use HP-GL/2 (Hewlett-Packard Graphics Language). In this case you would select a driver designed for a plotter.

For RS-232-C (Serial) Interface Users . . .

If your software or software documentation recommends specific printer settings, use the printer's rear-panel RS-232-C interface switches to select and store the recommended settings, as explained in Chapter 1. Your software package may ask for the following information.

- Baud rate
- Parity
- Handshake

If your software doesn't require any configuring, or if no printer settings are suggested in your software documentation, try setting the interface switches as advised in Chapter 1. *Be certain your software configuration matches the printer's settings.*

For HP-IB (Parallel) Interface Users . . .

If you are using the HP-IB interface, the printer's address setting must match the HP-IB address used by the graphics software package. If your software requires configuring, select an HP-IB address of 01 and be certain your printer's address is set to 01. If you need to use an address other than 01, use the HP-IB interface switches as explained in Chapter 1.

Understanding Printer Drivers

The printer driver is a program that works with the software package to transfer information from the computer to the HP PaintJet XL printer. Just as the cable is the link from the computer to the printer, the printer driver is the link from the software package to the printer.

How Do Printer Drivers Work?

Printer drivers control the printer by carrying information from your software package to the printer. The printer driver carries two types of information: the words, numbers, or graphics you wish to print and the instructions on how to print them (i.e., format instructions including paragraph breaks, margins, and enhancements, such as bold or underline).

Printer drivers have two limitations: they carry only the information they are given by the software package and only the information they were designed to carry. Because of these limitations, you may be unable to use a feature of your software package or printer if the driver doesn't support it on your printer. The features you will be able to use are the ones that have all three components (software, printer driver, and printer).

How Do I Get a Printer Driver?

The printer driver may come as part of your software package or may have to be obtained separately. In general, if an HP PaintJet XL or HP PaintJet Series driver is included, you will see the HP PaintJet XL or HP PaintJet Series listed in your software's 'select printer' screen. (When you 'select a printer', you are actually selecting a printer driver.)

If an HP PaintJet XL driver is not included in the installation directions for your application, check your application disk(s). Often software applications have a 'readme' file on the disk that contains information on using your printer with the software. List the directory of the disk and look for a file called 'readme' or a file name ending in '.DOC' or '.TXT'. To print the file, type the following at the DOS prompt.

```
a:filename.extension > LPT1
```

If you still don't locate an HP PaintJet XL driver or a PaintJet Series driver, contact your software vendor to see if one is available separately. Typically there is no extra cost.

In the meantime, you should be able to use an HP PaintJet driver with your PaintJet XL. Be aware that there are some differences between PaintJet and PaintJet XL. You may be unable to access all of PaintJet XL's features using a PaintJet driver (e.g., using B-size media). Additionally, you may have some difficulty with margins. Refer to *Setting Margins with Software* later in this chapter for more information on dealing with these difference.

If your software application has no PaintJet driver at all, you may still be able to use it with your PaintJet XL while waiting for your PaintJet XL driver to arrive. Printer drivers written for the HP LaserJet or HP DeskJet should give some ability to print although obviously you won't be able to use the color capabilities of the printer.

Alternatively, some software applications allow you to create a custom printer driver by entering the codes that turn on and off certain features on your printer; for example, bold, underline, line feed, etc. Depending on the software, you might need to enter these codes using escape sequences, decimal, or hexadecimal forms. All of these codes, in all three forms, are in the *Reference Table of Print Features* in Appendix A.

Printing a File

Most software packages have a 'print' or 'output' command. Check your software manual for printing information. To print from most software packages, you will use steps similar to the following.

Select the HP PaintJet XL printer driver. Refer to the install and/or setup instructions in your software manual.

Select the file or portion of a file you wish to print.

Use the 'print' command to send the file to the printer.

With many packages you can install a printer driver for more than one printer. If you are not getting the results you desire, check that the HP PaintJet XL is the printer being used to print your file. Usually there is a setup or 'options' screen that lists the currently selected printer.

Setting Margins with Software

The PaintJet XL has a text length of 60 lines. This gives you a half inch unprintable region at both the top and bottom of the page. If you are not using a PaintJet XL printer driver, you may need to adjust margins, page length, and/or header and footer positioning in order to get proper placement on the page. If your print outs are not positioned correctly try these steps

In your software, specify the page length as 10 inches.

You may need to set your footer to be printed above the bottom of the page than seems reasonable. This is because your software thinks the page is shorter than the actual page.

Obtaining the margins that you desire may require some experimenting with the top and bottom margin settings in your application.

Using Color

Your HP PaintJet XL printer can print 330 different colors. The number of colors you can use is determined by your software. Software packages generally support color on one of three levels, as follows.

- Software supports a limited number of colors, such as the basic eight (red, green, blue, cyan, yellow, magenta, black, and white).
- Software supports a limited number of colors, PLUS shades of those colors (shades are created by adding white to a color).
- Software supports all 330 of PaintJet XL's colors.

Matching Screen Colors to Print Colors

Color occurs in two places, on the screen and in the printer's output. In some software packages, the colors displayed on the screen may not match the colors that are printed.

Some applications allow you to adjust the colors displayed on the screen to match the printed colors. Look under 'color' or 'palette' in your software's documentation. Some packages have a menu for changing screen colors; some packages have a small program you can run that tells your computer's graphics adapter which colors to display. (also look under 'vga' or 'ega'.)

NOTE: It's a good idea to record your software package's default screen colors.■

Many packages allow you to define and save several different sets of colors, called 'palettes' or 'color sheets', for use with different files.

Importing Color Graphics

Some applications do not save color information. Thus a color graphic saved in one application may lose its color when copied into another application.

When importing color graphics from one application to another (for example, to merge text and graphics), you may have to experiment to see if the imported image retains its color. Try the following techniques.

- Use raster ('bit-map' or 'paint-type') graphics when creating color graphics for merging.
- Experiment with the graphics file format when saving images that you plan to merge. Many applications can save graphics in a variety of formats, some of which are more likely to retain HP-GL files rather than TIFF files to merge color graphics with other Windows® applications.
- In the Windows environment, use the 'clipboard' command to copy graphics from one application to another. The largest amount of information you can transfer with the clipboard is 64KB, so you may have to copy only a part of a drawing at a time.

Look for information on this subject in the index of your software's documentation under 'color', 'graphics files', and 'importing'.

Printing on Transparency Film

Use transparency mode when printing on transparency film. In transparency mode, the printer makes multiple printing passes to produce the intensity of ink needed for vibrant transparencies.

If transparency mode is available in your software package, select transparency mode through your application. Look under ‘transparency’ in your software’s documentation. Since many software settings override printer settings, it is important to set transparency mode from your software if possible.

If transparency mode is not available in your software, use the printer’s **Transparency Mode** button to turn on transparency mode. The **Transparency Mode** light is lit when the printer is in transparency mode.

When finished, turn transparency mode off the same way you turned it on. Again, since many software packages will override the printer’s setting, be sure that if you activated transparency mode with your software, you use your application to turn it off.

Writing Your Own Graphics Programs

If you want to write your own graphics programs using the PCL programming language, you can purchase an extensive programming document, the *HP PaintJet XL Programmer’s Reference*, from Hewlett-Packard. Refer to Appendix C of the user’s guide for ordering information.

If you have purchased the HP-GL/2 Language Interpreter cartridge and you want to write your own graphics programs using the HP-GL/2 programming language, you can purchase an extensive programming document, the *HP-GL/2 Reference Guide* plus the *Comparison Guide* from Hewlett-Packard. Refer to Appendix C of the user’s guide for ordering information.

Although most graphics software packages allow you to specify the labels you need for your graphs, there may be occasions when you would like to add additional labels or graphics, for example, a company logo. Both the *PaintJet XL Programmer’s Reference* and the *HP-GL/2 Reference* explain how you can write your own graphics programs that will add labels or graphics to software-generated graphs.

Using Your Printer with Peripheral Sharing Devices, Buffers, and Spoolers

This chapter is an educational section about peripheral sharing devices, buffers, and spoolers. It presents an overview of the functions of buffers, spoolers, and peripheral sharing devices and tells you how to determine if one will be an advantage to your system. Finally, it lists considerations to be aware of when making a purchasing decision. A matrix of Hewlett-Packard tested devices and some of their characteristics is included. For details about specific products, consult your computer dealer.

Because your computer can send data to the printer faster than the printer can print it, your computer is frequently unavailable for use while the printer is printing. Buffers and spoolers (and some peripheral sharing devices) allow your computer to send large amounts of data to the buffer to await printing, thus freeing your computer for other tasks.

The time savings you will realize depends on the type of computer or workstation you are using, the complexity of your drawing, and whether your computer's operating system supports multitasking. For example, using certain buffering/spooling devices with a 32-bit (80386 based) personal computer without multitasking (e.g., HP Vectra RS Personal Computer or IBM PS/2 Model 70), can reduce, by 50 to 70 percent, the time your computer is "tied-up" by the printer.



What Are Peripheral Sharing Devices, Buffers, and Spoolers?

The terms peripheral sharing device, buffer and spooler are beginning to be used interchangeably in the industry. The following are traditional definitions.

A *peripheral sharing device* allows two or more computers to use the same peripheral (e.g., printer). The simplest form would be an A/B switch, which allows two computers (A and B) to send output to the same peripheral. The A/B switch must be manually changed for the peripheral to receive data from the other computer.

Today, the technologies of peripheral sharing devices, buffers, and spoolers are beginning to converge. Many peripheral sharing devices have buffering or spooling capability, and many buffers and spoolers allow peripheral sharing.

The *buffer* in any computing device is an area where data is held until it can be processed. A buffer temporarily stores information that is being transmitted between a computer and a peripheral device such as a printer.

A buffer, then, expands the memory of your printer. The buffer will accept data from a computer as fast as the computer can send it. The buffer then sends that data to the printer as fast as the printer can accept it.

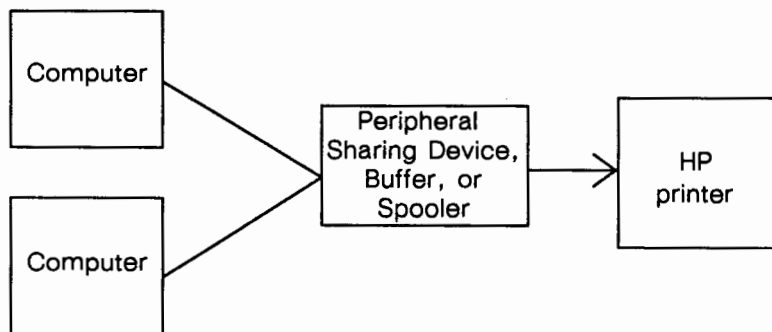
A *spooler* is a data storage and transmission device just as is a buffer. In addition, spoolers usually accept data from more than one computer at a time and send each job to the printer as the printer becomes available. Some spoolers also support multiple output devices and (once configured) automatically know that data from computer A goes to printer C. Additionally, some spoolers allow you to set priorities so that large jobs are held until after all smaller ones have been printed.

Two additional capabilities that buffers and spoolers may provide are reprinting (making multiple copies without resending the data from your computer each time) and peripheral sharing (allowing several computers to share a printer without having to switch the printer from computer to computer for printing).

Why Use Peripheral Sharing Devices, Buffers, and Spoolers?

