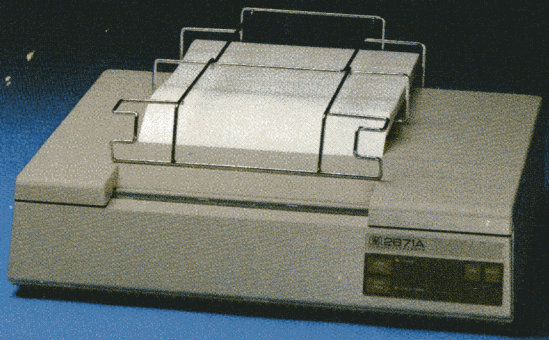
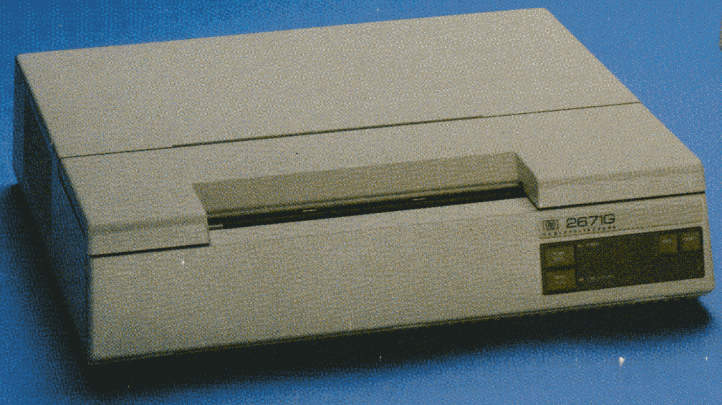
OWNER'S MANUAL

2671A PRINTER
2671G GRAPHICS PRINTER





HEWLETT PACKARD

A NOTE TO ALL WHO READ THIS MANUAL

This manual is structured in levels of information, according to what is needed, and you can read through it rapidly if you know how much information you want.

IF you already have an understanding of device control, and you want only the programmer's details, turn to **Section 6, the Appendices** Section 6 contains full charts of the control codes and escape sequence commands recognized by the HP 2671 printers.

IF you want only to know how to set up the printer and get it running with your particular system, skim through the first two sections. **Section 1, Getting to Know Your Printer,** contains basic information on setting up the printer and loading the paper. **Section 2, Starting Out,** gives specific information on using the printer with different Hewlett-Packard controllers.

IF you want to get the basic instructions, the background material, and all the details, you'll have to read the whole manual. The text was written with the intention of guiding you along, defining its terms as it goes.

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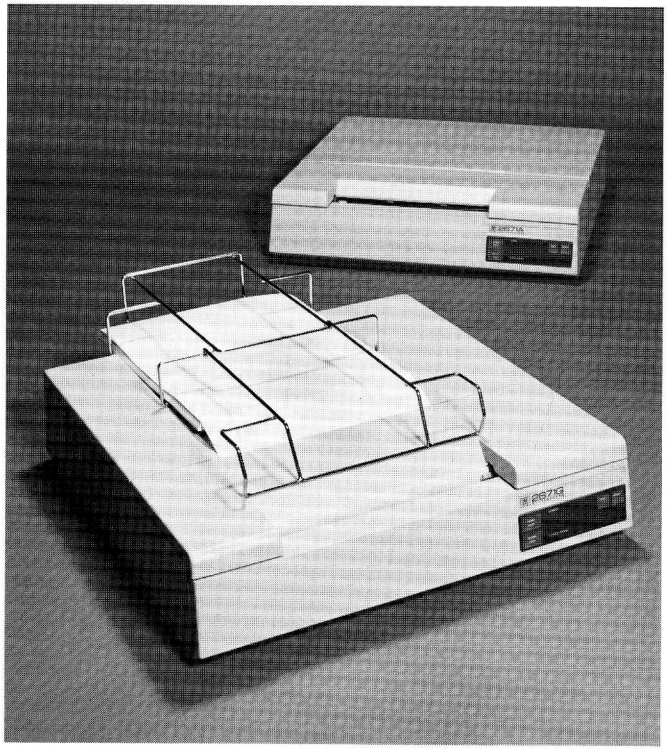

2671A
2673A

PREFACE

This manual will introduce you to all the features of the HP 2671 printers and guide you in their use. For your convenience, a full table of control codes and escape commands appears in **Section 6.**

UNPACKING AND INSPECTING YOUR PRINTER

Remove your printer from its shipping box carefully, and set it on a table or other flat surface. Remove the paper stacker, cables, accessories, and manuals from the box, and store the box in a dry place. Do not discard the box, because you may need it in the event that you have to return the printer to Hewlett-Packard for service.

Inspect for Damages

Inspect the printer for damage that may have occurred during shipment. If the printer is damaged, contact your local HP Sales and Service office for repairs and service information.

Check Interface Options

The rear panel of the printer houses the voltage switch matrix, the power connection, the printer interface, and the label, which shows the serial and model numbers of the printer. Check the interface you ordered against the interface provided with the printer (a list of interfaces appears on the option list on the following page). If you didn't get what you ordered, contact your local HP Sales and Service office.

Install the Fuse

The kind of fuse you need to use will depend on the voltage setting of the printer, which is determined by your local voltage requirements. The 220V and 240V power settings require use of a 0.75 Amp 250 Volt, 5 x 20 mm fuse, and the 100V and 120V settings require a 1.5 Amp 250 Volt 3AG style fuse. Extra fuses and fuseholder caps are provided with each shipment.

Two fuseholder caps are provided to accommodate your requirements. The grey cap accepts the 3AG style fuse (required for the 100/120V settings), and the black cap accepts the 5 x 20 mm European-style fuse (required for a 220/240V setting). The fuse receptacle is located on the left-hand side of the rear panel.

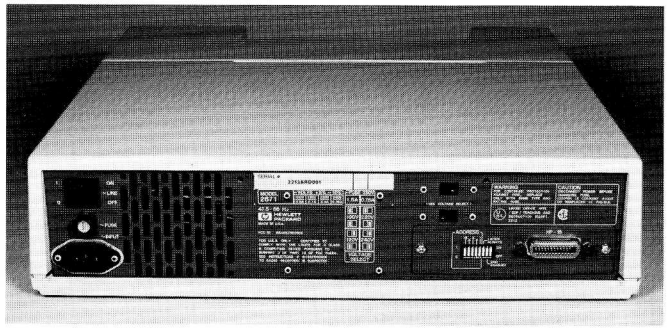
CAUTION: Make sure that the voltage setting of the printer matches your area's voltage requirement; an incorrect voltage setting can damage the printer and possibly injure personnel.

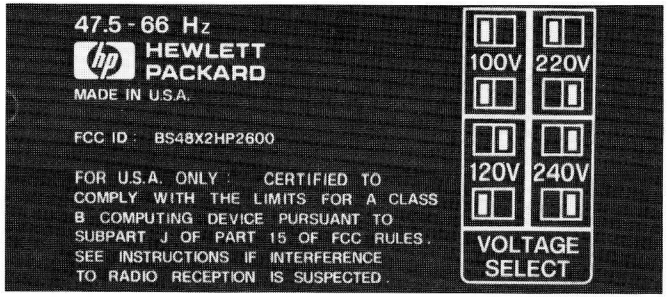
Changing the Voltage

Before turning your printer on for the first time, check the voltage switch matrix on the rear panel to make sure that the setting is correct. IF THE SETTING OF THE VOLTAGE SWITCH MATRIX DOES NOT MATCH YOUR LOCAL VOLTAGE, DO NOT TURN ON THE PRINTER.

To correct an incorrect voltage setting:

- Look at the matrix on the printer's rear panel. The numbers on the four curved lines are the voltages that will result from setting the switches to the positions indicated.
- Set the two switches to the positions that will give you the proper voltage.
- Check to make sure that you have the correct fuse (the fuse is located on the left-hand side of the rear panel). The 220V and 240V power settings require use of a 0.75 Amp 250 Volt fuse, and the 100V and 120V settings require a 1.5 Amp 250 Volt fuse. Extra fuses are provided with each shipment.





INTERFACE OPTIONS

-040 Delete HP-IB; add RS-232C serial interface (no cable)
-042 Delete HP-IB; add Centronics-compatible parallel interface (no cable)
-044 Delete HP-IB; add HP 8-bit parallel interface (no cable)
-240 HP 264X interface kit: 13238A Duplex Register card and 13232J interface cable (Deletes HP-IB, adds HP 8-bit Duplex interface)

ACCESSORIES

26710A HP-IB interface conversion kit
-040 RS-232C interface conversion kit
-042 Centronics-compatible interface conversion kit
-044 HP 8-Bit Parallel interface conversion kit

PAPER

Fan-fold Paper:

92160M (Blue)	Box of 8.5" x 11" Thermal Paper, page-perforated and fan-folded. Box contains 4 packs, 330 sheets (302.5') each.
92160N (Black)	

Roll Paper:

92160A (Blue)	Box (24 rolls) of 8.5" x 100' Roll Thermal Paper.
92160B (Black)	
92160C (Black, page-perforated)	

SYSTEM CONFIGURATION GUIDE

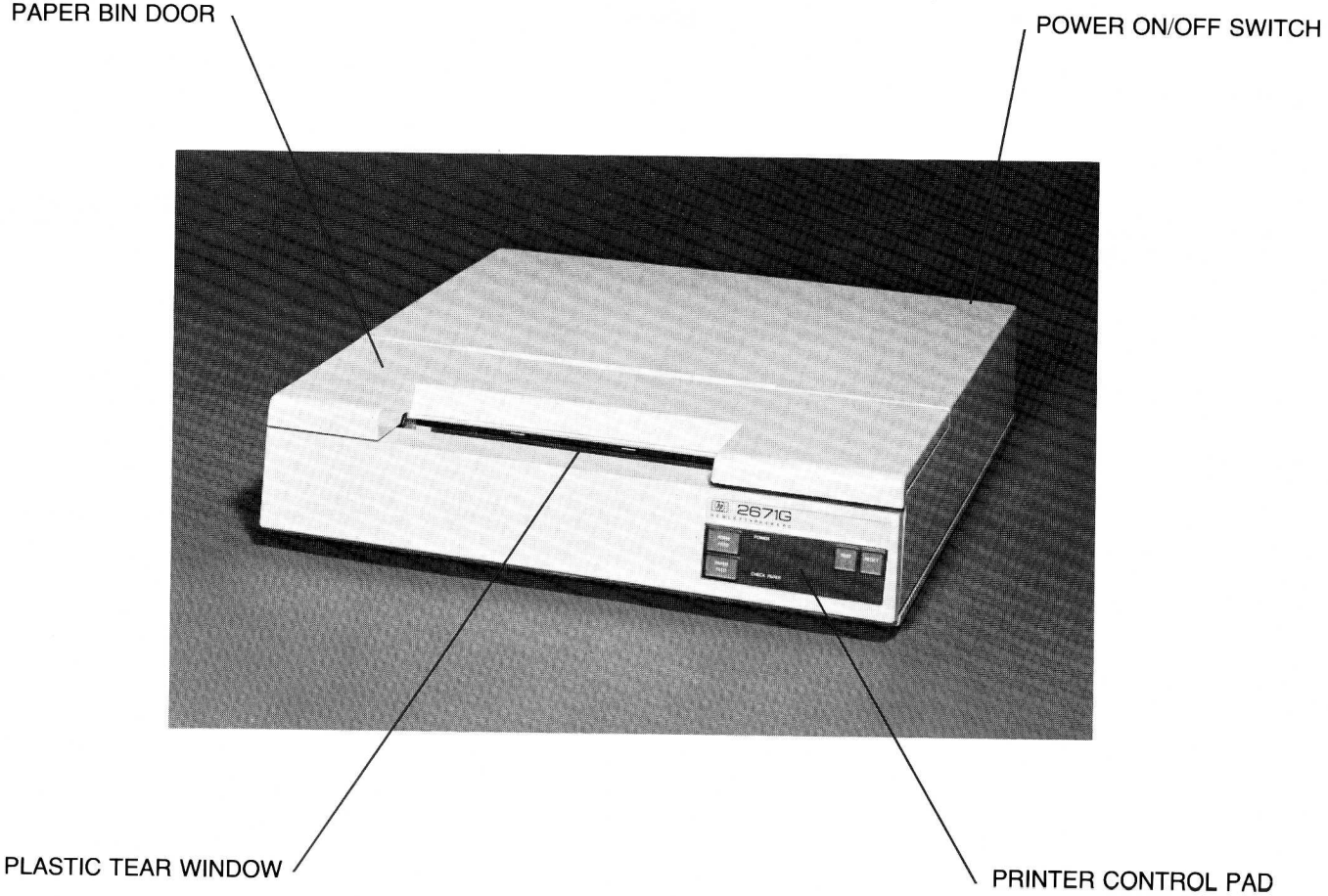
For obvious reasons, you need to have the right interface to successfully use the printer with your system. To make sure you have all the cables and interface cards needed to connect the HP 2671 printer to your controlling device, check the table below. The table shows what is needed to interface the HP 2671 printers to most Hewlett-Packard devices.

Product or System	Cables and Interfaces Required
9815S Desktop Computer	Computer ordered with 98135A HP-IB interface. Standard printer interface (HP-IB).
9825B/T Desktop Computer	Computer ordered with 98034A HP-IB interface. Standard printer interface (HP-IB).
9826A Desktop Computer	Standard 9826A includes HP-IB interface and cable. Standard printer interface (HP-IB).
9835A/B Desktop Computer	Computer ordered with 98034A HP-IB interface Standard printer interface (HP-IB).
9845B Desktop Computer	Computer ordered with 98034A HP-IB interface. Standard printer interface (HP-IB).
2640B Terminal	Printer ordered with option -240 (HP 264X interface kit).
2642A Terminal	Terminal ordered with Shared Peripheral Interface option -096. Standard printer interface (HP-IB).
2645A Terminal	Terminal ordered with one of the following: • 13261A device support firmware, OR • Integrated dual cartridge tape option Printer ordered with option -240 (HP 264X interface kit).
2647A Terminal	Terminal ordered with 13296A shared peripheral interface. Standard printer interface (HP-IB).

(continued next page)

SYSTEM CONFIGURATION GUIDE (continued)

Product or System	Cables and Interfaces Required
2648A Terminal	Terminal ordered with 13296A-048 peripheral interface. Standard printer interface (HP-IB).
262X Terminals	Printer ordered with option -040 (RS-232C interface). Cable required: #13242G (male-to-male 25 pin RS-232 connector) **Note: The 2621 terminals have only one RS-232 port and cannot support a printer.**
Series 80 Personal Computers	Computer ordered with all of the following: • 82936A ROM drawer. • 00085-15002 plotter/printer ROM. • 82937A HP-IB interface card. Standard printer interface (HP-IB).
HP 125	HP 125 includes HP-IB interface. Standard printer interface (HP-IB).


PAPER BIN DOOR
POWER ON/OFF SWITCH
PLASTIC TEAR WINDOW
PRINTER CONTROL PAD

GETTING TO KNOW YOUR PRINTER

1

INTRODUCING THE HP 2671

The receive-only HP 2671A and 2671G printers print bi-directionally at a rate of 120 characters per second. Their fast, quiet operation suits both these printers to a wide range of work environments. With three selectable character sets, the printers can format and print both text and forms with relative ease. The HP 2671G offers additional power by printing graphics from virtually any raster graphics source.

This chapter is to familiarize you with your printer, presenting information on day-to-day use of your printer, including instructions for loading and replacing the thermal paper and running basic printer functions.

The Printer Control Pad

The control pad on the front of the printer has four buttons, which are described below.

Paper Feed

The Paper Feed button causes the printer to feed one line of paper upward. If you hold the button down, the printer will feed paper line-by-line until you release the button.

Form Feed

The Form Feed button causes the printer to feed paper upward until the print head is positioned in the first line of the next page. If you are not using perforated paper, the printer will feed about 12 inches of paper (measured from the last top-of-form), then stop. If you are using perforated paper, the paper will feed until the perforation is positioned along the edge of the tear window.

Test

The Test button starts the printer self-test, in which the printer checks itself to make sure that it is in good operating condition. If the test is completed successfully, the printer will print a message that indicates that the self-test was successful. Because the self-test clears the printer features to their power-on settings, you should avoid performing a self-test in the middle of operation. **Section 6** contains more information on self-test.

Reset

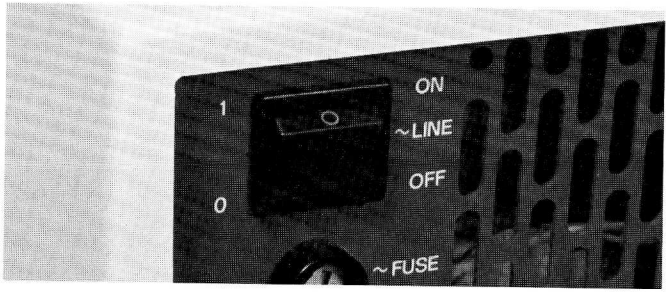
The Reset button clears the printer back to its power-on settings. **Section 6** of this manual contains more information on the reset function.

Indicator Lights

In addition to the buttons, the control pad has two indicator lights. The upper light is labeled, **"POWER"**, and indicates that the printer is plugged in and turned on. The lower light is labeled, **"CHECK PAPER,"** and it comes on when the printer is out of paper or when the paper latch in the paper bin is open.

Power-On Switch

The power-on switch, which turns the printer on and off, is located in the back of the printer. Simply rock the switch to the **"On"** position to turn on the power.



SPECIFICATIONS

Alphanumeric Printing

Print Speed	120 characters/second, bi-directional, optimized path. (Compressed mode 190 characters/second, bi-directional, optimized path.) Linefeed time: 66 ms first linefeed, 33 ms per linefeed for multiple linefeeds. Carriage Return time: 8.33 ms for each character position from print head position to left margin.
Character Type	7 x 11 dot matrix character in 9 x 15 character cell Full interstitial dots
Character Sets	128-character USASCII character set Line Drawing character set Roman Extension character set
Formatting	10 characters/inch (Normal mode) for 80-column lines 16.2 characters/inch (Compressed mode) for 132-column lines 6 lines/inch vertical spacing Command-controlled underlining

Graphics Printing (HP 2671G only)

Print Type	Unidirectional raster graphics copy 90 dots per inch print resolution (both vertical and horizontal) 720 dots per raster row across an 8" line of print
Output Format	Dot-for-dot copies from HP raster devices Dot-addressable graphics software-controllable from non-HP devices

Buffers

2671A	64 byte character buffer (2K byte input buffer standard with RS-232C interface)
2671G	2K byte ASCII buffer 1980 byte graphics buffer (equivalent to 22 raster rows, or 1.5 printed lines of graphics)

(continued next page)

SPECIFICATIONS (continued)

Controls	
Front Panel	Paper Feed, Form Feed, Test, and Reset buttons
Commands	Escape sequence control for margins, print mode, underlining, character set selection, perforation skip mode, display functions, printer reset, self-test
Interfaces	HP-IB (Hewlett-Packard Interface Bus), standard HP 8-bit parallel, optional Centronics-compatible 8-bit parallel, optional RS-232C serial, optional
Electrical	
Voltage	Switch-selectable: 100V, 120V, 220V, 240V (+5%, -10%)
Fuse Requirements	100V, 120V: 1.5 Amp 250 Volt Normal-Blo fuse 220V, 240V: 0.75 Amp 250 Volt Normal-Blo fuse
Frequency	47.5 to 66 Hz
Power Consumption	43 watts (maximum), operating 14 watts (maximum), standby
Physical	
Dimensions	Width: 428 mm (16.9″) Depth: 424 mm (16.7″) Height: 104 mm (4.1″)
Weight	6.9 kg (15 lb., 3 oz.)
Shipping weight	12.7 kg (28 lb.)

(continued next page)

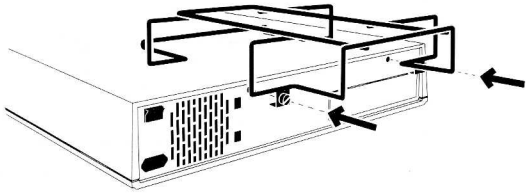
SPECIFICATIONS (continued)

Environmental	
Temperature	Operating: +0C to +55C* (+32F to +131F) Non-operating: -40C to +75C (-40F to +167F) *Thermal paper becomes unprintable at +40C (+104F)
Humidity	20% to 95% (non-condensing)
Altitude	Non-operating: 50,000 feet
Product Safety	
	UL Listed CSA Certified IEC 380 International Safety Standard Compliance
Additional Certifications	
	FCC Class B Certified Peripheral

SETTING UP

Place the printer on a flat surface convenient to your work area. Make sure that the air vent on the side of the printer is not blocked by a wall or other obstruction.

