

2 Printer-Specific Differences

Introduction

Each Hewlett-Packard printer implements minor variations of PCL 5 in order to best suit its intended use. This chapter describes specific differences that are important when developing applications for the various PCL 5 printers. The sections in this chapter describe such information as new commands not contained in the *PCL 5 Printer Language Technical Reference Manual*, and other miscellaneous differences in PCL operation particular to that printer.

HP LaserJet III and IIID Printers

With the introduction of the HP LaserJet III printer, Hewlett-Packard introduced the PCL 5 printer language. The PCL 5 printer language incorporated many new features over the PCL 4 language. A few of the more significant features included such things as the addition of a scalable font technology, HP-GL/2 vector graphics language support, print model features, raster graphics enhancements, and the Print Direction command.

The HP LaserJet IIID printer language support is basically identical to the HP LaserJet III printer except for the addition of the duplex feature, dual input bin, envelope feeder support and their associated commands (see Table 1-1).

HP LaserJet IIISi Printer

Several new PCL features were added to the PCL 5 language with the release of the HP LaserJet IIISi printer. These new features are summarized in Table 2-1 below.

Table 2-1. PCL Feature Additions for HP LaserJet IIISi Printer

Feature	Status	Comments
Number of Copies	Modified	Greater range, 1 to 32,767.
Page Size	Modified	C5 Envelopes not supported.
Output Bin Selection Command	New	Allows programmatic selection of upper or lower output paper bins.
End Raster Graphics Command	New/Modified	Modified version of the existing End Raster Graphics command.
Job Separation	New Command	Causes the paper stacker to shift positions to offset the output paper stack.
Fonts	New Additions	Four variations of Univers Condensed; ITC Zapf Dingbats in five symbol sets.

HP LaserJet IIIP Printer

Several new PCL features were added to the PCL 5 language with the release of the HP LaserJet IIIP printer. These new features are summarized in Table 2-2. One new feature listed here is adaptive compression (method 5) for the Raster Compression Mode command. In addition to compressing data for transmission, if certain rules are followed (discussed below), the HP LaserJet IIIP printer will store adaptive compressed data in compressed format and only decompress it when required for printing. There are certain requirements which must be met for this data to be stored in compressed format. These requirements are discussed following Table 2-2.

Table 2-2. HP LaserJet IIIP PCL Feature Additions

Feature/Command	Status	Comments
Set Compression Method	Modified	Adds Adaptive Compression method to the Set Compression Method command.
End Raster Graphics Command	Modified	Modified version of the End Raster Graphics command.
User-defined Patterns	New	Enables users to define and download their own user-defined pattern.
User-defined Pattern Command	New Feature	Used to download the binary data for user-defined pattern.
Set Pattern Reference Point Command	New	Sets pattern reference point.
Pattern Control Command	New	Used to make user-defined patterns permanent or temporary, or to delete them.
Select Pattern & Fill Rectangular Area Commands	Modified	Adds a parameter to support user-defined patterns.
Pattern ID Command	Modified	In addition to selecting internal patterns, this command is now used to assign an ID to a user-defined pattern as well as to select patterns. Also, parameter range is extended from 100 to 32,767.
User-defined Symbol Sets	New Feature	Enables user to build a symbol set which contains user-selected characters.
Define Symbol Set Command	New	Identifies the characters for a user-defined symbol set.
Symbol Set ID Code Command	New	Assigns a number for identification to the user-defined symbol set.
Symbol Set Control Command	New	Used to make user-defined symbol sets permanent or temporary, or to delete them.
Unbound Scalable Fonts	New Feature	Allows typefaces (unbound fonts), not just fonts (bound fonts) to be downloaded to the printer.
Unbound Scalable Font Descriptor	New	Addition of a new header used for unbound fonts (font type 10).

Raster Graphics Adaptive Compression (IIIP)

Adaptive compression was added to the PCL language with the introduction of the HP LaserJet IIIP printer. Adaptive compression (or method 5 as it is referred to) is a method for compressing raster data using the raster Set Compression Method command (parameter value 5). (Refer to the Set Compression Method command in the *PCL 5 Printer Language Technical Reference* manual for detailed information on using this compression technique.) Also, refer to Chapter 5 in this document, “Raster Graphics Adaptive Compression (Method 5)” for additional information.

HP LaserJet 4 Printer

Several new PCL features were added to the PCL 5 language with the release of the HP LaserJet 4 printer. These new features are summarized in Table 2-3. Most of these features are described in the revised *PCL 5 Printer Language Technical Reference Manual* (part number 5961-0509). (This revised technical reference manual is supplied as part of the *Technical Reference Documentation Package* which can be obtained by ordering part number 5961-0601.) In addition, there are some additional differences for the HP LaserJet 4 printer that are not covered in the technical reference manual but are described below.

Note

The HP LaserJet 4M printer, in addition to PCL, contains PostScript and a LocalTalk I/O for printing in the Macintosh environment. PCL operation and the PCL internal fonts for this printer are identical to the HP LaserJet 4 printer. Thus, for PCL information for the HP LaserJet 4M printer, refer to the HP LaserJet 4 printer features.

Table 2-3. PCL Feature Additions for HP LaserJet 4

Feature/Command	Support	Comments
Adaptive Compression System	New	Adaptive compression system enables the printer to compress internal raster data when memory becomes low. This operation occurs automatically; there are no PCL commands for this feature (refer to Chapter 5 for ADC information).
Configuration Command	New	Allows PCL jobs to be printed (using LocalTalk or EtherTalk MIO) using AppleTalk protocol.
Number of Copies	Modified	Supports 1-32,767 copies as does the HP LaserJet III Si printer.
Units of Measure Command	New	Allows selection of the units of measure for cursor moves, drawing rules, and for character spacing (font metrics).
Page Size	Modified	A parameter value is added for B5 envelope size; the HP LaserJet 4 printer supports the four standard paper sizes and five envelope sizes.
Bitmap Font Support	New Header	Printer will expand 300 dpi bitmap fonts to 600 dpi. A new 300/600 dpi bitmap font descriptor has been added to allow bitmap fonts to be created that work at either 1/300 or 1/600 inch printer resolution.
Scalable Font Support	New Header	A new Universal header has been added to allow design of typefaces of different scaling technologies to be supported by one header. This header is used to support TrueType on the HP LaserJet 4 printer. (This header will be used to support any other new scaling technologies HP may add in the future).
TrueType	New	TrueType scaling technology support has been added to the printer.
Internal Typefaces	New	Several new Intellifont and TrueType internal typefaces (and supporting symbol sets) are now provided in the printer.
Raster Resolution Command	Modified	Parameter values have been added to support raster resolutions of 200 dpi and 600 dpi.
User-defined Pattern	New Header	A new 300/600 dpi user-defined pattern header has been added to support patterns that work at either 1/300 or 1/600 inch printer resolution.
Continued on next page.		

Table 2-3. PCL Feature Additions for HP LaserJet 4 (continued)

Feature/Command	Support	Comments
Status Readback	New Feature	The addition of 6 new status readback commands enable the user to receive certain information back from the printer about fonts, symbol sets, macros, user-defined patterns, and available memory.
Location Type Command	New	Used to specify a status readback type of location (current, all, internal, downloaded, cartridge, SIMMs).
Location Unit Command	New	Specifies a status readback location unit (all, temporary or permanent, highest-lowest priority, specific SIMM).
Inquire Entity Command	New	Requests the status from the location (type and unit) specified for fonts, symbol sets, macros, or user-defined patterns.
Flush All Pages Command	New	Allows the user to clear page data from printer memory.
Free Memory Command	New	This command returns the current available memory.
Echo Command	New	Allows the user to send a unique ID number to the printer to be used as a "place holder."
Bezier Curve Commands	New	HP-GL/2 commands (relative and absolute) that allow a user to draw complex curves with less data required than that required for arcs.
Label Origin	Modified	Label position LO 21 is provided for correct alignment of HP-GL/2 text with PCL text.
Fill Polygon	Modified	Previously, the HP-GL/2 Fill Polygon command filled polygons using the odd/even fill technique. A second technique, non-zero winding fill, has been added.
Macros	Modified	HP-GL/2 is now supported in macros.
Configuration Command	New	Added to allow the user to communicate with the MIO card in the printer.

Configuration Command (AppleTalk)

The Configuration command allows a user to send PCL jobs to the printer over AppleTalk. This data is sent in the form of “key/value” data pairs (refer to “AppleTalk Configuration” below for more information).

ESC**C**#W [key]<sp>[value]

= Number of data bytes that follow command

Default = 0

Range = 0 - 32767

[key] can be 1 character through 32765 characters.

[value] can be 1 character through 32765 characters.

AppleTalk Configuration

The HP LaserJet 4 printer can be configured to receive PCL print jobs over an AppleTalk connection using the Configuration command. The HP LaserJet 4 MIO AppleTalk interfaces support three key values: **RENAME**, **JOB**, and **TYPE**. These keys are used for configuring an installed LocalTalk or EtherTalk MIO card to allow PCL print jobs generated by a Macintosh host to be printed.

Note

PostScript in the HP LaserJet 4 printer supports the PostScript level 1 operators *setprintername*, *AppleTalktype*, and *jobname*, and the PostScript level 2 *setdevparams* operator to allow PostScript print jobs to change the Name Binding Protocol (NBP) printer name and printer type, as well as change the print job name.

MIO sub-system in the printer accepts a new NBP printer name, NBP printer type, and job name from either the PCL or PostScript personalities. The printer passes that information across the MIO interface to the installed MIO card which indicated support for the MIO AppleTalk extensions. The MIO sub-system will treat the PCL NBP type and the PostScript NBP type separately.

For information about AppleTalk Name Binding Protocol refer to *Inside AppleTalk* published by Addison Wesley Company, Inc.

RENAME

RENAME changes the printer name portion of the printer's AppleTalk Name Binding Protocol name field.

ESC & b # W R E N A M E < s p > p r i n t e r n a m e

Valid characters for the printer name include 0-255 except for characters \$00, "@" (\$40), "." (\$3A), "*" (\$2A), "=" (\$3D), and \$C5. The printername must contain at least one character, and only the first 31 characters are used. If an invalid character (\$00 is not treated as an invalid character) is contained in the printername, the printer will ignore the escape sequence. If the printer encounters the NULL (\$00) character, the printer uses the NULL character to terminate the printer name. All the characters preceding the NULL will be used. If another device on the AppleTalk network uses the same printer name, another character is added to the end of the printer name.

The default printername is the printer model (for example, "HP LaserJet 4").

JOB

JOB renames the current job name.

ESC &b#WJOB<sp>jobname

All characters are valid. For the job name the first 127 characters are used.

There is no default jobname.

TYPE

TYPE changes the type (device type) portion of the printer's AppleTalk Name Binding Protocol type field.

ESC &b#WTYPE<sp>devicetype

Valid characters for the device type include 0-255 except for characters \$00, "@" (\$40), "." (\$3A), "*" (\$2A), "=" (\$3D), and \$C5. The devicetype must contain at least one character, and only the first 31 characters are used. If an invalid character (\$00 is not treated as an invalid character) is contained in the devicetype, the printer will ignore the escape sequence. If the printer encounters the NULL (\$00) character in the devicetype, it uses the NULL character to terminate the device type. All the characters preceding the NULL will be used as the devicetype. If the device type is invalid then the printer's type is not changed.

The default device type for PCL is "HP LaserJet 4" and for PostScript is "LaserWriter".

HP LaserJet 4Si Printer

The HP LaserJet 4Si printer is the follow-on to the HP LaserJet IIISi printer. The HP LaserJet 4Si printer contains many new PCL features over the HP LaserJet IIISi. PCL support for the HP LaserJet 4Si printer is identical to the HP LaserJet 4 printer except for the addition of the duplex feature, dual output bin (see Table 1-1) and resource saving.

Like the HP LaserJet IIISi printer, the HP LaserJet 4Si supports the HP LaserJet IIISi features listed in Table 2-1 with two exceptions. First, is that the HP LaserJet 4Si does not support ITC Zapf Dingbats. Font support for the HP LaserJet 4Si is identical to the HP LaserJet 4 printer (refer to Chapter 3, "Internal Typefaces/Fonts and Symbol Sets," for complete font support information). The other exception concerns job separation. The PCL Job Separation command is not supported. The HP LaserJet 4Si printer handles job separation through the control panel. If a PCL Job Separation command is received by the printer it will be ignored. Refer to the *HP LaserJet 4Si User's Manual* (part number C2010-90901) for additional information.

Resource saving, a new feature in the HP LaserJet 4Si printer, allows saving information for the current language (PCL or PostScript) when switching to the other language. If resource saving is enabled (from the control panel or PJL; no PCL commands are required for this operation), all the permanent fonts, macros, and user-defined patterns plus some other miscellaneous data is saved in a reserved portion of printer memory. This data is stored until the language is enabled again. When the language is re-enabled, the stored data will be made available for use.

HP LaserJet 4L Printer

The HP LaserJet 4L printer is a smaller, low-cost HP LaserJet printer. The control panel on this printer is limited to one button with four indicators. Many of the control panel functions must be controlled programmatically using Hewlett-Packard's Printer Job Language (refer to the *Printer Job Language Technical Reference Manual*, part number 5021-0380 for detailed PJP information).

The HP LaserJet 4L printer PCL command features are identical to those of the HP LaserJet 4 printer PCL features, except for some differences in parameter values (such as for paper source—refer to Table 1-1). Additional features which do not require PCL command control include EconoMode and HP Memory Enhancement technology (MEt). EconoMode causes the printer to print less dots, thus saving toner. Memory Enhancement technology involves some memory saving techniques to better utilize available memory (refer to Chapter 5, "Memory Usage" for additional information).

Typefaces in the HP LaserJet 4L printer are different from those of the HP LaserJet 4 printer. The HP LaserJet 4 printer contains both Intellifont and TrueType scaling technologies, but the 4L contains only Intellifont scaling technology. Thus, the 4L does not contain any of the TrueType typefaces, with one modification. The TrueType Wingdings typeface has been converted to Intellifont format and is available in the printer as an Intellifont typeface (refer to Chapter 3, "Internal Typefaces/Fonts and Symbol Sets" for additional information). The Line Printer bitmap font is not present on the HP LaserJet 4L printer.

HP LaserJet 4ML Printer

The HP LaserJet 4ML printer is similar to the HP LaserJet 4L printer, however, the 4ML includes PostScript and a LocalTalk I/O for printing in the Macintosh environment. The HP LaserJet 4ML printer also includes some new PCL features: print model logical operation (ROP3) and pixel placement, as described on the following pages.

The HP LaserJet 4ML supports the typefaces that the HP LaserJet 4 printer supports. Several of the typefaces in the HP LaserJet 4ML printer have additional support for the Latin 2 and Latin 5 symbol sets (refer to Chapter 3, "Internal Typefaces/Fonts and Symbol Sets," for complete font support information). The Line Printer bitmap font is not present on the HP LaserJet 4L printer.

Table 2-4. PCL Feature Additions for HP LaserJet 4ML

Feature	Status	Comments
Paper (Job) Size Command	Modified	An additional parameter (101) has been added to provide support for custom size.
Logical Operations	New	Modifies the print model to allow logical operations (such as AND, OR, XOR, NOT) to be performed on source, texture, and destination.
Pixel Placement (PCL)	New	Allows user to select either grid intersection or grid centered placement of pixels when rendering an image in PCL.
Pixel Placement (HP-GL/2)	New	Allows user to select either grid intersection or grid centered placement of pixels when rendering an image in HP-GL/2.
Merge Control	New	Allows the user to use logical operations (ROP's) in HP-GL/2.

Logical Operations

With the introduction of the HP LaserJet 4ML printer the print model was expanded to include logical operations.

The basic print model defines how a pattern, source image, and destination image are applied to each other using the print model's transparent and opaque modes to produce a resulting image (refer to the *PCL 5 Printer Language Technical Reference Manual* for detailed information about the basic print model operation). The Logical Operations ($E_c^*l\#O$) command can apply logical functions (e.g., AND, OR, XOR, NOT) to any of these operands except transparency, which must be specified first.

The print model process consists of the following steps:

- 1 Specify source and/or pattern transparency modes, if desired.
- 2 Specify the logical operation (or use the default).
- 3 Define the desired operands (source, destination, pattern).

Definitions

Source: The source image may be one of the following:

- HP-GL/2 primitives
- Rules
- Characters
- Raster images (single plane mask or multiplane color)

Destination: The destination image contains whatever is currently defined on the page. It includes any images placed through previous operations.

Pattern or Texture: The pattern is defined by Current Pattern ($E_c^*v\#T$). The terms pattern and texture are used interchangeably in this section.

Transparency Modes: The white pixels of the source and/or pattern may be made transparent (source transparency 0, pattern transparency 0). The destination shows through these areas.

Transparency modes are set by the Source Transparency ($E_c^*v\#N$) and Pattern Transparency ($E_c^*v\#O$) commands (refer to the *PCL 5 Printer Language Technical Reference Manual*).

The print model allows logical operations, such as AND, OR, XOR, NOT, to be performed on source, texture, and destination images. Transparency modes and Logical Operation must be specified before printable data is sent.

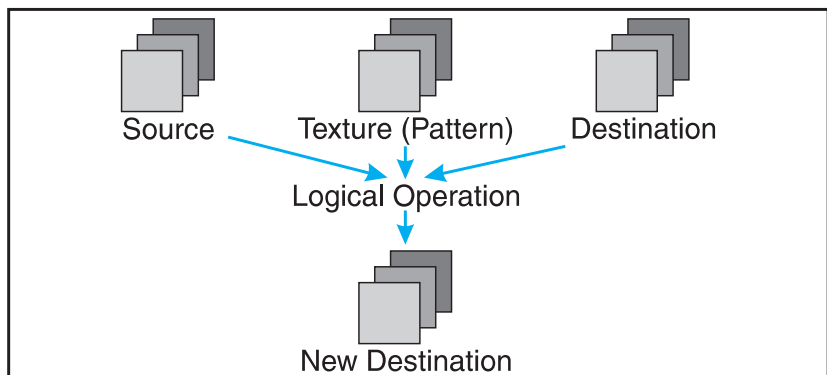
Operators

- Source Transparency (specified before logical operation; default is transparent)
- Pattern Transparency (specified before logical operation; default is transparent)
- Logical Operators (default is Texture OR Source)

Operands

- Source objects: character cell, raster image, rule, HP-GL/2 vectors and polygons
- Texture: pattern mask
- Destination: current page definition

Assuming three bits per pixel, the following diagram shows the print model process.



Note

The Logical Operation command ($E_c * \ell \#O$) provides 255 possible logical operations. All of these logic operations map directly to their ROP3 (raster operation) counterparts (see the Microsoft Document, Reference, Volume 2, Chapter 11, Binary and Ternary Raster Operation Codes).

The logical operations were defined by Microsoft Windows for an RGB color space (a "1" is white and a "0" is black).

