LaserJet 2000
Technical Reference Manual

HEWLETT PACKARD

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Printing History

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bout This Manual

Hewlett-Packard has developed a standard set of printer features (and corresponding commands) for use in its printers. The set of features designed by Hewlett-Packard for all of its printers is called Printer Command Language (PCL). This manual describes the PCL feature/commands available for the **LaserJet 2000** printer. In addition to the commands, this manual also describes basic requirements of PCL programming.

This manual is written for people who have some programming experience. Many of the concepts discussed assume some programming knowledge.

When writing a PCL program for the **LaserJet 2000** printer the user should be knowledgeable of the PCL concepts presented in this manual.

This manual is divided into 13 chapters. A brief description of each chapter is provided below.

Chapter 1
Introduction to HP PCL

This chapter gives a brief history of the development of PCL, describes PCL levels (architecture), and describes PCL commands (control codes and escape sequences).

Chapter 2
The Page

This chapter introduces the idea of the logical page and identifies the area in which printing can occur. It also describes the PCL coordinate system.

Chapter 3
The Print Environment

This chapter introduces the printer's feature settings, collectively, as the print environment and how it is affected by printer reset functions. Included are descriptions of the factory default environment user default environment, and the modified print environment.

Chapter 4
Job Control Commands

This chapter describes the commands providing job control. Job commands are usually grouped together and sent at the beginning of a job. Job control functionality includes restoration of the user default environment, duplexing commands, and selection of the number of copies of each page.

Chapter 5
Page Control Commands

This chapter describes the commands providing page format control. Page format control provides for selection of the page source, size, orientation, margins, and text spacing.

Chapter 6
Cursor Positioning

This chapter describes how to position the cursor within the logical page.

Chapter 7
Fonts

This chapter describes the characteristics of a font.

Chapter 8
Font Selection

This chapter describes how to select a font for printing using the font characteristics commands. The underline feature is described at the end of this chapter.

Chapter 9
Font Management

This chapter describes the fonts supplied with the printer; these fonts are referred to as internal fonts. Additional fonts can be added to the printer by inserting font cartridges or downloading soft fonts. Font management provides mechanisms for downloading and manipulating soft fonts.

Chapter 10
Soft Font Creation

This chapter describes how to design characters for downloading to the printer.

Chapter 11
Graphics

This chapter describes how to download raster graphics to the printer and how to use rules or predefined patterns and shading.

Chapter 12
Macros

A typical printer task requires the use of several commands. Applications may perform the same task numerous times. For tasks performed repeatedly, PCL provides macro functionality to reduce the number of commands that must be sent to the printer. A macro is a collection of escape sequences, control codes, and data downloaded to the printer, whose execution can be initiated using a single command.

Chapter 13
Programming Aids

This chapter provides information for use during the development of PCL software.

Customer Support

Sources of Support

Hewlett-Packard has support services available to help you in case you have a problem with your **LaserJet 2000** printer. The following are places to turn for this support.

Your Dealer

If you encounter a difficulty, begin by contacting the person who sold you your **LaserJet 2000**. Your salesman is familiar with your needs, equipment and software and should be able to provide you with the information you want.

LaserJet 2000 Customer Assist

Hewlett-Packard also has a **LaserJet 2000** Customer Assist service available to you. It is available from 7 am - 4 pm (MST), Monday through Friday. The **LaserJet 2000** Assist staff can provide you with help on questions.

(208) 323-2551

Before you call the **LaserJet 2000** Customer Assist line, do the following:

1. Check the "In Case of Difficulty" section of the *Operator's Manual.*
2. Check with your software vendor for help.

When you call the **LaserJet 2000** Assist group, please have the following information available to help us answer your questions more quickly:

- Identify which computer you are using.
- Identify any special equipment or software you are using (for example, spoolers, networks, switch boxes, modems or special software drivers).
- Identify which cable you are using and who sold it to you.
- Identify any special interface, I/O or RAM boards installed in your printer.
- Identify the software name and version you are currently using.
- Have a self-test printout available.

Related Documentation

The following is a list of other **LaserJet 2000** manuals that may be of interest to you:

LaserJet 2000 Operator's Manual (part number 02684-90901)

This manual is written for operators of the **LaserJet 2000** printer. It includes information on printing and configuration functions using the control panel, paper specifications, routine operation maintenance suggestions and troubleshooting hints.

LaserJet 2000 Service Manual (part number 02684-90903)

This is a reference document for qualified technicians to use when servicing the printer. Included is all routine preventive maintenance as well as troubleshooting guides and removal and replacement procedures.

HP LaserJet 2000 Printer Paper Specifications Guide (part number 5954-8953)

This guide provides information on paper selection to ensure the best print quality of the printer.

The above documents may be purchased directly from Hewlett-Packard. See your authorized dealer or Hewlett-Packard Service Representative for ordering information.

Hewlett-Packard also provides guides to help you configure the **LaserJet 2000** to your system. At present, the following are available:

LaserJet 2000/DEC VAX® Configuration Guide (part number 5954-8952)

LaserJet 2000 Data General MV Configuration Guide (part number 5954-8951)

To obtain a configuration guide, see your authorized HP Dealer, or contact a Hewlett-Packard Sales and Service Office.

1 Introduction to HP PCL

Contents

The History of PCL

In the past, printers were developed without a computer industry standard for feature access. Printers manufactured during this period were designed with features that differed from device to device. As a result, application programs written for one printer often had to be rewritten or modified to work correctly with another printer, requiring months or even years of software development.

For the printer user, reluctance to upgrade to new printer technologies stemmed from this need to modify the software applications for each printer. When printers were introduced, current applications required modifications to support them. Rather than providing a smooth upgrade path, the industry was creating chaos as the output capabilities of printers changed.

To minimize this chaotic situation, Hewlett-Packard developed a standard language for printer control called "Printer Command Language" (PCL). Hewlett-Packard's PCL defines a standard for printer features and feature access by software applications. It provides the highest level of communication between the system and the printer. PCL is designed to be independent of the host system, device drivers, I/O interface, and network communications. Its purpose is to bring together all HP printers under a common and consistent control structure that provides feature compatibility from printer to printer. This protects the investment in applications and driver software.

The key to designing PCL was determining the printing features for the various printer markets. Due to the diversity of printing needs from the low-end personal computer market to the high-end computer market, developing a common feature set would have either restricted the advanced printing capabilities of high end printers or added to the cost of the low-end printers. The solution was simple: design PCL by partitioning printer features so they align with the major printer markets.

Print and space, electronic data processing (EDP), and transaction office word processing, and page formatting emerged as the four level hierarchy of PCL. With this structure, the ability to address the diversity of printing needs while protecting the investment in applications and driver software for the printers has become a reality.

PCL Architecture

Printer Command Language provides four levels of printer features: *Print and Space, EDP/Transaction, Office Word Processing,* and *Page Formatting.* Each level has a specific market for which its feature set has been targeted.

Level I *Print and Space* is the base level printer feature set. Printers implementing this feature set are usually inexpensive and provide a convenient means for the user to obtain hard-copy output. This level is typically associated with a single user workstation.

Level II The *EDP/Transaction* feature set is a superset of the Print and Space level. Printers implementing this feature set are generally multi-user hard-copy devices which have a wide range of performance. This level is used in the EDP environment or for *Transaction* processing.

Level III The *Office Word Processing* feature set is a superset of the EDP/Transaction level. This level is tailored toward the needs of the office: high quality output with additional data formatting capabilities.

Level IV The *Page Formatting* feature set is a superset of the Office Word Processing Level. This level gives the user the most flexibility in the formation of hard-copy output. The **LaserJet 2000** printer is a level IV printer.

Each level is a proper superset of the previous level, providing upward compatibility. This allows leverage of applications across printers at or above the level for which the application was written. For example, any application written for Level I (Print and Space) will run properly on any Hewlett-Packard printer fitting into the PCL level structure. Likewise, a Level IV (Page Formatting) printer can run any PCL application written for a PCL level I, II, III, or IV device.

Each level of PCL provides a well-defined set of features which address the needs of a major printer market. Optional features have been defined which are extensions to the PCL level hierarchy; these features provide the flexibility to address special applications, such as paper handling and bar codes.

The PCL model succeeds because the following points are observed:

- All printers implement features identically.
- Each level is a proper superset of the previous level.
- A printer supporting a specific PCL level implements, as a minimum, the defined feature set of that level.
- Each printer is specific as to its application and any exceptions in features that it may have (for example, no raster graphics on daisy wheel printers).
- All PCL printers have the ability to ignore unsupported commands.

What are Printer Commands?

PCL commands provide access to printer features. Once a PCL command sets a parameter, that parameter will remain set until the same PCL command is repeated with a new value or the printer is reset to its user default environment. For example, if you send the printer a command to set landscape page orientation, each page will print in landscape orientation until you send the portrait orientation command or reset the printer.

There are three types of PCL commands:

- control codes,
- two-character escape sequences, and
- parameterized escape sequences.

A control code is a character that initiates a printer function, for example CR, LF, FF, etc.

PCL escape sequences consist of two or more characters. The first character is always the ASCII escape character, identified by the ^{E}c symbol. This character is a control code used specifically by the printer to identify a string of characters as a printer command. As the printer monitors incoming data from a computer, it is "looking" for this character. When this character appears, the printer reads it and its associated characters as a command to be performed and not as data to be printed.

Note

PCL printer commands are also referred to as escape sequences. The terms "escape sequence" and "printer command" are used interchangeably throughout this manual.

Some escape sequences shown in this manual contain spaces between characters for clarity. Do not include these spaces when using escape sequences.

Syntax of Escape Sequences

There are two forms of PCL escape sequences: two character escape sequences and parameterized escape sequences.

Two Character Escape Sequences

Two-character escape sequences have the following form:

$^{E}_{C}$ **X**

where "**X**" is a character which defines the operation to be performed. (Note, "**X**" may be any character from the ASCII table (see Appendix A) within the range 48 - 126 decimal ["0" through "~"]. For a list of the two character escape sequences supported by the printer refer to Appendix A.

Example

1. $^{E}_{C}$ **E** - is a two character escape sequence used for resetting the printer.
2. $^{E}_{C}$ **9** - is a two-character escape sequence used for resetting the left and right margins.

Parameterized Escape Sequences

Parameterized escape sequences have the following form:

$^{E}_{C}$ X y # z1 # z2 # z3 ... # Zn[data]

where **y**, **#**, **zi**, and **[data]** may be optional, depending on the command.

X **Parameterized Character** - A character from the ASCII table within the range 33-47 decimal ("!" through "/") indicating that the escape sequence is parameterized.

y **Group Character** - A character from the ASCII table within the range 96-126 decimal ("`" through "~") which specifies the group type of control being performed.

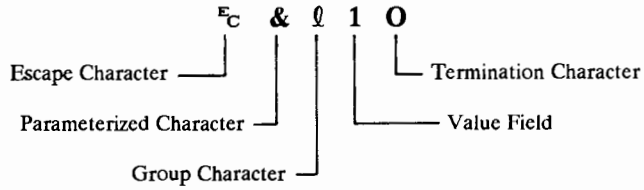
**Value Field** - A group of characters specifying a numeric value. The numeric value is represented as an ASCII string of characters within the range 48-57 decimal ("0" through "9") which may be preceded by a "+" or "-" sign and may contain a fractional portion indicated by the digits after a decimal point "."). If an escape sequence requires a value field and a value is not specified, a value of 0 is assumed.

zi **Parameter Character** - Any character from the ASCII table within the range 96-126 decimal ("`" through "~"). This character specifies the parameter to which the previous value field applies. This character is used when combining escape sequences.

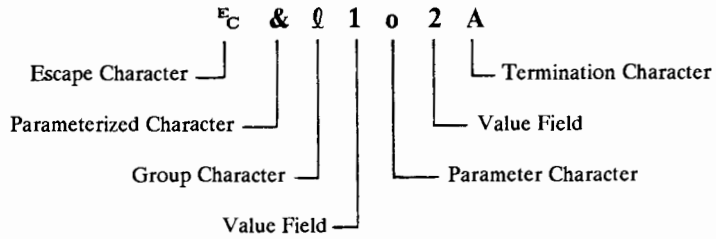
Zn **Termination Character** - Any character from the ASCII table within the range 64-94 decimal ("@" through "^"). This character specifies the parameter to which the previous value field applies. This character terminates the escape sequence.

[Data] Binary Data is eight-bit data (i.e., graphics data, downloaded fonts, etc.). The number of bytes of binary data is specified by the value field of the escape sequence. Binary data immediately follows the terminating character of the escape sequence.

The following is an example of an escape sequence with a termination character and no parameter character. This escape sequence performs a single function.



The following is an example of an escape sequence with a parameter character and a termination character. This escape sequence performs two functions.



The above command is a combination of the escape sequences: **ᴱc&ℓ1O** and **ᴱc&ℓ2A**.

Notice that the "**ᴱc**" and the "**&ℓ**" are dropped from the second printer command when they are combined. Also, the upper-case "**O**" that terminated the first command becomes a lower-case "o" parameter character when these commands are combined.

Use these three rules to combine and shorten printer commands:

1. The first two characters after "^{E}c" (the parameterized and group character) must be the same in all of the commands that will be combined. In the example above, these are "&" and "ℓ".
2. All alphabetic characters within the combined printer command will be lower-case, except the final letter which is always upper-case. In the combined example above, "O" becomes "o". The final character in the printer command must always be upper-case to let the printer know that the command is complete.
3. The printer commands will be performed in the order that they are combined (from left to right). Be sure to combine commands in the order that they are to be performed.

2 The Page

Contents

Introduction

This chapter describes the PCL coordinate system. It defines the logical page and the printable area, and identifies the boundaries of each.

Logical Page

The PCL logical page (also referred to as the addressable area) defines the area in which the cursor can be positioned.

Although the printer does not actually have a cursor (like the blinking underline character used on most computer terminals), the cursor position refers to the currently active printing position. In other words, the location of the "cursor" is the position on the logical page where the next character will be positioned. The cursor can be moved to different points on the logical page using the cursor positioning commands. The cursor cannot be moved outside of the logical page bounds.

The size of the logical page for the media supported by the printer is defined in Figures 2-2 and 2-3.

PCL Coordinate System

The PCL coordinate system is defined as shown in the following figure:

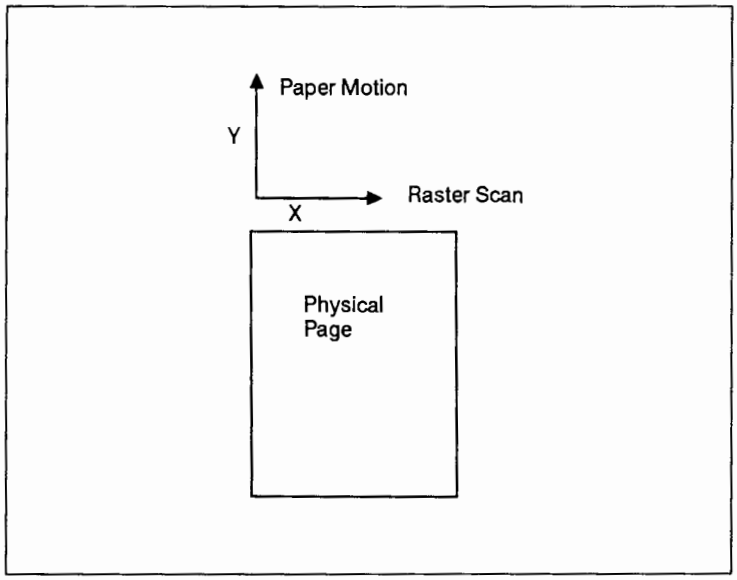


Figure 2-1. X,Y PCL Coordinates

The point (0,0) is at the left edge of the logical page at the current top margin position. Since the top margin may be changed using a printer command, the physical location of the point (0,0) may change.

Units of the PCL Coordinate System

The units of the X-axis of the PCL coordinate system may be dots, decipoints, or columns. The units of the Y-axis may be dots, decipoints, or rows.

The dot is the smallest printable unit. On the **LaserJet 2000**, one dot equals $1/300^{th}$ inch. The number of dots printed per inch is referred to as the printer's resolution.

A decipoint is $1/720^{th}$ inch or $1/10^{th}$ of a PCL typographic point.

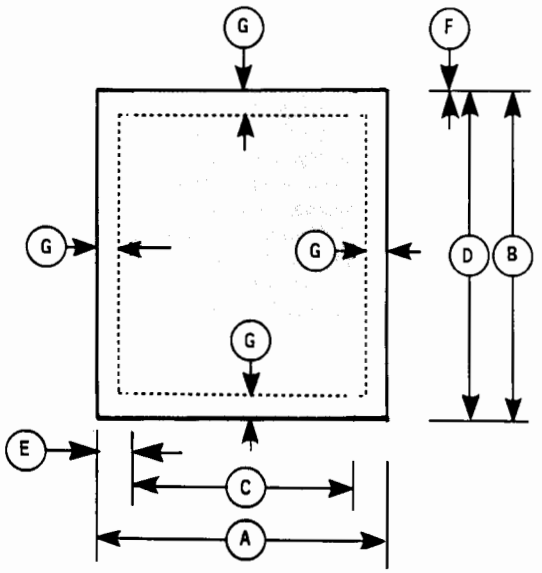
The width of a column is defined by the current horizontal motion index (HMI). The distance between rows is defined by the current vertical motion index (VMI) or lines-per-inch (lpi). HMI, VMI, and lpi are described in Chapter 5, Page Control Commands.

Internally, the printer uses a different unit of measure. It maps dots, decipoints, and columns and rows to this unit of measure. This internal unit is $1/7200^{th}$ inch. All positioning is kept in internal units and rounded to physical dot positions when data is printed.

Printable Area

The printable area is the area of the physical page in which the printer is able to place a dot. The physical page refers to the size of the media installed in the printer.

The relationship between physical page, logical page and printable area, is defined in Figures 2-2 and 2-3.



— Physical Page
---- Printable Area
□ Logical Page

A = Physical Page Width
B = Physical Page Length
C = Logical Page Width
D = Maximum Logical Page Length
E = Distance Between the Edge of the Physical Page and the Printable Area
F = Distance Between the Edge of the Physical Page and the Logical Page
G = Distance Between the Edge of the Physical Page and the Printable Area

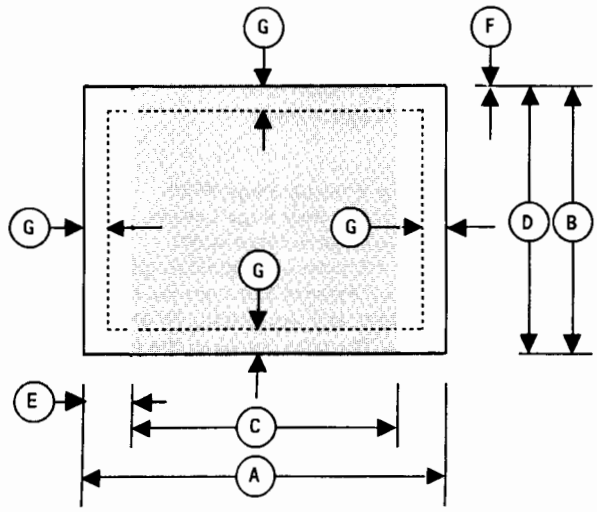
Width of the Printable Area = A-2*G

Length of the Printable Area = B-2*G

All Dimensions In Dots

PAPER SIZE	A	B	C	D	E	F	G
LETTER	2550	3300	2400	3300	75	0	50
EXECUTIVE	2175	3150	2025	3150	75	0	50
LEGAL	2550	4200	2400	4200	75	0	50
LEDGER	3300	5100	3150	5100	75	0	50
A4	2480	3507	2338	3507	71	0	50
A3	3507	4960	3365	4960	71	0	50

Figure 2-2. Portrait Logical Page and Printable Area Boundaries



— Physical Page
····· Printable Area
▭ Logical Page

A = Physical Page Length
B = Physical Page Width
C = Logical Page Width
D = Maximum Logical Page Length
E = Distance Between the Edge of the Physical Page and the Logical Page
F = Distance Between the Edge of the Physical Page and the Logical Page
G = Distance Between the Edge of the Physical Page and the Printable Area

Width of the Printable Area = A-2*G

Length of the Printable Area = B-2*G

All Dimensions in Dots

PAPER SIZE	A	B	C	D	E	F	G
LETTER	3300	2550	3180	2550	60	0	50
EXECUTIVE	3150	2175	3030	2175	60	0	50
LEGAL	4200	2550	4080	2550	60	0	50
LEDGER	5100	3300	4980	3300	60	0	50
A4	3507	2480	3389	2480	59	0	50
A3	4960	3507	4842	3507	59	0	50

Figure 2-3. Landscape Logical Page and Printable Area Boundaries

The **LaserJet 2000** performs pixel level clipping. This means that when printing characters or graphics, if any portion of the character or graphic is outside the printable area, only that portion outside the printable area will be clipped (see Figure 2-4).

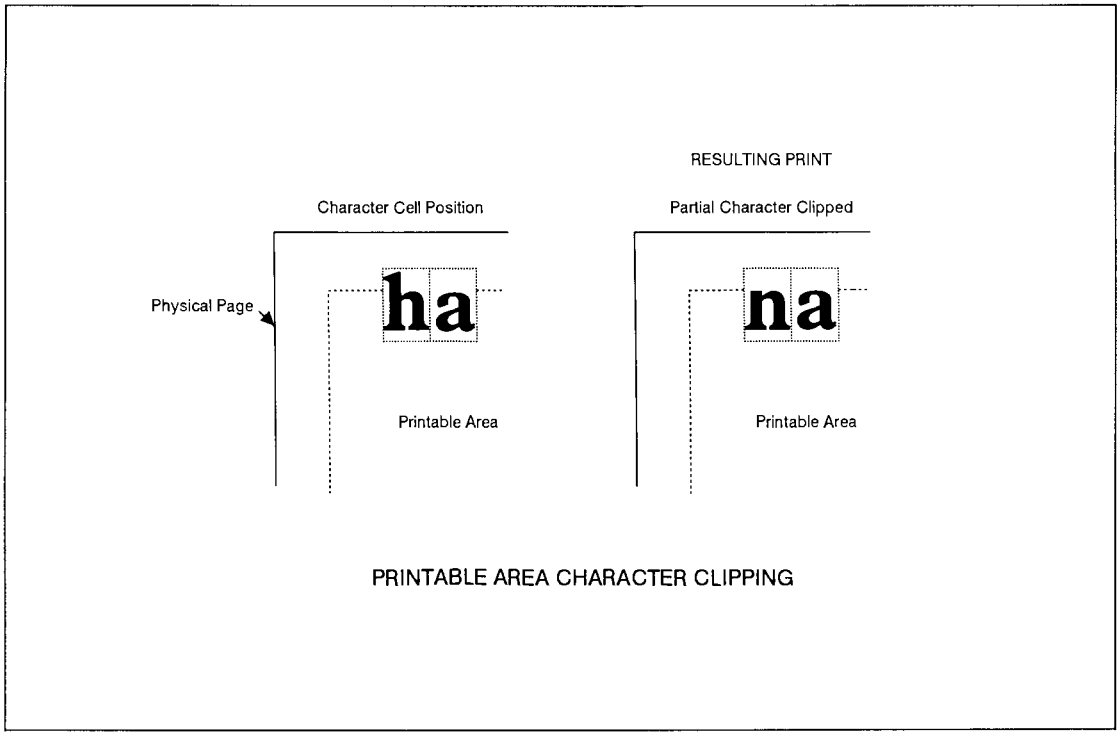


Figure 2-4. Printable Area Character Cell Positioning

3 The Print Environment

Contents

Introduction

The group of all of the printer's current feature settings, collectively, is referred to as the print environment. The printer maintains four print environments: the factory default environment, the user default environment, the modified print environment and the overlay environment. This chapter describes the factory default environment, the user default environment, and the modified print environment (the overlay environment is described in Chapter 12, "Macros").

Default settings refer to the settings programmed into the printer at the factory or settings selected using the control panel. The term default simply refers to the settings the printer uses unless printer commands are used to select other settings.

Each time a job is printed, some of the printer's feature settings may be changed from their default values to produce the desired printed output for that job. After the job has printed, the job specific feature settings will no longer be required, since the next job will likely have different output requirements. The next job should clear all previous job settings by performing a reset. This allows a job to start with the default settings as a base and vary only those settings that are needed. Returning to the default environment at the beginning of each print job eliminates the need for setting every feature each time a job is run.

Factory Default Environment

A factory default is a setting programmed into the printer at the factory. The group of all of the printer's factory settings is referred to as the factory default environment. (Each of these features is described later in this manual.) Table 3-1 lists the printer's factory defaults.

Table 3-1. Print Environment Features with Factory Default Settings

JOB CONTROL

- NUMBER OF COPIES = 1
- REGISTRATION (X=0, Y=0)
- DUPLEXING = OFF (SIMPLEX)

PAGE CONTROL

- ORIENTATION* = Portrait
- PAGE SIZE* = Letter
- VERTICAL MOTION INDEX * = 8 (6 lpi)
- HORIZ. MOTION INDEX = 12 (10 cpi)
- TOP MARGIN = 1/2" (150 dots or 3 lines)
- TEXT LENGTH = Installed paper length - (1/2" top margin + 1/2" bottom margin)
- LEFT MARGIN = Left logical page boundary
- RIGHT MARGIN = Right logical page boundary
- PERFORATION SKIP = ON
- LINE TERMINATION = CR→CR, LF→LF, FF→FF

FONT SELECTION**

- SYMBOL SET = ROMAN-8
- SPACING = Fixed
- PITCH = 10 cpi
- HEIGHT = 12 point
- STYLE = Upright
- STROKE WEIGHT = Medium
- TYPEFACE = Courier
- UNDERLINING MODE = OFF

FONT MANAGEMENT

- FONT ID = 0
- CHARACTER CODE = 0

RASTER GRAPHICS

- RASTER GRAPHICS RESOLUTION = 75 dpi
- RASTER GRAPHICS PRESENTATION = 3

RECTANGULAR AREA FILL

- HORIZONTAL RECTANGLE SIZE = 0
- VERTICAL RECTANGLE SIZE = 0
- AREA FILL ID = 0

MACRO

- MACRO ID = 0

TROUBLESHOOTING COMMANDS

- END-OF-LINE WRAP = OFF
- DISPLAY FUNCTIONS = OFF

* - User default values may be selected by the user from the printer control panel for these items.

** - The font characteristics are determined by the default font. The default font can be the factory default font or the user selected default font from the control panel or from a font cartridge with a default font.

User Default Environment

A user default setting is a setting selected from the printer's control panel.

There are five PCL features on the **LaserJet 2000** printer for which user default settings may be selected. These features are as follows:

Paper Size
Page Orientation
Font (primary and secondary)
Form Length (VMI)
Job Separation

Note

1. Choosing the user default paper size and/or page orientation will result in a change to the user default VMI setting.
2. Refer to discussion on VMI for the implications of setting this default.

For instructions on how to select user default settings from the control panel refer to the *LaserJet 2000 Operator's Manual.*

User default settings are stored in the User Default Environment and are retained even if the printer is turned OFF.

The User Default Environment consists of the user default settings (any user default settings selected from the control panel) with the remainder of the environment features set to their factory default values.

Modified Print Environment

The current printer feature settings constitute the modified print environment. Whenever a feature setting is altered using escape sequences, the new setting is recorded in the modified print environment.

The modified print environment consists of the current settings for the following features:

- Job separation
- Number of copies
- Simplex/Duplex print
- Left registration
- Top registration
- Paper Source
- Page size
- Page length
- Orientation
- Left margin
- Right margin
- Top margin
- Text length
- Perforation skip mode
- Line termination
- HMI
- VMI/lpi spacing
- Font characteristics
- Primary font
- Secondary font
- Underline mode
- Font ID
- Character code
- Raster graphics resolution
- Raster graphics presentation mode
- Raster graphics left margin
- Area fill ID
- Horizontal rectangle size
- Vertical rectangle size
- Macro ID
- End-of-Line wrap

The following items are not part of the modified print environment:

- Current cursor position
- Cursor position stack

Resetting the Print Environment

Resets are used to return the printer to a known environment. Depending on the type of reset performed, the printer returns to either the user default environment or the factory default environment.

A printer reset restores the user default environment and deletes temporary fonts and macros. A printer reset is performed by sending the ^{E}c E command or by pressing the RESET key on the control panel.

The ^{E}c E command prints any partial pages of data which may have been received. The control panel RESET discards any formatted pages which have not yet been printed.

Note 

Hewlett-Packard strongly recommends the use of the ^{E}c E command at the beginning and end of each job.

A COLD RESET restores the factory default environment. A COLD RESET is performed by power cycling the printer while pressing the ON LINE key (refer to the *LaserJet 2000 Operator's Manual*).

LaserJet Family Compatibility

Control panel functionality has been added to the **LaserJet 2000** to permit selecting user defaults for certain features. This permits users to tailor their printer's default environment to their printing requirements. For example, European users may choose to select a font other than the factory default font as their default and EDP users may choose to select 66 lines per letter page rather than 60 lines as their default. To insure compatibility with applications written for **LaserJet** family printers, the user defaults must be set equal to their factory default values. The following table shows the factory default setting for each feature for which a user default setting may be selected.

Table 3-2. LaserJet Family Compatibility

LaserJet 2000 Control Panel Functionality	Compatibility Mode
Paper Size	Configured to the required size
Primary Font	000
Secondary Font	000
Orientation	Portrait
Form Length	57 if executive is the default paper size 60 if letter is the default paper size 64 if A4 is the default paper size 78 if legal is the default paper size 93 if A3 is the default paper size 96 if ledger is the default paper size

4 Job Control Commands

Contents

Introduction

A job typically consists of three parts:

- commands providing job control,
- commands providing page control, and
- document data.

This chapter describes the commands providing job control. Job control commands are usually grouped together and sent at the beginning of a job. Page control commands and data are associated with each printed page of a job. Job control functionality includes the following:

- restoration of the user default environment,
- physical separation of the job outputs,
- selection of the number of copies of each page,
- selection of single or double-sided printing.

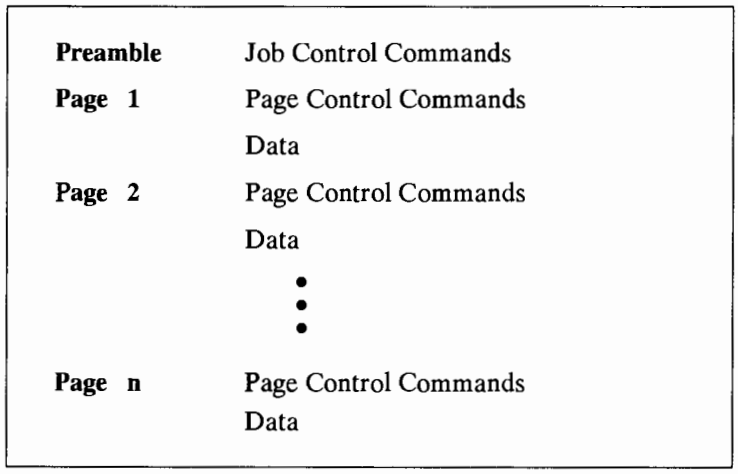


Figure 4-1. Structure of a Job

Note

If a number of consecutive pages within a job have the same format, the associated page control commands only need to be sent once per group of similar commands.

Printer Reset

Receipt of the printer reset command restores the user default environment, deletes temporary fonts and macros, and prints any partial pages of data which may have been received.

$^{E}_{C}$ E

Hewlett-Packard strongly recommends the use of the printer reset command at the beginning and end of each job.

Job Separation

As a means of differentiating between multiple print jobs that have been stacked together in the output stacker, the printer can be instructed to insert an identifying sheet at the beginning of each job. The inserted sheet is blank except for a heavy black bar that is printed along one edge of the page (refer to Figure 4-2).

The Job Separation command should be sent at the beginning of each job, following the Printer Reset command.

^{E}C &ℓ 1 T

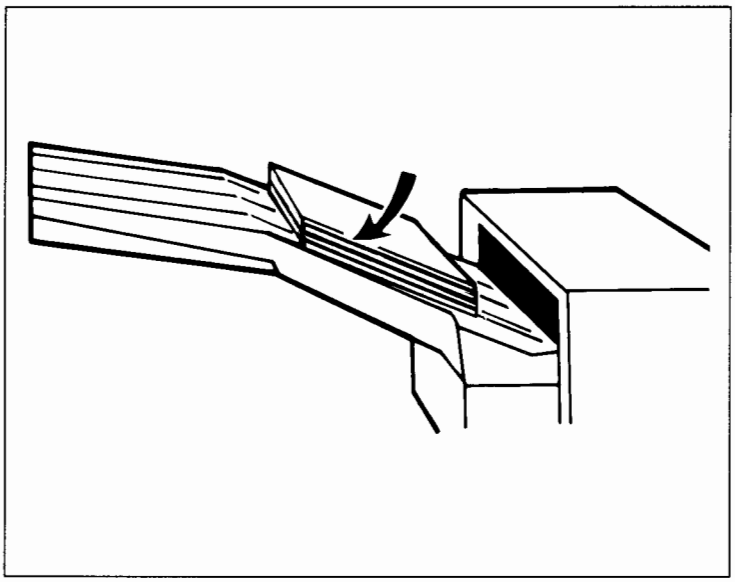


Figure 4-2. The Job Separation Sheet

The factory default is job separation enabled.

Job separation can be disabled from the control panel (refer to the *LaserJet 2000 Operator's Manual*).

If the job separation feature is enabled, the inserted sheet is produced automatically by the printer when the job separation command is received from the host computer. If the job separation feature is disabled or the Job Separation command is not received by the printer, no separation sheet is inserted.

Number of Copies

The Number of Copies command designates the number of printed copies of each page.

$^{E}_{C}$ & ℓ # X

= Number of copies (up to 99 maximum)

This command can be received anywhere within a page and affect the current page as well as subsequent pages.

The factory default number of copies is 1.

Example

To print 3 copies of a page, send:

$^{E}_{C}$&ℓ3X

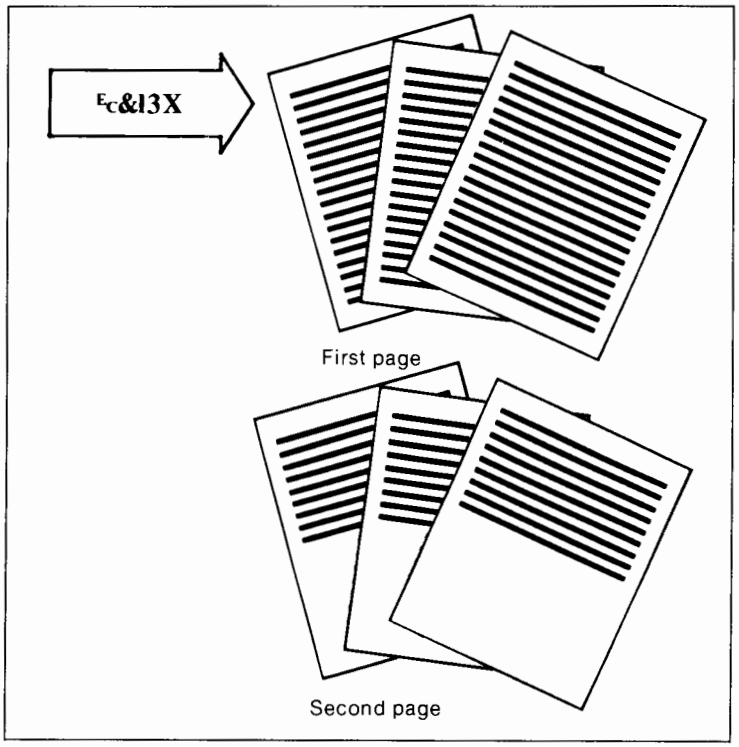


Figure 4-3. Number of Copies

Simplex/Duplex Print

Simplex is a mode of printing in which an image is placed on only one side of each sheet of paper. Duplex is a mode of printing in which an image is placed on both sides of a sheet of paper. The simplex/duplex print command designates the print mode.