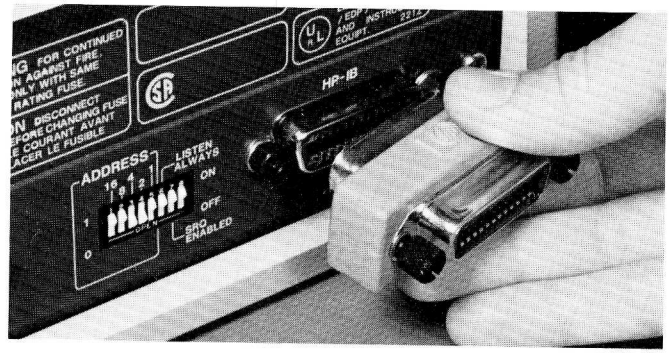
Install the paper stacker for fan-fold paper: position the stacker on top of the printer, and secure it in place with the mounting screws (see illustration below).

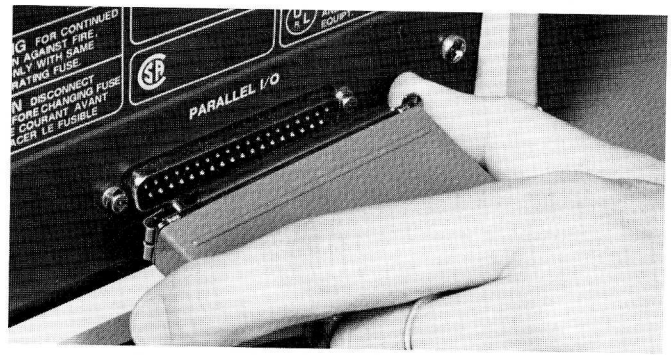


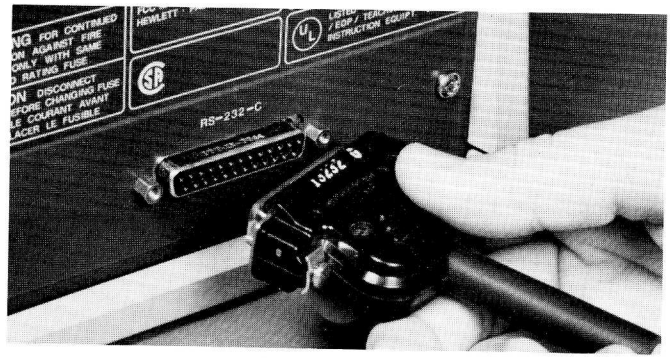
Connect the printer's power cable to the power receptacle on the rear panel, and plug the cord into a power outlet. **DO NOT** power the unit on until you have made sure that the setting of the voltage switch matrix matches your local power requirements. **See the instructions in Section 1.**

Connect the interface cable to the connector on the right side of the rear panel. Each interface cable is supplied with a secondary fastener to ensure a good connection between the cable and printer.

Load the thermal paper, as outlined later in this section.







LOADING AND REPLACING THE PAPER

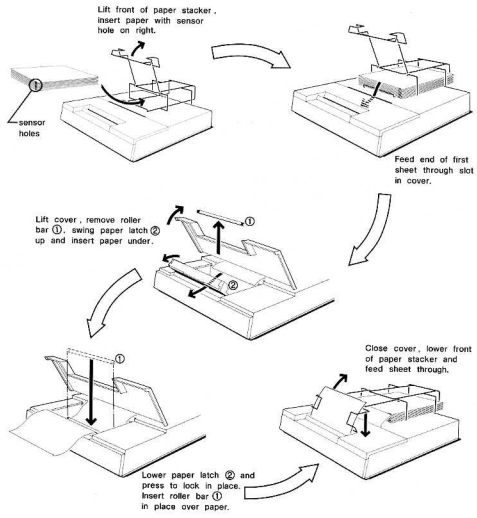
Your printer uses a thermal paper produced specifically for its print mechanism. You should always use HP Thermal Paper to ensure good print quality and long print head life.

NOTE: **You must always use HP Thermal Paper to maintain your service contract and HP warranty. Service contracts are available through your local HP Sales and Service office.**

Replacing Fan-fold Paper

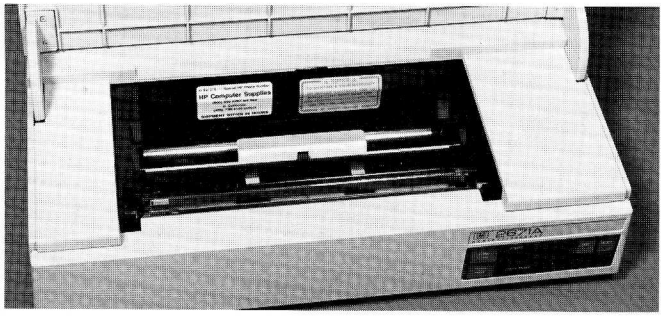
Proceed as follows to load-fan-fold paper into the printer:

- Slide the stack of new paper into the lower part of the paper stacker. Open the paper bin and raise the paper latch.
- Feed the leading edge of the paper forward into the paper bin between the raised paper latch and the clear plastic tear window. Make sure that the glossy side of the paper is facing the print head, or the printer won't be able to print on the paper. Be careful not to touch the print head.
- Lower the paper latch, but don't lock it into place. Line the edges of the paper up with the notches on the latch. Slide the metal rod into the guide slots of the paper bin, and press downward and back until it clicks into place.
- Press down on the paper latch until it locks into place with a distinct "click". Close the paper bin. Press the Form Feed button a few times to give the paper a head start on stacking itself on the paper stacker.



Replacing Roll Paper

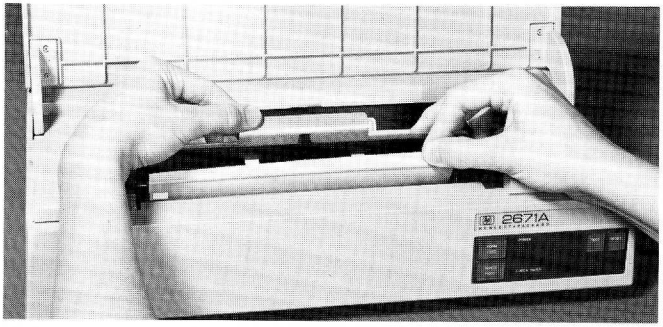
- Open the paper bin, and raise the metal paper latch. Remove any remaining paper, and pull out the metal rod that holds the paper roll.
- Remove the old paper core from the rod, and slide the rod into the core of a new paper roll.
- Place the rod and roll of paper into the guide slots and press downward and back until the rod clicks into place. The paper should unwind from the bottom of the roll toward the front, then upward past the print head. The glossy side of the paper must face the print head, or no print image will appear.
- Feed the leading edge of the paper toward the front between the paper latch and the clear plastic tear window. Be careful not to touch the print head.



- Lower the paper latch, but don't lock it into place. Line the edges of the paper up with the lines embossed on the edges of the tear window.

- Pull about 12 inches of paper upward past the plastic tear window and tear it off. The glue spot, which anchors the end of the paper on the roll, must not touch the print head during operation.

- Press down on the paper latch until it locks into place with a distinct "click." Close the paper bin. Tear off the excess paper.



MAINTENANCE

No routine maintenance other than paper replacement is required for your printer. If you wish to clean the external printer surfaces, either wash them with a very mild soap and water solution or clean with isopropyl alcohol.

IN CASE OF DIFFICULTY

In the event that your printer should stop during operation:

- Check to see if the printer is out of paper. If the paper has run out or the paper latch is open, the printer will not run (If either of these conditions exists, the **CHECK PAPER** light on the front panel should be lit).

- Press the **TEST** button to run the printer self-test. If the printer is operational, the self-test should run successfully.

- If the self-test doesn't work, perform a printer reset.

- If a reset doesn't solve the problem, power cycle the unit (turn the printer off, then on again).

- If the above have failed, you may need to replace the fuse. Always replace the fuse with one of the same type and rating.

- If the printer still fails to work after trying all of the above checks, turn the printer off, and contact your local HP Sales and Service office. A list of sales and service offices is located in the back of this manual.

STARTING OUT

2

In this section, you will find instructions for using the HP 2671 printers with various Hewlett-Packard devices. Detailed instructions concerning Hewlett-Packard terminals, desktop computers, and small computer systems cannot be contained in this manual; refer to the user's manual for your controlling equipment if you need more information.

IN INTRODUCTION: "SENDING" DATA TO THE PRINTER

The phrase, "send _____ to the printer" appears throughout this manual. Its meaning is outlined below.

Very simply, all you need to do to send something to the printer is to copy the characters to be sent from the memory of the controlling device (for example, to copy from the screen of a terminal). In some cases, this **COPY** procedure will be used to send a command to the printer, and other times it will be used to transfer text or graphics from a display screen to the printed page. In either event, the process is the same, and it is this process which is outlined in this section.

USING YOUR PRINTER WITH THE 9826 DESKTOP COMPUTER

The 9826 desktop computer is designed to let you copy both text and graphics in any of a number of ways: with special keys provided for the purpose of copying to a printer, with BASIC commands, or with HPL commands.

Before copying anything from the 9826 to your printer, you must tell the 9826 where to look for its printer. The method of doing this depends on the method of copying you plan to use.

If you plan to use the HP 9826 "Dump" keys or HPL commands, you must enter a " **prtsc** " statement. " **Prtsc** " defines the printer select code, with which the 9826 identifies its printer. The select code for an HP-IB printer is " **7** " followed by the HP-IB address. So, for example, if your printer's HP-IB address is " **01** ", you would enter the following statement to the 9826: " **prtsc701** ".

If you plan to use BASIC to copy to the printer, you must enter a " **DUMP DEVICE IS** " statement, which specifies the select code (" **7** ", followed by the HP-IB address). So, for example, if your printer's HP-IB address is " **01** ", your statement to the 9826 would read, " **DUMP DEVICE IS 701** ". (See **Section 6, Interfacing and Data Communications**, for more information on HP-IB addressing.)

Using the "Dump" Keys to Copy the Screen

The 9826 is equipped with two keys to copy text or graphics from the screen to the printer. These keys automatically enter the HPL commands to copy to the printer. After issuing the " **prtsc** " statement, you may copy either text or graphics from the screen simply and quickly.

After issuing the " **prtsc** " statement, you may copy text from the 9826 screen by **pressing:**

DUMP
ALPHA

You may copy graphics from the 9826 by **pressing:**

DUMP
GRAPHICS

Using HPL to Copy the Screen

If you are using HPL instead of the " **Dump** " keys, you may still easily copy the contents of the screen to the printer.

After issuing the " **prtsc** " statement, the HPL command to copy text from the 9826 screen is:

ADUMP

The HPL command to copy graphics from the 9826 screen is:

GDUMP

Using BASIC Commands to Copy the Screen

Using BASIC commands to copy text or graphics to the printer is also a simple matter, and, if you are executing a BASIC program, you may include the "Dump" commands as an integral part of your routine.

After issuing the **DUMP DEVICE IS** statement, the BASIC command to copy text from the 9826 screen is:

DUMP ALPHA

The BASIC command to copy graphics from the 9826 screen is:

DUMP GRAPHICS

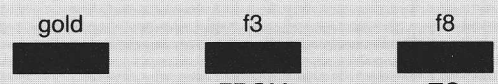
USING YOUR PRINTER WITH AN HP 2645 TERMINAL

(To interface your 2671 printer with the HP 2645 terminal, you will need the correct interface options and cables; refer to the **System Configuration** section at the beginning of this manual.)

The HP 2645 uses the Green and Gold key command convention, which is easy to use, once you know how it works. The method for copying text from the screen of the HP 2645 terminal to your 2671 printer is shown below.

The Gold key is used to define which device will be the Source (i.e., the device that the text is copied from) and which will be the Destination (i.e., the device that the text is copied to). Once you have defined the **"from"** and **"to"** devices, they will remain in effect until the terminal is either reset or turned off.

To prepare the HP 2645 terminal to copy from the screen to the printer, **press:**

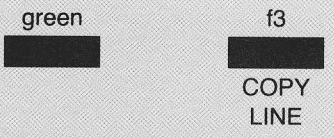


The Green key is used to define and start the function that you wish to perform. Any time after you have defined the **"from"** device as the display and the **"to"** device as the printer, you may use the green key to send text or control codes to the printer.

The **"Copy All"** instruction will copy everything from the cursor position onward in the display memory. To copy text from the terminal's screen to the printer, **press:**

To copy only one screenful of text, **press:**

To copy just one line from the screen, **press:**



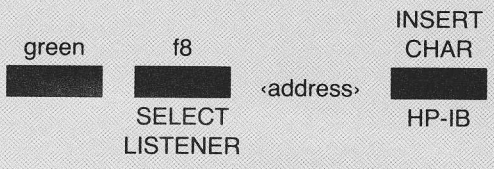
USING YOUR PRINTER OVER HP-IB WITH AN HP 2648 GRAPHICS TERMINAL

(To interface your 2671 printer with the HP 2648 terminal, you will need the correct interface options and cables; refer to the **System Configuration** section at the beginning of this manual.)

The HP 2648 graphics terminal uses the Green and Gold key command convention, which is outlined on the preceding pages (see **Using Your Printer with an HP 2645 Terminal**). The terminal understands the Green and Gold keys in the same manner as the HP 2645 terminal, and the HP 2648 understands the INSERT CHAR key (when used with the Green and Gold command keys) as a pointer to the HP-IB.

Before you can copy anything over HP-IB from the terminal to the printer, you must tell the terminal which HP-IB address the printer has.

To direct the terminal to the printer's HP-IB address, **press:**



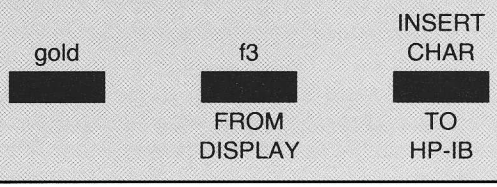
More information on HP-IB addressing appears in **Section 5.**

Once you have assigned the HP-IB address in the terminal's memory, you will not have to change it, unless you reset or power off the terminal or change the printer's HP-IB address.

Copying Text Over HP-IB From the HP 2648 Terminal

After you have told the terminal the HP-IB address of the printer, you may prepare the terminal to copy text to the printer by assigning the **"To"** and **"From"** devices with the Gold key, as shown in the following box.

To set the terminal up to copy text to the printer, **press:**



The device assignments set with the Gold key do not need to be repeated unless the terminal is reset or turned off. After defining the device assignments, you may copy text from the terminal's screen using the keys shown in the box below.

The **"Copy All"** instruction will copy everything from the cursor position onward in the display memory. To copy all to the printer, **press:**

To copy one screenful of text, **press:**

To copy just a line of text, **press:**

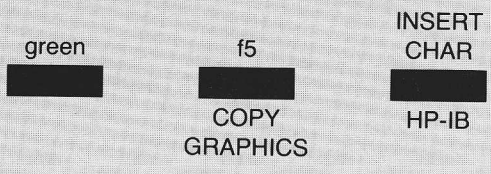
Copying Graphics Over HP-IB From the HP 2648 Terminal

After you have told the terminal the HP-IB address of the printer, you may prepare the terminal to copy graphics to the printer by assigning the devices with the Gold key, as shown in the box below.

To set the terminal up to copy graphics to the printer, **press:**

Once you have set the assignments with the Gold key, you will not need to reset them unless the terminal is reset or turned off. To perform the Copy Graphics operation, use the keys shown in the box below.

To start the Copy Graphics operation, **press:**



The terminal will send the printer the contents of its graphics memory.

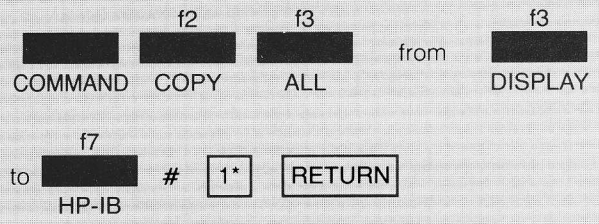
USING YOUR PRINTER WITH COMMAND KEY TERMINALS

(HP 2647, HP 2642)

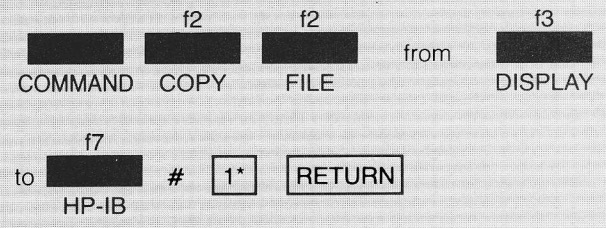
(To interface the 2671 printer with an HP 2647 or HP 2642 terminal, you will need the proper interface options and cables; refer to the " **System Configuration** " section at the beginning of this manual.)

Both the HP 2647 and HP 2642 terminals have a Command key, which guides you through the collection of functions that the terminal can perform. By pressing the Command key, you enable a special set of definitions for the eight function keys, and those definitions are displayed on the terminal's screen. You need only to press the appropriate function keys and end the sequence with the Return key to perform any of the terminal's functions.

To copy text from your terminal to the 2671 printer, **press:**



To copy just a screenful of text from the terminal to the printer, **press:**



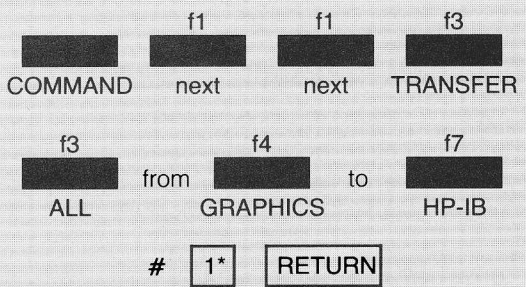
* HP-IB address, which may be any number from 0 to 29. See **Section 5** for details.

Copying Graphics from the HP 2647 Terminal

To copy graphics from the screen of the HP 2647 graphics terminal to the printer, you must use a **TRANSFER** (not a **COPY**) operation. When you *transfer* something from the terminal, the terminal will send everything in binary form (which means that each dot on the screen gets sent to the printer, rather than each character).

Again, copying from the terminal to the printer is a simple matter. Instructions appear in the box below.

To copy graphics from the HP 2647 to the 2671 printer, **press:**



When you are printing graphics from an HP 2647 graphics terminal, the image transfer will be a slow process. The HP 2647 has a time-delay built into its graphics transfer process, and it takes longer than some other devices to transmit fifteen raster rows.

Additional information on printing graphics with your 2671 printer appears in **Section 4** of this manual.

USING YOUR PRINTER WITH THE SERIES 80 PERSONAL COMPUTERS

(To interface your printer with a Series 80 personal computer, you will need the correct interface options and cables; refer to the **System Configuration** section at the beginning of this manual.)

Before copying anything from the Series 80 computer to your printer, you must tell the device where to look for its printer. To do this, enter a " PRINTER IS " statement which includes a select code for the HP-IB address. The select code for the HP-IB interface is " 7 ". So, for example, if the address of your printer is " 01 ", your PRINTER IS statement would read, " **PRINTER IS** 701 ". (See **Section 5, Interfacing and Datacommunications,** for more information on HP-IB addressing.)

Copying Text from the Series 80 Personal Computer

Once you have entered the **PRINTER IS** statement, any statements or operations on the Series 80 device that would normally result in printed output (such as **PRINT** statements) will cause the 2671 printer to print; no additional instructions are required.

Consult the User's and Reference Manuals for your Series 80 computer for detailed information on specific **PRINT** statements.

Dumping Graphics over HP-IB from the Series 80 Personal Computers

See the system configuration guide for information on hardware required to interface the Series 80 devices with the HP 2671G printer.

The two subroutines below will allow you to dump graphics over HP-IB from Series 80 devices. The first subroutine produces a dot-for-dot copy, giving you an image the same size as the screen image. The second subroutine doubles the length and width of the image, giving you a copy that is four times the size of the original screen image.

These routines are intended for use as subroutines in a larger program.

Routine 1: Same-size image

```
 10 INTEGER Q1
 20 DIM Q1$[32]
 30 PRINTER IS 701,132
 40 SET I/O 7,16,1                    ! Suppresses linefeed in end-of-line sequence.
 50 SETGU @ MOVE 0,100                ! Moves to upper left corner.

 60 FOR Q1 = 1 to 192
 70 BREAD Q1$, 32                     ! Reads a row of dots from the graphics image into Q1$.

 80 PRINT USING "K,K";CHR$(27) &
    "*b32W",Q1$                       ! Escape sequence.
 90 NEXT Q1
100 SETI/O 7,16,2                     ! Returns end-of-line sequence to CR-LF.

110 SETUU
120 END
```

Routine 2: Large Image

This routine sets up a conversion table which changes each dot of the graphics image into 4 dots on the printed page.

