

Command Reference Manual

PCL 5e

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1. DESCRIPTIONS OF CONTROL CODES HP LASERJET 5 EMULATION

1.1 Job Control Commands

Job Control Commands List

No.	Command	Code
1	Reset	ESC E
2	Universal Exit Language	ESC % -12345 X
3	Number of Copies	ESC & I # X
4	Simplex/Duplex Print	ESC & I # S
5	Left Edge Offset Registration	ESC & I # U
6	Top Offset Registration	ESC & I # Z
7	Duplex Page Side Selection	ESC & a # G
8	Units of Measure	ESC & u # D
9	Pixel Placement	ESC & I # R

1) Reset

Code : ESC E

Function : a. This command causes the printer to print remaining partial page of data which has been received, and then resets all of the programmable features to their default values.

Details : a. Following the reset, the printer remains on line and no data is lost.
b. When reset is sent to printer, at power-on, or when RECOVER switch is held down, starting cursor position becomes the position of default top margin and left margin settings. After reset, there are 60 printable lines (10 inches at 6 lines per inch).
c. Page Length, orientation, top margin, left margin and line spacing can be changed after Reset is received, but only prior to the reception of the first printable character.
d. After setting the starting cursor position, changes to page length or orientation causes from feed and carriage return.
e. The following table lists the default values:

PCL DEFAULTS * set to user default per operator panel

JOB CONTROL:

Number of Copies*	-	1
Registration	-	left = 0, top = 0
Tray*	-	Selected by control panel
Manual Feed*	-	Selected by control panel
Unit of Measure	-	300

PAGE CONTROL:

Print Direction	-	0
Orientation*	-	Portrait
Page Size*	-	Letter
Paper Source	-	Tray
Vertical Motion Index*	-	8 (6 lpi)
Horizontal Motion Index	-	12 (10 cpi)
Top Margin	-	0.5 inch (150 dots)
Text Length	-	Letter size 0.5" top margin 0.5" bottom margin
Left Margin	-	Left logical page boundary
Right Margin	-	Right logical page boundary
Perforation Skip	-	On
Line Termination	-	CR = CR, LF = LF, FF = FF

FONTS: Both Primary and Secondary fonts

Symbol Set*	-	PC-8
Spacing*	-	Fixed
Font Pitch*	-	10 cpi
Font Height*	-	12 point
Font Style	-	Upright
Font Stroke Weight	-	Medium
Font Type Face	-	Courier
Font Source	-	Resident
Underlining	-	Off

PCL DEFAULTS

FONT MANAGEMENT:

Font ID	-	0
Character Code	-	0
Symbol Set ID	-	0

RASTER GRAPHICS:

Left Margin	-	0
Resolution	-	75 dpi
Compression Method	-	0
Raster Height	-	N/A
Raster Width	-	Logical page width
Presentation Mode	-	3

PRINT MODEL:

Current Pattern	-	Solid
Source Transparency Mode	-	0 (transparent)
Pattern Transparency Mode	-	0 (transparent)
Pattern Reference Point	-	0
Pattern Rotation	-	0

RECTANGULAR AREA FILL:

Horizontal Rectangle Size	-	0
Vertical Rectangle Size	-	0
Area Fill ID	-	0

STATUS READBACK:

Current Location Type	-	0
Current Location Unit	-	0

PICTURE FRAME:

Picture Frame Width	-	Logical page width
Picture Frame Height	-	Text length
Picture Frame Anchor Point	-	Left edge logical page and 0.5" from top logical page
HPGL/2 plot horizontal size	-	Picture frame horizontal size
HPGL/2 plot vertical size	-	Picture frame vertical size

MACRO:

Macro ID	-	0
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TROUBLESHOOTING COMMANDS:

End-of-Line Wrap	-	Off
Display Functions	-	Off

Note : If Font Cartridge is installed, the Font Cartridge default (if present) will override the resident font default.

HPGL DEFAULTS

CHARACTER GROUP:

Symbol Set	-	PC-8
Font Spacing	-	Fixed
Pitch	-	10 cpi
Height	-	12 point
Posture	-	Upright
Stroke Weight	-	Medium
Typeface	-	HPGL Stick
Character Direction	-	Horizontal
Character Direction Mode	-	Absolute
Character Size Mode	-	Size transformation off
Character Width	-	N/A
Character Height	-	N/A
Character Slant	-	0
Extra Horizontal Space	-	0
Extra Vertical Space	-	0
Character Fill Mode	-	no edging and solid fill
Label Origin	-	1
Label Terminator	-	EXT (03 hex)
Transparent Data Mode	-	Off
Primary Font ID	-	0
Secondary Font ID	-	0
Scalable or Bitmap Font	-	Scalable only

VECTOR GROUP:

Plotting Mode	-	Absolute
Pen State	-	Up

POLYGON GROUP:

Polygon Buffer	-	Cleared
Polygon Mode	-	Off

LINE AND FILL ATTRIBUTE GROUP:

Line Type	-	Solid
Line Type Repeat Length	-	4% of diagonal P2-P1
Line Cap	-	Butt
Line Join	-	Mitered
Miter Limit	-	5
Pen Width	-	3 dots
Pen Width Selection Mode	-	Metric
Selected Pen	-	0 (no pen)
Symbol Mode	-	Off
Fill Type	-	Solid (bi-directional)
User-defined Line Type	-	Solid fill
Anchor Corner	-	Lower left
User-defined Fill Type	-	1 (solid)

PALETTE EXTENSION:

Number of Pens	-	2
Transparency Mode	-	On (transparent)
Screened Vector	-	No screening

HPGL DEFAULTS

CONFIGURATION AND STATUS GROUP:

Scale Mode	-	Off
Window	-	PCL default picture frame logical horizontal page 0.5" from logical page top & bottom
Coordinate System Orientation - P1, P2	-	Orientation of default PCL logical page P1 = lower left corner of picture frame P2 = upper right corner of picture frame

2) Universal Exit Language

Code : ESC % -12345 X

Function : a. Return to Printer Job Language (PJM) mode.
b. Prints all data received before the command.
c. Deletes temporary fonts, macros, user-defined symbol sets and patterns.

3) Number of Copies

Code : ESC & I # X

Function : a. Designates the number of printed copies.

Details : a. The value # specifies the number of copies (1 to 32,767).
b. # = 0 is ignored.
c. Each-page designation is possible, but in Duplex, printing will be performed according to the number of copies for the reverse side.

4) Simplex/Duplex Print

Code : ESC & I # S

Function : a. One-sided printing/both-sided printing is selected.
b. The printer does not support the duplex printing feature, but prints the current data when printer receives this command.

Details : a. # = 0 : Simplex Print
1 : Duplex Print, Long-Edge Binding
2 : Duplex Print, Short-Edge Binding

5) Left Edge Offset Registration

Code : ESC & I # U

Function : a. Specifies the Left Edge (Long Edge) Offset in decipoints.

Details : a. The value specifies the distance from the coordinate origin point in unit of 1/720 inches. The value is signed number valid to 2 decimal places.
b. Positive values cause the logical page to move right, and negative values to move left.
c. Purpose is to move logical page for ease of binding.
d. This command has same effect regardless of orientation selected.
e. Use of this command may cause loss of data by moving logical page outside printable area.

6) Top Offset Registration

Code : ESC & I # Z

Function : a. Specifies the Top Edge (Short Edge) Offset in decipoints.

Details : a. The value specifies the distance from the coordinate origin point in unit of 1/720 inches. The value is signed number valid to 2 decimal places.
 b. Positive values cause the logical page to move down, and negative values to move up.
 c. Purpose is to move logical page for ease of binding.
 d. This command has same effect regardless of orientation selected.
 e. Use of this command may cause loss of data by moving logical page outside printable area.

7) Duplex Page Side Selection

Code : ESC & a # G

Function : a. The printing side for both-sided printing is designated.
 b. The printer does not support the duplex printing feature, but prints the current data when printer received this command.

Details : a. # = 0 : Next side is designated (Select next side)
 1 : Front side is designated (Select front side)
 2 : Back side is designated (Select back side)

8) Units of Measure

Code : ESC & u # D

Function : a. Establishes the unit of measure for PCL unit cursor movement.
 The value # specifies the number of units-per-inch. The default is 300.

#	PCL Units	#	PCL Units
0 – 96	96	361 – 400	400
97 – 100	100	401 – 450	450
101 – 120	120	451 – 480	480
121 – 144	144	481 – 600	600
145 – 150	150	601 – 720	720
151 – 160	160	721 – 800	800
161 – 180	180	801 – 900	900
181 – 200	200	901 – 1200	1200
201 – 225	225	1201 – 1440	1440
226 – 240	240	1441 – 1800	1800
241 – 288	288	1801 – 2400	2400
289 – 300	300	2401 – 3600	3600
301 – 360	360	3601 – 32767	7200

Details : a. The value field defines the number of units-per-inch in the following commands:
 – Vertical cursor position
 – Horizontal cursor position
 – Vertical rectangle size
 – Horizontal rectangle size
 b. PCL unit defines the default Horizontal Index Movement (HMI) value.

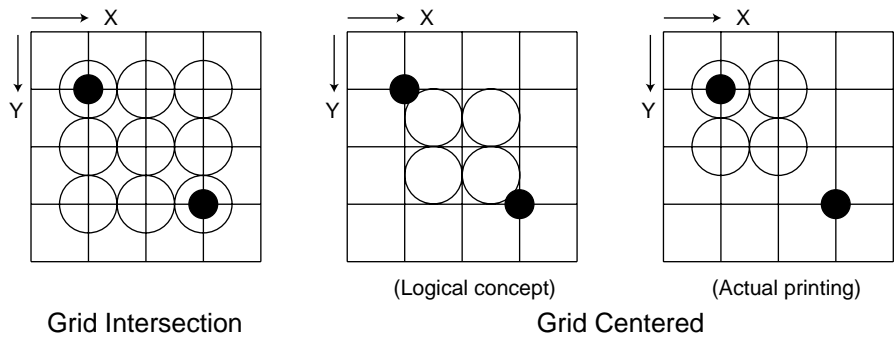
9) Pixel Placement

Code : ESC & I # R

Function : a. The position of pixel on the grid is designated in drawing an image.

Details : a. # = 0 : Grid intersection
1 : Grid Centered.

- b. In default, designating a value other than 0 and 1 for 0 will disable a command.
- c. This command affects the environment in GL/2 mode.
- d. The difference of printing between 'Grid Intersection' and 'Grid Centered' is as follows.



In Grid Centered, the pixel position is not actually moved, but the data in which each 1 dot is subtracted from an image at the right and bottom side is printed.

1.2 Page Control Commands

Page Control Commands List

No.	Command	Code
1	Page Size	ESC & I #A
2	Paper Source Control	ESC & I #H
3	Page Orientation	ESC & I # O
4	Print Direction	ESC & a # P
5	Set Left Margin	ESC & a # L
6	Set Right Margin	ESC & a # M
7	Clear Horizontal Margins	ESC 9
8	Page Length	ESC & I # P
9	Set Top Margin	ESC & I # E
10	Text Length Selection	ESC & I # F
11	Skip Over Perforation	ESC & I # L
12	Horizontal Motion Index (HMI)	ESC & k # H
13	Vertical Motion Index (VMI)	ESC & I # C
14	Line Spacing	ESC & I # D

1) Page Size

Code : ESC & I #A [# = ASCII type number]

Function : a. The Paper Size command selects the desired paper size or envelope size specified.

Details : a. Allowed paper size settings are below.

PAPER:

# =	1 - Executive	7-1/4 x 10-1/2 in.
	2 - Letter	8-1/2 x 11 in.
	3 - Legal (14 in.)	8-1/2 x 14 in.
	4, 9 - Legal (13 in.)	8-1/2 x 13 in.
	26 - A4	210 mm x 297 mm.
	25, 27 - A5	148 mm x 210 mm.
	24, 28 - B4	105 mm x 148 mm.
	37, 100 - B5	182 mm x 253 mm.

ENVELOPES:

# =	80 - Monarch	3-7/8 x 7-1/2 in.
	81 - Com-10	4-1/8 x 9-1/2 in.
	127 - Com-9	3-7/8 x 8-7/8 in.
	90 - International DL	110 mm x 220 mm.
	91 - International C5	162 mm x 229 mm.
	126 - International C4	229 mm x 324 mm.

b. Upon receipt of this command any unprinted pages are printed, the top margin, text length, and left and right margins are set to their user defaults, and any macro overlay is disabled.

2) Paper Source Control

Code : ESC & I #H [# = ASCII type number]

Function : a. Designates the location of paper input.

Details : a. Value fields specifies method of paper input per following values.

= 0 : Print the current page (paper source remains unchanged).

1 : Feed paper from standard (1st) tray.

2 : Feed paper from manual slot (Front Feeder).

3 : Feed envelope from manual slot (Front Feeder).

4 : Feed paper from optional lower (2nd) tray.

6 : Feed envelope from optional multi-feeder tray.

9 : Feed paper from optional 3rd tray.

b. When the command is received during formatting of a page, the current page formatting is immediately halted and a form feed and carriage return are executed. The next page will be fed as specified by the command.

c. This command remains effective until another tray is selected.

d. If specified paper tray is not installed, command is ignored.

e. The designated value (#) for each tray of Front, 2nd and 3rd can be changed in the maintenance menu.

3) Page Orientation

Code : ESC & I # O [# = ASCII type number]

Function : a. Print from left to right across the width of the paper (portrait mode) or along the length of the paper (landscape).

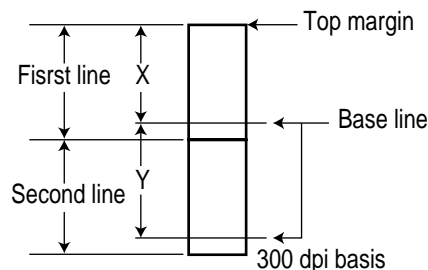
- Details : a. # = 0 : Select Portrait
1 : Select Landscape
2 : Select Reverse Portrait
3 : Select Reverse Landscape
- b. This sequence must be sent at the beginning of a page. All data received prior to this command, but after the previous Form Feed, will be printed and a Form Feed and carriage return will be executed.
- c. Switching print orientation causes page length, top margin text length, left margin, right margin, HMI and VMI to default. If a specified orientation is the same as the current orientation, this command will not affect any commands.
- d. Changing font orientation causes primary and secondary character fonts to be re-evaluated based on the new orientation.
- e. All fonts are automatically rotated to the current orientation as required.

4) Print Direction

Code : ESC & a # P [# = ASCII type number]

Function : a. Rotates the logical page coordinate system with respect to the current page orientation.
b. Value specifies the rotation angle in 90 degree increments in a counter-clockwise direction.

- Details : a. # = 0 - 0 degree rotation
90 - 90 degree ccw rotation
180 - 180 degree ccw rotation
270 - 270 degree ccw rotation
- b. The factory default is 6 LPI. The user default can be selected from the control panel.
- c. If request for a line spacing which is not supported is made, command is ignored.
- d. If specified LPI is a pitch which is not multiple of an integer of dot line; places after the decimal point are rounded down and the number of dot lines is corrected to have each line positioned as close to the edge of printable area as possible.
- e. Relation between LPI and Position of Base Line. Paste Up.



- f. At the top of the page, when LPI is changed, cursor position moves in relation to the top margin.
- g. After the commands listed below are received, cursor is not affected by LPI commands:
1. Printable codes
 2. CR, LF, Half LF
 3. Vertical positioning command

5) Set Left Margin

Code : ESC & a # L [# = ASCII type number]

Function : a. Left margin is specified by column number indicated by #.
b. Left margin setting may be overridden by Horizontal cursor position.

Details : a. Column positions vary depending on the print pitch of the character font selected (or space character width for proportional font).
b. Default margin is column zero for the left margin. Range is 0 to right margin.
c. Left and Right margins are cleared by ESC 9 sequence.
d. Priority between left and right margins depends on which is set first.
e. The following is margin limitation in conjunction with horizontal position settings:
1. Set print start position left of LM; data is printed and left margin is ignored for current line.
f. If LM is set left of current position, the current position does not change.

6) Set Right Margin

Code : ESC & a # M [# = ASCII type number]

Function : a. Right margin is specified by column number indicated by #.
b. Right margin setting may be overridden by Horizontal cursor position.

Details : a. Column positions vary depending on the print pitch of the character font selected (or space character width for proportional font).
b. Default margin is column zero for the left margin. Range is 0 to right margin.
c. Left and Right margins are cleared by ESC 9 sequence.
d. Priority between left and right margins depends on which is set first.
e. The following is margin limitation in conjunction with horizontal position settings:
1. Set print start position right of RM; data is printed within printable area of page.
f. If RM is set right of current position, setting becomes valid without sending CR.

7) Clear Horizontal Margins

Code : ESC 9

Function : a. The escape sequence is used to clear the left and right margins.
b. The margins are set to their default values.

Details : a. Sends a carriage return (CR) following to ESC 9 to return the cursor to the left margin.

8) Page Length

Code : ESC & I # P [# = ASCII type number]

Function : a. Page length specified in number of lines using the selected line spacing.

Details : a. Allowable page length settings are below.

Paper Size	Portrait		Landscape	
	6 lpi	8 lpi	6 lpi	8 lpi
Letter	66	88	51	68
Legal	84	112	*	*
Executive	63	84	43	58

- * To print a legal size page in landscape mode, first set the page length while in portrait mode (ESC & I 184 P) then select landscape mode (ESC & I 1 O). If range specified above is exceeded, an error occurs, but the setting remains valid.
- b. If a paper size greater than maximum (Portrait = 14", Landscape = 8.5") is requested, the page length command is ignored.
- c. If the vertical line spacing is set to zero, this command is ignored.
- d. Plus and minus signs as well as decimal point are ignored.
- e. If zero line is specified, the page length is set to the default.
- f. Default is determined from currently selected tray size.
- g. This command defaults the top margin, text length, left margin, right margin and cursor point.
- h. If the printer is in the manual feed mode, the page length defaults to the currently set paper size.
- i. When the printer receives the command, it prints the buffered pages that are stored in the printer (before requesting a change).
- j. If the specified page length is less than or equal to 1 inch, the perforation skip is ignored or off.
- k. If the specified page length is less than equal to 0.5 inch, the top margin is ignored along with the perforation skip.

9) Set Top Margin

Code : ESC & I # E [# = ASCII type number]

Function : a. Specifies the number of lines to skip at the top of page.
b. Margin may range from zero to page length.

Details : a. Setting a valid top margin causes the text length to be defaulted.
b. Top margin settings of 0 or 1 results in data loss due to printing in the unprintable region.
c. Within 0.25 inch from all sides of paper is non-printable area.
d. Top margin may be specified anywhere within a page.
e. In order to begin printing at top margin; vertical cursor must be moved to line 0 after top margin is set. Otherwise, printing begins at current cursor position on current page.
f. If vertical motion index is set to zero or if a top margin beyond current page length is selected, command is ignored.
g. Once top margin is set, changes to vertical line spacing do not affect it.
h. When top margin changes, absolute cursor position does not change.
i. Plus and minus signs are ignored along with decimal points.

10) Text Length Selection

Code : ESC & I # F [# = ASCII type number]

Function : a. Specifies the number of lines of text to be placed on one page.

Details : a. If text length is greater than page length minus the top margin, command is ignored.
b. Default text length is 1/2 inch less than the maximum allowable text length.
c. If top margin is set after text length is set, the command for text length is ignored.
d. If text length is set including non-printable area (0.25" from top and bottom), data to be printed in this region is ignored.
e. Plus and minus signs are ignored along with decimal points.
f. If a text length of zero is sent to the printer, the text length is defaulted.
g. If the print orientation, page length or top margin is changed, the text length is defaulted.

11) Skip Over Perforation

Code : ESC & I # L

Function : a. ON/OFF of skip Over Perforation is selected.

Details : a. # = 0 : Skip Over Perforation OFF.
1 : Skip Over Perforation ON.
b. If a Line Feed or Half Line Feed causes the current active position to enter the perforation region, the current page is ejected from the printer and the active position moves to the next top margin.
c. Perforation region of the paper is defined as the area outside the text area but within the page.
d. Plus and minus signs are ignored along with decimal points.

12) Horizontal Motion Index (HMI)

Code : ESC & k # H

Function : a. The Horizontal Motion Index (HMI) is set in units of 1/120 inch.

Details : a. Designation at a range of $0 \leq \# < 32,767$ is possible, and the decimal fraction is valid to 4th places.
b. The default is HMI of default font.
c. The HMI of a font is, in a fixed spacing font, its character pitch, and in a proportional spacing font, the cursor position is used.

13) Vertical Motion Index (VMI)

Code : ESC & I # C

Function : a. The Vertical Motion Index (VMI) is set in units of 1/48 inch.

Details : a. Designation at a range of $0 \leq \# < 32,767$ is possible, and the decimal fraction is valid to 4th places.
b. The setting of VMI exceeding the page length should be invalid.
c. Factory default is 6LPI (#=8).

14) Line Spacing

Code : ESC & I # D

Function : a. The Vertical Motion Index is set by the number of lines (LPI) per inch.

Details : a. # = 0, it should be 12 LPI.
≠ 0, it should be # LPI.
b. The sign of # and decimal fraction are ignored.

1.3 Cursor Positioning

Cursor Position Commands List

No.	Command	Code
1	Horizontal Cursor Position by Column	ESC & a # c
2	Horizontal Cursor Position by Decipoint	ESC & a # H
3	Horizontal Cursor Position by PCL Units	ESC * p # X
4	Carriage Return	CR (0Dh)
5	Space	SP (20h)
6	Back Space	BS (08h)
7	Horizontal Tab	HT (09h)
8	Vertical Cursor Position by Row	ESC & a # R
9	Vertical Cursor Position by Decipoint	ESC & a # V
10	Vertical Cursor Position by PCL Units	ESC * p # Y
11	Half Line Feed	ESC =
12	Line Feed	LF (0Ah)
13	Form Feed	FF (0Ch)
14	Line Termination	ESC & k # G
15	End of Line Wrap	ESC & s # C
16	Push/Pop Positioning	ESC & f # S

1) Horizontal Cursor Position by Column

Code : ESC & a # c [# = ASCII type number]

Function : a. Moves cursor from the current position to a new character position on the pending line based on the printing pitch in effect (or space character width for proportional fonts).

b. This function overrides margin settings.

Details : a. The value field # specifies the horizontal position — a plus (+) or a minus (-) in front of the value indicates that the new position relative to the current position and (+) moves the cursor # columns to the right while (-) moves the cursor # columns to the left.

If a request for column position outside printer's physical limits is made, the current active position is moved to the limit on that side.

b. When no plus or minus is indicated in value field, position is absolute. The first column in the line being column 0.

c. Current cursor position is located at the left edge of character on base line.

d. Valid to 4 decimal place.

2) Horizontal Cursor Position by Decipoint

Code : ESC & a # H [# = ASCII type number]

Function : a. Moves cursor horizontally in #/720 inch increments.

Details : a. A plus (+) or a minus (-) before the decipoint value indicates that the new position relative to the current position, (+) moves the cursor #/720 inch to the right while (-) moves the cursor #/720 inch to the left.

b. No plus or minus sign indicates that the cursor movement value is an absolute value with left boundary being position zero.

c. Current cursor position is located in left edge of character on base line.

d. Decimal places are ignored.

Note : Entry to specify fractional value to two places after the decimal is allowed.

e. If a request for horizontal position outside the printer's physical limits is made, the current active position is moved to the limit on that side.

3) Horizontal Cursor Position by PCL Units

Code : ESC * p # X [# = ASCII type numbers]

Function : a. This command moves the cursor horizontally in increments of PCL unit.

Details : a. Cursor movement is limited to the printable limits of the page.

b. # specifies the new horizontal position in dots. A sign preceding n indicates a relative move of the cursor: plus indicates "to the right" and minus indicates a move "to the left". No sign indicates an absolute position.

c. The left boundary of the page the default left margin.

d. Current cursor position is located in left edge of the current character location on the base line.

e. Fractional values are ignored.

4) Carriage Return

Code : CR

Function : a. Moves the carriage to the left margin on the current print line.

b. Vertical action is changed by line termination command.

5) Space

Code : SP

Function : a. If the space character exists for the selected font, the space character is printed and the cursor moves specified set-width of the space character.
b. If the space character does not exist for the selected font, cursor moves one current HMI unit to the right.

Details : a. For fixed pitch fonts, the cursor is updated according to the current HMI value even if the character is not printable.

6) Back Space

Code : BS

Function : a. Moves the cursor one column to the left.

Details : a. The set-width of the last character printed before the backspace command determines the amount to be backspaced.
b. When using HMI to change pitch in fixed pitch font, the amount of character backspace is determined by the HMI setting.
c. When printing with proportional font, the distance backspaced is determined by the width of the last character printed and not by the HMI setting.
d. When sending vertical position command, LF, half Line feed or FF followed by BS; BS are valid on the current line.

7) Horizontal Tab

Code : HT

Function : a. Moves the cursor to the next horizontal tab stop.

Details : a. Tab stops are located at the left margin and every 8 columns to the right margin.
b. If the cursor is past the last tab stop on the line when HT is received, the cursor moves to the right margin; except when in Auto Return/LF mode where cursor moves to the left margin on the next line.
c. If HMI = 0, then HT command is ignored.

