PRINTRONIX®

ANSI® Programmer's Reference Manual

ANSI® Printers

Programmer's Reference Manual

PRINTRONIX®

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Table of Contents

1 *Introduction*

About This Manual

This manual lists the ANSI® commands and explains how to configure the printer when this emulation is loaded in your printer.

Audience

This book assumes you are an experienced programmer and are familiar with the ANSI emulation.

Warnings and Special Information

Read and comply with all information highlighted under special headings:

WARNING **Conditions that could harm you as well as damage the equipment.**

CAUTION **Conditions that could damage the printer or related equipment.**

IMPORTANT **Information vital to proper operation of the printer.**

NOTE: Information affecting printer operation.

Related Product Information

The *User's Manual* describes the keys on the control panel and provides quick reference information on daily printer operations such as loading paper and replacing ribbons. This book also provides configuration instructions and descriptions and troubleshooting guidelines.

Software Features

The ANSI emulation software provides the following features:

- Graphics and a selection of print densities. You can enable graphics mode and specify a density mode (dots per inch).

- Print Attributes. Characters can be bold, italic, double high, double wide, etc.

- Page Formatting. American National Standards Institute (ANSI) commands allow you to set line spacing, page length, and vertical forms control.

- Font Typefaces. Also referred to as print modes. The five typefaces include Near Letter Quality (NLQ), Data Processing (DP), High Speed (HS), OCR A, and OCR B.

- Character Sets. Fifty-one character sets are available. You can print the character sets in the different print modes.

- Bar codes. Several bar codes are available: Code 3 of 9, IATA 2 of 5, Interleaved 2 of 5, UPC A, EAN 8, EAN 13, UCC 128, and Codabar.

- Expanded/Oversize print modes.

- Forms Positioning. Several commands are available to set print position (relative or absolute).

Installing Printer Emulations

Printer emulation software is stored in flash memory. Flash memory is contained in single in-line memory modules (SIMMs) located on the controller board. Printer emulation and operating system software are loaded into flash memory at the factory, but you will install software in some situations:

- A printer software upgrade is installed

- The printer controller board has been replaced

- The flash memory SIMM has been replaced

Emulation and operating system software are stored on a CD. You will copy the appropriate file to your computer's hard disk, then download that file to the printer. You can load software through the serial, parallel, or Ethernet NIC port of the printer.

NOTE: If the NIC is installed, you must download the code through the NIC port using ftp.

NOTE: Each printer type, line matrix, laser, and thermal, has its own CD with the specific file types for that printer. Be sure to use the appropriate CD for your printer type when downloading software.

IMPORTANT   **When downloading emulation and operating system software to the printer, all other optional font files, customer-supplied logos, setup files, and TIFF files will be erased. You will then need to reload those files. Before starting a download procedure, be sure that you have all the necessary files on hand.**

- **Serial or Parallel Port:** If you are going to load memory through the serial or parallel port of the printer, see "Downloading Software Through the Serial or Parallel Port" on page 11. The load commands are different, depending on the printer port you use. These differences are explained in the note following step 22., page 13.

- **NIC:** If the printer has the NIC installed, see "Downloading Software Through the Network Interface Card (NIC)" on page 14.

- **Font Files:** If you need to load optional font files, see "Downloading Optional Font Files to Flash Memory" on page 16.

Downloading Software Through the Serial or Parallel Port

1. Make a printout of all saved configurations. (Installing new software erases all saved configurations. You will use the printouts to restore the printer configurations.)

2. Set the printer power switch to O (Off).

3. If the printer is already connected to the serial or parallel port of an IBM-compatible computer running the PC-DOS™ or MS-DOS operating system, go to step 9. If not, go to step 4.

4. Unplug the AC power cord from the printer.

5. Disconnect all data input cables from the printer interfaces.

6. Connect a parallel data cable to the LPT1 port or a serial data cable to the COM1 port of an IBM-compatible computer running the PC-DOS or MS-DOS operating system.