Because this routine is written in BASIC, and because it uses ongoing calculations during the transfer, it is extremely slow. If you need a quick graphics copy from your Series 80 personal computer, you might prefer to do a dot-for-dot copy instead of the large image.

```
 10 REAL Q1,Q2,Q3                     ! Real math is faster than integer.
 20 DIM Q1$[512],Q2$[64],Q3$[6]
 30 PRINTER IS 701, 132
 40 SET I/O 7,16,1                    ! Suppress linefeed.
 50 SETGU @ MOVE 0,100
 60 Q3$=CHR$(27)&"*b64W"              ! Escape sequence.
 70 Q1$[1,1]=CHR$(0) @ IF LEN(Q1$)=512
     THEN 180                         ! Check whether conversion table is already set up.
```

(continued next page)

Routine 2: Large Image (continued)

```
 80 RESTORE 90
 90 DATA 0,3,12,15,48,51,60,63,192,
     195,204,207,240,243,252,255
100 FOR Q1=1 TO 16

110 READ Q2@ Q2$[Q1]=CHR$(Q2)              ! Set up preliminary 4-bit conversion table.
120 NEXT Q1
130 FOR Q1=1 TO 16
140 FOR Q2=1 TO 16
150 Q1$[2*((Q1-1)*16+(Q2-1))+1]=
     Q2$[Q1,Q1]&Q2$[Q2,Q2]                 ! Set up 8-bit conversion table.

160 NEXT Q2
170 NEXT Q1
180 FOR Q1=1 TO 192
190 BREAD Q2$[1,32],32
200 FOR Q2=32 TO 1 STEP -1

210 Q3=NUM(Q2$[Q2])*2+1
220 Q2$[Q2*2-1,Q2*2]=Q1$[Q3,Q3+1]          ! Convert character using table.
230 NEXT Q2
240 FOR Q2=1 TO 2
250 PRINT USING "K,K"; Q3$,Q2$

260 NEXT Q2
270 NEXT Q1
280 SET I/O 7,16,2                         ! Reset CR-LF.
290 PRINT
300 SETUU

310 END
```

USING YOUR PRINTER WITH THE HP 2626 TERMINAL

(To interface the 2671 printer with an HP 2626 terminal, you will need the proper interface option and cable; refer to the "**System Interfacing Guide**" at the beginning of this manual.)

The special function keys of the HP 2626 (numbered f1 through f8) include a "device control" keyset, which allows you to copy from the display to an external printer, such as the 2671. Before you can copy text to the printer, however, you must define the Source (i.e., the device from which text will be copied) and the Destination (i.e., the device that text will be copied to). Once you have defined these "**from**" and "**to**" devices, they will remain in effect until the terminal is reset or turned off.

Defining the "**from**" device:

To prepare the HP 2626 terminal to copy from the currently-displayed workspace (the workspace that the cursor is in), **press:**

AIDS	f1	f2	f4
	device control	"from" device	FROM CRS WSP

(Another workspace may be defined as the "**from**" device with keys f5 through f8 in the same keyset. You may specify only one "**from**" device.)

Defining the "**to**" device:

To tell the terminal to copy to the HP 2671 printer, **press:**

AIDS	f1	f3	f2
	device control	"to" devices	TO EXT DEV

(More than one device may be defined as "**to**" devices using keys f3 through f8 in the same keyset.)

Once you have defined the "**from**" and "**to**" devices, you may easily copy text from the terminal to the printer.

To copy text to the printer, you must be in the "**device control**" keyset of the terminal. To enter this keyset, **press:**

AIDS	f1
	device control

To copy the full display memory from the defined Source (the current display or the assigned workspace), **press:**

f6
COPY ALL

As with the other HP devices, the 2626 terminal allows you to choose to copy the full display memory, as outlined above, just the text visible on the screen, or a single line.

From the "**device control**" keyset:

To copy just the text visible on the screen, **press:**

f7
COPY
PAGE

To copy just the line of text which contains the cursor, **press:**

f8
COPY
LINE

TEXT AND FORMS

3

This chapter presents information needed to format and print both text and forms with the HP 2671 thermal printers. The chapter begins with some background material for those who are unfamiliar with Hewlett-Packard device control and continues with more specific information on text formatting. After the text section, the chapter briefly outlines the steps involved in preparing forms.

For a complete list of control codes and escape sequence commands, turn to **Section 6.**

PRINTER COMMANDS

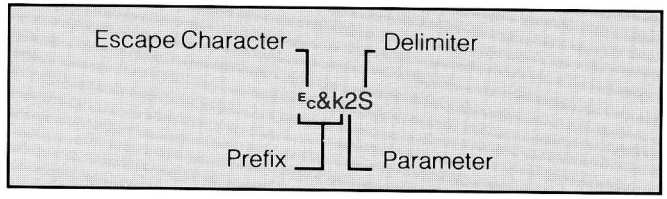
Most of the text formatting instructions discussed in this chapter appear in the form of escape sequence commands, which are sent from the controlling device to the printer. The following paragraphs outline some of the main characteristics of escape sequence commands. Feel free to do any of the exercises and examples as you read along.

Escape Sequence Commands

An escape sequence is composed of the following elements:

- The Escape character (Ec).
- A Prefix, made of two characters (not counting Ec) which define the general type of the escape sequence (prefixes are in parameterized escape sequences only).
- A Delimiter, which sets the outline of the command. Delimiters contained within an escape sequence are lower case alpha characters.
- A Parameter (or Value), which appears right before the delimiter and specifies the exact meaning of the command. The parameter may be any numeral (0 to 9).
- A Terminator, usually the last delimiter in a string of commands, which signals the end of the escape sequence. The terminator is always an uppercase letter.

For example, the escape sequence shown below enables the compressed printing mode. The prefix of the escape sequence (Ec&k) says that the sequence is used to set a latching function. The delimiter (S), which also functions as the terminator in this instance, says the command is a print mode selection. The parameter (2) defines the selection: compressed printing.



Parameters are optional and may be omitted; if you send a command without specifying the parameter, the printer will set the value of the parameter at zero (0). This is not to say that you may do anything with command parameters: if you specify a parameter in a command that does not require it, the printer will ignore the entire command. (A chart of escape sequence commands and their parameters is included in **Section 6** for your convenience.)

Combining Escape Sequences

Several commands with the same prefix may be combined into a single sequence, as in the following example. To combine escape sequences, begin the sequence with Ec and the rest of the shared prefix, then append the remaining characters from each command. The delimiters of the combined commands must appear in lower case, with the exception of the last delimiter, which must be in upper case because it serves as the Terminator for the sequence.

EXAMPLE: Combining Escape Sequences

Ec&k1F Ec&k2G and Ec&k1E

may be combined in the sequence

Ec&k1f2g1E

Command Errors

The printer executes commands in the order that it receives them. If the printer finds an error in the midst of a combined string of escape sequences, it will perform the commands preceding the error, and ignore the rest of the string. As soon as the printer receives a terminator for the string of commands, it will again be able to execute the commands as it receives them.

CONTROLLING BASIC PRINTER FEATURES

Form Feed and Paper Advance

To advance the paper without printing, you may either press one of the two forms buttons on the front of the printer or send the appropriate control code to the printer.

Paper Advance

The Paper Advance button advances the paper in the printer one line. The print head will remain in the same column position. The Linefeed control code ($^{L}_{F}$) is generated with CNTL and J on an ASCII keyboard, or by transmitting decimal 10 to the printer.

Form Feed

The Form Feed button will advance the paper in the printer twelve inches from the last top-of-form, or to the next perforation, if perforated paper is in use. During a Form Feed, the print head will remain in the current column position. The Form Feed control code ($^{F}_{F}$) is generated by CNTL and L on an ASCII keyboard, or by transmitting decimal 12 to the printer.

Display Functions

In the display functions mode, the printer prints control characters instead of acting on them. The printer will respond to only three commands when in display functions mode: carriage return ($^{C}_{R}$), turn off display functions (^{E}cZ), and, with an RS-232C interface, Enquire ($^{E}_{Q}$). The printer will print and execute Carriage Return and Turn Off Display Functions, and will execute Enquire without printing.

The display functions mode helps you to create and edit printed output, as it shows all the instructions the printer has received, both operator inputs and system commands. The display functions mode is a valuable tool in the editing process.

Display Functions Mode
Enable: ^{E}cY
Disable: ^{E}cZ

You may turn display functions on and off anywhere in a line of ASCII text.

Automatic Line Termination

Each line of text has a precise ending, which the printer can understand to be the end of a line. These line endings, or line terminators, are specific control characters and may differ from one controller to another. When you send text to the printer, the printer needs to know what kind of line termination you expect.

The line terminators that the printer accepts as valid are $^{L}_{F}$ and $^{F}_{F}$. If, for some reason, the printer receives a line that does not have a terminator, it will hold the line in its buffer and wait until it receives the terminator.

The printer can automatically terminate lines in a number of ways, as shown in the box below. At power-on or after a reset, the printer will understand a carriage return ($^{c}_{R}$) as a carriage return and a linefeed ($^{L}_{F}$) as a linefeed.

Choosing Line Terminators

^{E}c&k ‹definition› G

where the Definitions are expressed as follows:

0 = $^{c}_{R}$ maps to $^{c}_{R}$, $^{L}_{F}$ maps to $^{L}_{F}$, and $^{F}_{F}$ maps to $^{F}_{F}$ (default)

1 = $^{c}_{R}$ maps to $^{c}_{R}/^{L}_{F}$

2 = $^{L}_{F}$ maps to $^{c}_{R}/^{L}_{F}$; $^{F}_{F}$ maps to $^{c}_{R}/^{F}_{F}$

3 = both $^{c}_{R}$ and $^{L}_{F}$ map to $^{c}_{R}/^{L}_{F}$; $^{F}_{F}$ maps to $^{c}_{R}/^{F}_{F}$

FORMATTING

Margins

At power-on and after a reset, the left margin is set at column one, the leftmost print position, and the right margin is set at the rightmost position (column 80 in normal print mode).

To change the margins, send spaces to the printer to move the print head to the desired margin position and send the appropriate escape sequence to lock the margin there. The printer will not allow you to position the left margin to the right of the right margin or the right margin to the left of the left margin.

If you want to change the margins to a setting outside the bounds of existing margins, you must clear the old margins before defining the new ones.

Set Margins to Print Head Position

Set Left Margin: ^{E}c4

Set Right Margin: ^{E}c5

Clear Margins: ^{E}c9

The margins of the 2671 are logical margins, not physical stops. For instance, if the left margin is set at column 10, printing will always start at column 10; but whenever it is not printing, the print head will rest at the leftmost print position (column 1).

Margins in Compressed Mode

At power-on and after a reset, the left margin in compressed mode is set at column one and the right margin at column 132 (the rightmost print position). Margins in the Compressed printing mode are set and cleared in the same manner as in the Normal mode.

If you have redefined the margins in the Normal print mode and you change to the Compressed print mode, your margins will keep the same column numbers. For example, if you are printing in Normal mode with the margins set to 5 and 75, the margin settings you will have if you switch to the Compressed mode will also be 5 and 75 (note, though, that they have different meanings in terms of spacing).

If, on the other hand, you have redefined the margins in the Compressed mode, your margins may change column numbers when you switch to the Normal mode. Because the Normal mode prints just 80 characters per line, a right margin setting greater than 80 cannot be honored in the Normal mode; any such settings made in Compressed mode will default to 80 in the Normal mode.

Print Modes

The HP 2671 printer can print in either of two print pitches: the Normal print mode, in which the printer prints 10 characters per inch, and the Compressed print mode, in which the printer prints 16.2 characters per inch.

This is the Normal print mode. In the Normal mode, the printer prints 10 characters per inch, or 80 characters per eight-inch line, at a rate of 120 characters per second.

This is the Compressed print mode. In the Compressed mode, the printer prints 16.2 characters per inch, or 132 characters per eight-inch line, at a rate of 190 characters per second.

In the Normal mode, the default setting of the printer, the maximum line length is 80 characters. The maximum length for a line in the Compressed printing mode is 132 characters.

The escape sequence commands you need to select the print mode are shown below.

Select Print Mode

^{E}c&k ‹mode number› S

where the Mode Numbers are expressed as follows:

0 = Normal print mode (10 characters per inch) (default)

2 = Compressed print mode (16.2 characters per inch)

The printer recognizes commands to change print mode only when those commands appear at the beginning of a line. If a command to change print mode is sent to the printer while it is printing a line, the printer will hold off changing mode until the next line begins.

The HP 2671 printer will print in only one print mode per line. If two conflicting commands setting print mode appear in the same line, the printer will discard the first command, and execute the second command at the beginning of the next line. For example, if you command the printer to print in the Compressed mode, send a few words of text, then command the printer to print in the Normal mode (and if the two commands are embedded in the text and appear in the same line), the printer will print the entire line in the Normal mode. The reason: the printer sees two conflicting commands that apply to the same line of text, and it follows the latter of the two commands. (If, however, the command to start Compressed printing were to appear at the beginning of the line, the printer would print the entire line in Compressed and not shift to the Normal mode until the next line.)

Underlining

The printer can underline any line or a portion of a line on command. The printer underscores text by printing the characters, then underlining the text on the print head's next pass.

Underlining

Enable: ESC&dD
(The following terminators are also valid: E,F,G,L,M,N,O)

Disable: ESC&d@
(The following terminators are also valid: A,B,C,H,I,J,K)

The underlining feature may be defined to be a permanent feature, remaining active until it is specifically disabled, or it may be set to automatically turn off at the end of each line. At power-on, the printer is set to view underlining as a permanent feature.

Underlining Mode

One line at a time: ESC&k0E

On until disabled: ESC&k1E (Default)

Perf Skip Mode

The Perf Skip Mode causes the printer to skip over the paper perforation whenever the perforation is detected. In addition to keeping the printer from printing on the perforation, the Perf Skip mode formats your pages vertically by leaving margins at the top and bottom of each page. Before the first line of a page starts to print, the perforation will be in a position lined up with the tear window, and not in its top-of-page position.

CAUTION: The Perf Skip mode must always be enabled if the host system is not formatting your pages. If the Perf Skip mode is disabled and the host system is not formatting the pages, the print head may catch in the perf detection hole and tear the paper on its way back to the left margin.

Perf Skip Mode

Enable: ESC&l1L (default)

Disable: ESC&l0L

CHARACTER SETS AND HOW TO USE THEM

Definitions: Each character printed by the printer is a result of a coded signal that is received from the host computer or generated at a terminal when you press a key. The coded signal for each character is a *byte,* which is made of eight bits. A *bit* is a simple, two-state piece of information which is either on (=1) or off (=0). A *character set* is a group of characters which, together, represent all the letters or symbols of a particular language (such as USASCII) or function (such as Line Drawing or Math Symbols).

The HP 2671 printer has three character sets available for your use. They are:

- USASCII
- Roman Extension
- Line Drawing

A character code received by the printer may cause the printer to print one of two or three different characters, depending on which character set is active at the given time.

The *primary* character set, the character set in effect at power-on and normally in use, is always defined as USASCII. The *secondary* character set, which may be turned on and off by control codes during printer operation, can be defined with escape sequences as either Roman Extension or Line Drawing.

Using only 7 bits of a byte, you can generate 128 unique characters, the same number of characters that are contained in the USASCII character set. When using the 7-bit mode, a change from the primary character set to the secondary character set happens when the *shift-out* control code appears amid the data; characters generated following the *shift-out* character will be from the secondary set. A *shift-in* control code will return you to the primary character set.

Selecting the Secondary Character Set

At power-on, the secondary character set is defined to be the Roman Extension set. To change that, use one of the escape sequence commands shown below. The secondary character set will remain as defined until specifically changed or until the printer is powered off.

Define Secondary Character Set

Select Roman Extension: Esc)A (default)

Select Line Drawing: Esc)B

The Line Drawing character set helps you to create forms. When controlled by a device that supports the Line Drawing character set, the printer can exactly reproduce the forms which you create on the screen, using the same character codes and shift-in/shift-out instructions. For information on using the Line Drawing set to create forms, turn to the **"Forms"** section at the end of this chapter.

Using the Secondary Character Set

You may switch back and forth between the primary and secondary character sets, using the ASCII *shift-in* and *shift-out* control codes. The *shift-in* control code (generated by **CNTL O**) may be interpreted to mean, "**Shift into primary,**" while the *shift-out* control code (generated by **CNTL N**) may be interpreted to mean, "**Shift out of primary.**"

EXAMPLE: Shift Between Character Sets

If Line Drawing were selected as the secondary character set, you would proceed through the steps below to produce the following printout:

AAA┌─┐BBB┼─┼CCC

Step 1. Define the secondary character set to be the Line Drawing set, as described earlier in this section.

Step 2. Send " A " three times to the printer. The printer will print, " AAA ".

Step 3. Send a *shift-out* code (CNTL and N) to shift into the secondary character set. Send " A " again three times. The printer will print, " ┌─┐ ".

Step 4. Send a *shift-in* code (CNTL and O) to shift out of the secondary set. Send a " B " and note that you are back in the primary set.

Step 5. Continue, using the pattern in the steps above as a guide.

Character Set Access Mode

The *shift-in* and *shift-out* controls may be set to select character sets on either a line-by-line or semi-permanent basis. In the semi-permanent mode, the *shift-out* control code will cause the secondary set to remain active until it is specifically de-selected. In the line-by-line mode, the *shift-out* control code will be effective for one line only, and the linefeed or form feed at the end of the line will return the printer to the primary character set.

At power-on, the printer is set to access character sets on a semi-permanent basis. The escape sequence commands used to define the way these two control codes will work are shown in the box below.

Character Set Access Mode

Enable semi-permanent access: Ec&k1F (default)

Enable line-by-line access: Ec&k0F

8-Bit Mode

The 8-bit mode is an alternate method of switching between the primary and secondary character sets, and its operation is outlined in the paragraphs below.

Eight-bit mode uses all 8 bits of each character byte. In 8-bit mode, the status of the eighth bit (the most significant bit) determines whether a character will be from the primary or secondary character set. If the value of the bit is zero, the character code maps to a character from the primary character set. If the bit is set to one, the character will come from the secondary set. The **USASCII and Roman Extension Character Sets** table in **Section 6** offers a good illustration of how the eighth bit changes a character's definition between the USASCII and Roman Extension character sets.

The Roman Extension character set contains characters which are used in some European and Hispanic languages, but are not included in USASCII. When the printer is receiving data in 8-bit mode, and the data being received includes some European or Hispanic characters, the printer will reach into the Roman Extension character set to print the non-ASCII characters.

The *shift-in* and *shift-out* control codes are effective in 8-bit mode in the same manner as in 7-bit mode: the *shift-in* control code assigns the character map belonging to the primary set, and the *shift-out* control code assigns the map belonging to the secondary set.

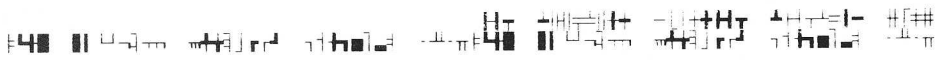
Relating Character Sets to Each Other

The print-out which results from the printer self-test, besides being a test pattern for the print head, is a good source of character code and character set information. The first lines of the print-out show the Line Drawing character set; the next pair of lines show the Roman Extension set; and the bottom two lines show the full 128-character USASCII set (which includes control codes, numbers, upper and lowercase letters, and punctuation marks).

The characters are arranged in such a way that the characters from one character set are placed in a position that lines up exactly with their corresponding character in another set. For example, the ASCII character " @ " corresponds with the Line Drawing character " ├ ", " C " corresponds to " ▀ ", and " S " corresponds to " ▄ ".

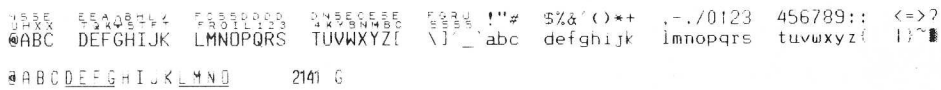
In addition to this tie between character sets, the print-out shows the relationship between ASCII characters and the control codes, as it places the ASCII characters directly beneath the codes generated by that character and CNTL. For example, " N " appears directly under " $^{S}_{O}$ " (the shift-out character).