$^{E}_{C}$ & ℓ # S

= 0 - Simplex
= 1 - Duplex, Vertical Binding
= 2 - Duplex, Horizontal Binding

Vertical binding duplex mode implies no orientation change from front side to back side.

Vertically bound duplexed pages are bound along the length of the physical page (see Figure 4-4).

Horizontal binding duplex mode implies the back side data is rotated 180 degrees from the front side data. Horizontally bound duplexed pages are bound along the width of the physical page (see Figure 4-5).

The factory default mode is simplex.

Note 

This command is ignored if the duplex option is not installed.

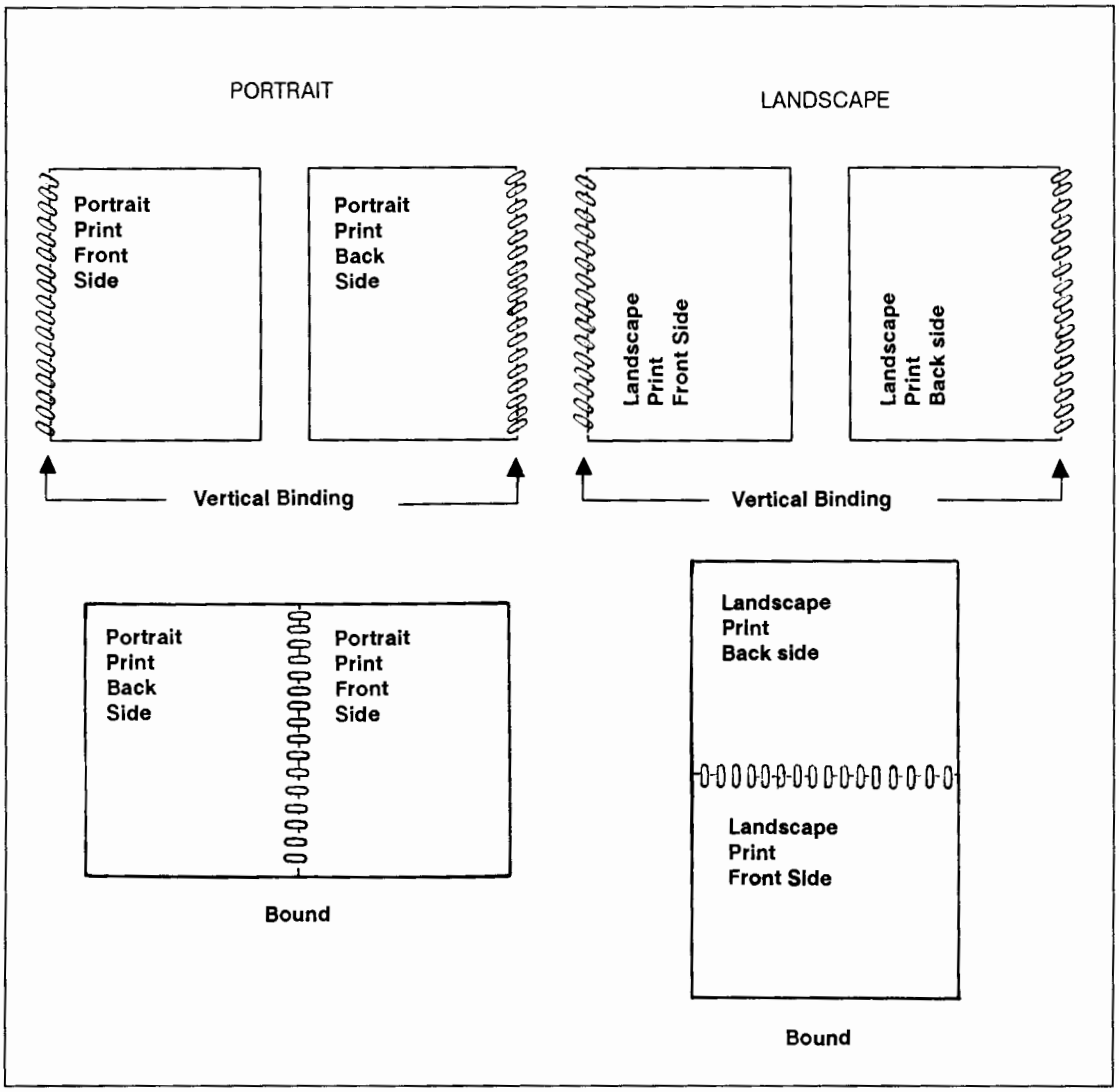


Figure 4-4. Vertical Binding Mode

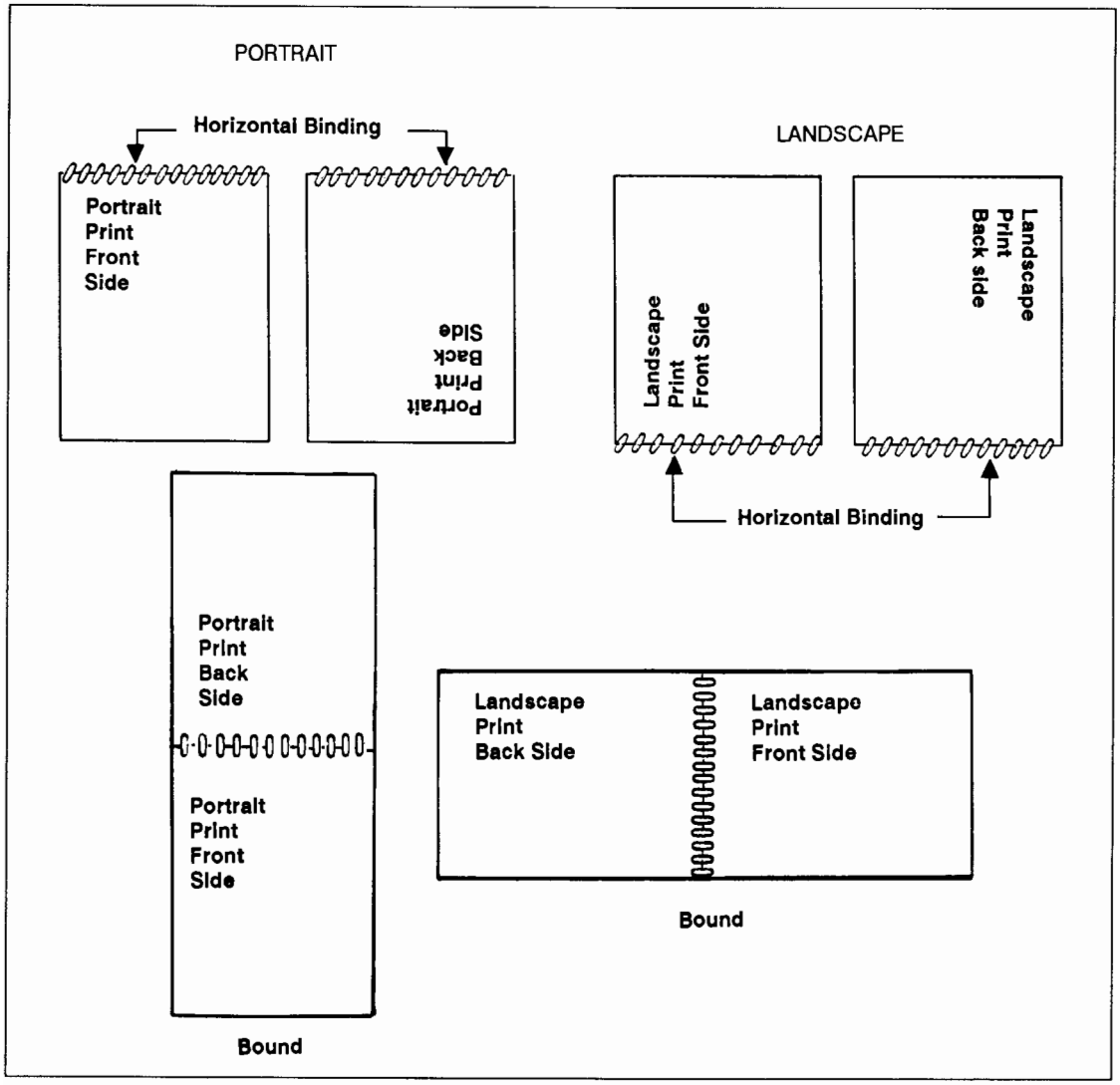


Figure 4-5. Horizontal Binding Mode

Left Offset Registration

The left offset registration command designates the position of the logical page across the width (short side) of the physical page.

$^{E}_{C}$ & ℓ # U

= The number of decipoints (1/720th inch)

The value (#) is a signed number, valid to 4 decimal places. The units are decipoints. Positive values cause the logical page, regardless of orientation, to move right along the width of the physical page, except, on the back side of sheets printed in vertical binding duplex mode where they cause it to move left (refer to Figures 4-6 an 4-7).

Negative values cause the logical page, regardless of orientation, to move left along the width of the physical page, except on the back side of sheets printed in vertical binding duplex mode where they cause it to move right (refer to Figures 4-6 and 4-7).

Note

1. The +/- value is absolute with respect to the default position of the logical page, along the width of the physical page. It is not relative to the present location.
2. The registration commands may cause data loss by moving the logical page outside the printable area.

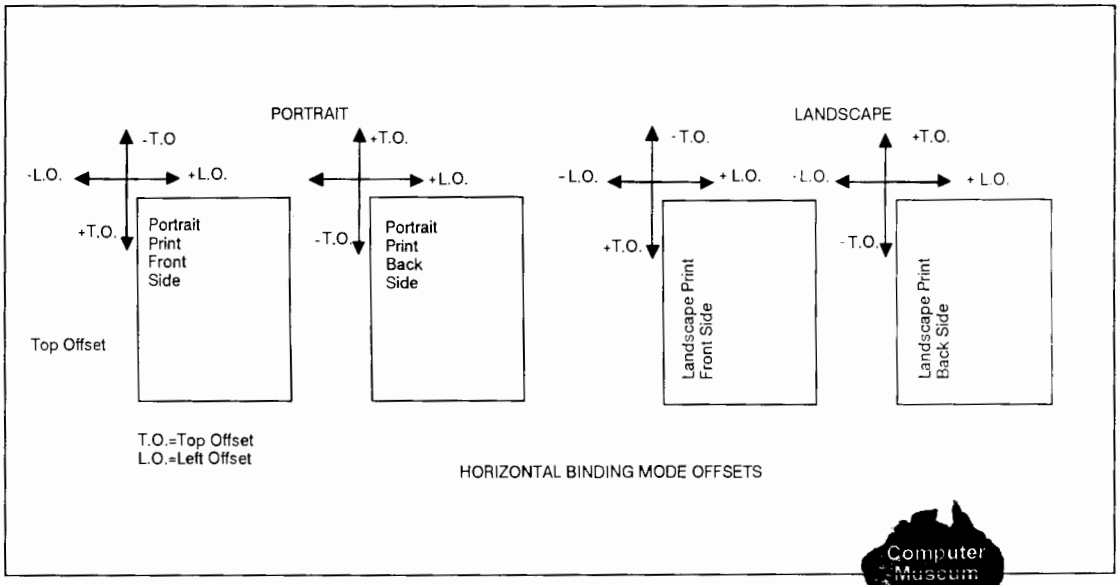


Figure 4-6. Horizontal Binding Mode Offset

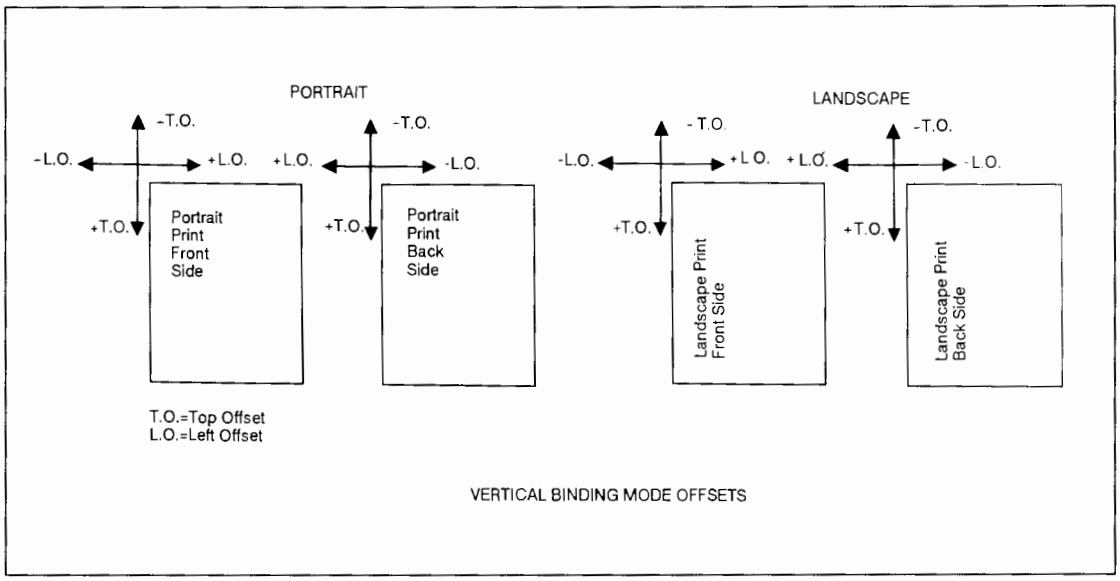


Figure 4-7. Vertical Binding Mode Offset

Top Offset Registration

The top offset registration command designates the position of the logical page along the length (long side) of the physical page.

^{E}C &l#Z

= The number of decipoints (1/720th inch)

The value (#) is a signed number, valid to 4 decimal places. The units are decipoints. Positive values cause the logical page, regardless of orientation, to move down along the length of the physical page except, on the backside of sheets printed in horizontal binding duplex mode, where they cause it to move up (refer to Figures 4-6 and 4-7).

Negative values cause the logical page, regardless of orientation, to move up, along the length of the physical page except, on the backside of sheets printed in horizontal binding duplex mode, where they cause it to move down (refer to Figures 4-6 and 4-7).

Note

1. The +/- value is absolute with respect to the default position of the logical page, along the length of the physical page. It is not relative to the current location of the logical page.
2. The registration command may cause data loss by moving the logical page outside the printable area.

Duplex Page Side Selection

The ability to skip a page while duplexing may be required at certain locations in a document. For example, a chapter typically begins on the front side of a page.

Receipt of the Duplex Page Side command causes a form feed and designates which side to print on next.

$^{E}_{C}$ **& a # G**

= 0 - Select next side
= 1 - Select front side
= 2 - Select back side

If duplexing is not enabled, these commands just eject the current page, positioning the cursor at the default position on the next page.

Example

To print on the front side of a page, regardless of the current side, send the following:

$^{E}_{C}$ **& a 1 G**

If, in the above example, the printer is currently formatting a front side, the printer will stop formatting and eject that page, and begin printing on the next front page (skipping the back page).

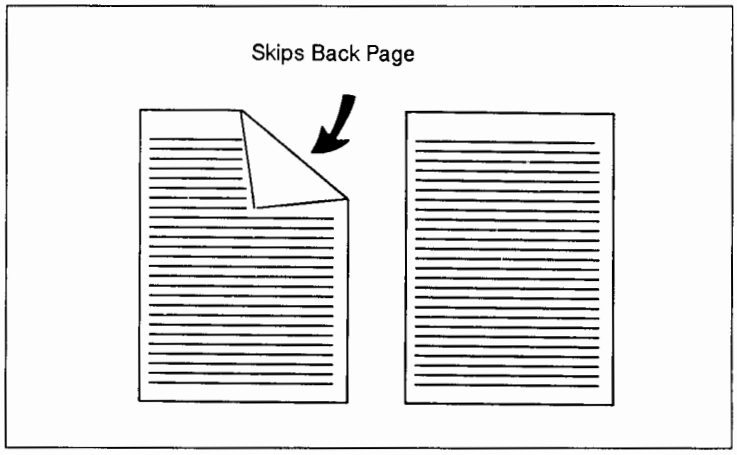


Figure 4-8. Page Side Selection

5 Page Control Commands

Contents

Introduction

A job typically consists of three parts:

- commands providing job control,
- commands providing page control, and
- document data.

Job control commands are usually grouped together and sent at the beginning of a job. Page control commands and data are associated with each printed page of a job. This chapter describes the commands providing page format control. Page format control functionality provides for selection of the page source, size, orientation, margins and text spacing.

Paper Source

The Paper Source command designates one of the three paper locations as the paper source for printing.

$^{E}_{C}$ & ℓ # H

= 0 - Print the current page (paper source remains unchanged)
1 - Feed from upper paper tray
4 - Feed from lower paper tray
5 - Feed from paper deck (PDX), if installed

Receipt of a Paper Source command causes the current page to be printed and the cursor to be moved to the left edge of the logical page at the top margin on the following page. If a Paper Source command requests paper from a location which contains a paper size that does not match the currently selected size, the printer will select a paper location with the correct paper size, provided one exists. (Paper size has priority over paper source selection.) When a paper source runs out of paper, the printer will automatically select a new source of the current page size, if one exists. This is referred to as Auto (Paper) Selection.

Using the Control Panel SECURE SOURCE menu selection, it is possible to prevent the printer from automatically selecting the lower paper tray (refer to the *LaserJet 2000 Operator's Manual*). However, the lower tray may still be selected using the Paper Source command. If the user has a special print job which consists of a letter-head cover page and several plain pages, the letter-head paper should be installed into the lower tray and SECURE SOURCE should be set ON. Using the Paper Source command, the user may select paper (letter head) from the lower tray for the first page and switch to the plain paper for the remainder of the pages. When SECURE SOURCE is ON, and the paper supply in the lower tray is depleted, the control panel will display a request for paper of the current size to be loaded into the lower tray. The printer will not auto select another paper source if SECURE SOURCE is enabled.

The default paper source is determined by the user default page size as configured at the control panel. The factory default paper source is determined by the factory default page size which is letter.

When all three sources contain the same paper size, the printer will select the sources in the following order:

- Paper Deck (PDX), if installed
- Upper Tray
- Lower Tray

Example To feed paper from the lower paper tray, send:

```
ESC&l4H
```

Page Size

The Page Size command designates the physical page size which in turn defines the size of the logical page.

^{E}C &ℓ# A

= 1 - Executive (7.25" x 10.5")
2 - Letter (8.5" x 11")
3 - Legal (8.5" x 14")
6 - Ledger (11" x 17")
26 - A4 (210mm x 297mm)
27 - A3 (297mm x 420mm)

If a page size different from that of the installed paper is specified, a message is displayed on the control panel requesting installation of paper of the specified size.

Upon receipt of this command any unprinted pages will be printed, the top margin, text length, and left and right margins will be set to their user defaults, and the automatic macro overlay will be disabled. The cursor is moved to the left edge of the logical page at the top margin on the following page.

The factory default page size is letter; however, a user default page size may be selected from the control panel.

Example

To select a legal size page, send:

^{E}C&ℓ3A

Page Length

The Page Length command designates the length of the logical page which in turn defines the physical page size.

^{E}c & ℓ # P

- Number of Lines

The value field (#) identifies the length of the logical page in lines. If a request is received for a page length greater than the maximum supported page size or if the VMI is 0, the Page Length command is ignored.

If a Page Length command is received that designates a page size different from that of the installed paper, a message is displayed on the control panel requesting installation of the appropriate paper size.

Upon receipt of this command any unprinted pages will be printed, the top margin, text length, left and right margins will be set to their user defaults, and the automatic macro overlay will be disabled. The cursor will be moved to the left edge of the logical page at the top margin on the following page.

The Page Length command used with the **LaserJet** and **LaserJet Plus** printers is an alternate way of setting the page size. Either command can be used with the **LaserJet 2000** printer. The command most recently received will be in effect.

The factory default logical page length is defined by the factory default page size, which is letter; however, a user default page size may be selected from the control panel.

The following tables list page length values associated with the standard paper values.

Note

A change in the control panel FORM LENGTH setting results in a modification of VMI. If the page length command (^{E}c&ℓ#P) follows a VMI change, the physical size of the page is recalculated. Therefore, depending on the VMI modification made, the printer may request a different paper size.

Table 5-1. Portrait Orientation Page Length Settings.

Page Size	Lines-per-inch Setting: 6	8
Letter	66	88
Legal	84	112
A4	70	93
Executive	63	84
Ledger	102	136
A3	99	132

Table 5-2. Landscape Orientation Page Length Settings

Page Size	Lines-per-inch Setting: 6	8
Letter	51	68
Legal*	---	----
A4	49	66
Executive	43	58
Ledger	66	88
A3	70	93

* To print a legal size page in landscape orientation, start out in portrait orientation, set the page length using the **Ec&ℓ84P** command, and then set the orientation using the **Ec&ℓ1O** command.

To determine the number of lines per page, simply multiply the line spacing setting (lines-per-inch) times the length of the page in inches.

Orientation

Orientation defines the position of the logical page and the direction of print with respect to the physical page as shown in Figure 5-1.

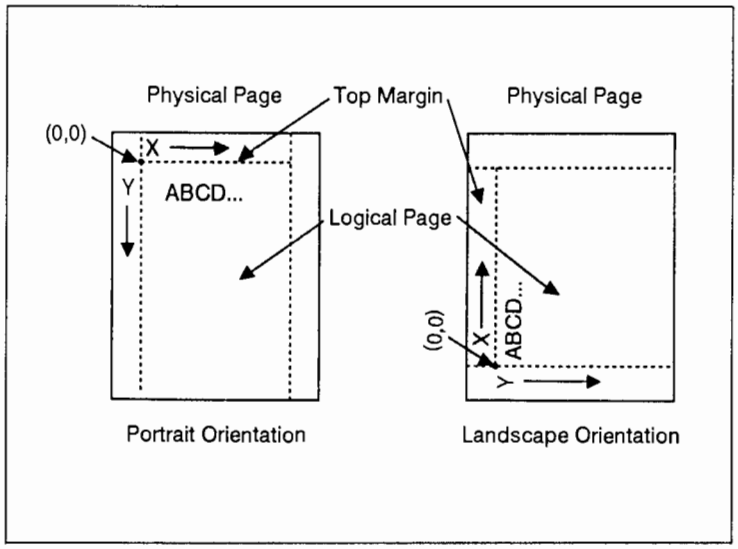


Figure 5-1. Page Orientation

Changing orientation causes any unprinted pages to be printed, the logical page length, top margin, text length, left and right margins, HMI and VMI to be set to their user defaults, and the automatic macro overlay to be disabled. The cursor is moved to the left edge of the logical page at the top margin on the following page.

The factory default page orientation is portrait. The user default orientation may be selected using the control panel.

See additional discussion of orientation in Chapters 7 and 8.

Text Area

Text printing may be restricted to a specific area within the logical page using the left margin, right margin, top margin, text length and perforation skip mode commands. This area is known as the text area.

The left margin defines the distance between the left edge of the logical page and the left edge of the text area. The right margin defines the distance between the left edge of the logical page and the right edge of the text area. The width of the text area is the distance between the left and right margins. The top margin defines the distance between the top of the logical page and the top of the text area. The text length defines the length of the text area. The perforation skip region is the distance from the bottom of the text area to the top of the text area on the next page. The text area is shown in Figure 5-2.

In general, characters will be printed when they fall within the text area. Characters will be printed between the bottom of the text area and the top of the text area on the next page only when perforation skip is disabled. Characters will be printed outside the text area if a cursor move escape sequence positions the cursor there.

Note

The text area may be larger than the printable area. Attempting to print characters outside the printable area will result in data loss. See Chapter 2 for a description of the printable area.

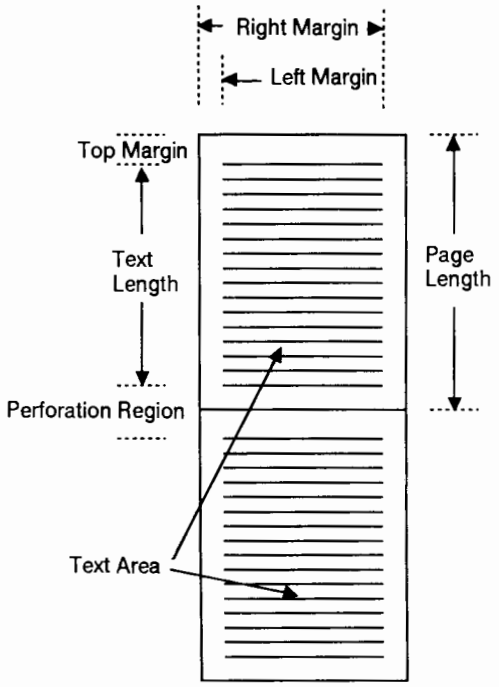


Figure 5-2. Text Area

Left Margin

The Left Margin command sets the left margin to the left edge of the specified column.

$^{E}_{C}$ & a # L

= Column number

The first column within a line is column 0, which is located at the left edge of the logical page (the distance between columns is defined by the current HMI). If the value field (#) specifies a column greater than the current right margin, the command is ignored.

Margins represent a physical position and once set do not change with subsequent changes in HMI.

If the cursor is to the left of the new left margin, the cursor will be moved to the new left margin.

The factory default left margin is column 0.

Example

To set the left margin to column 5, send:

$^{E}_{C}$&a5L

Right Margin

The Right Margin command sets the right margin to the right edge of the specified column.

^{E}C & a # M

= Column number

The maximum right column is located at the right edge of the logical page (the distance between columns is defined by the current HMI). If the value field (#) specifies a column which is greater than the right edge of the logical page, the right margin is set to the right edge of the logical page. If the value field specifies a column less than the left margin, the command is ignored.

Margins represent a physical position and once set do not change with subsequent changes in HMI.

If the cursor position is to the right of the new right margin, the cursor will be moved to the new right margin.

The factory default right margin is the right edge of the logical page.

Example

To set the right margin to column 45, send:

^{E}C&a45M

Clear Horizontal Margins

The Clear Horizontal Margins command resets the left and right margins. The left margin is set to the left edge of the logical page and the right margin is set to the right edge of the logical page.

^{E}c **9** - Reset left and right margins

Top Margin

The Top Margin command designates the number of lines between the top of the logical page and the top of the text area.

^{E}C &ℓ # E

= Number of lines

The Top Margin command is ignored if the value field (#) is greater than the current logical page length or if the current VMI is 0 (the distance between lines is defined by the current VMI or line spacing). Receipt of a Top Margin command resets the text length to logical page length in inches minus top margin in inches minus ½ inch.

The top margin represents a physical position and once set does not change with subsequent changes in VMI or line spacing.

The vertical cursor position of the first line of print on the logical page is determined by the current values of top margin and VMI, using the following equation:

first line in inches = top margin in inches + (3/4 * VMI)

Example

To set the top margin to 4 lines, send:

^{E}C&ℓ4E

Note

The first line of the logical page is line 0.

Text Length

The Text Length command designates the length of the text area in lines.

Esc & l # F

= Number of lines

The value field (#) sets the text length in lines referenced from the top margin. If a value greater than the logical page length minus the top margin is specified or if the current VMI is 0, the command is ignored. The user default text length is invoked whenever the orientation, page length, page size or top margin is changed. The user default text length is computed as follows:

TEXT LENGTH in lines =

integer portion of ((logical page length in inches - top margin in inches - 1/2 inch) 48/VMI)

The factory default text length in lines is:

((logical page length in inches - 1 inch) x 6).

Note

The user default VMI is selectable using the control panel FORM LENGTH menu item (refer to the *LaserJet 2000 Operator's Manual*).

Example

To select a text length of 60 lines, send:

Esc&l60F

Perforation Region

The perforation region is the distance from the bottom of the text area to the top of the text area of the next page. When perforation skip is enabled, a line feed or half line feed that would move the cursor beyond the bottom of the text area, moves the cursor to the top of the text area on the next page. When perforation skip is disabled, a line feed or half line feed moves to the next line or half line within the perforation region.

$^{E}_{C}$ & ℓ # L

= 0 - Disable
1 - Enable

The factory default is perforation skip enabled.

Note

When perforation skip is disabled, some print lines could fall outside the printable area, therefore, these lines will be lost.

Horizontal Motion Index

The Horizontal Motion Index (HMI) command designates the distance between columns.

^{E}C & k # H

= Number of $1/120^{th}$ inch increments.

The range of the value field (#) is 0 to 32767.

The value field is valid to 4 decimal places.

When fixed pitch fonts are selected, all printable characters including the space and backspace characters are affected by HMI. When proportional fonts are selected, the HMI affects only the control code space character.

HMI is defaulted when any of the font characteristics are changed and when switching between primary and secondary fonts with shift in and shift out.

The default HMI is determined by the pitch value in the font descriptor. The factory default font's HMI is 12 (which is $12/120^{th}$ = $1/10^{th}$ inch per character or 10 characters per inch).

Example

To select an HMI for 12 characters/inch, send:

^{E}C&k1ØH

Vertical Motion Index

The Vertical Motion Index (VMI) command designates the distance between rows.

^{E}c & l # C

= number of 1/48 inch increments between rows.

The range of the value field (#) is 0 to 32767. If the specified VMI is greater than the current logical page length, the command is ignored.

The value field is valid to 4 decimal places. A 0 in the value field indicates no vertical movement.

This command affects the line feed and half line feed spacing.

The factory default VMI is 8 which corresponds to 6 lines per inch. A user default VMI can be selected from the control panel using the FORM LENGTH menu item (refer to the *LaserJet 2000 Operator's Manual*).

Example

To designate a VMI of 6 (8 lines/inch) send:

^{E}c&l6C

(i.e., $6/48^{th} = 1/8^{th}$ inch/line)

Note

1. The following computation converts line-per-inch spacing to VMI:

$$VMI = 48 \times \left(\frac{1}{\#\text{ of lines per inch}}\right)$$

2. A change in the control panel FORM LENGTH setting results in a modification of VMI. If the page length command (^{E}c&l#P) follows a VMI change, the physical size of the page is recalculated. Therefore, depending on the VMI modification made, the printer may request a different paper size.

Line Spacing

The Line Spacing command sets the number of lines printed per inch.

$^{E}_{C}$ & ℓ # D

# =	1 - 1 lpi
	2 - 2 lpi
	3 - 3 lpi
	4 - 4 lpi
	6 - 6 lpi
	8 - 8 lpi
	12 - 12 lpi
	16 - 16 lpi
	24 - 24 lpi
	48 - 48 lpi

This command performs the same function as the Vertical Motion Index (VMI) command except that it identifies the VMI in lines per inch (lpi).

The factory default lines per inch setting is 6. A user default line spacing can be selected from the control panel using the FORM LENGTH menu item (refer to the *LaserJet 2000 Operator's Manual*).

Example

To select 12 lpi, send:

$^{E}_{C}$&ℓ12D

6 Cursor Positioning

Contents

Introduction

This section describes the cursor positioning commands. Although the printer does not actually have a cursor, the cursor position refers to the currently active printing position (like the blinking underline character [cursor] used on most computer terminals). The cursor can be moved anywhere within the logical page using a combination of horizontal and vertical cursor positioning commands and control codes.

Absolute/Relative Cursor Positioning

Either relative or absolute motion can be specified. **Relative motion** specifies the distance to move from the current active position; **absolute motion** specifies a physical position from the top margin at the left bound of the logical page, which is the horizontal and vertical 0 position. (See Figure 6-1).

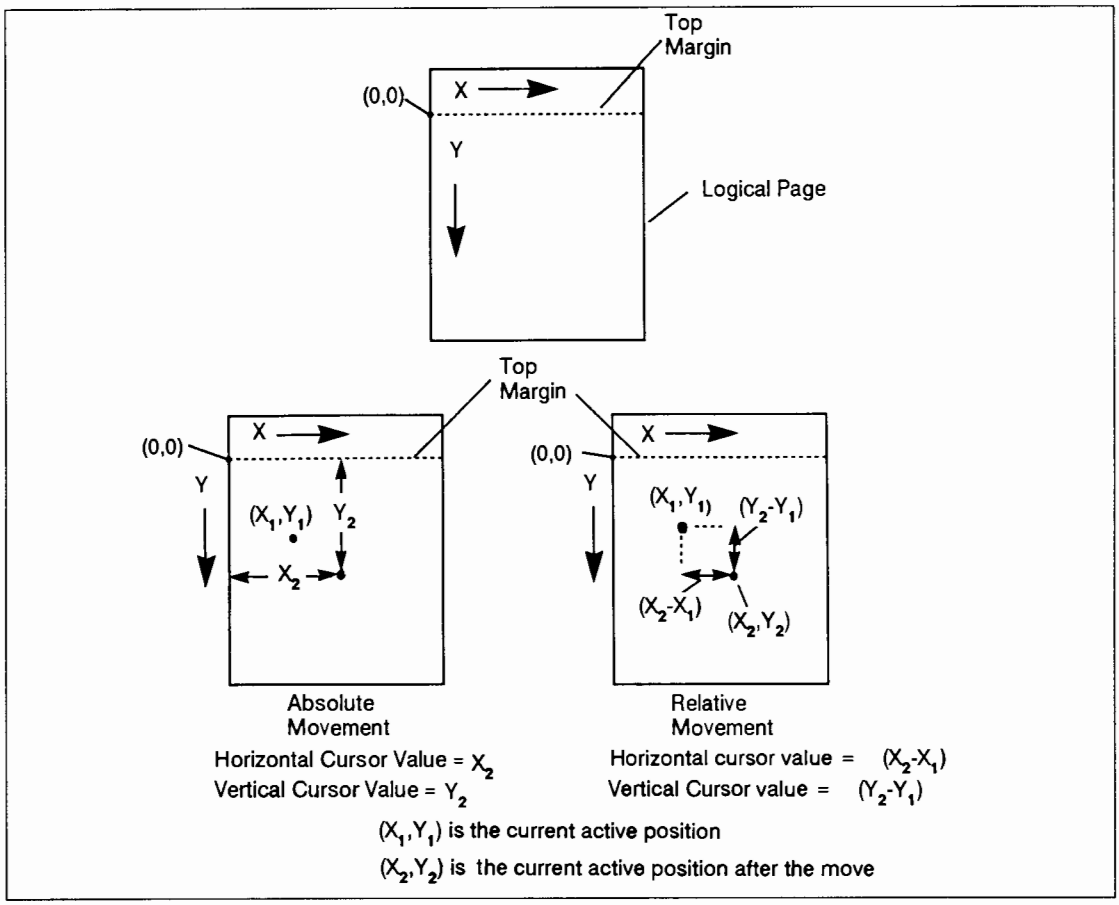


Figure 6-1. Absolute and Relative Cursor Positioning

Cursor Positioning Units

Cursor positioning is done in PCL coordinate system units.