Logical Operations and Transparency Interactions

As described above, transparency modes operate in addition to logical operations. The logical operations in Table 2-5, Logical Operations (ROP3), on the following pages, are true only if source and pattern transparency (for white pixels) are explicitly set to opaque ($E_C * v1N$ and $E_C * v1O$). If source and/or pattern transparency modes are transparent (defaulted), the additional operations shown on the following page must be performed to achieve the final result.

The four basic interactions are:

- **Case 1:** Source and Pattern are opaque.

Return ROP3 (Dest, Src, Texture).

- **Case 2:** Source is opaque, Pattern is transparent.

Temporary_ROP3 = ROP3 (Dest, Src, Texture).

Image_A = Temporary_ROP3, & Not Src.

Image_B = Temporary_ROP3 & Pattern.

Image_C = Not Pattern & Src & Dest.

Return Image_A | Image_B | Image_C

- **Case 3:** Source is transparent, Pattern is opaque.

Temporary_ROP3 = ROP3 (Dest, Src, Texture).

Image_A = Temporary_ROP3 & Src.

Image_B = Dest & Not Src.

Return Image_A | Image_B

- **Case 4:** Source and Pattern are transparent

Temporary_ROP3 = ROP3 (Dest, Src, Texture).

Image_A = Temporary_ROP3 & Src & Pattern.

Image_B = Dest & Not Src.

Image_C = Dest & Not Pattern.

Return Image_A | Image_B | Image_C.

Logical Operation Command

Specifies the logical operation to be performed in RGB color space on the destination, source and texture to produce new destination data.

$E_C * l \# O$

= Logical operation value (see Table 2-6)

Default = 252 (TSo)

Range = 0 to 255

Note

When source and/or pattern transparency modes are set opaque (not defaulted), values specified by this command map directly to the ROP3 (raster operation) table values on the following page. However, when source and/or pattern transparency modes are set transparent, the additional operations shown on the previous page must be performed to achieve the final result.

Logical operations in the table are shown in RPN (reverse polish notation). For example, the value 225 corresponds to TDSoxn, the logical function of

NOT (texture XOR (source OR destination))

Note

This command is the PCL Version of the HP-GL/2 MC command.

This command sets the ROP value which affects not only PCL operation but also the HP-GL/2 ROP value.

Example:

The Logical Operation default value is 252 (TSO), corresponding to a logical function of:

(texture | source)

The result is computed below for both case 1 (source and pattern opaque) and case 4 (source and pattern transparent) on the previous page. Note that the ROP3 value of 252 results only with case 1, when both source and pattern transparency modes are set to opaque.

Table 2-5. Logical Operation (ROP3)

	Bits							
	7	6	5	4	3	2	1	0
Texture	1	1	1	1	0	0	0	0
Source	1	1	0	0	1	1	0	0
Destination	1	0	1	0	1	0	1	0
ROP3 (source & pattern are opaque)	1	1	1	1	1	1	0	0
	(decimal 252)							
ROP3 Transparencies (source & pattern are transparent)	1	1	1	0	1	0	1	0

Each column of destination, source, and texture values are the input to the logical function. The result, 252, is the value that would be sent to identify the logical operation (source and pattern transparency modes are opaque). The last row, “ROP3 + Transparencies (source & pattern are transparent)” shows the result if source and pattern transparency modes are transparent (the default transparency mode).

Table of Logical Operations

Table 2-6, Logical Operations (ROP3), shows the mapping between input values and their logical operations. Note that the logical operations are specified as RPN (reverse polish notation) equations. Here is a key to describe what the Boolean Function values mean;

S = Source	a = AND
T = Texture	o = OR
D = Destination	n = NOT
	x = EXCLUSIVE OR

Note

Since logical operations are interpreted in RGB space (white = 1 and black = 0) rather than in CMY space (white = 0 and black = 1), the results may not be intuitive. For example, ORing a white object with a black object in RGB space yields a white object. This is the same as ANDing the two objects in CMY space. It must be remembered that the printer operates in something similar to a CMY space and inverts the bits and reverses the order.

Table 2-6. Logical Operations (ROP3)

Input Value	Boolean Function	Input Value	Boolean Function
0	0	27	SDTSxaxn
1	DTSon	28	TSDTaox
2	DTSona	29	DSTDxaxn
3	TSon	30	TDSox
4	SDTona	31	TDSon
5	DTon	32	DTSnaa
6	TDSxnon	33	SDTxon
7	TDSaon	34	DSna
8	SDTnaa	35	STDnaon
9	TDSxon	36	STxDSxa
10	DTna	37	TDSTanaxn
11	TSDnaon	38	SDTSaox
12	STna	39	SDTSxnox
13	TDSnaon	40	DTSxa
14	TDSonon	41	TSDTSaoxxn
15	Tn	42	DTSana
16	TDSona	43	SSTxTDxaxn
17	DSon	44	STDSoax
18	SDTxnon	45	TSDnox
19	SDTaon	46	TSDTxox
20	DTSxnon	47	TSDnoan
21	DTSaon	48	TSna
22	TSDTSanaxx	49	SDTnaon
23	SSTxDSxaxn	50	SDTSoox
24	STxTDxa	51	Sn
25	SDTSanaxn	52	STDSoax
26	TDSTaox	53	STDTSxnox

Table 2-6. Logical Operations (ROP3) continued

Input Value	Boolean Function	Input Value	Boolean Function
54	SDTox	81	DSTnaon
55	SDToan	82	DTSDaox
56	TSDToax	83	STDSxaxn
57	STDnox	84	DTSonon
58	STDSxox	85	Dn
59	STDnoan	86	DTSox
60	TSx	87	DTSoan
61	STDSonox	88	TDSToax
62	STDSnaox	89	DTSnnox
63	TSan	90	DTx
64	TSDnaa	91	DTSDonox
65	DTSox	92	DTSDxox
66	SDxTDxa	93	DTSnnoan
67	STDSanaxn	94	DTSDnaox
68	SDna	95	DTan
69	DTSnnaon	96	TDSxa
70	DSTDaox	97	DSTDSoaxxn
71	TSDTxaxn	98	DSTDdoax
72	SDTxa	99	SDTnox
73	TDSTDaoxxn	100	SDTSoax
74	DTSDdoax	101	DSTnox
75	TDSnox	102	DSx
76	SDTana	103	SDTSonox
77	SSTxDSsoxxn	104	DSTDSoaxxn
78	TDSTxox	105	TDSxxn
79	TDSnoan	106	DTSox
80	TDna	107	TSDTSoaxxn

Table 2-6. Logical Operations (ROP3) continued

Input Value	Boolean Function	Input Value	Boolean Function
108	SDTax	135	TDSaxn
109	TDSTDoaxxn	136	DSa
110	SDTSnoax	137	SDTSnaoxn
111	TDSxnan	138	DSTnoa
112	TDSana	139	DSTDxoxn
113	SSDxTDxaxn	140	SDTnoa
114	SDTSxox	141	SDTSxoxn
115	SDTnoan	142	SSDxTDxax
116	DSTDxox	143	TDSanan
117	DSTnoan	144	TDSxna
118	SDTSnaox	145	SDTSnaoxn
119	DSan	146	DTSDToaxx
120	TDSax	147	STDaxn
121	DSTDSoaxxn	148	TSDTSoaxx
122	DTSDnoax	149	DTsaxn
123	SDTxnan	150	DTsxx
124	STDSnoax	151	TSDTSonoxx
125	DTsxnax	152	SDTSonoxn
126	STxDSxo	153	DSxn
127	DTSaax	154	DTSoaxn
128	DTSaa	155	SDTSoaxn
129	STxDSxon	156	STDnax
130	DTsxnax	157	DSTDoxaxn
131	STDSnoaxn	158	DSTDSoaxx
132	SDTxna	159	TDSxan
133	TDSTnoaxn	160	DTa
134	DSTDSoaxx	161	TDSTnaoxn

Table 2-6. Logical Operations (ROP3) continued

Input Value	Boolean Function	Input Value	Boolean Function
162	DTSnoa	189	SDxTDxan
163	DTSDxoxn	190	DTSxo
164	TDSTonoxn	191	DTSano
165	TDxn	192	TSa
166	DSTnax	193	STDSnaoxn
167	TDSToaxn	194	STDSonoxn
168	DTSoa	195	TSxn
169	DTSoxn	196	STDnoa
170	D	197	STDSxoxn
171	DTSono	198	SDTnax
172	STDSxax	199	TSDToaxn
173	DTSDaoxn	200	SDToa
174	DSTnao	201	STDoxn
175	DTno	202	DTSDxax
176	TDSnoa	203	STDSaoxn
177	TDSTxoxn	204	S
178	SSTxDSxox	205	SDTono
179	SDTanan	206	SDTnao
180	TSDnax	207	STno
181	DTSDoaxn	208	TSDnoa
182	DTSDTaoox	209	TSDTxoxn
183	SDTxan	210	TDSnax
184	TSDTxax	211	STDSoaxn
185	DSTDaoxn	212	SSTxTDxax
186	DTSnao	213	DTSanan
187	DSno	214	TSDTSoaoxx
188	STDSanax	215	DTsxn

Table 2-6. Logical Operations (ROP3) continued

Input Value	Boolean Function	Input Value	Boolean Function
216	TDSTxax	236	SDTao
217	SDTSaoxn	237	SDTxno
218	DTSDanax	238	DSao
219	STxDSxan	239	SDTnoo
220	STDnao	240	T
221	SDno	241	TDSono
222	SDTxo	242	TDSnao
223	SDTano	243	TSno
224	TDSoa	244	TSDnao
225	TDSoxn	245	TDno
226	DSTDxax	246	TDSxo
227	TSDTaoxn	247	TDSano
228	SDTSxax	248	TDSao
229	TDSTaoxn	249	TDSxno
230	SDTSanax	250	DTo
231	STxTDxan	251	DTSnoo
232	SSTxDSxax	252	TSo
233	DSTDSanaxxn	253	TSDnoo
234	DTSao	254	DTSoo
235	DTSxno	255	1

Pixel Placement Command

This command determines how pixels are rendered in images.

$\text{E}_C^* \ell \# R$

- # = 0 - Grid intersection
- 1 - Grid centered

Default = 0

Range = 0, 1 (command is ignored for other values)

Two models are used for rendering pixels when an image is placed on paper:

- Grid Intersection Model
- Grid Centered Model

This command can be invoked multiple times during a page. It has no effect except to switch the model being used for imaging.

Note

The PCL Pixel Placement command determines how pixels are placed for both PCL and HP-GL/2 operation.

The example shown in Figure 2-1 illustrates the concepts of the two models. Assume a rectangle extends from coordinate position (1,1) to position (3,4). As shown below, each model produces a different result. (Since PCL printers print only at intersections, grid centered pixel placement is implemented as shown on the right.)

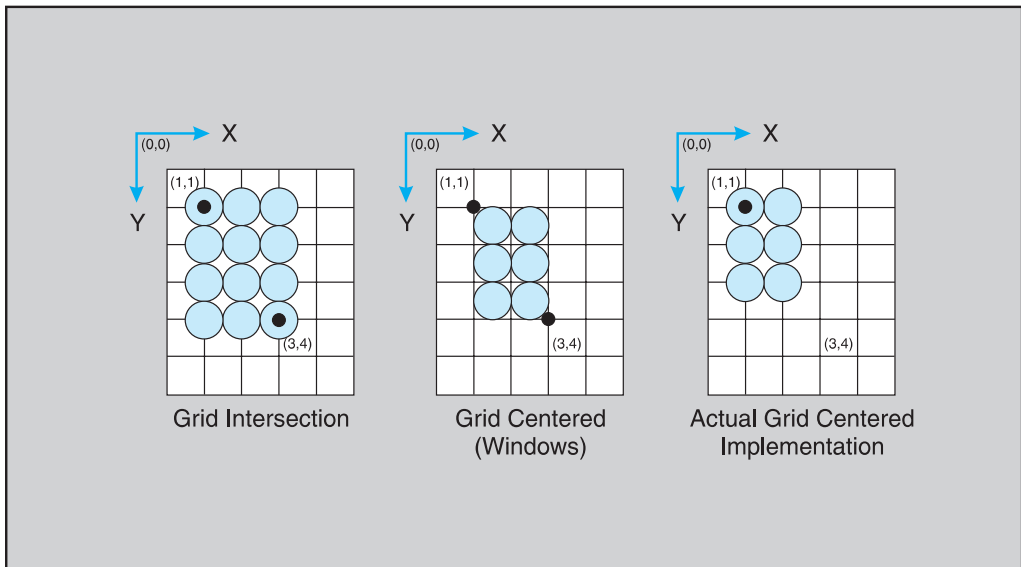


Figure 2-1 Pixel Placement

The grid centered model produces a rectangle that is one dot row thinner and one dot row shorter than the grid intersection model. The grid intersection model is the PCL default.

Note

The grid centered method is used by Microsoft Windows.

Placement Variations

PCL and HP-GL/2 (see following pages for HP-GL/2 pixel placement command description) provide two pixel placement modes: grid intersection (the default) and grid centered. Grid intersection places pixels on the intersections of the grid (see Figure 2-2). Grid centered places pixels in the center of the grid. In Figure 2-2, a rectangle extends from position (1,1) to (3,4). The grid centered model produces a rectangle one dot thinner and one dot shorter than the grid intersection model.

When rectangular area fills are used and grid intersection is used, an overlapping of pixels can occur if rectangular area fills are placed adjacent to one another (as shown below). Depending on the raster operation presently in effect, this overlap can produce undesirable results in the final printed image. To avoid this problem, use the grid centered method.

Note

Since PCL printers print only at intersections, grid centered is implemented as shown on the right.

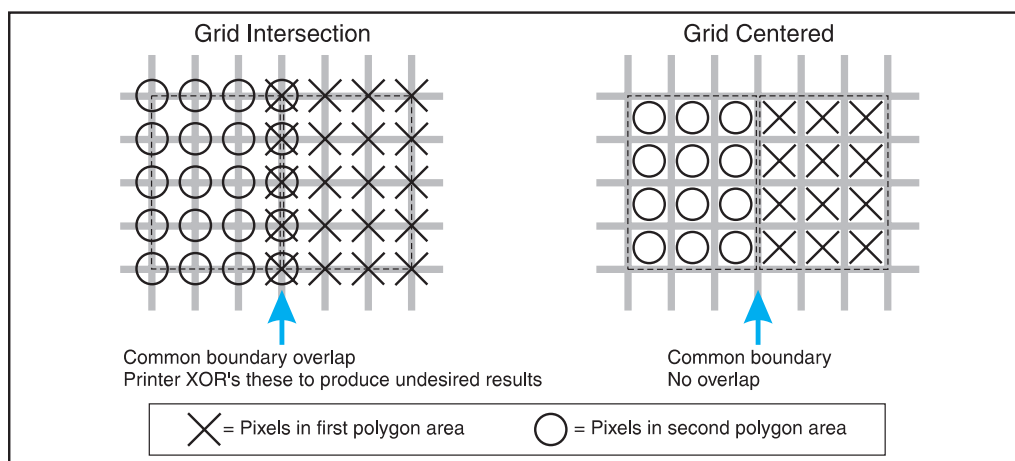


Figure 2-2 Pixel Placement Variations

Pixel Placement Command (HP-GL/2)

The Pixel Placement (PP) command controls how pixels are placed on the layout grid during polygon fills. Two pixel placement modes are grid intersection or grid centered.

PP [mode] ;

Pixel Placement Command (HP-GL/2)

Parameter	Format	Functional Range	Default
mode	clamped integer	0 or 1	0 (grid intersection)

mode

0 = grid intersection; device draws pixels centered at grid intersections (see Figure 2-1).

1 = grid centered; device draws pixels centered inside the boxes created by the grid (see Figure 2-1).

The command is the HP-GL/2 version of the PCL Pixel Placement command. Whatever mode is selected, using the HP-GL/2 PP command also applies to PCL operation. Likewise the PCL Pixel Placement command also affects HP-GL/2 pixel placement.

Note

Microsoft Windows fills polygons based on grid centered method.

This command determines how pixels will be placed for both HP-GL/2 and PCL operation.

The PP command is not defaulted by an IN command.

Merge Control Command (HP-GL/2)

The Merge Control (MC) command specifies the raster operation (ROP's) to be performed in HP-GL/2. Raster Operations specify how source, destination, and patterns are combined to produce final images. This command supports all 256 Microsoft Windows ternary (ROP3) raster-operation codes.

MC [mode, [opcode]] ;

Merge Control Command (HP-GL/2)

Parameter	Format	Functional Range	Default
mode	clamped integer	0 or 1	0 (ROP 252)
opcode	clamped integer	0...255 ¹	168, 252

¹ For opcode ROP values refer to Table 2-6, Logical Operation.

mode

0 = opcode value is ignored; printer sets ROP to 252.

1 = opcode value is used as the ROP value. If no opcode value is sent, printer sets ROP to 168. If opcode is out of range (some value other than 0-255), the command is ignored and the default ROP of 252 is used. (For example: **MC1,60**; **MC1,60-**; **MC1,+60**; **MC1,60+**; all set the ROP to 60; however, **MC1,-60**; or **MC1,300**; set the ROP to the default value (252).

Note

This command is the HP-GL/2 version of the PCL Logical Operation command.

This command sets a ROP value which affects not only HP-GL/2 operation but also the PCL ROP value.

The MC command is defaulted by an IN command.

Note

When using the MC command, some pattern types will not produce the expected ROP result. This only occurs when using the FT (Fill Type) command pattern types 1, 2, 3, and 4, and the ROP includes an XOR operation. (This problem is due to the fact that these patterns are the result of a vector operation and do not produce raster data for use by a ROP operation.) All other Fill Type command patterns (types, 10, 11, 21, or 22) operate as expected.

opcode

The operation code (opcode) specifies the logical operations that are performed on a source, destination, and patterned image prior to drawing the final image. The opcodes are created by listing all possible combinations of a single pattern, source and destination pixel, and constructing the desired final pixel values. The following table shows three common opcodes (also see Table 2-6).

Table 2-3. Common Opcodes

Pixel Combinations			Desired Destination Values		
Pattern Pixel	Source Pixel	Destination Pixel	Source Overwrite	Transparency (TR command)	Source Destination
0	0	0	0	0	0
0	0	1	0	1	1
0	1	0	1	1	1
0	1	1	1	1	0
1	0	0	0	0	0
1	0	1	0	1	1
1	1	0	1	1	1
1	1	1	1	1	0
Resulting Opcode			204 (0xCC)	238 (0xEE)	102 (0x66)

HP LaserJet 4P and 4MP Printers

The HP LaserJet 4P printer is the follow-on to the HP LaserJet IIIP printer. The HP LaserJet 4MP printer is the multi-platform (PostScript) version of the 4P printer. PCL operation and the internal fonts in these two printers are identical to that of the HP LaserJet 4ML printer. The 4P and 4MP printers have a control panel unlike the 4L and 4ML printers. Refer to Table 1-1, PCL Feature Support Matrix, for the commands these printers support and to Chapter 3, “Internal Typefaces/Fonts and Symbol Sets,” for font support information.