8) Vertical Cursor Position by Row (Line)

Code : ESC & a # R [# = ASCII type number]

Function : a. Moves the cursor from current active printing position to the column on a new line.

Details : a. The value field (n) specifies the new vertical position (in number of lines); (+) plus or (-) minus sign in front of the value indicates the new position relative to the current active position.
No plus or minus sign indicates that the new position is an absolute line number.
b. The minimum positioning rate is 1/7,200 inch.
c. The distance the cursor moves per line is determined by current vertical line spacing.
d. Absolute positioning is relative to the top margin.
Absolute or negative relative requests which exceed the physical limits of the printer moves the cursor to the appropriate limits.
e. Vertical cursor positioning ignores perforation skip mode, allowing cursor to move into perforation region.
f. Current cursor position is located in left edge of character on baseline.
g. Positive relative positioning allows you to move the cursor for specified number of lines off the current page, causing a page eject.

9) Vertical Cursor Position by Decipoint

Code : ESC & a # V [# = ASCII type number]

Function : a. Moves the cursor in vertical increments of 1/720 inch.

Details : a. Plus (+) or minus (-) sign before the decipoint value specifies the position relative to the current cursor position ((+) moves cursor downward and (-) moves cursor upward).

No sign indicates that the cursor movement is absolute, with zero position defined as the top margin and the bottom determined by the bottom of the page.

b. Current cursor position is located at the left edge of character on base line.

c. Decimals are rounded up to the first decimal place.

d. Absolute or relative requests which exceed the physical limits of the printer moves the cursor to the appropriate limit.

10) Vertical Cursor Position by PCL Units

Code : ESC * p # Y

Function : a. Moves the current cursor position to a new vertical position in PCL unit.

Details : a. Cursor movement is limited to the printable limits of the page.

b. A plus sign preceding # indicates a relative movement of the cursor towards the bottom of the page. A minus sign preceding # indicates a movement toward the top of the page. No sign indicates absolute positioning relative to the top margin.

c. The zero position is defined as the top margin.

d. The bottom limit is determined by the bottom of the page.

e. Current cursor position is located at the left edge of character in base line.

Followings are the conditions which causes the printer to eject a paper:

1. Receive FF code.
2. Enter perforation region with LF or Half-LF in perforation skip on.
3. Exceed the page length with LF, Half-LF or Relative vertical position by row.
4. Exceed the page length with Graphics in perforation skip on.
5. Change the page length when data exists in the page buffer.
6. Change the orientation when data exists in the page buffer.
7. Reset the printer by RESET command when data exists in the page buffer.
8. Self-test or Demo Page Print.
9. Change the paper input when data exists in the page buffer.
10. Eject current page command.
11. Press the FF Key when data exists in the printer while in off-line mode.
12. Changing emulation via operator panel when data exists in buffer.
13. Changing emulation via Auto Emulation command when data exists in buffer.

11) Half Line Feed

Code : ESC =

Function : a. Advances the current active printing position to the next half line in the same character slot (as defined by the current line spacing).

Details : a. If specified LPI is a pitch which is not a multiple of the integer of a dot line; places after the decimal pint are rounded down and the number of dot lines is corrected in order to make each line to be positioned as close to the edge of printable area as possible (refer to table in Line Spacing).
b. If the perforation skip mode is on and Half-LF causes the current active position to enter the perforation region, the current page is ejected and the active position moves to the top margin position of the next page.
c. If the perforation skip mode is off and Half-LF causes the current active position to exceed the page boundary, the current page is ejected from the printer and the active position moves to the position that is past the top of the next page by the amount of excess.

12) Line Feed

Code : LF

Function : a. Moves the cursor to the next printable line.
b. Horizontal action is changed by line termination command.

Details : a. If the perforation skip mode is ON and LF causes the current active position to enter the perforation region, the current page is ejected from the printer and the active position moves to the top margin position of the next page.
b. If the perforation skip mode is OFF and LF causes the current active position to exceed the page boundary, the current page is ejected from the printer and the active position moves to the position past the top of the next page by the amount of excess.

13) Form Feed

Code : FF

Function : a. Moves the cursor to the first line at the top of the next page (top margin position).
b. Horizontal action is changed by line termination command.
c. Send FF causes current page to be ejected and/or printed.

14) Line Termination

Code : ESC & k # G [# = ASCII type number]

Function : a. This sequence controls the manner in which the printer interprets line termination characters.

Details : a. The value field specifies which of the following modes is to be used:

#	Definition
Default 0	CR => CR, LF = LF; FF = FF
1	CR = CR + LF; LF = LF; FF = FF
2	CR = CR; LF = CR + LF; FF = CR + FF
3	CR = CR + LF; LF = CR + LF; FF = CR + FF

b. If # is specified as decimal, decimal portion is ignored.
c. Plus and minus signs are ignored.

15) End of Line Wrap

Code : ESC & s # C [# = ASCII type number]

Function : a. When enclosed, the receipt of a character which would ordinarily appear outside the right margin causes a carriage return and line feed to be executed.

Details : a. # = 0 : enable the end of line wrap
1 : disable the end of line wrap
b. If # is specified as decimal, decimal portion is ignored.
c. Plus and minus signs are ignored.

16) Push/Pop Positioning

Code : ESC & f # S [# = ASCII type number]

Function : a. This command allows you to save the current cursor position in a stack and to recall the stored cursor position when desired.
b. Storing the current cursor position is called pushing.
c. Recalling a cursor position from the stack and moving to that position is called popping.
d. Recalling the last stored cursor position is called popping.
e. A maximum of 20 cursor positions may be stored at one time.
f. A position pushed last will be popped first.

Details : a. # = 0 ; Cursor position is pushed.
1 ; Cursor position is popped.
b. If PUSH is requested after 20 cursor positions have already been stored, PUSH is ignored.
c. It is acceptable to PUSH a position while in a Macro and POP a position while outside a Macro, and vice versa.
d. When the number of POP's exceed the number of positions stored with the PUSH command, POP is ignored.
e. PUSHed positions are cleared when a RESET is executed.

1.4 PCL Font Selection

PCL Font Selection Commands List

No.	Command	Primary Code	Secondary Code
1	Primary/Secondary Fonts	SI	SO
2	Symbol Set	ESC (' ID ')	ESC) ' ID ')
3	Proportional/Fixed Spacing	ESC (s # P)	ESC) s # P)
4	Font Pitch	ESC (s # H)	ESC) s # H)
5	Font Pitch (Alternate Method)	ESC & k # S	
6	Font Height	ESC (s # V)	ESC) s # V)
7	Style	ESC (s # S)	ESC) s # S)
8	Stroke Weight	ESC (s # B)	ESC) s # B)
9	Typeface	ESC (s # T)	ESC) s # T)
10	Designate Download Font	ESC (# X)	ESC) # X)
11	Select Font	ESC (# @)	ESC) # @)
12	Transparent Print Data	ESC & p # X	
13	Start Underline	ESC & d # D	
14	Stop Underline	ESC & d @	

1) Primary/Secondary Fonts

Code : SO (Shift Out)

Function : a. Selects the characters that follow from the current secondary character set until the receipt of a shift in.
 b. If secondary character set is already being selected, this command is ignored. Or secondary character set is not re-evaluated.

Code : SI (Shift In)

Function : a. Selects the characters that follow from the current primary character set until the receipt of a shift out.
 b. If primary character set is already being selected, this command is ignored.

2) Symbol Set

Code : ESC (' ID ' – Primary Symbol Set
 ESC) ' ID ' – Secondary Symbol Set
 ['ID' = Symbol Set ID value ASCII code]

Function : a. This sequence allows selection of symbol sets.

Details :

Symbol Set Name	ID	Symbol Set Name	ID	Symbol Set Name	ID
PC-8	10U	IBM Codepage437	2038Z	Kamenicky (MJK)	2022Z
Roman-8	8U	IBM Codepage850	2039Z	Hebrew NC (862)	2020Z
ECMA-94 Latin1	0N	IBM Codepage860	2037Z	Hebrew OC	2021Z
PC-8 Dan/Nor	11U	IBM Codepage863	2036Z	Polska Mazovia	2023Z
PC-850	12U	IBM Codepage865	2035Z	ISO8859/10 Latin6	2027Z/6N
Legal	1U	PC Set1	8Q	Hebrew Win3.1	2019Z
ISO-2 IRV	2U	PC Extension US	9Q	HP ZIP Code	15Y
ISO-4 UK	1E	PC Extension D/N	2033Z	USPS ZIP Code	97Y
ISO-6 US ASCII	0U	PC Set2 US	2034Z	USPS FIM Bars	98Y
ISO-10 Swe/Fin	3S	PC Set2 D/N	2032Z	USPS Stamp Here	99Y
ISO-11 Swe:names	0S	Ventura Math	6M	Cyrillic Win3.1	9R
ISO-14 JIS ASCII	0K	Ventura International	13J	PC-866 (Cyrillic 2 CPG 866)	3R
ISO-15 Italian	0I	Ventura US	14J	Greek Win3.1	2042Z
ISO-16 Portugese	4S	PS Math	5M	PC-869 (Greek CPG 869)	2041Z
ISO-17 Spanish	2S	PS Text	10J	PC-855 (Cyrillic 1 CPG 855)	2031Z
ISO-21 German	1G	Math-8	8M	Wingdings Font	579L
ISO-25 French	0F	Pi Font	15U	Symbol Font	19M
ISO-57 Chinese	2K	MS Publishing	6J	Greek 437	2024Z
ISO-60 Norwe v1	0D	Win3.0 Latin1	9U	Greek 437 Cyprus	2025Z
ISO-61 Norwe v2	1D	Desk Top	7J	Greek 928	2026Z
ISO-69 French	1F	Win3.1 Latin1	19U	Serbo Croatic II	2018Z
ISO-84 Portugese	5S	MC Text	12J	Ukrainian	2017Z
ISO-85 Spanish	6S	PC-852 (East Europe CPG 852)	17U	Bulgarian	2016Z
HP German	0G	Win3.1 Latin5	5T	OCR-A	00
HP Spanish	1S	Win3.1 Latin2 (East Europe Win3.1)	9E	OCR-B	10
ISO Dutch	90D	CWI Hungarian	2044Z	PC1004	9J
Roman Ext	0E	PC-857 (Turkish CodePG857)	2040Z	Windows Baltic	19L
ISO Swedish1	91S	ISO8859/2 Latin2 (ECMA-94)	2N	PC775	26U
ISO Swedish2	92S	ISO8859/9 Latin5 (ECMA-128)	5N	Serbo Croatic I	2010Z
ISO Swedish3	93S	Turkish PC-8 (PC Turkish)	9T		

3) Proportional/Fixed Spacing

Code : ESC (s # P [Where # = 0 or 1] – Primary spacing
ESC) s # P [Where # = 0 or 1] – Secondary spacing

Function : a. Designates proportional or fixed spacing.

Details : a. # = 1 : Proportional spacing
0 : Fixed spacing
b. Plus sign, decimal point and out of range number are ignored.

4) Font Pitch

Code : ESC (s # H – Primary pitch
ESC) s # H – Secondary pitch
[# = ASCII type number]

Function : a. Selection of Font pitch

Details : a. # specifies the pitch size in characters per inch (dpi).
b. Selection of font pitch is limited to what is available with the resident font or cartridges.
c. Font pitch is ignored if Proportional spacing is activated.
d. If a font pitch which does not exist is selected, the next greater pitch is designated. If no greater value exists, the printer uses a lesser value.
e. Default font pitch is 10 dpi.
f. # is valid to second decimal place.
g. Plus and minus signs are ignored.
h. Decimal point is valid to two places.

5) Font Pitch (Alternate Method)

Code : ESC & k # S [# = 0, 2 or 4]

Function : a. Alternate method for selecting standard or compressed Font pitch.
b. # Specifies the pitch for both primary and secondary Font.

Details : a. # = 0 : Selects 10.00 dpi.
2 : Selects 16.66 dpi.
4 : Selects 12.00 dpi.
b. Font pitch may be overridden by changing horizontal cursor spacing.

6) Font Height

Code : ESC (s # V – Primary font height
ESC) s # V – Secondary font height
[# = ASCII type number]

Function : a. Specifies the font height in points; each point is equal to 1/72".

Details : a. # specifies the point size of the character font.
b. Size is measured from the top of a capital letter to the bottom of a descending lower case letter.
c. If requested point size is not available, the font with the closest point size is selected.
d. Default point size is 12.

7) Style

Code : ESC (s # S – Primary font style
ESC) s # S – Secondary font style
[# = ASCII type number]

Function : a. Specifies the posture and width of character, structure of font symbols such as upright, italic, etc.

Value	Font Style
0	(upright, solid)
1	Italic
4	Condensed
5	Condensed italic
8	Compressed, or extra condensed
24	Expanded
32	Outline
64	Inline
128	Shadowed
160	Outline shadowed

- b. If requested style is not present, this characteristic is ignored during font designation.
- c. Default style is upright.

8) Stroke Weight

Code : ESC (s # B – Primary stroke weight
ESC) s # B – Secondary stroke weight
[# = ASCII type number]

Function : a. This sequence allows selection of stroke weight.

Details : a. # specifies stroke weight.
Light -1 to -7
Medium 0
Bold 1 to 7

- b. If no bold or light stroke weight matches the specified one, closest font is selected from larger stroke weights.

9) Typeface

Code : ESC (s # T – Primary typeface
 ESC) s # T – Secondary typeface
 [# = ASCII type number]

Function : a. This sequence selects a typeface for the font.
 b. Range of valid value is 0 to 32,767.

Details : a. # specifies the typeface to be selected.
 b. Bits 15 through 12 of 2 byte code are assigned to Vendors.

Value	Vendor
0	Reserved
1	Agfa Division, Miles Inc.
2	Bitstream Inc.
3	Linotype Company
4	The Monotype Corporation plc
5	Adobe Systems Inc.
7	Bigelow & Holms

Bits 11 through 0 of 2 byte code are assigned to Typeface Family numbers.
 Typeface Family Code = Typeface Base Value + Vendor Value x 4096.

c. Examples of typeface values:

#	Typeface
0	Line printer
3	Courier
4	Swiss (Helvetica)
5	Dutch (Times Roman)
8	Prestige
21	Broadway
32	Brush
45	ITC Zapf Dingbats
48	Stick
52	Univers
53	Bodoni
59	Park Avenue
61	Dom Casual
104	OCR-A
110	OCR-B
4099	Courier (Agfa)
4101	CG Times (Agfa)
4102	Letter Gothic (Agfa)
4113	CG Omega (Agfa)
4116	Coronet (Agfa)
4140	Clarendon (Agfa)
4148	Univers (Agfa)
4168	Antique Olive (Agfa)
4197	Garamond (Agfa)
4297	Marigold (Agfa)
4362	Albertus (Agfa)
16602	Arial (Monotype)
16686	Symbol (Monotype)
16901	Times New Roman (Monotype)
31402	Wingdings (Bigelow & Holms)
65535	USPS POSTNET Bar Codes

- d. If requested typeface is not available, this characteristics is ignored during font selection.
- e. Default is Courier # = 4099.

10) Designate Download Font

Code : ESC (# X – Designate soft font # as primary
ESC) # X – Designate soft font # as secondary
[# = font number]

Function : a. Makes the specified font ID active as the primary/secondary font.
b. The font characteristics for the primary/secondary font are set to those of the designated font (for proportional fonts, the pitch parameter is not changed).

11) Select Font

Code : ESC (# @ – Primary font characteristics
ESC) # @ – Secondary font characteristics

Function : a. Makes the font in the current orientation the primary/secondary fonts.

Details : a. # = 0, 1 : The symbol set is reset to default (PC-8) and primary/secondary fonts are re-selected.
2 : In the attributes of the font which is selected as a primary font, primary/secondary fonts are re-selected.
3 : Default fonts are selected as a primary/secondary font.
b. If the user default is proportional, the pitch characteristic is not affected by the default font command.

12) Transparent Print Data

Code : ESC & p # X [Data] [# = ASCII type number]

Function : a. This sequence allows data to be sent to the printer without the printer performing any escape sequence or control codes.
b. Value field specifies the number of bytes of print data that will follow.
c. Print data should immediately follow X.
d. All control codes are printed as blanks.

13) Start Underline

Code : ESC & d # D [# = ASCII type number]

Function : a. Underlines a line or any portion of a line.
= 0 : Fixed position
1 : Floating position

Details : a. Underlining is performed when a space (20H) is sent.
b. During the underline mode, if horizontal cursor position is shifted, underline follows the shift and underlines portion of line shifted.
c. During underline mode, if vertical cursor position is shifted, underline continues from the shifted position.
d. During underline mode, if horizontal cursor position is shifted, then vertical cursor position is shifted, underline mode follows the shift and underlines the portion of line shifted horizontally and continues with vertical shifted position.
e. During underline mode, if vertical cursor position is shifted, then horizontal cursor position is shifted, underline continues from vertical shifted position and underlines portion of line shifted horizontally.
f. Underline function is effective in forward direction only and not in reverse direction.
g. Vertical movement is not underlined.
h. When # = 0 is specified, underline mode begins at 5th dot below the base line and will be 3 dots tall.
i. When # = 3 is specified, the distance of underline below the baseline is determined as the farthest underline distance of all fonts printed on the line. Underline size and position are determined by font attributes.

14) Stop Underline

Code : ESC & d @

Function : a. Disables Underline mode.

1.5 User-defined Symbol Set Commands

User-defined Symbol Set Commands List

No.	Command	Code
1	Symbol Set ID Code	ESC * c # R
2	Define Symbol Set	ESC (f # W [data]
3	Symbol Set Control	ESC * c # S

1) Symbol Set ID Code

Code : ESC * c # R [# = ASCII type number]

Function : a. Assigns a symbol set ID code to a user-defined symbol set.
 b. # (Symbol Set ID Code) corresponds to the symbol set ID selection value.
 The relationship between the ID code and the symbol set ID selection value in Symbol Set selection command is as follows:

$$\# \text{ (Symbol Set ID Code)} = ('n' \times 32) + ('ID' - 64)$$

Where 'n' represents the number portion of the ID selection value.
 'ID' represents the ordinal (decimal) value of the ID character.
 For example : 8U = Roman-8
 'n' = 8, 'ID' = 'U' = 85
 $(8 \times 32) + (85 - 64) = 277$

2) Define Symbol Set

Code : ESC (f # W [symbol set definition data]

Function : a. Defines the characters and character mapping for the user-defined symbol set.
 b. User-defined symbol sets are used only for unbound format scalable fonts.
 c. If a user-defined symbol set is already present in the printer with same ID, the old symbol set is deleted.

Byte	MSB 15-8	LSB 7-0
0	Header Size (18)	
2	Encoded Symbol Set	
4	Format	Symbol Set Type
6	First Code	
8	Last Code	
10 - (HdrSize - 1)	Character Requirements	
HdrSize -	Symbol Map [Last Code - First Code + 1]	

Details : a. The data format for the user-defined symbol set is shown below:

- Header size : The number of bytes from byte 0 to just before the beginning of the Symbol Map data bytes. This value is 18 or greater.
- Encoded symbol set : Symbol Set ID Code, same as the number specified in the Symbol Set ID Code command.
- Format : Format of defining Symbol Set data.
 1 for Intellifont Format (MSL), 3 for TrueType Format (Unicode).
- Symbol set type : Selects printable and unprintable code type.
 0 7-bit, 32-127 are printable.
 1 8-bit, 32-127 and 160-255 are printable.
 2 8-bit, 0-255 are printable, however, 0, 7-15 and 27 are printable only in transparency mode.
- First code : The First character code in the set. 0 - 65,535 are available.

Last code : The last character code in the set.
 $0 \leq \text{First Code} \leq \text{Last Code} \leq 65,535$.
 Total downloading byte size (#) should be Header size + (Last Code - First Code + 1) x 2.

Character requirements : 61 bits of bit 63 to 3 represent a specific Symbol Set collection. Setting a bit to 1 indicates that the collection is required; setting the bit to 0 indicates that the collection is not required.
 Bit 2 to 0 represent the code system (MSL/Unicode).

MSL Symbol Index Character Requirements

Bit	Designated Use
63	Basic Latin; 1: required, 0: not required
62	East European Latin; 1: required, 0: not required
61	Turkish; 1: required, 0: not required
34	Math; 1: required, 0: not required
33	Semi-graphic; 1: required, 0: not required
32	Dingbats; 1: required, 0: not required
2, 1, 0	'000' designated MSL Symbol Index

Unicode Symbol Index Character Requirements

Bit	Designated Use
31	ASCII; 1: required, 0: not required
30	West Europe extensions; 1: required, 0: not required
29	East Europe extensions; 1: required, 0: not required
28	Turkish extensions; 1: required, 0: not required
27	Desktop Publishing extensions; 1: required, 0: not required
26	Accent extensions; 1: required, 0: not required
25	PCL extensions; 1: required, 0: not required
24	Macintosh extensions; 1: required, 0: not required
23	PostScript extensions; 1: required, 0: not required
22	Code Page extensions; 1: required, 0: not required
2, 1, 0	'000' designates Unicode Symbol Index

Symbol map : A list of symbol index numbers. This list pairs a character code to a symbol index number. The symbol index numbers should be arrayed to the one for the First Code to the one for the Last Code.

3) Symbol Set Control

Code : ESC * c # S [# = ASCII type number]

Function : a. This command allows making user-defined symbol sets permanent or temporary, and deleting them.

- b. # = 0 : Delete all temporary and permanent user-defined symbol sets.
 - 1 : Delete all temporary user-defined symbol sets.
 - 2 : Delete last ID code specified user defined symbol set.
 - 4 : Make last ID code specified user defined symbol set temporary.
 - 5 : Make last ID code specified user defined symbol set permanent.

1.6 Downloading Fonts

Downloading Fonts Commands List

No.	Command	Code
1	Specify Font ID	ESC * c # D
2	Specify Character Code	ESC * c # E
3	Font and Character Control	ESC * c # F
4	Create Font Header	ESC) s # W [data]
5	Download One Character	ESC (s # W [data]
6	Download One Scalable Character	ESC (s # W [data]
7	Download One Compound Scalable Character	ESC (s # W [data]

1) Specify Font ID

Code : ESC * c # D

Function : a. The assigned font ID allows simplified accessing of the designated font.
b. # is the Font ID number.
c. The default for # is 0.
d. Acceptable font ID numbers are from 0 to 32,767.

2) Specify Character Code

Code : ESC * c # E

Function : a. This specifies the decimal ASCII value of the character to be defined.
b. The default character code is zero.
c. The character code range is from 0 to 65,535.
d. For unbound fonts, the character code for given character equals its symbol index value. Intellifont: MSL code, TrueType: Uni code.

3) Font and Character Control

Code : ESC * c # F [# = ASCII type number]

Function : a. The function is performed on the currently selected font ID.
b.

# Value	Control Function
0	Delete all fonts (temporary and permanent).
1	Delete all temporary fonts.
2	Delete font (current font ID)
3	Delete character code (last char. code and font ID).
4	Make font temporary (current font ID).
5	Make font permanent (current font ID).
6	Copy/Assign current font (current font ID).

Details : a. Temporary fonts are cleared by resets (control code, RECOVER key), or by turning the power off.
b. Permanent fonts are cleared by turning the power off, switching printer language, changing resolution, or changing the Page Buffer size.
c. The Copy/Assign command assigns the currently selected font ID as the currently selected font, and makes it a temporary font. If the font resides in a font card, the font is deleted when the card is removed.
d. A specific ID may be assigned to one font only.
e. ESC * c 6 F may be used to assign an ID to a DLL font.
f. Two different ID's may be assigned to the same DLL font. When one of the ID's are deleted, the other will be deleted also.
g. Copy/Assign will work when secondary font is in effect.

4) Create Font Header (Font Descriptor)

Code : ESC) s # W [Data]

Function : a. Creates the font descriptor for the specified font ID.

This command allows the following types of fonts to be downloaded: PCL bitmap, Intellifont Scalable, TrueType scalable.

- b. # specifies the number of bytes in the font descriptor.
- c. If a font is resident in the printer with the same font ID as the font being created, the previous font is deleted.
- d. If the new font cannot to be processed due to lack of memory in the printer, a previous font of same ID is deleted.
- e. There are 5 type formats:

Format 0 - PCL Bitmapped Fonts without Resolution Specification

Format 20 - PCL Bitmapped Fonts with Resolution Specification

Format 10 - Intellifont Bound Scalable Fonts

Format 11 - Intellifont Unbound Scalable Fonts

Format 15 - TrueType Scalable Fonts

Details : Definition of [data] bytes.