Line Drawing Character Set



Roman Extension Character Set

128 USASCII Character Set



CREATING FORMS

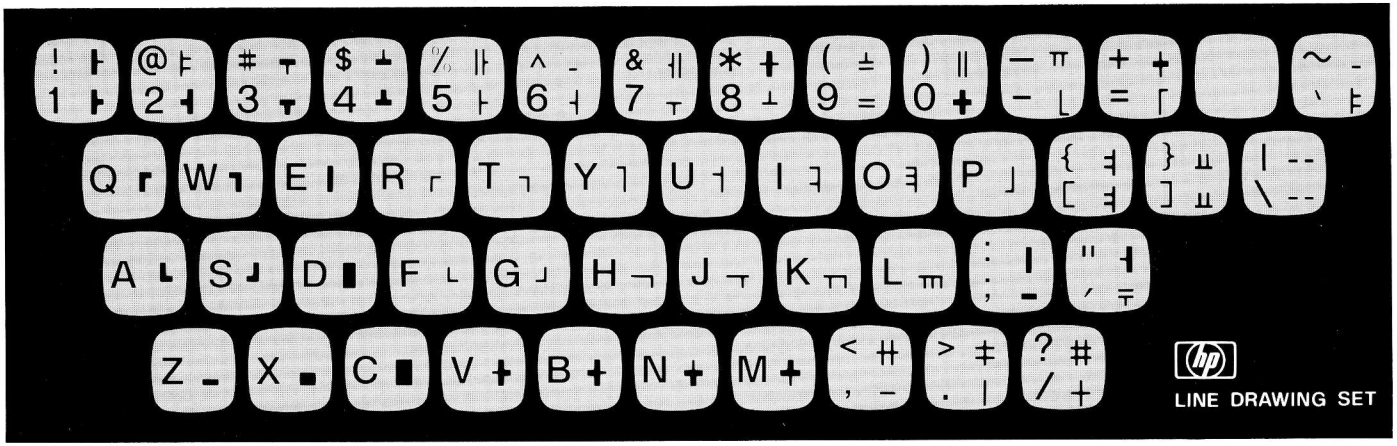
With Line Drawing selected as the secondary character set, the HP 2671 printers can print complex forms with relative ease. Forms printing requires only that the secondary set be active for each line of printing in the form. If the device controlling the printer is also equipped with the Line Drawing character set, any forms you wish to print may be generated first on the screen, then copied. You do not have to display the forms in order to print them, though; you may use the ASCII character that corresponds to each Line Drawing character to represent the Line Drawing character in either a display or a program. Remember to precede the ASCII characters with a shift-out control code.

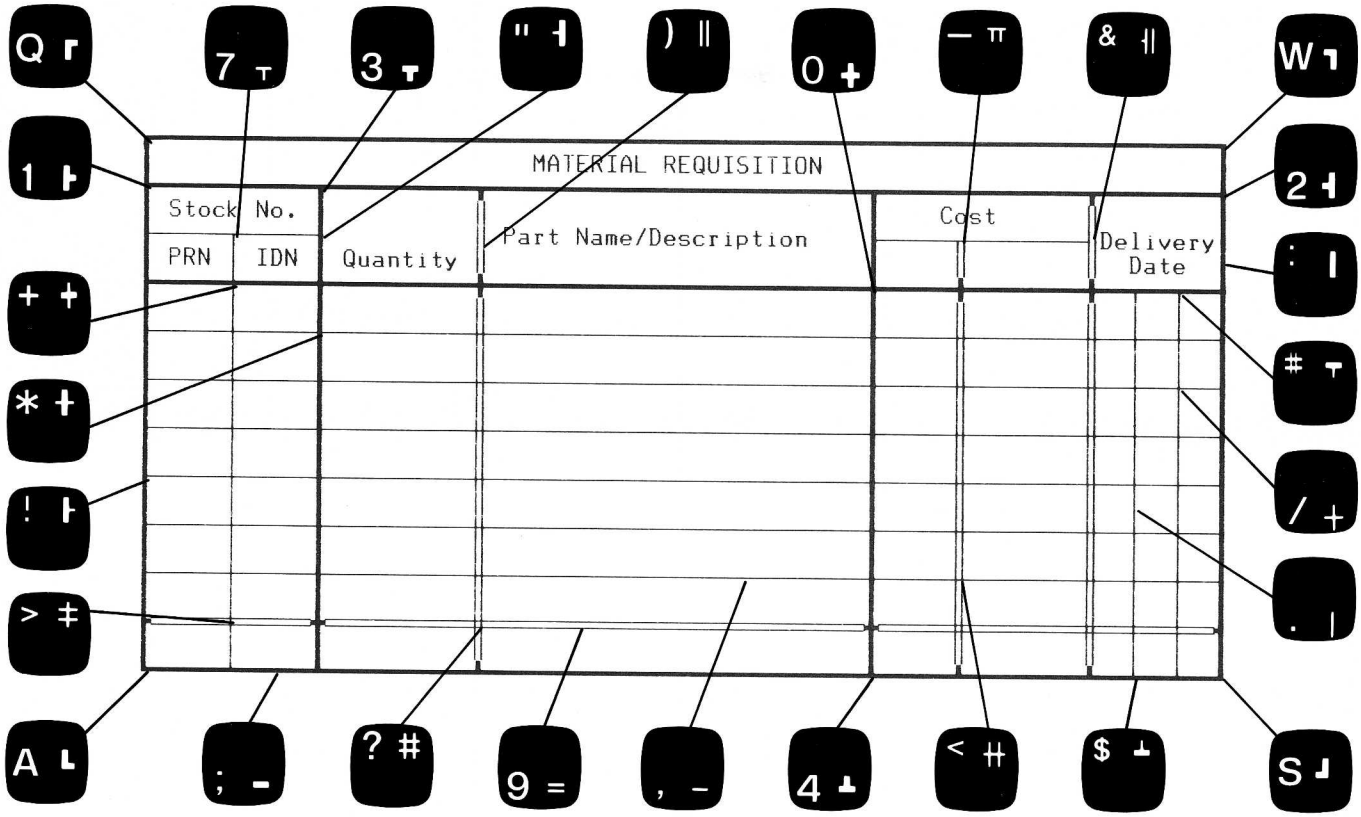
When creating forms, set the Character Set Access Mode to semi-permanent access, rather than line-by-line. The line-by-line mode will require you to send a shift-out code for each line of the form.

To create a form, select Line Drawing as the printer's secondary character set [Esc)B], send the printer a shift-out control code, and press the ASCII keys on the terminal keyboard that represent the Line Drawing characters you need. Lines containing Line Drawing characters will always be printed unidirectionally to ensure good vertical alignment of the characters from line to line.

The figure below shows the Line Drawing set as it corresponds to an ASCII keyboard, and how the different characters may be used in a form.

NOTE: Graphics and Line Drawing are not the same thing. Information on using the printer in graphics mode is featured in the next section of this manual.


LINE DRAWING SET


MATERIAL REQUISITION
Stock No.
PRN
IDN
Quantity
Part Name/Description
Cost
Delivery Date

GRAPHICS

4

This section applies only to the HP 2671G printer, which can print raster graphics from virtually any raster graphics source. This chapter is structured in two main parts: it begins with some general information about raster graphics and ends with instructions for printing graphics with your HP 2671G printer.

For a complete list of control codes and escape sequence commands, turn to **Section 6.**

ABOUT RASTER GRAPHICS

Raster graphics is, very simply, a dot matrix approach to graphics. A raster picture is a graphic image made up of little dots, which are called *pixels (picture element dots).*

In Hewlett-Packard devices, a raster picture is created and transmitted in horizontal rows of dots, one row at a time. Each such row of dots is called a *raster row.*

When you send a raster image from a terminal or other device to the HP 2671G printer, the image is sent one raster row at a time. The printer does not print each raster row as it is received, however, because the print head is fifteen dots high, and printing just one dot-row at a time wouldn't be efficient. Instead, the printer waits until it has received fifteen raster rows of the image, and then the head moves across the page to print.

PRINTING RASTER GRAPHICS

Printing raster graphics from a terminal or desktop computer requires a *binary transfer* of the image from the source to the printer. This means that the source must send 8-bit codes which say whether each dot in each raster row is On (=1) or Off (=0). On HP terminals with a command key, such as the HP 2647, such a transfer requires only that you use the **TRANSFER** command (i.e., "**TRANSFER ALL FROM GRAPHICS TO HPIB #__** ") instead of the **COPY** command. The **DUMP GRAPHICS** key on the HP 9826 Desktop Computer performs a Transfer operation without special instruction. *These command keys allow you to copy graphics without using escape sequence controls.*

The HP 2671G has simple graphics capabilities, and the escape sequence commands controlling graphics are very easy. The commands are outlined in the following paragraphs.

Starting Raster Mode

It is not absolutely necessary to send the HP 2671G the command to begin printing in raster mode; the printer "knows" that when it receives the Transfer Raster Row (^{E}c*b...) command, it should enter the raster mode. However, if you are using escape sequence control, it is good practice to send the **"Start"** and **"Stop"** raster commands every time you transfer graphics images.

Start Raster Mode

^{E}c*rA

Copying the Image to the Printer

The **"Transfer"** command shown below should be issued for each raster line to be printed. A detailed explanation of the parts of the command follow.

Transfer One Raster Row

^{E}c*b ‹byte count› W ‹binary data›

The Byte Count referred to in the above command is a numeral from 0 to 90, which specifies how much data is to be contained in the raster row. If the Byte Count is zero, then the printer will understand that to be a blank row. A 2647 terminal's screen is 720 dots wide. If a graphics image uses all 720 of those dots, it will require 90 bytes to transfer the image (because each dot is a bit of information, and 8 bits comprise a byte).

○○●○○●●●	00100111	(39)	(27)
dot pattern	binary	(decimal)	(hexadecimal)

NOTE: You may actually specify a transfer of up to 255 bytes, but the printer will ignore all data following the first 90 bytes of each raster row.

The "**W**" in the sequence is the delimiter and signals the printer that the data of the raster image will follow immediately.

The Binary Data field of the command is where the binary expression of the raster image comes through to the printer. As explained earlier, each dot is a bit which is either On (= 1) or Off (= 0). The method for translating dot patterns into binary expressions is shown in the figure at the top of this page.

Ending Raster Mode

As with the "Start" command, it is not absolutely necessary to send a command to tell the printer to exit the raster printing mode; the printer "knows" that when it receives data beyond the number of bytes specified in the last Transfer Raster Row ($^{E}c^{*}b$) sequence, that the data is ASCII data, and that it should empty its graphics buffer and start printing ASCII. However, if you are not following the graphics image with ASCII text, you must send the "**Stop**" command in order to empty the printer's graphics buffer.

Exit Raster Mode
$^{E}c^{*}rB$

GENERAL NOTES ON GRAPHICS PRINTING

- If you press the Form Feed or Paper Feed buttons on the printer control pad while printing graphics, the printer will perform a form feed or linefeed at the end of its next line of printing, and the graphics image will suffer: you will have a split image. The printer performs linefeeds and form feeds as soon as it is free to do so.

- If a " Graphics Module Failure " message was printed by the 2671 at power-on, your printer will not be able to print graphics. Any attempt to print graphics will have unpredictable results.

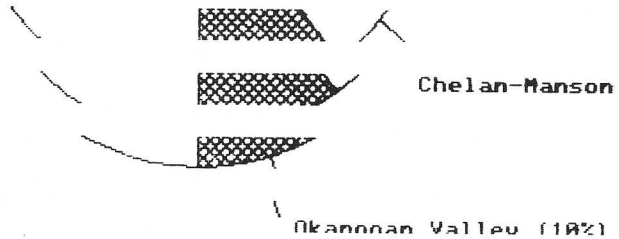
- Leading and trailing blanks are suppressed on each raster line. If you have a blank raster line, the print head will simply stay at the left margin and perform linefeeds.

- Graphics images are always printed unidirectionally to ensure good vertical alignment from line to line.

- When printing graphics on a printer equipped with an RS-232C interface, your printer must be configured for 8-bit data with no parity. Graphics data requires use of all 8 data bits.

Outline of the Raster Transfer Process

$^{E}_{c}$*rA	(Command to start raster mode)
$^{E}_{c}$*b90W ‹datadatadata›	(Printer receives one raster row)
$^{E}_{c}$*b90W ‹datadatadata›	(Printer receives fifteenth raster row and prints one line of graphics image)
$^{E}_{c}$*rB	(Command to exit raster mode; printer empties graphics buffer)



INTERFACING AND DATACOMMUNICATIONS

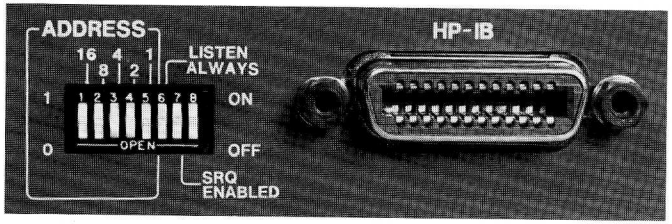
5

This section contains information on the four printer interfaces: HP-IB, 8-bit Parallel, RS-232C, and HP-IL. The information ranges from general definitions to details of handshaking and switch settings.

For information on system configuration, refer to the first pages of this manual.

HP-IB

The Hewlett-Packard Interface Bus is among the most common interfaces between two HP devices. HP-IB is a 16-line bus, of which the 2671 printers support only the lines involved in the transmission of data; the printers do not support secondary commands.



Setting the Switches

The eight switches on the rear panel are used to configure the HP-IB for Listen Always (or Address to Listen), Service Request (enabled or disabled), and HP-IB address. These functions and settings are described in the following paragraphs.

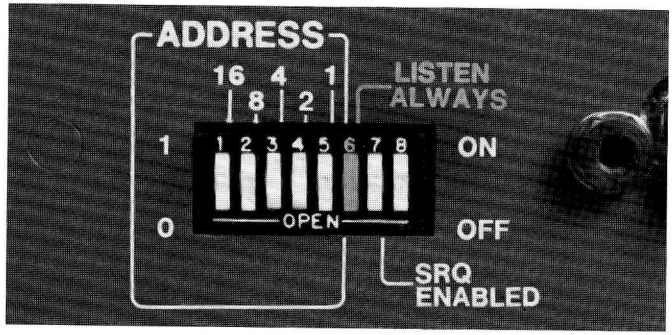
Listen Always/Addressed to Listen

Each device on HP-IB is a Listener, a Talker, or a Controller. Your 2671 printer is primarily a listener, meaning that it will receive data and will transmit only model number status. It can "**listen**" in either of two ways.

First, the printer can "**listen always.**" This means that the printer will receive everything that comes over the data lines, even if it is intended for another device on the HP-IB.

Secondly, the printer may be "**addressed to listen.**" This means that the printer will receive only data that is addressed specifically to it, and it will ignore everything else coming over the HP-IB. The printer's address is a specific number, by which the controlling device can recognize the printer, and is defined with external switches, which are discussed in the section on **Addressing** below.

Switch 6 sets the printer to Listen Always or Address to Listen, as shown below.

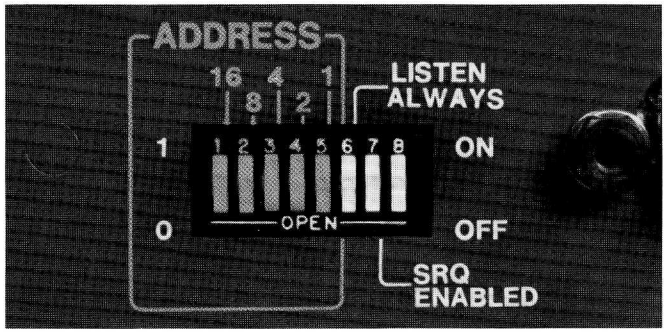


Addressing

The first five switches of the HP-IB group on the rear panel are used to set the HP-IB address, as mentioned earlier in Section 2. If the printer is set to Listen Always, the HP-IB address will not be used in sending data to the printer. The printer may be given any address from 0 to 29 (decimal).

NOTE: **Addresses 30 and 31 are invalid and will cause the printer to default to NO ADDRESS, LISTEN ALWAYS.**

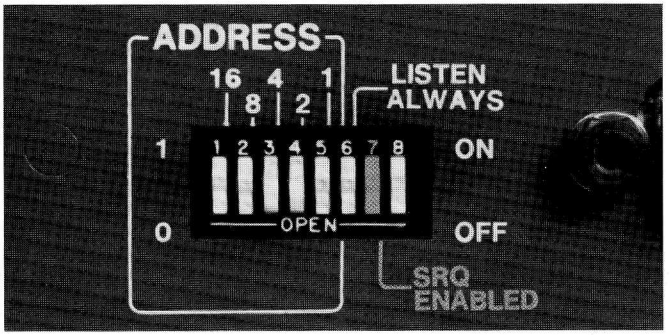
To set the address of the printer, choose a number that is not already in use by a device on the HP-IB. Set the switches in the open (=0) and closed (=1) pattern to match the binary equivalent of the number you have chosen for the address. For example, the address switches shown in the picture below define the HP-IB address as 6 decimal (00110 binary).



The HP-IB address is used whenever you send something to the printer over HP-IB (unless the printer is set to Listen Always). For example, a **COPY** command (from a 264X terminal) to send text to a printer configured as shown above would read, **" COPY ALL from DISPLAY to HP-IB #6 ".**

Service Request (SRQ)

The 7th switch of the HP-IB group is used to enable or disable the service request. The service request is a signal that the printer sends to interrupt the controlling device when it is out of paper or its paper bin door is open. With some systems, you cannot use the service request, because the system doesn't handle it.

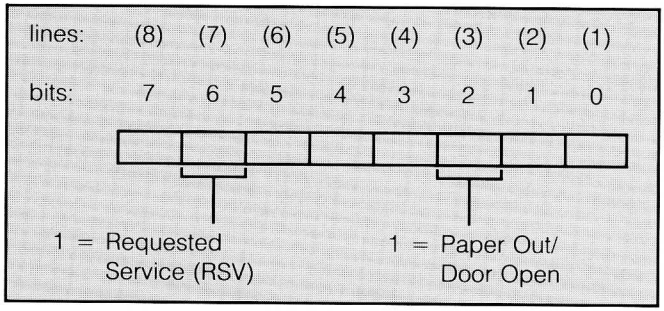


Polling

The controller on the HP-IB may run periodic checks of the devices on the bus to find out which, if any, of the devices requires service; or a device may request a service interrupt, which may prompt the controller to check the devices on the bus. Two kinds of polling may be performed over HP-IB: serial and parallel.

Serial Poll

The controller will perform a serial poll either in search of information or in response to an SRQ. In a serial poll, the controller requests status of one specific device on the bus by addressing only that device. The controller sends the printer a command to allow it to respond, and the printer returns an eight-bit status byte, which is shown below. Data In/Out (DIO) line numbers are given in parentheses.



If the controller is polling in response to the printer's Service Request (SRQ), the printer will have set bit 6 to 1 (DIO line 7 will go low).

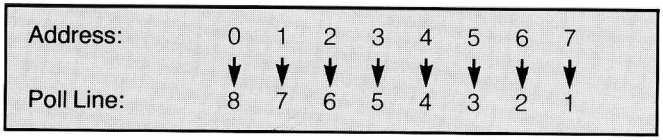
Serial polling is invalid if the printer is configured to Listen Always.

Commands used in serial polling: SPE (Serial Poll Enable, decimal 24), SPD (Serial Poll Disable, decimal 25).

Lines used in serial polling: ATN (Attention), DIO (Data In/Out) lines 1 through 8.

Parallel Poll

The controller can perform a parallel poll only if the devices on the bus have addresses 0 to 7. Each of the eight devices is assigned a line, and the line numbers correspond to the addresses in the following manner:



The controller activates the two lines that enable the parallel poll (EOI and ATN), and each device responds over its assigned DIO line. The device sets its line low if it requires service and high if it does not.

Any device on the interface bus can pull on SRQ and interrupt the controller; parallel polling provides a fast way to determine which device sent the SRQ.

Lines used in parallel polling: EOI (End or Identify), ATN (Attention), DIO lines one through eight.

Device Clear (DCL)

In addition to the commands used in serial polling, the printer recognizes the Device Clear (DCL) command. When the controller sends the printer a DCL (decimal 20), it is commanding the printer to "Go to a known state," which the printer interprets as "Clear any output pending to the HP-IB controller." (Output, if any, will be model number status information.) If the intention of the Device Clear command is to reset the printer, an $^{E}_{c}$E should be used instead of the DCL.