A buffering/spooling/sharing device can help optimize the efficiency of your computer system in four different ways:

- 1. Frees the computer.** Freeing your computer for other tasks is the primary purpose of a buffering/spooling/sharing device. Computers can usually send data faster than printers can print it. But with a buffering/spooling/sharing device, you won't have to sit and wait impatiently for the printout to finish before you can use your PC again. Once you have sent data to the buffering/spooling/sharing device, it will send the data on to the printer, so you can work on other tasks.
- 2. Provides reprint capability.** A buffering/spooling/sharing device with this capability can generate multiple copies of a print without tying up a PC—a wonderful timesaving feature. The number of copies you can select will vary by manufacturer.
- 3. Provides peripheral sharing.** Some devices enable you to connect two or more PCs to one or more printers. Many of these devices manage the incoming data from different computers without intervention on your part. They automatically store the data and send it to the printer as it becomes available.



- 4. Provides I/O compatibility.** Some external buffering/spooling/sharing devices have several interfaces (e.g., RS-232-C, Centronics, and/or HP-IB). For example, the device could receive data from an RS-232-C interface, and then send it to the printer over an HP-IB, Centronics, or RS-232-C interface.

What Form Do They Take?

As the technologies come together, we find buffers that spool, spoolers with buffers, and peripheral sharing devices that do both. In addition you will find features called buffers in some printers that do none of the things we've talked about in this note. What's important is that you find the product that meets your needs. Here are some definitions to help you identify the variety of products that are available and what each offers.

- **Internal** — Built into the printer's firmware. These types of buffers can often be adjusted using the printer's programming language. They are also called configurable graphics memory. Refer to your printer's programming manual for information on configuring these internal buffers.
- **Internal** — Optional RAM chips, hard disks, or other memory devices that are internal to the printer, but usually cannot be configured by the user.
- **Cartridge** — Optional cartridges that can be "plugged into" the printer. These buffers usually cannot be configured, but may contain additional features such as spooling or reprint capability.
- **External Hardware Device** — Buffers are sometimes referred to as buffer boxes because they tend to be "little black boxes" that the data goes into. The external buffer is connected between the computer and printer. A spooler can also be an external hardware device.
- **Computer Software Utility** — Spoolers can be a software utility resident on a computer's hard disk that either uses the hard disk or RAM for memory space.

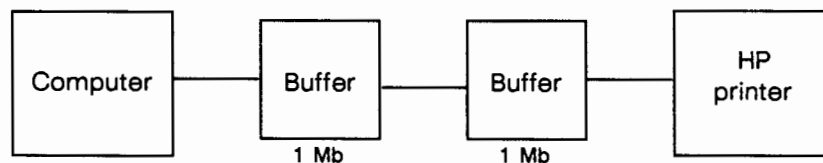
What Additional Features Are Available?

The four basic advantages of sharing/buffering/spooling devices are freeing the computer, reprint capability, peripheral sharing, and I/O compatibility. In addition, these devices have other helpful features. Look over the list below to get a general idea of what other features are available. The many buffering devices on the market vary greatly in the number of features they provide.

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- **Spooling and/or print stacking.** Devices that perform these functions are typically called “spoolers.” A spooler will take separate files/prints and print them out in a certain priority (usually the order received). Spooling is discussed in more detail in a following section.
- **Memory upgrades.** Buffers can range in memory from 64KB to 2MB and more. Some buffers have a memory upgrade option that lets you increase the memory size according to your needs. Most business applications require about 256KB of memory. Most CAD applications require at least one megabyte of memory. The PaintJet XL, for example, needs 1 MB to spool an A-size graphics page and 2 MB for a B-size graphics page.

On some products you can also increase memory by connecting or “daisy-chaining” two or more buffering devices together. This feature is particularly useful for CAD applications that require a lot of memory.

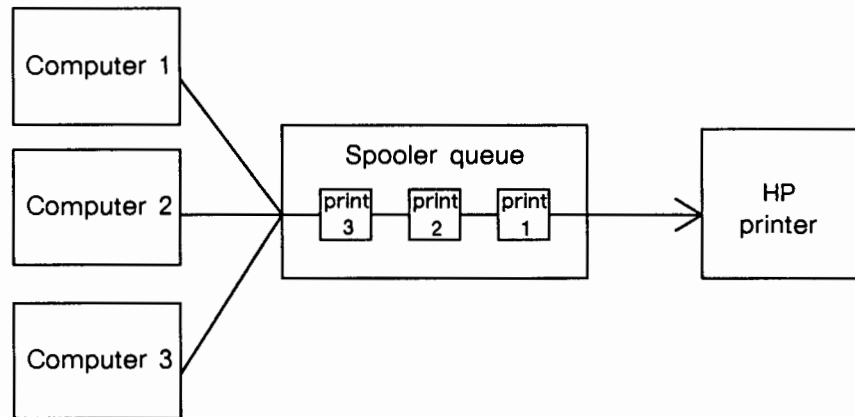


- **Multiple interfaces.** Buffering/spooling/sharing devices can have a serial (RS-232-C), parallel (Centronics), or HP-IB (IEEE-488) interface, or a combination of these. Multiple interfaces are very handy when your equipment has different interfaces. For example, you could output from the computer’s serial port to the buffer and then the buffer would output over an HP-IB interface to the printer.
- **Multiple handshaking protocols.** Although some devices offer only Xon-Xoff or hardware handshake, many devices offer both.
- **File Appendage.** With some devices you can insert a character string at the beginning or end of a print file. For example, with some peripherals, you could insert the HP-GL/2 *PG;* instruction so that a rollfeed printer would advance the paper, or an automatic sheetfeed device (like the PaintJet XL printer) would automatically load the next sheet.

Spoolers

When your sole objective is to free up your PC, then a printer buffering device is probably all you need. But if you want to send print files from several computers and arrange them in a specific order (queue) to be processed, you will need a spooler. A spooler can be either an independent hardware device or a software utility resident on a computer's hard disk or in random access memory (RAM).

A hardware spooler can take separate print files from different PCs, put them in a queue, and then direct the printer to print them in a given order (usually the order received).



Software Spoolers

A software spooling utility program sends a file from the computer's hard disk to the printer. The utility uses the hard disk as the buffer instead of needing a separate hardware device. Thus, the size of the buffer is dependent on the available hard disk space.

NOTE: To use a software spooler, your application software must be able to print to a file and must be using one-way communication (explained later in this chapter).■

Software spoolers are memory (RAM) resident. They are activated with "hot" keys (usually ALT + another key) and can be invoked anytime. They allow the printer to print "in the background" while you continue working on your primary task. With a software spooler you can arrange print files in a specific order (queue), cancel files, or print multiple copies.

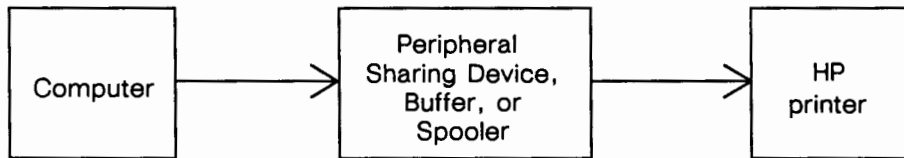
One-Way or Two-Way Communication?

If you are considering adding a buffering/spooling/sharing device to your system, you must know whether your application software functions with one-way or two-way communication. *Some buffering/spooling/sharing devices will not work with software that requires two-way communication.* Many devices offer both one-way and two-way communication; some devices are limited to one-way communication.

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One-Way Communication

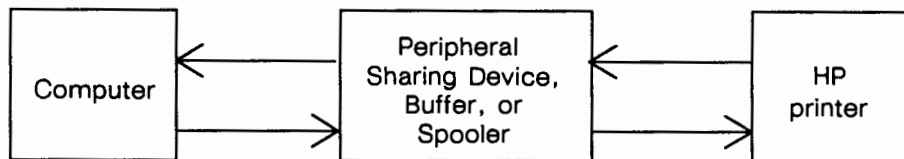
One-way (half-duplex) communication means just that: data goes one way only—from the computer to the buffer to the printer. A device that performs one-way communication will only work well when the printer software also uses one-way communication.



NOTE: All software packages for the Apple® Macintosh® computers use one-way communication. ■

Two-Way Communication

Similarly, software that performs two-way communication requires a buffering/spooling/sharing device that can perform two-way, or full-duplex, communication. A device that performs two-way communication not only sends data to the printer, it can also *receive* data from the printer and *send it back to the PC*. In this case, a printer can respond to inquiries from the computer. For example, the software may ask the printer to identify itself so the software “knows” the printer’s orientation, scaling point coordinates, etc. If the external buffer does not use two-way communication, it cannot respond to a computer inquiry, thus creating an error situation (possibly “hanging” the system).



Be aware. If a software package uses two-way communication extensively, it may defeat the main purpose of a buffering/spooling/sharing device: freeing the computer for other tasks. An inquiry from a PC results in an instruction being queued in the buffer. Now the PC is tied up again because it is waiting for a response from the printer.

Some two-way devices are preprogrammed to “fake” a standard response (e.g., dummy ENQ-ACK) to any inquiry that has been sent to the printer. Although this method provides a workable solution for most applications, a standard response will sometimes produce erroneous results.

The communication modes for some popular packages are listed in the table at the end of this note. If you do not know the requirements of your software package, consult your software vendor.

NOTE: All software packages for the Apple® Macintosh™ computers use one-way communication.■

Your Software Is the Key

Buffering/spooling/sharing devices are a solution to slow data transfer resulting from two devices having different data transmission speed. But whether or not a buffering/spooling/sharing device will be advantageous to you *depends primarily on your software*. If the application takes as much time outputting to the printer as the printer takes to print, then a buffering/spooling/sharing device will not necessarily save you any time. It will take just as long to send the program to the buffer and then on to the printer as it would to send it directly to the printer.

For example, if your software uses powerful HP-GL commands that instruct the printer to perform advanced tasks such as labeling or polygon fill, then the printer is performing the time-consuming calculations. In this case, an external buffer is most advantageous. On the other hand, if the computer is doing most of the calculations, or if the software pauses every time the printer changes pens, the computer will not be ahead of the printer by much, if at all. In this case (unless you plan to use the buffer to generate multiple prints), the time saved with a buffering/spooling/sharing device is minimal.

Helpful Hints

However, if you are using one-way communication, you can use your buffering/spooling/sharing device to its best advantage by sending your output to a file instead of the printer. Typically, the transmission to a file is faster than transmission to the printer. Once you've done this, then copy the file to the printer using the DOS COPY command. This method frees your computer and speeds printing because the printer doesn't have to wait for data.

Refer to your operating system documentation and the programming manual for your printer for information on implementing these hints.

Here's a Short Review

It is a good idea to have an understanding of the following questions before purchasing a buffering device. You can use this review as a check list.

1. Does the software function in a way that is conducive to using a printer buffer?

Above all, know your applications and your software. Remember, if the printer has to wait for the computer, then an external buffer may not save you much time. If, on the other hand, the computer has to wait for the printer, a buffer will offer you a time-saving advantage.

2. Does the application software use one-way or two-way communication?

You want to purchase a buffering device that functions with the type of communication employed by your application software.

3. What type of computer, and if applicable, how many computers will be used with the device?
4. What additional cables are required?

Since the printer buffer is connected between your PC and your printer, you will need at least one additional cable. Manufacturers will sometimes, but not always, provide a cable or information on cables. Be sure to note whether your computer ports are male or female so you can select the proper cables.