The units of the **X** axis of the PCL coordinate system may be dots, decipoints or columns. The units of the **Y** axis of the PCL coordinate system may be dots, decipoints or rows.

A dot is the smallest printable unit. On the **LaserJet 2000** one dot equals $1/300^{th}$ inch. The number of dots printed per inch is referred to as the printer's resolution.

A decipoint is $1/720^{th}$ inch or $1/10^{th}$ of a PCL typographic point.

The width of a column is defined by the current horizontal motion index (HMI). The distance between rows is defined by the current vertical motion index (VMI). HMI is the distance between consecutive characters. VMI is the distance between consecutive lines of text. HMI and VMI are described in more detail in Chapter 5.

Horizontal Cursor Positioning (Columns)

This Horizontal Cursor Positioning command moves the current active horizontal position to a new column position on the current line.

^{E}C **& a # C**

= Column Number

The width of a column is defined by the current HMI. A value field (#) with a plus sign (+) indicates the new position is the number of columns specified to the right of and relative to the current cursor position; a minus sign (-) indicates the new position is the number of columns specified to the left of and relative to the current cursor position. No sign indicates an absolute column number which is referenced from the left edge of the logical page. The first column within a line is column 0. This sequence ignores margins and can therefore be used to set the current active position to any location along the current line. If a request is made for a location outside the printer's logical page, the current active position is moved to the appropriate logical page limit.

The value field is valid to 4 decimal places.

Horizontal Cursor Positioning (Decipoints)

This Horizontal Cursor Positioning command moves the current active horizontal position to a new position along the horizontal axis.

^{E}C **& a # H**

= Decipoint Position ($1/720^{th}$ inch)

A value field (#) with a plus sign (+) indicates the new position is the number of decipoints specified to the right of and relative to the current cursor position; a minus sign (-) indicates the new position is the number of decipoints specified to the left of and relative to the current cursor position. No sign indicates an absolute decipoint position that is referenced from the left edge of the logical page. The left most position is 0 and the right most position is the right bounds of the logical page. If a request is made for a location outside the logical page, the current active position is moved to the appropriate logical page limit.

The value field is valid to 2 decimal places.

Horizontal Cursor Positioning (Dots)

This Horizontal Cursor Positioning command moves the current active horizontal position to a new position along the horizontal axis.

^{E}C * p # X

= Dot Position

A value field (#) with a plus sign (+) indicates the new position is the number of dots specified to the right of and relative to the current cursor position; a minus sign (-) indicates the new position is the number of dots specified to the left of and relative to the current cursor position. No sign indicates an absolute dot position which is referenced from the left edge of the logical page. The left most position is 0 and the right most is the right bound of the logical page. If a request is made for a location outside the logical page, the current active position is moved to the appropriate logical page limit.

Horizontal Cursor Positioning Control Codes

There are 4 control codes which can be used to position the cursor horizontally on the current line. These control codes are explained below.

CR - Carriage Return Moves the current active position to the left margin on the current line. (Refer to the Line Termination command described later in this chapter.)

SP - Space Moves the current active position to the right 1 column position. Space may be a printable character or a control code. If a character is defined for the space code, space is printable; otherwise, it is a control code. For proportionally spaced fonts a space control code updates the cursor by the current HMI value; however, a printable space updates the cursor the width of the character. For fixed pitch fonts a space, whether it be a control code or printable, updates the cursor according to the HMI value.

BS - Backspace Moves the current active position left a distance equal to the width of the last printed character or space. If the active position is at the left margin, no action is taken.

When using fixed pitch fonts, the backspace distance is defined by the current print pitch (i.e., HMI setting).

When using proportionally-spaced fonts, a single backspace moves back in such a way as to center the overstriking character with the character being overstruck. After printing the overstrike character the cursor position is at the same position as before the backspace. Multiple backspaces each move back the distance of the last printed symbol or space. For example, if "world" was printed and then five backspaces were performed, the distance moved back would be 5 times the width of the "d".

HT - Horizontal Tab Moves the current active position to the next tab stop on the current line. The tab stops are at the left margin, and every 8 columns between the left margin and the right bounds of the logical page. If the new horizontal position crosses the right margin, the new horizontal position is set to the right margin. If the current HMI value is 0 the command is ignored.

Vertical Cursor Positioning (Rows)

This Vertical Cursor Positioning command moves the current active vertical position to the same column position on a new line.

^{E}C & a # R

- Row Number

A value field (#) with a plus sign (+) indicates the new position is the number of rows specified downward from and relative to the current cursor position; a minus sign (-) indicates the new position is the number of rows specified upward from and relative to the current cursor position. No sign indicates the new position is an absolute row number referenced from the top margin. The distance between rows is defined by the current VMI. The top row, defined by the top margin, is 0 and the bottom row is determined by the bottom of the logical page.

Absolute or negative relative requests which exceed the logical page limits move the cursor to the appropriate logical page limit. Positive relative positioning allows the user to move off the current page the number of lines specified. Vertical cursor positioning ignores perforation skip mode, allowing the user to move into the perforation region.

The value field is valid to 4 decimal places.

Vertical Cursor Positioning (Decipoints)

This Vertical Cursor Positioning command moves the current active vertical position to a new position along the vertical axis.

^{E}C & a # V

= Decipoint Position (1/720th inch)

A value field (#) with a plus sign (+) indicates the new position is the number of decipoints specified downward from and relative to the current cursor position; a minus sign (-) indicates the new position is the number of decipoints specified upward from and relative to the current cursor position. No sign indicates an absolute decipoint position referenced from the top margin. The top position, defined by the top margin, is 0 and the bottom position is determined by the bottom of the logical page. If a request is made for a location outside the logical page bounds, the current active position is moved to the appropriate logical page limit.

The value field is valid to 2 decimal places.

Vertical Cursor Positioning (Dots)

This Vertical Cursor Positioning command moves the current active vertical position to a new position along the vertical axis.

$^{E}_{C}$ * p # Y

= Dot Number

A value field (#) with a plus sign (+) indicates the new position is the number of dots specified downward from and relative to the current cursor position; a minus sign (-) indicates the new position is the number of dots specified upward from and relative to the current cursor position. No sign indicates an absolute dot position referenced from the top margin. The top position, defined by the top margin, is 0 and the bottom position is determined by the bottom of the logical page. If a request is made for a location outside the printer's logical page limit, the current active position is moved to the appropriate logical page limit.

Half-Line Feed

The Half-Line Feed command moves the cursor to the same character position one-half line down. The distance moved for a half-line feed is one-half of the current line spacing (defined by the last VMI or line spacing setting).

^{E}C = - Half-line feed

Vertical Cursor Positioning Control Codes

There are 2 control codes which can be used to position the cursor vertically. These control codes are explained below.

LF - Line Feed Advances the current active position to the same horizontal position on the next line. The distance to the next line is defined by the current line spacing (defined by the last VMI or line spacing setting). (Refer to the Line Termination command described later in this chapter.)

FF - Form Feed Advances the current active position to the same horizontal position at the top of the text area on the next page. (Refer to the Line Termination command described later in this chapter.)

Line Termination

The Line Termination command controls the way the printer interprets CR, LF, and FF control characters.

$^{E}_{C}$ **& k # G**

= 0 - CR→CR; LF→LF; FF→FF
1 - CR→CR-LF; LF→LF; FF→FF
2 - CR→CR; LF→CR-LF; FF→CR-FF
3 - CR→CR-LF; LF→CR-LF; FF→CR-FF

The factory default line termination value is 0.

Push/Pop Cursor Position

The Push/Pop Cursor Position command allows the current cursor position to be stored and recalled.

$^{E}_{C}$ **& f # S**

\# = 0 - Push (Store cursor position)
1 - Pop (Recall a cursor position)

A value field of 0 **pushes** the cursor position onto the stack (leaving the current position unaffected). A value field of 1 **pops** the position from the stack, restoring it as the current cursor position.

Note

The last item **pushed** is the first item **popped**.

Twenty positions may be pushed. If the user tries to save more than twenty positions, the command is ignored. If the user tries to restore more positions than were pushed, the command is ignored. A printer reset restores the current active position stack to the top (all saved positions are discarded).

7 Fonts

Contents

Fonts

Introduction

A font is a set of characters that have similar characteristics. A font has an assigned name, **typeface**, and is further described by its **spacing, height, pitch, style, stroke weight, symbol set**, and **orientation**.

For example, the name of the font used for this text is TmsRmn; its **height** is 10 point, its **style** is upright, and its **stroke weight** is medium. The headings in this manual use a Helv font; the heading, "Fonts" at the top of this page, is 18-point Helv, upright, bold.

The following are some examples of different fonts:

This is Helv, 18 point, bold.

This is TmsRmn, 10 point, medium, **bold** *and italic*.

This is Helv, 10 point, medium, **bold,** *and italic*.

```
This is Courier, 12 point, medium.
```

This is Prestige, 10 point, medium, **bold**.

```
This is Line Printer, 8.5 point, medium.
```

Figure 7-1. Font Samples

Orientation

Orientation defines the position of the logical page and direction of print with respect to the physical page as shown in the following diagram.

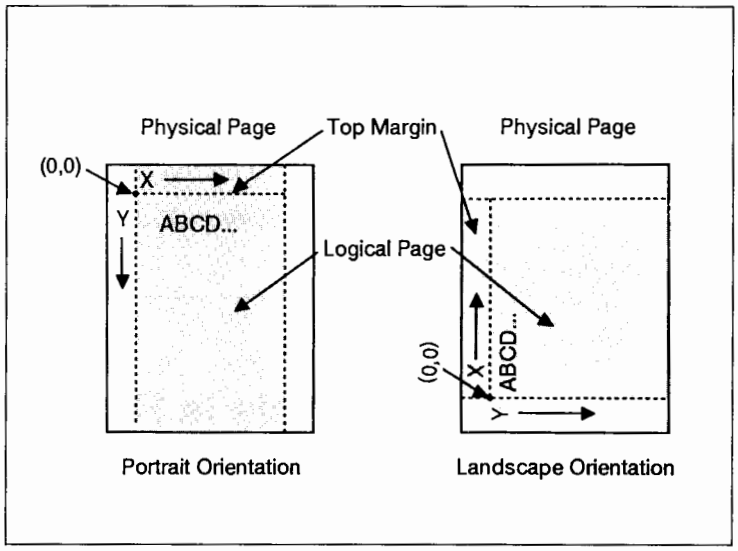


Figure 7-2. Orientation

LaserJet 2000 automatically rotates fonts to the current orientation; therefore, all fonts are available in either orientation.

Symbol Set

A symbol set is a unique ordering of the characters in a font. Each symbol set is defined with a specific set of applications in mind. Symbol sets are created for many purposes; for example, the PC-8 symbol set was designed to support US IBM-PC applications.

The following example shows two different symbol sets:

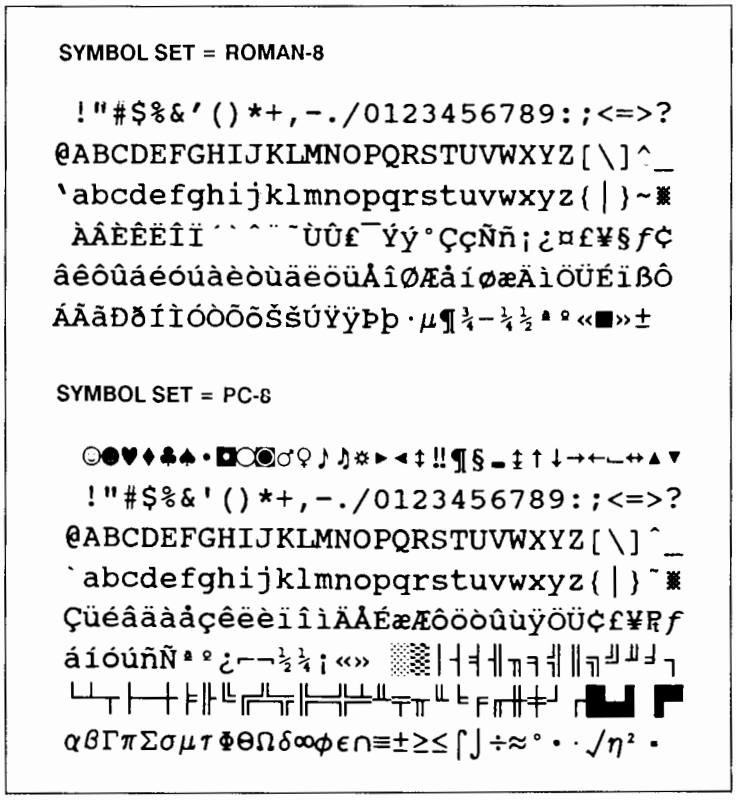


Figure 7-3. Symbol Set

Spacing

Another characteristic that differentiates fonts is spacing. Fonts have either fixed or proportional spacing. Fixed-spaced fonts are those for which the inter-character spacing is constant. Proportionally-spaced fonts are those for which the inter-character spacing varies with the natural shape of a character.

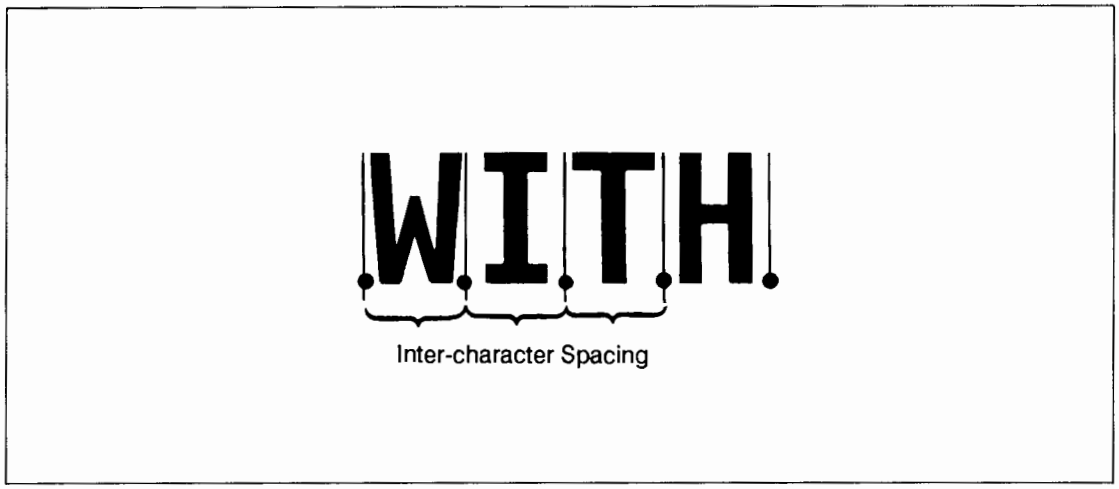


Figure 7-4. Fixed Spacing

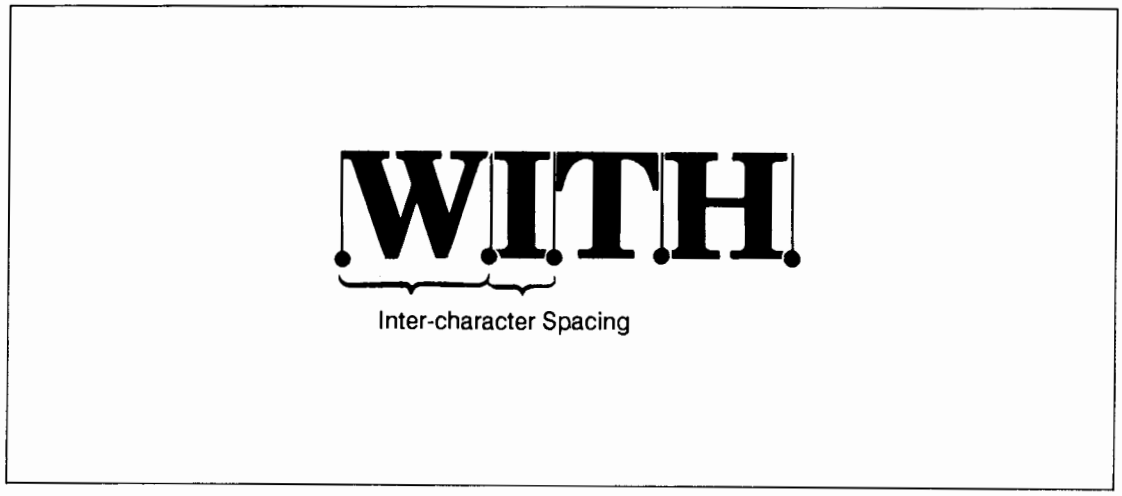


Figure 7-5. Proportional Spacing

Pitch

Pitch describes the number of characters printed in a horizontal inch. Pitch only applies to fixed-spaced fonts since the number of characters per inch varies for proportional fonts.

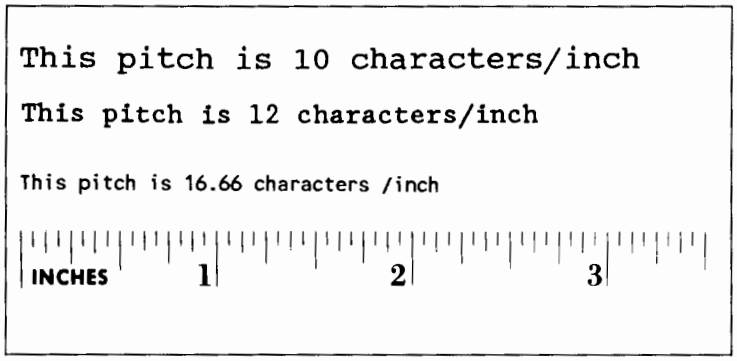


Figure 7-6. Pitch

Height

The height of a font is the measurement of the body of the type in points. A PCL point is $1/72^{nd}$ inch. The body of the type is slightly greater than the distance from the bottom of a descender to the top of an unaccented capital letter.

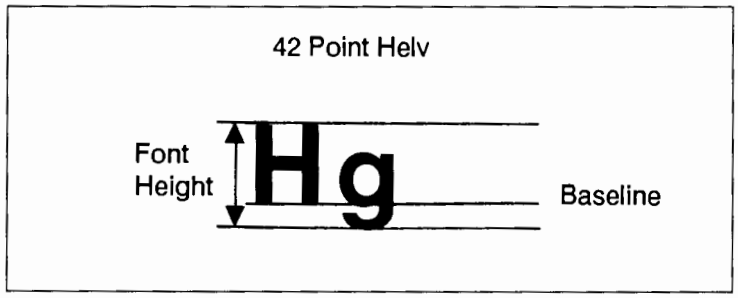


Figure 7-7. Height

Style

Font style is defined by the angularity of the strokes of the characters with respect to the X-axis. Examples of upright and italic styles are shown.

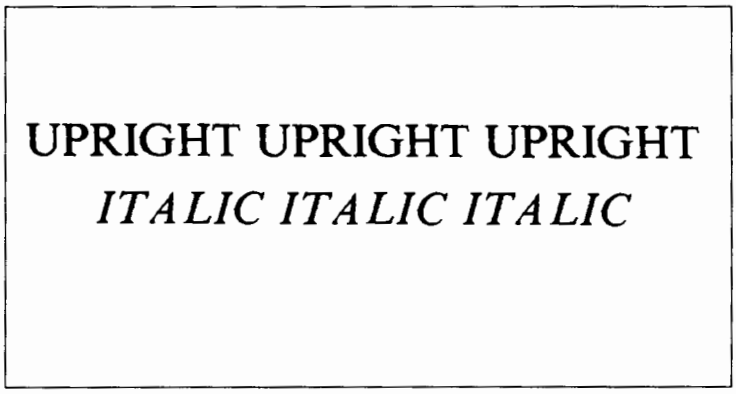


Figure 7-8. Style

Stroke Weight

Stroke weight describes the thickness of the strokes that compose characters. Examples of medium and bold stroke weights are shown.

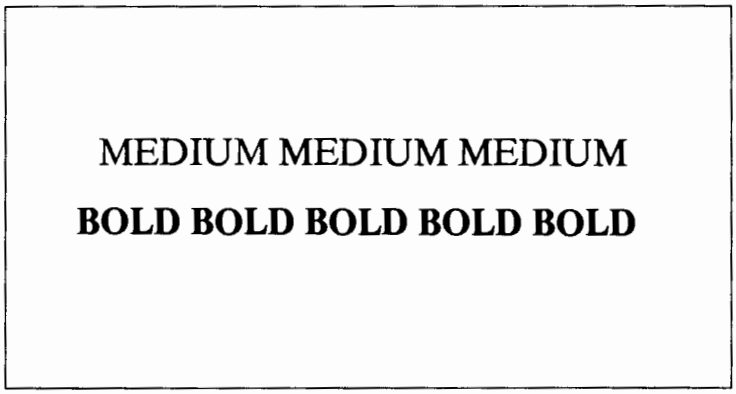


Figure 7-9. Stroke Weight

Typeface

Typeface is a generic name for graphics symbols having common design features. Each typeface has unique and distinguishing characteristics. The following example shows three typefaces.

Figure 7-10. Typeface

8 Font Selection

Contents

Introduction

A typical document is printed using a variety of fonts. For example, a large font may be used for the title and chapter headings of a document, a standard size font may be used for the body of the document, and key words or phrases may be highlighted, using a **bold** or *italic* font.

A number of fonts are supplied with the printer; these fonts are referred to as internal fonts. Additional fonts can be used by the printer by inserting font cartridges or downloading soft fonts.

Cartridge fonts are fonts that plug into font cartridge slots on the printer. The fonts contained in the cartridge become available once the cartridge is plugged into the printer. A large number of font cartridges may be purchased from Hewlett-Packard or an authorized dealer. Refer to your *HP LaserJet Printer Family Font Catalog* for a list of available cartridges. Contact your HP Sales Representative or authorized dealer for purchasing information.

Soft fonts are supplied on flexible discs. These discs are inserted into the personal computer disc drive, and the font files from the disc are transferred (downloaded) into the printer's RAM memory. Once the font has been downloaded into the printer, it may be selected for printing. A large number of soft fonts may be purchased from Hewlett-Packard or an authorized dealer. Refer to your *HP LaserJet Printer Family Font Catalog* for a list of available soft fonts. Contact your HP Sales Representative or authorized dealer for purchasing information.

Any internal, cartridge, or soft font may be selected for printing. Fonts are selected using font selection escape sequences. This chapter describes how to select fonts.

Font Selection by Characteristic

There are several characteristics used to identify a font; these characteristics are described in Chapter 7. A font is selected by specifying its characteristics. The font characteristics that must be specified are as follows: orientation, symbol set, spacing, pitch, height, style, stroke weight, and typeface.

The printer maintains a table which contains the values of all of the currently specified characteristics. Whenever the printer receives an escape sequence specifying a font characteristic, the printer records that characteristic in the table.

The printer selects a font based on a prioritization of the characteristics in the table. The priority of the characteristics is shown in the following list:

Priority of Characteristics

Orientation	*highest*
Symbol Set	↓
Spacing	↓
Pitch	↓
Height	↓
Style	↓
Stroke Weight	↓
Typeface	*lowest*

When selecting a font, the printer compares the highest priority characteristic in the table to the corresponding characteristic of the available fonts. If only one font is available that matches, that font is selected. However, when several fonts match, the printer compares the next highest priority characteristic to the corresponding characteristic of the available fonts and so on down the list. When only one font remains, that font is selected. If, after comparing all characteristics, more than one font remains, selection is determined by the priority of the font location. The priorities of the font locations are listed below, with the highest priority listed first:

Soft Font (Lowest ID)
Cartridge Font*
Internal Font

* The priority of cartridge locations (highest to lowest) is slot 1 (left), slot 2 (center), and slot 3 (right), as viewed from the rear of the printer.

The initial font specification in a job should be made using all of the font characteristics

To select a portrait, HP Roman-8, fixed-spaced, 10 pitch, 12 point, upright, bold, Courier font, specify each of the characteristics using font selection escape sequences. Once the characteristics have been specified, the font characteristic table will appear as follows:

Orientation	Portrait
Symbol Set	HP Roman-8
Spacing	Fixed
Pitch	10
Height	12 point
Style	Upright
Stroke Weight	Bold
Typeface	Courier

To subsequently select a font with the same characteristics differing only in stroke weight, medium rather than bold, only the stroke weight characteristic must be specified. Note the following change (shown in bold) to the font characteristic table:

Orientation	Portrait
Symbol Set	HP Roman-8
Spacing	Fixed
Pitch	10
Height	12 point
Style	Upright
Stroke Weight	**Medium**
Typeface	Courier

In general, when specifying a font, only the characteristics of the new font that differ from those of the previously designated font must be specified.

Note 

The **HP LaserJet 2000** Printer can print any number of distinct fonts per page, limited only by available memory.

Primary and Secondary Fonts

The printer maintains two independent font characteristic tables for use in selecting a primary font and a secondary font. All of the characteristics previously described apply to both tables. This provides access to two distinct fonts, only one of which is selected at a given time. To alternate between the primary and the secondary font, the control codes "SI" and "SO" are used. The font described by the primary table is designated by the "SI" control code; the font described by the secondary table is designated by the "SO" control code. The factory default state is primary font designated.

Orientation

The Orientation command designates the position of the logical page and direction of print with respect to the physical page.

$^{E}_{C}$ **&ℓ#O**

= 0 Portrait
= 1 Landscape

Note that this command applies to both the primary and secondary fonts.

LaserJet 2000 automatically rotates fonts to the current orientation; therefore, all fonts are available in either orientation.

The Orientation command sets the page length, top margin, text length, left and right margins, HMI and VMI to their user default values, and disables the auto overlay macro.

All data received prior to this command will be printed and a form feed and carriage return executed.

The factory default orientation is portrait.

The user default orientation can be selected from the control panel (refer to the *LaserJet 2000 Operator's Manual*).

Symbol Set

The Symbol Set escape sequence designates a unique ordering of characters in a font.

Esc (ID Primary Symbol Set

Esc) ID Secondary Symbol Set

If the specified symbol set does not exist, the default symbol set will be selected.

The primary and secondary factory default symbol sets are HP Roman-8. The primary and secondary user default symbol sets are implicitly set when the user default primary and secondary fonts are selected using the control panel configuration menu (refer to the *LaserJet 2000 Operator's Manual).*

Table 8-1 lists HP defined symbol sets.

Example

To select ASCII as the symbol set for the primary font, send:

Esc(ØU

To select HP Roman-8 as the symbol set for the secondary font, send:

Esc)8U

Table 8-1. HP Defined Symbol Sets

Symbol Set Name	Symbol Set ID
HP Math-7	0A
HP Line Draw	0B
ISO 60: Norwegian version 1	0D
ISO 61: Norwegian version 2	1D
HP Roman Extension	0E
ISO 4: United Kingdom	1E
ISO 25: French	0F
ISO 69: French	1F
HP German	0G
ISO 21: German	1G
HP Greek-8	8G
ISO 15: Italian	0I
ISO 14: JIS ASCII	0K
ISO 57: Chinese	2K
Technical-7	1M
HP Math-8	8M
ISO 100: ECMA-94 (Latin 1)	0N
OCR A	0O
OCR B	1O
ISO 11: Swedish	0S
HP Spanish	1S
ISO 17: Spanish	2S
ISO 10: Swedish	3S
ISO 16: Portuguese	4S
ISO 84: Portuguese	5S
ISO 85: Spanish	6S
ISO 6: ASCII	0U
HP Legal	1U
ISO 2: International Reference Version	2U
OEM-1	7U
HP Roman-8	8U
PC-8	10U
PC-8 (D/N)	11U
HP Pi Font	15U

ISO Symbol Sets

The printer provides several ISO (International Standards Organization) symbol sets to support European languages. Each ISO symbol set is a unique ordering of symbols contained in the HP Roman-8 symbol set. The printer automatically generates the requested ISO symbol set from an HP Roman-8 symbol set.

Example

To select the ISO French symbol set for the primary font, send:

$^{E}C(1F$

Table 8-2. ISO Substitution Characters

			DECIMAL CHARACTER EQUIVALENTS											
ISO	Name	ID	35	36	64	91	92	93	94	96	123	124	125	126
6	ASCII	0U	#	$	@	[	\	]	^	`	{	|	}	~
2	ISO IRV	2U	#	¤	@	[	\	]	^	`	{	|	}	¯
4	ISO United Kingdom	1E	£	$	@	[	\	]	^	`	{	|	}	¯
25	ISO French	0F	£	$	à	°	ç	§	^	`	é	ù	è	¨
69	ISO French	1F	£	$	à	°	ç	§	^	µ	é	ù	è	¨
	German	0G	£	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
21	ISO German	1G	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	ß
15	ISO Italian	0I	£	$	§	°	ç	é	^	ù	à	ò	è	ì
14	JIS ASCII	0K	#	$	@	[	¥	]	^	`	{	|	}	¯
57	ISO Chinese	2K	#	¥	@	[	\	]	^	`	{	|	}	¯
10	ISO Swedish	3S	#	¤	@	Ä	Ö	Å	^	`	ä	ö	å	¯
11	ISO Swedish:	0S	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
	Spanish	1S	#	$	@	¡	Ñ	¿	°	`	{	ñ	}	~
17	ISO Spanish	2S	£	$	§	¡	Ñ	¿	^	`	°	ñ	ç	~
85	ISO Spanish:	6S	#	$	·	¡	Ñ	Ç	¿	`	´	ñ	ç	¨
16	ISO Portuguese	4S	#	$	§	Ã	Ç	Õ	^	`	ã	ç	õ	°
84	ISO Portuguese:	5S	#	$	´	Ã	Ç	Õ	^	`	ã	ç	õ	~
60	ISO Norwegian v1	0D	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	¯
61	ISO Norwegian v2	1D	§	$	@	Æ	Ø	Å	^	`	æ	ø	å	|

Note

HP font cartridge products A through H, J through N, P through R, T through Y and HP soft font products AD, AF, and DA support a subset of the new HP Roman-8 symbol set. Characters with decimal character codes 177, 178, and 242 to 245 have since been added. They are Ý ý · µ ¶ ¾ , respectively.

Spacing

Inter-character spacing can be specified as either proportional or fixed.

^{E}C **(s # P** - Primary spacing

^{E}C **) s # P** - Secondary spacing

= 0 - Fixed spacing
1 - Proportional spacing

When proportional spacing is specified and a proportionally-spaced font is not available, a fixed pitch font with the current pitch specification will be selected.

The factory default primary and secondary spacings are fixed.

The user default primary and secondary spacings are implicitly set by selection of user default primary and secondary fonts from the control panel configuration menu (refer to the *LaserJet 2000 Operator's Manual*).

Example

To specify proportional spacing for the primary font, send:

^{E}C(s1P

To specify fixed spacing for the secondary font, send:

^{E}C)sØP

Pitch

The Pitch command designates the horizontal spacing of a fixed-spaced font in terms of the number of characters per inch.

Esc (s # H - Primary pitch

Esc)s # H - Secondary pitch

= Pitch in characters/inch

The value field (#) is valid to two decimal places.

If a pitch is specified that is not available, the next greater available pitch will be selected. If no greater value is available, the closest available lesser value will be selected.

The factory default primary and secondary pitches are 10 characters per inch.

The user default primary and secondary pitches are implicitly set by selection of user default primary and secondary fonts from the control panel configuration menu (refer to the *LaserJet 2000 Operator's Manual*).

Example

To specify 10 pitch for the primary font, send:

Esc(s10H

To specify 16.66 pitch for the secondary font, send:

Esc)s16.66H

Height

The Height command specifies the height of the font in points.

$^{E}_{C}$ **(s # V** - Primary Height

$^{E}_{C}$ **) s # V** - Secondary Height

\# = Height in points

The value field (#) is valid to two decimal places. If the requested height is unavailable, the closest height will be selected. All fonts whose heights are within a quarter point of the specified height are considered to have the specified height.

The factory default primary and secondary heights are 12 point. A PCL point is 1/72nd inch.

The user default primary and secondary heights are implicitly set by selection of user default primary and secondary fonts from the control panel configuration menu (refer to the *LaserJet 2000 Operator's Manual*).

Example

To specify a height of 12 points for the primary font, send:

$^{E}_{C}$**(s12V**

To specify a height of 14.4 points for the secondary font, send:

$^{E}_{C}$**)s14.4V**

Style

The Style command designates the font style.

$^{E}_{C}$ (s # S - Primary Style

$^{E}_{C}$) s # S - Secondary Style

= 0 - Upright
1 - Italic

If the requested style is not present, this characteristic is ignored during font selection.

The user default primary and secondary styles are implicitly set by selection of a user default font from the control panel configuration menu (refer to the *LaserJet 2000 Operator's Manual*).

The factory default primary and secondary styles are upright.

Example

To specify an upright style for the primary font, send:

$^{E}_{C}$(sØS

To specify an italic style for the secondary font, send:

$^{E}_{C}$)s1S

Stroke Weight

The Stroke Weight command designates the thickness of the strokes that compose the characters of a font.

$^{E}_{C}$ **(s # B** - Primary stroke weight

$^{E}_{C}$ **) s # B** - Secondary stroke weight

The value field (#) specifies the thickness of the strokes used in the design of a font. The supported stroke weight values are -7 through 7. The thinnest font available has a value of -7; the thickest font available has a value of 7. The standard stroke weight for a medium font is 0; the standard stroke weight for a bold font is 3; and, the standard stroke weight for a light font is -3.

Table 8-3. Stroke Weights

Value	Stroke Weight
-7	Ultra thin
-5	Thin
-3	Light
0	Medium
3	Bold
5	Black
7	Ultra Black

If the specified stroke weight is greater than or equal to 0 and is not available, the next thicker available stroke weight will be selected. If no thicker stroke weight is available, the closest available thinner stroke weight will be selected.

If the specified stroke weight is less than 0 and is not available, the next thinner available stroke weight will be selected. If no thinner stroke weight is available, the closest available thicker stroke weight will be selected.

The factory default primary and secondary stroke weights are 0.

The user default primary and secondary stroke weights are implicitly set by selection of user default primary and secondary fonts from the control panel configuration menu (refer to the *LaserJet 2000 Operator's Manual*).

Example

To specify a bold stroke weight for the primary font, send:

$^{E}_{C}$(s3B

To specify a medium stroke weight for the secondary font, send:

$^{E}_{C}$)sØB

Typeface

The Typeface command designates the design of the font.

$^{E}_{C}$ (s # T - Primary typeface

$^{E}_{C}$) s # T - Secondary typeface

= Typeface value

Table 8-4. Typeface Value Numbers*

Value (#)	Typeface
0	Line Printer
3	Courier
4	Helv
5	Tms Rmn
6	Letter Gothic
8	Prestige
11	Presentations
17	Optima **
18	Garamond **
19	Cooper Black **
20	Coronet Bold **
21	Broadway **
22	Bauer Bodoni Black Condensed**
23	Century Schoolbook **
24	University Roman **

* Additional typefaces will be available in the future.

** These typeface names may be registered trade marks of a third party. Use of these fonts may be conditional upon a license grant from the owners of the fonts. Hewlett-Packard makes no representation as to the quality or performance of the fonts, and references to the fonts does not grant any license or right to use the fonts.