Model Number Status

Some systems require a means for identifying the type of the printer. The 2671A or 2671G will transmit its model number when it receives either of the following escape sequences from the controller:

$^{E}_{c}$*s^

$^{E}_{c}$*rK

8-BIT PARALLEL INTERFACE

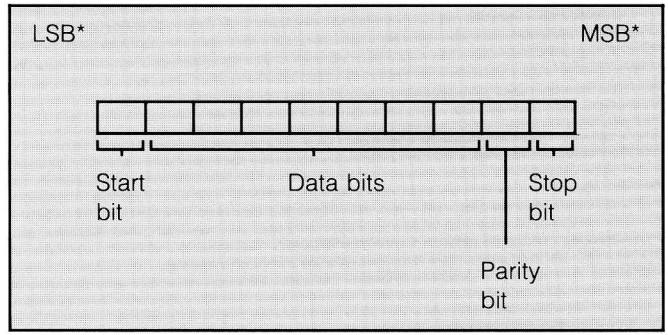
The HP 8-bit parallel interface (also called 8-bit Duplex) provides simple communications between the printer and a number of HP devices. The 37-pin connector on the rear panel provides a sliding-lock secondary fastener to ensure a snug connection between the printer and cable.

When you are interfacing your 2671 printer with an HP controller, use cable # 13232J.

If you ordered the Centronics-compatible parallel interface, your printer was also supplied with a pigtail adapter, which converts the 37-pin connector to a 36-pin connector. The adapter should be installed between the printer's connector and your cable.

RS-232C INTERFACE

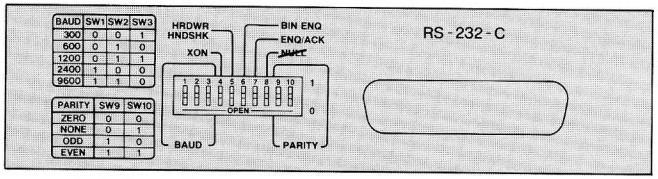
The optional RS-232C interface of the HP 2671 printer provides a means of serial data communications between the printer and a controller. Serial data communications differs from other forms of datacomm in that serial data is transmitted one bit at a time, rather than a whole byte at once. In the serial data transmissions recognized by the 2671 printers, data is transferred in the following format:



The start bit and stop bits frame each word of data. The 2671 printers can accept data with one or more stop bits, but data transmitted by the printer will always have two stop bits. The parity bit, as outlined in the paragraphs that follow, may be redefined or replaced by an eighth data bit.

*LSB = Least Significant Bit
MSB = Most Significant Bit

This section outlines how to configure the printer for your particular RS-232C application, what kind of status information may be requested of the printer, how to increase throughput if you are not using handshakes, and how to configure the 13250A/B interface board (which you may need to interface the printer to an HP 264X terminal or other controller).



Setting the Switches

Ten switches on the RS-232C rear panel determine the printer's baud rate, active handshake, and parity. The switch settings are defined in the paragraphs that follow.

Baud Rate

The baud rate is the speed of data transmission, measured in bits per second. If, for example, you have a data transfer at 1200 baud, you are transferring 1200 bits per second, which is equivalent to 120 characters per second (using 10-bit bytes).

Seven different baud rates, shown in the table below, may be selected by setting the first three switches on the back panel. The baud rate selected for the printer must match the baud rate setting of the host device.

Baud Rate	SW1	SW2	SW3
150	0	0	0
300	0	0	1
600	0	1	0
1200	0	1	1
2400	1	0	0
4800	1	0	1
9600	1	1	0
(reserved)	1	1	1
0 = Open 1 = Closed			

Handshakes

Handshakes are signals exchanged by the printer and its host to prevent data overrun (i.e., data being transmitted faster than the printer can accept it). The handshake needed for a specific application depends on the requirements of the host system.

Switches 4 through 7 on the RS-232 rear panel determine which handshake, if any, will be active for printer datacomm. The HP 2671 printers can use four distinct handshakes or a combination of the four: Xon/Xoff, Hardware Handshake, Binary Enq/Ack, and Enq/Ack. These are described in the following pages.

Xon/Xoff

With the Xon/Xoff handshake, the printer keeps track of how many characters are in its buffer and signals the host device when it can and cannot accept more data.

The printer has a 2048 (2K) byte buffer and will accept data until 1920 bytes have accumulated in the buffer (i.e., when the buffer has room for 128 more bytes). When the buffer has filled to that point, the printer will send the host an Xoff character to stop data transmission. The Xoff character used by the 2671 printer is a DC3 (19 decimal).

After sending the Xoff character, the printer will continue to print, pulling data from its buffer. When the buffer contents have fallen to 1792 bytes (i.e., when the buffer has room for 256 more bytes), the printer sends the host an Xon character to restart data transmission. The Xon character used by the printer is a DC1 (17 decimal).

The Xon/Xoff handshake is used by the HP 2624 and 2626 terminals (with cable 13242G) and is also frequently used by non-HP systems. To enable the Xon/Xoff handshake, set Switch 4 to its closed (=1) position.

Hardware Handshake

Unlike the other handshakes used by the printer, the Hardware Handshake uses an electrical impulse to signal its host (all other handshakes use characters sent in the data stream). With the Hardware Handshake, the printer keeps track of the number of characters in its buffer and signals the host when it can accept data. The handshake signal is in the form of a "Printer Ready" signal; when the signal is on (=1), the printer can accept data, and when the signal is off (=0), the host must hold off data transmission.

As with the Xon/Xoff handshake, the printer using the Hardware Handshake will accept data until 1920 bytes have accumulated in the buffer (i.e., when the buffer has room for 128 more bytes). When the buffer has filled to this point, the printer will turn off its hardware signal to the host device. The signal is carried on the Data Terminal Ready line (EIA CD or CCITT 108.2)

After turning off the handshake signal, the printer will continue to print, pulling data from its buffer. When the buffer contents have diminished to 1792 bytes (i.e., when the buffer has room for 256 more bytes), the printer turns its hardware signal back on, allowing the host to transmit more data.

When in use, the signal on the DTR line will always be asserted unless the buffer contains 1920 or more bytes of data. If you are using the hardware handshake, you should be aware that dropping the DTR line will disconnect a modem (hence, if you are using a modem, you will need to use a different handshake).

To enable the Hardware Handshake, set Switch 5 to its closed (=1) position.

Enq/Ack

The Enq/Ack handshake is primarily an HP protocol. The handshake is always initiated by the host device; the host transmits an Enq (the Enquire control code, decimal 5) and holds off data transmission until it receives an Ack control code (Acknowledge, decimal 6) from the printer.

When the printer has room in its buffer for at least 80 bytes, it sends the host an Ack. The host may send data to the printer as soon as it receives the Ack from the printer.

The printer will respond to an Enq every time it receives one unless the Enq is embedded in a raster graphics data stream. If your system requires Enq/Ack protocol during raster operations, you should use the Binary Enq/Ack handshake, outlined below.

To enable the Enq/Ack handshake, set Switch 7 to its closed (=1) position.

Binary Enq/Ack

The Binary Enq/Ack handshake follows a special Enq/Ack protocol that allows handshaking during a raster graphics transfer. If your system does not support handshaking during a binary transfer, you should not use the Binary Enq/Ack handshake.

In systems that require a binary handshake, the first character following the W in the raster transfer escape sequence will not be data, but will be an Enq. The system will expect the printer to respond with an Ack before the raster transfer can be completed. If the printer is using regular Enq/Ack protocol, it will not recognize an Enq embedded in the raster transfer sequence, but will interpret it as graphics data. When the Binary Enq/Ack handshake is enabled, however, the printer will look at the first character following the W in the transfer sequence and respond to any Enq appearing in that position.

To enable the Binary Enq/Ack handshake, set Switch 6 to its closed (=1) position.

Stripping Fill Characters

Some systems use Null and Delete characters as fill characters when handshakes are not available. In normal operation, the printer will discard each Null as it pulls it out of the buffer, since Nulls are not usually printed; the only times the printer won't strip Nulls are when Display Functions is enabled or when the printer is printing graphics.

If your system is one that uses Nulls and Deletes as fill characters to adjust the timing of data transmission (often in lieu of a handshake), you may need the printer to strip fill characters as it receives them to prevent data loss at baud rates greater than 600 baud.

To set the printer to automatically strip fill characters as they are received, set Switch 8 to its closed (=1) position.

NOTE: **Never set the printer to strip fill characters when you are planning to print graphics; the Null and Delete characters are necessary in graphics transfers and must not be stripped.**

Parity

Parity is a means of checking incoming data for accuracy. The 2671 printer provides four kinds of parity: Zeros, None, Odd and Even. The printer should use the same kind of parity used by your system. (Note that if you are printing graphics, you must be configured for 8-bit data, and the parity must be set to "None".)

Switches 9 and 10 are used to select parity. The chart below shows the switch settings.

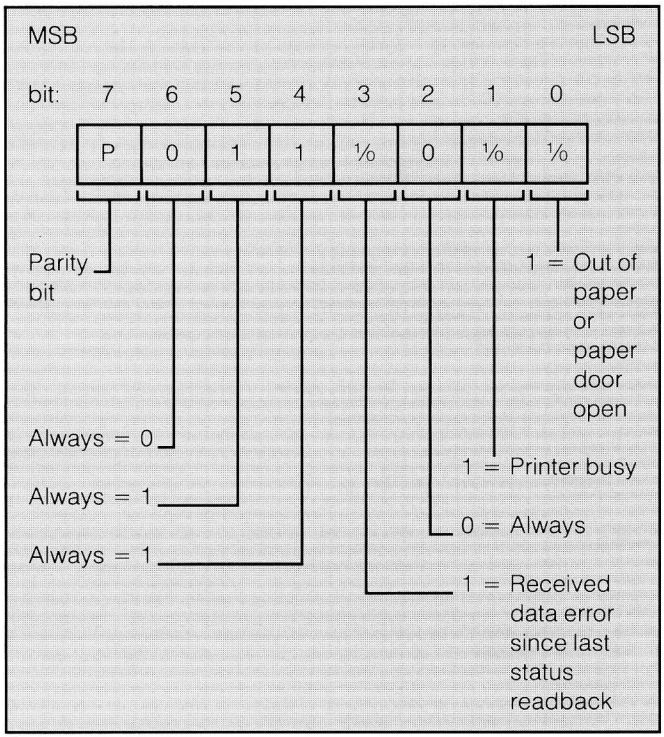
PARITY	SW9	SW10
Zeros (printer transmits zeros and ignores incoming parity)	0	0
None (printer recognizes 8-bit data, no parity)	0	1
Odd	1	0
Even	1	1
0 = Open 1 = Closed		

Status

A status request can give you information on the current printer operating condition, including whether or not the printer has received a data error, is out of paper, is busy and cannot accept data, or is off-line. To get a readback of I/O status, the host should send the following sequence to the printer:

$^{E}_{C}?^{D}_{1}$

The $^{D}_{1}$ (Device Control 1, decimal 17) functions as a transmit trigger and prompts the printer's response. The printer responds immediately with a status byte drawn from column three of the ASCII chart, to be interpreted as shown below.



When bit 1 is set (= 1), it signifies that the printer is buffered up and can't accept additional data until it finishes its current operations.

Model Number Status

Some systems require a means for identifying the type of the printer. The 2671A or 2671G will transmit its model number when it receives either of the following escape sequences from the controller:

$^{E}c^{*}s\hat{}^{D}1$

$^{E}c^{*}rK^{D}1$

In both instances, the $^{D}1$ functions as a transmit trigger.

Maximizing Throughput

With the use of any of the handshakes supported by the 2671 printer, throughput should not pose a problem.

If, however, you are transmitting data to the printer without the use of any handshake, throughput becomes more critical; your transmission speed will be limited by how efficiently you can use the 2K byte buffer.

NOTE: When transmitting data to the printer without the use of any handshake, you run the risk of data loss, especially at transmission rates of 600 baud or higher. Transmitting data without handshakes is not recommended.

To increase printer throughput:

- Try printing in the Compressed print mode. The Compressed print mode prints bidirectionally at a rate of 190 cps, rather than the 120 cps of the Normal print mode.
- By transmitting Nulls or Deletes at the end of lines, then stripping the fill characters (switch 8 on the rear panel configuration), you may give the printer some additional time to catch up at higher baud rates.

Datacomm Errors

The printer recognizes and may be affected by three kinds of datacomm errors: parity errors, framing errors, and data overrun.

Parity errors occur when some kind of parity check is enabled by the switch settings on the rear panel, and the parity bit of the incoming data doesn't match the parity expected by the printer.

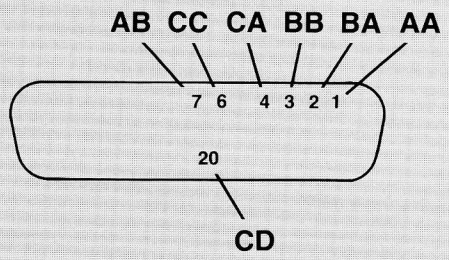
Framing errors occur when the printer fails to encounter a stop bit where it expects to find one. Framing errors often result from a printer baud rate setting that does not match the baud rate used by the host device.

Data overrun occurs when the datacomm driver has not removed the last byte from the buffer before the next byte begins to assemble. Data overrun is not the same thing as buffer overrun. The design of the printer firmware virtually eliminates the chance of encountering data overrun.

When the printer comes across a parity or data overrun error, it prints a Delete character (■). (Framing errors will be logged in the printer's firmware, but will not cause the printer to print a Delete; if you suspect framing errors, you should request printer status through $^{E}c?$.) If you are getting a lot of datacomm errors, check the settings of the parity and baud rate switches on the rear of the printer. If the settings seem to be correct and you still get datacomm errors, reseat the switches by turning them off, then on again. If you still have problems, check your cable.

RS-232C Connector

The illustration below shows the pin-out of the 25-pin female RS-232C connector used by the printer. A table following the illustration defines the function of each signal.



No connection on any other pins.

Pin Number	Signal Name	Function
1	AA	Chassis ground
2	BA	TXD (Transmitted data)
3	BB	RXD (Received data)
4	CA	RTS (Request to send)
6	CC	DSR (Data set ready)
7	AB	Signal ground
20	CD	DTR (Data terminal ready)

Configuring the 13250A/B Interface Board

The 2671 printer equipped with RS-232C sometimes requires that the host terminal use the 13250 asynchronous data communications printed circuit assembly, usually only if the host is an HP 264X terminal. The printed circuit assembly (PCA) must be configured correctly in order to provide a proper link between the terminal and the printer.

The settings for the various switches are shown in the following tables.

NOTE: The settings of the first group of three switches will depend on what kind of HP 264X terminal you have. An HP 2645 terminal uses different settings than other HP 264X terminals. Refer to the appropriate box below for the settings for your particular terminal.

Bank 1: Switches FC 7 through FC 5 (HP 2645 only)

Switch	Setting	Function
FC7	Closed	Sets the number of nulls sent after each control code to one (1).
FC6	Closed	
FC5	Closed	Printer should be configured to strip fill characters.

Bank 1: Switches FC4 and FC3

FC4	FC3	Parity
Closed	Closed	Odd
Closed	Open	Even
Open	—	None
Recommended parity: None		

Bank 1: Switches FC2 through FC0

FC2	FC1	FC0	Baud Rate
Closed	Closed	Open	110
Closed	Open	Closed	150
Closed	Open	Open	300
Open	Closed	Closed	1200
Open	Closed	Open	2400
Open	Open	Closed	4800
Open	Open	Open	9600
Recommended baud rate: 2400			

Bank 2: Switches B7 through 134
Bank 3: Switches S2 through B8

Not Used

Bank 4: Switches A4 through A9

Switch	Setting	Function
A4	Open	These switches set the PCA's octal address, defining its function as a serial printer interface.
A11	Closed	
A10	Open	
A9	Closed	

Bank 4: Switches IAT through RHE

Switch	Setting	Function
IAT	—	Not used.
2SB	Closed	Allows the terminal to send the printer two stop bits.
THE	Closed	Enables the hardware handshake.
RHE	—	Not used.

HP-IL INTERFACE

The Hewlett-Packard Interface Loop (HP-IL) was developed as a low-cost interface for the Series 80 Personal Computers, the Series 40 Calculators, and other HP personal computing products. The interface loop is a bit-serial cousin of the HP-IB, and many of the interface conventions resemble those of HP-IB.

To use the printer in your interface loop, you need only the information required to run your controlling device; loop protocol is designed to take care of itself. The information that follows is included for your reference only.

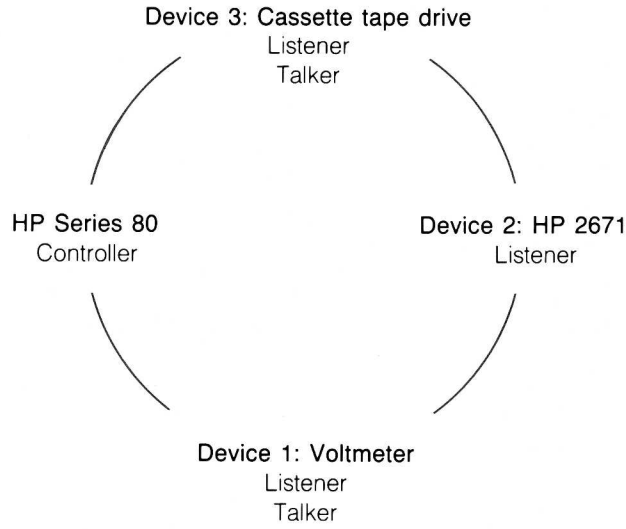
About the HP-IL

The interface loop is, quite literally, a loop: devices on the HP-IL are connected one to another, and the last device in the system completes the loop by connecting to the first. Each device is tied to the loop with two connectors: one for incoming data, and one for outgoing data.

The cable linking the devices together provides a two-line connection. One of the lines, the data line, fluctuates high and low in patterns that carry instructions and data messages through the loop. The second line is a base voltage line and remains fairly constant, providing a reference voltage against which to measure the variations in the data line's voltage.

In a typical system, one device on the loop functions as the Controller. The controller is in charge of interface protocol and sets up and maintains the rules for device interaction on the loop. The other devices on the loop may be Talkers (i.e., devices that transmit data) or Listeners (i.e., devices that receive data), depending on their individual functions. The HP 2671 is primarily a listener, as it receives data and transmits only printer status messages.

The illustration below shows an example of a possible HP-IL system. The Series 80 personal computer, shown as this system's controller, would address each of the devices on the loop to talk or listen, as required to keep the loop operating smoothly.



Data and command messages (bytes) are passed around the loop one at a time. The controller will typically send out a byte, and that byte will travel around the loop to the device (or devices) for which it was meant. After the device has processed the byte, it places it back on the loop, and the byte returns to the controller. In this way, the controller can "know" when a device has received a message and, at the same time, check loop messages for errors.

The table on the next page shows the HP-IL commands supported by the HP 2671 printers. For detailed command structures and information on how your particular controller uses command messages, please refer to the interface manual for your controller.

Supported HP-IL Features

The table below lists the HP-IL features supported by the HP 2671 printers. Additional information on various HP-IL features follows the table.

Auto-addressing	
Auto Address Unconfigure	AAU
Auto Address	AAD
Extended Addressing	
Auto Extended Primary	AEP
Auto Extended Secondary	AES
Listen Address	LAD
Secondary Address n	SADn
Talk Address	TAD
Send HP-IL Status	SST
Send Device ID	SDI
Send Accessory ID	SAI
Clear Commands	
Universal Device Clear	DCL
Selected Device Clear	SDC
Interface Clear	IFC
Parallel Polling	
Parallel Poll Enable	PPE
Parallel Poll Unconfigure	PPU
Parallel Poll Disable	PPD
Serial Poll	SST
Service Request	SRQ
Enable Device Not Ready	EDN

Addressing

The HP-IL address is a number which identifies each device on the loop. Using the HP-IL addresses, the controller can talk to the various devices on the loop and address them to talk or listen. Before you can do so, however, the addresses must be assigned to the individual devices.

The HP 2671 supports the HP-IL Auto-Addressing feature, which means that it will take an address that corresponds to its position in the loop when the controller sends an auto-address instruction around the loop. At power-on, the HP 2671 printer has the illegal address of 31 (decimal), and the controller must respond with some kind of Auto Addressing to correct the situation.

If, at power-on, the HP 2671 receives Auto Address (AAD) from the controller, the printer will respond in the standard fashion: it will take the address, increment it, and pass it on to the next device.

If the HP 2671 receives an Auto Address Unconfigure (AAU) from the controller, the printer will select Address 5 (decimal).

NOTE: The Reset (ᴱcE) and Self-test (ᴱcZ) escape sequences will clear the printer's HP-IL address. If either of these escape sequences is sent to the printer, the 2671's address must be reset; both escape sequences will return the printer's address to its illegal power-on setting of 31.