5. What are the handshaking requirements?

Some of the parameters (requirements) are baud rate, parity, and handshake method. You can configure some devices by pushing buttons on the front panel. On others, you must open the box and set switches and jumpers. On others, you can use a software utility. Some utilities support only one or two handshaking protocols, some support more. Note that if you have two packages that use different handshaking protocols, you may have to reconfigure the buffer whenever you use a different application.

6. Does the device have reprint capability?
7. What are the memory requirements of your application?

Most business applications will require 256KB of memory. Most CAD applications will require 1 MB of memory.

Some Final Considerations

External buffers are intended for a PC environment. Do not try to use them in an eavesdrop mode with a mainframe, a terminal, and a printer.

Although a buffer/spooler will free up the PC, it will not make your printer print faster. A buffering device cannot enable a printer to go beyond its mechanical limits.

Before making a purchase, contact the buffer's vendor and verify that the product you want will work with your hardware and software configuration.

Print Buffers, Spoolers, and Peripheral Sharing Devices

In this section you'll find lists of print buffers, spoolers, and peripheral sharing devices. The information includes the vendor, product name, buffer size, type of communication, and computers supported.

Print Buffers

This table lists buffers that support the HP ColorPro, HP 7475, HP 7550, HP DraftPro Series, and HP DraftMaster Series plotters. The Printer Optimizer and Systemizer Plus also support the HP PaintJet Series printers.

Vendor	Product ¹	Buffer ¹ Size	Input/Output Ports ¹			Data Communication		Replot (copies)	Personal Computers	
			RS-232-C	Parallel	HP-IB	One- way	Two- way		HP Vectra IBM PS/2, AT, PC/XT & Compatibles	Apple Macintosh
Applied Creative Tech. 8333 Douglas Ave., Suite 700 Dallas, TX 75225 (214) 352-2281	Printer Optimizer ² Systemizer Plus ²	128KB-1MB 256KB-1MB	X X	X X		X X	X X	99 1	X X	X
Consolink Corp 1275 S. Sherman Dr. Longmont, CO 80501 (303) 651-2014	MicroSpooler 128	64KB-128KB	X			X		1	X	
Dickerson Enterprises 8108 N. Milwaukee Ave. Niles, IL 60648 (312) 966-4884	CADDY	256KB	X			X		1	X	
Ergotron, Inc. 1631 E. 79th Street Minneapolis, MN 55420 (612) 452-8135	MacBuffer	256KB-1MB	X			X		1		X
Eventide, Inc. One Alisan Way Little Ferry, NJ 07643 (201) 641-1200	Cloverleaf ³ Expressway ³	256KB-2MB 256KB-2MB				X X	X X		X X	
ICT Technologies, Inc. 301 Galveston Drive Redwood City, CA 94063 (415) 361-1155	PlotStation 1		X				X			X
Intelligent Interfaces P.O. Box 1486 Stone Mountain, GA 80086 (404) 381-9891	MicroPlot 80A ³	256KB-2MB				X	X	1	X	
Western Automation 1700 North 35th St. Boulder, CO 80301 (303) 449-6400	Seleris	512KB-2MB	X				X	99	X	X

¹ Contact vendor for other models and configuration.

² Also supports the HP PaintJet Color Graphics Printer.

³ For the HP 150 and HP 9000 Series 200/300 computers.

Software Plot Spoolers

The following table lists software plot spoolers. These plot spoolers are memory resident and plot in the background. These spoolers support the HP Vectra, IBM PS/2, PC/XT/AT, and compatible computers. Software products listed support HP plotters.

Vendor	Product	Memory Used	Output Ports Supported		Queue/Spool Plots	Replot (copies)	Comments
			RS-232-C	Parallel			
ACS Telecom 25825 Eschelman Avenue Lomita, CA 90717 (213) 325-5035	10 Plot		X	X	X		Supports AutoCAD, VersaCAD, and other PC-CAD packages capable of outputting to a file.
The Software Machine 2450 East 7000 South, Suite 210 Salt Lake City, UT 84121 (801) 944-9212	AutoPlot II	33KB	X	X	X	9	Supports AutoCAD.
Digital Control Systems Five Cabot Place Stoughton, MA 02072 (617) 344-8100	Concurrent Plot II	78KB	X		X	999	Supports AutoCAD and VersaCAD.
SSC Soft Systems 301 West Holly Bellingham, WA 98225 (206) 676-6175	Plump	8KB	X		X	255	Supports AutoCAD and other PC-CAD packages.

Peripheral Sharing Devices

The following table lists peripheral sharing devices. Devices with serial (RS-232-C) interfaces support HP printers. All devices listed also support the HP PaintJet Series Color Graphics Printers.

Vendor	Product ¹	Buffer ¹ Size	Input/Output Ports ¹		Data Communication		Spool ³ Capability	Replot (copies)	Personal Computers ⁵
			RS-232-C	Parallel	One-way	Two- ² way			
Bay Technical Association 200 N 2nd Street Bay St. Louis, MS 39520 (800) 523-2702	PrintMaster	512KB-1MB	X	X	X	X	X		X
Bravo Communications 1310 Tully RD., Suite 107 San Jose, CA 95122 (408) 297-8700	CPS/1000	N/A		X	X		X		X
Datacom Technologies 1101 31st Place West Everett, WA 98204 (206) 355-0590	Metro Switch 431	512KB	X	X	X		X	99 ⁴	X
Digital Products 108 Water Street Watertown, MA 02172 (617) 924-1680	Print Director	256KB-2MB	X	X	X		X		X
Extended Systems 6062 Morris Hill Lane Boise, ID 83704 (208) 322-7163	MultiSpool 2398A	1MB-4MB	X	X	X		X	255 ⁴	X
Fifth Generation Systems 11200 Industriet Blvd. Baton Rouge, LA 70809 (504) 291-7221	Logical Connection	256KB-512KB B	X	X	X	X	X		X
Integrated Marketing Corp. 1031-H East Duane Ave. Sunnyvale, CA 94086 (408) 730-1112	Data Manager	256KB-1MB	X		X	X	X		X
Rose Electronics P.O. Box 742571 Houston, TX 77274 (713) 933-7673	CareTaker Plus Master Switch	64KB-256KB 256KB-1MB	X		X	X	X		X X

¹ Contact vendor for other models and configuration.

² Two-way communication supported on serial (RS-232-C) port only.

³ Spools one-way communication plots.

⁴ Multiple copies through software utility or control commands.

⁵ Apple Macintosh is not supported by any of these peripheral sharing devices.

Centronics Technical Information

The PaintJet XL printer either supports an RS-232-C serial interface and Centronics parallel interface or an HP-IB parallel interface.

The Centronics interface is recommended over RS-232-C for faster throughput with your printer. The Centronics interface transfers data and commands between the computer and printer on 15 signal lines. Eight data input lines are reserved for the transfer of data and other messages in a byte-serial, bit parallel manner. Data and message transfer is asynchronous, coordinated by three handshake lines. The remaining four lines are for management of bus activity.

If a cable is attached to the Centronics connector, the printer automatically uses the Centronics communication protocol.

Pin Assignments

Addressing is not necessary with this interface since it is not a shared bus. The following table lists and describes the Centronics connector pin assignments. (The second Pin Number column refers to a ground wire that is twisted with the signal wire.)



Signal	Pin	Pin	Signal
-Strobe (Input)	1	19	Strobe Return (GND)
Data 1 (Input)	2	20	Data 1 (GND)
Data 2 (Input)	3	21	Data 2 (GND)
Data 3 (Input)	4	22	Data 3 (GND)
Data 4 (Input)	5	23	Data 4 (GND)
Data 5 (Input)	6	24	Data 5 (GND)
Data 6 (Input)	7	25	Data 6 (GND)
Data 7 (Input)	8	26	Data 7 (GND)
Data 8 (Input)	9	27	Data 8 (GND)
-Acknlq (Output)	10	28	Acknlq Return (GND)
Busy (Output)	11	29	Busy Return (GND)
Paper error (Output)	12	30	Signal GND
Select (Output)	13	31	-Input Prime (Input)
NC	14	32	-Nfault (Output)
NC	15	33	Auxout1 (Output)
O VDC	16	34	NC
Chassis GND	17	35	NC
NC	18	36	NC

The “-” in front of the signals indicates that the signal is negative true (active LOW). GND means the connection is a ground. NC indicates that there is no connection for the pin.

Input Signals

Data Strobe (Pin 1)

This line defines when the information on the data lines is to be accepted by the printer. This line is normally HIGH, and is set LOW when data to be written to the printer is valid. BUSY is set HIGH after the falling edge of this signal. Refer to the previous table.

Data Lines (Pins 2-9)

Eight lines are used for character transfer from the host CPU to the printer. Data line 1 is the least significant bit; data line 8 is the most significant bit.

5

Input Pulse (Pin 31)

The printer will reinitialize on this signal.

Output Signals

Select Line (Pin 13)

The select line is LOW at power-up. It is set HIGH at initialization and remains HIGH.

Fault Line (Pin 32)

-Fault goes LOW if any malfunction or error occurs in the printer.

Busy Line (Pins 11 & 29)

When Busy is LOW, the printer can accept another character from the host. Busy goes HIGH after *every* valid HIGH-TO-LOW transition of the = Strobe signal. This allows a host CPU to handshake data with the printer using the BUSY signal instead of the -Ack signal.

Acknowledge Line (Pins 10 & 28)

-Ack is also used to synchronize the transfer of data from the host CPU to the printer. The -Ack pulse is a "request for data" signal generated by the printer, and expects one character in response from the Host CPU. During normal data transfer, the -Ack signal is generated *when or before* the BUSY signal changes from HIGH to LOW (not-BUSY). A -Ack pulse is generated each time the printer changes from OFF-LINE to ON-LINE.

Paper Error Line (Pin 12)

Normally LOW, this signal changes to HIGH when the printer runs out of paper. In addition to paper errors, this signal responds to any fault that occurs in the printer which requires the attention of the operator. When the signal is HIGH, the -Fault signal is always LOW.

O VDC (Pin 16)

Same as logic ground.

Chassis Grounds (Pin 17)

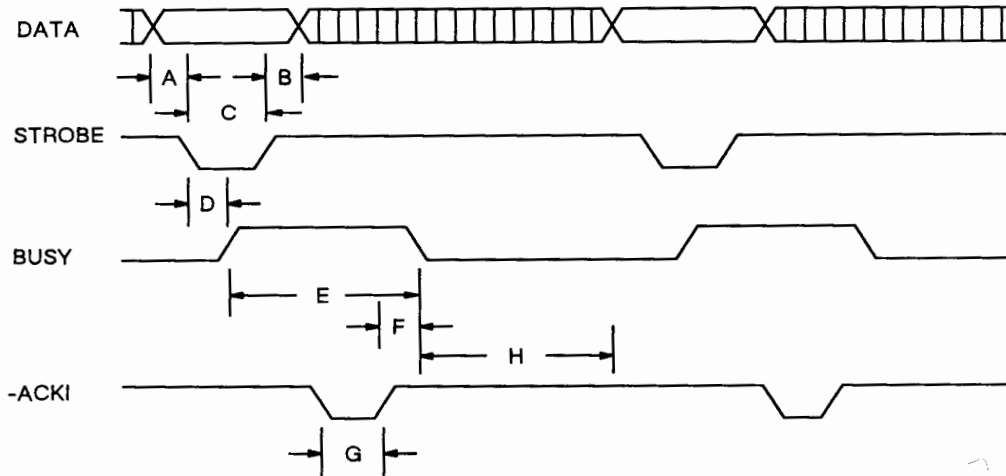
Same as frame ground.