Format 0 Bitmapped Font (without Resolution Specification)

Byte	MSB 15-8	LSB 7-0
0	Font descriptor size (64)	
2	Descriptor Format (0)	Font Type
4	Style MSB	Reserved (0)
6	Baseline Position	
8	Cell Width	
10	Cell Height	
12	Orientation	Spacing
14	Symbol Set	
16	Master Design 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 Distance (0)	Underline Height (0)
32	Text Height	
34	Text Width	
36	First Code	
38	Last Code	
40	Pitch Extended	Height Extended
42	Cap Height	
44	Font Number	
46	Font Number	
48 - 63	Font Name	
64 - (#-1)	Optional Copyright (format 0)	

Format 20 Resolution-Specified Bitmapped Font

Byte	MSB 15-8	LSB 7-0
0	Font descriptor size (68)	
2	Descriptor Format (20)	Font Type
4	Style MSB	Reserved (0)
6	Baseline Position	
8	Cell Width	
10	Cell Height	
12	Orientation	Spacing
14	Symbol Set	
16	Master Design Pitch (Default HMI)	
18	Height	
20	x-Height	
22	Width Type	Style MSB
24	Stroke Weight	Typeface LSB
26	Typeface MSB	Serif Style
28	Quality	Placement
30	Underline Distance (0)	Underline Height (0)
32	Reserved (0)	
34	Reserved (0)	
36	First Code	
38	Last Code	
40	Pitch Extended	Height Extended
42	Cap Height	
44 - 47	Font Number	
48 - 63	Font Name	
64	X Resolution	
66	Y Resolution	
68 - (#-1)	Optional Copyright	

Format 10 Intellifont Bound Scalable Font

Byte	MSB 15-8	LSB 7-0
0	Font descriptor size (80 or more)	
2	Descriptor Format (10)	Font Type
4	Style MSB	Reserved (0)
6	Baseline Position	
8	Cell Width	
10	Cell Height	
12	Orientation	Spacing
14	Symbol Set	
16	Master Design Pitch (Default HMI)	
18	Height	
20	x-Height	
22	Width Type	Style MSB
24	Stroke Weight	Typeface LSB
26	Typeface MSB	Serif Style
28	Quality	Placement
30	Underline Distance (0)	Underline Height (0)
32	Reserved (0)	
34	Reserved (0)	
36	First Code	
38	Last Code	
40	Pitch Extended	Height Extended
42	Cap Height	
44 - 47	Font Number	
48 - 63	Font Name	
64	Scale Factor	
66	Master X Resolution	
68	Master Y Resolution	
70	Master Underline Position	
72	Master Underline Height	
74	LRE Threshold	
76	Global Italic Angle	
78	Global Intellifont Data Size	
80 -	Global Intellifont Data	
n	Optional Copyright	
	Reserved (0)	Checksum

Format 11 Intellifont Unbound Scalable Font

Byte	MSB 15-8	LSB 7-0
0	Font descriptor size (88 or more)	
2	Descriptor Format (11)	Font Type (10)
4	Style MSB	Reserved (0)
6	Baseline Position	
8	Cell Width	
10	Cell Height	
12	Orientation	Spacing
14	Symbol Set	
16	Master Design Pitch (Default HMI)	
18	Height	
20	x-Height	
22	Width Type	Style MSB
24	Stroke Weight	Typeface LSB
26	Typeface MSB	Serif Style
28	Quality	Placement
30	Underline Distance (0)	Underline Height (0)
32	Reserved (0)	
34	Reserved (0)	
36	First Code	
38	Last Code	
40	Pitch Extended	Height Extended
42	Cap Height	
44	Font Number	
46	Font Number	
48 - 63	Font Name	
64	Scale Factor	
66	Master X Resolution	
68	Master Y Resolution	
70	Master Underline Position	
72	Master Underline Height	
74	LRE Threshold	
76	Global Italic Angle	
78 - 85	Character Complement	
86	Global Intellifont Data Size	
88 -	Global Intellifont Data	
n	Optional Copyright	
	Reserved (0)	Checksum

Format 15 TrueType Scalable Font

Byte	MSB 15-8	LSB 7-0
0	Font descriptor size (72 or more)	
2	Descriptor Format (15)	Font Type
4	Style MSB	Reserved (0)
6	Baseline Position	
8	Cell Width	
10	Cell Height	
12	Orientation	Spacing
14	Symbol Set	
16	Master Design Pitch (Default HMI)	
18	Height	
20	x-Height	
22	Width Type	Style MSB
24	Stroke Weight	Typeface LSB
26	Typeface MSB	Serif Style
28	Quality	Placement
30	Underline Distance (0)	Underline Height (0)
32	Reserved (0)	
34	Reserved (0)	
36	First Code	
38	Last Code	
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 Height	
70	Font Scailing Technology	Variety
72 -	(Optional)	
Dec. size	Segment Font Data	
(# - 2)	Reserved (0)	Checksum

- Description: • Bytes 0-1 Font descriptor size
 - a. This “unsigned integer” defines the total length of the font descriptor data (including these two bytes) in bytes.

- Byte 2 Descriptor Format

Value	Descriptor Format
0	Bitmap
10	Intellifont Bound Scalable
11	Intellifont Unbound Scalable
15	TrueType Scalable
20	Resolution-specified Bitmap

- Byte 3 Font Type
 - a. This “unsigned byte” specifies the font as either a 7-bit font, an 8-bit font or a PC-8 font.

Value	Font Type
0	Bound Font 7-bit (characters 0 - 127)
1	Bound Font 8-bit (characters 0 - 127 and 160 - 255)
2	Bound Font PC-8 (all characters)
10	Unbound Font Corresponds to MSL Codes.
11	Unbound Font Corresponds to Uni Code.

- Byte 4 Style MSB
 Byte 23 Style LSB
 - a. This “unsigned integer” specifies the font Style which is a combination of several parts.
 - b. The composite value of Style is composed as follows:
 $Style = P + (4 \times W) + (32 \times S)$
 Range of P (Posture) = 0 – 3
 Range of W (Width) = 0 – 7
 Range of S (Structure) = 0 – 31
 - c. Byte 4 = Style MSB = integer (Style/256)
 Byte 23 = Style LSB = Style - (Style MSB * 256)
 - d. Posture (P)
 - 0 Upright
 - 1 Italic
 - 2 Alternate Italic
 - 3 Reserved
 - e. Width (W)
 - 0 Normal
 - 1 Condensed
 - 2 Condensed or Extra Condensed
 - 3 Extra Compressed
 - 4 Ultra Compressed
 - 5 Reserved
 - 6 Extended or Expanded
 - 7 Extra Extended or Extra Expanded

- f. Structure (S)
 - 0 Solid
 - 1 Outline
 - 2 Inline
 - 3 Contour
 - 4 Solid with Shadow
 - 5 Outline with Shadow
 - 6 Inline with Shadow
 - 7 Contour with Shadow
 - 8-11 Patterned (assigned as required)
 - 12-15 Patterned with Shadow (assigned as required)
 - 16 Inverse
 - 17 Inverse in Open Border
 - 18-31 Reserved

- Byte 5 Reserved = 0
- Bytes 6-7 Baseline Position
 - a. This “unsigned integer” specifies the offset from the top of the character cell to the baseline.
 - b. The distance is specified in dots and is the same for portrait and landscape orientations.
 - c. The baseline must be located within the character cell. The range of values is 0 to (Cell Height - 1).
 - d. This field is ignored by the printer.
- Bytes 8-9 Cell Width
 - a. This “unsigned integer” specifies the width of the character cell in dots.
 - b. The cell width range is 1 to 65,535 dots.
 - c. This field is ignored by the printer.
- Bytes 10-11 Cell Height
 - a. This “unsigned integer” specifies the height of the character cell in dots.
 - b. The cell height range is 1 to 65,535 dots.
 - c. This field is ignored by the printer.
- Byte 12 Orientation
 - a. This “unsigned byte” determines the font’s printing orientation.

Value	Orientation	
0	Specifies Portrait	0 degrees rotation
1	Specifies Landscape	90 degrees ccw rotation
2	Specifies Reverse Portrait	180 degrees ccw rotation
3	Specifies Reverse Landscape	270 degrees ccw rotation

- b. All characters downloaded must have specified orientation or they are discarded.
 - c. Values out-of-range abort font creation.
- Byte 13 Spacing: Fixed/Proportional
 - a. This byte specifies fixed spacing or proportional spacing.

Value	Spacing
0	Specifies fixed spacing.
1	Specifies proportional spacing.
2	Specifies compressed proportional spacing.

- Bytes 14-15 Symbol Set

a. This “unsigned integer” selects the symbol set to be used for this font.

b. The number is generated by the following formula:

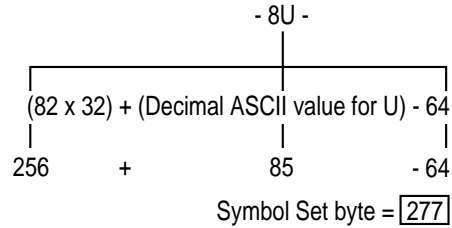
(Symbol set number x 32) + (decimal ASCII value of terminator - 64).

Note : The terminator is the upper case letter in the value field — for example, U in the 8U value field.

Example: 8-bit Symbol Set

Symbol Set	Value Field
Roman-8	8U

EXAMPLE for the Roman-8 symbol set



c. Range of values is 0-2,047.

Values 0-1,023 are reserved for assignment by manufacturer. 1,024-2,047 are available for use by independent font vendors.

d. Termination letters are capital letters from A-V.

e. Value 56 is only valid for a type 10 or 11 font (unbound intellifont scalable).

- Bytes 16-17 Pitch (default HMI)/Masters design pitch

Byte 40 Extended pitch

Bitmap Font:

a. This “unsigned integer” indicates the font’s pitch (horizontal width of the characters). It is represented by the character width in dots multiplied by four: radix dots.

b. A 10 pitch font would be 30 dots wide times 4 equals 120 radix dots.

c. The pitch may be specified to within a quarter of a dot.

d. Pitch Extended (Byte 40) allows any fractional remainder of radix dots to be re-encoded as 1/1,024 dot unit:

17 pitch font = 17.647059 dots per character = 70.588232 radix dots

Pitch value = 70 radix dots

Pitch Extended = 0.5882352/4 x 1,024 = 150.58823 units

Pitch Extended value = 150 units

e. For a proportional font, the default width of the “space” control code (20 Hex) is the pitch value.

f. Range of Pitch is 0-65,535.

Range of Pitch Extended is 0-255.

Scalable Fonts:

g. Contains the master design pitch.

- Bytes 18-19 Height
 - Byte 41 Height Extended
 - Bitmap Font:
 - a. The “unsigned integer” indicates the height of the cell.
The value is equal to the height in dots times 4.
 - b. A font height of 50 dots yields a value of 200.
 - c. This value may be specified to within a quarter of a dot.
 - d. The Height Extended byte is calculated in the same manner as the Pitch Extended byte. See Pitch above.
 - e. Range of Height is 0-65,535
Range of Extended Height is 0-255.
 - Scalable Font (Intellifont):
 - f. Specifies the master design height in 1/8 points.
A typical value is 2,000.
 - Scalable Font (TrueType):
 - g. This value is ignored by the printer.
- Bytes 20-21 x-Height
 - a. This “unsigned integer” indicates the height of the lower case “x”. The value is equal to the height in dots times 4.
 - b. A height of 50 dots yields a value of 200.
 - c. This value may be specified to within a quarter of dot.
 - d. Range of x-Height is 0-65,535.
 - e. This value is ignored by the printer.
- Byte 22 Width Type
 - a. This “unsigned byte” indicates various assigned font widths.
 - b.

Value	Width Type
-5	Ultra Compressed
-4	Extra Compressed
-3	Compressed or Extra Condensed
-2	Condensed
0	Normal
2	Expanded
3	Extra Expanded

- c. Range of Width Type is 0-255.
 - d. This value is ignored by the printer.
- Byte 23 Style LSB: See Byte 4 above.
- Byte 24 Stroke Weight
 - a. This “signed byte” specifies stroke weight.
 - b. Stroke weight may range from -7 to 7. Zero (0) is the normal stroke weight.
 - c. Negative numbers indicate a lighter stroke weight.
 - d. Positive numbers indicate a heavier stroke weight.
 - e. The normal stroke weight for bold is 3.
 - f. The normal stroke weight for light is -3.

- Byte 25 Typeface LSB
- Byte 26 Typeface MSB
- a. This "Unsigned integer" specifies the typeface of the font. Range of Typeface is 0-32,767.
- b. $\text{Typeface} = (\text{Typeface MSB} * 256) + \text{Typeface LSB}$
- c. $\text{Typeface MSB} = (8 * \text{Vendor}) + (\text{Version} * 2) + \text{integer} (\text{Typeface ID}/256)$

Vendor	Description
0	Reserved
1	AGFA
2	Bit Stream
3	Linotype
4	Monotype
5	Adobe
6 - 15	Reserved

Version	Description
0 - 3	As assigned by font vendor for different widths.

Typical CTG PCL5 font Typeface MSB = 16

Vendor = 2, Version = 0, Typeface ID is less than 256.

d. Typeface LSB

$\text{Typeface LSB} = \text{Typeface ID} - (\text{integer} (\text{Typeface ID}/256) * 256)$

Value	MSB	ID	LSB	Width Type
0	0	0	0	Like Line Printer
1	0	1	1	Like Pica
2	0	2	2	Like Elite
3	0	3	3	Like Courier
4	0	4	4	Like Helv
5	0	5	5	Like Tms Roman
6	0	6	6	Like Gothic
7	0	7	7	Like Script
8	0	8	8	Like Prestige
9	0	9	9	Like Caslon
10	0	10	10	Like Orator
11	0	11	11	Like Presentations
12	0	12	12	Like Swiss 721
13	0	13	13	Like Dutch 801
4101	16	5	5	CG Times
4184	16	88	88	CG Univers

- Byte 27 Serif Style
 - a. Bits - 5 of this value are ignored by the printer.
Range of Bitmap Font Serif is 0 to 63.

Value	Serif Style
0	Sans Serif Square
1	Sans Serif Round
2	Serif Line
3	Serif Triangle
4	Serif Swath
5	Serif Block
6	Serif Bracket
7	Rounded Bracket
8	Flair Serif, Modified Sans
9	Script Nonconnecting
10	Script Joining
11	Script Calligraphic
12	Script Broken Letter

- b. Bits 6-7 of this value are used by the printer as follows:

Bits 76	Value	Serif Style
00	00	Reserved
01	64	Sans Serif
11	128	Serif
12	192	Reserved

- Byte 28 Quality
 - a. This value is ignored by the printer.

Value	Quality
0	Data processing
1	Near Letter Quality
2	Letter Quality

- Byte 29 Placement
 - a. This value is ignored by the printer.

Value	Placement
1	Superior
0	Normal
-1	Inferior

- Byte 30 Underline Distance
Bitmap Font:
 - a. This "Signed byte" specifies the location of the top dot row of the underline relative to the baseline.
 - b. Positive values indicate positions above the baseline.
 - c. Negative values indicate positions below the baseline.
 Scalable Font:
 - d. This field is ignored by the printer.
- Byte 31 Underline Height
 - a. This value is ignored by the printer.
 - b. For bitmap fonts, the underline height is always 3 dots.
- Bytes 32-33 Text Height
 - a. This "unsigned byte" is ignored by the printer.
 - b. This is the font's optimum line spacing which is normally 120% of the font height. It is specified in quarter dot (radix) units.
- Bytes 34-35 Text Width
 - a. This "unsigned integer" is ignored by the printer.
 - b. The Text Width is specified in quarter dot (radix) units and is the average width of the lowercase a - z.
- Bytes 36-37 First Code
Bitmap Font:
 - a. This "unsigned integer" is ignored by the printer.
 Scalable Font:
 - b. Indicates the character code of the first printable character in the font.
- Bytes 38-39 Last Code
Bitmap Font:
 - a. This "unsigned integer" is ignored by the printer.
 Scalable Font:
 - b. Indicates the character code of the last printable character in the font.
- Byte 40 Extended Pitch: See Bytes 16-17 above.
- Byte 41 Extended Height: See Bytes 18-19 above.
- Bytes 42-43 Cap Height
 - a. This "unsigned integer" is ignored by the printer.
 - b. Cap Height is percent of em. Default = 70.87%.
 - c. Cap Height value is Cap Height percent x 65,535.
 - d. For Cap Height value of 0, value is set to 46,455 resulting in default value of 70.87%
- Bytes 44-47 Font Number
 - a. This four byte field is ignored by the printer.
 - b. This number is a vendor assigned number.
- Bytes 48-63 Font Name
 - a. This is a 16-byte ASCII field which may contain a 16 character font name which is included in the Font Print Sample that is output by pressing *Print Fonts* key.
- Bytes 72-73 Master Underline Height
 - a. This unsigned integer (0 to 65,535) specifies the height of the underline on the master design grid in design window units.
- Bytes 74-75 LRE Threshold
 - a. This unsigned integer (0 to 65,535) specifies threshold in pixel size in design window units at which the Low Resolution Enhancement (LRE) is cut into the Intellifont scaling and rasterization process.

- Bytes 76-77 Global Italic Angle
 - a. This unsigned integer (0 to 65,535) specifies the Scale Factor in design window units.
- Bytes 78-79 Global Intellifont Scalable Data Size
 - a. This unsigned integer (0 to 65,535) specifies the Scale Factor in design window units.
- Bytes 80-(n-3) Global Intellifont Scalable Data
 - a. This unsigned integer (0 to 65,535) specifies the Scale Factor in design window units.
- Bytes 78-85 (Intellifont)

“CC” field in Segment Font Data (TrueType)
Character Complements

 - a. This 8-byte field exists only in Unbound font. 61 bits of bit 63 to 3 represent a specific Symbol Set collection. Setting a bit to 1 indicates that the collection is required; setting the bit to 0 indicates that the collection is not required. Bits 2 to 0 indicate the code system (MSL/Unicode).

MSL Symbol Index Character Complement Bits

Bit	Designated Use
63	0 if font is compatible with standard Latin character sets; 1 otherwise.
62	0 if font is compatible with East European Latin character sets; 1 otherwise.
61	0 if font is compatible with Turkish character sets; 1 otherwise.
34	0 if font is compatible with Math character sets; 1 otherwise.
33	0 if font is compatible with Semi-graphic character sets; 1 otherwise.
32	0 if font is compatible with Dingbats character sets; 1 otherwise.
2, 1, 0	'111' if font is arranged in MSL Symbol Index order.

Unicode Symbol Index Character Complement Bits

Bit	Designated Use
31	0 if font is compatible with 7-bit ASCII character sets; 1 otherwise.
30	0 if font is compatible with ISO 8859/1 Latin 1 (West Europe) character sets; 1 otherwise.
29	0 if font is compatible with ISO 8859/2 Latin 2 (East Europe) character sets; 1 otherwise.
28	0 if font is compatible with Latin 5 (Turkish) character sets; 1 otherwise.
27	0 if font is compatible with Desktop Publishing character sets; 1 otherwise.
26	0 if font is compatible with Accent character sets; 1 otherwise.
25	0 if font is compatible with PCL character sets; 1 otherwise.
24	0 if font is compatible with Macintosh character sets; 1 otherwise.
23	0 if font is compatible with PostScript character sets; 1 otherwise.
22	0 if font is compatible with Code Page character sets; 1 otherwise.
2, 1, 0	'1100' if font is arranged in Unicode Symbol Index order.

- Bytes (n-2) - (n-1) Checksum

5) Download One Character (Descriptor and Data)

Code : ESC (s # W [Data] [# = ASCII type number]

- Function :
- a. Downloads a character to the printer which is added as currently selected font ID. If a character with the same character code already exists in the font, the existing character is loaded and the previous character is deleted.
 - b. If enough memory is not available to receive a character, the entire font is deleted.
 - c. Data contains the information described below:

Orientation
 Left Offset
 Top Offset
 Character Width
 Character Height
 Delta X
 Character Bit Map Data

Byte	MSB 15-8	LSB 7-0
0	Format (4)	Continuation (0, 1)
2	Descriptor size (14)	Class (1)
4	Orientation	Reserved (0)
6	Left Offset	
8	Top Offset	
10	Character Width	
12	Character Height	
14	Delta-x	
16-N	Character Data as required	

- Description:
- Byte 0 Format = 4
 (Scalable Format = 10)
 - Byte 1 Continuation
 0 = first block
 1 = continuation block
 - Byte 2 Descriptor size = 14
 - Byte 3 Class
 1 = Bitmap
 2 = Compressed Bitmap
 (3 = Contour = Intellifont Scalable)
 (4 = Compound Contour = Intellifont Scalable)
 - Byte 4 Orientation
 - a. Specifies the character orientation.

Value	Orientation
0	Specifies portrait
1	Specifies landscape
2	Specifies reverse portrait
3	Specifies reverse landscape

- Byte 5 Reserved = 0
- Bytes 6-7 Left Offset
 - a. The distance in dots from the reference point to the left side of the character pattern.
 - b. The value is different for different orientations.
 - c. The range of left offset values is -16,384 to 16,384.

Note: The reference point is where the cursor is located after printing one character and before printing the next character. The beginning location is the left-most dot location on the baseline of the current character.
- Bytes 8-9 Top Offset
 - a. The distance in dots from the reference point to the top of the character pattern.
 - b. The value is different for different orientations.
 - c. The range of top offset values is -16,384 to 16,384.
- Bytes 10-11 Character Width
 - a. The width of the character in dots.
 - b. The value is different for different orientations.
 - c. The range of the values is 1 to 16,384.
 - d. Values greater than 16,384 are ignored.
- Bytes 12-13 Character Height
 - a. The height of the character in dots.
 - b. The value is different for portrait and landscape.
 - c. The range of the values is 1 to 16,384.
 - d. Values greater than 16,384 are ignored.
- Bytes 14-15 Delta X
 - a. Two bytes indicate the distance the cursor travels after printing a character.
 - b. The value is expressed as the number of dots times 4.
 - c. Positive and negative values are treated as zero.
 - d. Delta X value is utilized only for proportionally spaced character fonts.
 - e. Legal values are from 0 to 32,767.
- Bytes 16-N Character Data
 - a. Character data is composed of a sequence of bytes that define the character. The bytes are ordered in rows. Each row contains as many bytes as required to define the width of the character.
 - b. For example, a character which is 27 bits wide would require 4 bytes of data to define each row of dots (27 divided by 8 = 3.375 bytes). The remaining unused bits in the last byte of data are ignored for each row of data.
 - c. A row describes one row of dots of the character from left to right, parallel to the raster scan.
 - d. The rows are stacked from top to bottom.
 - e. Each bit describes one pixel of the character. If the bit is set (1), a dot is printed. If the bit is set (0), no dot is printed.
 - f. The number of bytes of character data is exactly equal to the character width in bytes times the character height in dots.

6) Download One Scalable Character (Descriptor and Data)

Code : ESC (s # W [Data] [# = ASCII type number]

- Function :
- a. Downloads a character to the printer which is added as currently selected font ID. If a character with the same character code already exists in the font, the existing character is loaded and the previous character is deleted.
 - b. If enough memory is not available to receive a character, the entire font is deleted.
 - c. Data contains the information described below:

Metric Data
 Intellifont Scalable Data
 Contour Tree Data
 XY Data

Byte	MSB 15-8	LSB 7-0
0	Format (10)	Continuation (0, 1)
2	Descriptor Size (2)	Class (3)
4	Counter Data Size	
6	Metric Data Offset	
8	Character Intellifont Data Offset	
10	Contour Tree Offset	
12	XY Data Offset	
14	Metric Data	
	Character Intellifont Data	
	Contour Tree Data	
	XY Coordinate Data	
N-2	Reserved (0)	Checksum

- Description:
- Byte 0 Scalable Format = 10
(Bitmap Format = 4)
 - Byte 1 Continuation
0 = first block
1 = continuation block
 - Byte 2 Descriptor size = 2
 - Byte 3 Class
3 = Contour - Intellifont Scalable
4 = Compound Contour - Intellifont Scalable Compound Contour allows combining two characters together. See paragraph 431.
 - Bytes 4-5 Contour Data Size
 - a. This "unsigned integer" (0-65,535) specifies the total size in bytes (including this field) of Scaled Character Data in a block. Refer to the CTG FAIS font specification.
 - Bytes 6-7 Metric Data Offset
 - a. This "signed integer" (-32,767 to 32,767) indicates the Offset from Byte 4 to the beginning of the Font Metric Data. Refer to the CG FAIS font specification.

- Bytes 8-9 Character Intellifont Data Offset
 - a. This "signed integer" (-32,767 to 32,767) specifies the Offset from Byte 4 to the beginning of the Intellifont Character Data. Refer to the CG FAIS font specification.
- Bytes 10-11 Contour Tree Offset
 - a. This "signed integer" (-32,767 to 32,767) specifies the Offset from Byte 4 to the beginning of the Contour Tree Data. Refer to the CG FAIS font specification.
- Bytes 12-13 XY Data Offset
 - a. This "signed integer" (-32,767 to 32,767) specifies the Offset from Byte 4 to the beginning of XY Data. Refer to the CG FAIS font specification.
- Bytes 14-(n-3) Scalable Font Data
 - a. This data includes encoded Metric Data, Scalable Character Data, Contour Tree Data and XY Data. Refer to the CG FAIS font specification.
- Bytes (n-2)-(n-1) Checksum
 - a. This field appears only on the last continuation block (or a single data block) of Contour Data. Refer to the CG FAIS font specification.