NOTE: You can connect the cable to the LPT2 port if the LPT1 port is already in use. The load commands are different if you use this port, as described in the note after step 22.

7. Connect the data cable to the appropriate I/O port of the printer.

8. Plug the AC power cord into the printer.

9. On the printer control panel, press and hold down the **ONLINE** + **PAPER ADVANCE** keys. Without releasing the keys, power the printer on. Continue holding down the keys.

10. When you see "TESTING HARDWARE PLEASE WAIT" on the LCD, release the keys.

11. Wait until you see "WAITING FOR PROGRAM DOWNLOAD" on the LCD before proceeding. This can take up to 30 seconds to appear, depending on the emulations and interfaces installed in the printer.

12. Press the $\Rightarrow$ (NEXT) key. "SELECT DOWNLOAD PORT=CENTRONICS" appears on the LCD.

NOTE: The default port is CENTRONICS; this is the standard load through the parallel port. If you want to use the default, continue at step 14..

13. Press $\Rightarrow$ (NEXT) again to cycle through the download ports available in the printer:

    RS232-9600 (RS-232 serial, 9600 baud)
    RS232-19.2K (RS-232 serial, 19200 baud)
    RS232-38.4K (RS-232 serial, 38400 baud)
    RS232-115K (RS-232 serial, 115000 baud)
    RS422-9600 (RS-422 serial, 9600 baud)
    RS422-19.2 (RS-422 serial, 19200 baud)
    RS422-38.4K (RS-422 serial, 38400 baud)
    RS422-115K (RS-422 serial, 115000 baud)
    DEBUG

14. When the printer download port you want to use displays on the LCD, press the **ENTER** key. "WAITING DOWNLOAD / PORT = <*your selection*>" appears on the display.

11

15. Using Windows Explorer, create a directory named **download** at the root level of your C: hard drive.

16. Insert the printer emulation software CD into your computer.

Figure 1. Navigating to the Appropriate Emulation File on the CD

17. Using Windows Explorer, navigate to the appropriate file on the CD based on the printer model number and desired emulation, e.g., T5000 ▶ IGP. (See Figure 1.)

18. Make note of the file name, which is a six digit number plus **.exe** e.g., 123456.exe.

    This is the file you will download into the printer.
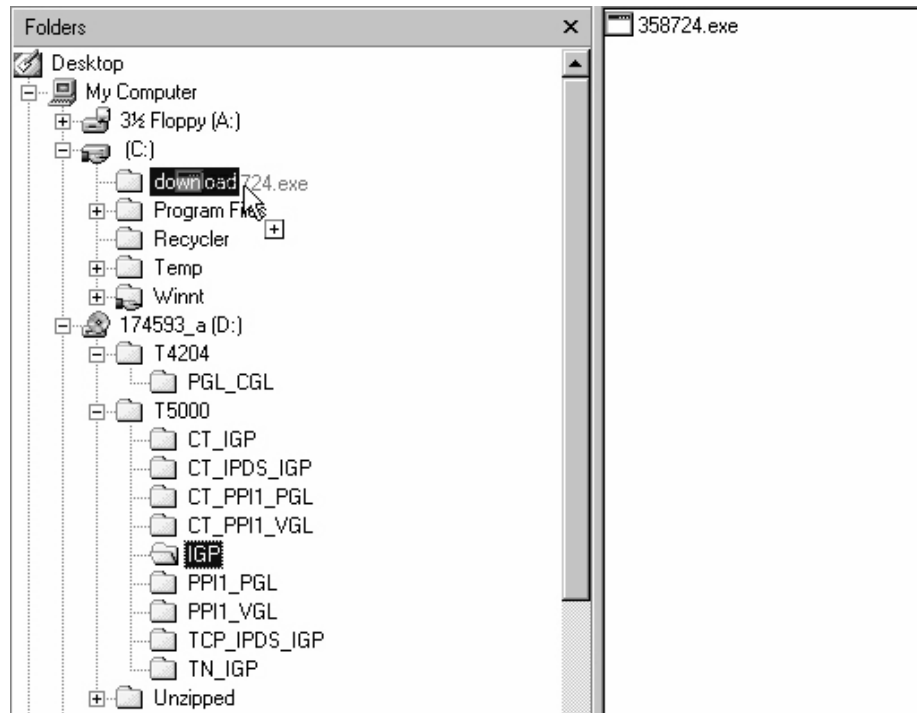
Figure 2. Copying the Emulation File to the Download Directory