If the value field (#) specifies a typeface that is unavailable this characteristic is ignored during font selection.

The factory default primary and secondary typefaces are Courier.

The user default primary and secondary typefaces are implicitly set by selection of user default primary and secondary fonts from the control panel configuration menu (refer to the *LaserJet* 2000 Operator's Manual).

Example

To specify Helv for the typeface of the primary font, send:

$^{E}_{C}$(s4T

To specify Letter Gothic for the typeface of the secondary font, send:

$^{E}_{C}$)s6T

Internal Fonts

Table 8-5. LaserJet 2000 Internal Fonts

TYPEFACE	ORIENTATION	POINT	PITCH	SYMBOL SETS										LASERJET FONT COMPATIBILITY [1]	
				ASCII	ROMAN-8	PC-8	PC-8 D/N	ECMA 94	LEGAL	MATH-8	TECHNICAL-7	OEM1	ISO	FONT CARTRIDGE	SOFT FONT
Line Printer	Portrait	8.5	15	•	•	•	•	•				•	•		
			16.66	•	•	•	•	•				•	•	C, F, L, Y	
	Landscape	8.5	15	•	•	•	•	•				•	•		
			16.66	•	•	•	•	•				•	•	A, B, C, L, Y	
Line Draw	Portrait	8.5	16.66												
	Landscape														
	Portrait	12	10											H, U, W, X	
	Landscape													V	
Prestige Elite	Portrait	7	16.66	•	•	•	•	•				•	•	G, H, J	EA
	Landscape			•	•	•	•	•				•	•	G, H	EA
	Portrait	10	12	•	•	•	•	•	•	•	•	•	•	D, G, J, M	EA
	Landscape			•	•	•	•	•	•	•	•	•	•	M	EA
Prestige Elite (Bold)	Portrait	10	12	•	•	•	•	•	•			•	•	D, G, J, M	EA
	Landscape			•	•	•	•	•	•			•	•	M	EA
Prestige Elite (Italic)	Portrait	10	12	•	•	•	•	•	•			•	•	D, G, J, M	EA
	Landscape			•	•	•	•	•	•			•	•	M	EA
Courier	Portrait	10	12	•	•	•	•	•				•	•		
	Landscape			•	•	•	•	•				•	•		
	Portrait	12	10	•	•	•	•	•	•	•	•	•	•	C, H, Y	
	Landscape			•	•	•	•	•	•	•	•	•	•		
Courier (Bold)	Portrait	12	10	•	•	•	•	•	•			•	•	A, C, H, L, Q, Y	
	Landscape			•	•	•	•	•	•			•	•	L, Q	
Courier (Italic)	Portrait	12	10	•	•	•	•	•	•			•	•	A, C, H, L, Q, Y	
	Landscape			•	•	•	•	•	•			•	•	L, Q	
Tms Rmn	Portrait	8	Prop	•	•								•		AD
	Landscape			•	•								•		
	Portrait	10	Prop	•	•								•		AD
	Landscape			•	•								•		
Tms Rmn (Bold)	Portrait	10	Prop	•	•								•		AD
	Landscape			•	•								•		
Tms Rmn (Italic)	Portrait	10	Prop	•	•								•		AD
	Landscape			•	•								•		
Helv (Bold)	Portrait	14	Prop	•	•								•		AD
	Landscape			•	•								•		

[1]This column is provided to assist you in selecting fonts to substitute for fonts previously used from LaserJet family cartridges or soft fonts. Since the fonts so designated are totally compatible, attributes such as inter-character spacing will be identical.

Font Selection Example

This example illustrates how to select a primary font with the following characteristics (note that **all** of the font characteristics are sent):

CHARACTERISTIC	VALUE	ESCAPE SEQUENCE
Orientation	**Portrait**	**Ec&ℓØO**
Symbol set	**ASCII**	**Ec(ØU**
Spacing	**Fixed**	**Ec(sØP**
Pitch	**10 cpi**	**Ec(s1ØH**
Height	**12 point**	**Ec(s12V**
Style	**Upright**	**Ec(sØS**
Stroke weight	**Bold**	**Ec(s3B**
Typeface	**Courier**	**Ec(s3T**

The following escape sequences could be sent to the printer to select a primary font with the above characteristics:

Ec&ℓØO Ec(ØU Ec(sØP Ec(s1ØH Ec(s12V Ec(sØS Ec(s3B Ec(s3T

The previous sequence can be shortened by combining sequences that have the same two characters following the Ec character.

Ec &ℓØOEc(ØUEc(sØp1Øh12vØs3b3T

Once the font has been selected as explained above, selecting another font with similar characteristics only requires changing the characteristics that are different. For example, to specify a font differing only in style (italic) and stroke weight (medium), only style and stroke weight need to be sent, as shown below:

Ec(s1SEc(sØB

or shortened:

Ec(s1sØB

Note

If an escape sequence does not contain a value field, the printer assumes a value of 0; therefore, the sequence **Ec(sB** could be sent to the printer instead of **Ec(sØB**.

Summary of Font Selection by Characteristic

The following summarizes the procedure the printer uses to select a font. The 8 steps are performed in the following order.

1. The specified orientation is selected.
2. If the specified symbol set exists, that symbol set is selected; otherwise, the default symbol set is selected.
3. If proportional spacing is specified and available, proportional spacing is selected. If proportional spacing is specified but is not available, fixed spacing is selected in the current pitch. If fixed spacing is specified and available, fixed spacing in the specified pitch is selected. If the specified pitch is not available, the next greater available pitch is selected. If no greater pitch is available, the closest available lesser pitch is selected. If fixed spacing is specified but is not available, proportional spacing is selected and the pitch characteristic is ignored.

Note

The pitch of a 16.66 cpi font is larger than the pitch of a 12 cpi font, and the pitch of a 10 cpi font is smaller than the pitch of a 12 cpi font.

4. The closest height available from the remaining fonts is selected. The closest height is in terms of absolute difference. All fonts whose heights are within a quarter point of the specified height are considered to have the specified height. For example, if the device has 6, 8, and 12 point fonts and the specified height is 10, both 8 and 12 point fonts are picked for the next selection criterion.
5. If the specified style is available in the remaining fonts, that style is selected; otherwise, this characteristic is ignored.
6. If the specified stroke weight is available in the remaining fonts, that stroke weight is selected. If the specified stroke weight is greater than or equal to 0 and is not available, the next thicker available stroke weight will be selected. If no thicker stroke weight is available, the closest available, the closest available thinner stroke weight will be selected.

If the specified stroke weight is less than 0 and is not available, the next thinner available stroke weight will be selected. If no thinner stroke weight is available, the closest available thicker stroke weight will be selected.

7. If the requested typeface is available in the remaining fonts, that typeface is selected; otherwise, this characteristic is ignored.
8. If after performing all the preceding steps, more than one font remains, the available font from the highest priority font location is selected. The priority of the font locations is as follows:

Soft Font (Lowest ID)	highest
Cartridge Font*	
Internal Font	lowest

* The priority of cartridge locations (highest to lowest) is slot 1 (left), slot 2 (center), and slot 3 (right) as viewed from the rear of the printer.

Note 

After following this procedure if more than one font remains, selection is determined by the priority of font location (see page 8-2).

Selection of the Default Font

The Default Font command sets all of the font characteristics, except for orientation, to those of the user default font.

$^{E}_{C}$ (3 @ - Default primary font characteristics

$^{E}_{C}$) 3 @ - Default secondary font characteristics

Note

If the user default font is a proportionally-spaced font, the pitch characteristic will not be affected by the default command.

Transparent Print Data

The Transparent Print Data command provides printing access to all characters in a font including those defined as unprintable.

^{E}c & p # X [Transparent Data]

= Number of bytes of transparent print data.

Each transparent print data byte is interpreted as a single character code. The appropriate character is printed if one exists; otherwise, a space is processed. For example, control codes such as LF, CR, FF are treated as print data while in transparent print data mode.

Example

Assuming the currently selected symbol set is PC-8, send the following to print a left-arrow (decimal code 27):

^{E}c&p1X[27]

Note

The ^{E}c character is decimal code 27 in the ASCII symbol set. Decimal code 27 is the left arrow in the PC-8 symbol set.

Underline Command

The Underline commands control automatic text underlining.

^{E}C & d # D - Enable underline

= 0 - Fixed position
3 - Floating position

^{E}C & d @ - Disable underline

Once underlining is enabled, any positive horizontal movement causes an underline to be drawn. Positive horizontal movement includes the printing of text and positive horizontal cursor motion.

When fixed position underlining is enabled, the underline is drawn five dots below the baseline and is three dots thick. (The baseline is an imaginary dot row on which all of the characters in a given line stand, see Chapter 10.) When floating position underline is enabled, the underline position is determined by the greatest underline distance below the baseline of all of the fonts printed on the current line. (The underline distance is defined in a font's descriptor, see Chapter 10.)

The factory default is underline disabled.

9 Font Management

Contents

Introduction

A number of fonts are supplied with the printer; these fonts are referred to as internal fonts. Additional fonts can be added to the printer by inserting font cartridges or downloading soft fonts. Font management provides mechanisms for downloading and manipulating soft fonts.

Downloading Soft Fonts

The process of transferring soft fonts from a host computer to the printer's user memory is called downloading. A unique identification (ID) number should be designated prior to the download of a font. This number is then associated with the soft font. If an existing font is already associated with this ID number, the existing font will be deleted during the download. Subsequent manipulation of the soft font is accomplished using the font's ID number.

Several escape sequences are required to download fonts to the printer. These escape sequences are described in detail in Chapter 10. Hewlett-Packard font files include the necessary escape sequences, thus assigning a font ID number, and then copying the file to the printer, downloads the font.

Once downloaded, a font occupies a portion of user memory. The number of soft fonts that can be stored simultaneously in user memory is limited only by the amount user memory available.

Temporary / Permanent Fonts

Once downloaded, a font is automatically designated as temporary. A temporary soft font is one that is deleted from user memory during a printer reset. A soft font can be designated as permanent to prevent the printer from deleting it during a printer reset. A soft font is designated as temporary or permanent by reference to its ID number.

Note 

Temporary and permanent fonts are removed from user memory whenever the printer's power is turned off.

Deleting Fonts

There are several mechanisms provided by PCL font management for explicit deletion of soft fonts from user memory. These include commands to delete all soft fonts, all temporary soft fonts, or an individual soft font by reference to its font ID number.

Font ID

The Font ID command is used to specify an ID number for use in subsequent font management commands.

$^{E}_{C}$ * c # D

= ID number - (0 through 32767)

The font ID will be used during subsequent soft font downloads, selections or deletions.

The factory default font ID is 0.

Example

To specify a font ID number of 1, send:

$^{E}_{C}$*c1D

This ID number will be used during subsequent soft font downloads, selections, or deletions.

Font Control

The Font Control command provides mechanisms for manipulating soft fonts.

$^{E}_{C}$ * c # F

= 0 - Delete all soft fonts
1 - Delete all temporary soft fonts
2 - Delete soft font (last ID specified
4 - Make soft font temporary (last ID specified)
5 - Make soft font permanent (last ID specified)

Note

If the primary or secondary font is deleted, a new primary or secondary font whose characteristics most closely resemble those of the deleted font is automatically selected from the remaining fonts.

Examples

To remove all soft fonts from user memory, send:

$^{E}_{C}$*c0F

To remove only those soft fonts that are temporary, send:

$^{E}_{C}$*c1F

To delete the soft font with an ID of 1, send:

$^{E}_{C}$*c1d2F

To make the soft font with an ID of 2 permanent, send:

$^{E}_{C}$*c2d5F

To make the soft font with an ID of 2 temporary, send:

$^{E}_{C}$*c2d4F

Font Selection by ID

Soft fonts can be selected using their associated ID numbers.

$^{E}_{C}$ **(# X** - Designates soft font as primary

$^{E}_{C}$ **) # X** - Designates soft font as secondary

\# = font ID number

If the designated font is present, the font is selected as the primary/secondary font and all primary/secondary font characteristics are set to those of the selected font. However, if the selected font is proportionally spaced, the pitch characteristic is not changed.

Note

For shared or multi-user environments, Hewlett-Packard recommends that soft fonts be selected by characteristics rather than ID number.

Examples

To select the font associated with ID number 7 as the primary font, send:

$^{E}_{C}$**(7X**

To select the font associated with ID number 5 as the secondary font, send:

$^{E}_{C}$**)5X**

Font Management Example

This example illustrates several typical font management operations. It assumes a soft font is stored and available on an MS-DOS based hard disc.

1. Set the font ID number to 2:

   Ec*c2D

2. Download a soft font file using the MS-DOS COPY command with the **/B** option:

   >COPY /B *filename* PRN:

   Note that the soft font is associated with font ID 2.

3. Make the soft font permanent in order to prevent its deletion during a printer reset:

   Ec*c5F

4. Designate the permanent soft font as primary:

   Ec(2X

10 Soft Font Creation

Contents

Introduction

A font descriptor and one or more character descriptors define a soft font. A font descriptor is a block of data used to communicate font design characteristics to the printer.

A character descriptor is a block of data describing for the printer the position and shape of an individual character and the implied movement after printing the character. Following each character descriptor is a block of raster data containing the dot-per-bit image of the character.

Coordinate System

Characters of a font are designed within a rectangular area referred to as a cell. The dimensions of the cell are in PCL Coordinate system dots and are therefore page orientation-independant (refer to Chapter 2, The Page, for a complete description of the PCL coordinate system).

Character design dimensions within the cell are in physical coordinate system dots (rather than PCL Coordinate System dots). The physical coordinate system is defined in terms of the directions of raster scan (X) and paper motion (Y) as illustrated in the following figure:

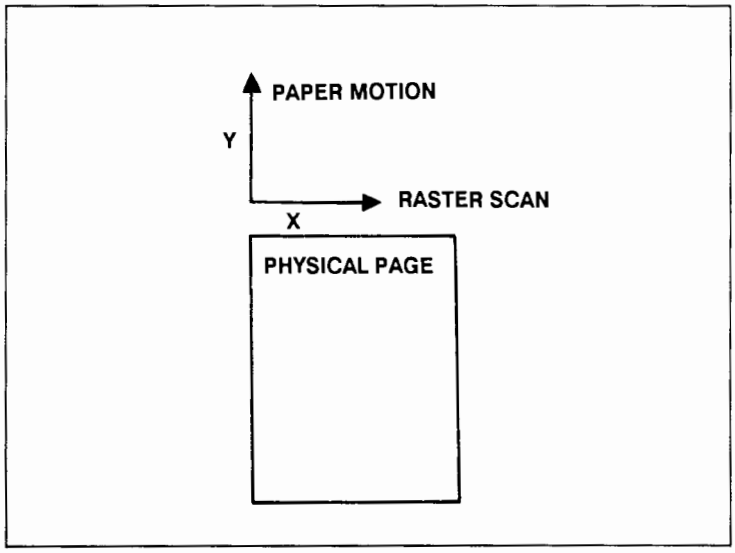


Figure 10-1. Physical Coordinate System

Since the raster scan and paper motion directions of a device are fixed, the physical coordinate system is page-orientation dependent. Character design dimensions within the cell are in physical coordinate system dots and therefore depend on the print orientation.

Note

Hewlett-Packard recommends that soft fonts be designed using the paper motion and raster scan direction of the **LaserJet Plus** and **LaserJet series II** printers. The **LaserJet 2000** printer will rotate the fonts to match the paper's physical coordinate system for the various paper sizes.

Font Descriptor Format

A unique ID number should be designated prior to the download of a font descriptor. If an existing font is already associated with this ID, the existing font will be deleted during the download of the font descriptor. Unless otherwise specified, inappropriate values in a font descriptor field will invalidate the font download process; a font will not be created and the associated font data will be discarded.

Although some devices do not use all of the data in the font descriptor, a font creator should use valid values in all of the font descriptor fields to insure font compatibility across the LaserJet family.

Those font descriptor fields identified as "reserved" should be set to 0.

The following illustrates the format of the font descriptor:

Byte	15 - MSB 8	7 LSB - 0
0	Font descriptor Size	
2	Reserved	Font Type
4	Reserved	
6	Baseline Distance	
8	Cell Width	
10	Cell Height	
12	Orientation	Spacing
14	Symbol Set	
16	Pitch (Default HMI)	
18	Height	
20	x Height	
22	Width Type	Style
24	Stroke Weight	Typeface
26	Reserved	Serif Style
28	Reserved	
30	Underline Distance	Underline Height
32	Text Height	
34	Text Width	
36	Reserved	
38	Reserved	
40	Pitch Extended	Height Extended
42	Reserved	
44	Reserved	
46	Reserved	
48-63	Font Name	

Figure 10-2. Font Descriptor Format

Note

The following notation is used to define the data type of each field in the font descriptor

(B)	: Boolean	(0, 1)
(UB)	: Unsigned Byte	(0 . . 255)
(SB)	: Signed Byte	(-128 . . 127)
(UI)	: Unsigned Integer	(0 . . 65535)
(SI)	: Signed Integer	(-32768..32767)
(ASCxx)	: ASCII string	array (0..xx-1) of characters

Font Descriptor Size (UI) Specifies the number of bytes in the font descriptor. This value is ignored by the **LaserJet 2000** printer. The standard Hewlett-Packard font descriptor size is 64 bytes.

Font Type (UB) Specifies one of the following defined font types. The font type should be set appropriately for the font's symbol set.

Table 10-1. Font Type Values

Value	Font Type
0	7-bit (character codes 32 to 127 [decimal] are printable)
1	8-bit (character codes 32 to 127 [decimal] and 160 to 255 [decimal are printable)
2	PC-8 (All character codes are printable except 0, 7 to 15, and 27 [decimal])

Note

Access to those codes that are unprintable, that have a character defined, requires the use of the transparent print data command.

Baseline Distance (UI) Specifies the distance from the top of the cell to the baseline. The baseline is an imaginary dot row on which all of the characters in a line stand. The measurement of this distance is in PCL coordinate system dots. The legal range for the baseline distance is 0 to cell height minus 1.

This field is ignored by the **LaserJet 2000** printer.

Cell Width (UI) Specifies the width of the cell in PCL coordinate system dots.

This field is ignored by the **LaserJet 2000** printer.

Cell Height (UI) Specifies the height of the cell in PCL coordinate system dots.

This field is ignored by the **LaserJet 2000** printer.

Orientation (UB) Specifies the orientation of the font. All characters within the font must have the same orientation; otherwise they will be discarded as they are downloaded. Zero specifies portrait and one specifies landscape.

Spacing (B) Specifies the spacing of the font. Zero specifies fixed spacing and one specifies proportional spacing.

Symbol Set (UI) Specifies the symbol set for the font. This value is computed by taking the PCL escape sequence value field value for the symbol set, multiplying it by 32, adding the ordinal value (ASCII decimal value) of the termination character of the PCL escape sequence, and subtracting 64.

Font Descriptor Symbol Set Value =

(PCL Escape Sequence Value Field Value * 32) +
(Decimal Value of PCL Escape Sequence Termination Character - 64).

The legal range of PCL symbol set escape sequence value field values is 0 to 2047. Refer to Table 10-1 for the HP defined font descriptor symbol set values. HP reserves the right to use the font descriptor symbol set values of 0 to 1023. PCL symbol set escape sequence value field values 1024 to 2047 are available for use by independent font vendors. PCL symbol set escape sequence termination characters can be any upper case ASCII character "A" through "V".

Table 10-2. Symbol Set Values

Symbol Set Name	PCL Value Field	PCL Termination Character	Symbol Set Value
HP Math-7	0	A	1
HP Line Draw	0	B	2
ISO 60: Norwegian version 1	0	D	4
ISO 61: Norwegian version 2	1	D	36
HP Roman Extensions	0	E	5
ISO 4: United Kingdom	1	E	37
ISO 25: French	0	F	6
ISO 69: French	1	F	38
HP German	0	G	7
ISO 21: German	1	G	39
HP Greek-8	8	G	263
ISO 15: Italian	0	I	9
ISO 14: JIS ASCII	0	K	11
ISO 57: Chinese	2	K	75
Technical-7	1	M	45
HP Math-8	8	M	269
ISO 100: ECMA-94 (Latin 1)	0	N	14
OCR A	0	O	15
OCR B	1	O	47
ISO 11: Swedish	0	S	19
HP Spanish	1	S	51
ISO 17: Spanish	2	S	83
ISO 10: Spanish	3	S	115
ISO 16: Portuguese	4	S	147
ISO 84: Portuguese	5	S	179
ISO 85: Spanish	6	S	211
ISO 6: ASCII	0	U	21
HP Legal	1	U	53
ISO 2: Intl Reference Version	2	U	85
OEM-1	7	U	245
HP Roman-8	8	U	277
PC-8	10	U	341
PC-8 (D/N)	11	U	373
HP PI Font	15	U	501

Pitch (UI) Specifies the pitch of the font in quarter-dot units (four quarter dot units equal one dot). This defines the default HMI for the font.

Height (UI) Specifies the design height of the font in quarter-dot units. This value, converted to points, is used as the height characteristic value of the font. A PCL point is $1/72^{nd}$ inch.

xHeight (UI) Specifies the height of the lower case "x" in quarter-dot units.

This field is ignored by the **LaserJet 2000** printer.

Width Type (SB) Specifies the proportionate width of characters in the font.

This field is ignored by the **LaserJet 2000** printer.

Table 10-3. Width Type Values

Value	Width Type
-2	Condensed
-1	Semi-Condensed
0	Normal
1	Semi-Expanded
2	Expanded
Additional width types may be added.	

Style (UB) Specifies the style of the font. Upright is specified by 0 and italics by 1. Additional styles may be added.

Stroke Weight (SB) Specifies the thickness of the strokes used in designing the font. The supported stroke weight values are -7 through 7. The thinnest stroke available is -7; and 7 is the thickest stroke weight available. The standard stroke weight for a medium font is 0; the standard stroke weight for a bold font is 3; and the standard stroke weight for a light font is -3.

Table 10-4. Stroke Weights Values

Value	Stroke Weight
-7	Ultra Thin
-5	Thin
-3	Light
0	Medium
3	bold
5	Black
7	Ultra Black

Typeface (UB) Specifies one of the following defined typefaces.

Table 10-5. Typeface Values*

Value	Typeface
0	Line Printer
3	Courier
4	Helv
5	TmsRmn
6	Letter Gothic
8	Prestige
11	Presentations
17	Optima**
18	Garamond**
19	Cooper Black**
20	Coronet Bold**
21	Broadway**
22	Bauer Bodoni Black Condensed**
23	Century Schoolbook**
24	University Roman**

* Additional typefaces will be available in the future.

** These typeface names may be registered trade marks of a third party. Use of these fonts may be conditioned upon a license grant from the owners of the fonts. Hewlett-Packard makes no representation as to the quality or performance of the fonts, and references to the fonts does not grant any license or right to use the fonts.

Independent font vendors should contact their Hewlett-Packard representative for assignment of typeface values.

Serif Style (UB) Specifies one of the following defined serif styles.

This field is ignored by the **LaserJet 2000** printer.

Table 10-6. Serif Style Values

Value	Serif Style
0	Sans Serif Square
1	Sans Serif Round
2	Serif Line
3	Serif Triangle
4	Serif Swath
5	Serif Block
6	Serif Bracket
7	Rounded Bracket
8	Flair Stroke
Additional serif styles may be added.	

Underline Distance (SB) Specifies the distance from the baseline to the top dot row of the underline in dots. Zero specifies an underline position at the baseline. A positive value specifies an underline position above the baseline. A negative value specifies an underline position below the baseline.

Underline Height (UB) Specifies the thickness of the underline in dots.

This field is ignored by the **LaserJet 2000** printer. It always prints three dot thick underlines.

Text Height (UI) Specifies the font's optimum inter-line spacing in quarter-dot units.

This field is ignored by the **LaserJet 2000** printer.

Text Width (UI) Specifies the font's optimum character spacing in quarter-dot units. HP recommends setting this value to the average width of the lower case letters "a" through "z".

This field is ignored by the **LaserJet 2000** printer.

Font Name (ASC16) This is a 16 character ASCII field to which the user may assign a font name.

This field is ignored by the **LaserJet 2000** printer.

Pitch Extended This is an addition to the Pitch field which extends the pitch an extra eight bits. The value of this field is in 1024^{ths} of one dot. For example, a 17 pitch font would have a Pitch field of 70 (17.5 dots, or 17.1429 cpi) and a Pitch Extended field of 150 (0.1465 dots additional, which adds to 17.6465 dots, or 17.0005 pitch).

Height Extended This is an addition to the Height field which extends the height an extra eight bits. The value of this field is in 1024^{ths} of one dot. For example, a 10 point font would have a Height field of 166 (41.5 dots, or 9.96 points) and a Height Extended field of 170 (0.1660 dots additional, which adds to 9.9998 points).

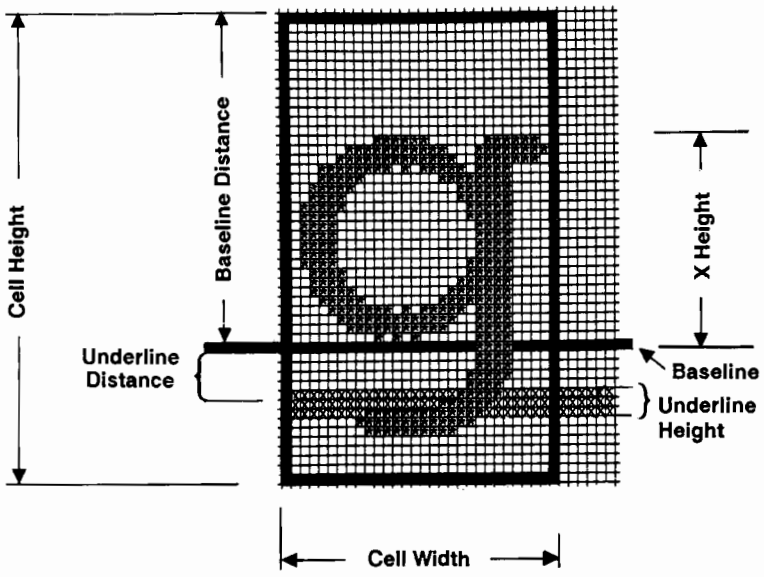


Figure 10-3. Character Cell

Font Descriptor Command

The Font Descriptor command is used to download a font descriptor to the printer.

$^{E}_{C}$) s # W [font descriptor]

The value field (#) identifies the number of bytes in the font descriptor (see example on following page).

Example To download a font descriptor for a portrait HP Roman-8, 10 pitch, 12 point, upright, medium, Courier font, with an ID number of one, send:

$^{E}_{C}$ *** c 1 D**
$^{E}_{C}$ **) s 64 W** [64 bytes of font descriptor data]

FIELD NAME	VALUE	DESCRIPTION
Font Descriptor Size	64	Bytes
Reserved	0	
Font Type	1	Eight bit
Reserved	0	
Baseline Distance	35	
Cell Width	30	
Cell Height	50	
Orientation	0	Portrait
Spacing	0	Fixed pitch
Symbol Set (8U)	277	(8*32 + (85-64))
Pitch	120	30 dots
Height	200	50 dots
x Height	92	23 dots
Width Type	0	Medium
Style	0	Upright
Stroke Weight	0	Normal
Typeface	3	Courier
Reserved	0	
Serif Style	2	Serif Line
Reserved	0	
Underline Distance	-5	
Underline Height	3	
Text Height	200	(50 dots)
Text Width	120	(30 dots)
Reserved	0	
Reserved	0	
Pitch Extended	0	
Height Extended	0	
Reserved	0	
Reserved	0	
Reserved	0	
Font Name	Courier10	

Character Descriptor and Data Format

A unique character code must be designated prior to the download of a character descriptor and data. If the font being downloaded already contains a character with this code, the existing character will be deleted during the download of the character descriptor and data. Unless otherwise specified, inappropriate values in a character descriptor field will invalidate the character download process; a character will not be created, and the associated descriptor and data will be discarded.

Those character descriptor fields identified as "reserved" should be set to 0.

The following illustrates the format of the character descriptor and data:

Byte	15 - MSB 8	7 LSB - 0
0	Format (4)	Continuation (0)
2	Descriptor Size (14)	Class (1)
4	Orientation	Reserved (0)
6	Left Offset	
8	Top Offset	
10	Character Width	
12	Character Height	
14	Delta X	
16	Character Data: (in bytes) ● ● ●	

Figure 10-4. Character Descriptor and Data Format

Note

The following notation is used to define the data type of each field in the character descriptor.

(B)	: Boolean	(0,1)
(UB)	: Unsigned Byte	(0 . . 255)
(SB)	: Signed Byte	(-128 . . 127)
(UI)	: Unsigned Integer	(0 . . 65535)
(SI)	: Signed Integer	(-32768 . . 32767)

Format (UB) Specifies the format of the character descriptor and data. The format number used by the **LaserJet 2000** printer is 4.

Continuation (B) Specifies whether the following data is a character descriptor block (0) or a continuation of the data (1) associated with the previous character descriptor.

Because the PCL escape sequence value field is limited to 32767, characters whose number of descriptor and data block bytes would exceed this limit must be downloaded in two or more blocks. The following illustrates the format of a character data continuation block.

Byte	15 - MSB 8	7 LSB - 0
0	Format (4)	Continuation (1)
2	Character Data: (in bytes) ● ● ●	

Figure 10-5. Character Descriptors/Data Continuation Block

Descriptor Size (UB) Specifies the size of the character descriptor in bytes. The descriptor size used by the **LaserJet 2000** printer is 14.

Class (UB) Specifies the format of the character data. The character data format number used by the **LaserJet 2000** printer is 1.

Orientation (UB) Specifies the orientation of the character. Zero specifies portrait and one specifies landscape. The orientation of the character must match the orientation of the font.

Left Offset (SI) Specifies the distance in dots from the reference point to the left side of the character pattern on the physical page coordinate system (i.e, this value is orientation dependent). The left and top offsets locate the character reference point about the current active position (see Figures 10-5 and 10-6).

The legal range for the left offset is -16384 to 16384.

Top Offset (SI) Specifies the distance in dots from the reference point to the top of the character pattern on the physical coordinate system (i.e., this value is orientation dependent.) The left and top offsets locate the character reference point about the current active position (see figures 10-5 and 10-6).

The legal range for the top offset is -16384 to 16384.

Character Width (UI) Specifies the width of the character in dots on the physical coordinate system.

The legal range for character width is 1 to 16384.

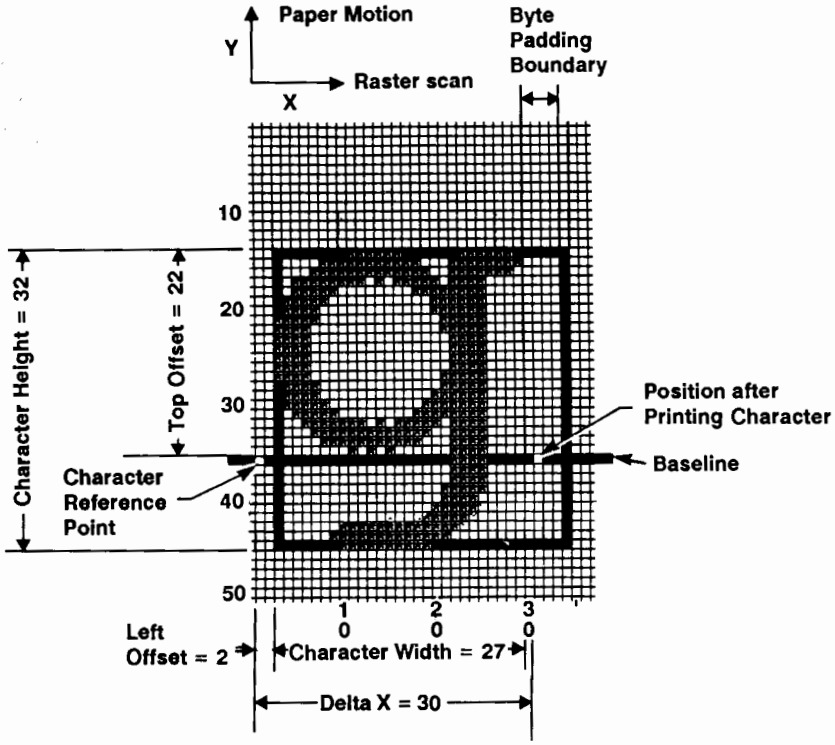
Character Height (UI) Specifies the height of the character in dots on the physical coordinate system.

The legal range for character height is 1 to 16384.

Delta X (SI) Specifies the number of quarter-dot units by which the horizontal position within the PCL logical page coordinate system will be incremented after printing the character. This value is only used by the printer when the font is proportionally spaced.

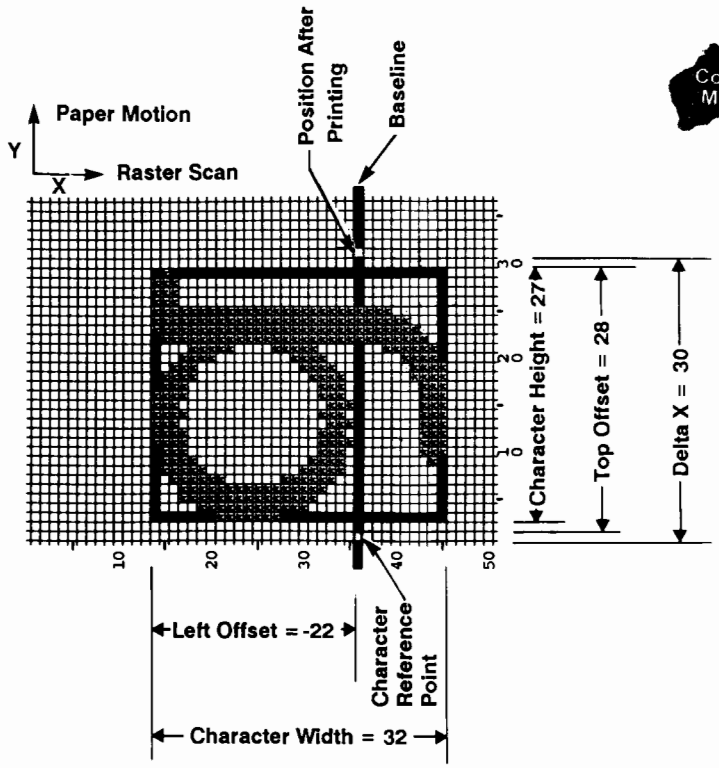
The legal range for delta X is 0 to 32767.

Character Data Character data is a string of bytes containing the dot-per-bit image of the character. If a bit is set to one, the corresponding dot will be printed. The data is grouped in dot rows; a row describes a one-dot high strip of the character from left to right, parallel to the printer's raster scan direction (see Figure 10-5). Zeroed bits must be added to the end of each row to make it contain an integral number of bytes. The dot rows are organized from top to bottom of the character, i.e., the first dot row of data corresponds to the top dot row of the character.



All values are in dots.

Figure 10-6. Portrait Character Example



All values are in dots.

Figure 10-7. Landscape Character Example

Character Code Command

The Character Code command establishes the decimal code that will be associated with the next character downloaded. This single byte value is used to reference the character for printing.