HP LaserJet 4PJ Printer

The HP LaserJet 4PJ printer is a modified version of the HP LaserJet 4P printer designed specifically for the Japanese market. The enhanced PCL 5 printer language in this printer includes all of the PCL 5 features of the HP LaserJet 4P, plus special features which specifically support the Asian printing market. These features include large font support, support for vertical printing, and the ESC/P printer language. Table 2-8 lists the PCL feature additions for this printer.

Table 2-4. PCL Feature Additions for HP LaserJet 4PJ

Feature	Status	Comments
Text Parsing Method Command	New	Provides a method for specifying character codes to select characters in large fonts (> 256 characters).
Character Text Path Direction Command	New	Allows vertical printing for Asian markets, which use both horizontal and vertical printing.
Font Header Format	Modified	Adds Font Format 16, a font header which supports large TrueType fonts. Five new font header segments are supported
Fonts	New Additions and Deletions	The resident typefaces are different than those in the HP LaserJet 4P printer. Two large fonts (fonts containing a large number of characters) are included to support the Japanese market: MS Mincho and MS Gothic. The printer also contains some Western TrueType typefaces (Arial and Times Roman families). The printer does not have any Intellifont typefaces except the Courier family.
Page Size Command	New Additions	Adds support for JIS B5 paper (E&l45A) and two Japanese postcard sizes: <i>Hagaki</i> (E&l71A) and <i>Oufuku-Hagaki</i> (E&l72A).
Character Enhancements	New	Allows pseudo-bold and pseudo-italic enhancements to be applied to MS Mincho, MS Gothic, and certain downloaded TrueType fonts.

Descriptions of the *Text Parsing Method* Command, *Character Text Path Direction* Command, and *Font Format 16* are provided in the following paragraphs. Following that, a “LaserJet 4PJ Programming Tips” section offers examples and tips for performing specific tasks using PCL 5.

Text Parsing Method Command

The Text Parsing Method command informs the PCL parser whether character codes should be interpreted as 1-byte or 2-byte character codes as described below.

ESC & t # P

- # = 0, 1 - All character codes are processed as one-byte characters.
- 21 - Character codes are processed as one-byte or two-byte characters as described below.
- 31 - Character codes are processed as one-byte or two-byte characters as described below.
- 38 - Character codes are processed as one-byte or two-byte characters as described below.

Default = 0 or 31 (if the default symbol set is WIN31J, the value is 31; otherwise it is 0)

Range = 0, 1, 21, 31, 38

If the value field is 21, character codes in the range 0x21-0xFF are processed as the first byte of a two-byte character. The following byte is processed as the second byte of the two-byte character. All character codes outside this range are processed as one-byte values. This method can be used for parsing characters in Asian seven-bit encoding specifications, including JIS X0208 (Japan), GB 2312-80 (China), and KS C 5601-1992 (Korea).

If the value field is 31, character codes in the range 0x81-0x9F and 0xE0-0xFC are processed as the first byte of a two-byte character. The following byte is processed as the second byte of the two-byte character. All character codes outside this range are processed as one-byte values. This method can be used for parsing characters in the Shift-JIS encoding specification.

If the value field is 38, character codes in the range 0x80-0xFF are processed as the first byte of a two-byte character. The following byte is processed as the second byte of the two-byte character. All character codes outside this range are processed as one-byte values. This method can be used for parsing Asian eight-bit encoding specifications, such as the Big Five and TCA encoding specifications (Taiwan), and KS C 5601-1992 and GB 2312-80, which can be either 7 or 8 bit.

Character Text Path Direction Command

This command allows the user to vertically rotate text for use in vertical writing applications.

$\text{E}_\text{c}\&\text{c}\# \text{T}$

= **0** - Horizontal printing
 -1 - Vertical rotated printing

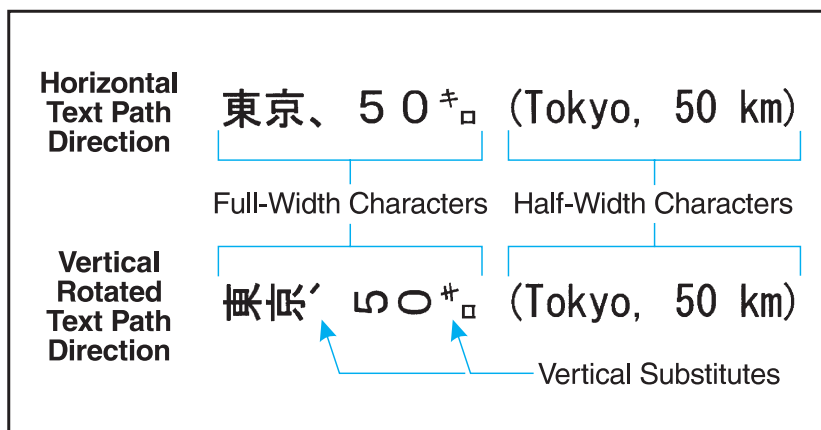
Default = 0

Range = 0, 1

Using $\text{E}_\text{c}\&\text{c}0\text{T}$, the printer's current active position (CAP) advances left to right, and linefeed advances top to bottom with horizontal, upright characters.

Using $\text{E}_\text{c}\&\text{c}-1\text{T}$, the following actions occur:

- Full-width characters in large fonts are rotated counter-clockwise 90 degrees ("vertical rotated" characters).
- Vertical substitutes are made for characters which change their appearance, orientation, or positioning when written vertically.
- All other characters are unaffected by this setting.
- The vertical-rotated printing mode ($\text{E}_\text{c}\&\text{c}-1\text{T}$) has the effect of transforming a portrait page with horizontal text into a landscape page with vertical text. The PCL Print Direction command can be used to achieve other text orientations.



Vertical substitution characters are those characters which change their appearance, orientation, or positioning when written vertically. Examples in Japanese fonts include parentheses, brackets, punctuation and small kana. In the example above, the two small characters are replaced with vertical substitutes. Vertical substitution characters are accessed through the Vertical Substitutes Character Segment, which is described in more detail later in this chapter.

Font Header Format 16

The HP LaserJet 4PJ printer provides support for large fonts. Large fonts, such as the MS Mincho and MS Gothic fonts supplied in the printer, are fonts which are bound to large symbol sets. The LaserJet 4PJ printer supports a new font header to accommodate large bound fonts. New segments are provided for support of vertical substitutes, galley characters, typeface strings, and character enhancements.

The Font Header Command, described beginning on page 11-6 of the *PCL 5 Printer Language Technical Reference Manual*, has several different header formats. The support of large fonts adds Font Header Format 16 (Universal Font Header). Font Header Format 16 is identical in structure to format 15 (Universal Scalable Font Header) except that the size field for data segments has been enlarged from 16 bits to 32 bits, and a new Font Type has been added for large fonts (Font Type 3).

New Font Format Header Segments

For the HP LaserJet 4PJ printer, Font Header Format 15 has been extended to include optional data segments for supporting galley characters, typeface strings, and character enhancements. Font Format 16 supports these segments plus optional segments for supporting vertical substitution and a vertical rotation offset. (Segmented Font Data is described beginning on page 11-45 of the *PCL 5 Printer Language Technical Reference Manual*.)

Galley Character Segment

If an application requests a character that does not exist within the current font, the printer checks the Galley Character Segment for a substitute character to print.

Vertical Substitution Character Segment

The Vertical Substitution Character Segment is used to identify vertical substitute glyphs for characters which change their appearance, orientation, or positioning when written vertically.

Typeface String Segment

The Typeface String Segment allows names of permanent downloaded fonts to be displayed, using non-Latin characters, in the appropriate typeface on the Typeface List.

Vertical Rotation Segment

When the character text path direction is set to vertical rotation, full-width characters are rotated counter-clockwise 90°. The Vertical Rotation Segment sets the point around which the character rotates, so that character alignment is compatible with the way Windows 3.1J rotates characters.

Character Enhancement Segment

The HP LaserJet 4PJ printer can apply pseudo-bold and pseudo-italic enhancements to MS Mincho, MS Gothic, and certain downloaded TrueType fonts. This segment is used to indicate that a particular downloaded font is able to have these character enhancements applied.

Table 2-5. Printer Segment Support for Font Format 16

Segment¹	LJ 4PJ	LJ 4V/ 4MV	LJ 4LC	LJ 4LJ Pro	DJ 1600	LJ 5P
Galley Character – GC	✓	✓	✓	✓	✓	✓
Vertical Substitution – VT	✓	✓	✓	✓	✓	✓
Typeface string – TF	✓	✓	✓	✓	✓	ns
Vertical Rotation – VR	✓	✓	✓	✓	✓	✓
Character Enhancement – CE	✓	✓	✓	✓	✓	✓
Bitmap Resolution – BR*	ns	✓	✓	✓	ns	✓
TrueType fonts	✓	✓	✓	✓	✓	✓
Bitmap fonts*	ns	✓	✓	✓	ns	✓
ns – not supported						
* Format 16 bitmap font support is described beginning on page 2-63.						
¹ These segments are supported for the HP LaserJet 5Si and all later LaserJet printers.						

Description of Font Header Segments

Each font header data segment contains three parts:

- Segment Identifier
- Data Segment Size
- Data Segment

Segment Identifier Values

The Segment Identifier Values for the Galley Character, Vertical Substitution Character, Typeface String, Vertical Rotation, and Character Enhancement Segments are as shown in the following table.

Value	Mnemonic*	Data Segment
18243	GC	Galley Character Segment
22100	VT	Vertical Substitute Segment
21574	TF	Typeface String Segment
22098	VR	Vertical Rotation Segment
17221	CE	Character Enhancement Segment
* The mnemonic is obtained when the two bytes of this big-endian word are treated as ASCII characters.		

Data Segment Size

The Data Segment Size indicates the number of bytes in the immediately following Data Segment. The size of this field is 4 bytes for Font Format 16 fonts, and 2 bytes for Font Format 15 fonts. The rest of the data segments are identical for both font formats.

Galley Character Segment

If an application requests a character that does not exist within the current font, the printer checks the Galley Character Segment for a substitute character to print instead. The Galley Character Segment specifies the character codes of the substitute characters to be printed. A different galley character can be specified for different regions of the symbol set. For example, this segment can be set up so that an asterisk prints when a non-existent character is selected in the region 0x81 - 0x9F, and a question mark for characters in the region 0xE0-0xFC.

Byte	15 (MSB) 8 7 (LSB) 0	Byte
0	GC (18243)	1
2 4	Data Segment Size (6*n+6) *	3 5
6	Format = 0	7
8	Default Galley Character	9

Byte	15 (MSB) 8	7 (LSB) 0	Byte
10	Number of Regions (n)		11
12	Region #1 Upper Left Character Code		13
14	Region #1 Lower Right Character Code		15
16	Region #1 Galley Character		17
...			...
6*n+6	Region #n Upper Left Character Code		6*n+7
6*n+8	Region #n Lower Right Character Code		6*n+9
6*n+10	Region #n Galley Character		6*n+11
* This segment is for Font Format 16. The Data Segment Size field for Font Format 16 fonts is 4 bytes; the segment for Font Format 15 fonts is identical except the Data Segment Size field is 2 bytes instead.			

- **Default Galley Character (UI).** Character code of the character to be printed when a specified character is not within any of the defined regions.
- **Number of Regions (UI).** Number of regions for which galley characters are defined. Regions are defined for a table in which the first character code byte specifies the row and the second byte specifies the column.
- **Region #x Upper Left Character Code (UI).** Character code defining upper left corner of Region #x.
- **Region #x Lower Right Character Code (UI).** Character code defining lower right corner of Region #x.
- **Region #x Galley Character (UI).** Character code of the character to be printed when a character within Region #x is missing from the selected font.

If the value of the galley character field is 0xFFFF, then if the font contains a missing character glyph, that glyph is printed. The missing character glyph can be downloaded using the PCL Download Character command with a character code = 0xFFFF and a glyph ID = 0.

If both the character specified by the original character code and by the galley character code are missing, the CAP is advanced in accordance with previous PCL rules for missing characters, that is, it is advanced according to the current setting of HMI (Horizontal Motion Index).

The Galley Character Segment will be invalid if the format number is not supported or if the segment size declared in the Segment Size field is larger or smaller than required for the number of regions (N). If the segment is invalid, the font download will be ignored.

Galley Character Segments can be downloaded with any Font Format 15 or 16 font, regardless of font type.

The Galley Character Segment can be used to implement a requirement of the *Microsoft Windows Version 3.1, Japanese Version, Microsoft Standard Character Set Specification* (March 11, 1993), which states “when there is an output request for a character of a specified typeface, even if the glyph corresponding to the specified character code does not exist, some glyph data will be output. For double-byte characters, the glyph of the default character defined for the given TrueType font is used. For single-byte characters, the glyph at 0xA5 (small dot, U+FF65) is used.”

The following table shows a Galley Character Segment which follows the Japanese Windows specification.

Byte	15 (MSB) 8 7 (LSB) 0	Byte
0	GC (18243)	1
2	Data Segment Size (12) *	3
4		5
6	Format = 0	7
8	Default Galley Character = 0xFFFF	9
10	Number of Regions (n) = 1	11
12	Region #1 Upper Left Character Code = 0x0000	13
14	Region #1 Lower Right Character Code = 0x00FF	15
16	Region #1 Galley Character = 0x00A5	17
* This segment is for Font Format 16. The Data Segment Size field for Font Format 16 fonts is 4 bytes; the segment for Font Format 15 fonts is identical except the Data Segment Size field is 2 bytes instead.		

In this example segment, there is one galley character region. This region is applied to all one-byte characters (character codes 0x0000-0x00FF); any missing character in this region is replaced with the character at character code location 0x00A5. Any missing characters falling into this region (e.g. character codes 0x0100 - 0xFFFF) are replaced with the default galley character. Since in this example the Default Galley Character field = 0xFFFF, the missing character glyph is printed if it is present in the font.

Vertical Substitution Segment

The Vertical Substitution Segment contains pairs of glyph IDs. Each pair specifies the horizontal and vertical glyph ID for a character. The segment can be built directly from a TrueType *mort* table which contains a vertical substitution array. The segment definition is shown in the table below.

Byte	15 (MSB) 8	7 (LSB) 0	Byte
0	VT (22100)		1
2	Data Segment Size (4*n+4) *		3
4			5
6	Horizontal Glyph ID #1		7
8	Vertical Glyph ID #1		9
...			...
4*n+2	Horizontal Glyph ID #n		4*n+3
4*n+4	Vertical Glyph ID #n		4*n+5
4*n+6	End of table mark #1 = 0xFFFF		4*n+7
4*n+8	End of table mark #2 = 0xFFFF		4*n+9

The Horizontal Glyph ID field is used by TrueType as an ID number for the horizontal glyph data associated with a given character. The Vertical Glyph ID field contains the ID number for the vertical glyph data associated with the same character.

The vertical glyphs can be downloaded using the PCL Character Definition Command using a character code = 0xFFFF.

A TrueType *mort* table typically contains a header of 76 bytes, followed by the vertical substitution array which follows the segment format described here. However, the mort table header is designed to be variable-length, and the location of the vertical substitution data may be located elsewhere in mort tables in future fonts.

If the Font Type is not Type 3 (16-bit fonts), this data segment is ignored.

If the value pairs are not sorted by horizontal glyph ID, the data segment is invalid. If the End of Table mark #1 is not 0xFFFF, the data segment is invalid. The location of the end of the table is determined using the Data Segment Size field. If the segment is invalid, the font download is ignored.

Typeface String Segment

The purpose of this segment is to provide a substitute string to print for a permanent downloaded font when doing a PCL Typeface List printout. It has the following structure:

Byte	15 (MSB)	8	7	(LSB) 0	Byte
0	TF (21574)				1
2	Data Segment Size (2*n+2) *				3
4					5
6	Embedded Font Name Flag		Substitute String Length (n)		7
8	Substitute String Character List				9
...					...

* This segment is for Font Format 16. The Data Segment Size field for Font Format 16 fonts is 4 bytes; the segment for Font Format 15 fonts is identical except the Data Segment Size field is 2 bytes instead.

Embedded Font Name Flag (UB)—A zero value in this field is used to indicate that the ASCII name of the font (from the Font Name field) should be printed in addition to the substitute string. A non-zero value is used to indicate that only the substitute string should be printed.

- Substitute String Length (UB)—the number of UI characters in the Substitute String Character List.

- **Substitute String Character List (array of UI)**—the characters which make up the substitute string. Each character is represented as a UI value. If the font is a bound font, then the values are accessed by their character codes values; if the font is unbound, then the Unicode index numbers (see Appendix D) are used.

The Typeface String Segment will be invalid if the Data Segment Size declared in the Data Segment Size field is larger or smaller than required for substitute string length, or if the Data Segment Size is an odd number of bytes. If the segment is invalid, the font download will be ignored.

Typeface String Segments can be downloaded with any Font Format 15 or Font Format 16 font, regardless of font type.

The following tables are examples of Typeface String Segments for two downloaded fonts. The first is for MS Mincho, and has the embedded font name flag set to true. The second is for MS Gothic, and has the embedded font name flag set to false.

MS Mincho					
Byte	15 (MSB)	8	7	(LSB) 0	Byte
0	TF (21574)				1
2	Data Segment Size (10) *				3
4					5
6	Embedded Font Name Flag = 1		Substitute String Length = 4		7
8	Substitute String Character List = 0x826c (Note: these are full-width 0x8272 Shift-JIS character codes 0x96be for “MS” and Kanji “Mincho”) 0x92a9				9
10					11
12					13
14					15

MS Gothic				
Byte	15 (MSB)	8	7 (LSB) 0	Byte
0	TF (21574)			1
2	Data Segment Size (14) *			3
4				5
6	Embedded Font Name Flag = 0		Substitute String Length = 6	7
	Substitute String Character List =			
8	0x826c	(Note: these are full-width		9
10	0x8272	Shift-JIS character codes		11
12	0x8353	for "MS" and Katakana for		13
14	0x8356	"Gothic")		15
16	0x8362			17
18	0x834e			19

* This segment is for Font Format 16. The Data Segment Size field for Font Format 16 fonts is 4 bytes; the segment for Font Format 15 fonts is identical except the Data Segment Size field is 2 bytes instead.