7) Download One Compound Scalable Character (Descriptor and Data)

Code : ESC (s # W [Data] [# = ASCII type number]

- Function :
- a. Downloads a character to the printer which is added as currently selected font ID. If a character with the same character code already exists in the font, the existing character is loaded and the previous character is deleted.
 - b. If enough memory is not available to receive a character, the entire font is deleted.
 - c. Data contains the information described below:

Compound Character Escapement
 Number of Components
 Component Character ID's and XY Offsets

Byte	MSB 15-8	LSB 7-0
0	Format (10)	Continuation (0, 1)
2	Descriptor Size (2)	Class (4)
4	Compound Character Escapement	
6	Number of Components	
8	Character Code	
10	X Offset	
12	Y Offset	

repeated when necessary

- Description:
- Byte 0 Scalable Format = 10
 - Byte 1 Continuation
 - 0 = first block
 - 1 = continuation block
 - Byte 2 Descriptor size = 2
 - Byte 3 Class = 4 Compound Contour - Intellifont Scalable

- Bytes 4-5 Compound Character Escapement
 - a. This "signed integer" (-32,767 to 32,767) specifies the escapement of the compound character in design window units. Refer to the CG FAIS font specification.
- Bytes 6-7 Number of Components
 - a. This "unsigned integer" (0 to 65,535) specifies number of components of the compound character.
- Bytes 8-9 Character Code
 - a. This "unsigned integer" (0 to 65,535) specifies Character Code of a component character to be part of the Compound Character created. Refer to the CG FAIS font specification.
- Bytes 10-11 X Offset
 - a. This "signed integer" (-32,767 to 32,767) specifies the Offset of a component character from the reference point (origin) in the X direction in design window units.
- Bytes 12-13 Y Offset
 - a. This "signed integer" (-32,767 to 32,767) specifies the Offset of a component character from the reference point (origin) in the Y direction in design window units.

8) Font Selection Procedure

1. The table below shows how a specific font is selected by using font attributes.

Attributes	Number of Corresponding Font		
	= 0	= 1	> 1
Symbol set	to Spacing	Select	to Spacing
Spacing	Fix. to Height	Select	to Pitch
	Prop. to Pitch	Select	to Height
Pitch	Closest one	Select	to Height
Height	Closest one	Select	to Style
Style	to Weight	Select	to Weight
Weight	Closest one	Select	to Type face
Typeface	Internally highest priority Font	Select	Internally highest priority Font

2. Font Priority

DLL Softfont Highest
 Slot 1 (top)
 Slot 2 (bottom) ↓
 Resident Lowest
 Bitmap fonts always have higher priority than Scalable fonts.

1.7 Raster Graphics

Raster Graphics Commands List

No.	Command	Code
1	Set Graphics Resolution	ESC * t # R
2	Raster Graphics Presentation	ESC * r # F
3	Raster Width	ESC * r # S
4	Raster Height	ESC * r # T
5	Start Raster Graphics	ESC * r # A
6	Y-Offset	ESC * b # Y
7	Set Compression Method	ESC * b # M
8	Transfer Raster Graphics	ESC * b # W [data]
9	End Raster Graphics	ESC * r B / ESC * r C

1) Set Graphics Resolution

Code : ESC : t # R [# = ASCII type number]

Function : a. Sets the resolution in which the graphics data is printed.

Details : a. Specific resolutions are 75, 100, 150, 200, 300 or 600 dots per inch.
 b. Default resolution is 75 dpi.
 c. Command should be sent before start graphics command.
 d. Size of raster image is limited by the resolution selected. Changing the resolution also changes size of printed raster image. At 300 dpi, each "1" sent to printer represents one dot. Lowering the resolution, each "1" also represents one dot.

Printer configuration	300 dpi	600 dpi
600 dpi 1 =	N/A	1 dot
300 dpi 1 =	1 dot	4 dots
200 dpi 1 =	N/A	9 dots
150 dpi 1 =	4 dots	16 dots
100 dpi 1 =	9 dots	36 dots
75 dpi 1 =	16 dots	64 dots

e. Once the start graphics command is received by the printer, this graphics resolution command is ignored until the END GRAPHICS command is received.

2) Raster Graphics Presentation

Code : ESC * r # F [# = ASCII type number]

Function : a. Specifies the orientation of the Raster Image on the Logical Page.

Details : a. Range of # = 0 or 3.
 b. If # is out-of-range, command is ignored.
 c. Default # = 3.
 d. For # = 0, graphics is printed in the orientation of the logical page. Graphic is rotated to align with logical page.
 e. For # = 3, graphics is printed along the width of the physical page, regardless of the logical page orientation. Graphic data is not rotated to align with logical page.
 f. For # = 0, Default Graphics Margin is "logical page left boundary" for all orientations.
 g. For # = 3, Default Graphics Margin for portrait and reverse-portrait orientations "logical page left boundary". For landscape and reverse-land-scape, Default Graphics Margin is 50 dots from "logical page top boundary".

3) Raster Width

Code : ESC * r # S [# = ASCII type number]

Function : a. Specifies maximum width of raster graphics data.

Details : a. Range of # = 0 to 32,767 in units of 300 dpi dots.
b. Values greater than (logical page width = left graphics margin) are set to (logical page width - left graphics margin).
c. Data rows shorter than # are padded with zeros to a length of #.
d. Data rows longer than # are clipped at length #.
e. Raster Width is measured in the direction that raster data rows are laid down.

4) Raster Height

Code : ESC * r # T [# = ASCII type number]

Function : a. Specifies maximum height of raster graphics data.

Details : a. Range of # = 0 to 32,767 in units of 300 dpi dots.
b. Values greater than (logical page height - Y-position of cursor) are set to (logical page height - Y-position of cursor).
c. If number of Raster rows are less than #, remaining Raster Height area is padded with zeros.
d. Raster rows greater than # are clipped.
e. Raster rows located above the Y-position at Raster Height definition are also clipped (Y-offset command could cause this case).
f. Raster Width is measured perpendicular to the direction that raster data rows are laid down.

5) Start Raster Graphics

Code : ESC * r # A [# = ASCII type number]

Function : a. Signifies that Raster graphics will follow and specifies the starting position.

Details : a. The value 0 specifies that graphics is to be started at the left-most printable position on the page.
b. The value 1 specifies the starting position is the current cursor position and the left graphics margin is set to the current (horizontal position).

6) Y-Offset

Code : ESC * b # Y

Function : a. Moves the cursor down the specified number raster lines.

Details : a. This command is valid only in Raster Graphics mode.
b. Range of # is 0 to 32,767. Signs and decimals are ignored.
c. When using Graphic Mode-3, this command sets the seed row to zero.

7) Set Compression Method

Code : ESC * b # M

Function : a. Specifies the raster graphics transferring formats.

- # = 0 : Unencoded
- 1 : Run Length Encoding
- 2 : Tagged Image File Format (TIFF)
- 3 : Delta Row Compression
- 4 : (Reserved)
- 5 : Adaptive Compression

b. Default is # = 0 (Standard Graphics Mode).

Details : a. Each compression method is described in Transfer Raster Graphics command.

8) Transfer Raster Graphics

Code : ESC * b # W [Data] [# = decimal ASCII number]

Function : a. Transfers the raster graphics data to the printer.

b. Value field indicates the number of bytes of binary data to be sent to the printer.

- Standard graphics mode-select (Compression Method Code = 0; unencoded)

Details : a. Standard graphics mode is printer default. Sequence must be sent for each line of raster data.

b. When "end raster graphics" command is received, the active graphics mode is set to Standard Graphics Mode.

- Graphics mode1-select (Compression Method Code = 1; Run Length Encoded)

Details : a. Bytes of data are Processed in pairs. (n is always even)

b. The first byte determines the "count"; number of times to print the "raster data" which is represented by the second byte.

c. The "first data byte" is a binary value equal to the "count - 1".

Example: 00h => 0 + 1 = 1 Print "raster data" byte one time.

FFh => 255+1 = 256 Print "raster data" byte 256 times.

d. The "second data byte" is the raster data byte to be repeated.

e. If n is odd, the last byte of data is ignored.

f. When the "end raster graphics" command is received, the active graphics mode is to set to Standard Graphics Mode.

- Graphics mode2-select (Compression Method Code = 2; TIFF)

Details : a. Graphics Mode 2 supports two different types of data.

1. Sends 1 to 128 bytes of raster bitmap data.

The first data byte indicates the number of data bytes to follow.

2. Repeats the next byte 2 to 128 times.

The first data byte indicates the number to times to repeat the next data byte.

b. If the binary value of the first data byte is less than 128, then the first data byte defines the "count", the number of "raster data bytes" to receive and print. The active cursor position is set to the next dot on the same raster line. The "first data byte" is a binary value equal to "count - 1".

Example: 00h => 0 + 1 = > Print 1 "raster data byte"

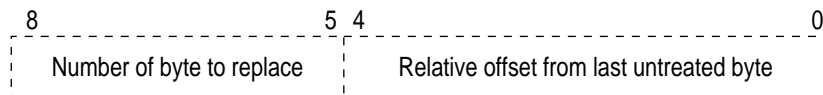
7Fh => 127+1 = 128 => Print 128 "raster data bytes"

- c. If the binary value of the first data byte is greater than 128, then the first data byte defines the "count", the number of times to repeat the single "raster data byte" which follows. The active cursor position is set to the next dot on the same raster line.
The "first data byte" is a binary value equal to $(256 - \text{count} + 1)$. Also, "count" = $256 - \text{"first data byte"} + 1$
Example: FFh $\Rightarrow 256 - 255 + 1 = 2$ Print "raster data" byte one time.
81h $\Rightarrow 256 - 129 + 1 = 128$ Print "raster data" byte 256 times.
- d. The value of 128 is invalid as a "first data byte". If 128 is received as a "first byte", the byte is ignored and trapped.
- e. When the "end raster graphics" command is received, the active graphics mode is set to Standard Graphics Mode.

- Graphics Mode3 - select (Compression method code = 3; delta row)

Details : a. Graphic data in Graphics Mode-3 consists of two parts. The first part is the command byte and the second part is the replacement byte. The command byte identifies 1 : Number of byte to replace and 2: Relative offset from last untreated byte.

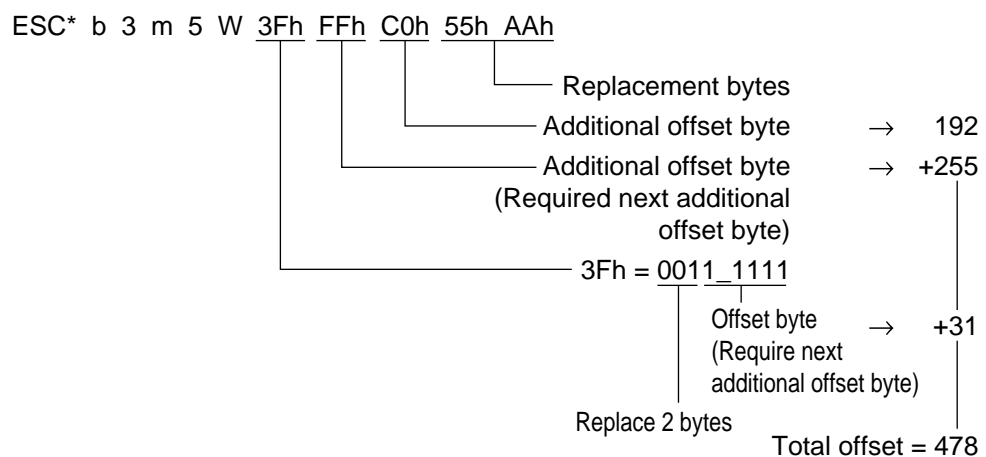
b. Command byte



1. Number of byte to replace is number of replacement byte. A value of 0 indicates one byte, a value of 7 indicates eight bytes. If more than eight bytes replacement are required, additional command byte and replacement bytes may be added.
2. Relative offset from last untreated byte is byte offset from previously replaced byte. A value of 0 indicates one byte offset, a value of 30 indicates thirty-one bytes offset. A value of 31 indicates that additional offset byte follows the command byte. An additional offset value is 0 to 255. Also, if an additional offset byte is set to 255, one more additional offset byte follows this offset byte.

The total offset is the sum of all the values of offset bytes.

Example :



- c. The current raster data row is called Seed Row. The seed row is updated by every raster graphic data transfer. This update takes place regardless of graphic mode. If no graphic data is transferred, seed row is all zero. The byte of raster data that is pointed using offset value is replaced by replacement byte.

- Graphics Mode 5-select (Compression Method Code = 5; Adaptive Compression)

Details : a. Graphics Mode-5 allows the combined use of any of the four previous compression methods (0 through 3).

Raster Image in Graphics Mode-5 is transferred as a block of raster data rather than individual rows.

Graphics data consists of two parts, the first part is three control bytes and the second part is the block of raster rows.

b. Control bytes

The first of three bytes, the command byte, identifies the type of compression for the row. The two following bytes identify the number of bytes or rows involved.

Command Byte Value	0 : Unencoded
	1 : Run Length Encoding
	2 : Tagged Image File Format
	3 : Delta Row Compression
	4 : Empty Row
	5 : Duplicate Row

9) End Raster Graphics

Code : ESC * r B

Function : a. Informs the printer that all raster graphics have been transferred.

Code : ESC * r C

Function : a. Informs the printer that all raster graphics have been transferred.

b. Defaults raster graphic data transfer mode to be "Standard Mode".

This command is a modified version of ESC * r B End Raster Graphics.

1.8 PCL Rectangular Area Fill Graphics

PCL Rectangular Area Fill Graphics Commands List

No.	Command	Code
1	Horizontal Rule/Pattern Size (in PCL Units)	ESC * c # A
2	Horizontal Rule/Pattern Size (in Decipoints)	ESC * c # H
3	Vertical Rule/Pattern Size (in PCL Units)	ESC * c # B
4	Vertical Rule/Pattern Size (in Decipoints)	ESC * c # V
5	Pattern ID	ESC * c # G
6	Print Rule/Pattern	ESC * c # P
7	Transfer User Defined Pattern	ESC * c # W [data]
8	Set Pattern Reference Point	ESC * cp # R
9	Pattern Control	ESC * c # Q

1) Horizontal Rule/Pattern Size (in PCL Units)

Code : ESC * c # A [# = ASCII type number]

Function : a. Specifies the horizontal size in number of dots of the rule or pattern.

Details : a. The horizontal size is relative to the current orientation of the page. Printing the same rule/pattern in both portrait and landscape orientations produces different absolute patterns on the page.
b. Patterns created that exceed the printable limits of the page stops at the printable limits of the page.
c. Power up and reset cause this value to default to zero.
d. Frame line is not drawn automatically for shading.
e. Plus sign has no effect on the command. Minus sign in command causes nothing to be printed.
f. When two patterns or gray scales which have the same pattern or density overlap, they automatically match the pattern.

2) Horizontal Rule/Pattern Size (in Decipoints)

Code : ESC * c # H [# = ASCII type number]

Function : a. Specifies the horizontal size of the rule or pattern with 1/720 inch increments.

Details : a. After the size is specified in decipoints, it is converted into dots.
b. 2.4 decipoints = 1 dot # divided by 2.4 gives the number of dots.
c. The number of dots is rounded up to the next integer value when it is calculated, if necessary.

3) Vertical Rule/Pattern Size (in PCL Units)

Code : ESC * c # B [# = ASCII type number]

Function : a. Specifies the vertical size in dots of the rule or pattern.

Details : a. The vertical size is relative to the current orientation of the page. Printing the same rule/pattern in both portrait and landscape orientations produces different absolute patterns on the page.
b. Patterns created that exceed the printable limits of the page stops at the printable limits of the page.
c. Power-up and resets cause this value to default to zero.

4) Vertical Rule/Pattern Size (in Decipoints)

Code : ESC * c # V [# - ASCII type number]

Function : a. Specifies the vertical size of the rule or pattern in 1/720's of an inch.

Details : a. After the size is specified in decipoints, it is converted in to dots.
b. 2.4 decipoints = 1 dot # divided by 2.4 gives the number of dots.
c. The number of dots is rounded up to the next integer value when it is calculated, if necessary.

5) Pattern ID

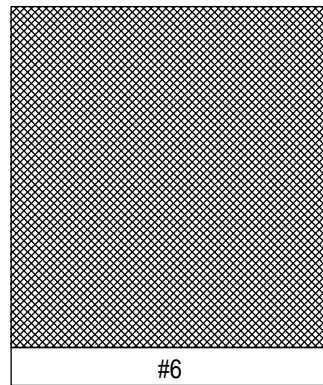
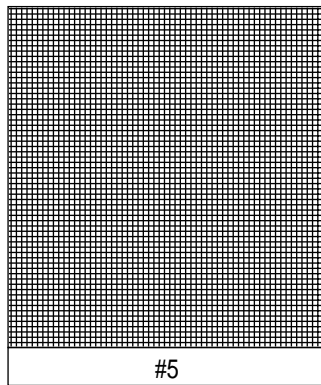
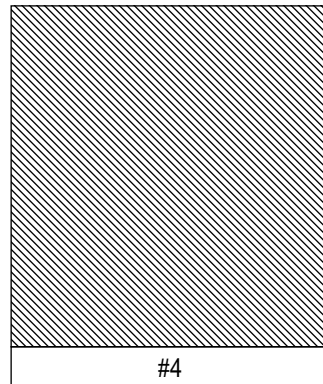
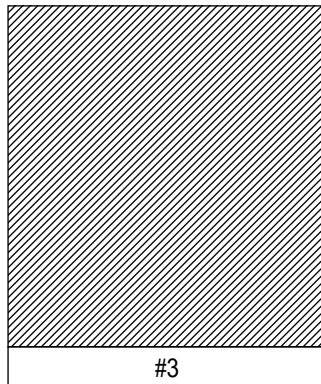
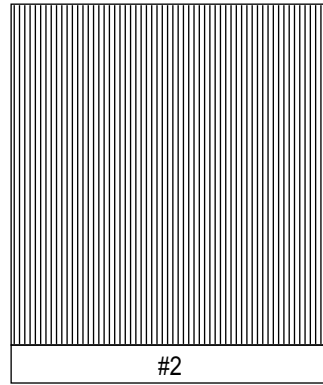
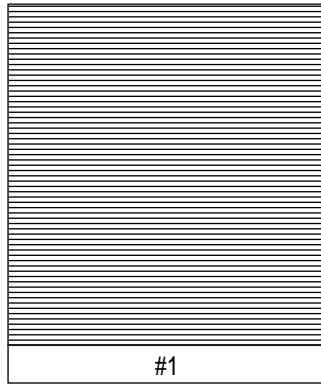
Code : ESC * c # G [# = ASCII type number]

Function : a. Used in conjunction with the print rule/pattern command to specify one of six shading patterns.

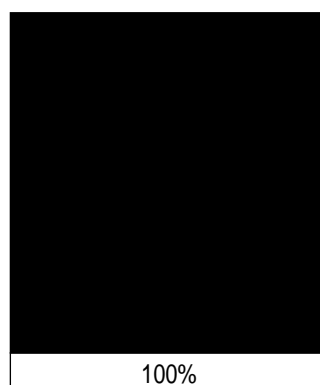
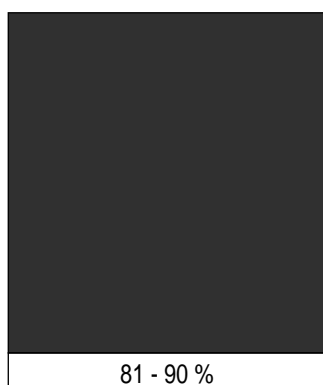
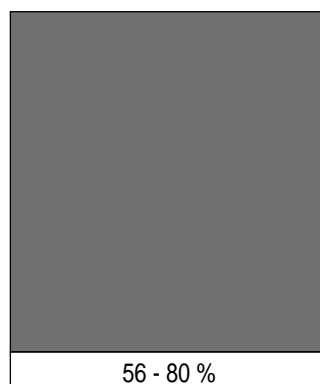
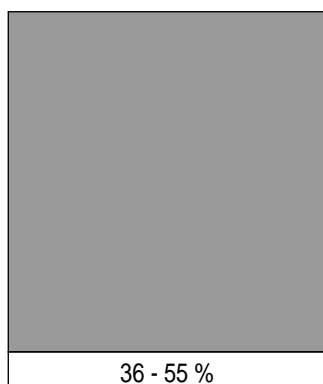
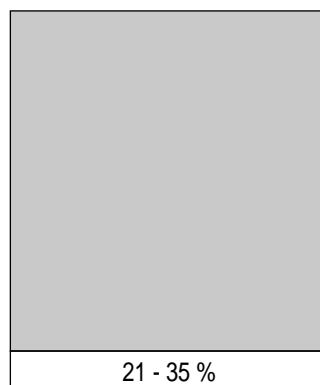
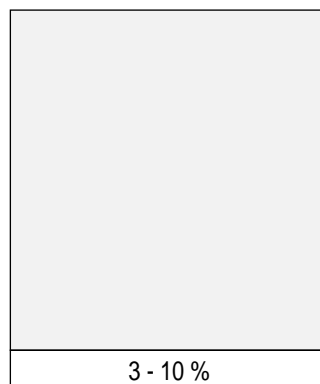
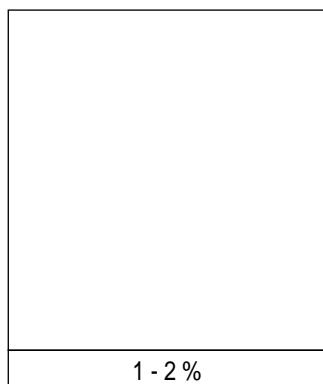
b. This sequence is used before the print rule/pattern command and determines which of eight gray patterns is to be printed when the print rule/pattern command is issued.

Details : a. In case of cross-hatch pattern, Value field specifies the pattern number (1 through 6).

b. In case of gray scale pattern, value field specifies the darkness (1 through 100). Output is one of 8 shades as follows:



OKIDATA Cross-Hatch Patterns



OKIDATA Gray Scale

6) Print Rule/Pattern

Code : ESC * c # P

Function : a. This command determines whether a rule, gray scale pattern, or OKIDATA defined pattern is to be printed, and causes the printer to print the selected rule or pattern.

Details : a. Pattern definition.

- # = 0 : Solid Black Fill
- 1 : Solid White Fill
- 2 : Gray Scale Pattern
- 3 : Cross Hatch Pattern
- 4 : User Defined Pattern
- 5 : Use Current Pattern set by "ESC * v # T"

- b. Range of n=0, 1, 2, 3, 5. If n is out-of-range, the command is ignored.
- c. The cursor position is at the top left corner of the area being filled and does not move due to this command.

7) Transfer User Defined Pattern

Code : ESC * c # W (Pattern descriptor and data)

Function : a. Download user-defined pattern descriptor and pattern data identified by the current pattern ID.

Details : to Transfer User Defined Pattern

User-Defined Pattern Data Format (without Resolution Specification)

Byte	MSB 15-8	LSB 7-0
0	Format (0)	Continuation (0)
2	Pixel Encoding (1)	Reserved (0)
4	Pattern Height in Pixels	
6	Pattern Width in Pixels	
8	Pattern Data	
:	:	

Resolution Specified User-Defined Pattern Data Format

Byte	MSB 15-8	LSB 7-0
0	Format (20)	Continuation (0)
2	Pixel Encoding (1)	Reserved (0)
4	Pattern Height in Pixels	
6	Pattern Width in Pixels	
8	X Resolution	
10	Y Resolution	
12	Pattern Data	
:	:	

- Byte 0 Format
0 = 300DPI Pattern
20 = Resolution-Specified pattern
- Byte 1 Continuation = 0
Only 0 (Not continued) is available.
- Byte 2 Pixel Code = 1
- Byte 3 Reserved = 0
- Byte 4-5 Pattern Height in Pixels
Specifies the number of height in pixels of the pattern.
- Byte 6-7 Pattern Width in Pixels
Specifies the number of width in pixels of the pattern.
- Byte 8-9 X Resolution
Specifies the resolution in DPI. 300 DPI, 600 = 600DPI.
- Byte 10-11 Y Resolution
Specifies the resolution in DPI. 300 =300DPI, 600 = 600DPI.
Only the combination of X resolution = Y resolution is available.
- Byte 12- Pattern data

8) Set Pattern Reference Point

Code : ESC * p # R

Function : a. Sets pattern reference point to the current cursor position.
 b. # = 0 : Rotates pattern with print direction.
 1 : Keeps patterns fixed.

9) Pattern Control

Code : ESC * c # Q

Function : a. The function is carried out to the currently selected pattern ID.
 b. # value Control Function
 0 : Delete all patterns.
 1 : Delete all temporary patterns.
 2 : Delete pattern (current pattern ID).
 4 : Make pattern temporary (current pattern ID).
 5 : Make pattern permanent (current pattern ID).

1.9 Print Model

Print Model Commands List

No.	Command	Code
1	Source Transparency Mode	ESC * v # N
2	Pattern Transparency Mode	ESC * v # O
3	Select Pattern	ESC * v # T
4	Set Logical Operation	ESC * l # O

1) Source Transparency Mode

Code : ESC * v # N [# = decimal ASCII number]

Function : a. Selects Advanced Graphics Source Transparency.

Details : a. This command is active in PCL mode only.
b. Range of # is 0, 1.
c. If # is out-of-range or omitted, traps and ignores the command.
d. If # = 0, then source is transparent (default).
If # = 1, then source is opaque.

2) Pattern Transparency Mode

Code : ESC * v # O [# = decimal ASCII number]

Function : a. Selects Advanced Graphics Pattern Transparency.

Details : a. This command is active in PCL mode only.
b. Range of # is 0, 1.
c. If # is out-of-range or omitted, traps and ignores the command.
d. If # = 0, then source is transparent (default).
If # = 1, then pattern is opaque.