$^{E}_{C}$ * c # E

= character code

Example

To designate the character code for an ASCII lower-case "g", send:

$^{E}_{C}$*c1Ø3E

Character Descriptor and Data Command

The Character Descriptor and Data command is used to download a character descriptor and associated character data to the printer.

$^{E}_{C}$ (s # W [character descriptor and data]

The value field (#) identifies the number of bytes in the character descriptor and data. The maximum number is 32767.

Example

To download the character descriptor and data for a portrait, 10 Pitch, 12 point, upright medium, Courier lower-case "g", send:

$^{E}_{C}$***c1Ø3E** (103 is the decimal character code for an ASCII lower-case "g")

$^{E}_{C}$**(s144W [character descriptor and data]**

Character format, continuation, and descriptor:

FIELD NAME	VALUE	DESCRIPTION
Format	4	
Continuation	0	
Descriptor Size	14	
Class	1	
Orientation	0	Portrait
Reserved	0	
Left Offset	2	
Top Offset	22	
Character Width	27	
Character Height	32	
Delta X	120	(30 dots)

Character data:

Dot Row	Bit Map	Decimal Equivalent			
01	00000000 11111100 00001111 1100000	0	252	15	192
02	00000111 11111111 00011111 1110000	7	255	31	224
03	00001111 11111111 10011111 1100000	15	225	159	192
04	00111111 11010111 11011110 0000000	63	219	224	0
05	00111110 00000001 11111110 0000000	62	1	254	0
06	01111100 00000000 01111110 0000000	124	0	126	0
07	01111000 00000000 01111110 0000000	120	0	126	0
08	11110000 00000000 00111110 0000000	240	0	62	0
09	11110000 00000000 00111110 0000000	240	0	62	0
10	11110000 00000000 00011110 0000000	240	0	30	0
11	11110000 00000000 00011110 0000000	240	0	30	0
12	11110000 00000000 00011110 0000000	240	0	30	0
13	11110000 00000000 00011110 0000000	240	0	30	0
14	11110000 00000000 00111110 0000000	240	0	62	0
15	01111000 00000000 00111110 0000000	120	0	62	0
16	01111000 00000000 01111110 0000000	120	0	126	0
17	01111100 00000000 11111110 0000000	124	0	254	0
18	00111110 00000001 11111110 0000000	62	1	254	0
19	00011111 11010111 11011110 0000000	31	219	222	0
20	00001111 11111111 10011110 0000000	15	255	158	0
21	00000111 11111111 00011110 0000000	7	255	30	0
22	00000000 10101000 00011110 0000000	0	172	30	0
23	00000000 00000000 00011110 0000000	0	0	30	0
24	00000000 00000000 00011110 0000000	0	0	30	0
25	00000000 00000000 00011110 0000000	0	0	30	0
26	00000000 00000000 00111110 0000000	0	0	62	0
27	00000000 00000000 00111100 0000000	0	0	60	0
28	00000000 00000000 01111100 0000000	0	0	124	0
29	00000000 00000001 11111000 0000000	0	1	248	0
30	00000001 11111111 11110000 0000000	1	255	240	0
31	00000011 11111111 11100000 0000000	3	255	224	0
32	00000001 11111111 10000000 0000000	1	255	128	0

Figure 10-8. Portrait Character Data Example

Example To download the character descriptor and data for a landscape, 10 pitch, 12 point, upright, medium, Courier lower-case "g", send:

$^{E}_{C}$***c1Ø3E** (103 is the decimal character code for an ASCII lower-case "g")

$^{E}_{C}$**(s124W** [character descriptor and data]

Character format, continuation, and descriptor:

FIELD NAME	VALUE	DESCRIPTION
Format	4	
Continuation	0	
Descriptor Size	14	
Class	1	
Orientation	1	
Reserved	0	
Left Offset	-22	
Top Offset	28	
Character Width	32	
Character Height	27	
Delta X	120	(30 dot)

Character data:

Dot Row	Bit Map	Decimal Equivalent			
01	01000000 00000000 00000000 00000000	64	0	0	0
02	11100000 00000000 00000000 00000000	224	0	0	0
03	11100000 00000000 00000000 00000000	224	0	0	0
04	11100000 00000000 00000000 00000000	224	0	0	0
05	11111111 11111111 11111111 11000000	255	255	255	192
06	11111111 11111111 11111111 11110000	255	255	255	240
07	11111111 11111111 11111111 11111000	255	255	255	248
08	01111111 11111111 11111111 11111100	127	255	255	252
09	00001111 10000111 11000000 01111110	15	135	192	126
10	00011110 00000001 11100000 00011110	30	1	224	30
11	00111000 00000000 11110000 00001111	56	0	240	15
12	01111000 00000000 01111000 00001111	120	0	120	15
13	01110000 00000000 00111000 00000111	112	0	56	7
14	11110000 00000000 00111000 00000111	240	0	56	7
15	11100000 00000000 00011100 00000111	224	0	28	7
16	11110000 00000000 00111000 00000111	240	0	56	7
17	11100000 00000000 00011100 00000111	224	0	28	7
18	11110000 00000000 00111000 00000111	240	0	56	7
19	11110000 00000000 00111100 00000111	240	0	60	7
20	01110000 00000000 00111000 00000111	112	0	56	7
21	01111000 00000000 01111000 00000010	120	0	120	2
22	01111100 00000000 11111000 00000000	124	0	248	0
23	00111111 00000011 11110000 00000000	63	3	240	0
24	00011111 11111111 11100000 00000000	31	255	224	0
25	00011111 11111111 11000000 00000000	31	255	192	0
26	00000111 11111111 10000000 00000000	7	255	128	0
27	00000001 11111100 00000000 00000000	1	252	0	0

Figure 10-9. Landscape Character Data Example

11 Graphics

Contents

Introduction

PCL provides several forms of graphics functionality. Included is the ability to build dot-per-bit raster images and to fill or shade rectangular areas with pre-defined patterns.

Raster Graphics

Images composed of groups of dots are raster images. Pictures in newspapers or on televisions are examples of raster images. PCL includes commands for printing raster images. The image is divided into dot rows; a row describes a one dot high strip of the image. A dot row of raster image data is transferred to the printer as a string of bytes containing a dot-per-bit representation of the row. If a bit in a row is set to one, the corresponding dot will be printed. Zeroed bits must be added to the end of each row to make it contain an integral number of bytes. The dot rows are organized from top to bottom of the image, i.e., the first dot row of data transferred to the printer corresponds to the top dot row of the image.

The following is an example of a raster image in the shape of an arrow:

Dot Row	Binary Representation			
	Byte 1	Byte 2	Byte 3	Byte 4
1	00000000	00000000	10000000	00000000
2	00000000	00000000	11000000	00000000
3	00000000	00000000	11100000	00000000
4	00000000	00000000	11110000	00000000
5	00000000	00000000	11111000	00000000
6	00000000	00000000	11111100	00000000
7	00000000	00000000	11111110	00000000
8	00000000	00000000	11111111	00000000
9	00000000	00000000	11111111	10000000
10	11111111	11111111	11111111	11000000
11	11111111	11111111	11111111	11100000
12	11111111	11111111	11111111	11110000
13	11111111	11111111	11111111	11111000
14	11111111	11111111	11111111	11111100
15	11111111	11111111	11111111	11111110
16	11111111	11111111	11111111	11111111
17	11111111	11111111	11111111	11111111
18	11111111	11111111	11111111	11111110
19	11111111	11111111	11111111	11111100
20	11111111	11111111	11111111	11111000
21	11111111	11111111	11111111	11110000
22	11111111	11111111	11111111	11100000
23	11111111	11111111	11111111	11000000
24	00000000	00000000	11111111	10000000
25	00000000	00000000	11111111	00000000
26	00000000	00000000	11111110	00000000
27	00000000	00000000	11111100	00000000
28	00000000	00000000	11111000	00000000
29	00000000	00000000	11110000	00000000
30	00000000	00000000	11100000	00000000
31	00000000	00000000	11000000	00000000
32	00000000	00000000	10000000	00000000

Figure 11-1. Arrow-Shaped Raster Image

Raster Graphics Resolution

Raster graphics can be printed at 300, 150, 100 or 75 dots-per-inch. This command designates the resolution of subsequent raster data transfers.

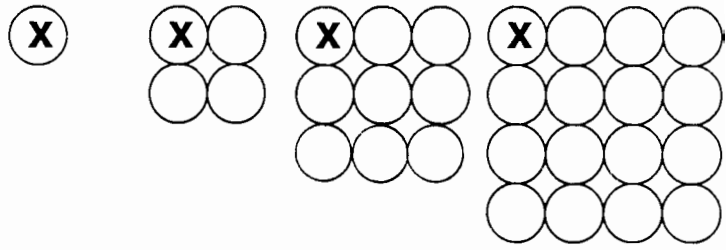
$^{E}_{C}$ * t # R

= 75 - 75 dots-per-inch
100 - 100 dots-per-inch
150 - 150 dots-per-inch
300 - 300 dots-per-inch

This command must be sent prior to the start graphics command. The factory default resolution is 75 dots-per-inch.

The **LaserJet 2000's** print resolution is 300 dots-per-inch. **LaserJet 2000** automatically expands raster graphics transferred at resolutions less than 300 dots-per-inch to 300 dots-per-inch during printing.

The following illustrates a single bit translated into the corresponding printed dots in each of the four resolutions:



300 dpi 150 dpi 100 dpi 75 dpi

X = reference position

Lower resolution graphics occupy less user memory. For example, the number of bits required to represent a two-inch by three-inch image at 75 dots-per-inch is 34,200. The same image at 300 dots-per-inch requires 540,000 bits.

Raster Graphics Presentation Mode

This command specifies the presentation of the raster image on the logical page.

$^{E}_{C}$ * r # F

= 0 or 3

A value of 0 indicates that the raster graphics will be printed in the orientation of the logical page.

A value of 3 indicates that the raster graphics will be printed along the width of the physical page, regardless of logical page orientation. In portrait orientation, a raster row will be printed in the positive X-direction of the PCL coordinate system and a subsequent raster row will be printed beginning at the next dot row position in the positive Y-direction. In landscape orientation, a raster row will be printed in the positive Y-direction of the PCL coordinate system and a subsequent raster row will be printed beginning at the next dot row position in the negative X-direction. The figure on the next page illustrates presentation mode 0 and 3.

The factory default is 3.

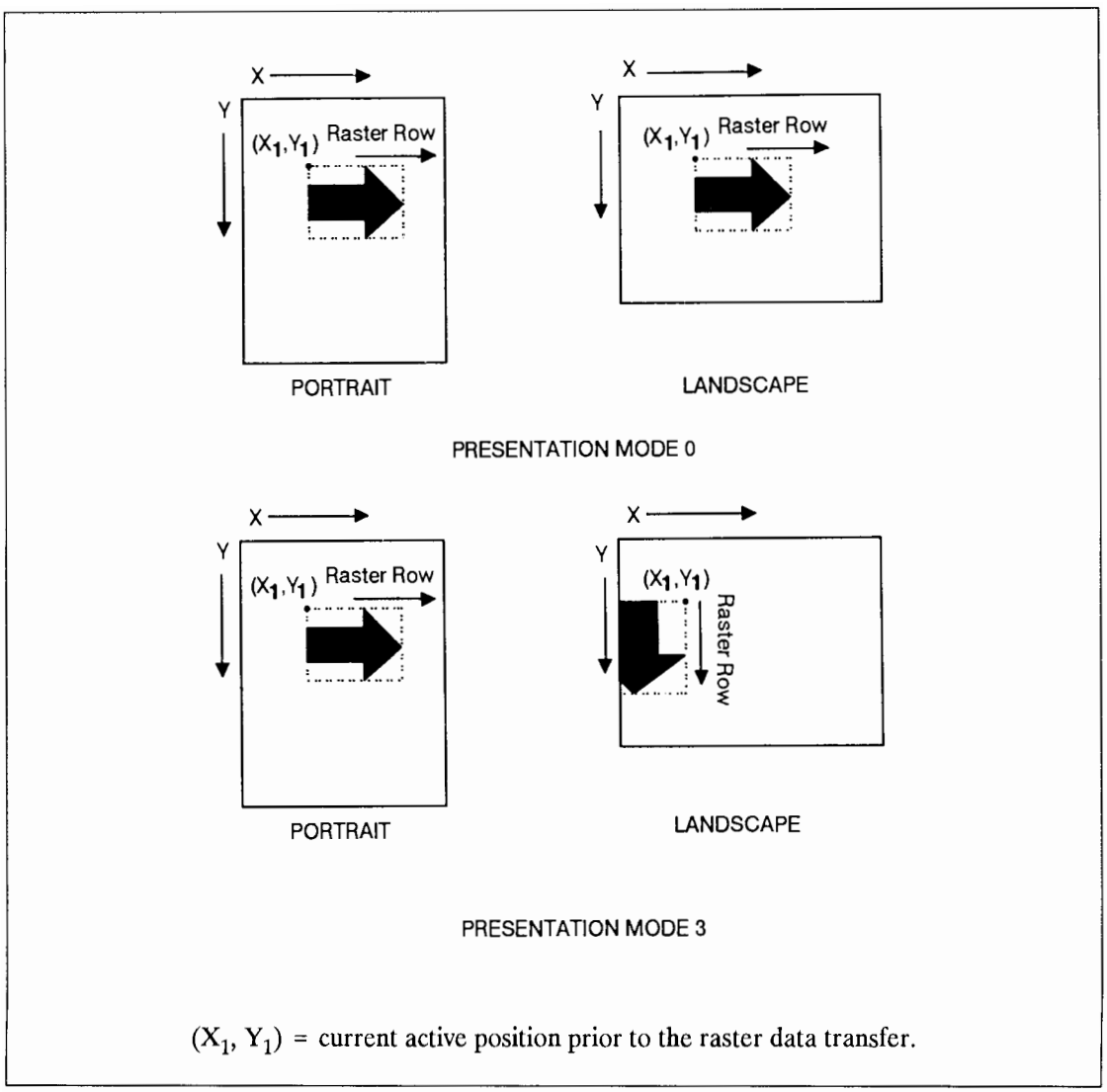


Figure 11-2. Raster Graphics Presentation Mode

Start Raster Graphics

The start raster graphics command specifies the left raster graphics margin.

$^{E}_{C}$ * r # A

= 0 or 1

A value of 0 specifies that the left graphics margin is at X position 0. A value of 1 specifies that the left graphics margin is at the current X position.

Once a start raster graphics command is received by the printer, raster graphics resolution, raster graphics presentation mode, and left raster graphics margin are fixed until an end raster graphics command is received.

Transfer Raster Data

The transfer raster data command is used to transfer a row of raster data to the printer.

$^{E}_{C}$ * b # W [raster data]

The value field (#) identifies the number of bytes in the raster row. These bytes are interpreted as one row of raster graphics data that will be printed at the current Y position at the left raster graphics margin. Upon completion of this command, the current active position is at the beginning of the next raster row at the left raster graphics margin. Within the raster data, each bit describes a single dot. The most significant bit (bit 7 is the most significant, bit 0 is the least significant) of the first byte of data corresponds to the first dot within that row. If a bit is set to 1, the corresponding dot will be printed. Each dot of the raster data is expanded according to the specified raster resolution.

Raster graphics is independent of the text area and perforation skip mode, i.e., these boundaries are ignored.

Raster graphic images are limited to the printable area; images that extend beyond the printable area or logical page are clipped.

End Raster Graphics

The end raster graphics command signifies the end of the transfer of a raster graphic image.

$^{E}_{C}$ * r B

Example

To transfer a raster graphic image in the shape of an arrow perform the following steps:

1. Position the cursor:

   Esc*p300x400Y This moves the cursor to dot position (300, 400) within the PCL coordinate system.

2. Specify the raster graphics resolution:

   Esc*t75R This sets the raster graphics resolution to 75 dots-per-inch.

3. Specify the raster graphics presentation mode:

   Esc*r0F This specifies that the raster graphics will be printed in the orientation of the logical page.

4. Specify the left raster graphics margin:

   Esc*r1A This sets the left graphics margin to the current X position (300).

5. Transfer the raster data to the printer:

   Divide the image into dot rows and transfer each dot row to the printer as a string of bytes as illustrated in Figure 11-3.

6. Signify the end of the raster graphic image transfer:

   Esc*rB

This example prints the arrow as shown in Figure 11-4.

Dot Row	byte 1	byte 2	byte 3	byte 4	Decimal Equivalent
1	00000000	00000000	10000000	00000000	^C*b4W[0, 0, 128, 0]
2	00000000	00000000	11000000	00000000	^C*b4W[0, 0, 192, 0]
3	00000000	00000000	11100000	00000000	^C*b4W[0, 0, 224, 0]
4	00000000	00000000	11110000	00000000	^C*b4W[0, 0, 240, 0]
5	00000000	00000000	11111000	00000000	^C*b4W[0, 0, 248, 0]
6	00000000	00000000	11111100	00000000	^C*b4W[0, 0, 252, 0]
7	00000000	00000000	11111110	00000000	^C*b4W[0, 0, 254, 0]
8	00000000	00000000	11111111	00000000	^C*b4W[0, 0, 255, 0]
9	00000000	00000000	11111111	10000000	^C*b4W[0, 0, 255, 128]
10	11111111	11111111	11111111	11000000	^C*b4W[255, 255, 255, 192]
11	11111111	11111111	11111111	11100000	^C*b4W[255, 255, 255, 224]
12	11111111	11111111	11111111	11110000	^C*b4W[255, 255, 255, 240]
13	11111111	11111111	11111111	11111000	^C*b4W[255, 255, 255, 248]
14	11111111	11111111	11111111	11111100	^C*b4W[255, 255, 255, 252]
15	11111111	11111111	11111111	11111110	^C*b4W[255, 255, 255, 254]
16	11111111	11111111	11111111	11111111	^C*b4W[255, 255, 255, 255]
17	11111111	11111111	11111111	11111111	^C*b4W[255, 255, 255, 255]
18	11111111	11111111	11111111	11111110	^C*b4W[255, 255, 255, 254]
19	11111111	11111111	11111111	11111100	^C*b4W[255, 255, 255, 252]
20	11111111	11111111	11111111	11111000	^C*b4W[255, 255, 255, 248]
21	11111111	11111111	11111111	11110000	^C*b4W[255, 255, 255, 240]
22	11111111	11111111	11111111	11100000	^C*b4W[255, 255, 255, 224]
23	11111111	11111111	11111111	11000000	^C*b4W[255, 255, 255, 192]
24	00000000	00000000	11111111	10000000	^C*b4W[0, 0, 255, 128]
25	00000000	00000000	11111111	00000000	^C*b4W[0, 0, 255, 0]
26	00000000	00000000	11111110	00000000	^C*b4W[0, 0, 254, 0]
27	00000000	00000000	11111100	00000000	^C*b4W[0, 0, 252, 0]
28	00000000	00000000	11111000	00000000	^C*b4W[0, 0, 248, 0]
29	00000000	00000000	11110000	00000000	^C*b4W[0, 0, 240, 0]
30	00000000	00000000	11100000	00000000	^C*b4W[0, 0, 224, 0]
31	00000000	00000000	11000000	00000000	^C*b4W[0, 0, 192, 0]
32	00000000	00000000	10000000	00000000	^C*b4W[0, 0, 128, 0]
	Raster Image				Raster Data Commands

The brackets and commas are not part of the raster data command; they are used only to delineate the data.

Figure 11-3. Example of Raster Graphic Image Data

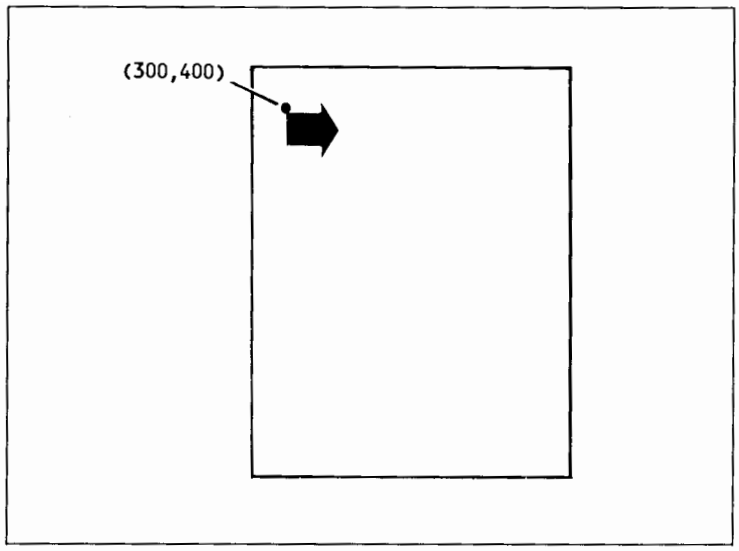


Figure 11-4. Example of Raster Graphic Image Transfer

Rectangular Area Fill

PCL includes commands for filling or shading rectangular areas with pre-defined patterns. Rectangular areas are printed in the orientation of the logical page. An area's width extends in the positive X-direction of the PCL coordinate system; an area's height extends in the positive Y-direction.

Note

Rectangular areas are not affected by the raster graphics resolution command.

Horizontal Rectangle Size (Decipoints)

This Horizontal Rectangle Size command specifies the rectangle width in decipoints.

$^{E}_{C}$ * c # H

= Number of decipoints (1/720th inch)

The value field (#) is valid to 4 decimal places.

The printer converts the specified width to dots by rounding up to an integral number of dots. For example, 5 decipoints, which corresponds to 2.08 dots on the **LaserJet 2000**, is converted to 3 dots.

The factory default horizontal rectangle size is 0.

Horizontal Rectangle Size (Dots)

This Horizontal Rectangle Size command specifies the rectangle width in dots.

$^{E}_{C}$ * c # A

= Number of dots.

The factory default horizontal rectangle size is 0.

Vertical Rectangle Size (Decipoints)

This Vertical Rectangle Size command specifies the rectangle height in decipoints.

$^{E}_{C}$ * c # V

= Number of decipoints (1/720th inch)

The value field (#) is valid to 4 decimal places.

The printer converts the specified width to dots by rounding up to an integral number of dots. For example, 5 decipoints, which corresponds to 2.08 dots on the **LaserJet 2000**, is converted to 3 dots.

The factory default vertical rectangle size is 0.

Vertical Rectangle Size (Dots)

This Vertical Rectangle Size command specifies the rectangle height in dots.

$^{E}_{C}$ * c # B

= Number of dots

The factory default vertical rectangle size is 0.

Area Fill ID

This command specifies the level of shading or type of patterned fill to be used when filling a rectangular area.

$$E_C * c \# G$$

The value field (#) identifies the level of shading or type of patterned fill. There are eight shading levels defined within PCL. To specify a shading level use any value between 1 and 100. Use a value within the range indicated in Figure 11-5 for the desired shading level.

There are six fill patterns defined within PCL. To specify a fill pattern type use any value between 1 and 6. Use a value indicated in Figure 11-6 for the desired fill pattern.

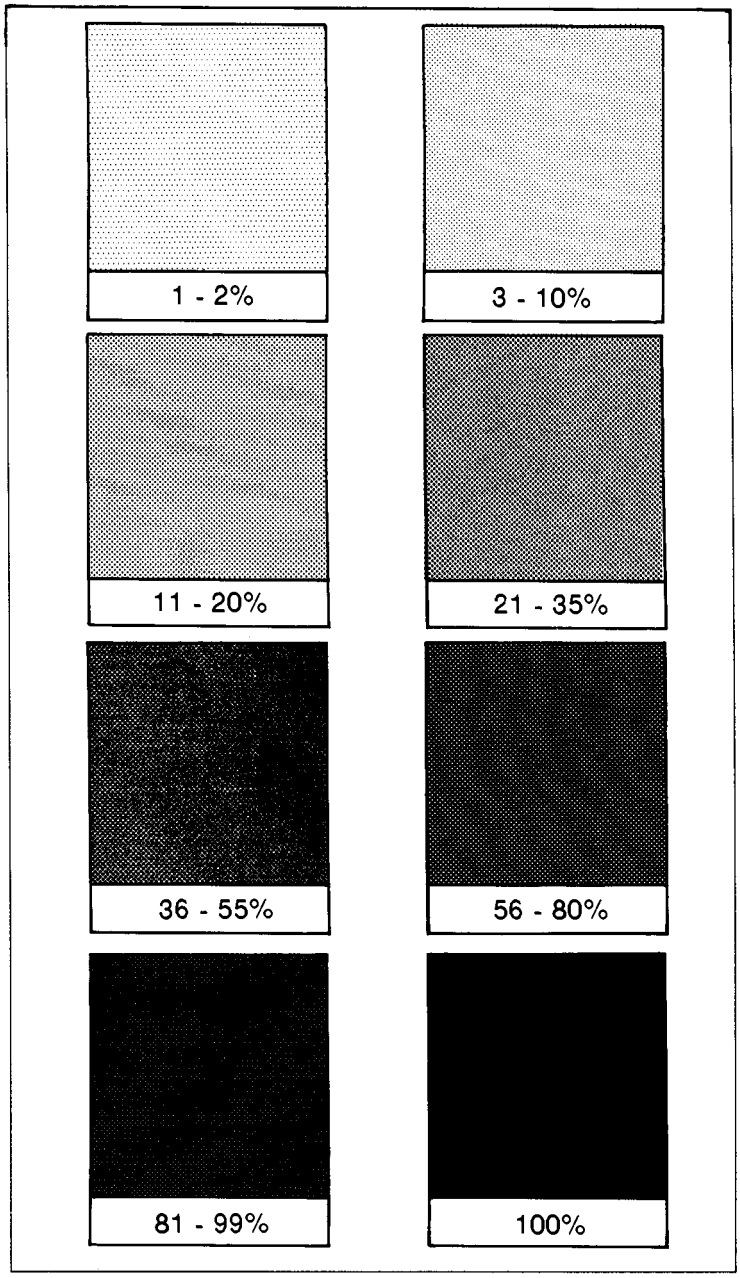


Figure 11-5. Shading Levels

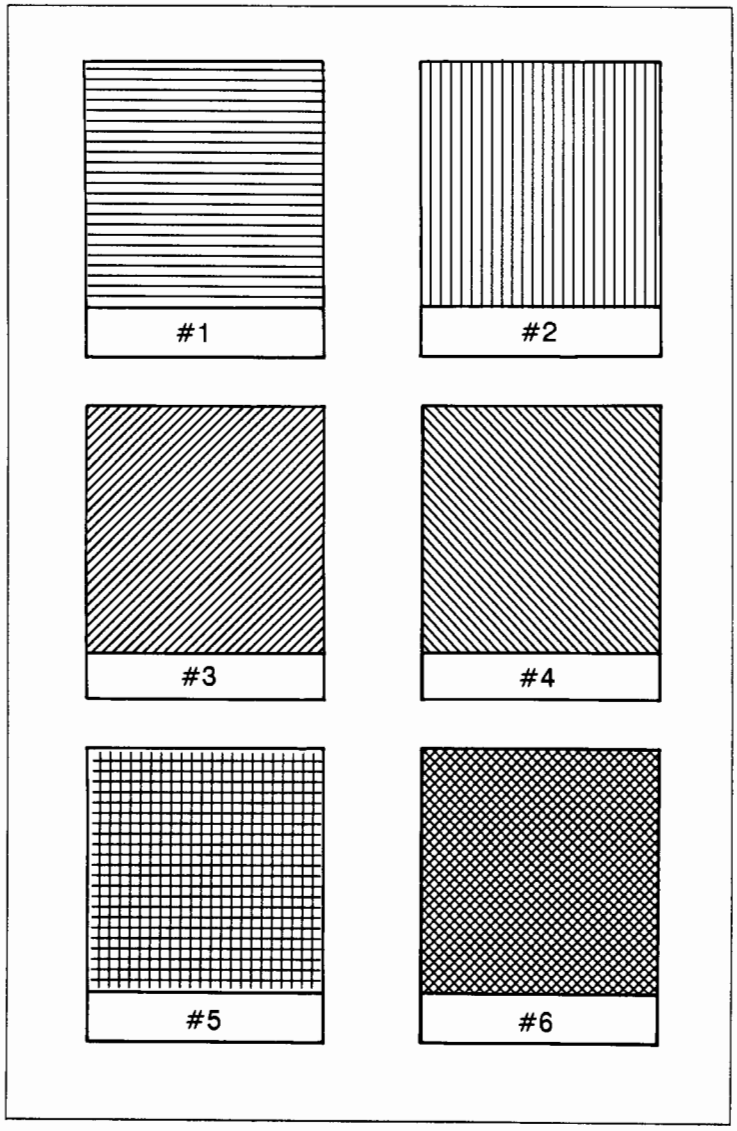


Figure 11-6. Fill Patterns

Fill Rectangular Area

This command is used to fill a rectangular area of the specified width and height.

$^{E}_{C}$ * c # P

= 0 - Solid fill
= 2 - Shaded fill
= 3 - Patterned fill

The level of shading or type of patterned fill used when filling a rectangle is specified by the current area fill ID. A solid-filled rectangular area is also known as a black rule and does not require specification of an area fill ID.

The upper left corner of the rectangular area is located at the current active position. The current active position is not changed during the printing of a rectangular area.

Rectangular areas are independent of the text area and perforation skip mode, i.e., these boundaries are ignored.

Rectangular areas are limited to the printable area; rectangular areas that extend outside the printable area or logical page are clipped.

Examples

To print a 3 inch by 5 inch black rule, perform the following steps.

1. Position the cursor:

   `<Esc>*p300x400Y` This moves the cursor to dot position (300, 400) within the PCL coordinate system.

2. Specify the width of the rule:

   `<Esc>*c900A` This sets the rule width to 900 dots (3 inches).

3. Specify the height of the rule:

   `<Esc>*c1500B` This sets the rule height to 1500 dots (5 inches).

4. Print the rule:

   `<Esc>*c0P`

This example prints the following:

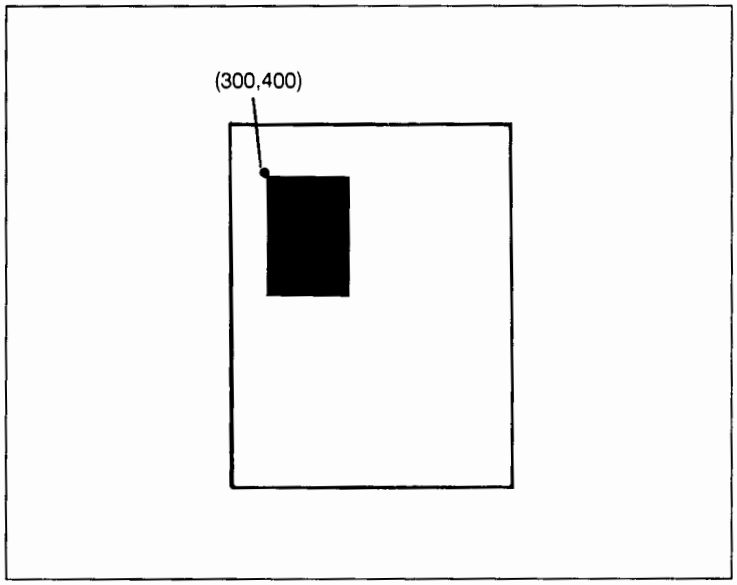


Figure 11-7. Solid Fill Example

To print a 3 inch by 5 inch 25% shaded rectangle, perform the following steps.

1. Position the cursor:

   Esc*p300x400Y This moves the cursor to dot position (300, 400) within the PCL coordinate system.

2. Specify the width of the rectangle:

   Esc*c900A This sets the rectangle width to 900 dots (3 Inches).

3. Specify the height of the rectangle:

   Esc*c1500B This sets the rectangle to 1500 dots (5 inches).

4. Specify the area fill ID:

   Esc*c25G This sets the area fill ID to 25.

5. Print the rectangular shaded area:

   Esc*c2P

This example prints the following:

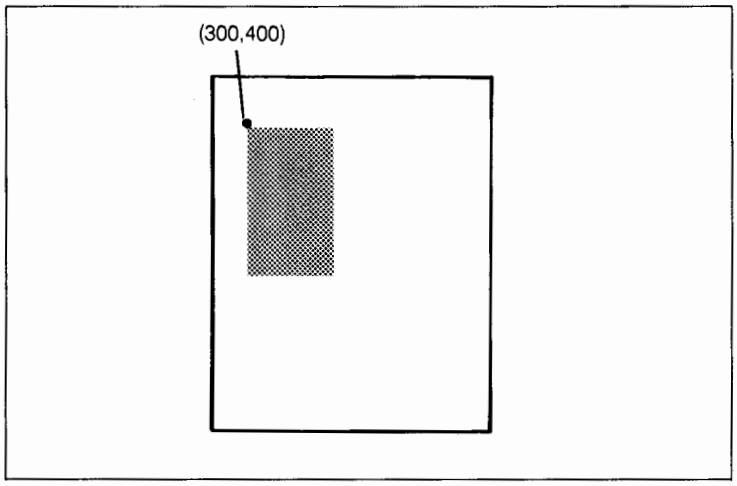


Figure 11-8. Shaded Fill Example

To print a 3 inch by 5 inch rectangular area filled with a horizontal line pattern, perform the following steps:

1. Position the cursor:

   Ec*p300x400Y Moves the cursor to dot position (300,400) within the PCL coordinate systems.

2. Specify the width of the rectangle:

   Ec*c900A Sets the rectangle width to 900 dots (3 inches).

3. Specify the height of the rectangle:

   Ec*c1500B Sets the rectangle height to 1500 dots (5 inches).

4. Specify the area fill ID:

   Ec*c1G Sets the area fill ID to 1.

5. Print the rectangular pattern-filled area:

   Ec*c3P

This example prints the following:

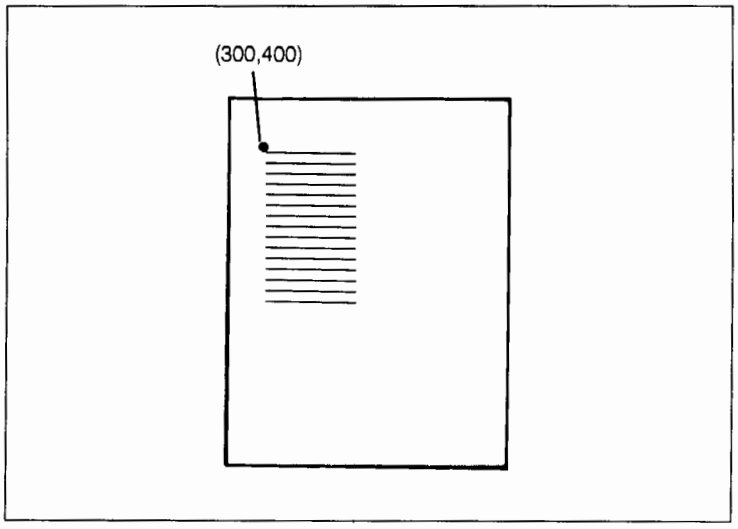


Figure 11-9. Patterned Fill Example

12 Macros

Contents

Introduction

A typical printer task requires the use of several commands. Applications may perform the same task numerous times. For tasks performed repeatedly, PCL provides macro functionality to reduce the number of commands that must be sent to the printer. A macro is a collection of escape sequences, control codes, and data downloaded to the printer, whose execution can be initiated using a single command.