To reset the printer's address, enter the following statement to the host device: "**RESET 9 _ _**". The 9 in the statement is the printer's select code, and the blank should be filled with the printer's address. For example, if the printer's address is 5, the statement would be "**RESET 905**".

Extended Addressing

The extended addressing feature of HP-IL allow you to include more devices on the loop by increasing the number of device addresses possible. In systems using "normal," single-level addressing, up to 31 devices may be addressed on the interface loop. By using extended addressing, the system's loop capacity can be expanded to include up to 961 addressable devices.

In systems using extended addressing, each device in the loop is identified by a set of two addresses: a primary address, which specifies which group of devices the device is in, and a secondary address, which specifies the placement of the device in its group.

Extended addressing is set up through the Auto Extended commands: Auto Extended Secondary (AES) and Auto Extended Primary (AEP). Because the secondary address specifies the position of a device within its group of 31, and the loop has not yet defined the number of devices present, the controller sends the AES message first. AES causes the devices on the loop to number themselves serially from 0 to 30. These numbers will stand as the devices' secondary addresses. The 32nd device and all devices following it on the loop will take the illegal address of 31.

When this first pass of secondary addressing is completed, the controller sends the Auto Extended Primary (AEP) message, which causes the first group of 31 devices to take on the number 0, their primary address. All devices bearing the illegal secondary address 31 will ignore the AEP message.

After the first group has accepted its primary address, the controller continues the Auto Extended process by sending out another AES. All devices which have a primary address ignore the AES, but the next 31 devices (which are still unaddressed) take on their secondary address. As before, all devices beyond the newly-addressed group of 31 take on an illegal address. When the AES returns to the controller, the controller sends out the AEP, assigning the second group the primary address of 1.

When Auto Extended addressing is completed, each device on the loop has its own primary and secondary addresses. **Examples:** the fifth device on the loop would have a secondary address of four and a primary address of zero; the thirty-fourth device on the loop would have a secondary address of two and a primary address of one.

Auto Extended addressing is performed automatically by the system and requires no user attention, aside from that required to operate the host device.

Status and Identification

The printer becomes a Talker only when it is addressed to talk by the controller. In response to HP-IL message, the printer will transmit only three kinds of information: HP-IL status, device identification, and accessory identification. (The printer will also respond to escape sequence requests for status such as ^{E}c*rK **and** ^{E}c*s^ **)**

In a typical sequence, the controller addresses the printer to talk by sending the Talk Address (TAD) message. When the message returns to the controller, the controller sends a second message to define what kind of information it wants from the printer. This second message may be Send HP-IL Status (SST), Send Device Identification (SDI), or Send Accessory Identification (SAI).

Send HP-IL Status (SSI)

The printer will respond in any of three ways to the SST message. The three responses are:

11000010	Requires manual intervention (Paper Out or Latch Open)
10100011	Not ready to transmit or receive (buffer full)
10100001	Ready to receive (buffer not full, printer powered on)

If both of the first two conditions exist, the first response ("Requires manual intervention") will take precendence.

Send Device Identification (SDI)

The Device Identification message, as its name implies, allows the controller to identify the various devices in the interface loop.

When the printer receives the SDI message, it responds with its model number, followed by a Carriage Return/Linefeed and an HP-IL End of Transmission (EOT) message:

" HP2671A $^{C}R^{L}F$ EOT "

" HP2671G $^{C}R^{L}F$ EOT "

Send Accessory Identification (SAI)

The Accessory Identification message allows the controller to identify the general classification of each device on the loop.

When the printer receives the Accessory Identification message, it responds as shown below. Note that the 2671A and 2671G will respond differently.

2671A response: 22 Hex
00100010 Binary
34 Decimat

(signifies that the device is an 80-column, alpha-only thermal printer)

2671G response: 23 Hex
00100011 Binary
35 Decimat

(signifies that the device is an 80-column alpha and graphics thermal printer)

Clear

The printer will accept any of three HP-IL "Clear" messages: Universal Device Clear (DCL), Selected Device Clear (SDC), or Interface Clear (IFC). The printer's response to each of these messages is described below.

Universal Device Clear (DCL)

The DCL message causes devices on the interface loop to clear any output pending to the HP-IL controller. In the case of the 2671 printers, any output would be a report on status or device identification, as discussed earlier. The DCL message affects all devices on the interface loop.

NOTE: If the intention of the Device Clear is to reset the printer, an ^{E}cE should be used instead of the DCL.

Selected Device Clear (SDC)

The SDC message is functionally the same as DCL, differing in that SDC causes only the addressed device to clear any output pending to the controller.

Interface Clear (IFC)

The IFC message clears any active Listener and Talker states on the interface loop. The IFC is a universal command, affecting all devices on the loop.

Parallel Poll

By performing a parallel poll, the controller can quickly determine which of a given set of devices requires service. The controller sends each device a command to tell it which bit of the response byte to use for its response. The controller then sends an IDY (identify) message, which the loop devices may use for their responses.

Three command messages control the parallel poll process: Parallel Poll Enable, Parallel Poll Unconfigure, and Parallel Poll Disable.

The **Parallel Poll Enable (PPE)** message sets up each loop device for parallel polling. The message is sent to each device after the device has been addressed to Listen. PPE tells the device which bit to use for its response and whether to set its bit high or low if it requires service.

The **Parallel Poll Unconfigure (PPU)** message turns off the condition established with the PPE message. PPU will effectively disable parallel polling, as it removes the definitions required for the devices to respond. PPU is a universal command.

The **Parallel Poll Disable (PPD)** message turns off the parallel poll response from each device on the loop, clearing the loop for other functions. PPD is not a universal command, but is sent to specifically addressed devices.

Service Request (SRQ)

The Service Request is a method by which a device on the loop can tell the controller that it requires some kind of attention. An HP 2671 printer will request service whenever it is out of paper or the paper latch is open.

To request service, the printer will set the SRQ bit of any data message it receives when a Paper Out or Latch Open condition exists (the controller will see the SRQ tag and sets SRQR in its status register). Once set, the Service Request bit will remain true until (a) the condition is corrected, or (b) the controller sends a serial poll to identify which device needs service.

The Service Request capability is always enabled.

Enable Device Not Ready for Data

The Enable Device Not Ready for Data (EDN) feature of HP-IL allows a Listener to send out a Not Ready for Data (NRD) whenever necessary.

When the printer has received an EDN and a Not Ready condition exists, the sequence of operation will proceed as follows:

The printer receives the last byte it can accept, and instead of passing the byte back to the talker, the printer replaces it with an NRD. The talker receives the NRD and returns the NRD to the printer. When the printer is again ready to receive data, it places the last byte back on the loop, signalling the talker to proceed.

This feature is enabled by the EDN command. It is canceled by any subsequent command frame (i.e., SDC, PPD, DCL, PPU, LAD, UNL, TAD, UNT, PPE, AAU) received by the printer.

Listen Only

In systems which contain only one talker and one or more listeners, the printer may be set up to listen only.

Listen Only is not the same as Listen Always. In Listen Only mode, the printer will receive everything as data. Any commands or identify messages will also be treated as data and will hang up the system. Listen Only is intended for systems which do not have a controller.

To enable Listen Only, open the switch marked "Listen Only" on the rear panel.

NOTE: Never enable Listen Only when using the printer in a system containing a controller, or you will hang up the entire system.

Special Considerations

- Never enable Listen Only in a system which contains a controller.

- If requesting printer status by escape sequence, the host must transmit a Send Data (SDA) message to initiate the printer response. The SDA should be used in the following manner: **(1)** Address the printer to Listen. **(2)** Send the escape sequence. **(3)** Address the printer to talk. **(4)** Send the SDA.

- If you send the printer the escape sequences for Reset (^{E}cE) or self-test (^{E}cz), you must wait 3 seconds before sending the printer any additional information. You may do this in the following manner:

```
PRINT "#A,A";CHR$(27),"E"        (Reset)
WAIT 3000

PRINT "#A,A";CHR$(27),"z"        (Self-test)
WAIT 3000
```

  If you do not allow a three-second delay after the printer receives the last character of the escape sequence, you can hang up the interface loop.

- If you reset the printer or perform a self-test, you must reset the printer's address.

HP 2671 HP-IL Capability Subsets

FUNCTION	DESCRIPTION
R	**Receiver.** Complete capability.
AH	**Acceptor Handshake.** Complete capability
SH1	**Source Handshake.** Complete capability
D	**Driver.** Complete capability
L1,2,3	**Listener.** Basic listener, listen-only mode, extended listener.
T1,2,3,4,6	**Talker.** Send data, send status, send device id, send accessory id, extended talker.
C0	**Controller.** No capability.
DC2	**Device Clear.** Responds to universal and addressed (selected) device clear commands.
DT0	**Device Trigger.** No capability.
PP1	**Parallel Poll.** Complete capability
SR1	**Service Request.** Basic capability.
AA1	**Auto Address.** Complete capability
AE1	**Auto Extended Address.** Complete capability
AM0	**Auto Multiple Address.** No capability.
RL0	**Remote Local.** No capability
PD0	**Power Down.** Basic capability.
DD0	**Device Dependent Commands.** No capability.

APPENDICES

6

This chapter contains several levels of information, ranging from the daily-use details of printer reset and self-test, to information that is largely for the more advanced user: tables of control codes, escape sequences, and character sets.

PRINTER RESET

The **RESET** button on the control panel of your printer will return the printer to its power-on state. You may need a printer reset to clear the configuration to its default settings, or you may wish to reset the printer while troubleshooting an application program. Whatever your reasons for performing a reset, you should remember that any and all of the following will be affected by a printer reset: margin settings, underlining mode, print mode, line terminator definition, active character set, character set access mode, perf skip mode, and display functions.

You may also reset the printer with an escape sequence, as shown in the box below.

Printer Reset

$^{E}_{c}E$

A reset from the control pad and a reset by escape sequence command differ from each other in a way that can be critical under some conditions:

The **RESET** button performs a hard reset (also called a hardware reset), which takes effect immediately when you press the button. The hard reset destroys all buffered data, which can be a substantial data loss (up to 2K bytes in the 2671G).

The reset performed by escape sequence command is a reset which allows data buffered previous to the $^{E}_{c}E$ to print before the reset is performed, so although there might be a slight delay before the reset is executed, no data will be lost.

If you send an $^{E}_{c}E$ over datacomm, especially over RS-232C, you must wait a short amount of time (about 1.5 seconds for HP-IB and 8-bit Parallel; about 5 seconds after the $^{E}_{c}E$ is pulled from the buffer in RS-232C) before transmitting additional data. If you transmit additional data before the printer has finished its reset process, some data will probably be lost.

SELF-TEST

The 2671 printer has two distinct self-tests: the power-on self-test and the confidence test.

Every time you turn the printer on, the printer runs a thorough test of its RAM and ROM while the print head clears (moves 81 character spaces to the right then returns to the left margin). If the printer immediately prints, " **Graphics Module Failure** " and your printer is a 2671G, your printer's ability to print graphics is damaged and will require attention. If the printer immediately prints, " **I/O Failure** ", the printer encountered a fatal error during its self-test and will be **"dead."** If this happens, contact your local HP Sales and Service office for assistance.

The **TEST** button on the control pad of your printer will cause the printer to run a series of tests on itself to ensure its proper operation. During a self-test, the printer will test the input/output processor boards, including a ROM and RAM check, and run a general test on the thermal print mechanism by printing all the resident character sets (see **"Relating Character Sets to Each Other" in Section 3).** If the test is completed successfully, the printer will print a message indicating that it passed its self-test. A more detailed outline of the printer self-test is included on the next page.

You may also start the self-test with the command shown in the box below.

Self-Test
^{E}cz

If you send an ^{E}cz over datacomm, especially over RS-232C, you must wait a short amount of time (about 1.5 seconds for HP-IB and 8-bit Parallel; about 5 seconds after the ^{E}cz is pulled from the buffer in RS-232C) before transmitting additional data. If you transmit additional data before the printer has finished its test process, some data will probably be lost.

NOTE: **The self-test is destructive; that is to say, the self-test will reset the printer to its power-on state.**

Printer Self-Test

- **TEST** button is pressed, or the printer receives an ^{E}cz
- Printer performs a carriage return and linefeed.
- The **"CHECK PAPER"** light comes on for 0.1 seconds.

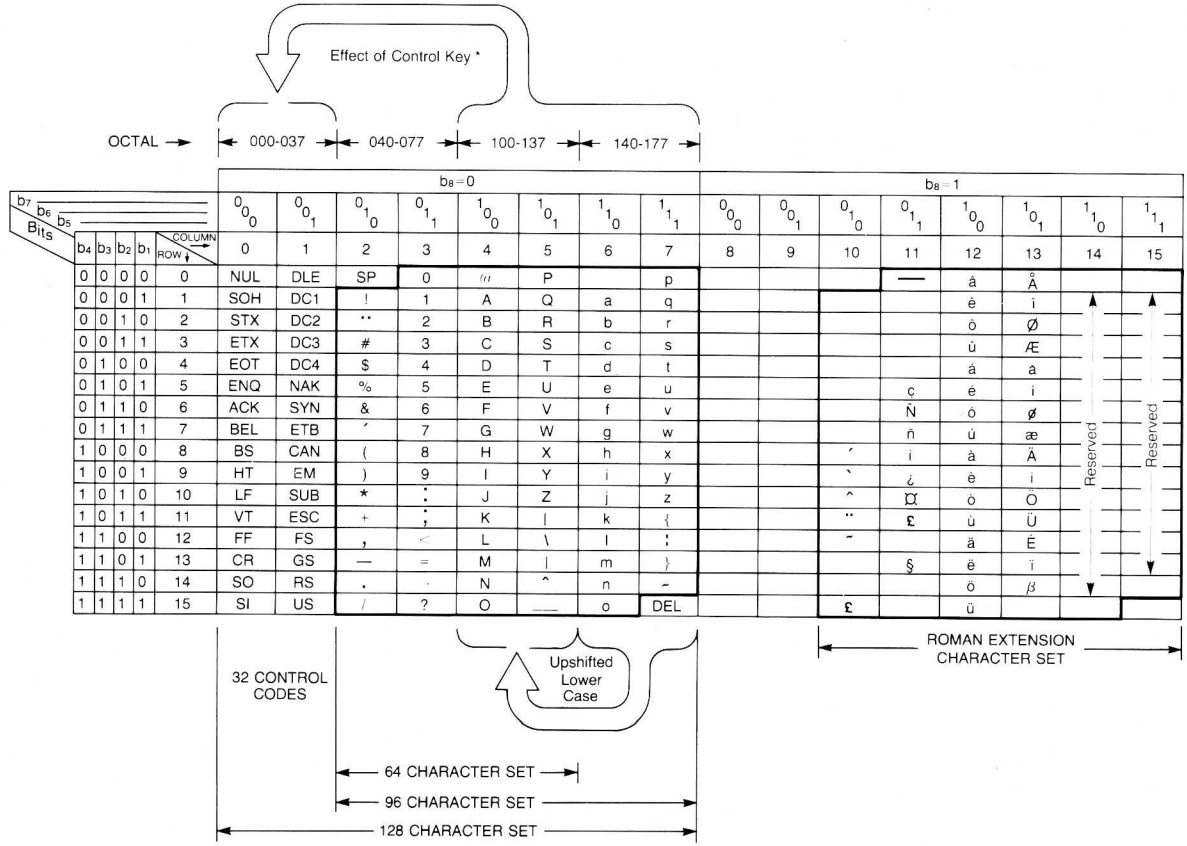
  If there is a RAM or ROM failure, the self-test will stop at this point; the LED will remain on, and the printer will be **"dead"**. If this happens, turn your printer off, and contact your local HP Sales and Service office.

- The test pattern prints. The test pattern, shown in **Section 3**, includes a printout of all the resident character sets, a string of compressed characters with the terminators that enable underlining underscored, and a series of numerals reporting printer status for HP Service personnel.
- The printer prints a message indicating that the self-test has passed successfully, or the printer prints a message indicating the area of failure.

  If you receive a failure message following a self-test, contact your local HP Sales and Service office to remedy the situation.

7-BIT USASCII AND ROMAN EXTENSION CHARACTER SETS

The relationship between the USASCII and Roman Extension character sets involves not only the primary and secondary character set conventions of shift-in and shift-out, but also 8-bit codes and their function as character set selectors. The chart below shows the relationship between these two character sets. Paragraphs providing details on chart structure and 8-bit mode appear following the chart.



b4	b3	b2	b1	ROW	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	0	0	0	NUL	DLE	SP	0	@	P		p				—	â	Å		
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q					ê	ì		
0	0	1	0	2	STX	DC2	"	2	B	R	b	r					ô	Ø		
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s					û	Æ		
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t					á	å		
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u				ç	é	ì		
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v				Ñ	ó	ø		
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w				ñ	ú	æ		
1	0	0	0	8	BS	CAN	(	8	H	X	h	x			´	¡	à	À		
1	0	0	1	9	HT	EM	)	9	I	Y	i	y			`	¿	è	ì		
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z			^	¤	ò	Ò		
1	0	1	1	11	VT	ESC	+	;	K	[	k	{			¨	£	ù	Ù		
1	1	0	0	12	FF	FS	,	<	L	\	l	¦			~		ä	Ë		
1	1	0	1	13	CR	GS	—	=	M	]	m	}				§	ë	ï		
1	1	1	0	14	SO	RS	.	>	N	^	n	~					ö	ß		
1	1	1	1	15	SI	US	/	?	O	_	o	DEL			£		ü			

Using the Chart

The USASCII character set, shown on the left side of the chart, comes in three widely-recognized levels, as indicated by the arrows below the ASCII portion of the chart. (Your printer supports the full 128-character ASCII set.)

The large arrows above and below the chart show how a character code is changed by using the SHIFT and CNTL keys of the host device. The CNTL (Control) key is used in combination with alpha keys to produce control codes. If, for example, you press CNTL and L, you will generate a Form Feed control code (shown on the chart as FF).

The binary codes for the various characters are shown both above and to the left of the characters in the chart. The first four bits of the character byte appear on the left side of the chart. The next three bits appear above each column of characters. The eighth bit appears at the very top of the chart. For example, the representation of the character "K" is:

	b_8	b_7	b_6	b_5	b_4	b_3	b_2	b_1
BINARY	0	1	0	0	1	0	1	1
OCTAL		1		1			3	

For quick reference, ranges of octal values are shown over each pair of columns in the ASCII portion of the chart.

8-Bit Mode

As shown by the character set chart, when the 8th bit of a character byte is set to zero (0), the character will come from the primary character set, and when the 8th bit is set to one, the character will come from the secondary character set.

Display Functions mode allows you to check data containing 8-bit codes. When Display Functions is enabled, it unsets the 8th bit and turns on the underline for every 8-bit character received by the printer.

So, for example, if the printer is in Display Functions and receives the German word, "hässlich" (in which the "ä" must come from the Roman Extension set), the printer will print, "hLsslich".

(In order to accomplish this, Display Functions will disable any underlining the printer might be configured to do. If underlining was enabled when Display Functions was turned on, and underlining is set as a latching function, it will be turned back on when you exit Display Functions. If, however, underlining is enabled on a line-by-line basis, it will be disabled as soon as you encounter a line terminator, regardless of whether Display Functions is on or off.)

The ability to recognize 8-bit codes by using Display Functions is most useful when you are analyzing graphics data (or any other data in binary format). As mentioned earlier in this manual, if you are sending the printer 8-bit data over an RS-232C interface, your parity must be selected as **"None."**

CONTROL CODES

The chart below contains the control codes recognized by both HP2671 printers. The control codes are arranged according to their decimal values.

FUNCTION	SYMBOL	KEYS	DECIMAL EQUIVALENT	DESCRIPTION
Enquire	$^{E}_{Q}$	CNTL E	5	Received by printer from host computer or controller. Printer will respond with an $^{A}_{K}$ when ready to accept data. (This control code effective over RS-232 only.)
Acknowledge	$^{A}_{K}$	CNTL F	6	Transmitted by printer in response to an Enquire ($^{E}_{Q}$) when the printer is ready to receive data. (This control code is effective over RS-232 only.)
Line Feed	$^{L}_{F}$	CNTL J	10	Prints the contents of the current line in the buffer and advances the paper one line.
Form Feed	$^{F}_{F}$	CNTL L	12	Printer will print contents of the current line in the buffer and advance the paper to the top line position on the next page.
Carriage Return	$^{C}_{R}$	CNTL M	13	Sets the position of the print head at the left margin. Does not advance the paper.
Shift Out	$^{S}_{O}$	CNTL N	14	Selects the currently-designated secondary character set to be active for printing operations.
Shift In	$^{S}_{I}$	CNTL O	15	Selects USASCII, the primary character set, to be active for printing operations.