3) Select Pattern

Code : ESC * v # T [# = decimal ASCII number]

Function : a. Selects Advanced Graphics fill pattern.

Details : a. This command is active in PCL mode only.
b. Range of # is 0, 1, 2, or 3.
c. If # = 0, then fill is solid black (default).
If # = 1, then fill is solid white.
If # = 2, then fill is currently selected shading pattern.
If # = 3, then fill is currently selected cross-hatch pattern.
If # = 4, user specification pattern is selected.

4) Set Logical Operation (ROP3)

Code : ESC * I # O

Function : a. The logical operating method of source pattern destination in RGB area is designated.

- Details :
- a. # = 0 ~ 255 the logical operating methods shown below are set.
 - b. A value designated other than 0 ~ 255 should be invalid.
 - c. Default is "252"(=TSQ).
 - d. '+' sign and decimal fraction of # are ignored.
An addition of '-' will make the command invalid.
 - e. The setting of Logical Operation by this command also affects the environment in GL/2 mode.
 - f. In RGB area, "white = 1, black = 0".
The logical operations set by this command are, including the tradeoffs of the transparency of source and pattern in CMY area with white = 0, black = 1, as the following operations.

Source	Pattern	Operating method
Opaqe	Opaqe	Image = Not (ROP3)
Opaqe	Transparent	A = Not (ROP3) & Not (Source) B = Not (ROP3) & Pattern C = Not (Pattern) & Source & Distnation Image = A B C
Transparent	Opaqe	A = Not (ROP3) & Source B = Distination & Not (Source) Image = A B
Transparent	Transparent	A = Not (ROP3) & Source & Patten B = Distination & Not (Source) C = Distination & Not (Pattern) Image = A B C

#	Logical operation	#	Logical operation	#	Logical operation	#	Logical operation	#	Logical operation
0	0	52	STDSaoux	104	DSTDSonoxn	156	STDnax	208	TSDnoa
1	DTSoon	53	STDSxnox	105	TDSxxn	157	DSTDoaxn	209	TSDTxoxn
2	DTSona	54	SDTox	106	DTSax	158	DSTDSaoux	210	TDSnax
3	TSon	55	SDToan	107	TSDTSoaxxn	159	TDSxan	211	STDSoaxn
4	STDona	56	TSDToax	108	SDTax	160	DTa	212	SSTxTDxax
5	DTon	57	STDnox	109	TDSTDoaxxon	161	TDSTnaoxn	213	DTSanan
6	TDSxnon	58	STDSxox	110	SDTSnoax	162	DTSnoa	214	TSDTSaoux
7	TDSaon	59	STDnoan	111	TDSxnan	163	DTSDxoxn	215	DTSxan
8	SDTnaa	60	TSx	112	TDSana	164	TDSTonoxn	216	TDSTxax
9	TDSxon	61	STDSonox	113	SSDxTDxaxn	165	TDxn	217	SDTSaouxn
10	DTna	62	STDSnaox	114	SDTSxox	166	DSTnax	218	DTSDanax
11	TDSnaon	63	TSan	115	SDTnoan	167	TDSToaxn	219	STxDSxan
12	STna	64	TSDnaa	116	DSTDxox	168	DTSoa	220	STDnao
13	TDSnaon	65	DTSxon	117	DSTnoan	169	DTSoxn	221	SDno
14	TDSonon	66	SDxTDxa	118	SDTSnaox	170	D	222	SDTxo
15	Tn	67	STDSanaxn	119	DSan	171	DTSono	223	SDTano
16	TDSona	68	SDna	120	TDSax	172	STDSxax	224	TDSoa
17	DSon	69	DTSnaon	121	DSTDSoaxxn	173	DTSDaoxn	225	TDSoxn
18	SDTxnon	70	DSTDaox	122	DTSDnoax	174	DSTnao	226	DSTDxax
19	SDTaon	71	TSDTxaxn	123	SDTxnan	175	DTno	227	TSDTaoxn
20	DTSxnon	72	SDTxax	124	STDSnoax	176	TDSnoa	228	SDTSxax
21	DTSaon	73	TDSTDoaxxn	125	DTSxnan	177	TDSTxoxn	229	TDSTaoxn
22	TSDTSanaxx	74	DTSDoax	126	STxDSsxo	178	SSTxDSxox	230	SDTSanax
23	SSTxDSxaxn	75	TDSnox	127	DTSaan	179	SDTanan	231	STxTDxan
24	STxTDxa	76	SDTana	128	DTSaa	180	TSDnax	232	SSTxDSxax
25	SDTSanaxn	77	SSTxDSxoxn	129	STxDSxon	181	DTSToaxn	233	DSTDSanaxxn
26	TDSTaoux	78	TDSTxox	130	DTSxna	182	DTSDTaoux	234	DTSao
27	SDTSxaxn	79	TDSnoan	131	STDSnoaxn	183	SDTxan	235	DTSxno
28	TSDTaoux	80	TDna	132	SDTxna	184	TSDTxax	236	SDTao
29	DSTDxaxn	81	DSTnaon	133	TDSTnoaxn	185	DSTDaoxn	237	SDTxno
30	TDSox	82	DTSDaox	134	DSTDSoaxx	186	DTSnao	238	DSo
31	TDSaon	83	STDSxaxn	135	TDSaxn	187	DSno	239	SDTnoo
32	DTSnaa	84	DTSonon	136	DSa	188	STDSanax	240	T
33	SDTxon	85	Dn	137	SDTSnaoxn	189	SDxTDxan	241	TDSono
34	DSna	86	DTSox	138	DSTnoa	190	DTSxo	242	TDSnao
35	STDnaon	87	DTSoan	139	DSTDxoxn	191	DTSano	243	TSno
36	STxDSxa	88	TDSToax	140	SDTnoa	192	TSa	244	TSDnao
37	TDSTanaxn	89	DTSnox	141	SDTSxoxn	193	STDSnaoxn	245	TDno
38	SDTSaon	90	DTx	142	SSDxTDxax	194	STDSonoxn	246	TDSxo
39	SDTSxonx	91	DTSDonox	143	TDSanan	195	TSxn	247	TDSano
40	DTSxa	92	DTSDxox	144	TDSxna	196	STDnoa	248	TDSao
41	TSDTSaouxn	93	DTSnoan	145	SDTSnoaxn	197	STDSxoxn	249	TDSxno
42	DTSana	94	DTSDnaox	146	DTSDToaxx	198	SDTnax	250	DTo
43	SSTxTDxaxn	95	DTan	147	STDaxn	199	TDSToaxn	251	DTSnoo
44	STDSoax	96	TDSxa	148	TSDTSoaxx	200	SDToa	252	TSo
45	TSDnox	97	DSTDSaouxn	149	DTSaxn	201	STDoxn	253	TSDnoo
46	TSDTxox	98	DSTDoax	150	DTSxx	202	DTSDxax	254	DTSoo
47	TSDnoan	99	SDTnox	151	TSDTSonoxx	203	STDSaouxn	255	1
48	TSna	100	SDTSoax	152	SDTSonoxn	204	S		
49	SDTnaon	101	DSTnox	153	DSxn	205	SDTono		
50	SDTSsoox	102	DSx	154	DTSoaxn	206	SDTnao		
51	Sn	103	SDTSonox	155	SDTSoaxn	207	STno		

S : Source image a : AND x : XOR Example) #- 225 (RDSoxn)
T : Pattern o : OR Logical operation : NOT (pattern XBR (source or destination))
D : Destination n : NOT

1.10 Macros

Macro Commands List

No.	Command	Code
1	Macro ID	ESC & f# Y
2	Macro Control	ESC & f# X

1) Macros

Function : a. A macro is a means of storing a combination of escape sequences that may be recalled and executed. A typical application is in the selection of fonts.
b. Macros can be defined as temporary or permanent.
c. Temporary macros are deleted by reset or power-on.
d. Permanent macros are deleted at power-on but are not affected by reset (ESC E) or by pressing the *RESET* or *RECOVER* key.

Correct Order of Sequences :

1. Procedure to define Macro:
 - a) Macro ID
 - b) Starts Macro definition.
 - c) Macro definition
 - d) Stops macro definition.
 - e) Stores Macro as temporary or permanent.
2. Execute macro:
 - a) Macro ID
 - b) Calls or executes macro.
3. Delete macro(s):
 - a) Macro ID
 - b) Deletes all macros, deletes all temporary macros, or deletes macro.
4. Enable or disable Auto. Macro Overlay:
 - a) Macro ID
 - b) Enables or disables Auto Macro Overlay.

2) Macro ID

Code : ESC & f # Y [# = ASCII type number]

Function : a. This sequence specifies the ID number of the macro.

Details : a. Available ranges of values are 0 to 32,767.
Any values which are greater than 32,767 are treated as 32,767.
b. Plus or minus sign and fractional values are ignored.

3) Macro Control

Code : ESC & f # X

Function : a. This sequence specifies which Macro control function you wish to perform.

Details : a. Macro Control Function :
= 0 : Starts Macro definition (temporary).
1 : Stops Macro definition.
2 : Executes Macro.
3 : Calls Macro.
4 : Enables Auto Macro Overlay.
5 : Disables Auto Macro Overlay.
6 : Deletes all Macros.
7 : Deletes all temporary Macros.
8 : Deletes Macro.
9 : Makes Macro temporary.
10 : Makes Macro permanent.
41 : Overlay macro is also designated permanent.
51 : Permanent designation of overlay macro is canceled.
b. MACRO START command contained in MACRO DEFINITION is ignored.
c. EXECUTE MACRO command and CALL MACRO command are valid in MACRO DEFINITION.

- d. Nesting of macros is allowed up to three levels:
 Macro 2 is called in macro 1.
 Macro 3 is called in macro 2.
- e. Macro is allowed to call itself. Same limitation as c.

Description:

- Start Macro definition
 Stop Macro definition
 # = 0, # = 1 Macro Control Function
 - a. A new temporary macro is created, identified by the current Macro ID.
 All data is read and stored as the definition of the specified ID until Stop Macro definition or reset command is received.

- Execute Macro (Macro ID)
 # = 2 Macro Control Function
 - a. The start macro command executes the macro specified by macro ID is executed. Changes to the current environment are remembered. The current environment is permanently changed by the macro. The variables considered to be the current environment are listed in the table below:

Current Environment Variables

- | | |
|--|---|
| • Page length | • Font ID |
| • Orientation | • Character code |
| • Input control | • Macro ID |
| • Copy count | • VMI/Line Spacing |
| • Margins (top, left and right) | • Pattern ID |
| • Pref. Skip mode | • Horizontal rule size |
| • Line termination | • Vertical rule size |
| • EOL wrap | • Underline mode |
| • Font attributes | • Graphics resolution |
| • HMI | • Graphics mode |
| • Primary font address | • Graphics left margin |
| • Primary font, Secondary font | • Raster Graphics Width, Height |
| • Graphics Presentation mode | • Graphics Compression mode |
| • Print direction | • Page offset (left, right) |
| • Source Transparency mode | • Pattern Transparency mode |
| • Transparency pattern | • Picture Frame Anchor point |
| • Picture Frame size
(Horizontal, Vertical) | • GL/2 Plot size (Horizontal, Vertical) |
| • Unit of measure | • Status Readback Location Unit |
| | • Status Readback Location Type |

- Call Macro (Macro ID)
 # = 3 Macro Control Function
 - a. The call macro command executes the marco identified by the current macro ID. The current environment is changed by the macro, but when execution has been competed, the current environment is restored to that the states prior to the execution of the macro. The cursor position remains altered by the macro.
- Enable Auto Macro Overlay (Macro ID)
 # = 4 Macro Control Function
 - a. The enable Auto Macro Overlay command assigns the last specified macro ID as the current forms overlay macro. The auto macro overlay macro is executed each time a page is printed. When execution has been completed, the overlay environment is restored to that of the state prior to the execution of the macro.

Overlay Environment Variables

PCL context:

- Overlay
- Page length
- Orientation
- Input control
- Copy count
- Position stack
- Page size
- Registration

HPGL/2 context:

- Pen Position
- Hard Clip Limits
- Logical Page
- Line Attributes
- Scaling Points
- Clip Window
- Fill Attributes

The overlay environment also consists of the default variables listed below:

Overlay Default Variables

- Top margin (1/2 inch from top of page)
- Bottom margin (1/2 inch from bottom of page)
- Left margin (left-most printable position)
- Right margin (right-most printable position)
- Perforation skip mode (on)
- Line termination (0)
- EOP wrap (off)
- Primary font address (SI)
- Font attributes (default)
- HMI (default)
- Primary font (default)
- Secondary font (default)
- Font ID (0)
- Character code (0)
- Macro ID (0)
- Current active position (left and top margin)
- VMI/Line spacing (6 lpi)
- Horizontal rule size (0)
- Vertical rule size (0)
- Underline mode (off)
- Graphics resolution (75 dpi)
- Graphics mode (off)
- Graphics left margin (left limit)
- Graphics presentation mode (3)
- Graphics compression mode (0)
- Pattern ID (0)
- Source Transparency mode (transparent)
- Pattern Transparency mode (transparent)
- Transparency pattern (solid black)
- Picture frame anchor point (default)
- Horizontal picture frame size (default)
- Vertical picture frame size (default)
- GL/2 horizontal plot size (default)
- GL/2 vertical plot size (default)
- Unit of measure (300 dpi)

- Disable Auto Macro Overlay
 - # = 5 Macro Control Function
 - a. This command disables the current Auto Macro Overlay on the current page. This command takes effect on the current page. Changing the page length or orientation causes the Auto Macro Overlay to be disabled after the command is executed.
- Delete All Macros
 - # = 6 Macro Control Function
 - a. Deletes all temporary, permanent, and auto overlay macros.
- Delete All Temporary Macros
 - # = 7 Macro Control Function
 - a. Deletes all temporary macros.
- Delete Macro (Macro ID)
 - # = 8 Macro Control Function
 - a. Deletes the macro last specified by macro ID.
- Make Macro Temporary (Macro ID)
 - # = 9 Macro Control Function
 - a. Makes macro last specified by macro ID temporary.
- Make Macro Permanent (Macro ID)
 - # = 10 Macro Control Function
 - a. Makes macro last specified by macro ID permanent.
- Make Macro Overlay Permanent
 - # = 41 Macro Control Function (OKI unique)
 - a. Makes macro currently overlay specified permanent.
The macro specified overlay permanent is not overlay-disabled by such operations as reset by command, changing page length, changing page orientation, changing paper size or disable auto macro overlay.
- Disable Macro Overlay Temporary
 - # = 51 Macro Control Function (OKI unique)
 - a. Makes macro currently overlay specified temporary.

1.11 Status Readback Commands

Status Readback Commands List

No.	Command	Code
1	Set Status Readback Location Type	ESC * s # T
2	Set Status Readback Location Unit	ESC * s # U
3	Status Readback Inquire Entity	ESC * s # I
4	Free Space	ESC * s # M
5	Flush All Pages	ESC & r # F
6	Echo	ESC * s # X

1) Set Status Readback Location Type

Code : ESC * s # T [# = ASCII type number]

Function : a. Specifies the Status Readback Location Type.
Location type is used in conjunction with the location unit to identify an entity location for a status request.

b. Value field # indicates the Location Type:

- # = 0 : Invalid Location
- 1 : Currently selected
- 2 : All locations
- 3 : Internal
- 4 : Downloaded entity
- 5 : Card
- 7 : User-installable ROM device

2) Set Status Readback Location Unit

Code : ESC * s # U [# = ASCII type number]

Function : a. Specifies the Status Readback Location Unit.
Location unit is used in conjunction with the location type to identify an entity location for a status request.

Location Type	Location Unit	Entity location
0	(ignored)	Invalid location
1	(ignored)	Currently selected
2	(ignored)	All locations
3	1, 2	All internal
4	0	All downloaded
	1	Temporary downloaded
	2	Permanent downloaded
5	0	All card
	1	(Highest priority card)
	2	(Lowest priority card)
7	0	All SIMMs
	1	(Highest priority SIMM)
	2	(Lowest priority SIMM)

3) Status Readback Inquire Entity

Code : ESC * s # I [# = ASCII type number]

Function : a. Specifies the Inquire Entity for Status Readback.
b. The value field # indicates the kind of the response.

- # = 0 : Invalid Location
- 1 : Font
- 2 : Macro
- 3 : User-defined pattern
- 4 : Font extended

Details : a. All responses being with the text "PCL". Each status line is followed by CR and LF. The last code of the responses is FF (0x0C).

Basic syntax is as follows:

```
PCL<CR><LF>
INFO TITLE<CR><LF>
KEYWORDn=DATA<CR><LF>
KEYWORDn=DATA<CR><LF>
:
:
KEYWORDn=DATA<CR><LF>
<FF>
```

The response keywords for each entity are as follows:

Font Response:

```
SELECT=
SYMBOLSETS=
LOCTYPE=
LOCUNIT=
```

Font Extended Response:

Two additional keywords as follows:

```
DEFID=
NAME=
```

Macro Response:

```
IDLIST=
```

User-Defined Pattern Response:

```
IDLIST=
LOCTYPE=
LOCUNIT=
```

Symbol Set Response:

```
IDLIST=
```

b. **Examples:**

For free Space command:

```
PCL<CR><LF>
TOTAL=100000<CR><LF>
LARGEST=25000<CR><LF>
<FF>
```

c. If out-of-range values are specified in the command, the printer responds with one of four possible errors:

```
ERROR = Invalid Entity
        Invalid Location
        None
        Internal Error
```

4) Free Space

Code : ESC * s # M

Function : a. Requests the printer to return the amount of available free memory size in it.

b. Normal Response:

```
TOTAL=totalsize
LARGEST=largestsize
```

“totalsize” is the total available user memory size in bytes.

“largestsize” is the largest continuous block size in bytes.

Error Response:

```
ERROR=INVALID UNIT
```

5) Flush All Pages

Code : ESC & r # F

Function : a. Suspends accepting input data until all pages which are currently in the printer are printed.

b. # = 0 : Waits only until completed pages are printed.

1 : Closes the current page and waits until all the pages are printed.

6) Echo

Code : ESC * s # X [# = ASCII type number]

Function : a. Echoes its value field back to the host.

b. Value field # is the value to be echoed.

Valid range is -32,767 to 32,767.

Details : a. The response:

PCL

ECHO valuefiled

1.12 HPGL/2 Picture Frame

HPGL/2 Picture Frame Commands List

No.	Command	Code
1	PCL Cursor/Palette	ESC % # A
2	HPGL/2 Cursor/Palette	ESC % # B
3	HPGL/2 Horizontal Size Inches	ESC * c # K
4	HPGL/2 Vertical Size Inches	ESC * c # L
5	Anchor Point at PCL Cursor	ESC * c # T
6	HPGL/2 Horizontal Size Decipoints	ESC * c # X
7	HPGL/2 Vertical Size Decipoints	ESC * c # Y

1) PCL Cursor/Palette

Code : ESC % # A [#=decimal ASCII number]

Function : a. Selects PCL mode with cursor position and palette specified by #.

Details : a. This command is active in PCL and HPGL/2 modes.
b. Range of # is 0, 1.
c. If # = 0, then uses previous PCL cursor position.
If # = 1, then uses current HPGL/2 pen position.
d. If # is out-of-range, traps and ignores the command.
e. If # is omitted, then # = 0.

2) HPGL/2 Cursor/Palette

Code : ESC % # B [#=decimal ASCII number]

Function : a. Selects HPGL/2 mode with pen position and palette specified by #.

Details : a. This command is active in PCL mode only.
b. If # = 0, then uses previous HPGL/2 pen position and palette.
If # = 1, then uses current PCL cursor position and palette.
c. If # is out-of-range, traps and ignores the command.
d. If # is omitted, then # = 0.

3) HPGL/2 Horizontal Size Inches

Code : ESC * c # K [#=decimal ASCII number]

Function : a. Sets horizontal size of HPGL/2 plot window in inches.

Details : a. This command is active in PCL mode only.
b. Range of # is 0.01 to 32,767.99 inches.
c. If # is out-of-range or omitted, traps and ignores the command.

4) HPGL/2 Vertical Size Inches

Code : ESC * c # L [#=decimal ASCII number]

Function : a. Sets vertical size of HPGL/2 plot window in inches.

Details : a. This command is active in PCL mode only.
b. Range of # is 0.01 to 32,767.99 inches.
c. If # is out-of-range or omitted, traps and ignores the command.

5) Anchor Point at PCL Cursor

Code : ESC * c # T [#=decimal ASCII number]

Function : a. Sets anchor point of HPGL/2 window at current PCL cursor position.

Details : a. This command is active in PCL mode only.

6) HPGL/2 Horizontal Size Decipoints

Code : ESC * c # X [#=decimal ASCII number]

Function : a. Sets horizontal size of HPGL/2 plot window in 1/720 inch.

Details : a. This command is active in PCL mode only.
b. Range of # is 0 to 32,767 inches valid to fourth place.
c. If # is out-of-range or omitted, traps and ignores the command.

7) HPGL/2 Vertical Size Decipoint

Code : ESC * c # Y [# = decimal ASCII number]

Function : a. Sets vertical size of HPGL/2 plot window in 1/720 inch.

Details : a. This command is active in PCL mode only.
b. Range of # is 0 to 32,767 inches valid to fourth place.
c. If # is out-of-range or omitted, traps and ignores the command.

1.13 HPGL/2 Graphics

(1) GL/2 Configuration/Status Group

Command	Code	Command	Code
Comment	CO	Input Window	IW
Set Default Value	DF	Rotate Coordinate System	RO
Initialize	IN	Scale Input Window Points	SC
Input Scaling Points	IP	Pixel Placement	PP
Input Relative P1 and P2	IR		

(2) GL/2 Line/File Attribute Group

Command	Code	Command	Code
Select Pen	SP	User Defined Raster Fill	RF
Pen Width	PW	Screen Vectors	SV
Pen Width Unit Selection	WU	Anchor Corner	AC
Line Type	LT	Transparency Mode	TR
User Defined Type	UL	Symbol Mode	SM
Line Attributes	LA	Number of Pens	NP
Fill Type	FT	Merge Control	MC

(3) GL/2 Vector Group

Command	Code	Command	Code
Pen Down	PD	Absolute Arc-Three Point	AT
Pen Up	PU	Relative Arc-Three Point	RT
Plot Absolute	PA	Circle	CI
Plot Relative	PR	Polyline Encoded	PE
Arc Absolute	AA	Absolute Bezier	BZ
Arc Relative	AR	Relative Bezier	BR

(4) GL/2 Polygon Group

Command	Code	Command	Code
Rectangle Edge Absolute	EA	Wedge with Fill	WG
Rectangle Edge Relative	ER	Polygon Mode	PM
Rectangle Absolute Filled	RA	Edge Polygon	EP
Rectangle Relative Filled	RR	Fill Polygon	FP
Wedge Edge	EW		

(5) GL/2 Character Group

Command	Code	Command	Code
Standard Font Definition	SD	Character Size Absolute	SI
Alternate Font Definition	AD	Character Size Relative	SR
Standard Character Set	SS	Direction Absolute	DI
Alternate Character Set	SA	Direction Relative	DR
Primary Font by ID	FI	Character Slant	SL
Secondary Font by ID	FN	Character Fill Mode	CF
Bitmap Font Enable	SB	Character Plot	CP
Label Text	LB	Extra Space	ES
Label Origin	LO	Define Variable Text Path	DV
Define Label Terminator	DT	Transparent Data	TD

- 1) End Label Code
 - Code : ETX
 - Function : a. This code is the default terminator for the LB Label Command.
 - Details : a. If this code is detected outside of a valid LB Label Command, then it is trapped and ignored.
 - b. If the code is not the currently selected Terminator Value by default or by the DT Define Terminator instruction, then it is trapped and ignored.

- 2) Backspace
 - Code : BS
 - Function : a. When used within the LB Label Command, this code causes the pen position to be moved back one character space.
 - Details : a. If this code is detected outside of valid LB Label Command, then it is trapped and ignored.

- 3) Horizontal Tab
 - Code : HT
 - Function : a. When used within the LB Label Command, this code causes the pen position to be moved 8 character space.
 - Details : a. If this code is detected outside of valid LB Label Command, then it is trapped and ignored.

- 4) Line Feed
 - Code : LF
 - Function : a. When used within the LB Label Command, this code causes the pen position to be moved back to the beginning point of the current line and then down one character height.
 - Details : a. If this code is detected outside of a valid LB Label Command, then it is trapped and ignored.
 - b. Current Character Height status is used.

- 5) Inverse Line Feed
 - Code : VT
 - Function : a. This code is trapped and ignored.

- 6) Carriage Return
 - Code : CR
 - Function : a. When used within the LB Label Command, this code causes the pen position to be moved back to the beginning point of the current line.
 - Details : a. If this code is detected outside of valid LB Label Command, then it is trapped and ignored.

7) Shift In

Code : SI

Function : a. When used in a LB Label Command, selects standard (primary) font.

Details : a. If not within a LB Label Command, then it is trapped and ignored.

8) Shift Out

Code : SO

Function : a. When used in a LB Label Command, selects alternate (secondary) font.

Details : a. If not within a LB Label Command, then it is trapped and ignored.

9) Space

Code : SP

Function : a. When used within the LB Label Command, this code causes the pen position to be moved forward one character width.

Details : a. If this code is detected outside of a valid Command, then it is trapped and ignored.

b. Current Character Width status is used.