Macro Creation

A unique identification (ID) number should be designated prior to the definition of a macro; this number is then associated with the macro. If a macro is already associated with this ID number, the existing macro will be deleted from user memory during the definition of the new macro. Subsequent macro operations are accomplished using the macro ID number.

A macro is created in several steps. First, a command is sent to the printer that indicates the start of a macro definition. Next, the escape sequences, control codes, and data that constitute the macro are sent to the printer in the intended order of their execution. Finally, a command is sent to the printer that indicates the end of the macro definition.

Macros occupy a portion of user memory. The number of macros that can be stored simultaneously in user memory is limited only by the amount of available user memory.

Macro Invocation

There are three ways to invoke a macro: **execute**, **call** and **overlay**.

When a macro is **executed**, it begins performing its commands using the current modified print environment. Changes made to feature settings during macro **execution** are recorded in the modified print environment; these changes are retained upon completion of the macro **execution**.

When a macro is **called**, it begins performing its commands using the current modified print environment. Changes made to feature settings during a macro **call** are recorded in the modified print environment; however, these changes are not retained upon completion of the macro **call**. The modified print environment that existed prior to the macro **call** is restored.

When a macro is enabled for automatic **overlay**, its execution will be the final operation each time a page is printed. Before the macro is executed, the current modified print environment is saved and replaced with the overlay environment. The overlay environment is a combination of the user default and the current modified print environments. Changes made to feature settings during macro **overlay** are recorded in the modified print environment; however, these changes are not retained upon completion of the macro **overlay**. The modified print environment that existed prior to the macro overlay is restored.

The overlay environment consists of the current settings for the following features with the remainder of the environmental features set to their user default values:

- **Page length**
- **Page size**
- **Orientation**
- **Duplex mode**
- **Registration**
- **Paper source**
- **Number of copies**
- **Cursor position stack**
- **Job offset**

Refer to Chapter 3 for descriptions of environments.

Note

The current cursor position is not part of the modified print environment; therefore, the cursor position is not saved when a macro is **called**, nor is it restored upon completion. The push/pop cursor position command can be used to save and recall a cursor position.

Temporary / Permanent Macros

During its definition, a macro is automatically designated as temporary. A temporary macro is one that is deleted from user memory during a printer reset. A macro can be designated as permanent to prevent the printer from deleting it during a printer reset. A macro is designated as temporary or permanent by reference to its ID number.

Note 

Temporary and permanent macros are removed from user memory whenever the printer's power is turned off.

Deleting macros

There are several mechanisms provided by PCL macro control for explicit deletion of macros from user memory. These include commands to delete all macros, all temporary macros, or an individual macro by reference to its macro ID number.

Macro ID

The Macro ID command specifies an ID number for use in subsequent macro commands.

$^{E}_{C}$ & f # Y

= Macro ID number (0 to 32767)

This number will be used in subsequent macro operations.

The factory default macro ID is 0.

Example

To establish a macro ID number of 5, send:

$^{E}_{C}$&f5Y

Macro Control

The macro control command provides mechanisms for definition, invocation, and deletion of macros.

$^{E}_{C}$ **& f # X**

- # = 0 Start macro definition (last ID specified)
- = 1 Stop macro definition
- = 2 Execute macro (last ID specified)
- = 3 Call macro (last ID specified)
- = 4 Enable macro for automatic overlay (last ID specified)
- = 5 Disable automatic overlay
- = 6 Delete all macros
- = 7 Delete all temporary macros
- = 8 Delete macro (last ID specified)
- = 9 Make macro temporary (last ID specified)
- =10 Make macro permanent (last ID specified)

Note

1. A macro may **call** or **execute** another macro which in turn may **call** or **execute** another macro; two levels of "nesting" are allowed.
2. Other than **call** and **execute**, no macro control operations may occur within a macro.
3. A printer reset command is not allowed in a macro.

Example To define a macro with an ID of 7, send:

```
EC&f7y0X
  •
  •
  •
escape sequences, control codes, and data
  •
  •
  •
EC&f1X
```

To make the macro with an ID of 7 permanent, send:

```
EC&f7y10X
```

To enable the macro with an ID of 7 for automatic overlay, send:

```
EC&f7y4X
```

To delete the macro with an ID of 7, send:

```
EC&f7y8X
```

Macro Control Example

The following illustrates the definition of a letterhead macro.

Ec&f1Y	Specify the Macro ID as one
Ec&f0X	Start Macro Definition
Ec&a540h360V	Position logo at (540, 360) decipoints in the PCL coordinate system.
Ec*t150R	Set graphics resolution to 150 dots-per-inch
Ec*r1A	Start raster image of logo
Ec*b60W [Raster data]	Send the first raster line
•	•
•	•
•	•
Ec*b60W [Raster data]	Send the last raster line
Ec*rB	Stop raster graphics
Ec&a540h780V	Position for lettering at (540, 780) decipoints
Ec(1X	Select font with ID of 1
ABC Corp.	Text
Post Office Box 15	Text
Fred, Texas 83707	Text
Ec&a540h960V	Position first rule at (540, 960) decipoints
Ec*c10v4680H	Set rule height and width
Ec*c0P	Print the first rule
Ec&a540h980V	Position second rule at (540, 980) decipoints
Ec*c0P	Print second rule
Ec&a1200v0H	Position for first line of text at (540, 1200) decipoints
Ec&f1X	Stop Macro Definition

This macro can now be **executed**, **called** or enabled for automatic **overlay**.

13 Programming Hints

Contents

Introduction

This chapter provides information for use during the development of PCL software.

PCL Command Parsing

A job stream may contain commands that are **device** specific. If these commands are not supported by the **PCL device**, they are ignored. For example, a job separation command will have no effect on the **LaserJet, LaserJet Plus**, and **LaserJet series II**; however, a **LaserJet 500 Plus** and **LaserJet 2000** will perform job separation.

Job Control

Printer Reset

- A printer reset (EcE) should be included as the first and last command of every job. A printer reset should not be used within a job.

Duplexing/Offset Registration

- To avoid data loss, text should be centered on a page either horizontally or vertically, depending on the type of offset selected. The borders used for centering determine the maximum value of the offset, where the maximum offset value is always at least 1/4 inch less than the size of the border. For example, to prevent data loss on the back side of a page in portrait orientation with vertical binding and a left offset, text should be centered along the width of the page. Note, that in this example only one left offset command is required since the direction of offset is automatically reversed for the back page. For more information see pages 4-7 to 4-9.

Page Control

Paper Source

- After specifying a paper source, the page size or page length must be set to the size of the paper in the selected source.

Page Length

- In landscape orientation, the page lengths of letter and legal paper are the same; therefore, to select legal paper for use in landscape orientation, specify the legal page length while in portrait orientation and then specify landscape orientation.
- The physical page size is calculated by multiplying the number of lines specified in the page length command by the current line spacing (i.e., the last VMI or LPI command). For example, to select executive size paper (7.25" x 10.5") when the current linespacing is 8 lines-per-inch (i.e., VMI is 6), select a page length of 84 lines.
- The user default VMI is selectable from the control panel using the FORM LENGTH menu item (see the *LaserJet 2000 Operator's Manual*). If the Page Length command (Ec&l#P) follows a VMI change (produced by a control panel selection or a PCL command), the length of a page will be recalculated; therefore, the printer may request a different page size.

Text Area/Margins

- Avoid setting the top margin or text length to values outside of the printable area. This may cause data loss.
- Top margin and text length commands use the current line spacing (i.e., the last VMI or lpi commands).
- Specifying the text length establishes the bottom margin.
- When using both the top margin and text length commands, the top margin command should be sent before the text length command.
- To address the entire logical page, set the top margin to 0, set perforation skip mode to OFF, then position the cursor to the desired location.

HMI

- When a font is selected, HMI is automatically set to correspond to the pitch of the selected font. Therefore, when using a non-standard HMI value, the value must be re-specified following each font selection.

Cursor Positioning

- Horizontal (decipoint, dot and column) positioning ignores margins and can therefore be used to move the cursor anywhere along the present line.
- When performing cursor positioning with decipoints, dots, or rows and columns, do not use margins. Margins are intended for print and space (i.e., CR, LF, FF) applications.
- Vertical (decipoint, dot and row) positioning allows the cursor to be moved into the perforation region.
- The top margin is the reference point for absolute vertical positioning.
- The left edge of the logical page is the reference point for absolute horizontal positioning.

Fonts

- Character spacing information for proportionally spaced fonts is available from Hewlett-Packard.
- Since line spacing is independent of font height, line spacing may require adjustment following font selection to insure proper vertical alignment of text.
- To insure compatibility with future products, select fonts by specifying all of the font characteristics. If all of the characteristics are not designated, the primary and secondary font tables may not contain the correct information to select the requested font from those available in the printer.
- The transparent print data command is required to access characters with character codes in the decimal range of 7 to 15 and 27 in the PC-8 symbol sets.
- All information about the design of a font, as well as the design of its characters, can be found in the font and character descriptors.
- A control code space is printed when an attempt is made to print a non-existent character.
- When a soft font is specified using an ID number with which no soft font has been associated, no font change occurs.
- Font characteristics combined into a single escape sequence are processed more efficiently than those sent independently.
- The short cut method of font selection (as documented in font product literature) may not result in the desired font change. This is due to the increased number of available fonts and the font characteristic tables and the font tables not correctly specifing all the desired font characteristics.

Raster Graphics

- To minimize I/O transmission time and conserve memory, avoid sending unnecessary raster data that represents white space to the printer.
- Resolution should be set prior to the start raster graphics command. Once the start raster command is received, the resolution cannot be set until after a subsequent end raster graphics command.
- Presentation mode should be set prior to the start raster graphics command. Once the start raster command is received, the presentation mode cannot be set until after a subsequent end raster graphics command.
- Some applications and I/O drivers insert carriage returns or line feeds into the data stream sent to the printer. This modification of the data stream must be suppressed for correct printer operation.
- Multiple top and left offset registration changes should be avoided to conserve printer memory.
- Horizontal and vertical on a page lines can be done most efficiently with rules (solid filled rectangular areas).

- When a macro ID is specified for which no macro has been defined, macro invocation, macro deletion, and make macro permanent or temporary commands are ignored.
- The macro enabled for auto macro overlay is executed on each page, until the macro is disabled or deleted, a reset occurs ("ESC E" or control panel), or the page length, page size or orientation is changed.
- When the modified print environment is restored, if the page length, page size, or the orientation has changed, or the primary or secondary font has been deleted, the following will occur:

    1. If the original page length or page size is different than the current page length and size, the current page is closed and printed; the page length and page size are changed to their original values; and, the cursor is positioned to the left edge of the logical page at the top margin.
    2. If the primary or secondary font is deleted, a new primary or secondary font is automatically selected from the remaining fonts using the current font characteristics.

Performance

PCL Commands

- Since PCL printers are command driven devices and each command takes a finite amount of time to process, pages that are composed of a large number of commands may not print at maximum speed. Most commands can be used frequently on a page without adversely affecting the printer's performance; however, certain commands take more time to process and therefore, if used frequently on a page, may decrease printer performance. An excessive number of font selections per page (selection using font characteristic commands or selection by ID number) may decrease printer performance.

Print Data

- There is a limit on the amount of data, as well as the number of commands, that the printer can process per page at maximum speed. In general, the **LaserJet 2000** printer can print at least 2500 uniformly distributed 12-point characters per page at maximum speed. This assumes the data does not contain any PCL commands and there are no I/O or host CPU constraints.

Print Overrun

- As data is received by the printer, it is processed and stored in an intermediate format. The intermediate data is later processed and printed. During the physical printing of a page, the page moves through the printer at a constant speed. Thus, there are pages that cannot be printed because the page's intermediate data cannot be processed and printed fast enough to keep up with the physical speed of the page as it moves through the printer. When this condition occurs, 21-PRINT OVERRUN is displayed on the printer's control panel. A page causing this error can never be printed by this device; however, it may be possible to remove or redistribute the page's data and subsequently print the page.

I/O

- The Parallel (Centronics) I/O has higher throughput than the RS-232C serial I/O. While text processing may not benefit from a faster I/O, raster graphics processing and soft font downloads benefit from increased I/O throughput.

End-of-Line Wrap

The End-of-Line Wrap command defines the action that occurs when a line of text reaches the right margin.

^{E}C &s#C

= 0 - Enables End-of-Line Wrap
1 - Disables End-of-Line Wrap

When end-of-line wrap is enabled, a character or space that would move the cursor to the right of the right margin causes a CR-LF to be executed (prior to the printing of the character or space).

When end-of-line wrap is disabled, a character or space that would move the cursor to the right of the right margin is clipped (refer to Chapter 2). When a character is clipped, the cursor is set to the right margin.

The primary use of this command is with display functions mode.

The factory default is end-of-line wrap disabled.

Example

To enable end-of-line wrap mode, send:

^{E}C&sØC

Display Functions Mode

The Display Functions Mode command allows all escape sequences and control codes to be printed instead of executed.

$^{E}_{C}$ **Y** - Enables Display Functions Mode
$^{E}_{C}$ **Z** - Disables Display Functions Mode

When the printer is in display functions mode, all control codes and escape sequences are printed and not executed with the following exceptions.

- CR is printed and executed as CR-LF.
- $^{E}_{C}$**Z** is printed and executed.

Display functions mode instructs the printer to display rather than execute the data it receives. The data is printed using the current text area and selected font.

Example

To enable display functions mode, send:

$^{E}_{C}$**&sØC**	Enables end-of-line wrap to prevent data truncation.
$^{E}_{C}$**Y**	Enable Display Functions Mode.
	• • •
	Data sent to the printer.
	• • •
$^{E}_{C}$**Z**	Disable Display Functions Mode.

Note

Most symbol sets do not have printable characters defined in the control code decimal range 0 to 31 and 128 to 159. If a printable character is not defined, a control code space is printed while in display functions mode. The PC-8 symbol sets do have printable characters defined in this range.

Common Errors

20 - Memory OverFlow

This error occurs when the printer runs out of memory during a font download, macro creation, raster graphic download, or page composition. To alleviate this error, the quantity of data sent to the printer must be reduced. This can be accomplished by eliminating unnecessary fonts or macros, reducing the raster graphics white space sent to the printer, or selecting a lower resolution for the raster graphics. An alternative solution is to install additional memory. Additional memory is available from your Hewlett-Packard Sales Representative or authorized dealer.

21 - Print Overrun

This error results when a page is too complex to print. This error can be corrected by reducing the complexity of the page. (Refer to the "Print Overrun" section described earlier in this chapter for additional information.)

A Reference Tables

Contents

Table A-1. Roman-8 Character Set (ASCII Plus ROMAN EXTENSION)

8-bit character = [b_8 b_7 b_6 b_5 b_4 b_3 b_2 b_1]

				b_8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
				b_7	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
				b_6	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
				b_5	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
b_4	b_3	b_2	b_1		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	Á	Þ
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q			À	Ý	ê	î	Ã	þ
0	0	1	0	2	STX	DC2	“	2	B	R	b	r			Â	ý	ô	ø	ã	·
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s			È	°	û	Æ	Đ	µ
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t			Ê	Ç	á	å	ð	¶
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u			Ë	ç	é	í	Í	¾
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v			Î	Ñ	ó	ø	Ì	—
0	1	1	1	7	BEL	ETB	’	7	G	W	g	w			Ï	ñ	ú	æ	Ó	¼
1	0	0	0	8	BS	CAN	(	8	H	X	h	x			´	¡	à	Ä	Ò	½
1	0	0	1	9	HT	EM	)	9	I	Y	i	y			`	¿	è	ì	Õ	a
1	0	1	0	10	LF	SUB	*	:	J	Z	j	z			^	¤	ò	Ö	õ	º
1	0	1	1	11	VT	ESC	+	;	K	[	k	{			¨	£	ü	Ü	Š	«
1	1	0	0	12	FF	FS	,	<	L	\	l	|			~	¥	ä	É	š	■
1	1	0	1	13	CR	GS	-	=	M	]	m	}			Ù	§	ë	ï	Ú	»
1	1	1	0	14	SO	RS	.	>	N	^	n	~			Û	ƒ	ö	ß	Ÿ	±
1	1	1	1	15	SI	US	/	?	O	_	o	DEL			£	ç	ü	Ô	ÿ	

Table A-2. Control Codes

Backspace	$^{B}_{S}$	Move one column left unless at left margin in which case no action is taken.
Line Feed	$^{L}_{F}$	Move to next print line while maintaining current column position.
Form Feed	$^{F}_{F}$	Move to first line at top of the next page while maintaining current column position.
Carriage Return	$^{C}_{R}$	Move to the left margin on current print line.
Shift Out	$^{S}_{O}$	Select characters that follow from the current secondary font until receipt of a Shift In.
Shift In	$^{S}_{I}$	Select characters that follow from the current primary font until receipt of a Shift Out.
Escape	$^{E}_{C}$	Indicates the beginning of a special control sequence (escape sequence).
Horizontal Tab	$^{H}_{T}$	Move to next horizontal tab stop. The tab stops are at the left margin and at every eight columns to the right of the left margin.
Space	$^{S}_{P}$	Move one column to the right unless at right margin in which case no action is taken.

Table A-3. Roman-8 Character Conversion Table

Graphic	Binary	Hex	Dec	Oct	Description
	0000 0000	00	0	000	NUL (null)
	0000 0001	01	1	001	SOH (start of heading)
	0000 0010	02	2	002	STX (start of text)
	0000 0011	03	3	003	ETX (end of text)
	0000 0100	04	4	004	EOT (end of transmission)
	0000 0101	05	5	005	ENQ (enquiry)
	0000 0110	06	6	006	ACK (acknowledge)
	0000 0111	07	7	007	BEL (bell)
	0000 1000	08	8	010	BS (backspace)
	0000 1001	09	9	011	HT (horizontal tabulation)
	0000 1010	0A	10	012	LF (line feed)
	0000 1011	0B	11	013	VT (vertical tabulation)
	0000 1100	0C	12	014	FF (form feed)
	0000 1101	0D	13	015	CR (carriage return)
	0000 1110	0E	14	016	SO (shift out)
	0000 1111	0F	15	017	SI (shift in)
	0001 0000	10	16	020	DLE (data link escape)
	0001 0001	11	17	021	DC1 (device control 1 or X-ON)
	0001 0010	12	18	022	DC2 (device control 2)
	0001 0011	13	19	023	DC3 (device control 3 or X-OFF)
	0001 0100	14	20	024	DC4 (device control 4)
	0001 0101	15	21	025	NAK (negative acknowledge)
	0001 0110	16	22	026	SYN (synchronous idle)
	0001 0111	17	23	027	ETB (end of transmission block)
	0001 1000	18	24	030	CAN (cancel)
	0001 1001	19	25	031	EM (end of medium)
	0001 1010	1A	26	032	SUB (substitute)
	0001 1011	1B	27	033	ESC (escape)
	0001 1100	1C	28	034	FS (file separator)
	0001 1101	1D	29	035	GS (group separator)
	0001 1110	1E	30	036	RS (record separator)
	0001 1111	1F	31	037	US (unit separator)
	0010 0000	20	32	040	Space
!	0010 0001	21	33	041	Exclamation point
"	0010 0010	22	34	042	Quotation mark
#	0010 0011	23	35	043	Number sign (hash mark)
$	0010 0100	24	36	044	Dollar sign
%	0010 0101	25	37	045	Percent sign
&	0010 0110	26	38	046	Ampersand
'	0010 0111	27	39	047	Apostrophe (closing single quote)

Table A-3. Roman-8 Character Conversion Table (continued)

Graphic	Binary	Hex	Dec	Oct	Description
(	0010 1000	28	40	050	Opening parenthesis
)	0010 1001	29	41	051	Closing parenthesis
*	0010 1010	2A	42	052	Asterisk
+	0010 1011	2B	43	053	Plus
,	0010 1100	2C	44	054	Comma
-	0010 1101	2D	45	055	Hyphen (minus)
.	0010 1110	2E	46	056	Period (point)
/	0010 1111	2F	47	057	Slant (solidus)
0	0011 0000	30	48	060	Zero
1	0011 0001	31	49	061	One
2	0011 0010	32	50	062	Two
3	0011 0011	33	51	063	Three
4	0011 0100	34	52	064	Four
5	0011 0101	35	53	065	Five
6	0011 0110	36	54	066	Six
7	0011 0111	37	55	067	Seven
8	0011 1000	38	56	070	Eight
9	0011 1001	39	57	071	Nine
:	0011 1010	3A	58	072	Colon
;	0011 1011	3B	59	073	Semicolon
<	0011 1100	3C	60	074	Less than sign
=	0011 1101	3D	61	075	Equal sign
>	0011 1110	3E	62	076	Greater than sign
?	0011 1111	3F	63	077	Question mark
@	0100 0000	40	64	100	Commercial at
A	0100 0001	41	65	101	Uppercase A
B	0100 0010	42	66	102	Uppercase B
C	0100 0011	43	67	103	Uppercase C
D	0100 0100	44	68	104	Uppercase D
E	0100 0101	45	69	105	Uppercase E
F	0100 0110	46	70	106	Uppercase F
G	0100 0111	47	71	107	Uppercase G
H	0100 1000	48	72	110	Uppercase H
I	0100 1001	49	73	111	Uppercase I
J	0100 1010	4A	74	112	Uppercase J
K	0100 1011	4B	75	113	Uppercase K
L	0100 1100	4C	76	114	Uppercase L
M	0100 1101	4D	77	115	Uppercase M
N	0100 1110	4E	78	116	Uppercase N
O	0100 1111	4F	79	117	Uppercase O

Table A-3. Roman-8 Character Conversion Table (continued)

Graphic	Binary	Hex	Dec	Oct	Description
P	0101 0000	50	80	120	Uppercase P
Q	0101 0001	51	81	121	Uppercase Q
R	0101 0010	52	82	122	Uppercase R
S	0101 0011	53	83	123	Uppercase S
T	0101 0100	54	84	124	Uppercase T
U	0101 0101	55	85	125	Uppercase U
V	0101 0110	56	86	126	Uppercase V
W	0101 0111	57	87	127	Uppercase W
X	0101 1000	58	88	130	Uppercase X
Y	0101 1001	59	89	131	Uppercase Y
Z	0101 1010	5A	90	132	Uppercase Z
[	0101 1011	5B	91	133	Opening square bracket
\	0101 1100	5C	92	134	Reverse slant
]	0101 1101	5D	93	135	Closing square bracket
^	0101 1110	5E	94	136	Caret (circumflex)
_	0101 1111	5F	95	137	Underscore (low line)
`	0110 0000	60	96	140	Opening single quote
a	0110 0001	61	97	141	Lowercase a
b	0110 0010	62	98	142	Lowercase b
c	0110 0011	63	99	143	Lowercase c
d	0110 0100	64	100	144	Lowercase d
e	0110 0101	65	101	145	Lowercase e
f	0110 0110	66	102	146	Lowercase f
g	0110 0111	67	103	147	Lowercase g
h	0110 1000	68	104	150	Lowercase h
i	0110 1001	69	105	151	Lowercase i
j	0110 1010	6A	106	152	Lowercase j
k	0110 1011	6B	107	153	Lowercase k
l	0110 1100	6C	108	154	Lowercase l
m	0110 1101	6D	109	155	Lowercase m
n	0110 1110	6E	110	156	Lowercase n
o	0110 1111	6F	111	157	Lowercase o
p	0111 0000	70	112	160	Lowercase p
q	0111 0001	71	113	161	Lowercase q
r	0111 0010	72	114	162	Lowercase r
s	0111 0011	73	115	163	Lowercase s
t	0111 0100	74	116	164	Lowercase t
u	0111 0101	75	117	165	Lowercase u
v	0111 0110	76	118	166	Lowercase v
w	0111 0111	77	119	167	Lowercase w

Table A-3. Roman-8 Character Conversion Table (continued)

Graphic	Binary	Hex	Dec	Oct	Description
x	0111 1000	78	120	170	Lowercase x
y	0111 1001	79	121	171	Lowercase y
z	0111 1010	7A	122	172	Lowercase z
	0111 1011	7B	123	173	Opening brace (curly bracket)
|	0111 1100	7C	124	174	Vertical line
	0111 1101	7D	125	175	Closing brace (curly bracket)
~	0111 1110	7E	126	176	Tilde
	0111 1111	7F	127	177	Delete (rubout)
	1000 0000	80	128	200	--undefined control code--
	1000 0001	81	129	201	--undefined control code--
	1000 0010	82	130	202	--undefined control code--
	1000 0011	83	131	203	--undefined control code--
	1000 0100	84	132	204	--undefined control code--
	1000 0101	85	133	205	--undefined control code--
	1000 0110	86	134	206	--undefined control code--
	1000 0111	87	135	207	--undefined control code--
	1000 1000	88	136	210	--undefined control code--
	1000 1001	89	137	211	--undefined control code--
	1000 1010	8A	138	212	--undefined control code--
	1000 1011	8B	139	213	--undefined control code--
	1000 1100	8C	140	214	--undefined control code--
	1000 1101	8D	141	215	--undefined control code--
	1000 1110	8E	142	216	--undefined control code--
	1000 1111	8F	143	217	--undefined control code--
	1001 0000	90	144	220	--undefined control code--
	1001 0001	91	145	221	--undefined control code--
	1001 0010	92	146	222	--undefined control code--
	1001 0011	93	147	223	--undefined control code--
	1001 0100	94	148	224	--undefined control code--
	1001 0101	95	149	225	--undefined control code--
	1001 0110	96	150	226	--undefined control code--
	1001 0111	97	151	227	--undefined control code--
	1001 1000	98	152	230	--undefined control code--
	1001 1001	99	153	231	--undefined control code--
	1001 1010	9A	154	232	--undefined control code--
	1001 1011	9B	155	233	--undefined control code--
	1001 1100	9C	156	234	--undefined control code--
	1001 1101	9D	157	235	--undefined control code--
	1001 1110	9E	158	236	--undefined control code--
	1001 1111	9F	159	237	--undefined control code--

Table A-3. Roman-8 Character Conversion Table (continued)

Graphic	Binary	Hex	Dec	Oct	Description
	1010 0000	A0	160	240	--undefined--
À	1010 0001	A1	161	241	Uppercase A grave accent
Â	1010 0010	A2	162	242	Uppercase A circumflex
È	1010 0011	A3	163	243	Uppercase E grave accent
Ê	1010 0100	A4	164	244	Uppercase E circumflex
Ë	1010 0101	A5	165	245	Uppercase E umlaut or diaeresis
Î	1010 0110	A6	166	246	Uppercase I circumflex
Ï	1010 0111	A7	167	247	Uppercase I umlaut or diaeresis
´	1010 1000	A8	168	250	Acute accent
`	1010 1001	A9	169	251	Grave accent
^	1010 1010	AA	170	252	Circumflex accent
¨	1010 1011	AB	171	253	Umlaut (diaeresis) accent
~	1010 1100	AC	172	254	Tilde accent
Ù	1010 1101	AD	173	255	Uppercase U grave accent
Û	1010 1110	AE	174	256	Uppercase U circumflex
£	1010 1111	AF	175	257	Italian Lira symbol
¯	1011 0000	B0	176	260	Over line (high line)
Ý	1011 0001	B1	177	261	Uppercase Y acute accent
ý	1011 0010	B2	178	262	Lowercase y acute accent
°	1011 0011	B3	179	263	Degree (ring)
Ç	1011 0100	B4	180	264	Uppercase C cedilla
ç	1011 0101	B5	181	265	Lowercase c cedilla
Ñ	1011 0110	B6	182	266	Uppercase N tilde
ñ	1011 0111	B7	183	267	Lowercase n tilde
¡	1011 1000	B8	184	270	Inverse exclamation mark
¿	1011 1001	B9	185	271	Inverse question mark
¤	1011 1010	BA	186	272	General currency symbol
£	1011 1011	BB	187	273	British pound sign
¥	1011 1100	BC	188	274	Japanese yen symbol
§	1011 1101	BD	189	275	Section sign
ƒ	1011 1110	BE	190	276	Dutch guilder symbol
¢	1011 1111	BF	191	277	U.S. cent symbol
â	1100 0000	C0	192	300	Lowercase a circumflex
ê	1100 0001	C1	193	301	Lowercase e circumflex
ô	1100 0010	C2	194	302	Lowercase o circumflex
û	1100 0011	C3	195	303	Lowercase u circumflex
á	1100 0100	C4	196	304	Lowercase a acute accent
é	1100 0101	C5	197	305	Lowercase e acute accent
ó	1100 0110	C6	198	306	Lowercase o acute accent
ú	1100 0111	C7	199	307	Lowercase u acute accent

Table A-3. Roman-8 Character Conversion Table (continued)

Graphic	Binary	Hex	Dec	Oct	Description
à	1100 1000	C8	200	310	Lowercase a grave accent
è	1100 1001	C9	201	311	Lowercase e grave accent
ò	1100 1010	CA	202	312	Lowercase o grave accent
ù	1100 1011	CB	203	313	Lowercase u grave accent
ä	1100 1100	CC	204	314	Lowercase a umlaut or diaeresis
ë	1100 1101	CD	205	315	Lowercase e umlaut or diaeresis
ö	1100 1110	CE	206	316	Lowercase o umlaut or diaeresis
ü	1100 1111	CF	207	317	Lowercase u umlaut or diaeresis
Å	1101 0000	D0	208	320	Uppercase A degree
î	1101 0001	D1	209	321	Lowercase i circumflex
Ø	1101 0010	D2	210	322	Uppercase O crossbar
Æ	1101 0011	D3	211	323	Uppercase AE ligature
å	1101 0100	D4	212	324	Lowercase a degree
í	1101 0101	D5	213	325	Lowercase i acute accent
ø	1101 0110	D6	214	326	Lowercase o crossbar
æ	1101 0111	D7	215	327	Lowercase ae ligature
Ä	1101 1000	D8	216	330	Uppercase A umlaut or diaeresis
ì	1101 1001	D9	217	331	Lowercase i grave accent
Ö	1101 1010	DA	218	332	Uppercase O umlaut or diaeresis
Ü	1101 1011	DB	219	333	Uppercase U umlaut or diaeresis
É	1101 1100	DC	220	334	Uppercase E acute accent
ï	1101 1101	DD	221	335	Lowercase i umlaut or diaeresis
ß	1101 1110	DE	222	336	Sharp s
Ô	1101 1111	DF	223	337	Uppercase O circumflex
Á	1110 0000	E0	224	340	Uppercase A acute accent
Ã	1110 0001	E1	225	341	Uppercase A tilde
ã	1110 0010	E2	226	342	Lowercase a tilde
Ð	1110 0011	E3	227	343	Uppercase D with stroke
đ	1110 0100	E4	228	344	Lowercase d with stroke
Í	1110 0101	E5	229	345	Uppercase I acute accent
Ì	1110 0110	E6	230	346	Uppercase I grave accent
Ó	1110 0111	E7	231	347	Uppercase O acute accent
Ò	1110 1000	E8	232	350	Uppercase O grave accent
Õ	1110 1001	E9	233	351	Uppercase O tilde
õ	1110 1010	EA	234	352	Lowercase o tilde
Š	1110 1011	EB	235	353	Uppercase S with caron
š	1110 1100	EC	236	354	Lowercase s with caron
Ú	1110 1101	ED	237	355	Uppercase U acute accent
Ÿ	1110 1110	EE	238	356	Uppercase Y umlaut or diaeresis
ÿ	1110 1111	EF	239	357	Lowercase y umlaut or diaeresis

Table A-3. Roman-8 Character Conversion Table (continued)

Graphic	Binary	Hex	Dec	Oct	Description
Þ	1111 0000	F0	240	360	Uppercase Thorn
þ	1111 0001	F1	241	361	Lowercase Thorn
•	1111 0010	F2	242	362	Middle dot
µ	1111 0011	F3	243	363	Lowercase mu (micro sign)
	1111 0100	F4	244	364	Pilcrow (paragraph sign)
¾	1111 0101	F5	245	365	Vulgar fraction ¾
—	1111 0110	F6	246	366	Long dash (horizontal bar)
¼	1111 0111	F7	247	367	One fourth (one quarter)
½	1111 1000	F8	248	370	One half
ª	1111 1001	F9	249	371	Feminine ordinal indicator
º	1111 1010	FA	250	372	Masculine ordinal indicator
«	1111 1011	FB	251	373	Opening guillemets (angle quotes)
■	1111 1100	FC	252	374	Solid
»	1111 1101	FD	253	375	Closing guillemets (angle quotes)
±	1111 1110	FE	254	376	Plus / minus sign
	1111 1111	FF	255	377	--undefined--

Table A-4. Printer Command Table*

FUNCTION	PARAMETER	PRINTER COMMAND	DECIMAL VALUE	HEXADECIMAL VALUE
JOB CONTROL COMMANDS				
RESET				
RESET		Ec E	027 069	1B 45
JOB SEPARATION	Output Sheet	Ec&l1T	027 038 108 049 084	1B 26 6C 31 54
NUMBER OF COPIES	# of Copies (1-99)	Ec&l#X	027 038 108 #...# 088	1B 26 6C #...# 58
SIMPLEX/DUPLEX OPERATION				
DUPLEX PRINT	Simplex	Ec&l0S	027 038 108 048 083	1B 26 6C 40 53
	Vertical Binding	Ec&l1S	027 038 108 049 083	1B 26 6C 41 53
	Horizontal Binding	Ec&l2S	027 038 108 050 083	1B 26 6C 42 53
LEFT OFFSET REGISTRATION	# of Decipoints (1/720 inch)	Ec&l#U	027 038 108 #...# 058	1B 26 6C #...# 55
TOP OFFSET REGISTRATION	# of Decipoints (1/720 inch)	Ec&l#Z	027 038 108 #...# 90	1B 26 6C #...# 5A
PAGE SIDE SELECTION	Next Side	Ec&a0G	027 038 097 048 071	1B 26 61 40 47
	Front Side	Ec&a1G	027 038 097 049 071	1B 26 61 41 47
	Back Side	Ec&a2G	027 038 097 050 071	1B 26 61 42 47
PAGE CONTROL COMMANDS				
PAPER SOURCE	Eject Page	Ec&l0H	027 038 108 048 072	1B 26 6C 30 48
	Feed from Upper Tray	Ec&l1H	027 038 108 049 072	1B 26 6C 31 48
	Feed from Lower Tray	Ec&l4H	027 038 108 051 072	1B 26 6C 34 48
	Feed from Paper Deck	Ec&l5H	027 038 108 051 072	1B 26 6C 35 48
PAGE SIZE	Executive	Ec&l1A	027 038 108 049 065	1B 26 6C 31 41
	Letter	Ec&l2A	027 038 108 050 065	1B 26 6C 32 41
	Legal	Ec&l3A	027 038 108 051 065	1B 26 6C 33 41
	Ledger	Ec&l6A	027 038 108 054 065	1B 26 6C 36 41
	A4	Ec&l26A	027 038 108 050 054 065	1B 26 6C 32 36 41
	A3	Ec&l27A	027 038 108 050 055 065	1B 26 6C 36 37 41
PAGE LENGTH	# of Lines	Ec&l#P	027 038 108 #...# 080	1B 26 6C #...# 50
ORIENTATION	Portrait	Ec&l0O	027 038 108 048 079	1B 26 6C 30 4F
	Landscape	Ec&l1O	027 038 108 049 079	1B 26 6C 31 4F
MARGINS and TEXT LENGTH				
TOP MARGIN	# of Lines	Ec&l#E	027 038 108 #...# 069	1B 26 6C #...# 45
TEXT LENGTH	# of Lines	Ec&l#F	027 038 108 #...# 070	1B 26 6C #...# 46
LEFT MARGIN	Left (col #)	Ec&a#L	027 038 097 #...# 076	1B 26 61 #...# 4C
RIGHT MARGIN	Right (col #)	Ec&a#M	027 038 097 #...# 077	1B 26 61 #...# 4D
CLEAR HORIZONTAL MARGINS		Ec9	027 057	1B 39
PERFORATION SKIP MODE				
PERF SKIP	Disable	Ec&l0L	027 038 108 048 076	1B 26 6C 30 4C
	Enable	Ec&l1L	027 038 108 049 076	1B 26 6C 31 4C
HORIZONTAL COLUMN SPACING				
HORIZONTAL MOTION INDEX	# of 1/20" Increments	Ec&k#H	027 038 107 #...# 072	1B 26 6B #...# 48