(continued next page)

CONTROL CODES (continued)

FUNCTION	SYMBOL	KEYS	DECIMAL EQUIVALENT	DESCRIPTION
Device Control 1 (DC1)	D_1	CNTL Q	17	Trigger for output status request. Used as an X-on character for RS-232C/CCITT V.24 handshake.
Device Control 3	D_3	CNTL S	19	Used as an X-off character for RS-232C/CCITT V.24 handshake.
Escape	E_C	CNTL [	27	Indicates that the characters immediately following are part of a command sequence.

ESCAPE SEQUENCES

The table below shows those escape sequences which are recognized by the HP 2671 printers. The escape sequences in this table are arranged alphabetically by function, rather than by escape sequence format; an alphabetical listing of the sequences by format follows this table.

Character Set Access Mode	
^{E}c&k0F	^{S}o control code can access secondary character set on line-by-line basis.
^{E}c&k1F	^{S}o control code can access secondary character set on a semi-permanent basis, staying in secondary set until a ^{S}i control code is received or the printer is reset (default)
Character Set Selection	
^{E}c)A	Selects Roman Extension set as the secondary character set (default).
^{E}c)B	Selects Line Drawing set as the secondary character set.
Display Functions	
^{E}cY	Turns on Display Functions.
^{E}cZ	Turns off Display Functions (default).
Line Termination	
^{E}c&k ‹parameter› G	Defines specific meaning of line terminator. Parameters are as follows: 0 = ^{C}R maps to ^{C}R; ^{L}F maps to ^{L}F; ^{F}F maps to ^{F}F (default) 1 = ^{C}R maps to ^{C}R/^{L}F 2 = ^{L}F maps to ^{C}R/^{L}F; ^{F}F maps to ^{C}R/^{F}F 3 = both ^{C}R and ^{L}F will map to ^{C}R/^{L}F; ^{F}F maps to ^{C}R/^{F}F

(continued next page)

ESCAPE SEQUENCES (continued)

Margins	
Ec4	Sets left margin at present print head position.
Ec5	Sets right margin at present print head position.
Ec9	Clears margins.
Perf Skip Mode	
Ec&l1L	Perf Skip mode enabled (default).
Ec&l0L	Perf Skip Mode disabled.
Print Mode	
Ec&k0S	Printer prints in Normal mode, 10.0 cpi (default).
Ec&k2S	Printer prints in Compressed mode, 16.2 cpi.
Raster Graphics (HP 2671G only)	
Ec*rA	Triggers start of raster mode.
Ec*rB	Triggers end of raster mode and causes all data remaining in the raster buffers to be printed.
Ec*b ‹byte count› W ‹binary data›	Transfers one row of raster data. Byte Count is the number of bytes in the raster row, a number from 0 to 255 (but the printer discards data after receiving 90 bytes). Binary Data is the 8-bit data comprising the raster row.

(continued next page)

ESCAPE SEQUENCES (continued)

Reset

^{E}cE ..... Resets printer to its power-on state.

Self Test

^{E}cz ..... Initiates printer self-test.

Status

^{E}c?^{D}1 ..... Returns printer status (effective over RS-232C only).

^{E}c*s^ ..... Returns model number status. Effective over RS-232C and HP-IB only. (RS-232C requires ^{D}1 transmit trigger).

^{E}c*rK ..... Returns model number status. Effective over RS-232C and HP-IB. (RS-232C requires ^{D}1 transmit trigger).

Underlining

^{E}c&d‹terminator› ..... Turns underline on or off (determined by the Terminator).

Terminators that turn underlining on:
D,E,F,G,L,M,N,O (D is recommended)

Terminators that turn underlining off:
@,A,B,C,H,I,J,K (@ is recommended)

Underlining Mode

^{E}c&k0E ..... Allows underlining escape sequence to work on a line-by-line basis.

^{E}c&k1E ..... Sets underlining escape sequence to work on a semi-permanent basis, remaining in effect until specifically disabled (default).

(continued next page)

ESCAPE SEQUENCES

The table below shows the escape sequences recognized by the HP 2671 printers. The escape sequences are arranged first, according to the number of characters in the sequence, and secondly, in the order of the character values.

NOTE: The 2671 printers do not recognize the $^{E}c,c$ escape sequences. If an $^{E}c,c$ sequence is sent to the printer, the printer will treat it as it would any escape sequence containing an error: it will ignore all characters following the comma until it receives an upper-case terminator (! and carriage return will not terminate the sequence).

TWO-CHARACTER ESCAPE SEQUENCES

$^{E}c4$ ..... Sets left margin at current print head position.

$^{E}c5$ ..... Sets right margin at current print head position.

$^{E}c9$ ..... Clears margins to 1, 80 (in normal mode).

$^{E}c?$ ..... Returns printer status (RS-232C only). Requires $^{D}1$ transmit trigger.

^{E}cE ..... Resets printer to power-on state.

^{E}cY ..... Turns on Display Functions.

^{E}cZ ..... Turns off Display Functions.

^{E}cz ..... Initiates printer self-test.

THREE-CHARACTER ESCAPE SEQUENCES

$^{E}c)A$ ..... Selects Roman Extension set as the secondary character set (default).

$^{E}c)B$ ..... Selects Line Drawing set as the secondary character set.

(continued next page)

ESCAPE SEQUENCES (continued)

PARAMETERIZED ESCAPE SEQUENCES

$^{E}_{c}$&d sequences — **Print Enchancements**

$^{E}_{c}$&d ‹terminator› ..... Turns underline on or off.

Terminators that enable underlining:
D,E,F,G,L,M,N,O (D is recommended)

Terminators that disable underlining:
@,A,B,C,H,I,J,K (@ is recommended)

$^{E}_{c}$&k sequences — **Set Latching Functions**

$^{E}_{c}$&k0E ..... Sets underlining as a line-by-line function, disabled at the end of each line.

$^{E}_{c}$&k1E ..... Sets underlining as a latching function, enabled until specifically disabled (default).

$^{E}_{c}$&k0F ..... Allows shift-out control code to be effective on a line-by-line basis.

$^{E}_{c}$&k1F ..... Allows shift-out control code to be effective on a semi-permanent basis, remaining in effect until specifically disabled (default).

$^{E}_{c}$&k ‹parameter› G ..... Defines specific meaning of line terminator.
Parameters are as follows:
0 = $^{C}_{R}$ maps to $^{C}_{R}$; $^{L}_{F}$ maps to $^{L}_{F}$; $^{F}_{F}$ maps to $^{F}_{F}$ (default)
1 = $^{C}_{R}$ maps to $^{C}_{R}/^{L}_{F}$
2 = $^{L}_{F}$ maps to $^{C}_{R}/^{L}_{F}$; $^{F}_{F}$ maps to $^{C}_{R}/^{F}_{F}$
3 = both $^{C}_{R}$ and $^{L}_{F}$ map to $^{C}_{R}/^{L}_{F}$; $^{F}_{F}$ maps to $^{C}_{R}/^{F}_{F}$

$^{E}_{c}$&k0S ..... Printer prints in Normal mode, 10.0 cpi (default).

$^{E}_{c}$&k2S ..... Printer prints in Compressed mode, 16.2 cpi.

(continued next page)

ESCAPE SEQUENCES (continued)

$^{E}_{c}$&l sequences	**Line Control**
$^{E}_{c}$&l1L	Perf Skip mode enabled (default).
$^{E}_{c}$&l0L	Perf Skip mode disabled.

$^{E}_{c}$*b sequences (HP 2671G only)	**Binary Commands**
$^{E}_{c}$*b ‹byte count› W ‹binary data›	Transfers one row of raster data.

Byte Count is the number of bytes in the raster row, a numeral from 0 to 255 (however, 90 bytes is the true upper limit, as the printer discards all data after receiving 90 bytes).

Binary Data is the 8-bit data comprising the raster row.

$^{E}_{c}$*r sequences (HP 2671G only)	**Raster Commands**
$^{E}_{c}$*rA	Triggers start of raster mode.
$^{E}_{c}$*rB	Triggers end of raster mode and causes all data remaining in raster buffers to be printed.
$^{E}_{c}$*rK	Returns model number status. Effective over RS-232C and HP-IB only. (RS-232C requires $^{D}_{1}$ transmit trigger).

$^{E}_{c}$*s sequences	
$^{E}_{c}$*s^	Returns model number status. Effective over RS-232C and HP-IB only. (RS-232C requires $^{D}_{1}$ transmit trigger).

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Messerschmittstrasse 7
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Telex:
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GREAT BRITAIN
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Navigation Road
ALTRINCHAM
Cheshire WA14 1NU
Tel: (061) 928-6422
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Oakfield House, Oakfield Grove
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Tel: 36806
Telex: 444302
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Yorkshire WF10 1AE
Tel: (0977) 550016
Telex: 5557355
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Telex: 0884-259
Cable: BLUESTAR
E

INDONESIA
BERCA Indonesia P.T.
P.O.Box 496/Jkt
Jln. Abdul Muis 62
JAKARTA
Tel: 373009
Telex: 31146 BERSAL IA
Cable: BERSAL JAKARTA
A,C,E,M,P

BERCA Indonesia P.T.
P.O. Box 174/Sby.
J.L. Kutei No. 11
SUBAEE-SURABAYA
Tel: 68172
Telex: 31146 BERSAL SD
Cable: BERSAL-SURABAYA
A,E,M,P*

IRAQ
Hewlett-Packard Trading S.A.
Mansoor City 9B/3/7
BAGHDAD
Tel: 551-49-73
Telex: 2455 HEPAIRAQ IK
CP

IRELAND
Hewlett-Packard Ireland Ltd.
Kestrel House
Clanwilliam Court
Lower Mount Street
DUBLIN 2, Eire
Tel: 680424, 680426
Telex: 30439
A,C,CM,E,M,P

Cardiac Services Ltd.
Kilmore Road
Arlane
DUBLIN *5, Eire*
Tel: (01) 351820
Telex: 30439
M

ISRAEL
Electronics Engineering Division
Motorola Israel Ltd.
16 Kremenetski Street
P.O. Box 25016
TEL-AVIV *67899*
Tel: 338973
Telex: 33569 Motil IL
Cable: BASTEL Tel-Aviv
A,CM,C,E,M,P

ITALY
Hewlett-Packard Italiana S.p.A.
Traversa 99C
Giulio Petrone, 19
I-70124 **BARI**
Tel: (080) 41-07-44
M

Hewlett-Packard Italiana S.p.A.
Via Martin Luther King, 38-111
I-40132 **BOLOGNA**
Tel: (051) 402394
Telex: 511630
CM,CS,E,MS

Hewlett-Packard Italiana S.p.A.
Via Principe Nicola 43G/C
I-95126 **CATANIA**
Tel: (095) 37-10-87
Telex: 970291
C,P

Hewlett-Packard Italiana S.p.A.
Via G. Di Vittorio 9
I-20063 **CERNUSCO SUL NAVLIGLIO**
Tel. (2) 903691
Telex: 334632
A,CM,CP,E,MP,P

Hewlett-Packard Italiana S.p.A.
Via Nuova san Rocco A
Capodimonte, 62/A
I-80131 **NAPOLI**
Tel: (081) 7413544
A,CM,CS,E

Hewlett-Packard Italiana S.p.A.
Viale G. Modugno 33
I-16156 **GENOVA PEGLI**
Tel: (010) 68-37-07 E,C

Hewlett-Packard Italiana S.p.A.
Via Turazza 14
I-35100 **PADOVA**
Tel: (49) 664888
Telex: 430315
A,CM,CS,E,MS

Hewlett-Packard Italiana S.p.A.
Viale C. Pavese 340
I-00144 **ROMA**
Tel: (06) 54831
Telex: 610514
A,CM,CS,E,MS,P*

Hewlett-Packard Italiana S.p.A.
Corso Giovanni Lanza 94
I-10133 **TORINO**
Tel: (011) 682245, 659308
Telex: 221079
CM,CS,E

JAPAN
Yokogawa-Hewlett-Packard Ltd.
Inoue Building
1348-3, Asahi-cho
ATSUGI, Kanagawa 243
Tel: (0462) 24-0451
CM,C*,E

Yokogawa-Hewlett-Packard Ltd.
3-30-18 Tsuruya-cho
Kanagawa-ku, Yokohama-Shi
KANAGAWA, 221
Tel: (045) 312-1252
Telex: 382-3204 YHP YOK
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.
Sannomiya Daiichi Seimei Bldg. 5F
69 Kyo-Machi Ikuta-Ku
KOBE CITY 650 Japan
Tel: (078) 392-4791
C,E

Yokogawa-Hewlett-Packard Ltd.
Kumagaya Asahi Yasoji Bldg. 4F
4-3 Chome Tsukuba
KUMAGAYA, Saitama 360
Tel: (0485) 24-6563
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.
Mito Mitsui Building
4-73, San-no-maru, 1-chome
MITO, Ibaragi 310
Tel: (0292) 25-7470
CM,CS,E

Yokogawa-Hewlett-Packard Ltd.
Sumitomo Seimei Bldg.
11-2 Shimo-sasajima-cho
Nakamura-ku
NAGOYA, Aichi 450
Tel: (052) 581-1850
CM,CS,E,MS

Yokogawa-Hewlett-Packard Ltd.
Chuo Bldg., 4th Floor
5-4-20 Nishinakajima, 5-chome
Yodogawa-ku, Osaka-shi
OSAKA, 532
Tel: (06) 304-6021
Telex: YHPOSA 523-3624
A,CM,CP,E,MP,P*

Yokogawa-Hewlett-Packard Ltd.
29-21 Takaido-Higashi 3-chome
Suginami-ku **TOKYO** 168
Tel: (03) 331-6111
Telex: 232-2024 YHPTOK
A,CM,CP,E,MP,P*

JORDAN
Mouasher Cousins Company
P.O. Box 1387
AMMAN
Tel: 24907, 39907
Telex: 21456 SABCO JO
E,M,P

KOREA
Samsung Electronics
4759 Shinkil, 6 Dong
Youngdeungpo-Ku,
SEOUL
Tel: 8334311, 8334312
Telex: SAMSAN 27364
A,C,E,M,P

KUWAIT
Al-Khaldiya Trading & Contracting
P.O. Box 830 Salat
KUWAIT
Tel: 42-4910, 41-1726
Telex: 2481 Areeg kt
A,E,M

Photo & Cine Equipment
P.O. Box 270 Safat
KUWAIT
Tel: 42-2846, 42-3801
Telex: 2247 Matin
P

LUXEMBOURG
Hewlett-Packard Belgium S.A./N.V.
Blvd de la Woluwe, 100
Woluwedal
B-1200 ***BRUSSELS***
Tel: (02) 762-32-00
Telex: 23-494 paloben bru
A,CM,CP,E,MP,P

MALAYSIA
Hewlett-Packard Sales (Malaysia)
Sdn. Bhd.
Suite 2.21/2.22
Bangunan Angkasa Raya
Jalan Ampang
KUALA LUMPUR
Tel: 483544
Telex: MA31011
A,CP,E,M,P*

Protel Engineering
Lot 319, Satok Rd.
P.O. Box 1917
KUCHING, SARAWAK
Tel: 535-44
Telex: MA 70904 Promal
Cable: Proteleng
A,E,M

MEXICO
Hewlett-Packard Mexicana, S.A. de C.V.
Avenida Periferico Sur No. 6501
Tepepan, Xochimilco
MEXICO CITY 23, D.F.
Tel: (905) 676-4600
Telex: 017-74-507
A,CP,E,MS,P

Hewlett-Packard Mexicana, S.A. de C.V.
Rio Volga 600
Colonia del Valle
MONTERREY, N.L.
Tel: 78-42-93, 78-42-40, 78-42-41
Telex: 038-410
CS

MOROCCO
Dolbeau
81 rue Karatchi
CASABLANCA
Tel: 3041-82, 3068.38
Telex: 23051, 22822
E

Gerep
2 rue d'Agadir
Boite Postale 156
CASABLANCA
Tel: 272093, 272095
Telex: 23 739
P

NETHERLANDS
Hewlett-Packard Nederland B.V.
Van Heuven Goedhartlaan 121
NL 1181KK **AMSTELVEEN**
P.O. Box 667
NL 1080 AR **AMSTELVEEN**
Tel: (20) 47-20-21
Telex: 13 216
A,CM,CP,E,MP,P

Hewlett-Packard Nederland B.V.
Bongerd 2
NL 2906VK **CAPPELLE**, A/D Ijessel
P.O. Box 41
NL2900 AA **CAPELLE**, Ijssel
Tel: (10) 51-64-44
Telex: 21261 HEPAC NL
A,CM,CP

NEW ZEALAND
Hewlett-Packard (N.Z.) Ltd.
169 Manukau Road
P.O. Box 26-189
Epsom, **AUCKLAND**
Tel: 68-7159
Cable: HEWPACK Auckland
CM,CS,E,P*

Hewlett-Packard (N.Z.) Ltd.
4-12 Cruickshank Street
P.O. Box 9443
Kilbirnie, **WELLINGTON** 3
Tel: 877-199
Cable: HEWPACK Wellington
CM,CP,E,P

Northrop Instruments & Systems Ltd.
Eden House, 44 Khyber Pass Road
P.O. Box 9682
Newmarket, ***AUCKLAND***
Tel: 794-091
A,M

Northrop Instruments & Systems Ltd.
Terrace House, 4 Oxford Terrace
P.O. Box 8388
CHRISTCHURCH
Tel: 64-165
A,M

Northrop Instruments & Systems Ltd.
Sturdee House
85-87 Ghuznee Street
P.O. Box 2406
WELLINGTON
Tel: 850-091
Telex: NZ 3380
A,M

NIGERIA
The Electronics Instrumentations Ltd.
N6B/S70 Oyo Road
Oluseun House
P.M.B. 5402
IBADAN
Tel: 461577
Telex: 31231 TEIL NG
A,E,M,P

The Electronics Instrumentations Ltd.
144 Agege Motor Road, Mushin
P.O. Box 6645
Mushin, ***LAGOS***
A,E,M,P

NORTHERN IRELAND
Cardiac Services Company
95A Finaghy Road South
BELFAST *BT 10 OBY*
Tel: (0232) 625-566
Telex: 747626
M

NORWAY
Hewlett-Packard Norge A/S
Folke Bernadottesvei 50
P.O. Box 3558
N-5033 **FYLLINGSDALEN** (BERGEN)
Tel: (05) 16-55-40
Telex: 16621 hpnas n
CM,CS,E

Hewlett-Packard Norge A/S
Oesterndalen 18
P.O. Box 34
N-1345 **OESTERAAS**
Tel: (02) 17-11-80
Telex: 16621 hpnas n
A*,CM,CP,E,MS,P

OMAN
Khimji Ramdas
P.O. Box 19
MUSCAT
Tel: 72-22-17, 72-22-25
Telex: 3289 BROKER MB MUSCAT
P

PAKISTAN
Mushko & Company Ltd.
10, Bazar Road
Sector G-6/4
ISLAMABAD
Tel: 28624
Cable: FEMUS Rawalpindi
A,E,M

Mushko & Company Ltd.
Oosman Chambers
Abdullah Haroon Road
KARACHI *0302*
Tel: 511027, 512927
Telex: 2894 MUSHKO PW
Cable: COOPERATOR Karachi
*A,E,M,P**

PANAMA
Electrónico Balboa, S.A.
Apartado 4929
Panama 5
Calle Samuel Lewis
Edificio "Alfa" No. 2
CIUDAD DE PANAMA
Tel: 64-2700
Telex: 3480380
Cable: ELECTRON Panama
A,CM,E,M,P

Foto Internacional, S.A.
P.O. Box 2068
Free Zone of Colon
COLON 3
Tel: 45-2333
Telex: 3485126
Cable: IMPORT COLON/Panama
P

PERU
Compania Electro Médica S.A.
Los Flamencos 145, San Isidro
Casilla 1030
LIMA *1*
Tel: 41-4325
Telex: Pub. Booth 25424 SISIDRO
Cable: ELMED Lima
A,CM,E,M,P

PHILIPPINES
The Online Advanced Systems Corporation
Rico House, Amorsolo Cor. Herrera Street
Legaspi Village, Makati
P.O. Box 1510
Metro ***MANILA***
Tel: 85-35-81, 85-34-91, 85-32-21
Telex: 3274 ONLINE
A,C,E,M