10) Illegal Control Codes

Function : a. Codes received, from 00 to 31 Hex, which have not been defined are trapped and ignored unless they have been assigned as the LB Label Command terminator code.

11) ARC Absolute

Code : A A x , y , arc , chd ; [x , y , arc , chd = decimal ASCII number]

Function : a. Draws arc beginning at the current pen position for "arc" number of degrees centered at "x" and "y" coordinates specified with smoothness specified by optional "chd" value.

Details : a. Range of x, y and arc is -1,073,741,824 to 1,073,741,823. Range of arc is -32,768 to 32,767. Range of chd is 0.5 to 180 degrees.

b. Default value of chd is 5 degrees.

c. x = X coordinate ; integer in plotter units or user units.

y = Y coordinate ; integer in plotter units or user units.

arc = Degrees of arc ; integer, negative value specifies clockwise arc, positive value specifies counter-clockwise arc.

chd = Chord angle ; integer, arc smoothness in degrees. Chord angle value is optional. Out of range values which are less than 0.5 are set to 0.5.

Out of range values which are greater than 180 are set to 180.

d. Current pen and line statuses are used.

e. If scaling is not in effect, x and y are in plotter units truncated to integers, if necessary.

f. If scaling is in effect, x and y are valid to four decimal places.

g. Do not use and adaptive line type. Printer will attempt to draw the complete pattern in every chord.

h. "," terminator is optional.

i. Related commands are AR, AT, CI, LA, LT, PW, RT.

12) Anchor Corner

Code : A C x , y ; [x , y = decimal ASCII number]

Function : a. Defines the starting point of any fill pattern.

Details : a. Setting the Anchor Corner guarantees that at this point, the selected fill pattern will be aligned vertically and horizontally.
b. Range of x, y and arc is -1,073,741,824 to 1,073,741,823.
c. If no parameters are provided, x and y are set to zero and Anchor Corner is set to current lower-left of picture frame.
d. If scaling is not in effect, x and y are in plotter units truncated to integers, if necessary.
e. If scaling is in effect, x and y are valid to four decimal places.
f. “;” terminator is optional.
g. Related instructions X are FT, RA, RF, RR, WG.

13) Alternate Font Definition

Code : A D knd , val ... , knd , val ; [knd , val = decimal ASCII number]

Function : a. Defines alternate font and character set using the parameters specified.

Details : a. Range of “knd” (kind) is integers 1 to 7.
b. For “knd” = 1, Symbol set is specified.
Range of “val” (value) is symbol set ID.
Refer to the HPGL/2 Symbol set values in paragraph 190.
Default is 277, Roman-8.
c. For “knd” = 2, Font spacing is specified.
Range of “val” is 0 or 1.
0 = fixed spacing (Default typeface is Stick).
1 = proportional spacing (Default typeface is Proportional Stick).
Default is fixed spacing.
d. For “knd” = 3, Font Pitch is specified.
Range of “val” is 0 to 32,767.9999.
Default pitch is 9.
Using this parameter with the spacing = 1 results in the Pitch Value being used as a “horizontal stretch” value.
e. For “knd” = 4, Font Height is specified.
Range of “val” is 0 to 32,767.9999. In Scalable font, the range is 0.25 ~ 999.75 in units of 0.25.
Default height is 11.5.
Tall narrow characters cannot be specified.
Aspect ratio is preserved.
f. For “knd” = 5, Posture is specified.
Range of “val” is 0, 1, 2.
0 = upright
1 = Italic
2 = Alternate Italic
Default is 0.
g. For “knd” = 6, Font Stroke Weight is specified.
Range of “val” is -7 to 7 and 9,999.
Default stroke weight is 0.
Stroke weight of 9,999 causes stick font to use current line width.
h. For “knd” = 7, Typeface is specified.
Range of “val” is 0 to 32,767.9999.
Default typeface is 48 : stick font.
52 = Universe, 5 = CG Times
Any printer font may be selected.

- i. Using equivalent PCL font attribute parameters, any PCL font may be selected.
- j. “;” terminator is optional.

14) ARC Relative

Code : A R x , y , arc , chd ; [x , y , arc , chd = decimal ASCII number]

Function : a. Draws arc centered relative to the current pen position with “x” and “y” offsets specified with smoothness specified by optional “chd” value.

- Details :
- a. Range of x, y and arc is -1,073,741,824 to 1,073,741,823.
Range of arc is -32,768 to 32,767.
Range of chd is 0.5 to 180 degrees.
 - b. Default value of chd is 5 degrees.
 - c. x = X coordinate ; integer in plotter units or user units.
y = Y coordinate ; integer in plotter units or user units.
arc = Degrees of arc ; integer, negative value specifies clockwise arc, positive value specifies counter-clockwise arc.
chd = Chord angle ; integer, arc smoothness in degrees. Chord angle value is optional. Out of range values which are less than 0.5 are set to 0.5.
Out of range values which are greater than 180 are set to 180.
 - d. Current pen and line statuses are used.
 - e. If scaling is not in effect, x and y are in plotter units truncated to integers, if necessary.
 - f. If scaling is in effect, x and y are valid to four decimal places.
 - g. “;” terminator is optional.

15) Absolute ARC-Three Point

Code : A T xi , yi , xe , ye , chd ; [xi , yi , xe , ye , chd = decimal ASCII number]

Function : a. Calculates and Draws arc beginning current pen position through intermediate point and ending at end point.

- Details :
- a. Range of xi, yi, xe and ye is -1,073,741,824 to 1,073,741,823. Range of chd is 0.5 to 180 degrees.
 - b. Default value of chd is 5 degrees.
 - c. xi = Intermediate X coordinate ; integer in plotter units or user units.
yi = Intermediate Y coordinate ; integer in plotter units or user units.
xe = End X coordinate ; integer in plotter units or user units.
ye = End Y coordinate ; integer in plotter units or user units.
chd = Chord angle ; integer, arc smoothness in degrees. Chord angle value is optional. Out of range values which are less than 0.5 are set to 0.5.
Out of range values which are greater than 180 are set to 180.
 - d. Current pen and line statuses are used.
 - e. If scaling is not in effect, x and y are in plotter units truncated to integers, if necessary.
 - f. If scaling is in effect, xi, yi, xe and ye are valid to four decimal places.
 - g. Related commands are AA, AR, LA, LT, PW, RT.
 - h. “;” terminator is optional.

16) Relative Bezier

Code : B R x1 , y1 ... xn , yn ; [x1 , y1 , xn , yn = decimal ASCII number]

Function : a. Draws bezier curves using relative coordinates.

Details : a. BR command uses the current pen position as the first control point, and three specified control points to draw a bezier curve as relative increments, and the last control point becomes the new current pen position.
b. Bezier curve needs at least three control points for drawing.
If the number of control points is not a multiple of three, the remaining points are ignored.
c. Parameters x1, y1 ... ranges are -8,388,608 to 8,3388,607.

17) Absolute Bezier

Code : B Z x1 , y1 ... xn , yn ; [x1 , y1 , xn , yn = decimal ASCII number]

Function : a. Draws bezier curves using absolute coordinates.

Details : a. BZ command uses the current pen position as the first control point, and three specified control points to draw a bezier curve as absolute coordinates, and the last control point becomes the new current pen position.
b. Bezier curve needs at least three control points for drawing.
If the number of control points is not a multiple of three, the remaining points are ignored.
c. Parameters x1, y1 ... ranges are -8,388,608 to 8,3388,607.

18) Character Fill Mode

Code : C F fm , ep ; [fm , ep = decimal ASCII number]

Function : a. Specifies how scalable fonts will be filled and edged.

Details : a. Range of ep is integers -1,073,741,824 to 1,073,741,823.

Range of fm is 0, 1, 2, 3.

- b. If no parameters are provided, values are defaulted to CF0,0; for solid black fill.
- c. Bitmap and Stick Font characters cannot be edged and defaults to solid fill.
- d. fm = Fill mode
 - For fm = 0, Fill is solid black.
 - For fm = 1, No fill, Edge with current pen pattern.
 - For fm = 2, Fill characters using the current fill type.
 - Edge parameter is ignored. Character is not edged.
 - For fm = 3, Fill with current pattern and edge with current pen.
- e. ep = Edge pen
 - For ep = 0 No Edging.
 - For ep = 1 Black Edging. Pen thickness cannot be set and varies according to point size.
- f. Fill patterns do not rotate with characters. Orientation of fill patterns remains constant relative to current orientation.
- g. Thickness of crosshatch fill lines is specified by PW pen width command. Wide fill lines may extend beyond the character edge. To achieve smooth look, small pen width is recommended with solid edge turned on.

19) Circle

Code : C I R , chd ; [r , chd = decimal ASCII number]

Function : a. Draws a circle centered at the current pen position with radius of "r" and smoothness specified by the optional "chd" value.

Details : a. Range of "r" is -1,073,741,824 to 1,073,741,823. Range of chd is 0.5 to 180 degrees.
b. Default value of chd is 5 degrees.
c. r = Radius of Circle; integer in plotter units and user units.
chd = Chord angle ; integer, arc smoothness in degrees. Chord angle value is optional. Out of range values which are less than 0.5 are set to 0.5. Out of range values which are greater than 180 are set to 180.
d. Current pen and line statuses are used.
e. ";" terminator is optional.
f. Related commands are LA, LT, PW, SC, WG.

20) Character Plot

Code : C P sp , lin ; [sp , lin = decimal ASCII number]

Function : a. Moves the pen the number of spaces and lines specified using the current character spacing and line spacing. If parameters are omitted, carriage return-line feed is performed.

Details : a. sp = Number of character space units.
Positive value moves pen position in current label direction.
Negative value moves pen opposite to current label direction.
For proportional spaced fonts, space character width is used.
lin = Number of character line (LF) units.
Positive value moves pen up relative to current label direction.
Negative value moves pen down relative to current label direction.
Use ES command to adjust line height.
b. If values are omitted, Carriage Return-Line Feed is executed.
c. If any values provided are out of range or only one value is provided, command is trapped and ignored.
d. This command performs an automatic "PEN UP" (PU). When execution has been complete, PEN UP/DOWN position is restored.
e. CP command only affects the current label. Additional CP commands are required to adjust subsequent labels.
f. ";" terminator is optional.
g. Related commands are DI, DR, DV, ES, LO, SI, SR.

21) Comment

Code : CO"c.....c"

Function : a. Add the comment to HPGL/2.

Details : a. Parameter (comment statement) must be surrounded with " (double quotes).
b. Printing can not be performed.

22) Set Default Values

Code : D F ;

Function : a. Sets plotter to default conditions:

Variable	Default Condition
AC Anchor Corner (AC)	Lower-left corner of Picture Frame
AD Alternate Font Definition	Stick Font (11.5pt, 9 cpi, uprt med)
CF Character Fill	Solid fill, no edging
DI1, 0 Direction Absolute	Parallel to x-axis
DT Label Terminator	ETX, non-printing mode
DV Variable Text Path	Text printed left to right-normal LF
ES Extra Space	No extra space
FT Fill Type	Solid fill
IW Input Window	Equal to PCL Picture Frame
LA Line Attributes	Butt ends, mitered joins, miter limit = 5
LO1 Label Origin	Standard labeling at current location
LT Line Type	Solid line, relative mode, Pattern length = 4% P1 P2 diagonal
PA Plotting Mode	Absolute plotting
PM0PM2 Polygon Mode	Polygon buffer cleared
RF Raster Fill	Solid black
SB0 Scalable or Bitmap Fonts	Scalable fonts only
SC Scale	User-unit scaling off
SD Standard Font Definition	Stick font (11.5 pt, 9 cpi, uprt, med)
SI Character Size Absolute	Turns off size transformation
SL Slant	No slant
SM Symbol Mode	Off
SS Select Font	Standard font
SV Screened Vectors	No screening
TR1 Transparency Mode	Transparency mode on
TD Transparent Data	Normal printing mode
UL User Defined Line Type	Defaults all 8 line type
Carriage Return Point	Set to current pen position
Chord Angle	5 degrees

b. Variables not affected by DF:

Location of P1 and P2

Current pen status: location, width, width unit selection, up/down

Plot size

Plot rotation

Generated errors

Escape sequences

c. Related command is IN.

d. Values of P1 and P2 are reset only with the IN initialize instruction.

e. “;” terminator is optional.

23) Direction Absolute

Code : D I run , ris ; [run , ris = decimal ASCII number]

Function : a. Sets the direction of labels.

- Details :
- a. Range of "run" and "ris" is integers -32,768 to 32,767.
 - b. run = "Run" ; Unitless decimal values, part of ratio. Cosine of angle.
 - ris = "Rise" ; Unitless decimal values, part of ratio. Sine of angle.
 - c. If values are omitted, direction of labels is set to horizontal; same as "DI1,0;".
 - d. The Carriage-Return point is set to the current pen position.
 - e. A DI instruction with only one parameter is trapped and ignored.
 - f. A change in the orientation of P1 and P2 does not affect the direction of labeling.
 - g. A labelling direction remains in effect until the receipt of one of the following commands: DI, DR, IN, DF.
 - h. The DV, Variable Text Path, setting interacts with the DI command.
 - i. ";" terminator is optional.

24) Direction Relative

Code : D R run , ris ; [run , ris = decimal ASCII number]

Function : a. Sets the direction of labels relative the current P1 and P2 values.

- Details :
- a. Range of "run" and "ris" is integers -32,768 to 32,767.
 - b. run = "Run" ; a percentage of the distance P2x - P1x.
 - ris = "Rise" ; a percentage of the distance P2y - P1y.
 - c. If values are omitted, direction of labels is set to horizontal; same as "DI1,0;".
 - d. The Carriage-Return point is set to the current pen position.
 - e. A DR instruction with only one parameter is trapped and ignored.
 - f. A DR instruction with extra parameters is executed and the extra parameters is ignored.
 - g. A change in the orientation of P1 and P2 does not affect the direction of labeling.
 - h. A labelling direction remains in effect until the receipt of one of the following commands: DI, DR, IN, DF.
 - i. The DV, Variable Text Path, setting interacts with the DI command.
 - j. ";" terminator is optional.

25) Define Label Terminator

Code : D T t , mod ; [t , mod = decimal ASCII number]

Function : a. This command defines the label terminator used in the LB command.

- Details :
- a. Range of "t" is 1 to 127 excluding, 0, 5, 27, 59.
Range of "mod" is 0 or 1.
 - b. If 0, 5 or 27 used, the command is trapped and ignored.
 - c. Default is 3 (ETX)
 - d. If "mod" Mode = 0 and label terminator is printable character, then character is printed and not treated as a label terminator.
If "mod" Mode = 0 and label terminator is a control code, then control code is treated as label terminator.
 - e. If "mod" Mode = 1 and label terminator is printable character, then character is not printed and is treated as a label terminator.
If "mod" Mode = 1 and label terminator is a control code, then control code is not treated as label terminator.
 - f. Only IN;, DF; or DT3; command returns to the default value of 3.
 - g. ";" terminator is optional.

26) Define Variable Text Path

Code : D V pat , lin ; [pat , lin = decimal ASCII number]

Function : a. This command defines the text path direction as right, left, up or down.

Details : a. Range of "pat" Path is 0, 1, 2 or 3.
Range of "lin" Line Feed is 0 or 1.
b. Default is 0 Horizontal with normal line feed (DVO;)
c. If Path = 0, then text path is horizontal to the right.
If Path = 1, then text path is vertical down.
If Path = 2, then text path is horizontal to the left.
If Path = 3, then text path is vertical up.
d. Related commands are DI, DR, LO.
e. ";" terminator is optional.

27) Rectangle Edge Absolute

Code : E A x , y ; [x , y = decimal ASCII number]

Function : a. Draws the edge of a rectangle between the current pen position and the point specified by "x" and "y" coordinates in plotter units or user units.

Details : a. Range of "x" and "y" is current units -1,073,741,824 to 1,073,741,823.
b. x = X coordinate ; integer plotter units or decimal user units.
y = Y coordinate ; integer plotter units or decimal user units.
c. Current pen, line type, line attributes and absolute plotting are used.
d. This command performs an automatic "PEN DOWN" (PD). When execution has been complete, PEN UP/DOWN position is restored.
e. If any parameter is missing, the command is trapped and ignored.
f. If too many parameters are provided, the first two are used and the rest are ignored.
g. If scaling is not in effect, x and y are in plotter units truncated to integers, if necessary.
h. If scaling is in effect, x and y are valid to four decimal places.
i. Related commands are ER, RA, RR.
j. ";" terminator is optional.
k. This command clears the polygon buffer and then uses it to define the rectangle before drawing.

28) Edge Polygon

Code : E P ;

Function : a. Draws the edge of the polygon currently stored in the polygon buffer (use the rectangle and wedge commands in polygon mode (PM) to create polygon: EA, ER, EW, RA, RR and WG).

Details : a. Current pen, line type, line attributes and absolute plotting are used.
b. This command accesses the information in the polygon buffer, but does not change it in any way.
c. Related commands are EA, ER, EW, LA, LT, PM.
d. ";" terminator is optional.

29) Rectangle Edge Relative

Code : E R x , y ; [x , y = decimal ASCII number]

Function : a. Draws the edge of a rectangle between the current pen position and the point specified by "x" and "y" using relative coordinates in plotter units or user units.

Details : a. Range of "x" and "y" is current units -1,073,741,824 to 1,073,741,823.
b. x = X coordinate ; integer plotter units or decimal user units.
y = Y coordinate ; integer plotter units or decimal user units.
c. Current pen, line type, line attributes and absolute plotting are used.
d. This command performs an automatic "PEN DOWN" (PD). When execution is complete, PEN UP/DOWN position is restored.
e. If any parameter is missing, the command is trapped and ignored.
f. If too many parameters are provided, the first two are used and the rest are ignored.
g. If scaling is not in effect, x and y are in plotter units truncated to integers, if necessary.
h. If scaling is in effect, x and y are valid to four decimal places.
i. Related commands are EA, RA, RR.
j. ";" terminator is optional.
k. This command clears the polygon buffer and then uses it to define the rectangle before drawing.

30) Extra Space

Code : E S wid , ht ; [wid , ht = decimal ASCII number]

Function : a. Adjusts space between characters and lines without affecting character size.

Details : a. Range of "wid" and "ht" is -32,768 to 32,767
b. Width (wid) value increases (+) or decreases (-) the distance between characters as a fraction of the space character.
c. Height (ht) value increases (+) or decreases (-) the distance between lines as a fraction of the line feed distance.
d. This setting is reset by the ES, IN and DF commands.
e. Related commands are CP and LB.
f. ";" terminator is optional.

31) Wedge Edge

Code : E W r , sa , sw , chd ; [r , sa , sw , chd = decimal ASCII number]

Function : a. Draws the edge of a wedge centered at the current pen position using specified parameters.

Details : a. Range of "x", "y" and "arc" is -1,073,741,824 to 1,073,741,823. Range of chd is 0.5 to 180 degrees.
b. Default value of chd is 5 degrees. chd value is optional.
c. r = Radius in plotter units or user units.
sa = Start angle ; integer, negative value specifies clockwise arc, positive value specifies counter-clockwise arc.
sw = Sweep angle ; integer, negative value specifies clockwise arc, positive value specifies counter-clockwise arc.
chd = Chord angle ; integer, arc smoothness in degrees. Chord angle value is optional. Out of range values which are less than 0.5 are set to 0.5. Out of range values which are greater than 180 are set to 180.
d. Current pen and line statuses are used.

- e. If scaling is not in effect, r is in plotter units truncated to integers, if necessary.
- f. If scaling is in effect, r is valid to four decimal places.
- g. This command performs an automatic "PEN DOWN" (PD). When execution is complete, PEN UP/DOWN position is restored.
- h. If parameters are missing, the command is trapped and ignored. And the rest are ignored.
- i. Related commands are LA, LT, PW, SC, WG.
- j. ";" terminator is optional.

32) Primary Font by ID

Code : F I id ; [id = decimal ASCII number]

Function : a. Defines primary font by PCL Font ID.

- Details :
- a. Range of "id" Font ID is integers 0 to 32,767.
 - b. If Font ID not found, then command is ignored.
 - c. Selected font becomes primary font for both PCL and HPGL/2 modes.
 - d. ";" terminator is optional.

33) Secondary Font by ID

Code : F N id ; [id = decimal ASCII number]

Function : a. Defines secondary font by PCL Font ID.

- Details :
- a. Range of "id" Font ID is integers 0 to 32,767.
 - b. If Font ID not found, then command is ignored.
 - c. Selected font becomes secondary font for both PCL and HPGL/2 modes.
 - d. ";" terminator is optional.

34) Fill Polygon

Code : F P mtd ; [mtd = decimal ASCII number]

Function : a. Fills the polygon currently in the polygon buffer using the current pen, fill type, line type and attributes, according to the fill method specified.

- Details :
- a. Range of "mtd" is 0 or 1. Default is 0.
 - b. mtd = Method of filling.
 - 0 = Even/Odd filling algorithm.
 - 1 = Non-Zero Winding filling algorithm.
 - c. This command performs an automatic "PEN DOWN" (PD). When execution has been completed, PEN UP/DOWN position is restored.
 - d. This command accesses the information in the polygon buffer, but does not change it in any way.
 - e. This command fills between edges defined with both pen up and pen down.
 - f. The polygon is filled using the current pen, fill type, line type and attributes.
 - g. Commands used to create data in polygon buffer include EA, ER, EW, WG, RA and RR.
 - h. If polygon buffer is "overflowed" due to previous PM, RA or RR instruction, command is ignored.
 - i. Due to possible overflow condition, it is possible to define and edge a polygon and not be able to fill it.
 - j. Related commands are EA, EP, ER, EW, FT, LA, LT, PM, PW.
 - k. ";" terminator is optional.

35) Fill Type

Code : FT typ , o1 , o2 ; [typ , o1 , o2 = decimal ASCII number]

Function : a. Selects a type of area fill for the FP, RA, RR, WG commands from shading, solid, parallel hatching, cross hatching or patterned raster.

- Details : a. Range of "typ" is an integer 1 to 4, 10, 11, 21, 22.
Range of "o1" is 0 to 32,767.9999 in plotter or user units.
Range of "o2" is -32,768 to 32,767.9999 degrees.
- b. Default value of typ is 1 (solid fill).
Default value of o1 is 1% of diagonal P1 to P2.
Default value of o2 is 0 (horizontal).
- c. "typ" is optional if "o1" and "o2" are omitted.
"o1" is optional if "o2" is omitted.
"o2" is optional.
- d. typ = Type of fill pattern
1 = solid fill
2 = solid fill
3 = parallel lines:
o1 = horizontal distance between lines
o2 = angle of lines counter-clockwise from x-axis
4 = cross-hatch:
o1 = horizontal distance between lines
o2 = angle of lines counter-clockwise from x-axis
10 = shading: o1 = percentage of shading, 100 = black
11 = user defined: o1 = user defined raster pattern index
21 = PCL crosshatch patterns: o1 = pattern type
22 = PCL user defined: o1 = pattern ID
- e. Current pen and line statuses are used.
- f. If scaling is not in effect, "o1" is in plotter units.
- g. If scaling is in effect "o1" is valid to four decimal places.
- h. If all parameters are missing, Fill Type is set to the default (FT1).
- i. If too many parameters are provided, the first three are used and the rest are ignored.
- j. If user defined raster pattern (type=11) is not found, solid black fill is used.
- k. 8 discrete levels of gray shading are supported:
- | | |
|------------|-------------|
| o1 = 0 | white |
| o1 = 1-2 | 1-2% gray |
| o1 = 3-10 | 3-10% gray |
| o1 = 11-20 | 11-20% gray |
| o1 = 21-35 | 21-35% gray |
| o1 = 36-55 | 36-55% gray |
| o1 = 56-80 | 56-80% gray |
| o1 = 81-99 | 81-99% gray |
| o1 = 100 | 100% black |
- l. For crosshatch pattern, fill lines use current line caps and are not clipped to the polygon.

36) Initialize

Code : I N

Function : a. Defaults all programmable HPGL/2 features to factory set condition.

Details : a. Resets all parameters affected by the Default DF command plus the following:

- PU Raises the pen
- PA0, 0 Sets pen position to lower-left of picture frame
- PO Resets plot rotation
- IP Sets P1 and P2 to lower-left and upper-right of picture frame
- WU Sets pen width mode to metric
- PW Sets pen width to 0.35mm
- Clears all HPGL/2 errors
- Sets the number of pens to 2.

- b. Related command is DF.
- c. “;” terminator is optional.

37) Input Scaling Points

Code : I P P1x , P1y , P2x , P2y ; [P1x , P1y , P2x , P2y = decimal ASCII number]

Function : a. Sets scaling points.

Details : a. Range of x and y values is integers -1,073,741,824 to 1,073,741,823.
 b. Default parameters for Letter and A4 size are:

- Letter (A4)
- Range of P1x is integers 0 to 8128 (7887)
- Range of P1y is integers 0 to 10160 (10835)
- Range of P2x is integers 0 to 8128 (7887)
- Range of P2y is integers 0 to 10160 (10835)

- c. If too many parameters are provided, the first four are used and the rest are ignored.
- d. If 1 or 3 parameters are provided, the command is ignored.
- e. P2x and P2y are optional. If they are omitted and P1x and P1y are provided, then P2x and P2y are adjusted so that the current x and y distances between P1 and P2 are maintained.
- f. If all parameters are omitted, then P1 and P2 are set to the default values for the paper size currently selected.