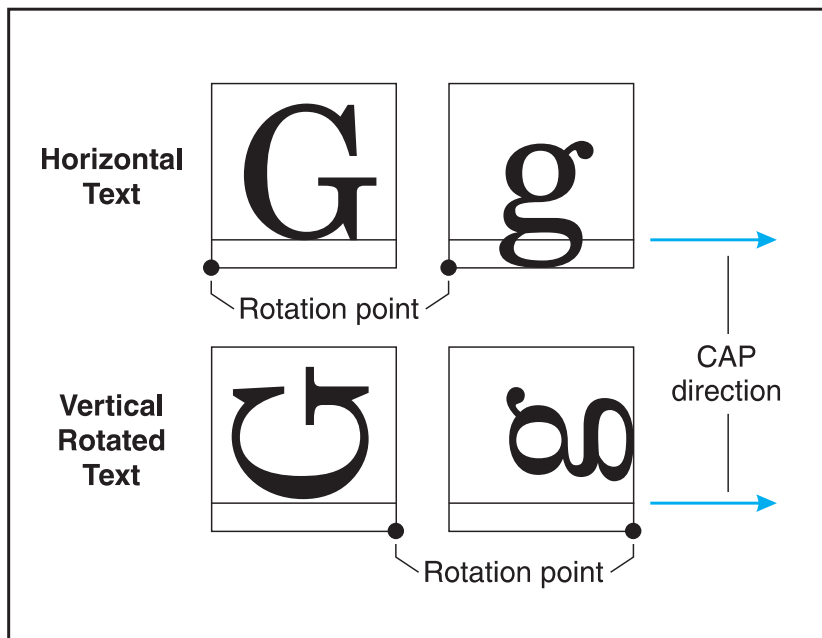
The following illustration shows how the PCL Typeface List would look.

HP LaserJet 4PJ Print		
PCL Typeface List		
Permanent Soft Fonts		
Typeface		Pitch/Point
MS 明朝	← MS Mincho	Scale
MS ゴシック		Scale
MSGothic		Scale

Vertical Rotation Segment

The Vertical Rotation Segment is used to define the lower boundary of the rotation box used when the character text path direction is set to vertical rotation. This is an optional segment which may be downloaded with Font Format 16 TrueType fonts.

The following illustration shows an example of character rotation. The boxes around each character represent the vertical rotation box. The distance between the baseline and the bottom of the character box is represented by the Descender value in the Vertical Rotation Segment.



The structure of the Vertical Rotation Segment is:

Byte	15 (MSB)	8	7	(LSB) 0	Byte
0	VR (22098)				1
2	Data Segment Size (4) *				3
4					5
6	Format (0)				7
8	Descender value				9

* This segment is for Font Format 16. The Data Segment Size field for Font Format 16 fonts is 4 bytes; the segment for Font Format 15 fonts is identical except the Data Segment Size field is 2 bytes instead.

- Format (UINT16)—Set this value to 0.
- Descender Value (SINT16)—Set this value to equal the “sTypoDescender” value from the “OS/2” table of the TrueType font.

- If the Vertical Rotation Segment is not downloaded with the font definition, a default value is used for the Descender value. The default value is set to the following:

$$\text{Descender value} = -36/256 * \text{ScaleFactor}$$

Where: ScaleFactor is Bytes 64 and 65 from the Font Format 16 Font Header.

Character Enhancement Segment

This segment indicates whether the pseudo-bold or pseudo-italic enhancements can be performed on a downloaded font.

The structure of the Character Enhancement Segment is:

Byte	15 (MSB) 8	7 (LSB) 0	Byte
0	CE (17221)		1
2	Data Segment Size (8)		3
4			5
6	Style		7
8			9
10	Stroke Weight		11
12	Reserved		13

* This segment is for Font Format 16. The Data Segment Size field for Font Format 16 fonts is 4 bytes; the segment for Font Format 15 fonts is identical except the Data Segment Size field is 2 bytes instead.

- **Style (UINT32)**—This field specifies the style types that the printer is allowed to perform on the font characters.

31	4	3	0
Reserved		Posture	

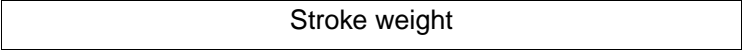
Bit Positions (#) = Posture

- 1 = Italics
0, 2, 3 = Reserved

- **Stroke Weight (UINT16)**—This field specifies the stroke weights which the printer is allowed to provide using the pseudo-bold enhancement algorithm.

15

0



Bit Position (#) = Stroke Weight

0 = Reserved	8 = “Book” or “Text” Weight
1 = Ultra Thin	9 = Semi-Bold
2 = Extra Thin	10 = Demi-Bold
3 = Thin	11 = Bold
4 = Extra Light	12 = Extra Bold
5 = Light	13 = Black
6 = Demi Light	14 = Extra Black
7 = Semi Light	15 = Ultra Black

Note

Only stroke weights greater than the stroke weight of the font can be provided using the pseudo-bold enhancement algorithm.

HP LaserJet 4PJ Programming Tips

This section provides programming tips concerning specific considerations for the HP LaserJet 4PJ printer. This section covers general print job initialization, font metric calculation, vertical writing, and other issues which are pertinent to printing Japanese text on the HP LaserJet 4PJ printer using PCL 5.

General Print Job Initialization

This example demonstrates the general print job initialization procedure for the HP LaserJet 4PJ printer, which is slightly different than that used for other HP LaserJet printers.

Output from pre-LaserJet 4PJ PCL drivers (for example, a HP LaserJet 4P driver) will only print correctly on the HP LaserJet 4PJ printer if the default PCL symbol set is set to a value other than the Japanese Windows 3.1 (Win3.1J) symbol set. This is because the default PCL text parsing method is set based on the default PCL symbol set. When the default PCL symbol set is set to Win3.1J, the default text parsing method is Shift-JIS parsing; for any other value, such as Roman-8, the default text parsing method is 1-byte parsing. To set the default PCL symbol set value, use PJL or the control panel.

The first example given here is nearly identical to the initialization used for other HP LaserJet 4 family printers. The only difference is that it includes a PJL command to set the default PCL symbol set to Roman-8.

```
^C%-12345X@PJL<CR><LF>
@PJL SET RESOLUTION=600<CR><LF>
@PJL PAGEPROTECT=OFF<CR><LF>
@PJL RET=MEDIUM<CR><LF>
@PJL COMMENT *** This command is added ***
@PJL SET LPARM:PCL SYMSET=ROMAN8<CR><LF>
@PJL ENTER LANGUAGE=PCL<CR><LF>
^C^C&l1x1s1h2a0o8c6e54F^C&a5L^C( 0U^C( s1p9vs3b41
^01T
```

The commands in the above example are explained in more detail in the PCL 5 and PJL technical reference manuals.

The second example given here initializes a PCL 5 print job for printing Japanese text. The major differences from the previous example are that it specifies A4 paper, initializes the text parsing method to Shift-JIS, selects Win3.1J as the primary symbol set, selects MS-Mincho as the primary font.

```

%C%-12345X@PJL<CR><LF>
@PJL SET RESOLUTION=600<CR><LF>
@PJL PAGEPROTECT=OFF<CR><LF>
@PJL RET=MEDIUM<CR><LF>
@PJL ENTER LANGUAGE=PCL<CR><LF>
%C%C&11x1h26a0o8c6e60F%C&a5L%C&t31P%C(19K
⤵%C(s1p10v0s0b28752T

```

The last line (2 lines, as shown) in the above example is a PCL 5 initialization string. This set of commands resets the printer, specifies 1 copy, specifies the paper tray as a paper source, chooses A4-size paper, selects portrait orientation, VMI=8 (6LPI), sets top margin to 6 lines, selects a text length of 60 lines, a 5-column left margin, Shift-JIS parsing, WIN3.1J symbol set, and a proportional, 10-point, upright, text-weight MS-Mincho font.

After the PCL print data, the following commands would be used to complete the job:

```

%C%C%-12345X

```

Font Metric Calculation

Accurate character placement relies on the ability to predict character width and height. As a character's point size changes, so does its width and height. (CAP displacement, the distance the CAP moves for vertically rotated text, is a full-width calculation.)

In proportionally spaced fonts, character widths also vary from character to character within the font. Variable character widths add complexity to maintaining accurate line widths, page breaks, or WYSIWYG operation. To support most proportionally spaced fonts, font metrics must be extracted from the font metric files.

In the MS-Mincho and MS-Gothic fonts provided in the HP LaserJet 4PJ, font metric calculation is somewhat easier than for the Latin-based fonts. Width calculations are easier because all characters of these fonts conform to one of two different character widths at a particular point size. The characters are either considered full-width or half-width. One-byte characters are always half-width and two-byte characters are always full-width.

Full-width characters occupy the entire EM width at a particular point size. Half-width characters occupy half of an EM width. The following equations show how to calculate the EM width and character widths for a full-width and a half-width character.

$$ppem = \text{round} (\text{DeviceResolution} * \text{PointSize}/72)$$

$$\text{FullWidthDeltaX} = \text{round} (ppem * \text{PCLUnits}/ \text{DeviceResolution})$$

$$\text{HalfWidthDeltaX} = \text{round} ((ppem/2) * \text{PCLUnits}/\text{DeviceResolution})$$

where:

$$ppem = \text{EM width in pixels}$$

$$\text{DeviceResolution} = \text{current device resolution in dots per inch} \\ (600 \text{ or } 300\text{dpi})$$

$$\text{PointSize} = \text{point size requested}$$

$$\text{FullWidthDeltaX} = \text{character width of full-width character in PCL Units}$$

$$\text{HalfWidthDeltaX} = \text{character width of half-width character in PCL Units}$$

$$\text{PCLUnits} = \text{PCL Units}$$

The PCL Unit of measure is explained in more detail in the *PCL 5 Technical Reference Manual*. The default PCL Unit size is 1/300th of an inch, but the *Unit of Measure* command can be used to set the PCL Unit size to other values.

Note that *HalfWidthDeltaX* may not be exactly half of *FullWidthDeltaX* because of rounding. For example, if *FullWidthDeltaX* = round(99.0) = 99, then the corresponding *HalfWidthDeltaX* = round(99.0/2) = round(49.5) = 50.

Character Enhancements

The HP LaserJet 4PJ printer supports PCL pseudo-bold and pseudo-italic character enhancements. These enhancements can be applied to the internal MS-Mincho and MS-Gothic fonts. They can also be applied to a TrueType soft font if a suitable “Character Enhancement” Segment is downloaded with the font header.

The enhancements are selected using PCL font selection commands. The pseudo-italic enhancement can be selected using the Style command. The pseudo-bold enhancement can be selected using the Stroke Weight command. The bold levels which can be applied to the internal MS-Mincho and MS-Gothic fonts are Semi Bold, Demi Bold, Bold, and Extra Bold. For example, to select a 10-point, Extra Bold, Italic, MS-Mincho font, use the following PCL command:

```
^C(19K^C(s1p10v1s4b28752T
```

In the above command, Italics style (1s) and Extra Bold weight (4b) are selected. Since there is not an Extra Bold Italic MS-Mincho font resident in the printer, pseudo-italics and pseudo-bolding algorithms are applied to characters printed from the regular MS-Mincho font.

If a soft font is selected using the “Font Selection by ID” command (e.g. ^C(#X), the font is selected without any character enhancements applied. To select a soft font by ID with character enhancements, first select the font by ID, then select the desired attributes. For example, assume a soft font is downloaded with ID = 1 and a Character Enhancement Segment indicating that pseudo-bold and pseudo-italics character enhancements can be applied. The following command can be used to select that font with those enhancements:

```
^C(1X^C(s1s3B
```

Other font effects, such as character shadowing, strike-through, and gray-shading can be accomplished using the print model.

Note

HP-GL/2 as implemented in HP LaserJet printers has no mechanism for parsing 2-byte characters. Therefore, HP-GL/2 character transformations (e.g. SI and SR commands) cannot be applied to these characters.

HP-GL/2 as implemented in HP LaserJet printers has no mechanism for parsing 2-byte characters. Therefore, HP-GL/2 character transformations (e.g. SI and SR commands) cannot be applied to these characters.

Vertical Writing

Vertical writing can be accomplished using the vertical rotated (“-1”) mode of the Character Text Path command (`Ec&c-1T`). When using a vertical rotated text path direction, full-width characters are rotated and printed “on their sides.” All other characters are unaffected and the CAP is still advanced in the horizontal direction. The “-1” mode has the effect of transforming a portrait page with horizontal full-width characters into a landscape page with vertical full-width characters. This can be combined with the Print Direction command (`Ec&a#P`) to achieve the desired text orientation (e.g. portrait, landscape, reverse portrait, or reverse landscape).

An example of horizontal and vertical rotated writing is shown below. The first line of text is horizontal writing and the second line is vertical rotated writing. Note that the “~” character is replaced with a vertical substitute on the second line. The C program that follows was used to generate the PCL commands for this example.

1 1 月 1 6 日 ~ 1 1 月 1 7 日
ㄱ ㄱ ㄱ ㄱ ㄱ ㄱ ㄱ ㄱ ㄱ ㄱ ㄱ ㄱ ㄱ ㄱ

```

#include <stdio.h>
#include <fcntl.h>
#define MONTH    "\202P\202P\214\216"
#define DAY1     "\202P\202U\223\372"
#define TILDE    "\201\140"
#define DAY2     "\202P\202V\223\372"
#define KANJITXT MONTH DAY1 TILDE MONTH DAY2
FILE *prn;
main()
{
    int point_size=24;
    prn = fopen("lpt1","wb");    /* open lpt1 for writing */
    fprintf(prn,"\33%-12345X"); /* send UEL to get to PJL */
    fprintf(prn,"@PJL ENTER LANGUAGE=PCL\n"); /* Enter PCL */
    fprintf(prn,"\33E");        /* send an esc E to reset printer */
    fprintf(prn,"\33&a4L");      /* left margin */
    fprintf(prn,"\33&t31P");      /* text parsing = Shift-JIS */
    fprintf(prn,"\33(19K");      /* symbol set = Win3.1J */
    fprintf(prn,"\33(slp&dv0s0b28752T",point_size); /* MS-Mincho */
    fprintf(prn,"\n\n\n\r" KANJITXT); /* print horizontal version */
    fprintf(prn,"\33&c-1T");      /* select vertical writing */
    fprintf(prn,"\n\n\n\r" KANJITXT); /* print vertical version */
    fprintf(prn,"\f");            /* formfeed */
    fprintf(prn,"\33%-12345X"); /* send UEL to get to PJL */
}

```

Printing Ruby Characters (Furigana)

Ruby characters, also known in Japanese as *furigana*, are small characters typically used as an aid in kanji pronunciation. Ruby characters are usually (but not always) hiragana. They are generally placed above the corresponding kanji in horizontal writing and to the right in vertical writing. Ruby characters can be generated using font scaling and cursor positioning commands.

An example of ruby characters is shown below. In this example, the ruby characters are printed at one-third the size of the kanji. The C program that follows was used to generate the PCL commands for this example.



```

#include <stdio.h>
#include <fcntl.h>
#define KANJITXT "\225\127\226\173"
#define RUBYTXT "\202\320\202\345\202\244 \202\331\202\361 "
FILE *prn;
main()
{
    int point_size=72;
    prn = fopen("lpt1","wb");          /* open lpt1 for writing */
    fprintf(prn,"\33%-12345X");        /* send UEL to get to PJL */
    fprintf(prn,"@PJL ENTER LANGUAGE=PCL\n"); /* Enter PCL */
    fprintf(prn,"\33E");                /* EscE to reset printer */
    fprintf(prn,"\33&t31P");            /* text parsing = Shift-JIS */
    fprintf(prn,"\33(19K");             /* symbol set = Win3.1J */
    fprintf(prn,"\33(slpdv0s0b28752T",point_size); /* MS-Mincho */
    fprintf(prn,"\33*p300x400Y");       /* set cursor position */
    fprintf(prn,KANJITXT);              /* print kanji characters */
    fprintf(prn,"\33(s%dV",point_size/3); /*furigana point size */
    fprintf(prn,"\33*p300x%dY",400-4*point_size);/*cursor position*/
    fprintf(prn,RUBYTXT);               /* print ruby characters */
    fprintf(prn,"\f");                  /* formfeed */
    fprintf(prn,"\33%-12345X");        /* send UEL to get to PJL */
}

```

Vertical Underlining

In Japanese writing, vertical underlines are placed to the right of vertical columns of text. This can be accomplished in PCL 5 using the Fill Rectangular Area command.

An underline is simply a long thin black-filled box. The length of the underline depends on the length of the text to be underlined.

An example of vertical underlining is shown below. The C program that follows was used to generate the PCL commands for this example.

1
1
月
1
6
日
～
1
1
月
1
7
日

```

#include <stdio.h>
#include <fcntl.h>
#define MONTH      "\\202P\\202P\\214\\216"
#define DAY1       "\\202P\\202U\\223\\372"
#define TILDE      "\\201\\140"
#define DAY2       "\\202P\\202V\\223\\372"
#define KANJITXT MONTH DAY1 TILDE MONTH DAY2
FILE *prn;
main()
{
    int point_size=24;
    prn = fopen("lpt1","wb");          /* open lpt1 for writing */
    fprintf(prn,"\\33%-12345X");      /* send UEL to get to PJL */
    fprintf(prn,"@PJL ENTER LANGUAGE=PCL\\n"); /* Enter PCL */
    fprintf(prn,"\\33E");              /* Esc E to reset printer */
    fprintf(prn,"\\33&t31P");          /* text parsing = Shift-JIS */
    fprintf(prn,"\\33(19K");           /* symbol set = Win3.1J */
    fprintf(prn,"\\33&a270P");          /* print direction = 270 */
    fprintf(prn,"\\33*p500x1300Y");     /* set CAP position */
    fprintf(prn,"\\33(slp%dv0s0b28752T",point_size); /* MS-Mincho */
    fprintf(prn,"\\33&c-lT");           /* select vertical writing */
    fprintf(prn, KANJITXT);            /* print vertical text */
    fprintf(prn,"\\33*p500x%dY",1300-point_size*4); /* set CAP for
    underline*/
    /* draw underline */
    fprintf(prn,"\\33*c%da3b0P",300 * strlen(KANJITXT)/2 *
    point_size/72);
    fprintf(prn,"\\f");                /* formfeed */
    fprintf(prn,"\\33%-12345X");      /* send UEL to get to PJL */
}

```

Vertical Clusters

Vertical clusters are groups of two or three narrow characters side-by-side in a vertical line of text. Vertical clusters containing half-width characters can be created by using a combination of print direction and cursor positioning commands.

An example of vertical clusters is shown below. The C program that follows was used to generate the PCL commands for this example. In this example, two half-width characters (e.g. 2-digit numbers) were printed as vertical clusters.