19. Copy the file to the download directory.

NOTE: You may need to hold **Ctrl** to make sure a **+** appears to the right of the pointer. (See Figure 2.)

20. Start a command prompt session. (The Start Menu icon is usually labeled MS-DOS Prompt or Command Prompt.)

21. At the command prompt type:
    `C:`<Enter>
    `cd \download`<Enter>

22. At the command prompt on the computer type:
    `filename.exe -pb`<Enter>
    where *filename*.exe is the file name you noted in step 18. This command decompresses the file on the hard drive and copies it as a binary file into the flash memory on the printer controller board.

NOTE: If you are loading the file using the LPT2 port on the computer, enter the following command:
    `filename.exe -pb2` <Enter>

The 9600 baud rate is the only selection older versions of MS-DOS can use. The baud rate information entered in the following commands must match the selection you made in step 13.

If you are loading the file through the printer serial port, enter the following commands:
    `mode COM1:9600,N,8,1,P`<Enter>
    `filename.exe -pbc1`<Enter>

CAUTION   **Do not interrupt the downloading process once it has started. Interrupting a download will damage the flash memory on the controller board and NIC.**

While the file is copied into memory, the printer LCD informs you of the load process and status.

23. When the new program has successfully loaded into memory and the printer has reset itself, set the printer power switch to O (Off).

24. Unplug the AC power cord from the printer.

25. Remove the CD from the host computer and store it with the printer.

26. Power off the computer.

27. If you had to install a data cable to the computer and printer in step 6, disconnect it from the computer and printer.

28. If required, reconnect the data input cable(s) to the printer.

Using the configuration printout(s) you made in step 1, reconfigure the printer and reload any optional font files.

Downloading Software Through the Network Interface Card (NIC)

1. Make a printout of all saved configurations. (Installing new software erases all saved configurations. You will use the printouts to restore the printer configurations.)

2. Set the printer power switch to O (Off).

3. On the printer control panel, press and hold down the **ONLINE** + **PAPER ADVANCE** keys. Without releasing the keys, power the printer on. Continue holding the keys down.

4. When you see "TESTING HARDWARE PLEASE WAIT" on the LCD, release the keys.

5. Wait until you see "WAITING FOR PROGRAM DOWNLOAD" on the LCD before proceeding. This can take up to 30 seconds to appear, depending on the emulations and interfaces installed in the printer.