Parameters	Default
P1x, P1y (Letter size)	0, 0
P2x, P2y (Letter size)	8128, 10160
P1x, P1y (A4 size)	0, 0
P2x, P2y (A4 size)	7887, 10835

- g. By adjusting the positions of P1 and P2, the following effects may be achieved:
 1. Mirror image
 2. Upside down
 3. Change of page orientation
 4. Reducing or enlarging an image
- h. The locations of P1 and P2 affect the commands DR, IW, LB, PW, RO, SC, SR and WU.
- i. An IP command remains in effect until IP, IR or IN is executed.
- j. Related commands are RO and SC.
- k. “;” terminator is optional.

38) Input Relative P1 and P2

Code : I R P1x , P1y , P2x , P2y ; [P1x , P1y , P2x , P2y = decimal ASCII number]

Function : a. Sets scaling points relative to current scaling points.

Details : a. Range of x and y values is integers -32,768 to 32,767.
b. P1x = percentage of picture frame distance to move
P1y = percentage of picture frame distance to move
P2x = percentage of picture frame distance to move
P2y = percentage of picture frame distance to move
c. If P1 or P2 are set outside hard clip limits with values greater than 100% or less than zero, only the part of the image within the picture frame is printed.
d. If P1x = P2x or P1y = P2y then the latter is incremented by one plotter unit.
e. If any parameter exceeds the range, the command is trapped and ignored.
f. If too many parameters are provided, the first four are used and the rest are ignored.
g. P2x and P2y are optional. If they are omitted and P1x and P1y are provided, then P2x and P2y are adjusted so that the current x and y distances between P1 and P2 are maintained.
h. If all parameters are omitted, then P1 and P2 are set to the current picture frame.
i. If 1 or 3 parameters are provided, the command is ignored.
j. The locations of P1 and P2 affect the commands DR, IW, LB, PW, RO, SC, SR and WU.
k. An IR command remains in effect until IP, IR or IN is executed.
l. Related commands are RO and SC.
m. ";" terminator is optional.
n. When the RO command is used, the location of P1 and P2 are fixed to plotter units.

39) Input Window

Code : I W Xlo , Ylo , Xhi , Yhi ; [Xlo , Ylo , Xhi , Yhi = decimal ASCII number]

Function : a. Defines a rectangular input window in current units, which establishes soft clip limits.

Details : a. Range of x and y values is integers -67,108,863 to 67,108,863.
b. When the window is defined in user units, the size of the window changes with changes in P1 and P2. Sending a subsequent SC command fixes the window to its equivalent plotter units.
c. If too many parameters are provided, the first four are used and the rest are ignored.
d. If 1 or 3 parameters are provided, the command is ignored.
e. If all parameters are omitted, then soft-clip Window is set to current picture frame.
f. An IW command remains in effect until IP, IR or SC is executed.
g. Related commands are IP, IR, SC
h. ";" terminator is optional.

40) Line Attributes

Code : L A knd , val... , knd , val ; [knd , val = decimal ASCII number]

Function : a. Specifies how line ends and line joins are drawn for lines thicker than 0.35mm.

Details : a. Range of "knd" (Kind) is integers 1 to 3.
b. For "knd" = 1, Line Ends are specified.
Range of "val" (Value) is 1 to 4.
Value = 1 : Butt ends (default)
Value = 2 : Square ends
Value = 3 : Triangular ends
Value = 4 : Round ends
c. For "knd" = 2, Line Joins are specified.
Range of "val" is 1 to 6.
Value = 1 : Mitered joins (default). Miter length is truncated at miter limit X
Line Width
Value = 2 : Mitered/beveled joins. If Miter Length/Line Width > Miter Limit,
then beveled joins truncated at miter limit X Line Width.
Value = 3 : Triangular joins
Value = 4 : Round joins
Value = 5 : Beveled joins
Value = 6 : No join applied.
d. For "knd" = 3, Miter Limit is specified.
Range of "val" is 1 to 1,073,741,823.
Default Miter Limit is 5.
Miter Limit : Miter length (max. width of corner)/Line Width
e. Miter Limit values which are less than 1 are set to 1.
f. Lines with width of 0.35 mm or less always have butt caps and no join,
regardless of attribute setting.
g. Labels are always drawn with rounded ends and joins.
h. Default settings are equivalent to LA1, 1, 2, 1, 3, 5.
i. If no parameters are provided, defaults are set.
j. Affected commands are AA, AR, AT, CI, EA, EP, ER, EW, FP, PA, PD, PE,
PR, RA, RR, RT, WG.
k. ";" terminator is optional.

41) Label Text

Code : L B c ... c t

Function : a. Defines a character string to be drawn using the currently selected font and character set, direction and slant settings.

Details : a. Range of "c" is the ASCII characters 10, 13, 32 though 256. Range of "t" is the currently selected value from DT command.
b. The value of "t" is as previously defined by the DT command. Default value of "t" is 03 hex (ETX).
c. Current character set assumes the currently active Outline Font and Character set or Default Stick Font.
d. Current direction, size and slant assume Default values unless previously specified by the DI, DR, SI, SR or SL commands.
Default character direction is 0 degrees (horizontal).
Default character height is 11.5 point.
Default character pitch is 9 characters per inch.
Default character slant is 0 zero degrees.
Default Outline font is 48: Stick Font

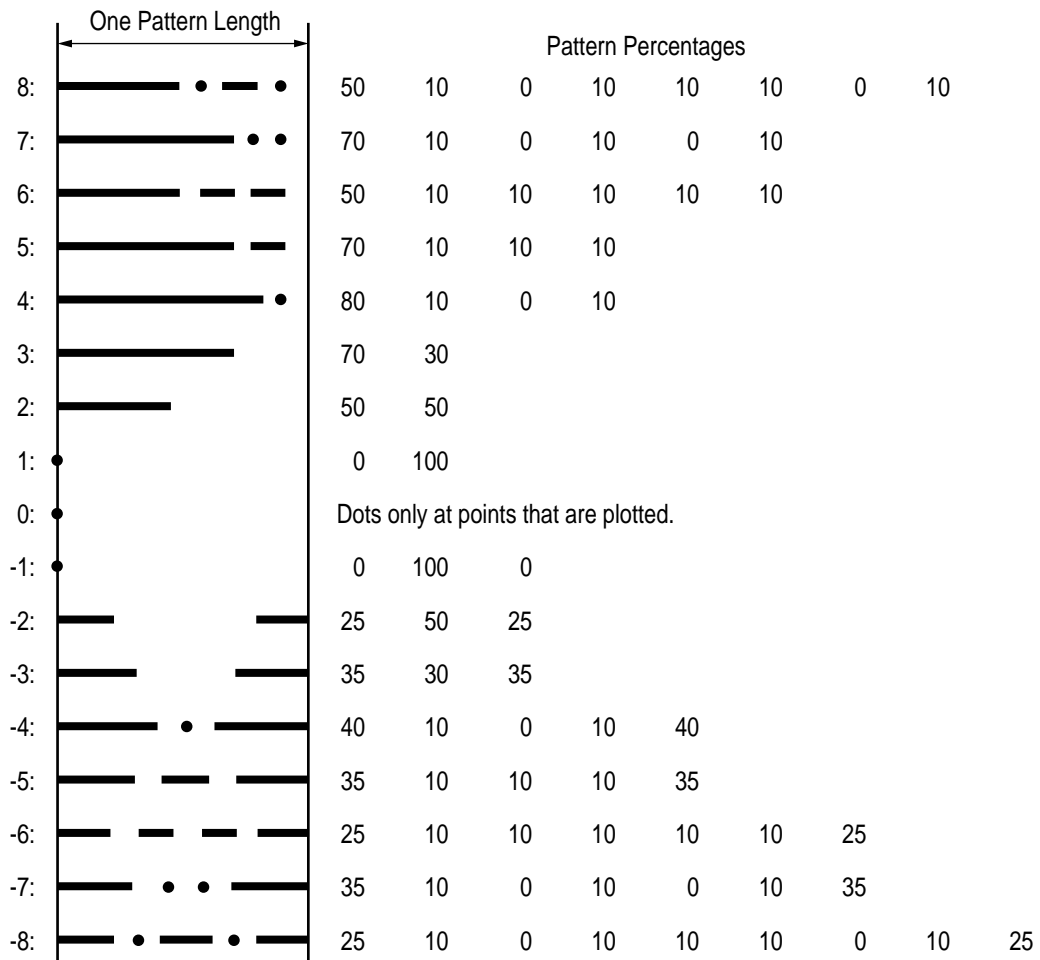
- e. The command is terminated only by the current Terminator Code as set by the DT command or, if it is not set, its default: 03 hex (ETX).
- f. Carriage Return (CR, 13d) and Line Feed (LF, 10d) may be included.
- g. Label is printed at current pen position unless LO label origin command has set an offset from current pen position.
- h. Related commands are AD, CP, SA, SD, SS, DT, DI, DR, DV, LO, SI, SR, SL.

42) Line Type

Code : LT typ , len , mod ; [typ , len , mod = decimal ASCII number]

Function : a. Defines the line pattern to be used for drawing lines.

- Details :
- a. Range of "typ" (Type) is integers -8 to 8, 99.
 Range of "len" (Length) is 0 to 32,767.9999.
 Range of "mod" (Mode) is 0 or 1
 - b. If no parameters are provided, line type is set to solid line.
 - c. Type = A Line Type pattern number from -8 to 8.



- d. Positive Type values represent Fixed Line Types and use the SECTION 11 HPGL/2 PCL5 GRAPHICS EMULATION specified pattern length to draw lines. At the end of a line the "residue" (remaining part of the line segment) is retained and used for the beginning of the next line for CI, EA, EP, ER, EW, FP, PM, RA, RR or WG. The following commands cause the "residue" to be cleared: CP, DF, IN, IP, IR, LB, PG, PU, SC, UL and LT (except LT; and LT99;)

- e. A Zero Type value draws a single dot in the X, Y coordinates for AA, AR, AT, CI, PA, PD, PR and RT commands. Zero pen down values and zero length lines also cause dots. A "dot" is a one plotter unit long vector using the current line end and pen width.
- f. A Negative Line Type provides "adaptive" line patterns that "adapt" to the line segment for a more pleasing effect. The pattern length is automatically adjusted so that one or more complete patterns are included in each line segment. Do not use adaptive line types for the chords of circles, arcs, wedges or polygons.
- g. If Mode = 0, then Length = Length of pattern segment in percent of diagonal distance between P1 and P2 (relative mode) (default).
If Mode = 1, then Length parameter defines pattern length in millimeters (absolute mode).
- h. If Type is 99 and current line type is solid, then last non-solid line type used is selected. If current line type is non-solid, LT99 command is ignored. Sending following commands with a solid line type selected causes the LT99 command to have no effect: DF, IN, IP, IR, PG, SC and UL.
- i. If Type is out of range, pattern is set to solid line and Length is ignored.
- j. If Length is out of range or omitted, the previous pattern length is used or if not previously set, then a default value of 4 is used.
- k. If a vector ends in the PEN UP section of a pattern, a PEN DOWN PD command does not put the pen down physically until the next vector is executed and the pen has moved so it is in a PEN DOWN portion of a pattern segment.
- l. Related commands are AA, AR, AT, CI, EA, EP, ER, EW, FP, FT, PA, PD, PE, PR, RA, RR, RT, UL, WG.
- m. ";" terminator is optional.
- n. LT command remains in effect until LT, IN or DF.

43) Label Origin

Code : L O # ; [# = decimal ASCII number]

Function : a. Locates label relative to current cursor position.

Details : a. Range of # is 1 to 9 and 11 to 19, 21.
 b. If # is omitted (LO;), then Label Origin defaults to LO1; current pen position.
 c. If # = 1 then, left justified, baseline corner of label is at pen position.
 If # = 4 then, centered, baseline of label is at pen position.
 If # = 7 then, right justified, baseline of label is at pen position.
 If # = 2 then, left justified, center of label is at pen position.
 If # = 5 then, centered, center of label is at pen position.
 If # = 8 then, right justified, center of label is at pen position.
 If # = 3 then, left justified, top of label is at pen position.
 If # = 6 then, centered, top of label is at pen position.
 If # = 9 then, right justified, top of label is at pen position.
 If # = 11 then, left justified, baseline corner of label is offset from pen position.
 If # = 14 then, centered, baseline of label is offset from pen position.
 If # = 17 then, right justified, baseline of label is offset from pen position.
 If # = 12 then, left justified, center of label is offset from pen position.
 If # = 15 then, centered, center of label is pen position.
 If # = 18 then, right justified, center of label is offset from pen position.
 If # = 13 then, left justified, top of label is offset from pen position.
 If # = 16 then, centered, top of label is offset from pen position.
 If # = 19 then, right justified, top of label is offset from pen position.
 If # = 21 then, the characters are printed at the same location as in PCL.

- d. Offset for # = 11 to 19 is 0.25 the point size or 16 grid units (0.33 the point size) for the Stick Font.
- e. Include CR (CHR\$(13)) in label before termination character to set pen back to its original location before the next command.
- f. The DV define variable text path command rotates the label origins set by LO.
- g. When carriage returns are embedded as characters in the label, each portion of the label is positioned according to the label origin, just as if they were written as separated label instructions.
- h. Stick font does not have LO21. It is printed same as LO1.
- i. Related commands are DV and LB.
- j. “;” terminator is optional.

44) Merge Control

Code : MC mod , ocd ; [mod , ocd = decimal ASCII number]

Function : a. Specifies the Raster Operation (ROP's).
Specifies how source, destination and patterns are combined to produce final image.

Details : a. Range of mode “mod” is 0 or 1.
Range of operation code “ocd” is from 0 to 255.
b. If no parameters are provided, ROP is set to 252 (default).
c. mod = 0, ROP is set to Default (ROP 252). ocd is ignored.
d. mod = 1, ROP is set to “ocd”. If ocd is omitted, ROP is set to 168.
e. The ROP value which set by this command will be valid not only within HPGL/2, but also in PCL.
f. The ROP value will be valid until it is reset by “ESC * I # O” of MC command or PCL logical operation, or reset to Default.
g. “;” terminator is optional.
h. See ESC * I # O for details of ROP value.

45) Number of Pens

Code : N P # ; [# = decimal ASCII number]

Function : a. Sets the number of pens.

Details : a. Range of # is from 2 (default) to 256.
b. Effective number of pens are defined by value field # as follows:

Range of #	Effective pens
less than 1.5	Command ignored
from 1.5 under 2.5	2
from 2.5 under 4.5	4
from 4.5 under 8.5	8
from 8.5 under 16.5	16
from 16.5 under 32.5	32
from 32.5 under 64.5	64
from 64.5 under 128.5	128
128.5 or more	256

46) Plot Absolute

Code : P A x1 , y1 ... ; [x1 , y1 = decimal ASCII number]

Function : a. Plots the X, Y coordinates in the order listed using the current pen, line width, type and attributes.

Details : a. Range of X is from -1,073,741,824 to 1,073,741,823. Range of Y is from -67,108,863 to 67,108,863.
b. x = X coordinate; in current units.
y = Y coordinate; in current units.
c. When more than one set of coordinates are provided, the pen moves to each point in the order given using the current pen up/down position.
d. When SM symbol mode is active, PA draws the specified symbol at each X, Y coordinate.
e. When PM polygon mode is active, the information is entered into the polygon buffer and is not printed.
f. When scaling is off, positive values are truncated and negative numbers are rounded to the next larger negative integer value. The resultant integers are plotter units.
g. When parameters are omitted, Absolute Plotting Mode is set for use with PU (Pen Up) and PD (Pen Down) commands.
h. If an extra coordinate parameter is provided, it is ignored and all parameters preceding it are processed normally.
i. PU and PD commands may be included in the PA command parameters and executed.
j. Commands are required delimiters between X and Y values, and are optional between PU or PD commands and X or Y values.

Example:

VALID: PAx1, y1, x2, y2;

VALID: PAPDx1, y1, x2, y2PUx3, y3PDx4, y4;

k. The current pen and line statuses are used (PU and PD commands alter the current pen statuses).
l. PA defaults may be reset by the following:
1. Power-On reset
2. IN; (Initialize Command)
3. DF; (Set Defaults Command)
4. PA command with or without parameters
m. Portions of lines specified which fall outside the current Input Window (IW Command) are plotted with the Pen Up. When the pen enters the Input Window Area, it assumes its programmed position: Pen Up or Pen Down.
n. X, Y coordinates which exceed the range are ignored and the line is plotted to the next valid X, Y coordinate in the command.
o. Related commands are PE and PR.
p. ";" terminator is optional.

47) Pen Down

Code : P D x1 , y1 ... , xn , yn ; [x1 , y1 , xn , yn = decimal ASCII number]

Function : a. Lowers the pen causing line and edges to be printed using the current line status.

Details : a. Parameters may be included to function as PA or PR command; whichever has been most recently used (default is PA with plotter units). Refer to PA Plot Absolute and PR Plot Relative command.
b. If no parameters are provided, sets pen to Pen Down status.
c. Related commands are PA, PE, PR, PU.
d. ";" terminator is optional.

48) Polyline Encoded

Code : P E flg , val ... x , y ; [flg = ASCII numbers]
 [val = ASCII decimal numbers]
 [x, y = encoded binary numbers]

Function : a. Reduces polygon file size by encoding vectors in base 64 or base 32.

- Details : a. PE command uses PA, PR, PC, PU and SP. Lines are drawn using the current line types and attributes and current units. Relative plotting mode and Pen Down are assumed.
- b. Range of Flag "flg" is :, <, >, =, 7. MSB is ignored.
 - c. If Flag = ":", then the subsequent value is the decimal ASCII pen number. Range of pen number is 0 or 1. Pen number values out of range cause pen selection to be ignored. Default is currently selected pen.
 - d. If Flag = "<", then Pen Up (PU) command is executed (all coordinate values not preceded by Pen Up command are processed with Pen Down).
 - e. If Flag = ">", the decimal ASCII Value indicates the number of "fractional bits" in the coordinate data. Default is zero.
 - f. If Flag = "=", indicates that the subsequent coordinate pair should be created as absolute coordinates.
 - g. If Flag = "7", then coordinate data is interpreted as a 7 bit data. Once "7" is sent, base 32 is used and 8th bit of coordinate data is ignored for the remainder of the command. Default is 8 bit.
 - h. Coordinate pair values are represented by two bytes (encoded binary values). The first value is the "x" value. The second value is the "y" value. Each value consists of several ASCII encoded characters including "non-terminator" characters ending with one "terminator" character.

	Non-Terminator	Terminator
7-bit range-base 32	63 - 94	95 - 126
8-bit range-base 64	63 - 126	191 - 254

- i. The following method is required to encode the "x" and "y" coordinate (relative or absolute) into the base 32 or base 64 values.
 - 1. Fraction adjustment:
 - a. Multiply the number of decimal places in the data by 3.33.
 - b. Round that number up to the next integer to get integer n.
 $n = \text{round}(\text{decimal places} \times 3.33)$
 $x = x \times 2^n$
 - 2. Round to an integer. Round the results of step 1 up to an integer.
 $x = \text{round}(x)$
 - 3. Set the sign bit.
 - a. If x is positive, multiply x by 2.
 - b. If x is negative, multiply the absolute value of x by 2 and add 1.
 - c. This sets the sign bit.
 $\text{If } X \Rightarrow 0 \text{ then } x = 2 * \text{abs}(x)$
 $\text{else } x = 1 * \text{abs}(x) + 1$
 - 4. Convert the number to base 64 or 32.
 Use base 64 if your computer is set for 8 bits - no parity.
 Use base 32 if your computer sends 7 bits with parity (use Flag = 7 command).

5. Encode the data. Encode each base 64 or 32 digit into the ASCII character range beginning with the Least Significant Digit. Values following the Fractional Data flag and Select Pen (SP) command must be encoded.
- BASE 64:** Encode all the low order digits into the ASCII range 63 to 126 using CHR\$(63+i) where i = value to encode.
 Encode the highest order digit (or the single digit of a 1 digit number) into the range 191 to 254.
- BASE 32:** Encode all the low order digits into the ASCII range 63 to 94 using CHR\$(63+i) where i = value to encode.
 Encode the highest order digit (or the single digit of a 1 digit number) into the range 95 to 126.
- ```

While n = > base
 output chr$(63 + (n MOD base))
 n = n DIV base
and
 if base = 64, then n = 191 + n
 if base = 32, then n = 95 + n
output chr$(n)

```
- j. SP Select Pen command is ignored while in PE Polygon mode.
- k. PR0, 0 is recommended after a PU Pen Up command. This ensures that the next plotting coordinates will be drawn.
- l. Related commands are PA, PR, PD, PU, SP.
- m. “;” terminator is required.

#### 49) Polygon Mode

Code : P M # ; [ # = decimal ASCII code]

Function : a. This command encodes graphics in Polygon Mode and stores them in Polygon Buffer.

Details : a. Use EP and FP commands through Polygon Mode to create the graphics in Polygon Buffer.

b. # = 0 Erase Polygon Buffer and enter Polygon Mode.

# = 1 Close the current graphics. Pen Position move to the default position in Polygon Mode which inherits.

# = 2 Close the current graphics, to exit Polygon Mode.

# not exist.

# = 0.

# = Others

All the commands are ignored.

c. “;” terminator is optional.

#### 50) Pixel Placement

Code : P P mod ; [ mod = decimal ASCII number]

Function : a. Controls how pixels are placed on the layout grid.

Details : a. Range of mode “mod” is 0 or 1.

b. mod = 0, then pixels centered at grid intersections (default).

c. mod = 1, then pixels centered at grid centered.

d. If mod is omitted, then pixels centered at grid intersections (default).

e. Valid not only within GL/2, but also in PCL.

f. Valid until reset by PP (“ESC \* I # R”) command, or reset to Default.

g. “;” terminator is optional.

h. See ESC \* I # R for details.

51) Plot Relative

Code : P R x1 , y1 ... , xn , yn ; [ x1 , y1 , xn , yn = decimal ASCII number]

Function : a. Plots in order using X, Y coordinates Relative to current pen position.

Details : a. Functions as PA command.  
Refer to PA Plot Absolute command.  
b. “;” terminator is optional.

52) Pen Up

Code : P U x1 , y1 ... , xn , yn ; [ x1 , y1 , xn , yn = decimal ASCII number]

Function : a. Raises Pen pen, causing line and edges not to be printed.

Details : a. Parameters may be included to function as PA or PR command; whichever has been most recently used (default is PA with plotter units). Refer to PA Plot Absolute and PR Plot Relative command.  
b. If no parameters are provided, sets pen to Pen Up status.  
c. Related commands are PA, PD, PE, PR.  
d. “;” terminator is optional.

53) Pen Width

Code : P W wid , pen ; [ wid , pen = decimal ASCII number]

Function : a. Selects new width for the specified pen.

Details : a. Range of width “wid” is from 0 to 32,767. Range of pen “pen” is 0 to n: (n: NP reserved).  
b. If pen is omitted, then all effective pens are used.  
c. If no parameters are provided, all pen width is set to default: all effective pens are set to default.  
If current WU mode is metric, then width is set to 0.35mm.  
If current WU mode is relative, then width is set to 1% diagonal distance between P1 and P2.  
d. When specifying a line width LESS than 0.8mm, the following width selections will result.

| Millimeters      | 300 dpi pixel widths                      |
|------------------|-------------------------------------------|
| 0.0000 to 0.0846 | 1 pixel                                   |
| 0.0847 to 0.1693 | 2 pixels                                  |
| 0.1694 to 0.2540 | 3 pixels                                  |
| 0.2541 to 0.3386 | 4 pixel                                   |
| 0.3387 to 0.4233 | 5 pixels (default width for metric units) |
| 0.4234 to 0.5080 | 6 pixels                                  |
| 0.5081 to 0.5926 | 7 pixels                                  |
| 0.5927 to 0.6773 | 8 pixels                                  |
| 0.6774 to 0.7620 | 9 pixels                                  |
| 0.7621 to 0.8466 | 10 pixels                                 |

e. All lines with widths of less than 0.35mm have butt caps and no joins. Performance is better with lines with 0.35mm width and narrower.  
f. Pen width does not affect the width of lines in labels unless stroke weight is set to 9,999.  
g. The pen width for a specific pen number remains in effect until another PW command for the same pen number or a WU command is issued. WU command sets all pen widths to default width for the units selected.

#### 54) Rectangle Absolute Filled

Code : R A x , y ; [ x , y = decimal ASCII number]

Function : a. Draws a filled rectangle using the specified X, Y coordinates as the opposite corner beginning at the current pen position using the current FT Fill Type.

Details : a. Range of "x" and "y" is current units -1,073,741,824 to 1,073,741,823.  
b. x = X coordinate ; integer plotter units or decimal user units.  
y = Y coordinate ; integer plotter units or decimal user units.  
c. Current FT Fill Type is used.  
d. This command performs an automatic "PEN DOWN" (PD). When execution has been completed, PEN UP/DOWN position is restored.  
e. If any parameters are missing, the command is trapped and ignored.  
f. If too many parameters are provided, the first two are used and the rest are ignored.  
g. If scaling is not in effect, x and y are in plotter units truncated to integers, if necessary.  
h. If scaling is in effect, x and y are valid to four decimal place.  
i. Related commands are EA, EP, ER, FT, LT, RF, RR.  
j. ";" terminator is optional.  
k. This command clears the polygon buffer and then uses it to define the rectangle before drawing.