11
月
16
日
～
11
月
17
日

```

#include <stdio.h>
#include <fcntl.h>
#define MONTH    "\214\216"
#define TILDE    "\201\140"
#define DAY      "\223\372"
#define CLUSTER  "\201\100\033&f0S\033&a0P%s%d\033&a270P\033&f1S"
FILE *prn;
main()
{
    int point_size=24;
    int offset;
    char OFFSET[40];
    prn = fopen("lpt1","wb"); /* open lpt1 for writing */
    offset = (    36 * point_size * 300) /
/*      —   —————      */
        ( 256 *      72    );
    sprintf(OFFSET,"\33*p-%dx-%dY",offset,offset); /* used to
        place cluster */
    fprintf(prn,"\33%-12345X"); /* send UEL to get to PJL */
    fprintf(prn,"@PJL ENTER LANGUAGE=PCL\n"); /* Enter PCL */
    fprintf(prn,"\33E"); /* Esc E to reset printer */
    fprintf(prn,"\33&t31P"); /* text parsing = Shift-JIS */
    fprintf(prn,"\33(19K"); /* symbol set = Win3.1J */
    fprintf(prn,"\33&a270P"); /* print direction = 270 */
    fprintf(prn,"\33*p500x1300Y"); /* set CAP position */
    fprintf(prn,"\33{slp%dv0s0b28752T",point_size); /* MS-Mincho */
    fprintf(prn,"\33&c-1T"); /* select vertical writing mode */
    fprintf(prn, CLUSTER MONTH, OFFSET, 11); /* print month */
    fprintf(prn, CLUSTER DAY, OFFSET, 16); /* print day */
    fprintf(prn, TILDE); /* print tilde */
    fprintf(prn, CLUSTER MONTH, OFFSET, 11); /* print month */
    fprintf(prn, CLUSTER DAY, OFFSET, 17); /* print day */
    fprintf(prn,"\f"); /* formfeed */
    fprintf(prn,"\33%-12345X"); /* send UEL to get to PJL */
}

```

Paper Size

Three new paper sizes were added to the HP LaserJet 4PJ printer. These paper sizes include: JIS B5, Hagaki, and Oufuku-hagaki. The logical page size in dots per inch are shown in the table below. See page 1-26 in this manual and pages 2-9 to 2-10 in the *PCL 5 Printer Language Technical Reference Manual* for an explanation of these values.

	DIMENSIONS (at 300 DPI - double for 600 DPI)							
PAPER SIZE	A	B	C	D	E	F	G	H
Portrait Dimensions								
JIS B5	2149	3035	2007	3035	71	0	50	150
Hagaki	1181	1748	1039	1748	71	0	50	150
Oufuku-hagaki	1748	2362	1606	2362	71	0	50	150
Landscape Dimensions								
JIS B5	3035	2149	2917	2149	59	0	50	150
Hagaki	1748	1181	1630	1181	59	0	50	150
Oufuku-hagaki	2362	1748	2244	1748	59	0	50	150

HP LaserJet 4 Plus and 4M Plus Printers

HP LaserJet 4 Plus and 4M Plus printers are performance-enhanced follow-on products for HP LaserJet 4 and 4M printers, respectively. The HP LaserJet 4M Plus printer is the multi-platform (PostScript) version of the LaserJet 4 Plus printer.

In addition to extra speed, these printers also have the following added features which are not controlled using PCL:

- Memory Enhancement technology (MEt), which uses memory-saving techniques to better utilize available memory (refer to Chapter 5, “Memory Usage” for additional information). MEt is not controlled using PCL.
- Resource saving, as in the LaserJet 4Si printer. Resource saving allows saving information for the current language (PCL or PostScript) when switching to another language. If resource saving is enabled, all the permanent fonts, macros, and user-defined patterns plus other miscellaneous data is saved in a reserved portion of printer memory. This data is stored until the language is enabled again. When the language is re-enabled, the stored data is made available for use. Resource saving is enabled from the control panel or using PJP—no PCL commands are required for this operation.
- EconoMode, a feature supported by HP LaserJet 4L and 4P printers, allows the user to reduce the amount of toner used by removing about 75% of the dots from the printed page. EconoMode is selected using PJP or from the control panel—it is not controlled using PCL.
- Powersave mode, which minimizes power consumption when the printer is sitting idle. The amount of idle time required before the printer goes into powersave mode is configurable using the control panel or PJP.

PCL operation in these two printers is almost identical to that of HP LaserJet 4 and 4M printers, except HP LaserJet 4 Plus and 4M Plus printers support Logical Operations (ROP3) as explained in the HP LaserJet 4ML printer section in this chapter. In addition, the internal fonts in HP LaserJet Plus and 4M Plus printers support the Latin 2 and Latin 5 symbol sets for all typefaces (in the HP LaserJet 4, 4M, 4Si, and 4SiMx, only 15 of the 35 Intellifont typefaces support these symbol sets). Refer to Table 1-1, PCL Feature Support Matrix, for the commands these printers support and to Chapter 3, “Internal Typefaces/Fonts and Symbol Sets,” for font support information.

HP LaserJet 4V and 4MV Printers

HP LaserJet 4V and 4MV printers print at speeds up to 16 pages per minute and handle many paper sizes including 11"x17" paper. The HP LaserJet 4MV is the multi-platform (PostScript) version of the HP LaserJet 4V printer.

The HP LaserJet 4V/4MV PCL 5 feature set is similar to that of the HP LaserJet 4 Plus/4M Plus printers, with the addition of wide format media support. As an option, the printer can also support Japanese printing as does the HP LaserJet 4PJ printer, including the following PCL enhancements:

- Font header support for large bitmap fonts
- Text parsing method
- Character text path direction
- Japanese media/postcard support
- Japanese fonts (large fonts)

As with HP LaserJet 4Plus and 4M Plus printers, the LaserJet 4V and 4MV printers support the following added features which are not controlled using PCL:

- Memory Enhancement technology (MEt)
- Resource saving
- EconoMode
- Powersave mode

Refer to Table 1-1, the PCL Feature Support Matrix, for the commands these printers support, and to Chapter 3, "Internal Typefaces/Fonts and Symbol Sets," for font support information.

Font Header Format 16 Bitmap Font Support

Font Header Format 16 was introduced with the HP LaserJet 4PJ for downloading large TrueType fonts. For the HP LaserJet 4V, Font Header Format 16 has been extended to support large bitmap fonts as well. The Font Header command (E_c) s # W [font header data]) is used to download font header data to the printer.

A large font is a bound font with character codes that are not limited to 8-bit values. For this reason a large font is sometimes called a 16-bit font.

Font Header Format

Font Header Format 16 was introduced because some font data segments in large fonts could be larger than 65535 bytes, and this was not supported by Font Header Format 15. The structures of Format 15 and Format 16 are identical with the exception of the Segment Size field in the Segmented Font Data format. Table 2-10 below shows the Format 15 and Format 16 Font Header format. Table 2-11 shows the Format 15 Segmented Font Data format. Table 2-12 shows the Format 16 Segmented Font Data format. Note that Format 15 does not support bitmap fonts.

Table 2-6. Format 15 and Format 16 Font Header

Byte	15 (MSB)	8	7	(LSB) 0
0	Font Descriptor Size (minimum 72)			
2	Header Format (15 or 16)		Font Type	
4	Style MSB		Reserved	
6	Baseline Position			
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 LSB	
24	Stroke Weight		Typeface LSB	
26	Typeface MSB		Serif Style	
28	Quality		Placement	
30	Underline Position (Distance)		Underline Thickness	
32	Text Height			
34	Text Width			
36	First Code			
38	Last Code/Number of Characters			
40	Pitch Extended		Height Extended	
42	Cap Height			
44 - 47	Font Number			
48 - 63	Font Name			
64	Scale Factor			
66	Master Underline Position			
68	Master Underline Thickness			
70	Font Scaling Technology		Variety	
72	<i>[additional data may be inserted here]</i>			
...				
Desc. Size	Segmented Font Data			
...	...			
# - 2	Reserved (0)		Checksum	

Table 2-7. Format 15 Segmented Font Data

Byte	15 (MSB)	8	7	(LSB) 0
x + 0	First segment, Segment Identifier			
x + 2	First segment, Segment Size			
x + 4	First segment, Data Segment			
...	...			
x + 4 + 1st seg size	Second segment: Segment identifier, Size, Data Segment			
...	...			
# - 6	Null Segment Identifier (FFFF - hex)			
# - 4	Null Segment Size (0)			
# - 2	Reserved (0)		Checksum	
x = Font Descriptor Size				
# = Font header length (as defined in the Font Header command).				

Table 2-8. Format 16 Segmented Font Data

Byte	15 (MSB)	8	7	(LSB) 0
x + 0	First segment, Segment Identifier			
x + 2 x + 4	First segment, Segment Size			
x+ 6 ...	First segment, Data Segment ...			
x + 6 + 1st seg size	Second segment: Segment identifier, Size, Data Segment ...			
...	...			
# - 8	Null Segment Identifier (FFFF - hex)			
# - 6 # - 4	Null Segment Size (0)			
# - 2	Reserved (0)		Checksum	

x = Font Descriptor Size

= Font header length (as defined in Font Header command).

The Segment Size field, which is part of each segment within the Segmented Font Data, was changed from an unsigned integer in Format 15 to an unsigned long integer in Format 16. This allows segments to be up to $2^{32} - 1$ bytes long.

Font Header Format 15 is described in more detail in the *PCL 5 Printer Language Technical Reference Manual* in the “Soft Font Creation” chapter.

Format 16 supports new segments and new values for the Font Type and Font Scaling Technology fields. New segments which are specific to large TrueType fonts are described in this chapter in the section titled “HP LaserJet 4PJ printer.” (This information will included be in future versions of the *PCL 5 Printer Language Technical Reference Manual*.) The new segments and values which are specific to bitmap fonts are described below.

Header Format

The Header Format byte identifies the font header format. For large fonts, this field should be set to 16. Note that Format 15 does not support bitmap fonts.

Scale Factor

For bitmap fonts, set this field to 0.

Master Underline Position

For bitmap fonts, set this field to 0.

Master Underline Thickness

For bitmap fonts, set this field to 0.

Font Scaling Technology

For bitmap fonts, set this field to 254.

Variety

For bitmap fonts, set this field to 0.

The remaining fields should be set the same as in the Format 0 Font Header for PCL Bitmapped Fonts, with the following exceptions:

Font Type

Font type describes the font's relation to symbol sets. For Format 16 bitmap fonts, set this field to 3. A value of 3 is used to identify a large (16-bit) font. All character codes 0 to 65534 are printable, except 0, 7 to 15, and 27 [decimal]. Access to those codes which are unprintable, yet have a character defined, requires the use of the Transparent Print Data command. In older font header formats, PCL 5 LaserJet printers use this field to determine the first and last codes of the symbol set.

First Code

For Format 16 bitmap fonts, set this field to the first printable character in the font. In older bitmap font formats, PCL 5 LaserJet printers ignore this field.

Last Code

For Format 16 bitmap fonts, set this field to the last printable character in the font. In older bitmap font formats, PCL 5 LaserJet printers ignore this field.

One new data segment is defined for Format 16 bitmap fonts:

Bitmap Resolution Data Segment

The bitmap resolution data segment is used to define the x-resolution and y-resolution for the bitmap. This segment is required for Format 16 bitmap fonts.

The structure for the bitmap segment is shown in Table 2-13.

Table 2-9. Bitmap Resolution Data Segment

Byte	15 (MSB)	8	7	(LSB) 0
x + 0	Segment Identifier ('BR')			
x + 2 x + 4	Segment Size (4)			
x + 6	X Resolution			
x + 8	Y Resolution			

The decimal equivalent for the 'BR' mnemonic is 16978.

X Resolution (unsigned long integer)

This field specifies the resolution of the font in the X dimension in dots per inch.

Y Resolution (unsigned long integer)

This field specifies the resolution of the font in the Y dimension in dots per inch.

If the specified combination is not supported by the printer, the font will be invalidated. In the HP LaserJet 4V, supported combinations are (X Resolution=300,Y Resolution=300) and (X Resolution=600,Y Resolution=600).

Character Definition

The Character Descriptor and Data command ($E_c(s \# W$ [character descriptor and data]) is used to download character data blocks to the printer. Format 4 is used to download character descriptors and data for bitmap characters. This command is described in detail in the *PCL 5 Printer Language Technical Reference Manual*.

Limitations

The following limitations apply to Format 16 Font Headers for bitmap fonts:

- The Font Type field for Format 16 bitmap fonts must be set to 3. This is the case for 1-byte as well as 2-byte bitmap fonts. First Code and Last Code fields need to be set.
- Format 16 optional data segments are ignored for bitmap fonts. These include the galley character segment, vertical substitution character segment, typeface string segment, and vertical rotation segment.
- Vertical rotated printing (character text path direction command, $E_c\&c-1T$) is not available for bitmap fonts.

HP Color LaserJet Printer

As its name implies, the HP Color LaserJet printer is a color laser printer. This 300 dpi printer adds several new features to the PCL 5 language. These new features are summarized in the table below and are described in detail in the *PCL 5 Color Technical Reference Manual* (part number 5961-0940). The printer also supports logical operations, the HP-GL/2 Merge Control command, and pixel placement (both PCL and HP-GL/2 commands). These commands are described in the HP LaserJet 4L section of this chapter and also in the *PCL 5 Color Technical Reference Manual*.

Table 2-10. PCL Feature Additions for HP Color LaserJet Printer

Feature	Status	Comments
AppleTalk Configuration	Modified	In addition to supporting the RENAME, JOB, and TYPE key values, this printer also supports the ZONE value.
Assign Color Index	New	Assigns the three current color components to the specified palette index number.
Color Components 1, 2, 3	New	These three commands specify the three color components of any new color entry in the color palette.
Color lookup Tables	New	Enables and specifies color lookup tables to map color input data into a new output range based on point-by-point conversions. A lookup table is specified for each primary color.
CR (Color Range—HP-GL/2)	New	Sets the range for specifying relative color data.
Configure Image Data	New	Configures the printer for color imaging—establishes a modifiable color palette, sets the pixel encoding mode, and sets the number of bits per index and per primary color.
Download Dither Matrix	New	Specifies a single dither matrix for all three primary colors.
Download Pattern	New	Downloads user-defined patterns, including color patterns, to the printer.
Foreground Color	New	Sets the foreground color to the specified index of the current palette.
Gamma Correction	New	Specifies the gamma correction to be applied equally to each primary color.
Monochrome Print Mode	New	Provides a means to convert a color page to a quick-printing gray-scale equivalent.
NP (Number of Pens—HP-GL/2)	New	Resizes the palette after the IN or $E_C^*v\#W$ commands.
Palette Control	New	Provides a mechanism for marking and deleting palettes.
Palette Control ID	New	Identifies a palette to be used for some of the palette control functions.

Table 2-14. PCL Feature Additions for HP Color LaserJet Printer (continued)

Feature	Status	Comments
PC (Pen Color—HP-GL/2)	New	Changes the pen color in a palette created by the IN or CID command ($\text{E}_c^*v\#W$).
Push/Pop Palette	New	Pushes or pops the palette from the palette stack.
Raster Scaling	New/Modified	Several commands are added for raster scaling: Destination Raster Width ($\text{E}_c^*t\#H$), Destination Raster Height ($\text{E}_c^*t\#V$); also, two parameters are added to the Start Raster Graphics command to initiate scaling (E_c^*r2A and E_c^*r3A). (See the <i>PCL 5 Color Technical Reference Manual</i> for more information.)
Render Algorithm	New	Selects the algorithm to be used for rendering page marking entities on a given page.
Select Palette by ID	New	Activates a palette with the specified ID number.
Set Viewing Illuminant	New	Specifies the relative white point used in the determination of a viewing illuminant condition.
Simple Color	New	Specifies an unmodifiable fixed-size palette.
Transfer Raster Graphics (by plane)	New	Provides a means to send raster data by color plane. This command sends a plane of raster data to the printer and advances to the next plane.

AppleTalk Configuration Command

As discussed in the HP LaserJet 4 section of this chapter, the AppleTalk Configuration command allows a user to send PCL jobs to the printer over AppleTalk. In addition to the key values previously discussed (RENAME, TYPE, and JOB), the HP Color LaserJet printer also supports the ZONE key value as follows.

ZONE

ZONE changes the zone field of the printer's AppleTalk Network Identifier (Name Binding Protocol type field).

$\text{E}_c^*\&\text{b}\#W\text{ZONE}<\text{sp}>\text{zonename}$

Valid characters for the zone name include 0-255 except for characters \$00, "@" (\$40), "." (\$3A), "*" (\$2A), "=" (\$3D), \$C5, and (\$FF). The zone name must contain at least one character, and only the first 31 characters are used. If the zone is invalid, then the printer's zone is not changed. Zone changes only occur after the present job has completed.

HP LaserJet 4LJ Pro Printer

The HP LaserJet 4LJ Pro printer (C3935), released in May 1995, is designed primarily for the Japanese market. This printer provides a print resolution of 600 dpi, has a maximum print speed of 4 ppm, 2 Mb of internal base memory, and improved font cache algorithm. PCL operation for this printer is identical to that of the HP LaserJet 4PJ printer. For command support, refer to Table 1-1, PCL Feature Support Matrix and to the “HP LaserJet 4PJ Printer” section earlier in this chapter.

The HP LaserJet 4LJ Pro printer contains the same two Japanese typefaces, MS Mincho and MS Gothic (and WIN3.1J symbol set), as those in the HP LaserJet 4PJ printer. (The HP LaserJet 4PJ and the 4LJ Pro printers have a reduced set of Intellifont fonts from that of the standard HP LaserJet 4 printer family.) For detailed font information refer to Chapter 3.

HP LaserJet 4LC Printer

The HP LaserJet 4LC printer (C3932), released in March 1995, is designed primarily for the Chinese market. This printer provides a print resolution of 600 dpi, has a maximum print speed of 4 ppm, 2 Mb of internal base memory, and improved font cache algorithm. PCL operation for this printer is identical to that of the LaserJet 4PJ printer. For specific PCL command support information, refer to Table 1-1, PCL Feature Support Matrix.

The HP LaserJet 4LC printer contains three new Chinese typefaces, SimSun, SimHei, and GW-Kai (and a new symbol set for these fonts, GB2312). The default typeface is SimSun and the default symbol set is GB2312. (The HP LaserJet 4LC printer contains the standard set of Intellifont fonts, unlike the HP LaserJet 4PJ and 4LJ Pro printers which have reduced Intellifont typeface sets.) Refer to Chapter 3 for detailed font information.

The typeface/font information, described in the “HP LaserJet 4PJ Printer” section earlier in this chapter for the Japanese typefaces, also applies to the LaserJet 4LC printer's Chinese typefaces with the following differences. The default values for the Text Parsing Method command are different for the HP LaserJet 4LC. These default values are 0 or 38 (provided the default symbol set is GB2312, otherwise it is 0). Also, the examples in this section can be used for the Chinese fonts, provided the symbol set value field in the Symbol Set command is changed to 18C (for the GB2312 symbol set) and the typeface value in the font selection command string is changed to one of the Chinese fonts [for example, the Japanese font selection command $\text{E}_\text{C}(19\text{K}\text{E}_\text{C}(\text{s1p10v1s4b2852T}$ should be changed to $\text{E}_\text{C}(18\text{C}\text{E}_\text{C}(\text{s1p10v1s4b37058T}$].

HP LaserJet 5P and 5MP Printers

The HP LaserJet 5P and 5MP printers were released March 6, 1995. These printers are similar to the HP LaserJet 4P printer except that they are designed to run faster, have an MP paper tray in place of the manual feed slot, and have a reduced control panel similar to the HP LaserJet 4L printer. The HP LaserJet 5P / 5MP printer's maximum print speed is 6 pages per minute (HP LaserJet 4P runs at 4 ppm) and has a print resolution of 600 dpi.