6. Using Windows Explorer, create a directory named **download** at the root level of your C: hard drive.

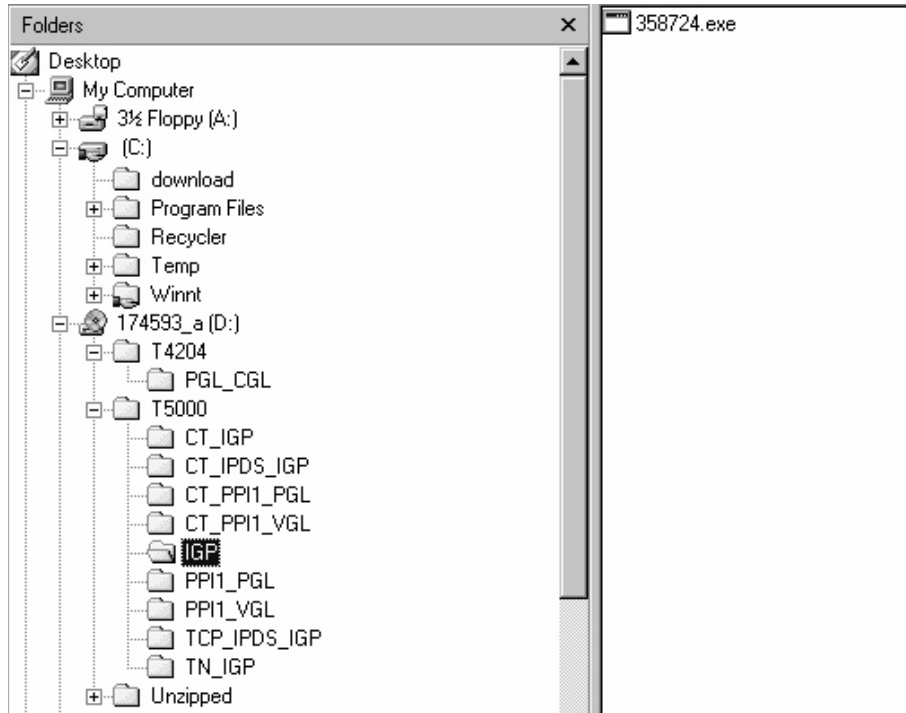7. Insert the printer emulation software CD into your computer.
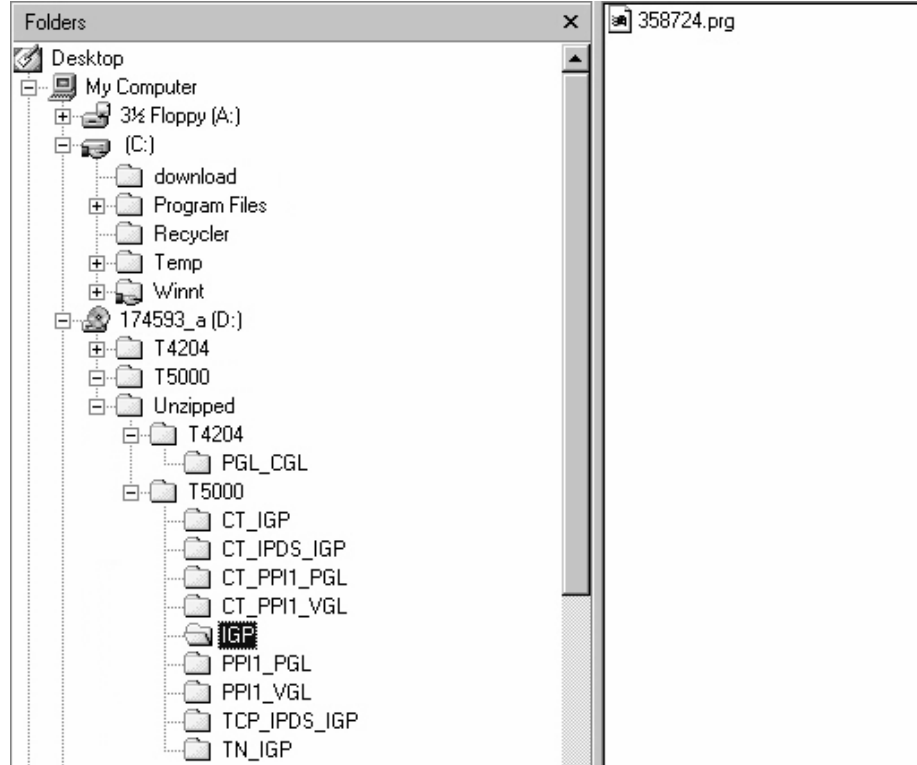
Figure 3. Navigating to the Appropriate Emulation File on the CD

8. Using Windows Explorer, navigate to the appropriate file on the CD (using the Unzipped directory) based on the printer model number and desired emulation, e.g., Unzipped ▶ T5000 ▶ IGP. (See Figure 3.)