#### 55) User Defined Raster Fill

Code : R F ind , wid , ht , pen ... ; [ ind , wid , ht , pen = decimal ASCII number]

Function : a. Defines a rectangular pattern which may be used for area fill.

Details : a. Range of Index "ind" is 1 to 16.  
Range of Width "wid" is 1 to 255.  
Range of Height "ht" is 1 to 255.  
Range of Pixel "pen" is 0 or 1.  
b. Index indicates Fill Pattern Index to be referenced by FP Fill Pattern command.  
c. If no parameters are provided (RF;) defaults ALL user fill patterns to solid black fill.  
d. If Index parameter is provided without additional parameters, the specified Index Pattern is set to solid black fill.  
e. Width and Height define the size of the pattern in pixels.  
f. Each "pen" value represents a dot in the pattern.  
Pixel = 0 provides a white pixel.  
Pixel > 0 provides a black pixel.  
Missing pixel parameters are set to white.  
Pixel patterns are defined from left to right, top to bottom beginning at the top left.  
g. Related command is FT.  
h. ";" terminator is optional.

56) Rotate Coordinate System

Code : R O ang ; [ ang = decimal ASCII number]

Function : a. Rotates the Coordinate System counter-clockwise in 90 degree increments.

- Details :
- a. Range of "ang" is 0, 90, 180 or 270.
  - b. ang = Degrees of rotation.
  - c. If "ang" is out of range, command is ignored.
  - d. If parameter is omitted, then "ang" = 0. (default)
  - e. Rotation is absolute, not cumulative.
  - f. P1 and P2 retain their current coordinate units and may be rotated outside of the picture frame.
  - g. The current input window is also rotated and any portion of the input window extending beyond the picture frame is clipped.
  - h. P1 and P2 can be defaulted to the new picture frame by using the IW and IP commands without parameters.
  - i. Rotated Default Coordinate Values:

|     | Letters | (A4)   |
|-----|---------|--------|
| P1x | 0       | 0      |
| P1y | 0       | 0      |
| P2x | 10,160  | 10,835 |
| P2y | 8,128   | 7,887  |

- j. The IN command defaults the rotation state to 0 (zero) degree.
- k. When the coordinate system is rotated, the current pen position remains the same and new logical pen position coordinates are assigned.
- l. Related commands are IP, IR, IW.
- m. ";" terminator is optional.

57) Replot

Code : R P # ; [ # = decimal ASCII number]

Function : a. This command is trapped and ignored.

58) Rectangle Relative Filled

Code : R R x , y ; [ x , y = decimal ASCII number]

Function : a. Draws a filled rectangle from the current cursor to the specified X Y point using the current FT Fill Type.

- Details :
- a. Range of "x" and "y" is current units -1,073,741,824 to 1,073,741,823.
  - b. x = X coordinate ; integer plotter units or decimal user units.  
y = Y coordinate ; integer plotter units or decimal user units.
  - c. Current FT Fill Type is used.
  - d. This command performs an automatic "PEN DOWN" (PD). When execution has been completed, PEN UP/DOWN position is restored.
  - e. If any parameters are missing, the command is trapped and ignored.
  - f. If too many parameters are provided, the first two are used and the rest are ignored.
  - g. If scaling is not in effect, x and y are in plotter units truncated to integers, if necessary.
  - h. If scaling is in effect, x and y are valid to four decimal places.
  - i. Related commands are EA, ER, RA.
  - j. ";" terminator is optional.
  - k. This command clears the polygon buffer and then uses it to define the rectangle before drawing. If a polygon buffer overflows, excess data is ignored.



#### 59) Relative ARC - Three Point

Code : R T xi , yi , xe , ye , chd ; [ xi , yi , xe , ye , chd = decimal ASCII number]

Function : a. Calculates and Draws arc beginning at the current pen position and going through a relative intermediate point and ending at a relative end point.

Details : a. Range of xi , yi , xe and ye is -1,073,741,824 to 1,073,741,823. Range of chd is 0.5 to 180 degrees.  
b. Default value of chd is 5 degrees.  
c. xi = Intermediate X coordinate ; integer in plotter units or user units.  
yi = Intermediate Y coordinate ; integer in plotter units or user units.  
xe = End X coordinate ; integer in plotter units or user units.  
ye = End Y coordinate ; integer in plotter units or user units.  
chd = Chord angle ; integer, arc smoothness in degrees. Chord angle value is optional. Out of range values which are less than 0.5 are set to 0.5. Out of range values which are greater than 180 are set to 180.  
d. Current pen and line statuses are used.  
e. If scaling is not in effect, x and y are in plotter units truncated to integers, if necessary.  
f. If scaling is in effect, xi , yi , xe and ye are valid to four decimal places.  
g. Related commands are AA, AR, AT, LA, LT, PW.  
h. “;” terminator is optional.

#### 60) Alternate Character Set

Code : S A # ; [ # = decimal ASCII number]

Function : a. Selects alternate font currently specified by AD Alternate Font Definition for use by LB command.

Details : a. Same effect can be achieved by using Shift-Out SO (CHR\$(14)) character inside LB Label command string.  
b. Default character set is 277: Roman-8. Default font is 48: Stick Font.  
c. This font remains in effect until an SS, IN, DF or Shift-In SI (CHR\$(15)) character.  
d. Related commands are AD, LB, SD, SS.  
e. “;” terminator is optional.

#### 61) Bitmap Font Enable

Code : S B # ; [ # = decimal ASCII number]

Function : a. Controls the selection of Bitmap Fonts for LB Label Command.

Details : a. Range of # is 0 or 1.  
b. If # = 0, then Bitmap Fonts cannot be selected in PCL or HPGL/2.  
c. If # = 1, then only Bitmap Fonts and Stick Font can be selected for use in the Label Command. Default condition is: Bitmap fonts are selectable. (SB1)  
d. FI and FN commands change the state of SB.  
If FI or FN selects a bitmap font, SB is set to 1.  
e. Bitmapped characters cannot be edged. (CF)  
f. Bitmapped characters can only be rotated at 0, 90, 180, 270 degrees (DI, DR).  
g. SL slant command is ignored for bitmapped fonts.  
h. If # is out-of-range, command is ignored.  
i. “;” terminator is optional.

## 62) Scale Input Window Point

Code : S C Xlo , Xhi , Ylo , Yhi , typ , lef , bot ;  
[ Xlo , Xhi , Ylo , Yhi , typ , lef , bot = decimal ASCII number]

Function : a. Defines the USER UNIT coordinates of P1 and P2. Used for setting automatic isotropic scaling and to relocate the origin and set ratio of plotter units to user units.

Details : a. Range of Xlo is -1,073,741,824 to 1,073,741,823.  
Range of Xhi is -1,073,741,824 to 1,073,741,823.  
Range of Ylo is -1,073,741,824 to 1,073,741,823.  
Range of Yhi is -1,073,741,824 to 1,073,741,823.  
Range of Type "typ" is 0, 1 or 2. Default is 0.  
Range of Left "lef" is 0 to 100%. Default is 50%.  
Range of Bottom "bot" is 0 to 100%. Default is 50%.

b. Xlo = X minimum coordinate; in user units.  
Xhi = X maximum coordinate; in user units.  
Ylo = Y minimum coordinate; in user units.  
Yhi = Y maximum coordinate; in user units.

c. Xlo and Ylo define the user coordinates of P1.

d. Xhi and Yhi define the user coordinates of P2.

e. Type defines the type of scaling:  
If Type = 0, then scaling is Anisotropic. Allows user units to be different sizes along x and y axis.  
If Type = 1, then scaling is Isotropic. User units are the same along both x and y axis.  
If Type = 2, then scaling is Point Factor scaling. Left and Bottom parameter are not used.  
Xlo becomes Xfactor with Range -1,073,741,824 to 1,073,741,823.  
Ylo becomes Yfactor with Range -1,073,741,824 to 1,073,741,823.  
Xfactor and Yfactor cannot equal or approach 0.

f. For Anisotropic scaling, Left and Bottom values are ignored.

g. For Isotropic scaling, Left and Bottom values determine positioning of Isotropic Origin (0, 0). Left defines percentage of unused area between P1 and P2 to be placed to the left of the Isotropic area. Bottom defines the percentage of unused area between P1 and P2 to be placed below the Isotropic area.

h. Point Factor scaling sets a specific ratio of plotter units to user units for the X and Y directions and sets the user-units coordinates of P1.

i. SC0, 1, 0, 1, 2 command set the origin at P1 and sets 1 to 1 ratio of plotter units to user units.

j. Type, Left and Bottom parameters are optional.

k. If the Type parameter is omitted, Type is defaulted to 0.

l. If no parameters are provided, scaling is turned off and values are interpreted as plotter units (0.025mm/plotter unit).

m. If one or more parameters are missing, the command is trapped and ignored.

n. If no parameters are provided, then scaling is turned off.

o. Specified scaling remains active until, and SC; turns off scaling or a subsequent valid Scaling command is received.

p. If more than seven parameters are provided, additional parameters are ignored and all parameters proceeding it will be processed normally.

q. If less than four parameters are provided, the command is ignored.

r. If Xlo = Xhi or Ylo = Yhi or Xfactor = Yfactor, then command is ignored.

s. An SC command remains in effect until an IN, DF or another SC command.

t. Related commands are IP.

### 63) Standard Font Definition

Code : S D knd , val ... , knd , val ; [ knd , val = decimal ASCII number]

Function : a. Defines primary font and symbol set using the parameters specified.

Details : a. Range of "knd" (kind) is integers 1 to 7.

b. For "knd" = 1, Symbol set is specified.

Range of "val" (value) is symbol set ID.

Reference HPGL/2 Symbol set values in paragraph 190.

Default is 277, Roman-8.

c. For "knd" = 2, Font spacing is specified.

Range of "val" is 0 or 1.

0 = fixed spacing (default typeface is Stick).

1 = proportional spacing (default typeface is Proportional Stick).

Default is fixed spacing.

d. For "knd" = 3, Font Pitch is specified.

Range of "val" is 0 to 32,767.9999.

Default pitch is 9.

Using this parameter with the spacing = 1, results in the Pitch Value being used as a "horizontal stretch" value.

e. For "knd" = 4, Font Height is specified.

Range of "val" is 0 to 32,767.9999. In Scalable font, the range is 0.25 ~ 999.75 in units of 0.25.

Default height is 11.5.

Tall narrow characters cannot be specified.

Aspect ratio is preserved.

f. For "knd" = 5, Posture is specified. Default is 0.

Range of "val" is 0, 1, 2.

0 = upright

1 = Italic

2 = Alternate Italic

g. For "knd" = 6, Font Stroke Weight is specified.

Range of "val" is -7 to 7 and 9,999.

Default stroke weight is 0.

Stroke weight of 9,999 causes stick font to use current line width.

h. For "knd" = 7, Typeface is specified.

Range of "val" is 0 to 32,767.9999.

Default typeface is 48 : stick font.

52 = Universe, 5 = CG Times

Any printer font may be selected.

i. Using equivalent PCL font attribute parameters, any PCL font may be selected.

j. ";" terminator is optional.

#### 64) Character Size Absolute

Code : S I wid , ht ; [ wid , ht = decimal ASCII number]

Function : a. Allows the stretching of the currently selected font to meet specified size requirement.

Details : a. Range of Width "wid" is -32,768 to 32,767.  
Range of Height "ht" is -32,768 to 32,767.  
b. wid = Width of characters in centimeters.  
ht = Height of characters in centimeters.  
c. The Width value defines the new "normal" width for the font.  
For a proportionally spaced font, individual character widths will vary.  
d. A negative width value causes right to left printing with reversed "mirror" characters.  
e. The Height value defines the new "normal" height for the font.  
f. A negative height value causes "mirror" top to bottom printing.  
g. If parameter is out of range, command is trapped and ignored.  
h. If no parameters are provided with command, default settings are set.  
i. If only one parameter is provided, the command is trapped and ignored.  
j. If extra parameters are provided, the command is executed using the first two parameters and the rest are ignored.  
k. If the SB1 command is in effect, characters cannot be "mirrored" and Bitmap fonts (selected by width) are used.  
l. Related commands are AD, SD, SR, DI, DR.  
m. ";" terminator is optional.

#### 65) Character Slant

Code : S L tan ; [ tan = decimal ASCII number]

Function : a. Specifies the slant for printing characters with the LB command.  
Slant angle can be from -89.998 to 89.998 degrees from vertical.

Details : a. Range of "tan" is from -32,768 to 32,768.  
b. tan = Tangent of the desired slant angle from vertical.  
c. If no parameters are provided with command, slant is set to zero for upright printing (SL0).  
d. The slant angle is changed only by the IN, DF and SL commands.  
e. If extra parameters are provided, the command is executed using the first two parameters and the rest are ignored.  
f. The selected slant remains in effect until changed by the IN, DF or SL commands.  
g. Related commands are DI, DR, LB.  
h. ";" terminator is optional.

#### 66) Symbol Mode

Code : S M chr ; [ chr = ASCII character]

Function : a. Specifies a character to be printed centered at the end of each point plotted by the PA, PD, PE, PU or PR commands.

Details : a. Range of "chr" is ASCII characters with decimal codes from 33-58, 60-126, 161, 254.  
b. chr = ASCII character from currently active character set.  
c. If "chr" is out of range, Symbol Mode is cancelled.  
d. Semi-colon ";" serves only as a terminator and cannot be used as the symbol character.

- e. The character does not change when the character set is changed.
- f. If no parameters are provided with command, Symbol Mode is turned off.
- g. If extra parameters are provided, the command is executed using the first two parameters and the rest are ignored.
- h. Symbol Mode is remains in effect until the receipt of the IN, DF or another SM command.
- i. Characters are printed regardless of PEN UP/DOWN status.
- j. The character printed uses the current character status as set by SI, SR, SL, DI and DR instructions.

#### 67) Select Pen

Code : S P # ; [ # = decimal ASCII number]

Function : a. Selects a pen and assumes the current pen attributes.

- Details :
- a. Range of “#” is integers 0 or 1,073,741,823.
  - b. If # = 0, pen selection is solid white pen.  
If # = 1, or more pen selection is solid black pen.
  - c. If # is out of range, command is ignored and the pen is not change.
  - d. If no parameters are provided, # = 0 (SP0).
  - e. Pen patterns are fixed to the current rotation and are not affected by the printing direction.
  - f. When NPn is specified, n kind of pens (from 0 to (n-1)) are selectable.
  - g. Related commands are PW, WU, NP.
  - h. SP1 must be sent prior to plotting to achieve black image.
  - i. “;” terminator is optional.

#### 68) Character Size Relative

Code : S R wid , ht ; [ wid , ht = decimal ASCII number]

Function : a. Specifies the size of characters relative to the P1 and P2 scaling points.

- Details :
- a. Range of Width “wid” is -32,768 to 32,767.  
Range of Height “ht” is -32,768 to 32,767.
  - b.  $wid = \text{Width} - \text{Percentage multiplier of } (P2x - P1x)$   
 $ht = \text{Height} - \text{Percentage multiplier of } (P2y - P1y)$   
Actual Character Width = “wid”% x (P2x - P1x) horizontal distance.  
Actual Character Height = “ht”% x (P2y - P1y) vertical distance.
  - c. If no parameters are provided with command, default settings are set:  
Default “wid” = 0.75%  
Default “ ht” = 1.5%
  - d. A negative width value causes right to left mirror printing.
  - e. A negative height value causes top to bottom mirror printing.
  - f. If any value is out of range, the command is trapped and ignored.
  - g. If only one parameter is provided, the command is trapped and ignored.
  - h. If extra parameters are provided, the command is executed using the first two parameters and the rest are ignored.
  - i. Related commands are SI, DI, DR.
  - j. “;” terminator is optional.

## 69) Standard Character Set

Code : S S ;

Function : a. Selects primary font currently specified by SD Standard Font Definition for use by LLB command.

Details : a. Same effect can be achieved by using Shift-In SI (CHR\$(15)) character inside LB Label command string.  
b. Default character set is Roman-8. Default font ID is 48: fixed Spacing.  
c. This font remains in effect until an SA, IN, DF or Shift-Out (CHR\$(14)) character.  
d. Related commands are AD, LB, SA, SD.  
e. “;” terminator is optional.

## 70) Screened Vectors

Code : S V scr , op1 , op2 ; [ scr , op1 , op2 = decimal ASCII number]

Function : a. Selects a vector shading pattern for use with lines.

Details : a. Range of Screen Type “scr” is an integer 0, 1, 2, 21, 22.  
b. Default value of scr is 0: no screening, solid fill.  
c. If any parameter is omitted, default parameters are used.  
d. scr = Type of screening  
e. scr = 0, No screening, solid Fill  
op1, op2 are ignored.  
f. scr = 1, Standard Shaded Fill  
op1 = % PCL shading, 0 - 100 (8 PCL standard gray patterns)  
op2 is ignored.  
g. scr = 2, User Defined Raster Fill  
op1 = user pattern ID number  
op2 = pen selection 0 = pen 1  
1 = current pen  
h. scr = 21, PCL Crosshatch pattern  
op1 = PCL Crosshatch pattern number 0 - 6  
op2 is ignored.  
i. scr = 22, PCL user defined  
op1 = pattern ID  
op2 is ignored.  
j. Current pen and line statuses are used.  
k. If too many parameters are provided, the first three are used and the rest are ignored.  
l. All screened pattern use the current anchor corner.  
m. Related command is FT.  
n. “;” terminator is optional.

## 71) Transparent Data

Code : T D mod ; [ mod = decimal ASCII number]

Function : a. This command allows the printing of LB Label characters which would normally be processed as control characters.

Details : a. Range of Mode "mod" is 0 or 1.  
b. If "mod" Mode = 0, then characters with assigned functionality perform their function and do not print (Normal data).  
c. Characters with assigned functionality are:

| Hex | Dec | Name | Function                          |
|-----|-----|------|-----------------------------------|
| 03  | 03  | ETX  | label terminator                  |
| 08  | 08  | BS   | backspace                         |
| 09  | 09  | HT   | horizontal tab                    |
| 0A  | 10  | LF   | line feed                         |
| 0D  | 13  | CR   | carriage return                   |
| 0E  | 14  | SO   | shift-out (alternate font select) |
| 0F  | 15  | SI   | shift-in (standard font select)   |
| 1B  | 27  | ESC  | begin device-control command      |

d. If "mod" Mode = 1, then all characters print and do not perform their function except terminator character which prints and terminates the label. A space is printed for nonprinting and undefined characters (Transparent data).  
e. If no parameters are provided, Normal mode is selected (TD0).  
f. Related commands are DT, LB, SD.  
g. ";" terminator is optional.

## 72) Transparency Mode

Code : T R mod ; [ mod = decimal ASCII number]

Function : a. Selects Opaque or Transparent plotting for HPGL/2 environment.

Details : a. Range of Mode "mod" is 0 or 1.  
b. If "mod" Mode = 0, Opaque mode is selected.  
When images overlap on the plotted page, plotting a white pixel sets the pixel to white, regardless of its current condition.  
c. If "mod" Mode = 1, Transparent mode is selected (default).  
When images overlap on the plotted page, plotting a white pixel does not change the pixel from black to white. Pixels that are turned to black remain set to black.  
d. If no parameters are provided, default Transparent mode is selected (TR1).  
e. ";" terminator is optional.

### 73) User Defined Type

Code : U L typ , gap ... , gap ; [ typ , gap = decimal ASCII number]

Function : a. Redefines the line segment pattern for the specified index.

- Details :
- a. Range of Type "typ" is 1 to 8.  
Range of Gap "gap" is 0 to 32,767.
  - b. Negative Line Types are set to positive. Corresponding Adaptive line type is automatically redefined to match User Line Type.
  - c. Odd numbered gaps indicate Pen Down portion.  
Even numbered gaps indicate Pen Up portion.
  - d. A zero value for an Odd gap (pen down) indicates a dot (one plotter unit long).
  - e. Negative gap values are ignored.
  - f. If the total of the gap units is zero, the command is ignored.
  - g. If no parameters are provided (UL;), All Line Types are defaulted.
  - h. If Index parameter is provided without additional parameters, the specified Line Type is set to default pattern per LT line types.
  - i. A maximum of 20 gap values are allowed. Additional gap values are ignored.
  - j. This command does not select a line type.
  - k. Related command is LT.
  - l. ";" terminator is optional.

### 74) Wedge with Fill

Code : W G r , sa , sw , chd ; [ r , sa , sw , chd = decimal ASCII number]

Function : a. Draws a filled wedge centered at the current pen position using the current pen (PU/PD) and fill (FT) status.

- Details :
- a. Range of "x", "y" is -1,073,741,824 to 1,073,741,823.  
Range of chd is 0.5 to 180 degrees.
  - b. Default value of chd is 5 degrees. chd value is optional.
  - c. r = Radius in plotter units and user units.  
sa = Start angle ; integer, negative value specifies clockwise arc, positive value specifies counter-clockwise arc.  
sw = Sweep angle ; integer, negative value specifies clockwise arc, positive value specifies counter-clockwise arc.  
chd = Chord angle ; integer, arc smoothness in degrees. Chord angle value is optional. Out of range values which are less than 0.5 are set to 0.5. Out of range values which are greater than 180 are set to 180.
  - d. Current fill is used.
  - e. If scaling is not in effect, r is in plotter units truncated to integers, if necessary.
  - f. If scaling is in effect, r is valid to four decimal places.
  - g. This command performs an automatic "PEN DOWN" (PD). When execution has been completed, PEN UP/DOWN position is restored.
  - h. If parameters are missing, the command is trapped and ignored, and the rest are ignored.
  - i. If polygon buffer overflow condition occurs, contents of buffer are filled.
  - j. Related commands are EP, EW, FT, LA, LT, PW, SC.
  - k. ";" terminator is optional.



#### 75) Pen Width Unit Selection

Code : W U typ ; [ typ = decimal ASCII number]

Function : a. Specifies metric or relative pen width units.

Details : a. Range of "typ" is 0 or 1.

b. If typ = 0, then Pen Width Units are metric in millimeters.

All pen widths are set to the default of 0.35mm.

c. If typ = 1, then Pen Width Units are relative.

All pen widths are set to the default of 1% of the diagonal distance from P1 to P2.

d. WU commands remains in effect until IN or WU command is used.

WU is not defaulted by DF command.

e. Related commands are PW and SP.

f. ";" terminator is optional.

## 1.14 Miscellaneous Command

Miscellaneous Commands List

| No. | Command                | Code  |
|-----|------------------------|-------|
| 1   | Enter Display Function | ESC Y |
| 2   | Exit Display Mode      | ESC Z |
| 3   | Self Test              | ESC z |

1) Enter Display Function

Code : ESC Y

Function : a. When in display function mode, all control codes and escape sequences are not executed and all control codes including escape code and CR are printed as blanks. The only exceptions are CR and ESC Z, which cause printer to exit display function mode.

2) Exit Display Mode

Code : ESC Z

Function : a. This sequence is printed as "blank" followed by a Z; then printer exits in display function mode.

3) Self Test

Code : ESC z

Function : a. Print Font list.

## 1.15 Other Commands

Other Commands List

| No. | Command                           | Code               |
|-----|-----------------------------------|--------------------|
| 1   | Emulation Select                  | ESC DEL #          |
| 2   | Multi-copy Start Command          | ESC / m # S        |
| 3   | Multi-copy End Command            | ESC / m E          |
| 4   | Specifying Multi-copy Mark        | ESC / m # M        |
| 5   | USPS PostNet Command              | ESC / b # W [data] |
| 6   | Reception and Elimination of Data | ESC & EM           |

1) Emulation Select

Code : ESC DEL # [ # = ASCII number]

Function : a. Prints data in buffer (if any), resets printer, and selects indicated emulation.

Details : a. # = 0 PostScript - If option board is being installed.  
# = 1 OKIDATA ProPrinter III XL Emulation - Ignored  
# = 2 Future - Ignored  
# = 3 Future - Ignored  
# = 4 Future - Ignored  
# = 5 OKIDATA HP LaserJet 4 Emulation  
# = 6 Future - Ignored  
:  
# = 9 OKI Hyper-W  
:  
# = 126 Future - Ignored  
# = NULL (00H) Shifted to the default emulation of the menu.

2) Multi-copy Start Command

Code : ESC / m # S

Function : a. The reception of this command causes copies to be made for the number of pages given in # from the received page to the page of end command reception.

Details : a. # = 2 ~ 99 The number of printing copies in multi-copy.  
b. The number of printing copies designated in a value other than 2 ~ 99 should be made invalid by the command.

3) Multi-copy End Command

Code : ESC / m E

Function : a. The multi-copy is applicable before this command is received.

4) Specifying Multi-copy Mark

Code : ESC / m # M

Function : a. Sets multi-copy mark designating command to be invalid and flush it.  
This command won't be supported and the command be flushed.

5) USPS PostNet Command

Code : ESC / b # W [Data]

Function : a. This command prints out PostNet bar code.

Details : a. # means the quantity of data (bytes) at "W" or after.

6) Reception and Elimination of Data

Code : ESC & EM

Function : a. Data of 5 bytes following this command is received and eliminated.