Table A-4. Printer Command Table (continued)

FUNCTION	PARAMETER	PRINTER COMMAND	DECIMAL VALUE	HEXADECIMAL VALUE
VERTICAL LINE SPACING				
VERTICAL MOTION INDEX	# of 1/48" Increments	Ec&l#C	027 038 108 #...# 067	1B 26 6C #...# 43
LINES/INCH	1 line/inch	Ec&l1D	027 038 108 049 068	1B 26 6C 31 44
	2 lines/inch	Ec&l2D	027 038 108 050 068	1B 26 6C 32 44
	3 lines/inch	Ec&l3D	027 038 108 051 068	1B 26 6C 33 44
	4 lines/inch	Ec&l4D	027 038 108 052 068	1B 26 6C 34 44
	6 lines/inch	Ec&l6D	027 038 108 054 068	1B 26 6C 36 44
	8 lines/inch	Ec&l8D	027 038 108 056 068	1B 26 6C 38 44
	12 lines/inch	Ec&l12D	027 038 108 049 050 068	1B 26 6C 31 32 44
	16 lines/inch	Ec&l16D	027 038 108 049 054 068	1B 26 6C 31 36 44
	24 lines/inch	Ec&l24D	027 038 108 050 052 068	1B 26 6C 32 34 44
	48 lines/inch	Ec&l48D	027 038 108 052 056 068	1B 26 6C 34 38 44
CURSOR POSITIONING				
VERTICAL and HORIZONTAL				
VERTICAL	Row #	Ec&a#R	027 038 097 #...# 082	1B 26 61 #...# 52
	# of Dots	Ec*p#Y	027 042 112 #...# 089	1B 2A 70 #...# 59
	# of Decipoints	Ec&a#V	027 038 097 #...# 086	1B 26 61 #...# 56
HORIZONTAL	Column #	Ec&a#C	027 038 097 #...# 067	1B 26 61 #...# 43
	# of Dots	Ec*p#X	027 042 112 #...# 088	1B 2A 70 #...# 58
	# of Decipoints	Ec&a#H	027 038 097 #...# 072	1B 26 61 #...# 48
HALF LINE FEED		Ec=	027 061	1B 3D
END-OF-LINE TERMINATION				
LINE TERMINATION	CR=CR LF=LF FF=FF	Ec&kØG	027 038 107 048 071	1B 26 6B 30 47
	CR=CR+LF LF=LF FF=FF	Ec&k1G	027 038 107 049 071	1B 26 6B 31 47
	CR=CR LF=CR+LF FF=CR+FF	Ec&k2G	027 038 107 050 071	1B 26 6B 32 47
	CR=CR+LF LF=CR+LF FF=CR+FF	Ec&k3G	027 038 107 051 071	1B 26 6B 33 47
PUSH/POP POSITION				
PUSH/POP POSITION	Push	Ec&fØS	027 038 102 048 083	1B 26 66 30 53
	Pop	Ec&f1S	027 038 102 049 083	1B 26 66 31 53
FONT SELECTION				
ORIENTATION				
ORIENTATION	Portrait	Ec&lØO	027 038 108 048 079	1B 26 6C 30 4F
	Landscape	Ec&l1O	027 038 108 049 079	1B 26 6C 31 4F
SYMBOL SET SELECTION				
PRIMARY SYMBOL SET	HP Math7	Ec(ØA	027 040 048 065	1B 28 30 41
	HP Line Draw	Ec(ØB	027 040 048 066	1B 28 30 42
	ISO 60: Norwegian 1	Ec(ØD	027 040 048 068	1B 28 30 44
	ISO 61: Norwegian 2	Ec(1D	027 040 049 068	1B 28 31 44

Table A-4. Printer Command Table (continued)

FUNCTION	PARAMETER	PRINTER COMMAND	DECIMAL VALUE	HEXADECIMAL VALUE
	HP Roman Extension	Ec(ØE	027 040 048 089	1B 28 30 45
	ISO 4: United Kingdom	Ec(1E	027 040 049 069	1B 28 31 45
	ISO 25: French	Ec(ØF	027 040 048 070	1B 28 30 46
	ISO 69: French	Ec(1F	027 040 049 070	1B 28 31 46
	HP German	Ec(ØG	027 040 048 071	1B 28 30 47
	ISO 21: German	Ec(1G	027 040 049 071	1B 28 31 47
	HP Greek8	Ec(8G	027 040 056 71	1B 28 38 47
	ISO 15: Italian	Ec(ØI	027 040 048 073	1B 28 30 49
	ISO 14: JIS ASCII	Ec(ØK	027 040 048 075	1B 28 30 4B
	HP Katakana	Ec(1K	027 040 049 075	1B 28 31 4B
	ISO 57: Chinese	Ec(2K	027 040 050 075	1B 28 32 4B
	HP Math7	Ec(ØM	027 040 048 077	1B 28 30 4D
	Technical	Ec(1M	027 040 049 077	1B 28 31 4D
	HP Math8	Ec(8M	027 040 056 77	1B 28 38 4D
	ISO 100: ECMA-94 (Latin 1)	Ec(ØN	027 040 048 78	1B 28 30 4E
	OCR A	Ec(ØO	027 040 048 079	1B 28 30 4F
	OCR B	Ec(1O	027 040 049 079	1B 28 31 4F
	ISO 11: Swedish	Ec(ØS	027 040 048 083	1B 28 30 53
	HP Spanish	Ec(1S	027 040 049 083	1B 28 31 53
	ISO 17: Spanish	Ec(2S	027 040 050 083	1B 28 32 53
	ISO 10: Swedish	Ec(3S	027 040 051 083	1B 28 33 53
	ISO 16: Portuguese	Ec(4S	027 040 052 083	1B 28 34 53
	ISO 84: Portuguese	Ec(5S	027 040 053 083	1B 28 35 53
	ISO 85: Spanish	Ec(6S	027 040 054 083	1B 28 36 53
	ISO 6: ASCII	Ec(ØU	027 040 048 085	1B 28 30 55
	HP Legal	Ec(1U	027 040 049 085	1B 28 31 55
	ISO 2: IRV	Ec(2U	027 040 050 085	1B 28 32 55
	OEM-1	Ec(7U	027 040 055 85	1B 28 37 55
	HP Roman8	Ec(8U	027 040 056 85	1B 28 38 55
	PC-8	Ec(1ØU	027 040 049 048 085	1B 28 31 30 55
	PC-8 (D/N)	Ec(11U	027 040 049 049 085	1B 28 31 31 55
	HP Pi Font	Ec(15U	027 040 049 053 085	1B 28 31 35 55
SPACING				
PRIMARY SPACING	Proportional	Ec(s1P	027 040 115 049 080	1B 28 73 31 50
	Fixed	Ec(sØP	027 040 115 048 080	1B 28 73 30 50
PITCH				
PRIMARY PITCH	# CPI	Ec(s#H	027 040 115 #...# 072	1B 28 73 #...# 48
POINT SIZE				
PRIMARY POINT SIZE	# Pt.	Ec(s#V	027 040 115 #...# 086	1B 28 73 #...# 56
STYLE				
PRIMARY STYLE	Upright	Ec(sØS	027 040 115 048 083	1B 28 73 30 53
	Italic	Ec(s1S	027 040 115 049 083	1B 28 73 31 53
STROKE WEIGHT				
PRIMARY STROKE WEIGHT	Medium (0)	Ec(sØB	027 040 115 048 066	1B 28 73 30 42
	Bold (3)	Ec(s3B	027 040 115 051 066	1B 28 73 33 42

Table A-4. Printer Command Table (continued)

FUNCTION	PARAMETER	PRINTER COMMAND	DECIMAL VALUE	HEXADECIMAL VALUE
		TYPEFACE		
PRIMARY TYPEFACE	Line Printer	Ec(sØT	027 040 115 048 084	1B 28 73 30 54
	Courier	Ec(s3T	027 040 115 051 084	1B 28 73 33 54
	Helv	Ec(s4T	027 040 115 052 084	1B 28 73 34 54
	Tms Rmn	Ec(s5T	027 040 115 053 084	1B 28 73 35 54
	Letter Gothic	Ec(s6T	027 040 115 054 084	1B 28 73 36 54
	Prestige	Ec(s8T	027 040 115 056 084	1B 28 73 38 54
	Presentations	Ec(s11T	027 040 115 049 049 084	1B 28 73 31 31 54
	Optima	Ec(s17T	027 040 115 049 055 084	1B 28 73 31 37 54
	Garamond	Ec(s18T	027 040 115 049 056 084	1B 28 73 31 38 54
	Cooper Black	Ec(s19T	027 040 115 049 057 084	1B 28 73 31 39 54
	Coronet Bold	Ec(s20T	027 040 115 050 048 084	1B 28 73 32 40 54
	Broadway	Ec(s21T	027 040 115 050 049 084	1B 28 73 32 41 54
	Bauer Bodoni Black Condensed	Ec(s22T	027 040 115 050 050 084	1B 28 73 32 42 54
	Century Schoolbook	Ec(s23T	027 040 115 050 051 084	1B 28 73 32 43 54
	University Roman	Ec(s24T	027 040 115 050 052 084	1B 28 73 32 44 54
		FONT PITCH		
PRIMARY & SECONDARY FONT PITCH (Alternate Method)	10.00 Pitch	Ec&kØS	027 038 107 048 083	1B 26 6B 30 53
	16.66 Pitch	Ec&k2S	027 038 107 050 083	1B 26 6B 32 53
DEFAULT FONT	Primary Font	Ec(3@	027 040 051 064	1B 28 33 40
	Secondary Font	Ec)3@	027 041 051 064	1B 29 33 40
		UNDERLINE		
UNDERLINE	Enable Fixed	Ec&dØD	027 038 100 048 068	1B 26 64 30 44
	Enable Floating	Ec&d3D	027 038 100 051 068	1B 26 64 33 44
	Disable	Ec&d@	027 038 100 064	1B 26 64 40
		FONT MANAGEMENT		
ASSIGN FONT ID	Font ID #	Ec*c#D	027 042 099 #...# 068	1B 2A 63 #...# 44
FONT AND CHARACTER CONTROL	Delete all Fonts	Ec*cØF	027 042 099 048 070	1B 2A 63 30 46
	Delete all Temporary Fonts	Ec*c1F	027 042 099 049 070	1B 2A 63 31 46
	Delete Last Font ID Specified	Ec*c2F	027 042 099 050 070	1B 2A 63 32 46
	Make Font Temp.	Ec*c4F	027 042 099 052 070	1B 2A 63 34 46
	Make Font Perm.	Ec*c5F	027 042 099 053 070	1B 2A 63 35 46
		FONT SELECTION BY ID NUMBER		
SELECT FONT WITH ID #	ID # Primary Font	Ec(#X	027 040 #...# 088	1B 28 #...# 58
	ID # Secondary Font	Ec)#X	027 041 #...# 088	1B 29 #...# 58

Table A-4. Printer Command Table (continued)

FUNCTION	PARAMETER	PRINTER COMMAND	DECIMAL VALUE	HEXADECIMAL VALUE
SOFT FONT CREATION				
CREATE FONT (FONT HEADER)	# of Bytes	Ec)s#W [Data]	027 041 115 #...# 087	1B 29 73 #...# 57
DOWNLOAD CHARACTER	# of Bytes	Ec(s#W [Data]	027 040 115 #...# 087	1B 28 73 #...# 57
CHARACTER CODE	ASCII Code # (Decimal)	Ec*c#E	027 042 099 #...# 069	1B 2A 63 #...# 45
GRAPHICS				
RASTER GRAPHICS				
RESOLUTION	75 Dots/inch	Ec*t75R	027 042 116 055 053 082	1B 2A 74 37 35 52
	100 Dots/inch	Ec*t1ØØR	027 042 116 049 048 048 082	1B 2A 74 31 30 30 52
	150 Dots/inch	Ec*t15ØR	027 042 116 049 053 048 082	1B 2A 74 31 35 30 52
	300 Dots/inch	Ec*t3ØØR	027 042 116 051 048 048 082	1B 2A 74 33 30 30 52
GRAPHICS PRESENTATION				
GRAPHICS PRESENTATION	Rotate LaserJet Landscape	Ec*rØF	027 038 114 048 070	1B 26 72 30 46
	Compatible	Ec*r3F	027 038 114 051 070	1B 26 72 33 46
START GRAPHICS	Left Graphics Margin	Ec*rØA	027 042 114 048 065	1B 2A 72 30 41
	Current Cursor	Ec*r1A	027 042 114 049 065	1B 2A 72 31 41
TRANSFER	# of Rows	Ec*b#W [Data]	027 042 098 #...# 087	1B 2A 62 #...# 57
END GRAPHICS		Ec*rB	027 042 114 066	1B 2A 72 42
RECTANGLE DIMENSIONS				
RECTANGLE WIDTH (Horizontal Size)	# of Dots	Ec*c#A	027 042 099 #...# 065	1B 2A 63 #...# 41
	# of Decipoints	Ec*c#H	027 042 099 #...# 072	1B 2A 63 #...# 48
RECTANGLE HEIGHT (Vertical Size)	# of Dots	Ec*c#B	027 042 099 #...# 066	1B 2A 63 #...# 42
	# of Decipoints	Ec*c#V	027 042 099 #...# 086	1B 2A 63 #...# 56
RECTANGULAR AREA FILL				
FILL RECTANGLE AREA	Rule	Ec*cØP	027 042 099 048 080	1B 2A 63 30 50
	Gray Scale	Ec*c2P	027 042 099 050 080	1B 2A 63 32 50
	HP Pattern	Ec*c3P	027 042 099 051 080	1B 2A 63 33 50
SHAPE	2% Gray	Ec*c2G	027 042 099 050 071	1B 2A 63 32 47
	10% Gray	Ec*c1ØG	027 042 099 049 048 071	1B 2A 63 31 30 47
	15% Gray	Ec*c15G	027 042 099 049 053 071	1B 2A 63 31 35 47
	30% Gray	Ec*c3ØG	027 042 099 051 048 071	1B 2A 63 33 30 47
	45% Gray	Ec*c45G	027 042 099 052 053 071	1B 2A 63 34 35 47
	70% Gray	Ec*c7ØG	027 042 099 055 048 071	1B 2A 63 37 30 47
	90% Gray	Ec*c9ØG	027 042 099 057 048 071	1B 2A 63 39 30 47
	100% Gray	Ec*c1ØØG	027 042 099 049 048 048 071	1B 2A 63 31 30 30 47
PATTERN	1 Horiz. Line	Ec*c1G	027 042 099 049 071	1B 2A 63 31 47
	2 Vert. Lines	Ec*c2G	027 042 099 050 071	1B 2A 63 32 47
	3 Diagonal Lines	Ec*c3G	027 042 099 051 071	1B 2A 63 33 47
	4 Diagonal Lines	Ec*c4G	027 042 099 052 071	1B 2A 63 34 47
	5 Square Grid	Ec*c5G	027 042 099 053 071	1B 2A 63 35 47
	6 Diagonal Grid	Ec*c6G	027 042 099 054 071	1B 2A 63 36 47

Table A-4. Printer Command Table (continued)

FUNCTION	PARAMETER	PRINTER COMMAND	DECIMAL VALUE	HEXADECIMAL VALUE
MACROS				
MACRO ID and CONTROL				
MACRO ID	Macro ID #	Ec&f#Y	027 038 102 #...# 089	1B 26 66 #...# 59
MACRO CONTROL	Start Macro Def.	Ec&fØX	027 038 102 048 088	1B 26 66 30 58
	Stop Macro Def.	Ec&f1X	027 038 102 049 088	1B 26 66 31 58
	Execute Macro	Ec&f2X	027 038 102 050 088	1B 26 66 32 58
	Call Macro	Ec&f3X	027 038 102 051 088	1B 26 66 33 58
	Enable Overlay	Ec&f4X	027 038 102 052 088	1B 26 66 34 58
	Disable Overlay	Ec&f5X	027 038 102 053 088	1B 26 66 35 58
	Delete Macros	Ec&f6X	027 038 102 054 088	1B 26 66 36 58
	Delete All Temp. Macros	Ec&f7X	027 038 102 055 088	1B 26 66 37 58
	Delete Macro ID	Ec&f8X	027 038 102 056 088	1B 26 66 38 58
	Make Temporary	Ec&f9X	027 038 102 057 088	1B 26 66 39 58
	Make Permanent	Ec&f1ØX	027 038 102 049 048 088	1B 26 66 31 30 58
PROGRAMMING AIDS				
DISPLAY FUNCTIONS	ON	EcY	027 089	1B 59
	OFF	EcZ	027 090	1B 5A
TRANSPARENT PRINT DATA	# of Bytes	Ec&p#X [Data]	027 038 112 #...# 088	1B 26 70 #...# 58
END-OF-LINE WRAP				
END-OF-LINE WRAP	Enabled	Ec&sØC	027 038 115 048 067	1B 26 73 30 43
	Disabled	Ec&s1C	027 038 115 049 067	1B 26 73 31 43

The primary font printer commands in this table can be selected as secondary by replacing the left parenthesis "(" in the command with a right parenthesis ")."

B Serial Interface

Contents

Introduction

The **LaserJet 2000** printer supports a serial interface (RS-232C / RS-422) which allows the printer to transfer data in accordance with the RS-232C and RS-422 standard using either a hardware handshake (Data Terminal Ready protocol) or a data stream handshake (Xon/Xoff). The operation and selection of these handshake protocols is described later in this appendix.

Serial Data Format

Transmission is asynchronous, with one start bit, eight data bits and one stop bit. Parity is not used.

Serial Data Communication Throughput

The selected baud rate of the serial interface limits the rate at which data passes through the printer. The **LaserJet 2000** printer supports the following baud rates:

300 600
1200 2400
4800 9600
19,200

The baud rate is configured via the configuration switch (S14) located in the printer (refer to "Serial Configuration Switch Settings", below). The serial interface can keep the printer running at typical text throughput with the baud rate set at 9600 or higher.

Serial Configuration Switch Settings

To set printer operation for serial, turn the printer off, and set rocker switches on switch S12 to OPEN, as shown in Table B-1. Then set switch S14 for the desired serial configuration options shown in Table B-1.

Figure B-1 shows the location of switches S12 and S14.

Table B-1. Serial I/O Configuration Switch (S12 & S14) Settings

SWITCH S12		SWITCH S14	
Rocker #	Function	Rocker #	Function
1	OPEN	1	OPEN
2	OPEN	2,3,4	Used for baud rate selection
3	OPEN		(1= CLOSED and 0= OPEN)
4	OPEN		000 = 300 Baud
5	OPEN		001 = 600 Baud
6	OPEN		010 = 1200 Baud
7	OPEN		011 = 2400 Baud
8	OPEN		100 = 4800 Baud
			101 = 9600 Baud
			110 = 19200 Baud
		5	OPEN
		6	OPEN
		7	OPEN
		8	CLOSED - Normal Polarity DTR handshake
			OPEN - Inverted DTR handshake
		9	DTR handshake enabled if CLOSED
		10	OPEN
		11	CLOSED
		12	Xon/Xoff enabled if CLOSED

Note

Throughout this section the number "1" means "closed" and the number "0" means "open". Open means the rocker switch is down on the side labeled "open".

After selecting the proper rocker switch settings, turn the printer on. Once the printer is on line, take it off line and press the SELF TEST key. The first page of the self test printout lists the I/O configuration along with a representation of the rockers for switches S12 and S14. A "0" means the rocker switch is OPEN and an "1" indicates that the rocker is CLOSED.

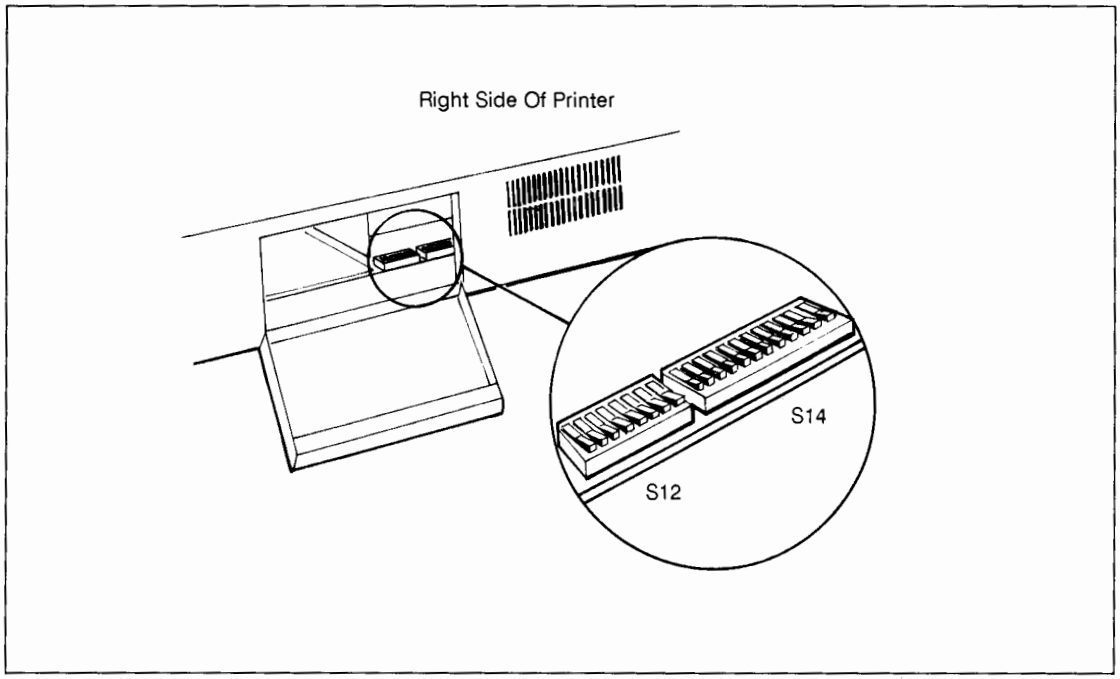


Figure B-1. Configuration Switch Location

RS-232C / RS-422 Operation

The jumper (E12) located on the serial interface is used to select either RS-232C or RS-422 operation. To configure the printer for RS-232C or RS-422 operation place the jumpers as shown in Figure B-2 below.

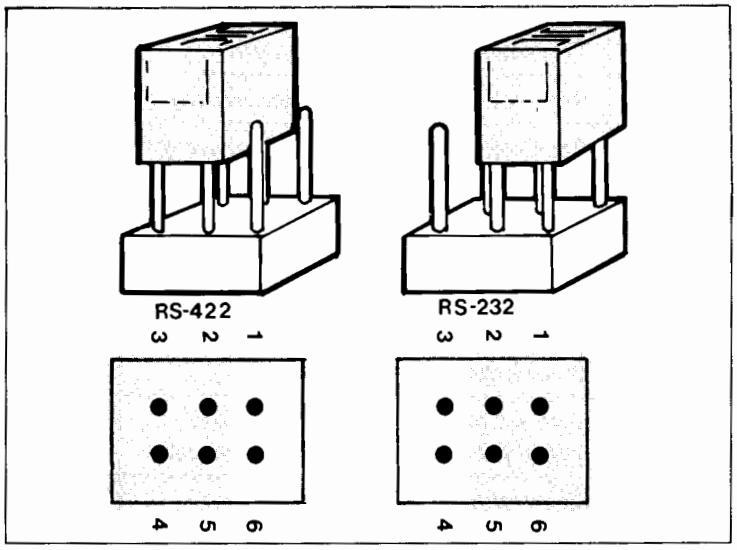


Figure B-2. RS-232 or RS-422 Configuration

The following table lists RS-232C and RS-422 pin assignments and signal descriptions.

Table B-2. RS-232C/-422A Signals; Connector Pin Assignments

Pin Number	Description	232C	422	Printer Signal
1	Protective ground	*	*	-
2	Transmitted data (data from printer)	*		Output
3	Received data (received from printer)	*		Input
	Received data inverted (RDA) (received by printer)		*	Input
4	Request to send. This signal is HIGH when unit is powered on	*		Output
5	Clear to send. This signal is not required for the controller to transmit flow control characters. (DC1/DC3)	*		Input
6	Data set ready. This signal is not required for the controller to receive data	*		Input
7	Signal ground	*	*	
8	NC			
9	Send data inverted (SDA)		*	Output
10	Send data noninverted (SDB)		*	Output
11	NC			
18	Receive data noninverted (RDB)		*	Input
19				
20	Data terminal ready	*		Output
25	NC			

Serial Interface Protocol

Two handshake methods are available for controlling data transfer between the host and the controller: Xon/Xoff and a hardware handshake. (The Data Terminal Ready signal (pin 20) on the RS-232C interface indicates buffer/printer status.)

Xon/Xoff

Xon/Xoff is a data stream handshake protocol. The printer sends Xon (DC1; 11 Hex) when it is able to accept data and sends Xoff (DC3; 13 Hex) when the printer is not ready for data.

The printer will request data, that is transmit an Xon, when the following two conditions exist:

1. The printer's 6 kbyte buffer has less than 512 characters, and
2. When it is placed ON-LINE.

If the printer is ready for data and has transmitted an initial Xon character and does not receive any data, the printer will transmit additional Xon characters every two seconds until data is received.

Xoff characters are transmitted by the printer, to the host system, to indicate that the printer is not ready to accept data. An Xoff is transmitted by the printer when any one of the following conditions exist:

- The printer buffer does not have room for 256 characters or
- The printer is in the OFF-LINE.

If additional characters are received from the host after an initial Xoff is transmitted, then additional Xoff characters will be transmitted after every 16 characters received.

Data Terminal Ready (RS232C - pin 20)

The Data Terminal Ready (DTR - pin 20) signal line is available for hardware handshake. This signal indicates when the printer is ready or is not ready to accept data. When the printer is ready for data, the DTR signal line switches to a HIGH (or LOW if DTR line is set for inverted operation). The printer will request data when the following two conditions exist:

1. When the printer's 6 kbyte buffer has less than 512 characters, and
2. When the printer is ON-LINE.

The DTR signal goes LOW (or HIGH if the DTR line is set for inverted operation) when the printer is not ready to accept data. The printer will not accept data when any of the following conditions exist:

- The printer buffer does not have room for 256 characters or
- The printer is OFF-LINE.

Transitions on the DTR line correspond to the transmissions of Xon (DTR transition to high) and Xoff (DTR transition to low).

Using switch S14-8 it is possible to invert the signal line logic (polarity) so that a LOW indicates a ready for data condition and a HIGH indicates a not ready for data condition.

Hardware

Connector

The RS-232C/RS-422 connector is a 25-pin, D-subminiature female connector.

Cable

The external cable connecting the host CPU to the printer is supplied by the user. The plug required for the user's cable must be a male, 25-pin, D-subminiature connector. The RS-232C interface is designed to work with cables shorter than 15 metres (50 feet). RS-422 is designed to operate with cables up to 1220 metres (4000 feet).

C Centronics Interface

Contents

Introduction

The **LaserJet 2000** printer supports a (Centronics) parallel interface. The interface allows the printer to be operated on systems which use Centronics communication format.

Centronics Configuration Switch Settings

To set the printer operation to Centronics, set the rocker switches for switch S12 as shown in Table C-1, under switch heading "S12". Then set the rocker switches for switch S14 for the desired Centronics configuration options as shown in Table C-1, under switch heading "S14".

Table C-1. Switch S12 and S14 Centronics I/O Configuration Settings

SWITCH S12		SWITCH S14	
Rocker #	Function	Rocker #	Function
1	OPEN	1	OPEN
2	OPEN	2	OPEN
3	OPEN	3	OPEN
4	OPEN	4	OPEN
5	OPEN	5	OPEN
6	OPEN	6	OPEN
7	CLOSED	7	OPEN
8	OPEN	8	OPEN
		9	OPEN
		10	OPEN
		11	OPEN
		12	OPEN

After selecting the proper rocker switch settings, power the ON, take it off-line, and press the SELF TEST key. The first page the self test prints lists the I/O configuration along with a representation of the rockers in switches S12 and S14. A "0" means the rocker is **OPEN** and a "1" means that the rocker is **CLOSED**. Open means the rocker is down on the side labeled OPEN.

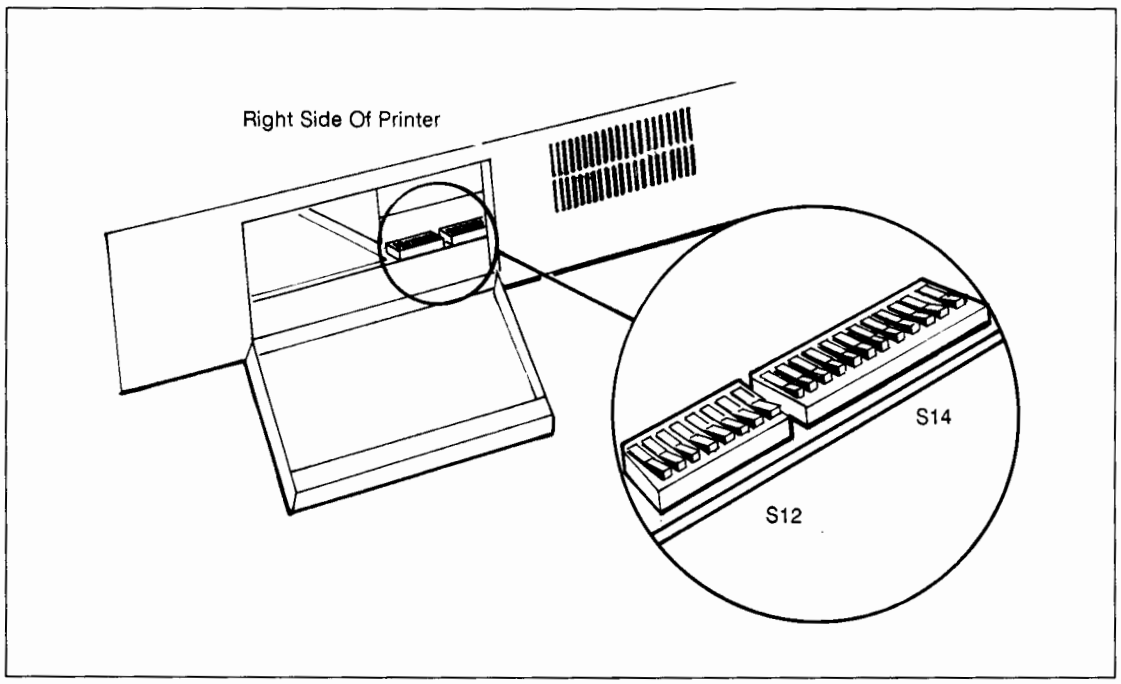


Figure C-1. Configuration Switch Location

Centronics Interface Signals

The signals shown in Table C-2, are described following the section.

Table C-2. Centronics Interface Connector Pin Assignments

Signal	Pin	Pin	Signal
-Strobe (Input)	1	19	Strobe Return (GND)
Data 1 (Input)	2	20	Data 1 (GND)
Data 2 (Input)	3	21	Data 2 (GND)
Data 3 (Input)	4	22	Data 3 (GND)
Data 4 (Input)	5	23	Data 4 (GND)
Data 5 (Input)	6	24	Data 5 (GND)
Data 6 (Input)	7	25	Data 6 (GND)
Data 7 (Input)	8	26	Data 7 (GND)
Data 8 (Input)	9	27	Data 8 (GND)
-Acknlg (Output)	10	28	Acknlg Return(GND)
BUSY (Output)	11	29	BUSY Return (GND)
Paper out (Output)	12	30	Signal GND
Select (Output)	13	31	-Input Prime (Input)
NC	14	32	-Nfault (Output)
NC	15	33	Auxout1 (Output)
O VDC	16	34	NC
Chassis GND	17	35	Auxout2 (Output)
+5 VDC (Output)	18	36	NC

The "-" in front of the signal indicates that the signal is an inverted (NOTed) signal, negative true or active LOW. "GND" means the connection is a ground. "NC" indicates that pin is not connected to anything. Information on the following pages describes the functions of the other pin assignments.

Input Signals

Data Strobe (Pin 1)

This line defines when the information on the data lines is to be accepted by the printer. This line is normally HIGH, and is set LOW when data to be written to the printer is valid. BUSY is set HIGH at the falling edge of this signal. Refer to Figure C-2.

Data Lines (Pins 2-9)

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

Input Prime (Pin 31)

The printer ignores this input signal.

Output Signals

Select line (Pin 13)

This signal indicates that the printer has been placed ON-LINE and that no printer errors or malfunctions exist. The select line is HIGH when the printer is ON-LINE, LOW when the printer is OFF-LINE.

When the printer is changed from OFF-LINE to ON-LINE, this signal changes from the **de-select state** to the **select** state, an -Ack pulse is sent to the host CPU and the BUSY signal is set LOW.

When the printer is changed from ON-LINE to OFF-LINE, this signal changes from the **select** state to the **de-select** state. If the BUSY signal is HIGH when **select** changes, BUSY remains HIGH. If the BUSY signal is LOW when **select** changes, BUSY will change to HIGH to indicate that the printer is no longer ready for data. If no -Ack pulse is generated before **select** changes, no -Ack pulse will be generated until the printer is put back ON-LINE. The host CPU can catch either the momentary not-BUSY signal or an extraneous -Ack pulse and strobe another character into the printer while it is going OFF-LINE. The printer interface can detect and accept this late-coming character without data loss.

If a malfunction occurs in the printer while in the ON-LINE state the printer goes OFF-LINE and this signal changes just as it would for a normal ON-LINE to OFF-LINE transition.

The printer is set to a **select** state at power-on.

Fault line (Pin 32)

-Fault goes LOW when the printer is OFF-LINE or if any malfunction or error occurs in the printer.

BUSY line (Pin 11 & 29)

When BUSY is LOW, the printer can accept another character from the host. BUSY goes HIGH after every HIGH-to-LOW transition of the -Strobe signal. This allows a host CPU to handshake data with the printer using the BUSY signal instead of the -Ack signal. BUSY will stay HIGH (not ready for data) whenever -Fault is LOW and whenever the I/O buffer is full.

Acknowledge line (Pin 10 & 28)

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

Paper error line (Pin 12)

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

O VDC (Pin 16)

Same as logic ground.

Chassis Grounds (Pin 17)

Same as frame ground.