IMPORTANT   **You must use the Unzipped directory, since this contains the uncompressed files necessary for NIC download.**

9. Make note of the file name, which is a six digit number plus **.prg** e.g., 123456.prg.
    This is the file you will download into the NIC.

10. Copy the file to the download directory.

11. Start a command prompt session. (The Start Menu icon is usually labeled MS-DOS Prompt or Command Prompt.)

12. At the command prompt type:

    `c:`<Enter>
    `cd \download`<Enter>

13. Start the FTP protocol by typing:

    `ftp xxx.xxx.xxx.xxx`<Enter>
    (where *xxx.xxx.xxx.xxx* represents the IP Address of the printer.)

14. Log in to the printer by typing:

    `root`<Enter>

    You are given a password prompt.

NOTE: The default is no password. If the FTP program requires a password, contact your system administrator.

15. At the password prompt, press <Enter>.

16. Once logged in, type the following sequence at the command prompt to download the *filename*.prg file to the printer:

    ```
    cd dest<Enter>
    cd d1prn<Enter>
    bin<Enter>
    put filename.prg<Enter>
    ```
    (where *filename*.prg is the file name you noted in step 9.)

CAUTION   **Do not interrupt the downloading process once it has started. Interrupting a download will damage the flash memory on the controller board and NIC.**

17. As the file downloads, the FTP program shows the progress as a percentage. Once the download is complete, exit out of the FTP program by typing:

    ```
    quit<Enter>
    ```

18. When the new program has successfully loaded into flash memory and the printer has reset itself, set the printer power switch to O (off).

19. Unplug the AC power cord from the printer.

20. Remove the CD from the host computer and store it with the printer.

21. Using the configuration printout(s), reconfigure the printer and reload any optional font files.

Downloading Optional Font Files to Flash Memory

Optional font files are stored on a 3.5 inch floppy diskette that contains file names comprised of a part number with a **.dwn** extension. You will insert the diskette in your IBM-compatible computer and use either the parallel or serial port to download the desired font file(s) to the printer's flash memory.

1. Set the printer power switch to O (off).

2. Connect a parallel data cable to the LPT1 port or a serial cable to the COM1 port of an IBM-compatible computer running the PC-DOS or MS-DOS operating system.

NOTE: You can connect the cable to the LPT2 port on the computer if the LPT1 port is already in use. The load commands are different if you use this port, as described in the notes after step 16.

3. Verify that the data cable is connected to the appropriate I/O port on the printer and to the host computer.

4. Power on the computer and allow it to boot up.

5. On the printer control panel, press and hold down the **ONLINE** + **PAPER ADVANCE** keys while powering the printer on. Continue holding the keys down.

6. When you see "TESTING HARDWARE PLEASE WAIT" on the LCD, release the keys.

7. Wait until you see "WAITING FOR PROGRAM DOWNLOAD" on the LCD before proceeding. This can take up to 30 seconds to appear, depending on the emulations and interfaces installed in the printer.

NOTE: The printer default port is CENTRONICS; if you want to use this port, continue to step 16.

8. Press the ⇒ (NEXT) key; "SELECT DOWNLOAD PORT = CENTRONICS" appears on the LCD.

9. Press the ⇒ (NEXT) key again to cycle through the download ports available in the printer:

RS232-9600 (RS-232 serial, 9600 baud)
RS232-9600 (RS-232 serial, 19200 baud)
RS232-9600 (RS-232 serial, 38400 baud)
RS232-9600 (RS-232 serial, 115000 baud)
RS422-9600 (RS422 serial, 9600 baud)
RS422-9600 (RS422 serial, 19200 baud)
RS422-9600 (RS422 serial, 38400 baud)
RS422-9600 (RS422 serial, 115000 baud)
DEBUG

10. When the printer download port you want to use displays on the LCD, press the **ENTER** key. "WAITING DOWNLOAD / PORT" = *<your selection>* appears on the display.