Another new feature on this printer is an IrDA-compliant infrared serial I/O port located on the front of the printer.

PCL operation is almost identical to that of the HP LaserJet 4 Plus printer. (Refer to Table 1-1, HP LaserJet Printer Feature Comparison, for the specific PCL implementation.)

HP LaserJet 5L Printer

The HP LaserJet 5L printer, introduced in September 1995, is much different in appearance than the LaserJet 4L printer, but it has a very similar feature set, including the same set of 26 internal typefaces. One of the main differences is that the LaserJet 5L printer offers 600 dpi printing. Although both printers have a print engine speed of 4 pages per minute, the LaserJet 5L printer has faster processing which increases performance. As the LaserJet 4L printer, the printer has a reduced-function control panel.

The HP LaserJet 5L printer has a vertical design and supports all paper sizes supported by the LaserJet 4L printer. In addition, the “custom” paper size is supported through the printer driver.

The default symbol set is PC-8 instead of Roman-8.

Manual feed operation is slightly different for the HP LaserJet 5L printer. When manual feed is selected, the printer pauses and waits for the user to insert the correct media into the printer (either in the paper input bin or the single sheet input slot) and press the control panel key.

PCL and PJP operation is almost identical to that of the HP LaserJet 4L printer. Two differences are that the LaserJet 5L printer adds support for the logical operations and pixel placement commands. These features are described in this chapter in the LaserJet 4ML section. (Refer to Table 1-1, HP LaserJet Printer Feature Comparison, for the specific PCL implementation.)

HP LaserJet 5Si and 5SiMx Printers

HP LaserJet 5Si and 5SiMx printers are designed for using in shared printing environments. The HP LaserJet 5SiMx printer is equivalent to the HP LaserJet 5Si printer, but also includes PostScript Level 2, 8 Mb of additional memory, and the HP JetDirect network interface card.

HP LaserJet 5Si and 5SiMx printers have features similar to those of HP LaserJet 4Si and 4SiMx printers, with improved performance and extra paper handling features. Some of the feature differences are listed below.

- The printers include the same set of internal fonts, but there are no font cartridge slots on the printers. Both printers support font/macro SIMMs and downloaded soft fonts and macros.
- The default symbol set is PC-8 instead of Roman-8.
- Additional paper and envelope sizes are supported, including ledger (11" x 17"). Executive size paper is only supported by the MP tray.
- There is no job offset mechanism in the printers.
- HP LaserJet 5Si and 5SiMx printers do not request the envelope size every time the power is cycled. It is assumed that the size does not usually change between power down and power up.
- Base HP LaserJet 5Si and 5SiMx printers have one 100-sheet multi-purpose tray (Tray 1), and two 500-sheet universal-input trays. Optional paper handling devices include a duplex unit, a power envelope feeder, a 2000-sheet input tray and a multi-bin mailbox.
- HP LaserJet 4Si and 4SiMx printers used "tray locking" to prevent automatic selection of a paper tray. HP LaserJet 5Si and 5SiMx printers accomplish "tray locking" using the Alphanumeric ID command to select the paper tray by media type.

Table 2-15 lists the PCL feature additions for HP LaserJet 5Si and 5SiMx printers.

Table 2-11. PCL Feature Additions for HP LaserJet 5Si/5SiMx Printers

Feature	Status	Comments
Paper (Media) Source	Modified	Additional parameters have been added to provide support for Tray 1, the printer's right side multi-purpose tray and the other optional trays (see the description of this command in the following paragraphs).
Output Bin	Modified	The Output Bin command ($\text{E}\text{C}\&\text{I}\#\text{G}$) selects the destination bin for the print job.
Alphanumeric ID	New	Specifies alphanumeric String IDs for selecting and manipulating fonts, macros, and media types. Specifies media selection by the type of media and supports enhancements for the printer disk drive.

Descriptions of the *Paper (Media) Source*, *Output Bin*, and *Alphanumeric ID* commands are provided below.

Paper (Media) Source Command

The Paper (Media) Source command selects the specified input media source. Parameters have been added to enable printing from the LaserJet 5Si/5SiMx printer trays.

$\text{E}\text{C}\&\text{I}\#\text{H}$

- # = 0 - Print current page (source is unchanged)
- 1 - Tray 2 (upper drawer)
 - 2 - Manual feed (tray 1, right side tray)
 - 3 - Manual envelope feed (tray 1, right tray)
 - 4 - Tray 3 (lower drawer)
 - 5 - High Capacity Input (HCI), first tray
 - 6 - Optional envelope feeder
 - 7 - Autoselect
 - 8 - Tray 1 (right side tray)
- 20 - 39 - High Capacity Input (HCI) trays 2- 21

Default = 7

Range = 0 to 8, 20 - 39

The following table compares the paper/media source values and the trays they select on various printers.

Value (#)	LaserJet 4, 4 Plus, 4V	LaserJet 4Si, 4SiMx	LaserJet 5Si/ 5SiMx
1	PC Tray	Upper Cassette	Tray 2 (upper drawer)
2, 3 (manual feed)	MP Tray	Manual Feed Slot	Tray 1 (right side, manual feed)
4	MP Tray as Cassette	Lower Cassette	Tray 3 (lower drawer)
5	LC Tray		First Tray of HCI
8	N/A	N/A	Tray 1 (right side, normal)

Output Bin Command

This command selects the destination bin into which the print job is output when printed.

E_C&l#G

- # = 0** - Automatic selection
- 1 - Selects bin #1 (printer top/face-down bin)
 - 2 - Selects bin #2 (printer left/face-up bin; this bin not available when the High Capacity Output (HCO) is attached)
 - 3 - Selects bin #3 (HCO face up bin)
 - 4 - Selects bin #4 (HCO #1 face down bin)
 - 5 - Selects bin #5 (HCO #2 face down bin)
 - 6 - Selects bin #6 (HCO #3 face down bin)
 - 7 - Selects bin #7 (HCO #4 face down bin)
 - 8 - Selects bin #8 (HCO #5 face down bin)
 - 9 - Selects bin #9 (HCO #6 face down bin)
 - 10 - Selects bin #10 (HCO #7 face down bin)
 - 11 - Selects bin #11 (HCO #8 face down bin)

Default = 0

Range = 0 to 11

Note

The Output Bin command is not recommended. Instead, it is preferred that the P_JL OUTBIN command be used to set the default media destination.

Alphanumeric ID Command

The Alphanumeric ID command performs several different functions depending on the *operation* specified. This command:

- Specifies the type of print media on which to print a job (rather than specifying its location)
- Specifies an ID string for different PCL objects (fonts and macros)
- Supports the mass storage PCL enhancements for the LaserJet 5Si/5SiMx printer disk (allowing, for example, downloading a font with a String ID to RAM—downloading to the printer disk must be done using PJL)

The format of the Alphanumeric ID command is as follows:

ESC & n # W [Operation] [String ID]

- Number of bytes of String ID data

Default = 0

Range = 2 to 512

The value field (#) identifies the number of bytes in the String ID.

The *Operation* byte determines the type of operation and the type of object on which the operation is to be performed. The operations are listed in the table below.

The *String ID* begins with the second byte and can be up to 511 characters long.

Operation	Description
0	Sets the current Font ID to the given String ID. This operation allows the user to set the current PCL Font ID to a string name, which gives the user the ability to download fonts to a string name. If the current Font ID has been set with both the Alphanumeric ID command and the Font ID command ($E_c*c\#D$), the ID last sent takes precedence. For example, if the current font ID was set to 10 and then to "Font1", the current font ID would be "Font1".
1	Associates the current Font ID to the font with the String ID supplied. This operation finds the font with the supplied String ID and assigns the current Font ID to that font so that the font now has two names. The original font name is used to perform font management commands on the font, and the new associated name is used when selecting the font for usage. Note that since fonts with string names can be associated to numeric Font IDs, these fonts are selectable in HP-GL/2 using the numeric Font ID.
2	Selects the font referred to by the String ID as primary. This operation finds the associated font using the supplied String ID and specifies that font as the current primary font. The command is ignored if there is no font with that String ID.
3	Selects the font referred to by the String ID as secondary. This operation functions the same as the primary font specification (operation number 2), however this command specifies the font as secondary.
4	Sets the current Macro ID to the String ID. This operation allows the user to set the current PCL Macro ID to a String ID name. If the current Macro ID has been set with both the Alphanumeric ID command and the Macro ID command ($E_c\&f\#Y$), the ID last sent takes precedence. For example, if the current Macro ID was set to 10 and then to "Macro1", the current macro ID would be "Macro1".
5	Associates the current Macro ID to the supplied String ID. This operation finds the macro with the supplied String ID and assigns the current Macro ID to that macro. This macro then has two names. The original Macro ID name is used to perform macro management commands on the macro, and the new associated name is used when executing, calling, or overlaying the macro.
20	Deletes the font association named by the current Font ID. The font must have been associated with an alphanumeric Font ID (using operation 0). No String ID is supplied ($E_c\&n1W20$). This command removes the alphanumeric font name association, however the disk resource itself is not changed.

Operation	Description
21	Deletes the macro association named by the current Macro ID. The macro must have been associated with an alphanumeric Macro ID (using operation 4). No String ID is supplied (E&n1W21). This command removes the alphanumeric macro name association, however the disk resource itself is not changed.
100	Media select (see media selection table). Media types are specified using the printer control panel. The following table indicates which media type and paper size is used in the various media-select situations.

Note

PCL objects stored on the printer disk cannot be deleted, set to temporary, set to permanent, or modified in any way using the PCL language.

Media Type	Paper Size	Paper Source	Size/Type Used
Not specified	Not specified	Not specified	Default size Default type
Not specified	Not specified	Specified (not manual feed)	Default size Type configured in specified tray
Not specified	Not specified	Specified (manual feed)	Manual feed request Default size
Not specified	Specified	Not specified	Specified size Default type
Not specified	Specified	Specified (not manual feed)	Specified size Type configured in specified tray
Not specified	Specified	Specified (manual feed)	Manual feed request Specified size
Specified	Not specified	Not specified	Default size Specified type
Specified	Not specified	Specified (not manual feed)	Default size Specified type
Specified	Not specified	Specified (manual feed)	Manual feed request Default size Specified type
Specified	Specified	Not specified	Specified size Specified type
Specified	Specified	Specified (not manual feed)	Specified size Specified type
Specified	Specified	Specified (manual feed)	Manual feed request Specified size Specified type

A paper source is considered to be not specified when a Media Source command has not been received or when the media source is set to autoselect (value 7). The media type is considered to be not specified when an Alphanumeric ID command for media type (value 100) has not been received.

Selecting the default media type causes the printer to consider the media type as not specified.

Selecting an undefined or unavailable ID causes the printer to generate a manual feed request.

Example: Using the Alphanumeric ID Command to Download a Font

Fonts can be downloaded to the printer disk using PjL, or using PCL you can download a font with a String ID to RAM. The following example demonstrates downloading a font to a string name using PCL.

Set the alphanumeric font ID to "TTFont1"

```
^C&n8W0TTFont1
```

Download the font. It is assigned the String ID "TTFont1"

```
^CsW[data]
```

Example: Using a Font with a String ID

When the user wants to use a font with a String ID, the user must first associate that font with a new Font ID number. This association is required so that whether the font is on disk or RAM, the procedure is the same.

Set the current Font ID to "AssociatedFontID"

```
^C&n17W0AssociatedFontID
```

Find the font with ID "UnivRomanID" on disk or in RAM and give it the associated ID of "AssociatedFontID"

```
^C&n12W1UnivRomanID
```

Set the current Font ID to 10

```
^C*c10D
```

Find the font with String ID "TimesRmID" on disk or in RAM and give it the associated Font ID of 10

```
^C&n10W1TimesRmID
```

Set the current secondary font to the font with a Font ID of 10 (which in this case, is an associated font)

```
^C)10X
```

Specify the current font as primary using the alphanumeric ID command

Ⓔc&n17W2AssociatedFontID

Delete the name “AssociatedFontID” from the PCL database

Ⓔc&n17W0AssociatedFontID

Ⓔc&n1W20

Reset the printer. Resetting deletes all font and macro associations.

ⒺcE

HP DeskJet 1200C Printer

The DeskJet 1200C is a 300-dpi LaserJet-compatible thermal inkjet color printer. It uses PCL 5 and is very compatible with the LaserJet 4 family of printers. The main differences between the DeskJet 1200C and the LaserJet 4 printer are summarized in the table below (for a complete listing, see Table 1-1).

Table 2-12. PCL Feature Additions for HP DeskJet 1200C Printer

Feature	Status	Comments
Enter HP-GL/2 Mode	Modified	Three additional parameters (-1, 2, 3) have been added to provide support for Standalone HP-GL/2 Mode ($\text{E}_C\%1\text{B}$), for using the current PCL coordinate system/previous HP-GL/2 pen position ($\text{E}_C\%2\text{B}$), and for using the current PCL coordinate system/current PCL CAP ($\text{E}_C\%3\text{B}$).
Media Type	New	Sets the print mode required for printing on various media types.
Mechanical Print Quality	New	Determines the graphics print quality.
Negative Motion	New	Specifies whether negative motion will be used.
Raster Scaling	New/Modified	Several commands are added for raster scaling: Destination Raster Width ($\text{E}_C^*t\#H$), Destination Raster Height ($\text{E}_C^*t\#V$), Scale Algorithm ($\text{E}_C^*t\#K$); also, two parameters are added to the Start Raster Graphics command to initiate scaling (E_C^*r2A and E_C^*r3A). (See the <i>PCL 5 Color Technical Reference Manual</i> for more information.)
Color Commands	New	See Table 1-1 for a complete list of color commands supported by the printer. See the <i>PCL 5 Color Technical Reference Manual</i> for descriptions of the color commands.

The DeskJet 1200C printer does not support the following LaserJet 4 features:

- Unit of Measure ($\text{E}_C\&\text{u}\#D$)
- Status Readback ($\text{E}_C^*s\#X$, $\text{E}_C^*s\#U$, $\text{E}_C^*s\#M$, $\text{E}_C^*s\#T$, $\text{E}_C^*s\#I$)
- Raster resolutions of 200 dpi and 600 dpi
- Page sizes: Executive, A4, JIS B5 paper, International B5 envelope, Monarch envelope
- HP-GL/2 in macros

Updated Features

Printers with a “B” or “C” revision code, indicated by the third digit in the serial number, have the following additional new features. (Print the self-test to see the serial number.)

- **Two-Byte Fonts.** Provides support for two-byte (large) fonts with more than 256 characters. Two-byte fonts support such large symbol set mappings as Unicode, Shift-JIS, JIS208, and Big5. Two-byte fonts are compatible with current PCL data structures.
- **Frame Buffer/MEt Architecture.** Provides MEt (Memory Enhancement technology), which overcomes memory contention problems. Drivers can use the PJL SET command (@PJL SET PAGEPROTECT=LETTER/ LEGAL/ A4/OFF) to put the printer into a page protect mode that reserves the memory equivalent of a complete full-color frame buffer for the current page size. Page protect mode reserves printer memory blocks large enough to represent cyan, magenta, and yellow (CMY) bitmaps for an entire page of the currently selected media).
- **Noise Dither.** Two new halftone render algorithms (noise dither and monochrome noise dither) have been added.
- **Arbitrary Dither Matrix Sizes.** The printer now allows the full 16-bit range for downloaded dither matrix height and width ($E_C * m \# W$).

Enter HP-GL/2 Mode Command

The Enter HP-GL/2 Mode command causes the printer to interpret data as HP-GL/2 commands instead of PCL commands. Three new parameters are added: one enables stand-alone plotter mode ($E_C\%-1B$), and the other two affect the coordinate system and pen position when switching into HP-GL/2 ($E_C\%2B$ and $E_C\%3B$).

$E_C\%\#B$

- # =**
- 1** - Stand-alone plotter mode (single context)
 - 0** - Use previous HP-GL/2 pen position
 - 1** - Use current PCL CAP
 - 2** - Use current PCL dot coordinate system and old HP-GL/2 pen position
 - 3** - Use PCL dot coordinate system and the current PCL CAP

Default = 0

Range = -1 to 3

HP-GL/2 mode remains in effect until a Start Raster command ($E_C*r\#A$), Reset ($E_C E$), UEL command ($E_C\%-12345X$), or power-on.

In stand-alone plotter mode ($E_C\%-1B$), only a single context can be used (HP-GL/2 and PCL cannot be merged on the same page).

A value field of 1 or 3 sets the HP-GL/2 pen position and the label carriage return point to the current PCL CAP. A value field of 2 or 3 transfers the current PCL dot coordinate system, including the PCL origin and axes; the coordinate system thus established is independent of the positions of P1 and P2.

This command cannot be executed from display functions mode or within a binary data transfer. HP-GL/2 ignores this command.

Media Type Command

This command sets the print mode required for printing on various media types.

E_C&l#M

- # =**
- 0** - Plain paper
 - 1** - Bond paper
 - 2** - Special paper
 - 3** - Glossy film
 - 4** - Transparency film

Default = 0

Range = 0 to 4

If no printable data has been sent, this command moves CAP to the top of form at the left margin of the current page. If printable data has been sent, the page is closed and printed, and CAP moves to the top of form at the left margin of the next physical page.

When transparency media is loaded, the printer automatically adjusts the media type to Transparency and the print quality to Presentation Graphics, regardless of the language or remote-panel selection.

The Media Type and Print Quality commands always override remote control panel settings if the printer detects a different type of media than was requested. It may override these commands and the remote control panel settings.

Note

This command may override the remote panel. HP recommends programmatically setting media type, especially in network environments.

Print Quality Command

This command determines print quality and speed.

$\text{E}_\text{C}^*\text{o}\#\text{Q}$

- # = -1** - EconoFast
- 0** - Normal quality
- 1** - Best/Presentation graphics

Default = 0

Range = -1, 0, 1

EconoFast prints black text at 300 dpi. When transparency or glossy media is loaded, the printer automatically adjusts the media type to Transparency and the print quality to Presentation graphics, regardless of the language or remote-panel selection.

The Media Type and Print Quality commands always override remote control panel settings if the printer detects a different type of media than was requested. It may override these commands and the remote control panel settings.

Note

This command must be sent at the beginning of the page before any printable data; otherwise, when the command is received, the current page is closed and printed.

Negative Motion Command

The Negative Motion command specifies whether negative motion will be used, thus determining whether the full page must be buffered before printing can begin.

$\text{E}_\text{C}\&\text{a}\# \text{N}$

- # = 0** - Picture contains negative motion (page formatting printers)
1 - Picture contains no negative motion (swath printers)

Default = 0

Range = 0, 1

If the page contains no negative motion, using the $\text{E}_\text{C}\&\text{a}1\text{N}$ command increases print speed.