+5 Volts (Pin 18)

This is not +5 VDC directly, but rather it is +5 VDC with a 220 ohm in-line resistor. This signal is not intended to provide power to any external devices; it is provided only to be compatible with host CPU's that may test this pin for a logic HIGH before attempting data transfers.

Auxout1 (Pin 33)

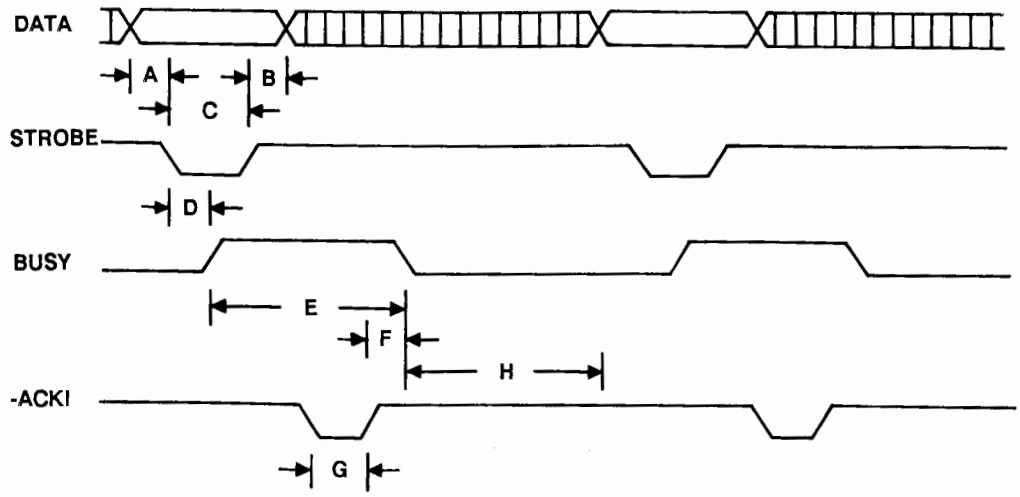
This signal is always HIGH while the printer is powered on.

Auxout2 (Pin 35)

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

Handshake Timing

The critical timing specifications for Centronics plug-compatible interfaces are described in the following figure.



Timing Specification Description	minimum value	typical value	maximum value
A: Data set-up time before -Strobe on	0.5 usec.	-	-
B: Data hold time after -Strobe off	0.5 usec.	-	-
C: -Strobe-on pulse width	1.0 usec.	-	500 usec.
D: -Strobe-on to Busy-on	0.0 usec.	-	1.0 usec.
E: Busy-on duration (printer-ON-LINE)	10.0 usec.	* 143 usec. **2.0 msec.	10sec.
F: -Ack-off to Busy-off	0.0 usec.	2.5 usec.	
G: -Ack-on pulse width	2.5 usec.	-	10 usec.
H: Busy-Off to start of next cycle	0.0 usec.		

*Image and font download data **Text data

Figure C-2. Centronics Handshake Timing

Hardware

The connector and cabling hardware requirements are described below. Descriptions of the input (receiver) and output (driver) circuits are also described briefly.

Connector

The receptacle installed in the printer is the Amphenol 850-57FE-403600-20 36-pin connector, or equivalent.

Cable

The external cable connecting the host CPU to the printer is supplied by the user. The plug required for the user's cable must be compatible with the Amphenol 57-30360 36-pin connector.

The Centronics interface is designed to work with cables shorter than ten feet.

Line Driver Circuitry

Each output signal from the printer (-Ack, Busy, Paper Error, Select, Auxout1, Auxout2, and -Fault) is driven onto the interface cable line with an SN7407 (or equivalent) open-collector buffer with an output pull-up resistor between 1K and 3.3K ohms to +5 VDC. The -Ack and Busy signals have a "return" line associated with them; this is simply logic ground

Line Receiver Circuitry

Each Data input signal to the printer is received off the interface cable with an SN74LS241 (or equivalent) buffer with hysteresis with an input pull-up 1K ohm resistor to +5 VDC. The "return" signal associated with each data line is simply logic ground.

The Strobe input signal to the printer is received off the interface cable with an SN74LS14 buffer with hyteresis with an input pull-up 680 ohm resistor to +5 VDC and a 33pF capacitor to ground. The "return" signal associated with the Strobe line is simply logic ground. The "return" signal associated with the Strobe line is simply logic ground.

D Dataproducts Interface

Contents

Introduction

The **LaserJet 2000** supports two Dataproducts (parallel) interfaces: a short-lines version (HP26843C) and a long-lines version (HP26843D). These interfaces allow the printer to be operated on systems using Dataproducts communication configurations.

Dataproducts I/O Configuration Switch Selection

To set the printer to operate with the HP26843C (short-lines) or HP 26843D (long-lines) Dataproducts Interface, set the rocker switches on switch S12 as shown in Table D-1; then select the desired Dataproducts options on switch S14, also shown in Table D-1.

Figure D-1 shows the location of swtiches S12 and S14 in the printer.

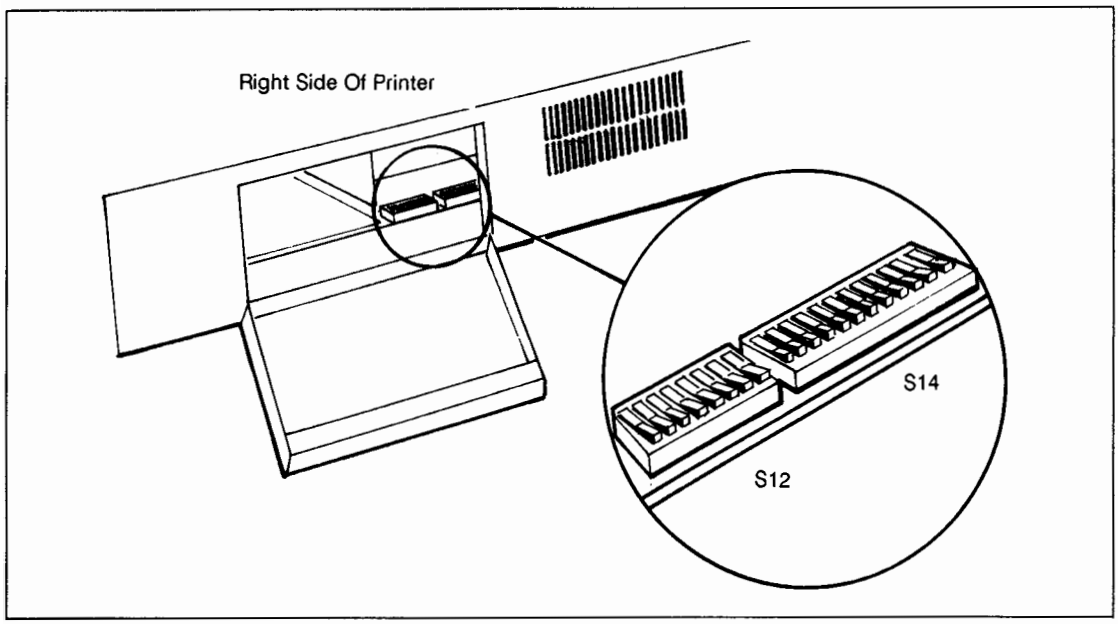


Figure D-1. Configuration Switch Location

The Dataproducts short line and long line interfaces use the same configuration for switches S12 and S14. A host computer with a Long Line driver (up to 500 feet) can not drive a printer with a Short Line interface, and a host computer with a Short Line interface (up to 50 feet) can not drive a printer with a Long Line interface.

After selecting the proper rocker switch settings, turn the printer ON, wait until it is ready, take printer offline then press the SELF TEST key. The first page that the self test prints will list the I/O configuration along with a representation of the rockers in switches S12 and S14. A "0" means the rocker is OPEN and "1" indicates that the rocker is CLOSED. Open means the rocker is down on the side labeled OPEN.

Table D-1. Dataproducts Switch Configuration

SSWITCH S12		SWITCH S14	
Rocker #	Function	Rocker #	Function
1	OPEN	1	Used with rocker 8 of S12 to set record limiting
2	OPEN	2,3,4	Demand to check delay (usually set to 001)
3	OPEN		Set rockers 2 and 3 OPEN, set rocker 4 CLOSED
4	OPEN	5	Enable Hex dump mode if CLOSED
5	OPEN	6	OPEN
6	OPEN	7	Auto CARRIAGE RETURN after FORM FEED if CLOSED
7	OPEN	8	Auto CARRIAGE RETURN after LINE FEED if CLOSED
8	Record	9	Auto LINE FEED after CARRIAGE RETURN if CLOSED
	Limiting	10	Parity check disabled if CLOSED
	(See S14-1)		Parity check enabled if OPEN
		11	Use PI for 8th data bit if OPEN
			Use D8 for 8th data bit if CLOSED
		12	Enable the PI line to the printer if OPEN
			Ignore the PI line if CLOSED

Rocker 8 of S12 and rocker 1 of S14 are used, together, for record limiting, as follows:

S12-8	S14-1		SELECTION
0	0	=	No limiting (normal setting)
0	1	=	1 record per buffer
1	0	=	2 records per buffer
1	1	=	4 records per buffer

D8, PI, and Parity ENABLE/DISABLE MODES

The standard Dataproducts interface has historically been a seven bit interface. As the need for eight bit interfaces developed over the years, the industry has solved the eighth bit problem using two different solutions. Use of the paper instruction line (PI) has fallen off over the years, so some interfaces have reallocated PI to carry the eighth data bit. If parity is used on these interfaces, the PI line is also used in the parity check just as D1 through D7 are. Some interfaces do not use PI for the eighth data bit, rather they have allocated an additional line as D8. With the additional D8, PI can still be used for paper instruction if it is needed, but even when PI is available, not all interfaces use it. The use of PI is gradually becoming obsolete. Rocker 12 of switch S14 will pass PI to the printer if the switch is open. Rocker 11 of switch S14 is used to determine the use of the PI line. It will be used for D8 if the rocker is open, or it will be used as PI if the rocker is closed. If rocker 11 of switch S14 is closed, then the eighth data bit is taken from D8.

Systems that use the PI bit MUST have it available to do any printing at all. However, systems that do not use the PI bit MUST turn it off.

Newer systems need the eighth data bit for graphics and font downloads. They MUST leave this bit enabled to get full access to those features. Older systems do not have an eighth data bit and will leave it floating so that it may be ON or OFF. If the host is configured to send only 7 bit data transmissions and normal text, a floating eighth bit will cause the printer to print spaces for each of the characters with the 8th bit set. Random or unpredictable voltage fluxuations on the unused 8th bit may cause the value of the bit to float on and off. If a system is incapable of 8 bit data transmission and must use 7 bit data transmission, not all of the LaserJet 2000 features will be accessable, and the eighth bit must be disabled to prevent unexpected character disappearance.

When parity is enabled, a check is done on all 8 data lines regardless of the choice between D8 and PI for the eighth data bit. Parity check is not available for seven bit data transmission.

End-of-Record Sequence Compensation

This feature was added to take care of what may be the most common problem to be encountered during installation.

Line printers DO NOT print received data until the entire line of data has been received. The problem is that a variety of methods have evolved to indicate that the end of the line (or record) has been reached. The Dataproducts interface in the LaserJet 2000 has been designed to handle them all.

The oldest method of indicating end-of-record (EOR) with Dataproducts interfaces is to send down a "print command", i.e., a byte of data with the PI bit set high. The PI bit indicates that the data is not a character but rather an EOR and that the previously received data is to now be printed, and the paper to be moved. Exactly how the paper is to be moved is detailed in the byte of data received with the PI bit. If the customer is using this method, the PI bit must be enabled, and rocker 12 on DIP switch S14 set closed. No EOR compensation needs to be done.

If the user has a relatively new system, the PI command concept may have been abandoned. Instead, the newer systems tend to use some combination of CR/LF. On some systems, the convention has been adopted to use only CR or only LF. They did this because they wanted to be able to indicate EOR with a single byte, as they were able to with the PI command.

The Hewlett-Packard Printer Command Language (PCL) will not produce usable printout if the user sends records terminated only by CR or only by LF. The CR only moves the cursor to the left margin. If the system is sending only CR's at the end-of-record, nothing will ever print. If the system is sending only LF's at the end-of-record, everything will print on the same line. The Printer Command Language (PCL) formatter in the LASERJET 2000 interprets CR and LF literally, and for normal operation, each line must be terminated with both a CR and LF.

With the Dataproducts interface installed, rockers 6, 7, 8, and 9 of switch S14 allows the printer to be attached to any system that terminates lines with a single byte. For example, if the host is only terminating lines with LF, by setting rocker 8 of S14 to the closed position, the interface will insert a CR after each LF that is received while printing text. Hence, the printer can be immediately attached to such systems without modifying the host operating system.

DEMAND-ON to Check-For-Character Delay

This configuration setting is one of the most esoteric features provided. Only if much slower than expected print speeds or if the HP printer is suspected of causing undue overhead on the host system should these rockers be set at any value other than 001.

The symptoms of the problem, which can only be viewed with a logic timing analyzer such as the HP-1615A, are that the interface will raise the DEMAND signal and check immediately if a character has been strobed in. If it checks BEFORE the host cpu has a chance to strobe the byte in, the program in the printer interface suspends the "read data" section of its code and branches to "background" tasks. Only after some delay does it come back and check again for a strobed-in byte. This adds about 180 extra microseconds between strobed-in bytes.

By using rockers 2 through 4 of S14, the user can cause the interface to insert a delay between raising DEMAND and checking for the character. This will keep the printer from suspending the read operation after every byte.

Again, the problem cannot be viewed without the aid of a timing analyzer, and the precise setting of the timing cannot be determined without an analyzer. When the minimum setting of the byte is reached, the time between DEMAND pulses will suddenly decrease by about 180 microseconds.

HEX Dump Mode

This rocker allows the user to set the printer into a special print mode that can be extremely handy in debugging system problems of all kinds. In particular, end-of-record sequences can be determined so that the configuration switch settings can be resolved.

The hex-dump feature prints out the data, 20 bytes per line. No data will print until 20 bytes have been received, but there are no restrictions on what that data has to be; i.e., no end-of-record needs to be received to cause printing. Each print line displays the data received by the printer in two formats; on the right, the ASCII representations of the data are printed, including all control characters. If print commands are being used, a lower-case "p" appears before the hex representation of the data bytes that have the PI bit set. If parity is enabled, a lower case "e" appears before error and a lower case "b" occurs after the byte if a buffer clear was received prior to the byte. The hardware detection and reporting of parity

errors is independent of hex-dump mode, so the CPU will still get parity error reports if errors occur.

Incomplete end-of-record sequences will also be printed out. This will allow the CE or the customer to determine exactly what bits in configuration byte 23 need to be set to allow normal printing. For example, if the user is sending only line feeds, the ASCII portion of the Hex mode dump will show the user's text separated only by line feeds. The CE or customer will then know that they need to have the interface insert carriage returns after feeds, by setting rocker 8 of S14 to closed.

Records-per-Buffer Limiting

This is another configuration byte that will be useful during many system installations.

Many older Dataproducts printer drivers were written to detect when the printer was failing. One of the ways this was accomplished was for the programmer to set timers after each command it sent to the printer. If the timer expires before response from the printer is received, the driver assumes the printer is defective. The values of these timers were derived from the characteristics of the printers that they had on hand at the time.

One major timeout is the time after a character has been strobed into the printer until the printer "demands" another character. The design of the DP interfaces can sometimes cause this timeout to be triggered, if the default configuration settings are used. The interface will buffer up as many lines as it can, and not demand another character until the printer has printed ALL of them. This can lead to delays between characters that stretch out for ten or twenty seconds, or even more.

The symptoms of this problem are fairly easily detected: the user will start up a print job, and everything looks like it is working just fine. The printer begins to print at full speed. After one or two pages have printed, it stops dead in its tracks and the console of the host CPU is flashing a message like "PRINTER NOT READY" or "DEVICE TIMEOUT" or something similar.

To identify what to do, use the HEX Dump mode first. Put the printer into HEX mode and let at least half a page of text print. Check the printout to determine if the system is using PRINT COMMANDs to terminate lines, or CR/LF.

If print commands are being used, set rocker 1 of S14 to closed.

Leave rocker 8 of S12 open.

This tells the interface to only store one print line in it's internal buffer before sending it on to be printed.

If the software is using CR/LF to terminate lines, rocker 8 of S12 should be set to closed. Leave rocker 1 of S14 open. This lets the interface store two print lines before sending it off to be printed. This is necessary as the first CR is interpreted to be the end of one line, and the LF is considered the end of a second line. Erratic print speed would result if the interface only buffered up one line at a time.

Connector Requirements

The Dataproducts Interface connector is an Amphenol 117-DD-50S-U 50-pin D-Subminiature (female) connector, or equivalent. (Cable used for making cables should be shielded.)

The wiring connections used for the connector are shown Table D-2.

Table D-2. Cable Connector Signal Connections

PIN	SIGNAL	PIN	SIGNAL
1	- DATA BIT 3	26	
2	- D3 RTN	27	- PARITY ERROR
3	- D1 RTN	28	- DATA BIT 8
4	- D2 RTN	29	- PARITY
5	- ON LINE RTN	30	- PAPER INSTRUCTION
6	- READY RTN	31	-/BUFFER CLEAR
7	- DEMAND RTN	32	
8		33	
9		34	- DATA BIT 5
10		35	- D7 RTN
11	- PARITY ERROR RTN	36	- DATA BIT 7
12	-	37	- STROBE RTN
13	- PARITY RTN	38	- STROBE
14	- PI RTN	39	- SIGNAL GROUND
15	- BUFFER CLEAR RTN	40	- D4 RETURN
16		41	- DATA BIT 4
17		42	- D6 RETURN
18	- D5 RTN	43	- DATA BIT 6
19	- DATA BIT 1	44	
20	- DATA BIT 2	45	- INTERFACE VERIFY
21	- ON-LINE	46	- INTERFACE CONNECT
22	- READY	47	
23	- DEMAND	48	- DATA BIT 8
24		49	
25		50	

Note - "D1 RTN" is the return signal line for "DATA BIT 1".
- Unlabeled pins are not used.
- "/" indicates that the signal line is active low.

Data Handshake

The timing specifications for the Dataproducts Interface are shown in Figure D-2 and the handshake signals are described below. (The handshake signals are active high.)

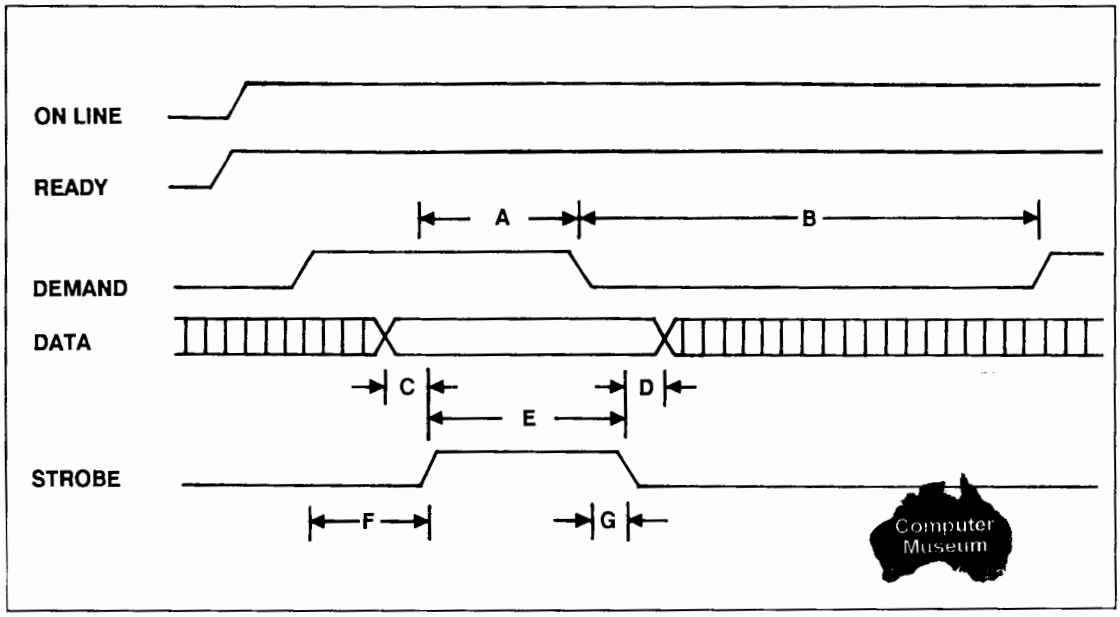
DEMAND (Output Signal)

When the DEMAND signal, originated in the interface, goes true it indicates that the interface can accept another data byte from the system. This signal is used, along with the STROBE signal, to synchronize data transmission from the host system to the printer.

If the printer is taken off-line by the operator, DEMAND will not go true following the receipt of an end-of-line character until the printer has been put back on line. (Note DEMAND will never be true when the printer is off-line.)

STROBE (Input Signal)

The STROBE signal, originated by the host system, is used by the printer interface to latch the data into the interface input latches.



REF.	TIMING SPEC.	COMMENTS
A	50 nsec. typ.	* STROBE ON to DEMAND OFF
B	(1)95 usec. typ.	* DEMAND OFF to next DEMAND ON
	(2)55 usec. typ.	(Printer ON-LINE)
C	50 nsec. min.	** Data setup-time before STROBE ON
D	0 nsec. min.	** Data hold-time after STROBE OFF
E	15 nsec. min.	** STROBE pulse width
F	0 nsec. min	** DEMAND ON to STROBE ON
G	Don't Care	* DEMAND OFF to STROBE OFF

* - Function of the interface ** - Function of system
(1) Text data; no escape sequences or CR/LF/VT/FF
(2) Raster download data

Figure D-2. Dataproducts Handshake Timing Requirements

Input Signal Lines

The input signal lines to the printer (except for the STROBE line which was described earlier, under "Data Handshake") are described below.

Data Lines

There are eight data lines (D1-D8) used for character transfer from the host CPU to the printer. Data line 1 (D1) is the least-significant bit of the ASCII character.

The standard Dataproducts interface format only defines seven data lines, some newer systems have included the eighth bit. This interface is compatible with both seven or eight bit systems.

These data bits are normally positive-true, however the user can redefine (configure) the data lines for negative-true operation.

PAPER INSTRUCTION Signal Line

The PAPER INSTRUCTION signal line identifies whether the information on the data lines (D1-D8) is data or is a paper instruction command. When this signal is false the information on the data lines is data to be printed; when this signal is true the information on the data lines is a print command. Print commands tell the printer to either print its line buffer and slew a specific number of lines or to print its line buffer.

PARITY Signal Line

When parity operation is enabled the parity line is used to maintain an odd parity for the data lines and PI line.

This line is also used conjunction with the ERROR status line and the BUFFER CLEAR signal line. If parity checking is enabled and an error is detected, the ERROR line will be asserted. After the printer asserts the ERROR line, the system will assert the BUFFER CLEAR line. The BUFFER CLEAR line causes the printer to discard all the data received after the last (error-free) record. Data handshaking will continue until the BUFFER CLEAR line is asserted, which clears the error state.

This line can also be configured for use as the 8th data line.

BUFFER CLEAR Signal Line

The BUFFER CLEAR signal line, when asserted, causes the interface to discard all data received since the last end-of-record (assuming a parity error was detected in the current record). (An end-or-record can be a Paper Instruction command, carriage-return line feed, form feed, or any Hewlett-Packard escape sequence).

Status

The interface status consists of three signal lines: ON-LINE, READY, and the ERROR signal lines. These lines provide interface status signals to the host system as described below.

ON-LINE

The ON-LINE signal indicates when the printer has been placed on-line from the Operator Control Panel. If the interface is receiving data from the system when the operator takes the printer off-line, the status of the ON-LINE signal will not change until an end-of-record has been received. If the system stops sending data to the interface after sending an end-of-record (for example, at the end of a job), and the operator takes the printer off-line via the front panel, the ON-LINE signal will not go false until approximately six seconds have passed after receiving the end-of-record (also refer to Section D-6, On-to-Off Line Transition Conditions for additional information).

READY

The READY signal will be true if the printer is not out of paper and has not detected a self-test error. The READY signal will not go low when the printer goes offline unless there is a paper out condition or a self-test error has occured.

The READY signal will not change from true to false until an end-of-record has been received.

ERROR Signal Line

This signal indicates that a parity error was detected in a received data byte. Once the signal is line is set it will not be cleared until a Buffer Clear signal is received from the system.

Glossary

Auto-Continue Auto-Continue mode can be configured using the **LaserJet 2000** printer control panel (refer to the *LaserJet 2000 Operator's Manual*).

Baud Rate Baud rate is the rate at which information is transferred between the computer and the printer. To communicate properly, the computer and the printer must both be configured to the same baud rate.

Centronics I/O An industry standard parallel input/output (I/O) interface.

Column The width of a column is defined by the current horizontal motion index (HMI).

Configuration Configuration is the process of changing certain printer settings to allow a computer to communicate properly with the printer. For example, interface selection is part of printer configuration. The printer is configured using the control panel configuration menu.

Control Code A control code is a type of PCL command. A control code is a character that initiates a printer function, for example CR, LF and FF.

Control Panel The combination of keys, LEDs, and a display that allow an operator to communicate with a device and allow the device to communicate with an operator.

Current Active Position See Cursor.

Cursor Although the printer does not actually have a cursor, the cursor position refers to the currently active printing position (like the blinking underline character used on most computer terminals). The cursor can be moved anywhere within the logical page using a combination of horizontal and vertical cursor positioning commands and control codes.

Decipoint A decipoint is a unit of measurement that equals $1/720^{th}$ of an inch.

Default A value used in lieu of a programmatically selected value. A factory default is a value programmed into the device at the factory; this value is stored in read-only memory (ROM) and cannot be changed by a user or operator. A user default is a default that is selectable via the control panel.

Dot The dot is the smallest printable unit. On **LaserJet 2000** printer, one dot equals $1/300^{th}$ inch. The number of dots printed per inch is referred to as the printer's resolution.

Download The process of transferring soft fonts, macros, or raster data from a host computer to the printer's user memory is called downloading.

DTR Polarity The configuration of DTR polarity determines whether pin 20, on the serial interface connector, is high or low when the printer is ready. If DTR polarity is HI, pin 20 is high when the printer is ready. If DTR polarity is LO, pin 20 is low when the printer is ready.

Escape Character The first character of a PCL escape sequence, identified by the "$^{E}_{C}$" symbol, (ASCII decimal code 27). This character is a control code used specifically by the printer to identify a string of characters as a printer command. As the printer monitors incoming data from a computer, it is "looking" for this character. When this character appears, the printer reads it and its associated characters as a command to be performed and not as data to be printed.

Escape Sequence PCL escape sequences consist of two or more characters. The first character is always the escape character, identified by "$^{E}_{C}$" symbol. This character is a control code used specifically by the printer to identify a string of characters as a printer command. As the printer monitors incoming data from a computer, it is "looking" for this character. When this character appears, the printer reads it and its associated characters as a command to be performed and not as data to be printed.

Factory Default Factory default's refer to the settings that are programmed into the printer at the factory. These settings are in use unless you override them using either the control panel or by sending printer commands.

Factory Default Environment A factory default is a setting programmed into the printer at the factory. The group of all the printer's factory settings is referred to as the factory default environment. The factory default symbol set is selectable from the control panel configuration menu (refer to the *LaserJet 2000 Operator's Manual*).

Font A font is a set of characters that have similar characteristics. A font has an assigned name, typeface, and is further described by its spacing, height, pitch, style, stroke weight, symbol set, and orientation. For example, the name of the font used for this text is TmsRmn; its height is 10 point, its style is upright, and its stroke weight is medium.

Font Cartridge A removable media containing multiple fonts. When a cartridge is plugged into the slot in the printer provided for this purpose, the printer has access to the fonts contained in the cartridge.

Height The height of a font is the measurement of the body of the type in points. A PCL point is $1/72^{nd}$ inch. The body of the type is slightly greater than the distance from the bottom of a descender to the top of an unaccented capital letter.

Horizontal Motion Index (HMI) HMI defines the distance between columns in $1/120^{th}$ inch increments. When fixed pitch fonts are selected all printable characters including the space and backspace characters are affected by HMI. When proportional fonts are selected, the HMI affects only the control code space character.

HMI is defaulted when font orientation, symbol set, pitch, spacing or height is specified and when switching between primary and secondary fonts with shift in and shift out.

The default HMI is equal to the pitch value in the font header. The factory default font's HMI is 12 (which is 12/120 = 1/10 inch per character or 10 characters per inch.)

I/O I/O is an acronym for input/output (I/O) and is used in this document when referring to hardware used to interface printers with computers.

I/O Buffer The area within the device's internal random access memory where PCL commands and data are stored.

Interface Connector The **LaserJet 2000** printer comes with two interface connectors, serial and parallel, located on the lower part of the back panel. The cable that attaches the computer to the printer is connected here.

Internal Fonts Internal fonts are the fonts resident in the printer when shipped.

ISO Symbol Set 128 symbol sets containing European versions of the Roman alphabet (e.g., ISO-German contains umlaut vowels, ISO-French contains e accent grave, etc.) based on the standards produced by the International Standards Organization (ISO).

Landscape See Orientation.

Logical Page The PCL logical page (also referred to as the addressable area) defines the area in which the cursor can be positioned. Although the printer does not actually have a cursor (like the blinking underline character used on most computer terminals), the cursor position refers to the currently active printing position. In other words, the location of the "cursor" is the position on the logical page where the next character will be positioned. You can move the cursor to different points on the logical page using the cursor positioning commands; however, the cursor cannot be moved outside of the logical page bounds.

Macro A macro is a collection of escape sequences, control codes, and data downloaded to the printer, whose execution can be initiated using a single command.

Menu A list of configurable items. In the nomenclature of this document, an "item" is one particular configurable entity (that is, Copies); a "value" is an "item's" particular configuration (that is, Copies = 10).

Modified Print Environment The current printer feature settings constitute the modified print environment. Whenever a feature setting is altered using escape sequences, the new setting is recorded in the modified print environment.

Non-volatile RAM Random Access Memory whose contents are preserved following a power failure (volatile RAM is memory whose contents are not preserved when the device is powered off). Non-volatile RAM is generally used to preserve configured (vs. programmed) device state information.

Off-line/On-line On-line is a condition when the printer will accept data from the host computer. When the is on-line, the ON LINE lamp is lit. When off-line, the printer will not accept data from the host.

Orientation The orientation of characters on a page; if the print is across the width of the page, it is "portrait-oriented"; if the print is across the length of the page, it is "landscape-oriented". Orientation is a PCL font attribute; portrait-oriented fonts are not printable in landscape orientation and vice versa.

Overlay Environment The overlay environment consists of the current settings for the following features with the remainder of the environmental features set to their user default values: Page length Paper source Page size Number of copies Orientation Cursor position stack

Parallel I/O An input/output interface that transmits more than one bit of information simultaneously. Centronics is an industry-wide standard form of a parallel interface.

PCL Commands PCL commands provide access to printer features. Once a PCL command sets a parameter, that parameter remains set until the same PCL command is repeated with a new value or the printer is reset. There are three types of PCL commands: control codes, two-character escape sequences, and parameterized escape sequences.

A control code is a character that initiates a printer function, for example CR, LF, and FF.

PCL escape sequences consist of two or more characters. The first character is always the escape character, identified by the "^{E}C" symbol. This character is a control code used specifically by the printer to identify a string of characters as a printer command. As the printer monitors incoming data from a computer, it is "looking" for this character. When this character appears, the printer reads it and its associated characters as a command to be performed and not as data to be printed. (Note, PCL printer commands are also referred to as escape sequences.)

PCL Coordinate System Units The units of the X-axis of the PCL coordinate system may be dots, decipoints, or columns. The units of the Y-axis may be dots, decipoints, or rows.

Perforation Region The perforation region is the distance from the bottom of the text area to the top of the text area of the next page. When perforation skip is enabled a line feed or half line feed that would move the cursor beyond the bottom of the text area, moves the cursor to the top of the text area on the next page. When perforation skip is disabled, a line feed or half line feed moves to the next line or half line within the perforation region.

Permanent Image An image (font, macro, etc.) can be designated "permanent" via a PCL escape sequence. A "permanent" image is not cleared from internal memory as a result of either an ^{E}cE or an operator control reset whereas a "temporary" one is cleared by either of the aforementioned operations. Both "permanent" and "temporary" images are cleared from internal memory by a power failure.

Pitch Pitch describes the number of characters printed in a horizontal inch. Pitch only applies to fixed-spaced fonts since the number of characters per inch varies for proportionally-spaced fonts.

Point A PCL point is a unit of measurement that equals $1/72^{nd}$ inch. Font height is measured in points.

Primary (Secondary) Font A PCL convention whereby two fonts can be defined internally simultaneously; the primary font is accessed via the control code "SI" and the secondary font is accessed via the control code "SO." The factory default state is primary font designated.

Printable Area The printable area is the area of the physical page in which the printer is able to place a dot. The physical page refers to the size of the media installed in the printer.

The relationship between physical page, logical page and printable area, is defined in Figures 2-2 and 2-3.

Portrait See Orientation.

Print Environment The group of all the printer's current feature settings, collectively, is referred to as the print environment. The printer maintains four print environments: the factory default environment, the user default environment, the modified print environment and the overlay environment.

Printer Commands See PCL Commands.

Raster Graphics Images composed of groups of dots are raster images. Pictures in newspapers or on televisions are examples of raster images. PCL includes commands for printing raster images.

Row The distance between rows is defined by the current vertical motion index (VMI).

Rule A solid-filled rectangular area.

Serial I/O An input/output (I/O) interface that transmits information bit-by-bit. RS-232 is an industry-wide standard form of a serial interface.

Soft Font Soft fonts are fonts stored on floppy discs. These fonts can be transferred to the printer's memory and used the same way as cartridge or resident fonts.

Spacing Fonts have either fixed or proportional spacing. Fixed-spaced fonts are those for which the inter-character spacing is constant. Proportionally-spaced fonts are those for which the inter-character spacing varies with the natural shape of a character.

Stroke Weight Stroke weight describes the thickness of the strokes that compose characters. Medium and bold are examples of stroke weights.

Style Font style is defined by and angularity of the strokes of the characters with respect to the X-axis. Upright and italics are examples of font styles.

Symbol Set A symbol set is a unique ordering of the characters in a font. Each symbol set is defined with a unique set of applications in mind. Symbol sets are created for many purposes, for example the PC-8 (IBM-US) symbol set was designed to support US IBM-PC applications.

Typeface Typeface is a generic name for graphics symbols having common design features. Each typeface has unique and distinguishing characteristics.

User Default A user default is a default that is selectable via the operator control panel. User defaults may be selected for the following items via the LaserJet 2000 control panel: (1) number of copies, (2) orientation, (3) primary and secondary font, and (4) vertical form length (i.e., VMI).

User Default Environment The User Default Environment consists of the user default settings (any user default settings selected from the control panel) with the remainder of the environment features set to their factory default values.

Vertical Motion Index (VMI) VMI defines the distance between rows in $1/48^{th}$ inch increments. This command affects the line feed and half line feed spacing.

The factory default VMI is eight which corresponds to six lines per inch. A user default VMI can be selected from the control panel using the FORM LENGTH menu item.

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