11. Insert the optional font diskette into diskette drive A (or B) of the computer.

12. Start a command prompt session. (The Start Menu icon is usually labeled MS-DOS Prompt or Command Prompt.)

13. Make the diskette drive the active drive by typing:

   `A:`<Enter> (if the diskette is in drive B, type `B:`<Enter>)

14. List the contents of the diskette at the command prompt by typing the following:

   `dir`<Enter>

   You will see a directory listing containing files with a **.dwn** extension, e.g., 94021.dwn, 94022.dwn, 94023.dwn.

15. Make note of the file name with the **.dwn** extension of each file you want to download to the printer.

NOTE: The numeric portion of the file name will match the numbers of the font typefaces listed in the PGL and VGL Programmer's Reference Manuals and provide you with a description and print sample of the typeface.

16. At the command prompt type:

   `copy /b `*`filename.dwn`*` LPT1`<Enter>
   (where *filename*.dwn is file name you noted in step 15.)

NOTE: If you are loading the file using the LPT2 port on the computer, type the following command:

   `copy /b `*`filename.dwn`*` LPT2`<Enter>
   (where *filename*.dwn is a file you noted in step 15.)

If you are loading the file using the serial port on the computer, type the following commands:

```
mode COM1:9600,N,8,1,P<Enter>
copy /b filename.dwn COM1<Enter>
```
(where *filename*.dwn is a file you noted in step 15.)

The 9600 baud rate is the only selection older versions of MS-DOS can use. The baud rate information entered in the above commands must match the selection you made in step 9.

You can download the optional font files one at a time by entering one file name per the **copy** command or you can copy multiple files in one **copy** command.

To download one file at a time, enter the following at the command prompt:

```
copy /b filename.dwn LPT1<Enter>
```

To download multiple files, enter the following at the command prompt, for example:

```
copy /b filename1.dwn+filename2.dwn+...LPT1<Enter>
```

17. While the font file is copied into flash memory, the printer LCD informs you of the load process and status. When the new file is successfully loaded into memory, the printer will reset itself and go online.

18. To verify that the optional fonts have been downloaded:

    a. Perform a configuration printout.

    — OR —

    b. Select **MAINT/MISC ▶ File Systems ▶ View Files List**. The new file names will appear with the same part number file name you downloaded, but with an **.sf** extension.

NOTE: The optional font typefaces cannot be selected via the printer control panel. They can only be selected via a software command from the host.

NOTE: Press the **ONLINE** key to place the printer online and return the printer to normal operation.

Flash Memory Message Guide

Message	Explanation	Required Action
CLEARING PROGRAM FROM FLASH	The program successfully loaded into printer RAM and the checksum matched. The old program is now being deleted from flash memory.	None
DIAGNOSTIC PASSED	The printer passed its memory and hardware initialization tests.	None
ERROR: DC PROGRAM NOT VALID	Printer cannot find the data controller program or the validation checksum is corrupt.	1. Download the program again. 2. If the message occurs again, replace the flash memory.
ERROR: DRAM AT ADDRESS *XXXXXXXX*	The printer found a defective memory location.	Replace the DRAM.
ERROR: EC PROGRAM NOT VALID	Printer cannot find the engine controller program or the validation checksum is corrupt.	1. Download the program again. 2. If the message occurs again, replace the flash memory.
ERROR: EC STOPPED AT STATE *XXXX*	Hardware fault in the engine controller.	Replace the CMX controller board.
ERROR: FLASH DID NOT PROGRAM	The printer could not find any flash memory.	1. Download the program again. 2. If the message occurs again, replace the flash memory.
ERROR: FLASH NOT DETECTED	The printer could not find any flash memory.	Install flash memory before attempting to download this program.
ERROR: NO DRAM DETECTED	The printer could not find any DRAM.	Check DRAM on CMX. If present, reseat DRAM. If missing, install DRAM.
ERROR: NVRAM FAILURE	The non-volatile memory has failed.	Replace the CMX controller board. (Do NOT attempt to replace NVRAM.)
ERROR: PROGRAM NEEDS MORE DRAM	The printer requires more DRAM memory in order to run the downloaded program.	Add DRAM or use a smaller emulation program.