Negative motion includes:

- Vertical motion toward the top of the page
- HP-GL/2 operations
- Print directions other than 0 degrees
- Landscape text
- When the top of the character cell on the next line is above the top of the character cell on the current line

The default value of 0 delays printing until all the processing of input data for a page is complete. This is for software that needs to compose the data before printing.

A value of 1 allows data to be printed as received, rather than first stored in a buffer. Otherwise, printing will be delayed until all processing of input data is complete.

Note

This command must be sent before any printable data is received by the printer.

HP DeskJet 1600C Printer

The DeskJet 1600C printer is a follow-on to the DeskJet 1200C. It has 600 x 600 dpi black text resolution (plus TES, which is similar to REt) and 300-dpi color resolution. Like the 1200C, the DeskJet 1600C is font- and language- compatible with the latest LaserJet 4 series printers. The DeskJet 1200C and 1600C contain most of the same PCL 5 color features as the Color LaserJet (described in the *PCL 5 Color Technical Reference Manual*), with some exceptions and additions (see Table 1-1). DeskJet 1200C and 1600C drivers should work on the Color LaserJet, but not vice versa. Changes from the DeskJet 1200C are listed below.

Table 2-13. PCL Feature Additions for the HP DeskJet 1600C Printer

Feature	Status	Comments
Raster Resolution	Modified	200 and 600 dpi are supported.
Enter HP-GL/2 Mode	Modified	HP-GL/2 standalone mode (-1) is not supported.
Compression Method	Modified	Method 9, replacement delta row is added.
Unit of Measure	New	Same as LaserJet 4 series printers.
Paper Source	Modified	Autoselect (7) is added.
HP-GL/2 in PCL macros	New	HP-GL/2 commands may appear in PCL macros.
Noise Dither*	Modified	Noise ordered dither (13) and monochrome noise ordered dither (14) are added.
Downloaded dither Matrix*	Modified	The full 16-bit range for height and width is allowed.
Two-Byte Fonts*	New	Font header format 16 two-byte font downloading.
Text Parsing Method*	New	Same as LaserJet 4PJ printer.

* Also on “B” and “C” versions of the DeskJet 1200C.

Additional features include:

- **Simplified Control Panel.** The IEEE-P1284 ECP port described below allows front-panel simplification and the elimination of DIP switches. The DeskJet 1600C control panel is similar to that of the LaserJet 4L, with one button and four LED indicators.
- **IEEE-P1284.** This bi-directional enhanced capability port (ECP) allows most printer features to be monitored and controlled through Microsoft Windows or a DOS remote control panel shipped with the product. In previous HP printers, PJI provided some job-level status and control, but PJI is embedded in the data stream, synchronous with the printer description data. With the implementation of MLC (Multiple Logical Channels) on the ECP and MIO 6.0, the printer can be controlled and monitored on a separate channel, asynchronous to the data stream. PJI still provides control that must be synchronous with the data stream.
- **ENERGY STAR.** The printer lowers its power consumption if it has not been used for 15 minutes.
- **Out-of-Ink Sensing.** An LED on the control panel lights when a pen runs out of ink.
- **MIO.** Modular I/O interface with auto-sensing I/O configuration.
- **JetDirect.** Optional network cards: Novell, TCP-IP, LocalTalk, EtherTalk, and third party.
- **PostScript.** A SIMM upgrade is available.
- **Optional Media Source.** An optional sheet feeder tray is available.
- **Media Detection.** Automatic detection of media size and media type (transparency).

- **PJL.** Unlike the DeskJet 1200C, which implemented only the PJL kernel, the DeskJet 1600C printer supports all of the PJL commands listed below. Full PJL implementation is not needed because of the multiple-channel capability of the IEEE-P1284 Extended Capabilities Port. DeskJet 1600C also supports page protection with the @PJL SET PAGEPROTECT command.

COMMENT	INQUIRE
DEFAULT	JOB
ECHO	RESET
ENTER	SET
EOJ	UEL

- **Print Modes.** The DeskJet 1600C has the following user-selectable print modes:

EconoFast. The primary goal is cost per copy. The secondary goal is high speed.

Presentation Graphics. Best quality graphics.

Normal. Equal emphasis on quality and throughput. Best mode for most uses, minimizing the need to switch to other modes.

Media Source Command

The Paper (Media) Source command ($E_cI\#H$) for the DeskJet 1600C uses a value of 5 for its optional sheet feeder and also supports a value of 7 (autoselect). A value of 7 selects the current printer default source. The user, through the application, may select a particular tray for the first page or pages (for example, a fancy cover page), then choose autoselect to pull paper from a default tray (for example, containing standard paper). This is different than option 0, which continues printing from the currently selected source. The “default” source may be user-selected, or based upon the printer's own algorithm.

Compression Method Command

The Compression Method command ($E_c*b\#M$) for the DeskJet 1600C supports Method 9 compression (compressed replacement delta row encoding) in addition to compression methods 0, 1, 2, 3, and 5.

Method 9 (Replacement Delta Row Encoding)

Like Method 3, this method replaces only bytes in the current row that differ from the preceding (seed) row. Unlike Method 3, the replacement (delta) bytes may be encoded.

The replacement byte string (delta compression string) consists of a command byte, optional offset bytes, optional replacement count bytes, and the replacement data.

Command Byte	Optional Offset Bytes	Optional Replacement Count Bytes	Data Bytes
--------------	-----------------------	----------------------------------	------------

The command byte itself has three parts:

Control Bit	Offset Count	Replacement Count
-------------	--------------	-------------------

- **Control Bit.** Determines whether the replacement data is compressed, and also the bit boundaries of the command byte's other two fields.
- **Offset Count.** The left offset (number of bytes) the replacement data is offset from the current byte position in the seed row.
- **Replacement Count.** The number of consecutive bytes to be replaced. One more byte than the replacement count is replaced (for example, 6 bytes are replaced by a replacement count of 5).

Like compression method 3, the “current” byte follows the last replacement byte; at the beginning of a row, the current byte immediately follows left raster margin. An offset of 0 indicates the current byte; an offset of 1 indicates the byte following the current byte.

The size of the offset count and replacement count fields depends on the value of the control bit.

CONTROL BIT = 0

7	6	3	2	0
Control Bit = 0	Offset Count	Replacement Count		

If the control bit is 0, the replacement data is uncompressed. If the control bit is 0, bits 0-2 indicate the replacement count and bits 3-6 indicate the offset count.

If the offset count is 15, an additional offset count byte follows and is added to the total offset count. If the offset count byte is 255, another offset count byte follows. The last offset count byte is indicated by a value less than 255.

If the replacement count is 7, an additional replacement count byte follows and is added to the total replacement count. If the replacement count byte is 255, another replacement count byte follows. The last replacement count byte is indicated by a value less than 255. One more than the total replacement byte count will be replaced.

CONTROL BIT = 1

7	6	5	4	0
Control Bit = 1		Offset Count		Replacement Count

If the control bit is 1, the replacement data is run length encoded. the bit boundaries are different than if the control bit is 0: bits 5-6 contain the offset count, and bits 0-4 contain the replacement count. As when the control bit is 0, optional offset bytes and replacement bytes may be added.

HP LaserJet 5 and 5M Printers

HP LaserJet 5 and 5M printers are performance-enhanced follow-on products for HP LaserJet 4 Plus and 4M Plus printers, respectively. The enhanced PCL 5 printer language in these printers include all of the PCL 5 features supported by HP LaserJet 4 Plus and 4M Plus printers as well as the features listed in Table 2-18.

Table 2-14. PCL Feature Modifications for HP Color LaserJet 5 and 5M Printers

Feature	Status	Comments
Character Text Path Direction Command	Modified	A new algorithm decides whether or not to counter-rotate characters when using the vertical rotated printing mode.
Text Parsing Method Command	Modified	The default text parsing method is based on the font type and symbol set fields in the default font.
Label Mode (LM) Command	New	HP-GL/2 support for 2-byte applications.

Text Parsing

When 2-byte text parsing methods were introduced in HP LaserJets (from LaserJet 4PJ on), the default text parsing method was based on the default symbol set. For example, if a user selected Roman-8 as the default symbol set (via the control panel or a PJI command), then 1-byte text parsing was the default method. If they selected WINJ-DBCS as the default symbol set, Shift-JIS text parsing was the default method.

HP LaserJet printers (from LaserJet 5 and 5M on) now base the default text parsing method on the font type and symbol set fields in the default font. If the default font is a 16-bit font, the default text parsing method is set to one that matches the symbol set field. In all other cases, the default text parsing method is set to 1-byte text parsing.

Two-Byte HP-GL/2 Support

One-byte applications (which support non-orthogonal rotation, scaling, and shearing of text) have long been able to use HP-GL/2 to print to HP LaserJet printers. Two-byte applications have not had this capability until the introduction of HP LaserJet 5 and 5M printers.

The capability of 2-byte applications (which support non-orthogonal rotation, scaling, and shearing of text) to print to HP LaserJet printers using HP-GL/2 is provided by the Label Mode (LM) command.

Label Mode Command

Determines how the Label (LB) and Symbol Mode (SM) commands interpret characters. Used for printing a 2-byte character set such as WinJ-DBCS, GB2312, or Big-5.

Syntax:

LM(*mode*,[*row number*]:)

Parameter	Format	Functional Range	Default
mode	clamped integer	0, 1, 2, or 3	0 (8-bitmode)
row number	clamped integer	0 to 255	0

Comments:

- **MODE.** Determines the interpretation mode as follows:
 - 0** Interprets each byte as a character (8-bit mode where the default row_number equals "0"). Computed character code is equal to $(\text{row_number} * 256) + 8\text{-bit code sent in LB or SM command}$.
 - 1** Interprets the next two bytes as a character (16-bit mode). LB and SM commands will read two bytes to form one 2-byte character code equal to $(\text{first_byte} * 256) + \text{second_byte}$. Label terminator and 8-bit control codes must be preceded by a NULL byte. To turn symbol mode off while in 16-bit mode, you must send SM<NULL>; where NULL is ASCII or decimal 0.
 - 2** Same logic as mode 0, except that vertical substitutes are used if found in a VT segment of the current font. Characters are rotated counter clock-wise to match the vertical-rotated printing mode of the Character Text Path Direction command. Default row_number equals "0".
 - 3** Same input logic as mode 1, except that vertical substitutes are used if found in a VT segment of the current font. Full width characters are rotated counter clock-wise to match the vertical-rotated printing mode of the Character Text Path Direction command.

- **Row Number.** Used only in modes 0 and 2 (8-bit modes) when a 16-bit character set is selected. The row number indicates the first byte while the LB or SM instruction will supply the second byte.

For example, if you send *LMO,37*, and you have selected a 16-bit character set, sending *LBAB<TERM>* would result in the device printing characters 65 and 66 from row 37 of the character set grid.

If you are using an 8-bit character set in 16-bit mode (modes 1 or 3), you must specify the first byte of each character as 0. All other first byte values are treated as undefined characters.

Notes:

- When LM switches modes, it turns off symbol mode (executes SM;).
- LM affects the way SM and LB interpret bytes.
- LM does not affect the DT or DL commands.
- DT allows 8-bit terminator definitions only. To terminate a label in 16-bit mode, precede the current label terminator by the null character (decimal 0). The only exception is the E_{cE} (Reset) instruction in dual-context devices. E_{cE} is executed regardless of the byte boundaries within LB and SM.

Vertical Writing with Proportional Fonts

The Character Text Path Direction command was introduced with the HP LaserJet 4PJ printer to allow users to vertically rotate Asian fonts which were dual pitched. That is, the single-byte characters were half-width and the other characters were full-width.

An algorithm was implemented to determine whether or not to counter-rotate characters when using the vertical-rotated printing mode of the Character Text Path Direction command. A character is rotated if the glyph is full-width; otherwise, the character is not rotated.

Since the introduction of the LaserJet 4PJ, many vendors have produced proportional versions of their Asian fonts. Thus, the algorithm described above is no longer appropriate for determining character rotation.

A new method to explicitly enumerate which characters should be counter-rotated in the font is being introduced with HP LaserJet 5 and 5M printers. The new method consists of adding an optional font segment to Font Format 16. The optional segment, which is called the Vertical Exception (VE) segment, has the following form:

```
UBYTE[2] SEGMENT ID           = 'VE'
UBYTE Format                   = 0
                               (other values reserved)
UBYTE NumRanges               = N
UINT16 Range1FirstCode
UINT16 Range1LastCode

    •
    •
    •
UINT16 RangeNFirstCode
UINT16 RangeNLastCode
```

The new algorithm for deciding whether or not to counter-rotate characters (when using the Character Text Path Direction command's vertical-rotated printing mode) is as follows:

```

if (the current font contains a VE segment)
{
    if(the character code* is NOT contained in
        a VE range)
        rotate
    else
        don't rotate
}
else
    use the old logic

```

* The original character code, even if a galley character were substituted at some point.

Examples:

	Japanese ShiftJIS		Japanese Unicode	
Segment ID	V	E	V	E
Format/NumRanges	0	1	0	2
Range1FirstCode	0x0000		0x0000	half-width latin characters
Range1LastCode	0x00FF		0x007F	
Range2FirstCode			0xFF61	half-width katakana
Range2LastCode			0xFF9F	

HP Color LaserJet 5 and 5M Printers

HP Color LaserJet 5 and 5M printers use new HP Image Resolution Enhancement technology 1200 (HP Image REt 1200) to project outstanding text, graphics, and more vibrant colors than before.

The HP Color LaserJet 5M printer is network-ready with genuine Adobe PostScript Level 2 software, 36 Mbytes of memory, and an HP JetDirect card. The HP Color LaserJet 5 printer is upgradable so you can tailor it to suit the needs of your particular environment.

HP Color LaserJet 5 and 5M printers can use glossy paper or transparency film for special output.

Modifications to the PCL language for HP Color LaserJet 5 and 5M printers are summarized in the table below and are described in detail in the *PCL 5 Color Technical Reference Manual* (P/N 5961-0940):

Table 2-15. PCL Feature Modifications for HP Color LaserJet 5 and 5M Printers

Feature	Status	Comments
Render Algorithm Command	Modified	Five new algorithms have been added.
Configure Image Data Command	Modified	Has unique functionality while in PCL Imaging mode.
Download Dither Matrix Command	Support	Not supported.
Driver Configuration Command	Support	Do not support all features of the function_index argument.
Download Pattern Command	Modified	Restricts the width and height of a user pattern to less than 16384 pixels.
Scale Algorithm Command	Support	Not supported.
Font Cartridges	Support	Not supported. Customized fonts, if needed, can be utilized via SIMMs.

Render Algorithm Command

The Render Algorithm command selects the algorithm to be used for rendering page marking entities on a given page.

$E_C^*t\#J$

- # = 0-14** - See section 4, "Modifying Output Color" in the *PCL 5 Color Technical Reference Manual* for information on algorithms 0 through 14.
- 15** - Continuous tone smooth 150 lpi
 - 16** - Monochrome continuous tone detail 300 lpi
 - 17** - Monochrome continuous tone smooth 150 lpi
 - 18** - Continuous tone basic 100 lpi
 - 19** - Monochrome continuous tone basic 100 lpi

Default = 3

Range = 0 to 19 (invalid values are ignored; values 1, 2, 9, and 10 are ignored for device-independent color)

HP Color LaserJet 5 and 5M printers remap non-continuous tone render algorithms (3 - 14) into continuous tone smooth (15) and monochrome continuous tone smooth (17) algorithms.

HP LaserJet 6P/ 6MP Printers

The HP LaserJet 6P and 6MP printers are similar to the LaserJet 5P and 5MP printers, with the addition of higher performance and faster print speed (up to 8 ppm). The PCL 5 feature set is identical to the LaserJet 5P/5MP printers, with the exception that the LaserJet 6P/6MP printers support some additional paper sizes (A5, JIS B5, JIS B4, and Oufuku-Hagaki postcards).

The HP LaserJet 6MP printer also includes the Adobe PostScript Level 2 printer language with 35 additional built-in PostScript fonts.

HP LaserJet 5Si Mopier

The HP LaserJet 5Si Mopier combines the performance and network strengths of the LaserJet 5Si/5SiMx printers with the ability to print, collate, and staple multiple copies of a document. The LaserJet 5Si Mopier has the same PCL feature set as the LaserJet 5Si/5Si printers, but allows you to download a document just once and then print as many originals as you need.

Multiple-original printing (“mopying”) and stapling is accomplished using PJI commands. The application software, using PJI commands, determines to which output bin the printed copy will be delivered. If the stapling bin is selected, the job is automatically stapled.

Note

Multiple copies are produced using the PJI SET QTY command. In order for the mopier to produce more than one original of a print job, the PCL *number of copies* command (`%c&l#X`) must not be included in the data stream, since this command will limit the job to one copy or produce multiple uncollated copies.

See the *PJI Printer Job Language Technical Reference Manual* for a PJI example of printing to the mopier.

HP LaserJet 6L and LaserJet 6L Gold Printers

The HP LaserJet 6L and LaserJet 6L Gold printers look like the LaserJet 5L printer and have an identical PCL feature set. At 6 pages-per-minute, they print two more pages per minute than the LaserJet 5L, contain the same standard typefaces, and support the same paper sizes. Like the LaserJet 5L, the LaserJet 6L and LaserJet 6L Gold printers do not have a control panel.

(Refer to Table 1-1, *HP LaserJet Printer Feature Comparison*, for the specific PCL implementation.)

HP LaserJet 4000 Series Printers

The HP LaserJet 4000 series printers are similar to the LaserJet 5/5M printers in their design and PCL feature set, with increased font support and 600 dpi support in PCL 5 (the printer offers 1200 dpi in PCL 6). The printers support a very similar set of paper sizes. (Refer to Table 1-1, *HP LaserJet Printer Feature Comparison*, for the specific PCL implementation.)

Note

The highest resolution you can access with PCL 5 is 600 dpi.

Selecting Paper Source

With the HP LaserJet 4000 series printer, the paper source commands are somewhat different than in Table 1-1B. The table below shows the commands for selecting the various paper sources.

Paper Source	Command
Manual Feed Tray (2)	<code>ESC&L2H</code>
MultiPurpose Tray (Tray 1)(4)	<code>ESC&L4H</code>
Tray 2 (first cassette)(1)	<code>ESC&L1H</code>
Tray 3 (second cassette)(5)	<code>ESC&L5H</code>
Tray 4 (third cassette)(8)	<code>ESC&L8H</code>
Envelope Feeder	<code>ESC&L6H</code>
External Trays (HCI)(20-59)	<code>ESC&L20H</code> to <code>ESC&L59H</code>

Selecting Output Bins

The paper source commands for the HP LaserJet 4000 printer are somewhat different than in Table 1-1B. The table below shows the commands for selecting the various output bins.

Output Bins	Command
Default (0)	<code>Ec&l0G</code>
Top Bin (face down)(1)	<code>Ec&l1G</code>
Face Up Bin (2)	<code>Ec&l2G</code>
External Bins (3-99)	<code>Ec&l3G</code> to <code>Ec&l99G</code>

Selecting Media Type

Besides using the Media Type command (`Ec&l#M`) to select a print media, with the LaserJet 4000 series printers you can also use the Paper Type command as follows:

(This command is actually a variation of the Alphanumeric ID command. For information on this command, see page 2-79.)

