Chapter 3: The PCL Page

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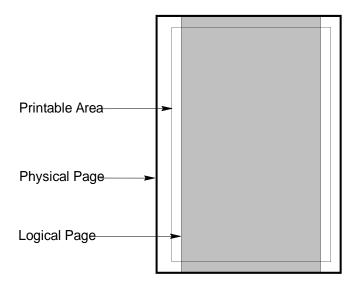## 3.1 Introduction

The Physical Page

The *physical page* is the actual sheet of media. The term refers to the size of the media installed in the printer. The *printable area* is the maximum area on the physical page in which the printer is able to place a dot. This is an absolute, device-dependent limitation, which is determined by the technology of the printing device.

The Logical Page

The *logical page* is the current addressable area on the physical page; it defines the area in which the PCL cursor can be positioned. The PCL cursor, called *CAP* (Current Active Position), is the position on the logical page where the next character will be positioned.

As shown on the next page, the logical page extends the length of the physical page — it may, in fact, extend into the unprintable area of a device. On most HP printers, there is a gap between the logical page and the unprintable region.
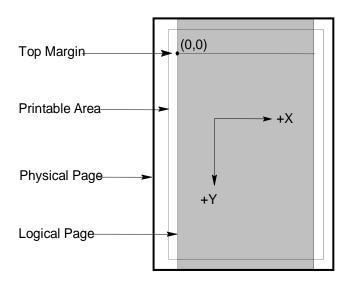
CAP may be moved anywhere on the logical page using Move CAP commands (e.g., *Esc&a#H*, *Esc&a#V*); but CAP cannot be moved outside the logical page bounds.

The Logical Page
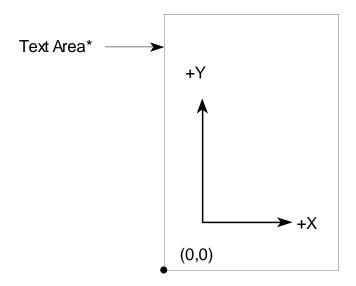
The PCL Coordinate System

The PCL coordinate system is shown below. Relative to the PCL coordinate system the Y direction is always downward and the X direction is to the right. The point (0,0) is the intersection of the left edge of the logical page and the current top margin. Usually the top margin defaults to 1/2", but it may be changed by the Top Margin command (*Esc&l#E*). The point (0,0) moves with the top margin and will rotate around the page if the orientation is changed.

The PCL Coordinate System

The HP-GL/2 Coordinate System

The HP-GL/2 coordinate system is shown below. Both PCL and HP-GL/2 use a Cartesian coordinate system with perpendicular X and Y axes. However, they differ in unit dimension and orientation. Positive Y values are plotted below the origin in PCL and above the origin in HP-GL/2.

The HP-GL/2 Coordinate System

* The default "text area" of an HP-GL/2 graphic that is imported into PCL is coincident with the right and left edges of the logical page, one-half inch down from the top of the logical page, and one-half inch up from the bottom of the logical page.
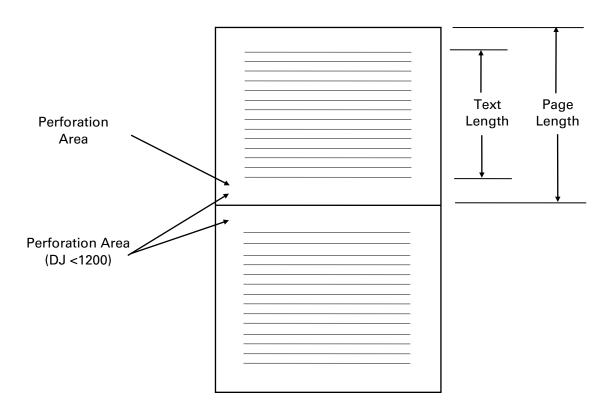
3.2 Margins

The logical page represents the current addressable area on the physical page; but the actual text area within the logical page is restricted by text margins, and the raster graphics area is restricted by graphics margins.

Text Margins

The text margins define the *text area*, the area on the physical page where text may be printed. The defaults for the left and right margins are the left and right logical page boundaries. The default for the top margin is 1/2" below the top of the logical page.