Message	Explanation	Required Action
ERROR: PROGRAM NEEDS MORE FLASH	The printer requires more flash memory in order to run the downloaded program.	Add flash memory or use a smaller emulation program.
ERROR: PROGRAM NOT COMPATIBLE	The printer is not compatible with the downloaded program.	Use the correct emulation software option(s) for this model.
ERROR: PROGRAM NOT VALID	The printer does not see a program in flash memory.	There is no program in printer memory. Download the program again.
ERROR: SECURITY PAL NOT DETECTED	The security PAL is not present or has failed.	Check the security PAL at location U54 on the CMX controller. If the PAL is absent, install correct PAL. If security PAL is present, replace the CMX controller board.
ERROR: SHORT AT ADDRESS *XXXX*	Hardware failure in DRAM or CMX controller circuitry.	Replace DRAM. If message occurs with new DRAM, replace CMX controller board.
ERROR: WRITING TO FLASH	Hardware or software fault in flash memory.	1. Download the program again. 2. If the message occurs again, replace the flash memory.
ERROR: WRONG CHECKSUM	The printer received the complete program but the checksum did not match. The data were corrupted during download.	Download the program again.
ERROR OCCURRED FLUSHING QUEUES *	This is an interim message that displays while the printer discards host data it cannot use because a fault condition exists. While this message displays, the asterisk (*) rotates.	Wait. When the asterisk (*) stops rotating, a different fault message will appear: troubleshoot the final message.
LOADING PROGRAM FROM PORT *XX*%	The new program is loading into printer RAM. *XX* indicates how much of the program has loaded.	None

Message	Explanation	Required Action
LOADING PROGRAM INTO FLASH	The printer has deleted the previous program from flash memory and is loading the new program into flash memory.	None
PLEASE WAIT...RESET IN PROGRESS	The printer finished loading the program into flash memory and is automatically resetting itself.	None
RESTORING BOOT CODE	Normal download initialization message.	None
SECURITY CODE VIOLATION	The software running or being downloaded does not match the security PAL code.	Install the correct PAL or program. (PAL and program must match.)
SENDING PROGRAM TO EC PROCESSOR	The printer is loading the engine controller program into the engine controller.	None
TABLE MISMATCH DOWNLOAD AGAIN	EC software update in process.	Download the program again.

2 *ANSI Emulation*

Overview

This chapter describes the American National Standards Institute (ANSI) host control codes that are supported on your printer. "Emulation" refers to the ability of a printer to execute the commands of a particular printer control language. A printer control language is the coding system used to convey, manipulate, and print data. In this manual, the terms "emulation", "printer protocol", and "printer control language" are synonymous.

In the ANSI emulation mode, the printer can print files coded for the ANSI printer control language. To select the ANSI emulation as the active printer emulation, refer to your *User's Manual.*

The ANSI emulation provides many adjustable parameters. The default parameter values for this emulation are shown in Table 1. You can modify these parameter values in two ways:

- **The ANSI host control codes.** A set of ANSI control code commands can be sent to the printer from an attached host computer via the printer I/O port. This chapter describes these ANSI control code commands.

- **The printer configuration menus.** You can modify a subset of the ANSI emulation parameters using the configuration menus and the control panel keys, as described in your *User's Manual.*

NOTE: A parameter value set by a host control code overrides a value set from the printer control panel.