Electronic Specialists and Proponents Inc.
690-B Epifanio de los Santos Avenue
Cubao, ***QUEZON CITY***
P.O. Box 2649 Manila
Tel: 98-96-81, 98-96-82, 98-96-83
Telex: 742-40287
P

POLAND
Biuro Informasji Technicznej
Hewlett-Packard
Ul Stawki 2, 6P
PL00-950 ***WARSZAWA***
Tel: 39-59-62, 39-67-43
Telex: 812453 hepa pl

PORTUGAL
Telectra-Empresa Técnica de Equipmentos Eléctricos S.a.r.l.
Rua Rodrigo da Fonseca 103
P.O. Box 2531
P-LISBON *1*
Tel: (19) 68-60-72
Telex: 12598
A,C,E,P

Mundinter
Intercambio Mundial de Comércio S.a.r.l.
P.O. Box 2761
Avenida Antonio Augusto de Aguiar 138
P-LISBON
Tel: (19) 53-21-31, 53-21-37
Telex: 16691 munter p
M

PUERTO RICO
Hewlett-Packard Puerto Rico
P.O. Box 4407
CAROLINA, Puerto Rico 00630
Calle 272 Edificio 203
Urb. Country Club
RIO PIEDRAS, Puerto Rico 00924
Tel: (809) 762-7255
Telex: 345 0514
A,CP

QATAR
Nasser Trading & Contracting
P.O. Box 1563
DOHA
Tel: 22170
Telex: 4439 NASSER
M

Scitecharabia
P.O. Box 2750
1'DOHA
Tel: 329515
Telex: 4806 CMPARB
P

ROMANIA
Hewlett-Packard Reprezentanta
Boulevard Nicolae Balcescu 16
BUCURESTI
Tel: 130725
Telex: 10440

SAUDI ARABIA
Modern Electronic Establishment
P.O. Box 193
AL-KHOBAR
Tel: 44 678, 44 813
Telex: 670136
Cable: ELECTA AL-KHOBAR
C,E,M,P

Modern Electronic Establishment
P.O. Box 1228, Baghdadiah Street
JEDDAH
Tel: 27-798
Telex: 401035
Cable: ELECTA JEDDAH
C,E,M,P

Modern Electronic Establishment
P.O. Box 2728
RIYADH
Tel: 62-596, 66-232
Telex: 202049
C,E,M,P

SCOTLAND
Hewlett-Packard Ltd.
Royal Bank Buildings
Swan Street
BRECHIN, Angus, Scotland
Tel: 3101, 3102
CM,CS

Sales and Service Offices

Hewlett-Packard Ltd
SOUTH QUEENSFERRY
West Lothian, EH30 9TG
GB-Scotland
Tel: (031) 3311000
Telex: 72682
A,CM,E,M

SINGAPORE
Hewlett-Packard Singapore (Pty.) Ltd.
P.O. Box 58 Alexandra Post Office
SINGAPORE, 9115
6th Floor, Inchcape House
450-452 Alexandra Road
SINGAPORE 0511
Tel: 631788
Telex: HPSGSO RS 34209
Cable: HEWPACK, Singapore
A,CP,E,MS,P

SOUTH AFRICA
Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 120
Howard Place
Pine Park Center, Forest Drive,
Pinelands
CAPE PROVINCE 7450
Tel: 53-7955, 53-7956, 53-7957
Telex: 57-0006
A,CM,CS,E,MS,P

Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 37066
Overport
DURBAN 4067
Tel: 28-4178, 28-4179, 28-4110
CM,CS

Hewlett-Packard South Africa (Pty.) Ltd.
P.O. Box 33345
Glenstantia 0010 **TRANSVAAL**
1st Floor East
Constantia Park Ridge Shopping Centre
Constantia Park
PRETORIA Tel: 98-1126 or 98-1220
Telex: 32163
C,E

Hewlett-Packard South Africa (Pty.) Ltd.
Daphny Street
Private Bag Wendywood
SANDTON 2144
Tel: 802-5111, 802-5125
Telex: 89-84782
Cable: HEWPACK Johannesburg
A,CM,CP,E,MS,P

SPAIN
Hewlett-Packard Española S.A.
c/Entenza, 321
E-**BARCELONA** 29
Tel: (3) 322-24-51, 321-73-54
Telex: 52603 hpbee
A,CM,CP,E,MS,P

Hewlett-Packard Española S.A.
c/San Vicente S/N
Edificio Alba II,7 B
E-**BILBAO** 1
Tel: (944) 423-8306, 423-8206
A,CM,E,MS

Hewlett-Packard Española S.A.
Calle Jerez 3
E-**MADRID** 16
Tel: 458-2600
Telex: 23515 hpe
A,CM,E,MP,P

Hewlett-Packard Española S.A.
Colonia Mirasierra
Edificio Juban
c/o Costa Brava 13, 2.
E-**MADRID** 34
Tel: 734-8061, 734-1162
CM,CP

Hewlett-Packard Española S.A.
Av. Ramón y Cajal 1-9
Edificio Sevilla 1,
E-**SEVILLA** 5
Tel: 64-44-54, 64-44-58
Telex: 72933
A,CM,CS,MS,P

Hewlett-Packard Española S.A.
C/Ramon Gordillo, 1 (Entlo.3)
E-**VALENCIA** 10
Tel: 361-1354, 361-1358
CM,CS,P

SWEDEN
Hewlett-Packard Sverige AB
Enghetsvägen 3, Fack
P.O. Box 20502
S-16120 **BROMMA**
Tel: (08) 730-0550
Telex: (854) 10721 MESSAGES
Cable: MEASUREMENTS
STOCKHOLM
A,CM,CP,E,MS,P

Hewlett-Packard Sverige AB
Sunnanvagen 14K
S-22226 **LUND**
Tel: (46) 13-69-79
Telex: (854) 10721 (via BROMMA office)
CM,CS

Hewlett-Packard Sverige AB
Vastra Vintergatan 9
S-70344 **ÖREBRO**
Tel: (19) 10-48-80
Telex: (854) 10721 (via BROMMA office)
CM,CS

Hewlett-Packard Sverige AB
Frötallisgatan 30
S-42132 **VASTRA-FROLUNDA**
Tel: (031) 49-09-50
Telex: (854) 10721 (via BROMMA office)
CM,CS,E,P

SWITZERLAND
Hewlett-Packard (Schweiz) AG
Clarastrasse 12
CH-4058 **BASLE**
Tel: (61) 33-59-20
A,CM

Hewlett-Packard (Schweiz) AG
47 Avenue Blanc
CH-1202 **GENEVA**
Tel: (022) 32-30-05, 32-48-00
CM,CP

Hewlett-Packard (Schweiz) AG
29 Chemin Château Bloc
CH-1219 **LE LIGNON** Geneva
Tel: (022) 96-03-22
Telex: 27333 hpag ch
Cable: HEWPACKAG Geneva
A,CM,E,MS,P

Hewlett-Packard (Schweiz) AG
Zürcherstrasse 20
Allmend 2
CH-8967 **WIDEN**
Tel: (57) 50-111
Telex: 59933 hpag ch
Cable: HPAG CH
A,CM,CP,E,MS,P

SYRIA
General Electronic Inc.
Nuri Basha Ainat Ebn Kays Street
P.O. Box 5781
DAMASCUS
Tel: 33 24 87
Telex: 11215 ITIKAL
Cable: ELECTROBOR DAMASCUS
E

Sawah & Co.
Place Azmé
Boite Postale 2308
DAMASCUS
Tel: 16 367, 19 697, 14 268
Telex: 11304 SATACO SY
Cable: SAWAH, DAMASCUS
M

TAIWAN
Hewlett-Packard Far East Ltd.
Kaohsiung Branch
68-2, Chung Cheng 3rd Road
Shin Shin, Chu
KAOHSIUNG
Tel: 24-2318, 26-3253
CS,E,MS,P

Hewlett-Packard Far East Ltd.
Taiwan Branch
5th Floor
205 Tun Hwa North Road
TAIPEI
Tel (02) 751-0404
Cable: HEWPACK Taipei
A,CP,E,MS,P

Hewlett-Packard Far East Ltd.
Taichung Branch
#33, Cheng Yih Street
10th Floor, Room 5
TAICHUNG
Tel: 289274

Ing Lih Trading Co.
3rd Floor 18, Po-la Road
TAIPEI
Tel:
Telex:
Cable: INGLIH TAIPEI
A

THAILAND
UNIMESA Co. Ltd.
Elcom Research Building
2538 Sukhumvit Ave.
Bangchak, ***BANGKOK***
Tel: 393-2387, 393-0338
Telex: TH81160, 82938, 81038
Cable: UNIMESA Bangkok
A,C,E,M

Bangkok Business Equipment Ltd.
5/5-6 Dejo Road
BANGKOK
Tel: 234-8670, 234-8671,
234 8672
Cable: BUSIQUIPT Bangkok
P

TRINIDAD & TOBAGO
Caribbean Telecoms Ltd.
P.O. Box 732
50/A Jerningham Avenue
PORT-OF-SPAIN
Tel: 624-4213, 624-4214
A,CM,E,M,P

TUNISIA
Tunisie Electronique
31 Avenue de la Liberte
TUNIS
Tel: 280 144
E,P

Corema
1 ter Av. de Carthage
TUNIS
Tel: 253-821
Telex: 12319 CABAM TN
M

TURKEY
Teknim Company Ltd.
Riza Sah Pehevi
Caddesi No. 7
Kavaklidere, ***ANKARA***
Tel: 275800
Telex: 42155
E

EMA. Muhendislik Kollektif Sirketi
Mediha Eldem
Sokak 41/6
Yüksel Caddesi, ***ANKARA***
Tel: 17-56-22
Cable: Ematrade
M

UNITED ARAB EMIRATES
Emitac Ltd.
P.O. Box 1641
SHARJAH
Tel: 354121, 354123
Telex: 68136
E,M,P,C

UNITED KINGDOM
see: GREAT BRITAIN
NORTHERN IRELAND
SCOTLAND

UNITED STATES
Alabama
Hewlett-Packard Co.
700 Century Park South
Suite 128
BIRMINGHAM, AL 35226
Tel: (205) 822-6802
CM,CS,MP

Hewlett-Packard Co.
P.O. Box 4207
8290 Whitesburg Drive, S.E.
HUNTSVILLE, AL 35802
Tel: (205) 881-4591
CM,CP,E,M*

Alaska
Hewlett-Packard Co.
1577 "C" Street, Suite 252
ANCHORAGE, AK 99510
Tel: (206) 454-3971
CM,CS**

Arizona
Hewlett-Packard Co.
2336 East Magnolia Street
PHOENIX, AZ 85034
Tel: (602) 273-8000
A,CM,CP,E,MS

Hewlett-Packard Co.
2424 East Aragon Road
TUCSON, AZ 85702
Tel: (602) 889-4631
CM,CS,E,MS**

Arkansas
Hewlett-Packard Co.
P.O. Box 5646
Brady Station
LITTLE ROCK, AR 72215
Tel: (501) 376-1844, (501) 664-8773
CM,MS

California
Hewlett-Packard Co.
7621 Canoga Avenue
CANOGA PARK, CA 91304
Tel: (213) 702-8300
A,CM,CP,E,P

Hewlett-Packard Co.
1579 W. Shaw Avenue
FRESNO, CA 93771
Tel: (209) 224-0582
CM,MS

Hewlett-Packard Co.
1430 East Orangethorpe
FULLERTON, CA 92631
Tel: (714) 870-1000
CM,CP,E,MP

Hewlett-Packard Co.
5400 W. Rosecrans Boulevard
LAWNDALE, CA 90260
P.O. Box 92105
LOS ANGELES, CA 90009
Tel: (213) 970-7500
CM,CP,MP

Hewlett-Packard Co.
3939 Lankershim Blvd.
NORTH HOLLYWOOD, CA 91604
Tel: (213) 877-1282
Regional Headquarters

Hewlett-Packard Co.
3200 Hillview Avenue
PALO ALTO, CA 94304
Tel: (415) 857-8000
CM,CP,E

Hewlett-Packard Co.
646 W. North Market Boulevard
SACRAMENTO, CA 95834
Tel: (916) 929-7222
A*,CM,CP,E,MS

Hewlett-Packard Co.
9606 Aero Drive
P.O. Box 23333
SAN DIEGO, CA 92123
Tel: (714) 279-3200
CM,CP,E,MP

Hewlett-Packard Co.
3003 Scott Boulevard
SANTA CLARA, CA 95050
Tel: (408) 988-7000
A,CM,CP,E,MP

Hewlett-Packard Co.
454 Carlton Court
SO. SAN FRANCISCO, CA 94080
Tel: (415) 877-0772
CM,CP

Colorado
Hewlett-Packard Co.
24 Inverness Place, East
ENGLEWOOD, CO 80112
Tel: (303) 771-3455
A,CM,CP,E,MS

Connecticut
Hewlett-Packard Co.
47 Barnes Industrial Road South
P.O. Box 5007
WALLINGFORD, CT 06492
Tel: (203) 265-7801
A,CM,CP,E,MS

Florida
Hewlett-Packard Co.
P.O. Box 24210
2727 N.W. 62nd Street
FORT LAUDERDALE, FL 33309
Tel: (305) 973-2600
CM,CP,E,MP

Hewlett-Packard Co.
4080 Woodcock Drive, #132
Brownett Building
JACKSONVILLE, FL 32207
Tel: (904) 398-0663
CM,C*,E*,MS**

Hewlett-Packard Co.
P.O. Box 13910
6177 Lake Ellenor Drive
ORLANDO, FL 32809
Tel: (305) 859-2900
A,CM,CP,E,MS

Hewlett-Packard Co.
6425 N. Pensacola Blvd.
Suite 4, Building 1
PENSACOLA, FL 32575
Tel: (904) 476-8422
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Hewlett-Packard Co.
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Vanguard Bldg.
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P.O. Box 105005
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Tel: (404) 955-1500
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Hewlett-Packard Co.
Executive Park Suite 306
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11311 Chinden Boulevard
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DOWNERS GROVE, IL 60515
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Louisiana
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Maryland
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7121 Standard Drive
HANOVER, MD 21076
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Hewlett-Packard Co.
2 Choke Cherry Road
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Telex: 910-771-2087
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Telex: 510-221-2183
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North Carolina
Hewlett-Packard Co.
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2905 Guess Road (27705)
DURHAM, NC 27704
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5605 Roanne Way
GREENSBORO, NC 27409
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1503 W. Gore Blvd., Suite #2
LAWTON, OK 73502
Tel: (405) 248-4248
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304 N. Meridan Avenue, Suite A
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Suite 121
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Oregon
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1500 Valley River Drive, Suite 330
EUGENE, OR 97401
Tel: (503) 683-8075
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WILSONVILLE, OR 97070
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Hewlett-Packard Co.
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King of Prussia Industrial Park
KING OF PRUSSIA, PA 19406
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Telex: 510-660-2670
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PITTSBURGH, PA 15238
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P.O. Box 6442
6941-0 N. Trenholm Road
COLUMBIA, SC 29260
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South Carolina (Cont.)
Hewlett-Packard Co.
814 Wade Hampton Blvd.
Suite 10
GREENVILLE, SC 29609
Tel: (803) 232-0917
C

Tennessee
Hewlett-Packard Co.
P.O. Box 22490
224 Peters Road
Suite 102
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Suite 103
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Texas
Hewlett-Packard Co.
Suite 310W
7800 Shoalcreek Blvd.
AUSTIN, TX 78757
Tel: (512) 459-3143
CM,E

Hewlett-Packard Co.
Suite C-110
4171 North Mesa
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FORT WORTH, TX 76106
Tel: (817) 625-6361
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Hewlett-Packard Co.
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10535 Harwin Street
HOUSTON, TX 77036
Tel: (713) 776-6400
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Hewlett-Packard Co.
3309 67th Street
Suite 24
LUBBOCK, TX 79413
Tel: (806) 799-4472
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Hewlett-Packard Co.
P.O. Box 1270
930 E. Campbell Rd.
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Hewlett-Packard Co.
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SAN ANTONIO, TX 78226
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Utah
Hewlett-Packard Co.
3530 W. 2100 South Street
SALT LAKE CITY, UT 84119
Tel: (801) 974-1700
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Virginia
Hewlett-Packard Co.
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2914 Hungary Spring Road
RICHMOND, VA 23228
Tel: (804) 285-3431
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Hewlett-Packard Co.
P.O. Box 4786
3110 Peters Creek Road, N.W.
ROANOKE, VA 24015
Tel: (703) 563-2205
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Hewlett-Packard Co.
P.O. Box 12778
5700 Thurston Avenue
Suite 111
VIRGINIA BEACH, VA 23455
Tel: (804) 460-2471
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Washington
Hewlett-Packard Co.
15815 S.E. 37th Street
BELLEVUE, WA 98006
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Hewlett-Packard Co.
Suite A
708 North Argonne Road
SPOKANE, WA 99206
Tel: (509) 922-7000
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West Virginia
Hewlett-Packard Co.
4604 MacCorkle Ave., S.E.
CHARLESTON, WV 25304
Tel: (304) 925-0492
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Wisconsin
Hewlett-Packard Co.
150 S. Sunny Slope Road
BROOKFIELD, WI 53005
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URUGUAY
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Casilla de Correo 370
MONTEVIDEO
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Telex: 901 Public Booth Para Pablo Ferrando 919520
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Representative Office
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MOSCOW 101000 Tel: 294-2024
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VENEZUELA
Hewlett-Packard de Venezuela C.A.
Apartado 50933
3A Transversal Los Ruices Norte
Edificio Segre 2Y3
CARACAS 1071
Tel: 239-4133, 239-4777, 239-4244
Telex: 25146 HEWPACK
Cable: HEWPACK Caracas
A,CP,E,MS,P

YUGOSLAVIA
Iskra-Commerce-Representation of Hewlett-Packard
Sava Centar Delegacija 30
Milentija Popovica 9
*11170 **BEOGRAD***
Tel: 638-762
Telex: 12042, 12322 YU SAV CEN

Iskra-Commerce-Representation of Hewlett-Packard
Koprska 46
*61000 **LJUBLJANA***
Tel: 321674, 315879
Telex:

ZAMBIA
R. J. Tilbury (Zambia) Ltd.
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LUSAKA
Tel: 81243
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ZIMBABWE
Field Technical Sales
45 Kelvin Road, North
P.B. 3458
SALISBURY
Tel:
C,E,M,P

FOR COUNTRIES AND AREAS NOT LISTED:

CANADA

Ontario
Hewlett-Packard (Canada) Ltd.
6877 Goreway Drive
MISSISAUGA, Ontario L4V 1M8
Tel: (416) 678-9430
Telex: 610-492-4246

EASTERN USA

Maryland
Hewlett-Packard Co.
4 Choke Cherry Road
Rockville, MD 20850
Tel: (301) 258-2000

MIDWESTERN USA

Illinois
Hewlett-Packard Co.
5201 Tollview Drive
ROLLING MEADOWS, IL 60008
Tel: (312) 255-9800

SOUTHERN USA

Georgia
Hewlett-Packard Co.
P.O. Box 105005
450 Interstate N. Parkway
ATLANTA, GA 30339
Tel: (404) 955-1500

WESTERN USA

California
Hewlett-Packard Co.
3939 Lankersim Blvd.
LOS ANGELES, CA 91604
Tel: (213) 877-1282

EUROPEAN AREAS NOT LISTED, CONTACT

SWITZERLAND
Hewlett-Packard S.A.
7 Rue du Bois-du-Lan
CH-1217 **MEYRIN 2**, Switzerland
Tel: (022) 83-81-11
Telex: 27835 hpse
Cable: HEWPACKSA Geneve

EAST EUROPEAN AREAS NOT LISTED, CONTACT

AUSTRIA
Hewlett-Packard Ges.m.b.h.
Wehlistrasse 29
P.O. Box 7
A-1205 **VIENNA**
Tel: (222) 35-16-210
Telex: 135823/135066

MEDITERRANEAN AND MIDDLE EAST AREAS NOT LISTED, CONTACT

GREECE
Hewlett-Packard S.A.
Mediterranean & Middle East Operations
35, Kolokotroni Street
Platia Kefallariou
GR-Kifissia, **ATHENS**, Greece
Tel: 808-0359, 808-0429
Telex: 21-6588
Cable: HEWPACKSA Athens

INTERNATIONAL AREAS NOT LISTED, CONTACT

OTHER AREAS
Hewlett-Packard Co.
Intercontinental Headquarters
3495 Deer Creek Road
PALO ALTO, CA 94304
Tel: (415) 857-1501
Telex: 034-8300
Cable: HEWPACK

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