The left, right, and top margins may be explicitly set by PCL commands (*Esc&a#L, Esc&a#M, Esc&l#E*). The bottom margin is set indirectly by the Text Length command (*Esc&l#F*) when the perforation skip region is enabled (default). The perforation skip region extends from the bottom of the text area on one page to the top of the text area on the next page. Disabling perforation skip (*Esc&l0L*) causes text to be printed to the end of the page.

DEVICE NOTE: LJs and SPR products include only the bottom margin in the perforation area. With perforation skip enabled, a linefeed within the top margin moves CAP down one line. DJs below 1200 include both the bottom margin of the current page and the top margin of the next page in the perforation skip area. With perforation skip enabled, a linefeed within the top margin moves CAP to the top margin.

Printing Outside Text Margins

Characters are usually printed only in the text area between the margins. However, characters can be printed outside the margins by using Move CAP commands (e.g., *Esc&a#H*, *Esc&a#V*). Once outside the left and right margins, all features function normally to the edge of the logical page. That is, if CAP is to the right of the right margin, characters are printed and CAP is updated accordingly

Disabling perforation skip mode (*Esc&l0L*) allows characters to be printed in the perforation region between the bottom margin of one page and top margin of the next.

Even with perforation skip enabled, printing may occur outside the top and bottom margins by using Move CAP commands (e.g., *Esc&a#H*, *Esc&a#V*).

DEVICE NOTE: LJs and SPR products include only the bottom margin in the perforation area. With perforation skip enabled, a linefeed within the top margin moves CAP down one line. DJs below 1200 include both the bottom margin of the current page and the top margin of the next page in the perforation skip area. With perforation skip enabled, a linefeed within the top margin moves CAP to the top margin. Therefore, with perforation skip enabled, DJs below 1200 must use Move CAP commands rather than linefeeds if more than one line is to be printed within the top margin

Generally, characters are never printed outside the logical page. However, some characters may extend outside the left and right boundaries of the logical page; for example, the italic f starts to the left of CAP. In most HP printers, there is a gap between the left and right boundaries of the logical page and the unprintable area.

Characters are not clipped unless they extend into the unprintable area. Some printers allow *pixel clipping*, where parts of characters are clipped. Without pixel clipping, printers clip the entire character if it extends into the unprintable area.

Raster Graphics Margins

Raster mode is different than text mode. Raster mode may be started explicitly by a Start Raster command (*Esc*r#A*), or implicitly by sending data with a Transfer Raster command (*Esc*b#V* or *Esc*b#W*).

The PCL raster graphics system uses the concept of a raster graphics picture, or *raster area*. The raster area represents a boundary within which the printer will zero-fill missing and short. The raster area can be started at CAP anywhere on the logical page.
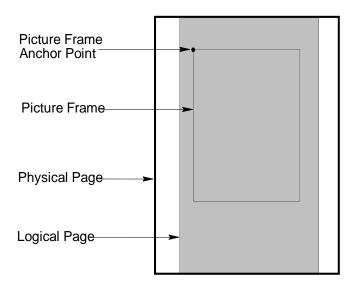
Raster margins may be different than text margins. Raster height and width can be set explicitly; otherwise they are clipped at the logical page or unprintable area.

Raster graphics never causes a page eject. At the end of the physical page, CAP is set to the logical page boundary and the rest of the graphic is clipped and discarded.

Vector Graphics Margins

In addition to text and raster graphics, PCL5 printers can merge HP-GL/2 vector graphics with text on the logical page. The simplest procedure is to enter the HP-GL/2 context by *Esc%#B*, create the drawing using HP-GL/2 commands, and re-enter the PCL context by *Esc%#A*.