Auxout1 (Pin 33)

This signal is always LOW while the printer is powered on.

Handshake Timing

The time specifications for parallel plug-compatible interfaces are described in the following figure.



5

Timing Specification Description	Minimum Value	Typical Value	Maximum Value
A: Data set-up time before -Strobe on	0.5 usec.	-	-
B: Data hold time after -Strobe off	0.5 usec.	-	-
C: -Strobe-on pulse width	0.5 usec.	-	500 usec.
D: -Strobe-on to Busy-on	0.0 usec.	-	0.5 usec.
E: Busy-on duration (printer-ON-LINE)	10.0 usec.	* 143 usec. **2.0 msec.	10 Sec
F: -Ack-off to Busy-off	0.0 usec.	0.1 usec.	
G: -Ack-on pulse width	4.5 usec.	-	5 usec.
H: Busy-off to start of next cycle	0.0 usec.		

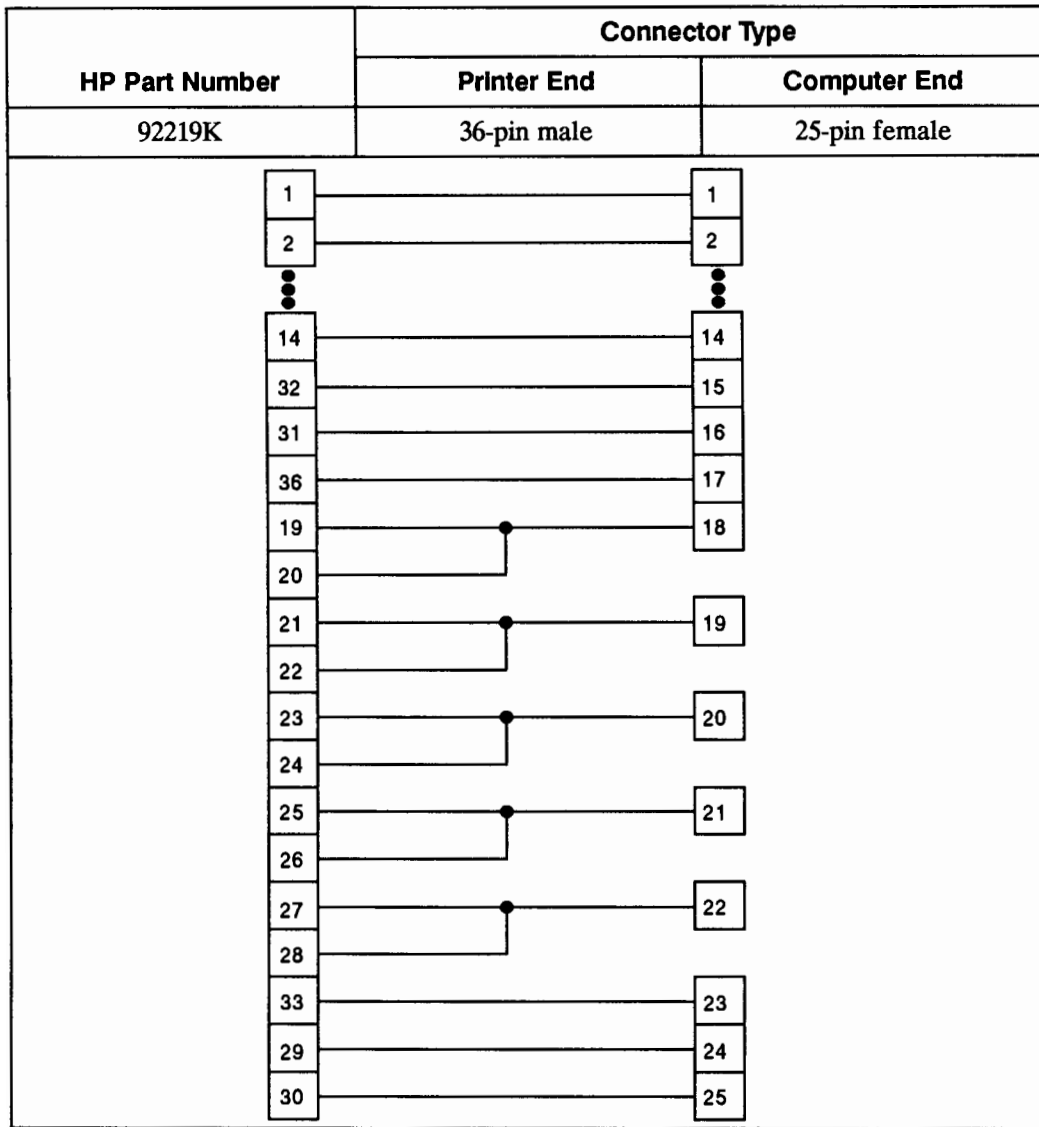
* Image and font download data.

** Text data.

Centronics Cable Schematics

The following cable schematics are for Hewlett-Packard cables.

HP Part Number	Connector Type																																																													
	Printer End	Computer End																																																												
13242-D	36-pin male	25-pin male																																																												
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5

RS-232-C Technical Information

Interfacing is a multistep process that establishes compatibility between a computer and a peripheral device. Handshaking controls the manner in which data is transferred between the two devices, once an interface has been established. This chapter explains the underlying concepts about establishing an interface and initiating a handshake.

The first section of this chapter pertains to interfacing—establishing compatibility between your printer and computer. The four areas of compatibility: mechanical, electrical, timing, and data, are explained. Communication compatibility (timing and data) is discussed in depth. The rest of the chapter discusses handshaking, the way data is transferred between the printer and computer, once an interface has been established. Guidelines are provided to help you select a handshake. Once you select a handshake, read the section pertaining to that handshake method for specific instructions and examples of implementation.

6

An Overview of Interfacing and Handshaking

What is interfacing, and why is it necessary? Ideally, all printers and computers would standardize their input/output connections, making them compatible once interconnected. Unfortunately, no such standard exists and, as a result, two RS-232-C devices are not necessarily compatible. In the case of the serial RS-232-C interface, the EIA standards refer only to the mechanical and electrical characteristics and signal functions; other characteristics are not discussed. To communicate successfully, there must be timing and data format (i.e., communication compatibility), electrical and mechanical compatibility between all devices adhering to the RS-232-C standard. This chapter briefly explains the electrical and mechanical areas of compatibility before dealing in depth with communication (data and timing) compatibility.

Mechanical Compatibility

RS-232-C mechanical compatibility implies the use of a standard 25-pin connector. The EIA standard defines 25 lines and their respective signal functions; in addition to data transfer, these lines are used for interfacing functions. On HP printers a maximum of nine of the 25 available lines are connected to the printer's internal circuitry. The use of these nine lines is very common in the industry, and many computers now have connectors only for those nine lines. If you need more detailed information on signal designation and direction, refer to *RS-232-C Pin Allocations* later in this chapter.

Electrical Compatibility

Data passes between devices over the lines using two voltage levels. These levels represent the two possible states (1 or 0) of a binary digit. The voltage levels must be the same for both devices. RS-232-C standards specify that voltage levels between +3V and +25V on lines used for data transfer be recognized as 0 or "space" and on control lines (such as Data Set Ready and Clear To Send) as ON. Voltage levels between -3V and -25V must be recognized as 1 or "mark" for data transfer lines and as OFF for control lines.

Communication Compatibility

Computers and printers have a wide range of operating speeds. Printers may execute instructions slower or faster than computers generate them, necessitating a system that ensures the efficient transmission and receipt of data. You must provide this communication compatibility to interface your printer with your computer.

Communication compatibility includes both data format and timing compatibility as well as communication protocol. In order to establish communication compatibility, your computer and printer must be set to use the same:

- Number of data bits
- Parity
- Baud rate
- Number of stop bits

Each of these subjects is discussed in this chapter, with reference to printers. The requirements of your computer system will dictate the conditions you establish.

Data Format

Once an interface has made a computer and printer mechanically and electrically compatible, they can exchange messages in the form of electrical signals. In order for these messages to be understood and executed, certain data formatting conventions must be followed. Devices may use any data format for internal communication. However, each device must input and output data in a standard character representation such as Extended Binary Coded Decimal Interchange Code (EBCDIC) or American Standard Code for Information Interchange (ASCII). All HP printers use standard 8-bit ASCII code; as a result, they are compatible with a wide variety of devices. If data from the computer is not in this format, you need a protocol converter. HP printers are not compatible with 6-bit or 12-bit ASCII devices.

The following table shows the binary code for the uppercase characters A through C and the decimal code of their seven low-order bits. The lowercase p in the binary code represents the required eighth bit, the parity bit, which can have the value 0 or 1. You will use the decimal codes of ASCII characters to specify some parameters of the printer instructions which establish communication between the printer and computer.

6

ASCII Character	Binary Code*	Decimal Code of Low-Order Seven Bits
A	p100001	65
B	p100010	66
C	p100011	67

* The lower case 'p' represents the required eighth bit, the parity bit.

Parity – The number of bits per character and the format of those bits is important when transferring data between the computer and printer. ASCII characters are coded in seven bits, with an eighth bit to be used as a parity, or error-checking, bit. While the parity bit may not be active, it still must be included as the eighth bit of each character. Most devices can be set to odd, even, mark, or space (no) parity. Set your printer and terminal to the same parity as your computer. On the HP PaintJet XL, you set the parity using rear-panel switches.

Most PC systems use 8-bits and no parity checking. This is because graphics data requires 8 data bits of information; otherwise, part of the image will be missing as well as any extended characters above decimal 127.

Refer to *Setting the RS-232-C Interface Switches* in Chapter 1 for detailed instructions.

Timing Compatibility

Baud Rate – The baud rate is approximately equal to the number of bits transmitted per second. This can be translated into an approximate number of characters per second, since each character is 10 bits long (eight bit code plus one start and one stop bit). For example, at 300 baud a maximum of 30 characters per second may be transmitted. The device receiving the data must be prepared to interpret the eight-bit characters at the same rate at which they are sent. Failure to do so will result in garbled data.

Match the data transmission speeds of your computer and printer by setting the baud rates equal. The HP PaintJet XL printer receives and transmits data at the standard baud rates shown in the following table. Make the baud rate selection using the rear-panel switches on the printer.

Baud Rates
1200
4800
9600
19 200

Refer to *Setting the RS-232-C Interface Switches* in Chapter 1 for instructions.

Stop Bits – Data is transmitted asynchronously across the signal lines by means of the eight-bit characters. Asynchronous transmission means the data transfer may be initiated at any time, and the interval of time between characters may vary. To enable the receiving device to distinguish the starting and ending point of each character, each eight-bit group must be preceded by a “start” bit and followed by one or two “stop” bits.

In most cases, HP printers verify and generate a single stop bit. Two stop bits are generated and verified by HP printers with baud rate settings less than or equal to 110. Switches can be used on some printers to generate two stop bits at settings above 110. You should set your printer and computer to the same number of stop bits, if possible.

Communication Protocol – The communication protocol for the HP PaintJet XL is automatically established and cannot be altered. The output parameters are as follows:

Output Terminator:	decimal 13 (carriage return)
Output Trigger Character:	none
Echo Terminator:	none
Output Initiator:	none
Intercharacter Delay:	none

Handshaking

Once you've established an interface, you will need to initiate a handshake. Handshaking is a means of assuring correct and complete data transfer between the printer and computer.