Paper Type	Command
Bond	<code>Ec&n5WdBond</code>
Plain	<code>Ec&n6WdPlain</code>
Color	<code>Ec&n6WdColor</code>
Labels	<code>Ec&n7WdLabels</code>
Recycled	<code>Ec&n9WdRecycled</code>
Letterhead	<code>Ec&n11WdLetterhead</code>
Cardstock	<code>Ec&n10WdCardstock</code>
Prepunched	<code>Ec&n11WdPrepunched</code>
Preprinted	<code>Ec&n11WdPreprinted</code>
Transparency	<code>Ec&n13WdTransparency</code>
Custom	<code>Ec&n#WdCustomType¹</code>
¹ For custom paper, replace "CustomType" with the name of the paper, and replace the "#" with the number of characters in the name, plus 1.	

HP LaserJet 5000 Series Printers

The HP LaserJet 5000 series printers have a nearly identical feature set as the HP LaserJet 4000 series printers. The LaserJet 5000 series printers support a set of paper sizes similar to the HP LaserJet 4V/4MV printers.

Selecting Paper Source

With the HP LaserJet 5000 series printer, the paper source commands are somewhat different than in Table 1-1B. The table below shows the commands for selecting the various paper sources.

Paper Source	Command
Manual Feed Tray (2)	$\text{E}_\text{C}\&\text{l}2\text{H}$
MultiPurpose Tray (Tray 1)(4)	$\text{E}_\text{C}\&\text{l}4\text{H}$
Tray 2 (first cassette)(1)	$\text{E}_\text{C}\&\text{l}1\text{H}$
Tray 3 (second cassette)(5)	$\text{E}_\text{C}\&\text{l}5\text{H}$
Tray 4 (third cassette)(8)	$\text{E}_\text{C}\&\text{l}8\text{H}$
Envelope Feeder	$\text{E}_\text{C}\&\text{l}6\text{H}$
External Trays (HCI)(20-39)	$\text{E}_\text{C}\&\text{l}20\text{H}$ to $\text{E}_\text{C}\&\text{l}39\text{H}$

Selecting Output Bins

The paper source commands for the HP LaserJet 5000 printer are somewhat different than in Table 1-1B. The table below shows the commands for selecting the various output bins.

Output Bins	Command
Default (0)	$\text{E}_\text{C}\&\text{l}0\text{G}$
Top Bin (face down)(1)	$\text{E}_\text{C}\&\text{l}1\text{G}$
Face Up Bin (2)	$\text{E}_\text{C}\&\text{l}2\text{G}$
External Bins (3-99)	$\text{E}_\text{C}\&\text{l}3\text{G}$ to $\text{E}_\text{C}\&\text{l}99\text{G}$

Selecting Media Type

Besides using the Media Type command (`Ec&l#M`) to select a print media, with the LaserJet 5000 series printers you can also use the Paper Type command as follows:

(This command is actually a variation of the Alphanumeric ID command. For information on this command, see page 2-79.)

Paper Type	Command
Bond	<code>Ec&n5WdBond</code>
Plain	<code>Ec&n6WdPlain</code>
Color	<code>Ec&n6WdColor</code>
Labels	<code>Ec&n7WdLabels</code>
Recycled	<code>Ec&n9WdRecycled</code>
Letterhead	<code>Ec&n11WdLetterhead</code>
Cardstock	<code>Ec&n10WdCardstock</code>
Prepunched	<code>Ec&n11WdPrepunched</code>
Preprinted	<code>Ec&n11WdPreprinted</code>
Transparency	<code>Ec&n13WdTransparency</code>
Custom	<code>Ec&n#WdCustomType¹</code>
¹ For custom paper, replace "CustomType" with the name of the paper, and replace the "#" with the number of characters in the name, plus 1.	

HP LaserJet 8000 Series Printers

The HP LaserJet 8000 is a 24-ppm printer with 600 dpi support in PCL 5 (the printer offers 1200 dpi in PCL 6). It has built-in mopy capability, which is enabled when at least 16 Mb of memory or a disk drive are installed.

The LaserJet 8000 series printers are direct replacements for the LaserJet 5Si, LaserJet 5SiMx, and LaserJet 5Si Mopier printers. They support the same PCL 5 commands and options, except as described below.

The LaserJet 8000 series printers use the same PCL 5 implementation as found in the LaserJet 4000 series, and support exactly the same PCL 5 and HP-GL/2 commands as the LaserJet 4000 series. They support the same options to the PCL 5 command set, with the exceptions listed below.

Selecting Paper Source

The HP LaserJet 8000 series printers support the same option set as the LaserJet 5Si printer. This is a superset of what the LaserJet 4000 series supports.

Page Size

The LaserJet 8000 series printers do not support ledger, A3, or JIS B4 paper. It does support A5 paper, which the 5Si did not support.

Advance Full Page HP-GL/2 Command

The LaserJet 8000 series supports the HP-GL/2 Advance Full Page command (PG). The LaserJet 5Si printer does not support this command.

HP LaserJet 8100 Series Printers

The HP LaserJet 8100 series printers are 32-ppm printers with 600 dpi support in PCL 5. They are a direct replacement for the LaserJet 8000 series, and support exactly the same PCL 5 commands and options as the LaserJet 8000 printers. It includes built-in mopy support, which is enabled when 16 Mb of memory or a disk drive are installed.

HP Color LaserJet 4500 Series Printers

The HP Color LaserJet 4500 printer is the third in the series of Color LaserJet printers that started with the HP Color LaserJet printer. It is a 600 dpi device with 8-bit continuous tone support on each color channel. This means the printer uses 24 bits to represent each color it prints.

This printer can be considered as the direct descendent of the HP Color LaserJet 5 and the HP LaserJet 5 printers, since it combines the PCL 5 features of both. For example, the Text Parsing methods are supported as in the LaserJet 5, while such color features as Palette, Monochrome Print Mode, and Foreground Color commands are supported in the Color LaserJet and Color LaserJet 5 printers.

The HP Color LaserJet 4500 printer is also very much like a LaserJet 4000 series printer, with respect to PCL 5. With very few exceptions, the LaserJet 4500 supports the same PCL 5 and HP-GL/2 commands and options as the LaserJet 4000 printer. The differences are listed below.

The HP Color LaserJet 4500N printer is the network-ready version of the base model (4500) printer. It includes an HP JetDirect card and 32 Mb of additional memory. The HP Color LaserJet 4500DN printer is network-ready, with an HP JetDirect card, duplexer, 500-sheet paper tray, and 32 Mb of additional memory.

Simplified Color Management

The HP Color LaserJet 4500 does represent a significant departure from the HP Color LaserJet and Color LaserJet 5 printers in the area of color specification and management. The use of sRGB (Standard RGB) greatly simplifies the process of matching colors displayed on a color monitor with those in the printed document. Furthermore, an examination of customers and the way they use HP Color LaserJet printers allowed HP to simplify the color command set without any decrease in color print quality, print speed, or color matching.

Color Raster Images

The suggested method for printing color images is by using 24-bit, direct color pixels with delta row compression. The 24-bit, direct color is specified using the Configure Image Data command. Delta row compression is recommended over run length, or TIFF pack bits since 24-bit, direct color uses three bytes per pixel so there is little redundancy from one byte to the next. Delta row compression exploits the redundancy from row to row, and therefore yields better compression than any other supported PCL compression mode.

Asian Font Support

The following commands are supported especially for Asian font printing:

- Character Text Path Direction
- Text Parsing Method
- 2-byte characters
- HP-GL/2 Label allows 2-byte characters.

Media Handling

The HP Color LaserJet 4500 printer has two standard paper trays and one optional tray. They are accessed as follows:

Tray	Description	Command
Tray 1	Multi-purpose paper tray. This is the upper-most paper input tray and has a retractable paper support.	<code>^C&l4H</code>
Tray 2	Lowest standard paper tray	<code>^C&l1H</code>
Tray 3	Optional 500-sheet input paper tray. When installed, it is the bottom tray.	<code>^C&l5H</code>

Paper can be selected by requesting a media type using the Paper Type command (`^C&n#Wdpapertype`, where # is the number of characters in “*papertype*”). For example, the command to select Color paper is `^C&n6WdColor`. To select “Prepunched” the `^C&n11WdPrepunched` command would be used.

The following paper types are supported:

Paper Type	Command
Bond	E _c &n5WdBond
Plain	E _c &n6WdPlain
Color	E _c &n6WdColor
Labels	E _c &n7WdLabels
Recycled	E _c &n9WdRecycled
Letterhead	E _c &n11WdLetterhead
Cardstock	E _c &n10WdCardstock
Card stock	E _c &n11WdCard stock
Prepunched	E _c &n11WdPrepunched
Preprinted	E _c &n11WdPreprinted
Transparency	E _c &n13WdTransparency
Custom	E _c &n#WdCustomType ¹
Rough	E _c &n6WdRough
Vellum	E _c &n7WdVellum
Heavy	E _c &n6WdHeavy
Gloss	E _c &n6WdGloss
Default	E _c &n8WdDefault
¹ For custom paper, replace “CustomType” with the name of the paper, and replace the “#” with the number of characters in the name, plus 1.	

Sending the “Default” paper type will cancel any previous media type request that may be in effect, and stops selection of media by type. Note that both “Card Stock” and “Cardstock” are supported.

Note

When the printer is set to TRAY1=FIRST and paper is in tray 1, the printer will use the paper from tray 1 without regard to the media source and page size commands. The page will be formatted to the size specified in the page size command, but will be printed on the paper from tray 1. This default behavior can be avoided by either setting TRAY1= CASSETTE, or by only placing special media such as overhead transparencies in tray 1.

New Paper Sizes

The HP Color LaserJet 4500 printer supports ISO A5 and B5 paper sizes.

Forms Support

Forms are supported by the use of PCL macros which also include support for HP-GL/2 commands.

Alphanumeric ID Command

The HP Color LaserJet 4500 printer supports all the options of the Alphanumeric ID command. However, since the HP Color LaserJet 4500 does not support a disk drive, associations can only be made with non-disk-based fonts or macros. For more information on the Alphanumeric ID command, see page 2-79.

Color Space Support

The supported color spaces are Standard RGB (sRGB), Device RGB, and Device CMY. Standard RGB replaces Colorimetric RGB (cRGB). All other color spaces supported in the HP Color LaserJet or Color LaserJet 5 are not supported in the HP Color LaserJet 4500 printers.

Changes to PCL 5 Color Commands

The focus of the printer's color support is on WYSIWYG color usage and a simplified usage model. A number of PCL 5 color commands introduced in the HP Color LaserJet and supported in the Color LaserJet 5 printer have been made obsolete as a direct result of using Standard RGB color to achieve WYSIWYG color. Furthermore, several commands have been modified to match the predicted use of the HP Color LaserJet 4500 printer.

PCL 5 Commands No Longer Supported or Greatly Simplified

- **Driver Function Configuration** — This command had five options for the HP Color LaserJet and Color LaserJet 5 printers: Lightness, Saturation, Scaling Algorithm, Select Color Treatment, and Download Color Map. Select Color Treatment is the only option supported on the HP Color LaserJet 4500 printer. The range of values has been reduced to two choices: Vivid (2) (no color adjustment) and Screen Match (6).
- **Raster Destination and Raster Width** — four decimal places of precision were added to avoid rounding errors when converting to pixels.
- **Picture Frame Scaling Command** — four decimal places of precision were added to avoid rounding errors.
- **Configure Image Data** — This command had two major forms, the short form which selected default values for each of the color spaces specified, and the long form which allowed a complete specification of the parameters that characterize the color spaces. The long form of the command is not supported on this printer since the Luminance-Chrominance, CIE $L^*a^*b^*$, and Colorimetric RGB (cRGB) color spaces are not supported. The supported color spaces are Standard RGB (sRGB), Device RGB, and Device CMY. The sRGB color space is selected using the same value as cRGB to enable files printed with the Color LaserJet and Color LaserJet 5 drivers to take advantage of the Color LaserJet 4500's use of sRGB for WYSIWYG color. Furthermore, the specification of white and black points for the Device RGB and CMY color spaces, and the HP-GL/2 Color Range command, is not supported.

- **Render Algorithms** — There are no new algorithms for this command that had twenty different algorithms, of which almost half of them were monochrome equivalents of color algorithms. The following table lists the algorithms that are supported:

Algorithm	Command
Contone Best (High LPI)	E_C*t0J
Device Best (Best)	E_C*t3J
Smooth Contone (High LPI)	E_C*t15J
Basic Contone (Low LPI)	E_C*t18J

The monochrome algorithms are no longer supported since there are no applications which allow the user to specify that a color image should sometimes be printed in color and other times in black and white. The remainder of the algorithms are not supported as they are not needed for quality WYSIWYG color printing.

- **Download Dither Matrix** — Not supported
- **Color Lookup Tables** — Not supported since it does not support WYSIWYG color.
- **Gamma Correction** — Not supported since it does not support WYSIWYG color.
- **Viewing Illuminant** — Not supported since it does not support WYSIWYG color.
- **Monochrome Print Mode** — This command is only supported at the beginning of a job, since user applications only support the choice of monochrome printing of color documents for an entire document.

New PCL 5 Commands

The Finish Mode command allows the user to specify the finish, matte or glossy, to be applied to the document. A normal page has a matte finish. Glossy finish can be requested to be applied to the page as it is printed. The finish is distinct from the type of media. Therefore, a matte finish can be requested for glossy media, and a glossy finish can be requested for plain or matte paper.

ESC b #F

- # = 0** - Matte finish
- 1** - Glossy finish

Default = 0

Range = 0, 1 (command is ignored for invalid values)

The finish mode must be set before the first page is marked and applies to all the pages in the document. Each document defaults to a matte finish.

Differences with the HP LaserJet 4000 Series Printers

The HP Color LaserJet 4500 series printers support the color extensions to PCL 5e and HP-GL/2, commonly known as PCL 5c. The HP LaserJet 4000 series printers do not support any of these commands.

Windows driver output from a LaserJet 4000 series printer driver will print correctly on the Color LaserJet 4500 printer. However, driver output from a Color LaserJet 4500 series driver does not print well on the LaserJet 4000 series because the HP LaserJet 4000 series printers do not have PCL 5c support.

- The HP Color LaserJet 4500 printer supports JIS B4, Hagaki Postcard, and Oufuku-Hagaki Postcard paper sizes. The LaserJet 4000 series printers do not.
- The HP LaserJet 4500 series printers do not support the envelope feeder options of the Page (Media) Source command, because these devices do not exist for the HP Color LaserJet 4500 printer. Envelopes are fed into the Color LaserJet 4500 printer using the multipurpose tray, and selected using that option.
- The HP Color LaserJet 4500 printer ignores the external bin options to the Output Destination Bin command ($\text{\textasciix{27}}\text{\textasciix{92}}\text{\textasciix{64}}\text{\textasciix{77}}$), because no external bins can exist on the HP Color LaserJet 4500 printer.
- The HP Color LaserJet 4500 printer does support setting the raster destination width and height commands, as well as transferring raster data by plane. The HP Color LaserJet 4000 printer does not support these commands.
- The HP Color LaserJet 4500 printer does not support the Free Space ($\text{\textasciix{27}}\text{\textasciix{92}}\text{\textasciix{64}}\text{\textasciix{83}}$) or Flush All Pages ($\text{\textasciix{27}}\text{\textasciix{92}}\text{\textasciix{64}}\text{\textasciix{70}}$) status readback commands. The LaserJet 4000 printer supports these commands, and manages its memory itself (as the Color LaserJet 4500 printer does).
- The HP Color LaserJet 4500 printers do not support the HP-GL/2 Advance Full Page (PG) command, which the LaserJet 4000 printer does support.

HP Color LaserJet 8500 Series Printers

The HP Color LaserJet 8500 series printer is a high-end color laser printer. The printer is based on the feature set of the HP LaserJet 5Si printer, with the addition of color and an EIO interface. The color features are similar to the HP Color LaserJet 4500 series printer.

Asian Font Support

Two-byte printing is not supported, however, the PCL driver allows the user to print two-byte characters.

Paper Types and Sizes

The printer can print a number of media types and sizes, including: letter-size, A4, A3, ledger (11 x 17), envelopes, card stock, labels, and heavy media up to 58 pound (216 g/m²) bond. Depending on the paper size and type, the optional duplex printing accessory enables color printing on two sides.

Paper Trays

The printer has two 500-sheet input trays (trays 2 and 3) that support letter, legal, and A4-sized media. In addition, tray 3 supports 11 x 17 inch and A3-sized media. Tray 1, a 100-sheet multipurpose tray, supports such media sizes and types as letter, legal, executive, A4, and custom-sized media (up to 12 x 18.5 inch), as well as envelopes, labels, and card stock. In addition to these three trays, an optional tray can be installed that holds up to 2,000 sheets of paper.

Proof and Print

The Proof and Print feature allows you to print one copy of a job for proofreading and then quickly and easily print any remaining copies from the printer control panel. To use this feature, an optional hard disk is required in the printer.

HP LaserJet 1100 Series Printers

The HP LaserJet 1100 series printers are similar to the LaserJet 6L printers. They have an identical PCL feature set. At 8 pages-per-minute, they print two more pages per minute than the HP LaserJet 6L, contain the same standard typefaces (except the Line Printer font), and support the same paper sizes. Like the LaserJet 6L, the HP LaserJet 1100 series printers do not have a control panel.

(Refer to Table 1-1, HP LaserJet Printer Feature Comparison, for the specific PCL implementation.)

HP LaserJet 2100 Series Printers

The HP LaserJet 2100 series printers are versatile 10 page-per-minute laser printers designed for small workgroups and individuals with advanced printing needs. These printers offer 600 dpi support in PCL 5 (and 1200 dpi in PCL 6).

The HP LaserJet 2100 series printers have nearly the same PCL 5 feature set as the HP LaserJet 4000 series printers. Some of the specific feature differences are listed below (Refer to Table 1-1, HP LaserJet Printer Feature Comparison, for the specific PCL implementation.)

Selecting Paper Source

The table below shows the commands for selecting the various paper sources.

Paper Source	Paper Source
First Available Tray (7)	$\text{E}_\text{C}\&\ell 7\text{H}$
Manual Feed Tray (2)	$\text{E}_\text{C}\&\ell 2\text{H}$
Tray 1 (4)	$\text{E}_\text{C}\&\ell 1\text{H}$
Tray 2 (1)	$\text{E}_\text{C}\&\ell 4\text{H}$
Tray 3 (5)	$\text{E}_\text{C}\&\ell 5\text{H}$

Selecting Output Bins

Unlike the HP LaserJet 4000 printer, the HP LaserJet 2100 series printers have no selectable output bins. All output lands in the one standard output bin.

Selecting Media Type

The HP LaserJet 2100 series printers do not support the Paper Type command.