The HP-GL/2 graphic is placed on the logical page within a rectangle called the ***picture frame***, which effectively defines the margins for vector graphics. The default picture frame position or *anchor point* is 0,0 and the default size is the default PCL text area (the logical page minus the top and bottom margins); but the picture frame size and position may be modified by PCL commands called *picture frame directives* prior to entering the HP-GL/2 context.
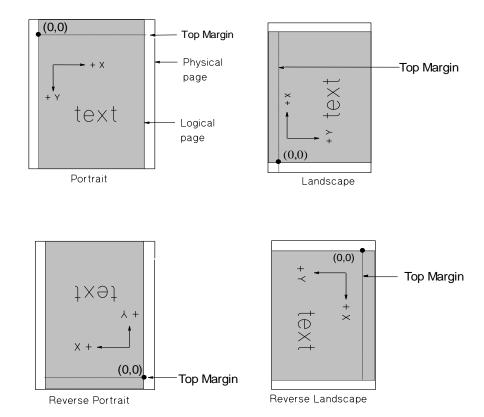

The Picture Frame

When an HP-GL/2 graphic is placed on the page, it is limited by both HP-GL/2 and PCL restrictions. The HP-GL/2 hard clip and soft clip boundaries limit the original plot; the picture frame limits the transferred plot; and the logical page may clip the picture frame.

Several strategies may be used to handle these restrictions. The size and position of the picture frame may be adjusted to exactly match HP-GL/2 and PCL coordinates, with no picture frame scaling. Of course, if only user-units were used to create the plot, it will be automatically scaled to fit any size picture frame. The plot can also be horizontally and vertically scaled with respect to the picture frame by any desired scale factor — even if it was originally created with absolute units — by using PCL picture frame directives.

3.3 Orientation

Orientation defines the position of logical page with respect to the physical page. Orientation refers to the viewing aspect, and has no relation to the print scan or paper loading directions.

Portrait orientation means the logical page origin (0,0) is toward the top left corner of the physical page, with the X-direction to the right and the Y-direction downward. *Landscape* orientation means the origin is rotated counterclockwise by 90 degrees toward the lower left corner of the physical page; then the X direction is upward and the Y direction is to the right.

Portrait

Landscape

Reverse Portrait

Reverse Landscape

The Orientation command (*Esc&l#O*) can be used to change logical page orientation only once per physical page because it ejects the page. The Print Direction command (*Esc&a#P*), which rotates the logical page coordinate system **with respect to the current orientation**, does not eject the page and may be used change orientation multiple times on the same page.

Raster graphics do not track logical page orientation (although Raster Presentation (*Esc*r#F*) can be used change raster orientation). HP-GL/2 graphics do track changes caused by the Orientation command (*Esc&lO*), but not those caused by the Print Direction command (*Esc&aP*) unless the Enter HP-GL/2 command has been sent with a value field of 2 or 3 (*Esc%2B*, *Esc%3B*). It is also possible to alter the HP-GL/2 picture orientation within the logical page by using the HP-GL/2 RO command.
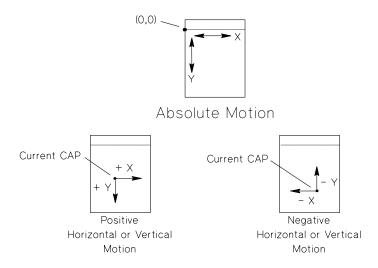
Fonts track logical page orientation.

3.4 The Current Active Position (CAP)

The PCL cursor, which is called the **Current Active Position (CAP)**, is analogous to the blinking character that identifies the current position on the computer screen. In PCL, it is the position where the next character or graphics dot will be printed. After printing a character, CAP moves to the right a distance equal to the width (escapement) of that character. After printing a raster row, CAP moves one dot row down.

Move CAP Commands

CAP may be moved anywhere within the logical page using Move CAP Horizontal (*Esc&a#C, Esc&a#H, Esc*p#X*) and Vertical (*Esc&a#R, Esc&a#V, Esc*p#Y*) commands and control codes (CR, SP, BS, HT, LF, FF, etc). Either absolute or relative movement can be specified. **Absolute motion** is referenced to the intersection of the top margin and the left boundary of the logical page (0,0). A Move CAP command with an unsigned value field is an absolute move. **Relative motion** is referenced to the current position of CAP. A Move CAP command with a signed value field is a relative move.

Absolute Motion

Positive
Horizontal or Vertical
Motion

Negative
Horizontal or Vertical
Motion

Relative Motion

Default CAP

CAP is *floating* until printable data or a command affecting CAP is received. The floating CAP is always at the (0,0) position on left margin and 3/4 of a line space below the top margin. A floating CAP tracks the (0,0) position with changes to orientation, top margin, left margin, and line spacing. Reception of any printable character or command affecting CAP will *fix* CAP. A fixed CAP is not affected by changes to the orientation, top margin, left margin, or line spacing.