If you know which type of handshake you will use, skip this section and refer to the section about that particular handshake.

Hewlett-Packard printers use an input/output buffer, called the logical input/output buffer in some printers, to adjust for the rate at which data is received and processed. To prevent data loss due to I/O buffer overflow, the computer and printer must communicate about the availability of I/O buffer space in the printer. This process is called "handshaking." An efficient handshake optimizes computer/peripheral communication while preventing data loss. The computer system's capabilities and requirements dictate which handshake method is appropriate. There are two handshakes you can use with the PaintJet XL printer:

- **Hardwire Handshake** — This method uses a physical wire, pin 20 of the RS-232-C connector, to control handshaking. You can use it if the computer and the printer are directly connected, without a modem, and the computer system can or does monitor pin 20 (CD, Data Terminal Ready). Most personal computers use hardwire handshake.
- **Xon-Xoff Handshake** — This method is initiated by the printer. You can use it if your computer system supports an Xon-Xoff protocol. An Xon-Xoff handshake transmits a control character from the printer to the computer when the printer's I/O buffer is full, and another character when the buffer is ready to receive more data.

This guide will help you determine which handshake to use.

Guidelines for Selecting a Handshake

The sections discuss the two handshakes implemented on the PaintJet XL printers and gives guidelines for selecting a handshake. Each of the following sections includes definitions of the terms associated with that handshake.

How do you know which handshake is best for your specific configuration? The ideal handshake minimizes I/O transactions while keeping the printer's I/O buffer supplied with data. The communication characteristics and capabilities of the host computer dictate which handshaking method is possible and will be most efficient. *A thorough understanding of the computer's communication characteristics is necessary in order to make the best decision on the type of handshake.*

If you are not sure which is the best handshake to use, consult the computer systems documentation or the installation manual for your computer and/or graphics software package. Most software packages designed for use with Hewlett-Packard RS-232-C printers tell you which handshake to select. You may need to fill in parameters suitable to your system, to be used in subroutine calls. The information you need to do this is found in the installation guides for the software. If you are not using a commercial software package, your system manual may tell you whether your system supports Xon-Xoff protocol or hardwire handshake. If there isn't a recommendation in your documentation, the following information should help you choose an efficient handshake.

Printers Hardwired to the Computer

If your printer operates in a hardwire configuration there is no intermediate hardware between the printer and computer; a cable goes directly from printer to computer. This is the only configuration in which the hardwire handshake can be used. Hardwire handshake is a very efficient handshake; sometimes the term automatic handshake is used to refer to this type of handshake. Many personal computers use hardwire handshake.

Printers in a Remote Environment

If your printer will be in a configuration other than hardwire, you can use the Xon-Xoff handshake. The Xon-Xoff handshake is implemented in the operating system or device driver. The Xon-Xoff handshake is efficient when sending variable or fixed-length records.

You can test your system for Xon-Xoff support by printing a long program listing (or other text) to a terminal plugged into the RS-232-C connector where you plan to attach to your printer. While information is printing on your display, send the ASCII character **DC3** (Xoff) to the computer. On many terminals, this is done by pressing and holding the terminal's **CONTROL** key (sometimes labeled "CNTL" or "CTRL") and then pressing the **S** key. If printing immediately stops, send the character **DC1** (Xon), often sent by pressing and holding the **CONTROL** key and then pressing the **Q** key. The printing should resume. If you can stop and start printing in this manner, you can probably use the Xon-Xoff handshake.

6



Hardware Handshake

As the name implies, the hardware handshake takes place in the hardware rather than the firmware or software. Generally speaking, to use hardware handshake there must not be intermediate hardware between the printer and computer. You cannot use hardware handshake in eavesdrop mode, where both a computer and a terminal are connected to the printer. Many personal computers use hardware handshake. This handshake uses the printer's Data Terminal Ready (DTR) control line (pin 20) to control handshaking. You can use this handshake if your computer can monitor pin 20.

In a hardware handshake, the printer controls the data exchange sequences by setting the electrical voltage on pin 20 of the connector (CD line) to the computer to signal the computer when to send another block of data. If there is enough room in the printer's I/O buffer to store another block of data, the printer sets the Data Terminal Ready (DTR or CD) line to a high state. You can think of this as turning the line ON. If there is insufficient buffer space, it sets the line low (or OFF). By monitoring this line, the computer knows when it can safely transmit each block of data.

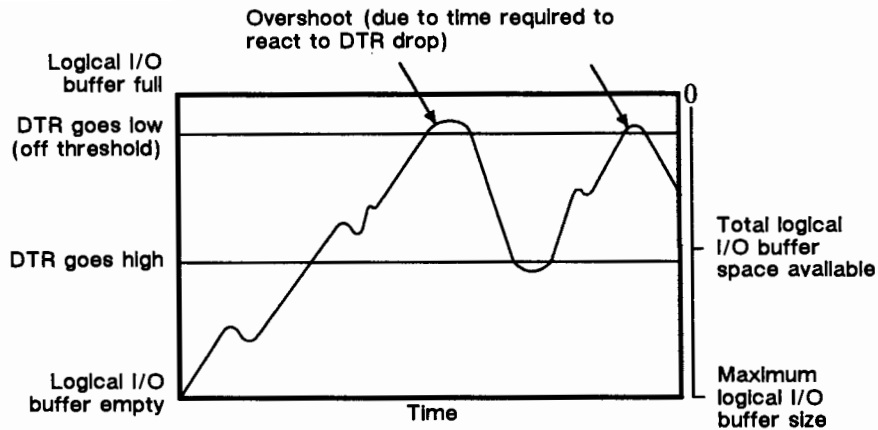
In a hardware handshake, the computer monitors one of the interface lines from the printer. The hardware handshake works as follows.

1. When the printer has room for data in its I/O buffer, it signals the computer to send data by setting the DTR line high (turning it on). The DTR line is pin 20 on the printer's RS-232-C connector. The DTR line is high at power-on.

The printer raises the DTR line when the I/O buffer has 860 bytes more than the threshold level available.

2. The printer has a threshold level that determines when the input buffer is in danger of overflowing and losing data. When the threshold level of (17 200) is reached, the printer sets the DTR line low (off).

The computer continually checks the status of the line: if the line is high, it sends data; if the line is low, the computer waits until the line is high again before sending more data. This prevents the computer from overfilling the printer's input buffer.



Hardware Handshaking

NOTE: Using a hardware handshake in a PC environment is likely to cause device timeouts. Since the DTR line remains low while the plot is rasterized and executed, the PC is likely to time-out while waiting for the DTR to go high. You should be sure to set the P parameter of the MODE command when using the hardware handshake. Refer to *Verifying Communication* in Chapter 1 for details on the MODE command. ■

Initiating Hardware Handshake

Hardware handshake is implemented on the PaintJet XL by setting the rear-panel **XON-XOFF/DTR** switch to **DTR**. Establishing the hardware handshake sets the following parameter.

Threshold level 860 bytes

Output Terminate Character — The output terminate character is a one- or two-character terminator that the computer requires the printer to send at the end of each response to a data request. The output terminate character tells the computer, “This completes my transmission.” The printer sends a carriage return (**CR**) as the output terminator.

Threshold Level — Threshold level is used to prevent data loss due to buffer overflow. It is a number of bytes in the buffer for the receipt of data. When this portion of the buffer is full of data, the **DTR** line is set low to tell the computer to stop sending data until buffer space is available.

Xon-Xoff Handshake

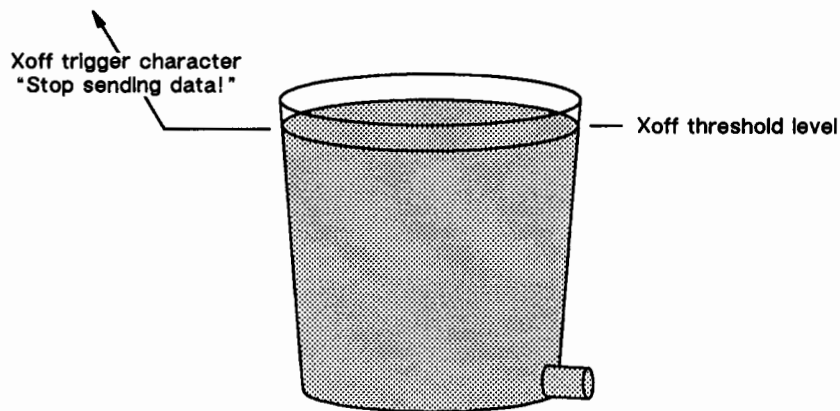
To understand the way Xon-Xoff handshake works, think of the printer's buffer as a bucket, which serves to contain water (data). The water source in this discussion is the computer. As water is used (data is processed), it drains out of the bucket.

The bucket has two markings. The first marking (Xoff threshold level) indicates when the bucket is so full of water that it is in danger of overflowing. Once the water reaches the danger level, a warning (Xoff trigger character) is sent to the water source, telling it to stop the flow of water.

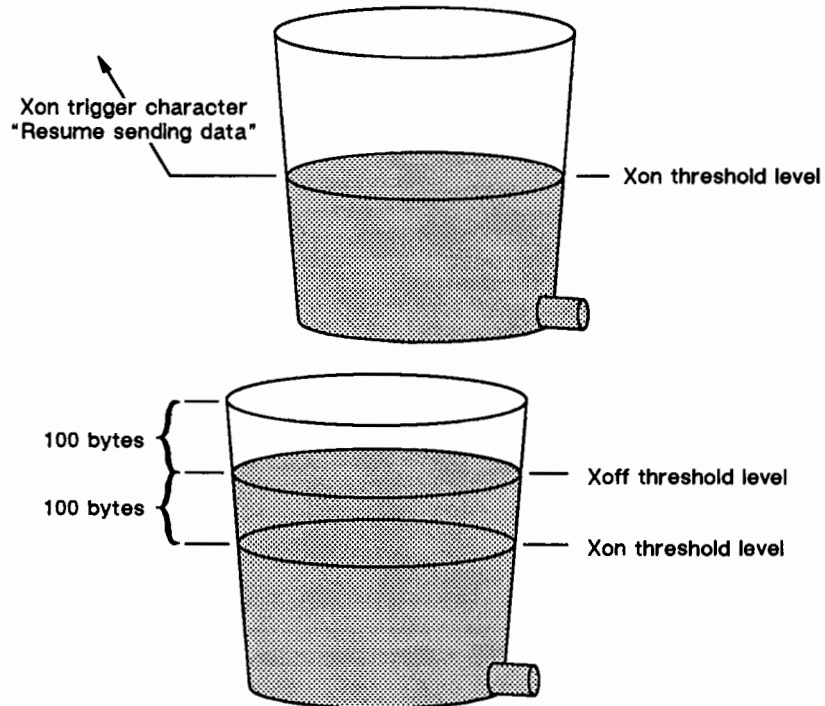
The second marking (Xon threshold level) is halfway up the bucket. The Xon threshold level is automatically set by the printer. When enough water has drained out of the bucket, so that the bucket is half full, a signal (Xon trigger character) is sent to the water source. This signal tells the source, "There's enough room in the bucket for more water," and the water is turned on again. This process is repeated until the water source is depleted.

The following diagrams illustrate the way the Xon-Xoff handshake works.

1. Water enters the bucket faster than it can be used, and the bucket starts to fill.
2. The water level reaches the overflow level, and a danger signal is sent to the water source, telling it to turn off the water.



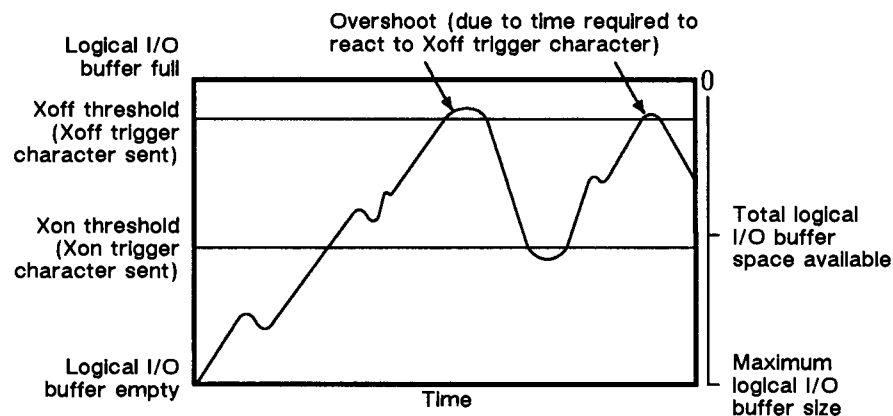
3. There is a delay between the time the warning signal is sent and the time the water is shut off. The printer automatically allows extra room for overflow (164 bytes), to avoid losing water.
4. Water continually drains out of the bucket. When the water level reaches the Xon threshold level, a signal is sent to the source to turn the water on again.



When using the Xon-Xoff handshake method, the printer controls the data exchange sequence by signaling the computer when it has sufficient room in its I/O buffer for data and when to stop sending data. The printer uses buffer threshold indicators (an Xon trigger character and an Xoff trigger character) to prevent buffer overflow.

1. Data enters the printer's buffer faster than it can be processed, and the buffer starts to fill. When the data in the I/O buffer reaches the Xoff threshold level, the printer sends the Xoff trigger character to the computer.
2. The printer's buffer empties as data is processed. When the Xon threshold level is reached, the printer sends the Xon trigger character to the computer, restarting the flow of data.

This process is repeated until all data has been sent. The following is a graphic representation of this process.



Xon-Xoff Handshaking

RS-232-C Pin Allocations

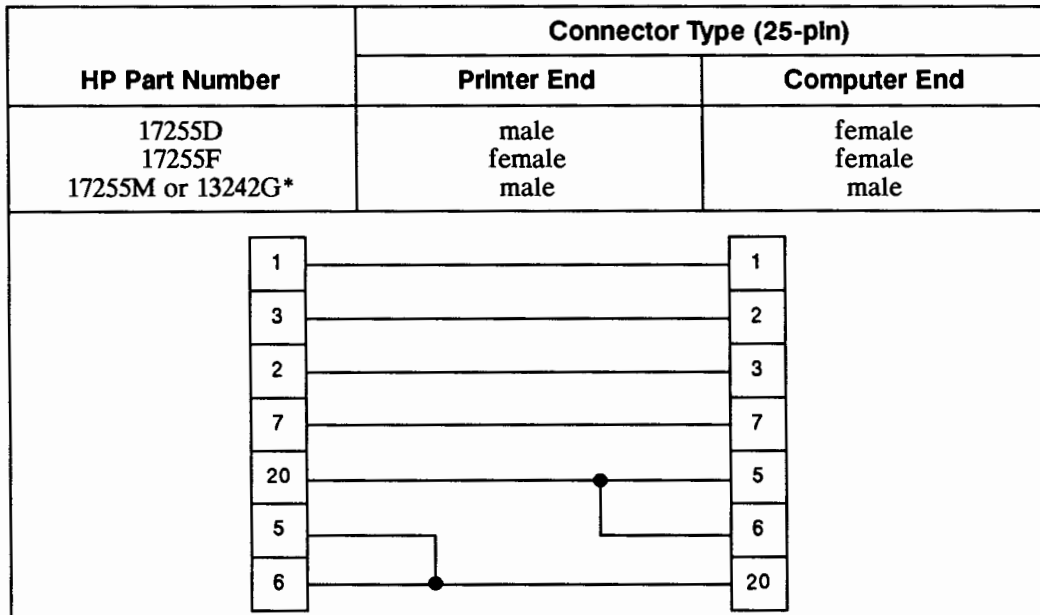
The printer interfaces to the RS-232-C communications lines through a standard 25-pin female connector. Connector pin allocations are identified and described in the following table.

Wire/Signal Name	Pin #	RS-232-C	CCITT V.24
Protective Ground	1	AA	101
Transmitted Data	2	BA	103
Received Data	3	BB	104
Request to Send	4	CA	105
Signal Ground	7	AB	102
Data Carrier Detect	8	CF	109
Data Terminal Ready	20	CD	108.2

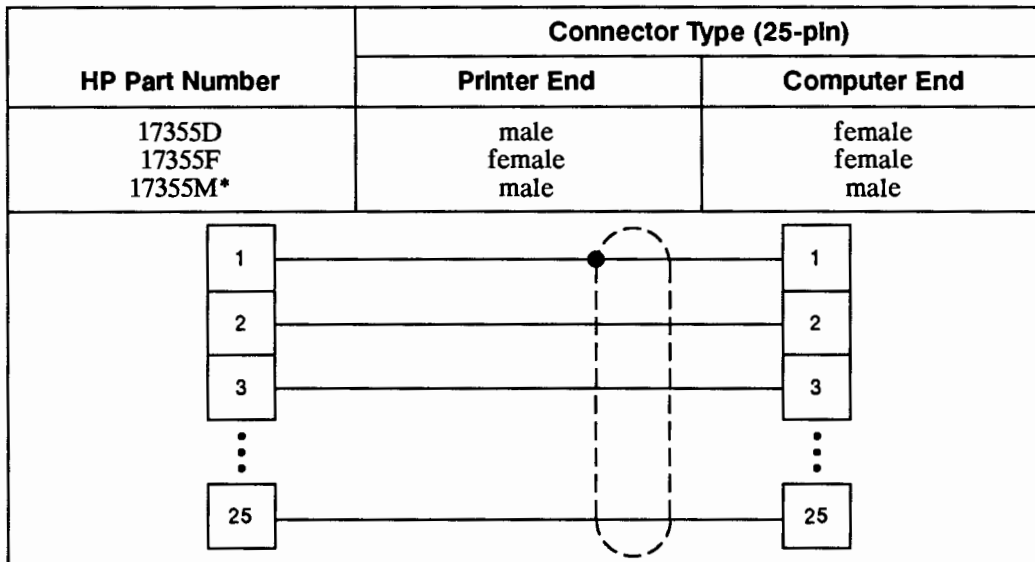
6

RS-232-C Cable Schematics

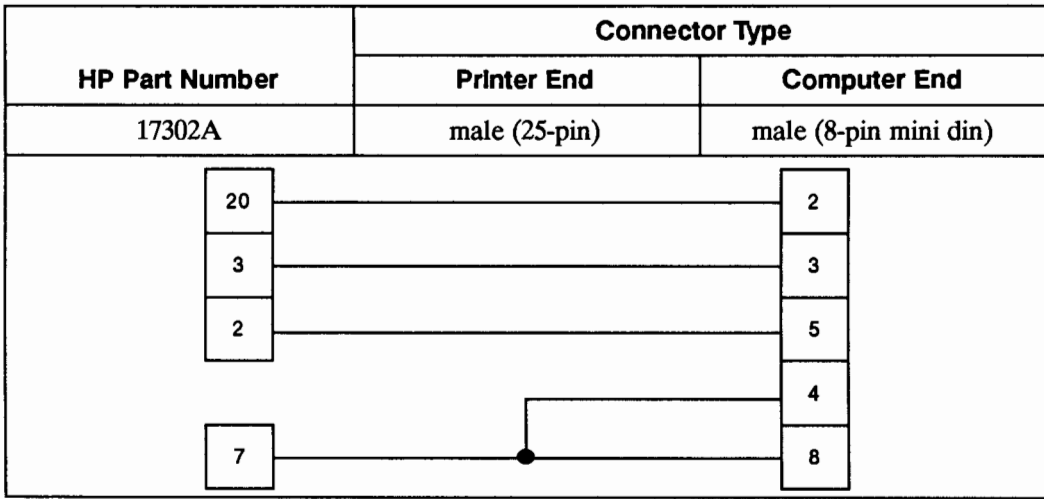
The following cable schematics are for Hewlett-Packard cables.



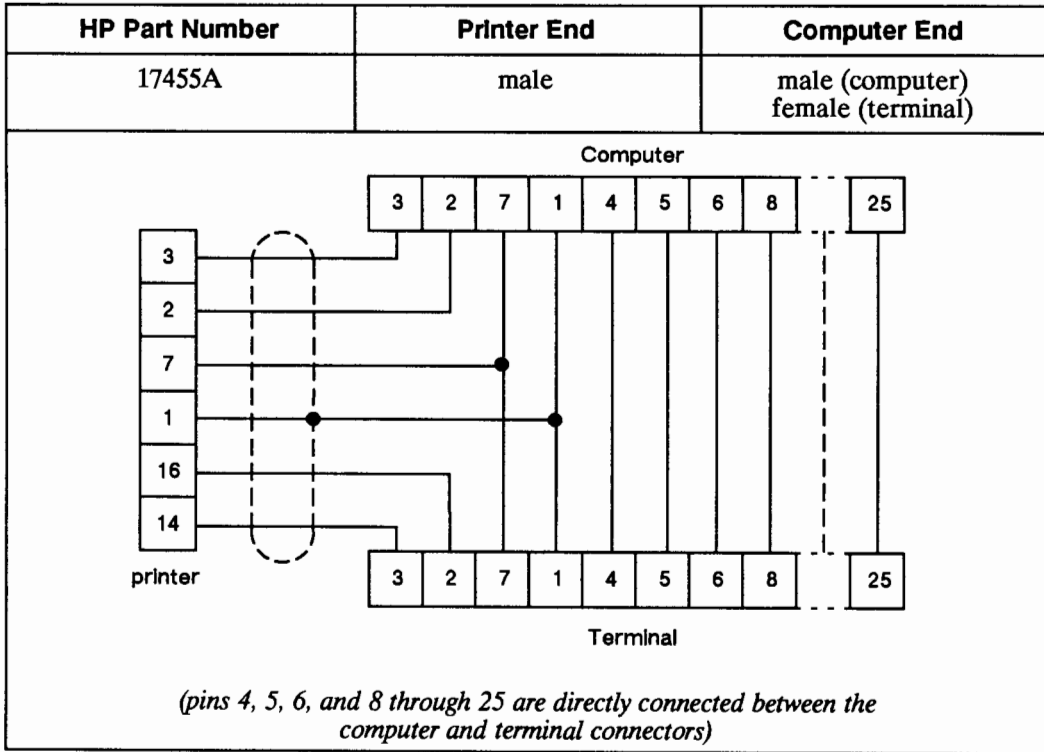
* Symmetrical; either end may be connected to the printer. Other pins are connected in the 13242G but do not affect printer operation.