The HP-GL/2 Cursor

The HP-GL/2 cursor is called the **Pen Location**. It may be moved anywhere within the current HP-GL/2 addressable area

3.5 Units of Movement

A printer's resolution is not related to the size of the units used to position CAP. The units of movement on the X-axis of the PCL coordinate system may be PCL Units, decipoints, or columns. The units on the Y-axis may be PCL Units, decipoints, or rows.

PCL Unit

The size of a PCL Unit is user-definable by the Unit of Measure command (*Esc&u#D*). Devices using this command round movements using the Move CAP (PCL Unit) commands to the nearest PCL Unit, rather than to the nearest internal unit. The default PCL Unit is 1/300" unless changed by the control panel.

PCL Units were formerly referred to as "dots", but were renamed to prevent confusion with the printer's physically printed dots, which are determined by the printer's resolution (see the discussion on resolution on the next page.)

Decipoint

A decipoint is 1/720" or 1/10 of a PCL point. (A PCL point is *exactly* 1/72" as opposed to a typographic point which is *approximately* 1/72".)

Column

Column width depends on the current CMI (character motion index).

Rows

Row height depends on the current LMI (line motion index) or lines-per-inch (lpi) setting.
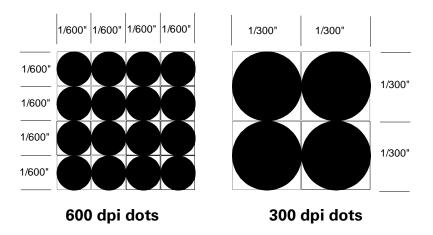
Printer Internal Units

Internally, the printer maps PCL units, decipoints, columns, and rows to its own internal units. LaserJets generally use 1/7200" as an internal unit; DeskJets below 1200 use 1/3600". CAP positioning is always rounded to the nearest internal unit; however, the start position of printed text glyphs is rounded to the nearest PCL Unit if the Unit of Measure command (Esc&u#D) is supported.

HP-GL/2 Units

In HP-GL/2, the device moves in either *user units* or absolute *plotter units*. One plotter unit equals .025 mm (approximately .00098 in). User units can be set to any size by HP-GL/2 scaling commands. Both types of HP-GL/2 units are converted to the device resolution prior to printing.
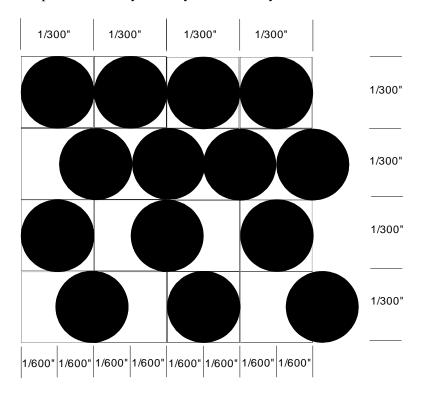
3.6 Resolution

A dot is the smallest mark a printer can make. A printer's resolution in dots per inch (dpi) refers to the number of dots that can be placed horizontally and/or vertically in a square inch.

600 dpi dots   **300 dpi dots**

Addressability

Addressability refers to the ability of a device to position a dot. As shown below, a device with 300 dpi resolution may have 600 dpi addressability. Usually addressability is defined in the horizontal direction.

Raster Graphics Resolution

Some devices allow the selection of different raster resolutions, up to the maximum machine resolution. At lower raster resolutions, each pixel, which is the smallest picture element that can be defined, consists of more than one dot. However, dot-spacing remains the same, and the same number of dots-per-inch are printed.

When 150 dpi is requested in a 300 dpi machine, 300 dpi is still printed; but the pixel is now composed of four dots, and is twice as wide and twice as tall.

bit	300 dpi	150 dpi
1	•	• •
		• •

Requesting a lower resolution does not print less detail. The printer still prints at its highest resolution; it just prints the image larger. Using the same data, a 150 dpi image is printed twice as large as a 300 dpi image (with four times the number of dots). The larger image may be clipped if it exceeds the raster area. To keep the destination image the same size, it is necessary to send the printer one-fourth the information.