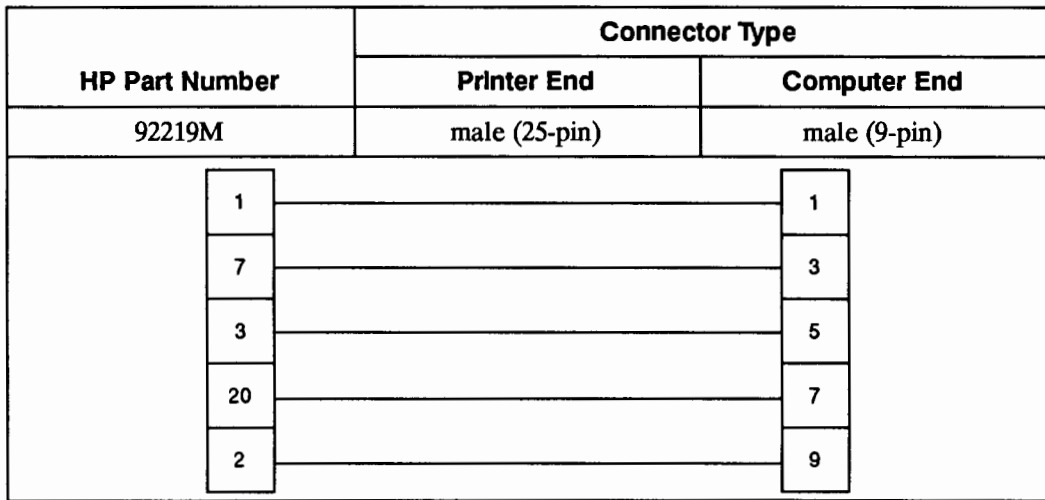
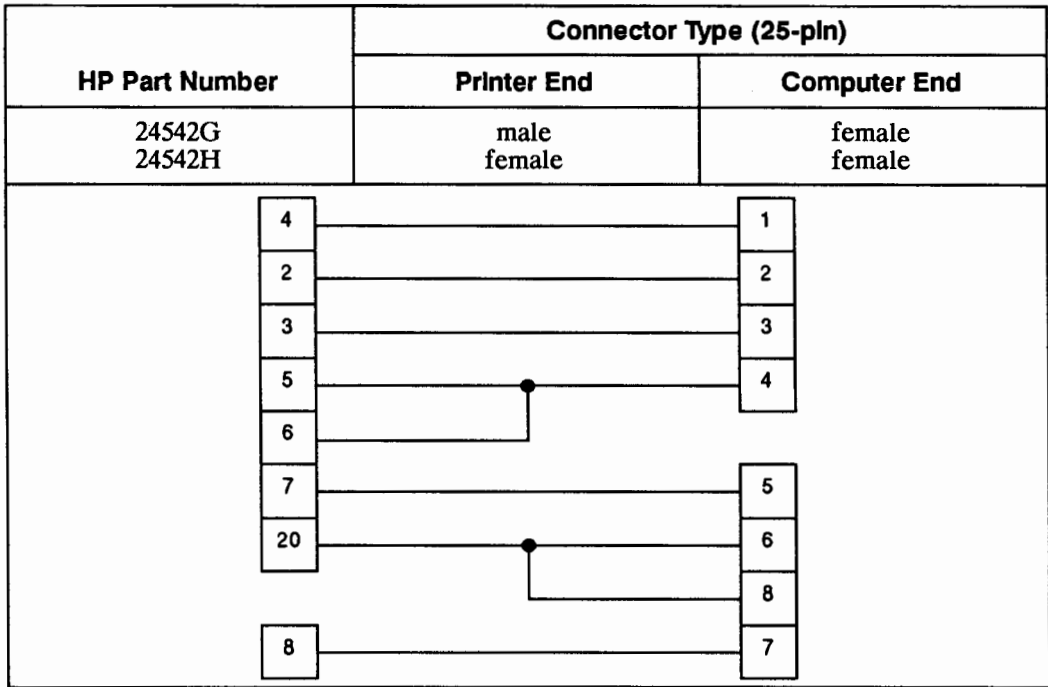


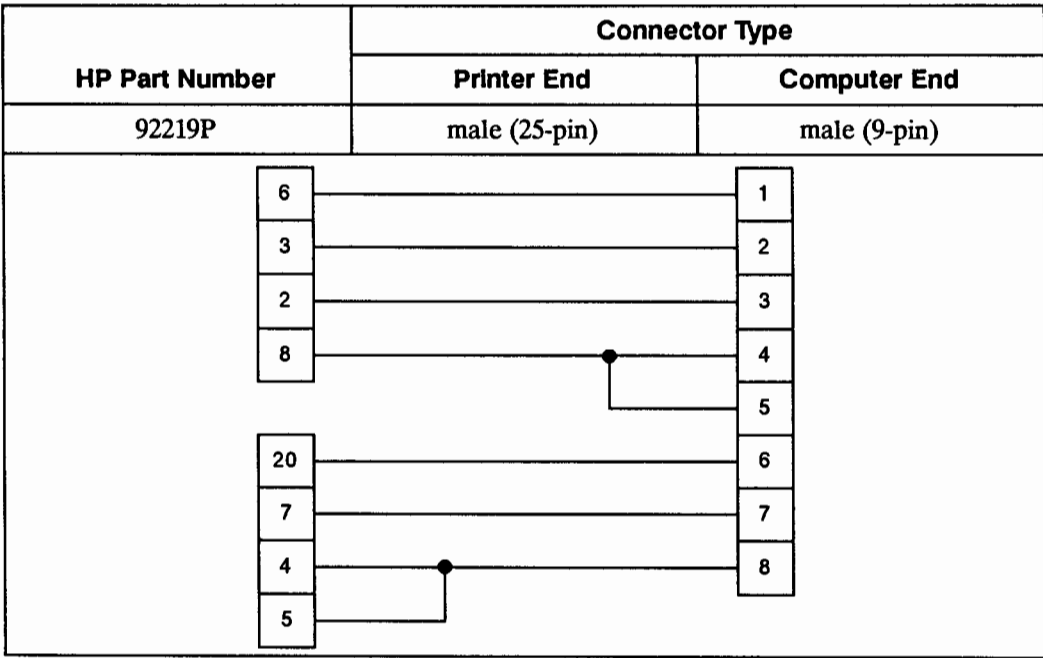
* Symmetrical; either end may be connected to the printer.



6







6

Notes

6

HP-IB Technical Information

This chapter discusses how to programmatically establish communication compatibility between the printer and the computer using the HP-IB (IEEE-488) parallel interface, including normal and secondary command support modes.

For most applications, you probably only need to understand how to address your printer. Setting the printer address is detailed in Chapter 1.

HP-IB (IEEE-488) Information

The Hewlett-Packard Interface Bus (HP-IB) provides for compatibility between all devices adhering to the ANSI/IEEE-488 (1978) standard. HP-IB is the most common interface between Hewlett-Packard computers, peripherals and instruments. HP-IB is recommended over RS-232-C for faster throughput with your printer.

HP-IB transfers data and commands between the computer and printer on 16 signal lines. Eight data I/O lines are reserved for the transfer of data and other messages in a byte-serial, bit parallel manner. Data and message transfer is asynchronous, coordinated by three handshake lines. The remaining five lines are for management of bus activity.

Devices connected to the bus can be talkers, listeners, or controllers. The controller dictates the role of each of the other devices by setting the attention (ATN) line true and sending talk or listen addresses on the data lines. Addresses are set into each device at the time of system configuration either by switches built into the device or by jumpers on an internal board. While the ATN line is true, all devices must listen to the data lines. When the ATN line is false, only devices that are addressed actively send or receive data.

Interface Modes: Normal or Secondary Command Support

Two command modes are available on the printer: the standard (normal) HP-IB mode and secondary command support (SCS).

The following table shows what functions are implemented according to the mode selected.

HP-IB Interface Functions

Interface Function Name	Normal Implementation	SCS Implementation
Source Handshake	SH1	SH1
Acceptor Handshake	AH1	AH1
Talker	T6	—
Listener	L3	—
Extended Talker	—	TE6
Extended Listener	—	LE4
Service Request	SR1	—
Parallel Poll	PP2 or PP0*	PP2
Device Clear	DC1	DC1
No Remote Local	RL0	RL0
No Device Trigger	DT0	DT0
No Controller	C0	C0

* PP0 is implemented if the printer is in listen-only mode; PP2 is implemented if the printer's address is less than 8; PP1 is implemented otherwise.

Normal HP-IB Protocol

This is the standard implementation of HP-IB that establishes mechanical, electrical, timing, and data compatibility between devices. It allows high-speed communication between many peripherals on one computer port. A device on the HP-IB may function in the following ways.

- As a 'listener' that receives data sent over the bus.
- As a 'talker' that transmits data to other devices on the bus.
- As a 'controller' (computer) that regulates interaction of the devices on the HP-IB system.

The printer functions primarily as a 'listener,' receiving data sent over the bus.

Controlling Addressing Sequences

When you are programmatically controlling the HP-IB, one of the first things you must consider is addressing. Using HP-IB addresses, the controller can identify and individually access various devices on the interface. The following table lists the listen and talk characters for specific addresses. Select the HP-IB address using the printer's interface switches as explained in Chapter 1.

Printer Address		Address Characters	
Decimal	Octal	Listen	Talk
0	0	(space)	@
1	1	!	A
2	2	"	B
3	3	#	C
4	4	\$	D
5	5	%	E
6	6	&	F
7	7	'	
15	17	/	O

← Usual printer address

← Sets listen-only mode

An addressing sequence is made up of three major parts, with the ATN (Attention) line true.

<Unlisten Command> <Talk Address> <Listen Addresses>

The purpose of these parts is as follows.

- **Unlisten Command** — A universal bus command; its character is ? (ASCII decimal code 63). It unaddresses all listeners. After transmitting the unlisten command, no active listeners remain on the bus.
- **Talk Address** — Indicates the device that is to talk, or send data. A new talk address automatically unaddresses the previous talker.
- **Listen Addresses** — Indicate one or more devices that are to listen, or receive data. A listen address adds the designated device as listener along with other addressed listeners.

This addressing sequence directs who talks to whom. You can implement the commands (unlisten, talk, listen) by putting data on the bus and setting the ATN control line true. The unlisten command (?) plays a vital role in this sequence. It is important that a device receive only the data that is intended for it.

When a new talk address is transmitted in the addressing sequence, the previous talker is unaddressed. Therefore, only the new talker can send data on the bus and you don't need to use an untalk command in the same manner as the unlisten command.

For example, to tell a computer at address 21 to talk and a printer at address 05 to listen, the controller (usually the computer) sets the proper control line true and sends the following sequence.

? U %

where ? — tells all devices on the bus to unlisten,
 U — designates the device at address 21 as the talker,
 % — designates the device at address 05 as the listener.

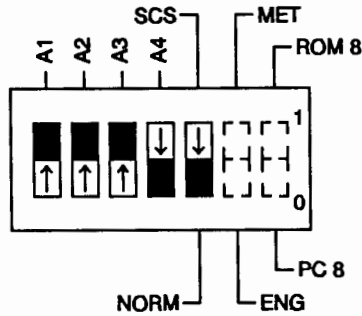
To have the printer talk and the computer listen, you would set the control lines and send the following, with ATN true.

? E 5

Listen-Only Mode

In listen-only mode, the printer plots all data transmitted over the bus without being addressed by a computer.

To activate listen-only mode, set the rear-panel HP-IB switches A1-A3 to the **ON** position as shown in the following illustration. In listen-only mode, the printer does not have an address, but listens to all data transmitted on the bus. The printer cannot then be placed in a talker-active state.



Listen-Only Setting

Listen-only mode is useful in a system that has no controller but has a dedicated talker (such as a tape drive or other mass storage unit) transmitting information to the printer.

NOTE: Listen-only mode is disabled if Secondary Command Support is selected for the printer.■

Serial and Parallel Polling

Serial and Parallel Polling are processes used by the controller to determine if any of the devices (such as plotters and printers) on the HP-IB require service. Like most HP-IB devices, your printer can request service.

Serial Polling

Refer to your computer's documentation to determine whether or not your system has serial poll capability, and for the necessary (enable/disable) commands.

In a serial poll, the computer polls the devices on the bus in sequence, one at a time. The computer requests the status of one specific device by addressing only that device and asking it to respond. The printer responds to this request by sending a status byte. The definition of each bit in the status byte is shown in the following table.

Status Byte Bit Definition

Bit	Bit Value When Set	Condition Indicated When Bit Set to 1
0	1	Carriage or paper motion disabled.
2	4	Out of paper.
6	64	Request for service.
1 3 4 5 7		Always disabled.

The printer sets bit 0 or 2, respectively, of the status byte, when carriage/paper motion is disabled or the printer is out of paper. It also sets bit 6 to assert a service request. When the status byte is read or the problem is fixed by loading paper or restoring normal carriage motion, the service request is terminated by clearing bit 6 (setting it to 0).

Use an interrupt routine to halt your program when the computer receives a service request. Then, send a serial poll to determine which device on the line needs service. Sending a serial poll clears bit 6 of the status byte.

NOTE: The printer cannot respond to a serial poll when it is in either listen-only mode or secondary command support mode.■

Parallel Polling

Refer to your computer's documentation to determine if your system has parallel polling capability and for the necessary (enable/disable) commands.

Parallel polling provides a fast way for the computer to determine which, if any, of the devices on the bus needs service. The computer performs a parallel poll by asserting the EOI (End or Identify) and ATN (Attention) lines simultaneously. If it requires service, the printer responds by asserting its assigned DI/O line.

When enabled in normal HP-IB mode, the printer responds to a parallel poll when it is out of media. Loading media terminates the printer's response.

When enabled in SCS mode, the printer responds to a parallel poll under the following conditions: ready for data, ready to transmit, media error, and power up. Eliminating the cause (loading media, for example) terminates the response.

NOTE: In listen-only mode, the printer cannot respond to a parallel poll.■

Bus Commands

Devices on the HP-IB receive special instructions in the form of commands. To send a command over the bus, the controller asserts the ATN line. Once the ATN line is asserted, the devices on the bus understand that what follows is a command, not data.

Listen Address (LAD) X01AAAAA

AAAAA represents the HP-IB address of the device for which the command is intended. This command causes the printer to become a listener.

Device Clear (DCL) X0010100

Sets all devices on the HP-IB system to a predefined or initialized state. It clears the I/O buffer and resets the parser to begin accepting a new instruction, and disables any current output. (The DCL command does not reset any parameters in the printer to default values. It is not the same as the PCL instruction **ESC E** or the HP-GL instructions **DF** or **IN**.) Partially parsed instructions and/or parameters are lost.

If the printer is parsing an instruction, DCL aborts it; if the printer is executing an instruction (processing and storing it internally), it is completed. DCL does not affect instructions already stored in the printer's buffer.

Selected Device Clear (SDC) X0000100

This command clears only those devices on the bus that are selected to listen. Except for this difference, SDC has the same effect as DCL.

Sent along with the addresses of the devices, SDC sets selected devices to a predefined or initialized state. This command clears only those devices on the bus that are selected to listen. It clears the I/O buffer and resets the parser to begin accepting a new instruction, and disables any current output. (The SDC command does not reset any parameters in the printer to default values. It is not the same as the PCL instruction **ESC E** or the HP-GL instructions **DF** or **IN**.) Partially parsed instructions and/or parameters are lost.

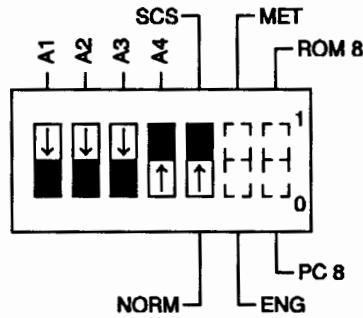
Interface Clear (IFC)

The controller uses the IFC line to override all bus operations and return the bus to a known inactive state. All pending output on the bus is cleared. IFC does not affect data already received by the printer.

Secondary Command Support

Your system must support secondary commands for the printer to function in this mode. Secondary command support extends the capabilities of the normal HP-IB protocol. Implementation of secondary commands avoids HP-IB lock-up in a multiuser environment.

To activate secondary command support, turn off the printer and set the **SCS/NORM** of the rear-panel HP-IB switches to **SCS**. Turn on the printer; secondary command mode is now in effect. The following illustration shows **SCS ON** and HP-IB address 01.



When this protocol is selected, listen-only mode and the service request are automatically disabled. The printer can be identified with addresses 0-7.

Secondary commands have a two-byte structure to carry their more detailed instructions. The printer functions as Extended Talker or Extended Listener. The first byte is always a primary talk or listen command, which sets up the second byte as a more specific talk or listen instruction.

The printer supports four secondary commands, two talk and two listen.

Secondary Talk Commands

The secondary talk commands are Device Specified Jump and I/O Status.

Device Specified Jump (DSJ) X1110000

When the printer receives the primary talk command followed by a secondary DSJ command, it responds with one byte of data with the EOI line asserted. The value of the byte is decimal zero, one, or two.

Decimal Value of Response Byte	Printer Status
0	Ready to receive.
1	Ready to send.
2	Status change (power cycled or not ready).

7

I/O Status X1101110

The I/O status is a means by which the controller checks the current printer status. When the printer receives the primary talk command followed by a secondary I/O status command, it responds with one byte of data with the EOI line asserted. Set bits in the byte have the following meaning.

Bit	Bit Value When Set	Printer Status
0	1	Power cycled.
1	2	Paper out.
2-5	—	Undefined
6	64	Ready to receive data.
7	128	On-line.

Unrecognized Secondary Talk Commands

When the printer receives a secondary talk command it does not recognize, it responds by sending a null byte (00000000) with the EOI line asserted.

Secondary Listen Commands

The secondary listen commands are Device Clear and Enter Data.

Device Clear X1110000

This performs the same function as a DCL and has no effect on the printer. Device clear is followed by a required parity byte used by other devices, which the printer ignores.

Enter Data X1100000

This command tells the printer that bytes following the command contain data to be printed. The printer should receive data bursts that are 16 bytes (or less) in length. For maximum throughput, the printer should receive data bursts of 1000 bytes (or less) in length. A burst length that exceeds 1000 bytes may be processed at a slightly reduced rate. If more than one burst size is sent, the critical time spec may be exceeded.

Unrecognized Secondary Listen Commands

When the printer receives a secondary listen command it does not recognize, it acknowledges the command as valid. It then reads and ignores all incoming data bytes until it receives an Unlisten command or a data byte with the EOI line asserted.

Identify Command Sequence

This command is used by the controller to identify devices on the bus and determine their characteristics. When the printer receives a primary untalk command followed by a secondary identify command specifying the printer's address in the lowest 3 bits, it responds with two data bytes. The first byte tells the controller that the device is a printer. The second byte tells the controller that the printer is an HP PaintJet XL printer. The response bytes are shown below.

Byte 1	(printer)	00100000	(20 hex)
Byte 2	(HP PaintJet XL designator)	00100000	(20 hex)

Appendix

A symbol set is a unique sub-grouping of all the available characters in a font. Each symbol set is defined to support a specific set of applications. Symbol sets are created for many purposes. The Roman8 set supports many non-English languages, and the PC8 set supports IBM PC applications. Note that the term character set is used interchangeably with symbol set in some applications.

The following tables show the Roman8 and PC8 symbol sets. You select one of these sets to be the default set for your HP PaintJet XL using one of the rear-panel switches. Refer to *Establishing a Symbol Set* in Chapters 1 and 2.

Roman8

Dec.	32	48	64	80	96	112	160	176	192	208	224	240
Hex.	2	3	4	5	6	7	A	B	C	D	E	F
0	0		@	P	'	p	À	—	â	À	À	Ð
1	1	!	A	Q	a	q	Á	ÿ	ê	Í	Á	Þ
2	2	"	B	R	b	r	Â	ó	ë	Î	Â	·
3	3	#	C	S	c	s	Ã	°	ô	Ï	Ã	¸
4	4	\$	D	T	d	t	Ä	¸	á	È	Ä	¹
5	5	%	E	U	e	u	Å	¸	â	É	Å	º
6	6	&	F	V	f	v	Ä	¸	ó	Ê	Ä	»
7	7	'	G	W	g	w	Å	¸	ô	Ë	Å	¼
8	8	(	H	X	h	x	Ä	¸	á	Ì	Ä	½
9	9	)	I	Y	i	y	Ä	¸	ê	Í	Ä	¾
10	A	*	J	Z	j	z	Ä	¸	ë	Î	Ä	¸
11	B	+	K	[	k	{	Ä	¸	ò	Ï	Ä	¸
12	C	,	L	\	l	|	Ä	¸	û	Ò	Ä	¸
13	D	-	M	]	m	}	Ä	¸	ä	Ó	Ä	¸
14	E	.	N	^	n	~	Ä	¸	ë	Ô	Ä	¸
15	F	/	O	_	o	¸	Ä	¸	ü	Õ	Ä	¸



PC-8

Dec.	0	16	32	48	64	80	96	112	128	144	160	176	192	208	224	240
Hex.	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	▶	!	0	@	P	'	p	Ç	É	á	⋮	L	⊥	α	≡
1	1	◀	"	1	A	Q	,	q	ü	Ê	í	⋮	⊥	⊥	β	±
2	2	⊙	‡	‡	B	R	a	r	ë	Ë	ó	⋮	⊥	⊥	Γ	≥
3	3	⊙	‡	‡	C	S	b	s	ä	ë	ü	⋮	⊥	⊥	π	≤
4	4	⊙	‡	‡	D	T	c	t	å	ö	ñ	⋮	⊥	⊥	Σ	∫
5	5	⊙	‡	‡	E	U	d	u	ä	ö	ñ	⋮	⊥	⊥	σ)
6	6	⊙	‡	‡	F	V	e	v	ä	ö	ñ	⋮	⊥	⊥	τ	+
7	7	⊙	‡	‡	G	W	f	w	ä	ö	ñ	⋮	⊥	⊥	μ	•
8	8	⊙	‡	‡	H	X	g	x	ä	ö	ñ	⋮	⊥	⊥	φ	•
9	9	⊙	‡	‡	I	Y	h	y	ä	ö	ñ	⋮	⊥	⊥	θ	•
10	A	⊙	‡	‡	J	Z	i	z	ä	ö	ñ	⋮	⊥	⊥	Ω	•
11	B	⊙	‡	‡	K	[j	{	ä	ö	ñ	⋮	⊥	⊥	δ	√
12	C	⊙	‡	‡	L	\	k		ä	ö	ñ	⋮	⊥	⊥	ε	η
13	D	⊙	‡	‡	M]	l	}	ä	ö	ñ	⋮	⊥	⊥	φ	²
14	E	⊙	‡	‡	N	^	m	~	ä	ö	ñ	⋮	⊥	⊥	ε	■
15	F	⊙	‡	‡	O	_	n	~	ä	ö	ñ	⋮	⊥	⊥	∩	■

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