Configuration values selected from the menus or via host control codes can be saved to memory so that they will not be lost when you power off the printer. The menu selection for saving a configuration to memory is described in your *User's Manual.*

ANSI Emulation Default Settings

The ANSI factory settings are shown in Table 1 on page 24. Table 2 on page 25 lists additional factory settings for parameters provided by the LinePrinter Plus® formatting menus. (The EMULATION menu options are described in the *User's Manual*). Host control codes can override many of the settings for these menu options.

Table 1. ANSI Menu Option Factory Settings

Characteristic	Default Setting
CPI	10.0
LPI	6.0
Typeface	Data Processing
Proportional Spacing	Disable
Bold Print	Disable
Slash Zero	Disable
Left Margin	0 columns
Right Margin	0 columns
Top Margin	0 lines
Bottom Margin	0 lines
Form Length	66 lines
Form Width	136 characters
Define CR Code	CR = CR
Auto LF	Disable
Define LF Code	LF = CR + LF
Character Set	Latin 1 8859-1
Printer Select	ON = DC1/OFF = DC3
ESC c sequence	Enable
Reset Cmd CFG Ld	Disable
Received CR	Observe
Received Del	Observe
Private Mode	Set 2
Pos. on BC/OvrSz	Set to top
BC check digit	By host
Barcode Darkmode	Enable
PUM Default	Decipoints
Truncate PI Slew	Truncate at TOF

Table 2. LinePrinter+ Menu Option Factory Settings

Characteristic	Default Setting
CPI	10.0
LPI	6.0
Host Command	Enable
Typeface	Data Processing
Proportional Spacing	Disable
Bold Print	Disable
Italic Print	Disable
Slashed Zero	Disable
Text Position	Top of Line
Left Margin	0 columns
Right Margin	0 columns
Bottom Margin	0 lines
Perforation Skip	Disable
Form Length	11.0 inches 279.4 millimeters 66 lines
Form Width	13.6 inches 345.4 millimeters 136 characters
Reset Cmd CFG Ld	Disable

Configuring The ANSI Emulation

Control codes transmit information other than printable characters to the printer. They occupy the first 32 locations on the ASCII code chart (shown in Appendix A) and are represented by two- or three-letter abbreviations. The control code LF (decimal 10, hex 0A), for example, is usually interpreted as a line feed. The response of the printer to other control codes will depend on the emulation.

NOTE: Commands and control codes sent from a host system generally override previous settings that result from the configuration menus. However, any configuration settings from host control codes will be gone once the printer is powered off (or reset to the default values), unless you have saved them to memory using the configuration menus. The *User's Manual* describes the configuration menu option for saving changes.

Control Codes

ACK (Acknowledge 06H)

A received ACK is ignored. A transmitted ACK is used as part of the serial interface ETX/ACK protocol. Upon the end of transmission of a block of data terminated with an ETX, the host stops sending data until the printer interface sends an ACK back to the host.

BEL (Bell 07H)

Receipt of a BEL code causes the beeper to sound for approximately 1 second.

BS (Backspace 08H)

A BS permits overprinting of characters. This command moves the character position one character width to the left. If the current print position is at column one, this command is ignored.

CR (Carriage Return 0DH)

If configured CR=CR+LF, the line will print, the paper will advance to the next line, and the print position will move to column one.

If configured CR=CR, the print position is set at column one of the current line. Any subsequent printable data preceding a paper motion command will overstrike previously printed data. If it is set to ignore by the panel, then the CR will be ignored.

DC1 (Device Control-1 11H)

Switches the printer from local to on-line mode and enables the printer to receive data. If the serial interface is selected, DC1 acts as a data stream control code. When the buffer is empty, the printer will send a DC1 (XON) to the host computer, which will send data to the printer until the printer sends a DC3 (XOFF) to the host computer.

DC3 (Device Control-3 13H)

Switches the printer from on-line to local mode. Causes the printer to ignore all data except a DC1. If the serial interface is selected, DC3 acts as a data stream control code. When the buffer is full, the printer will send a DC3 (XOFF) to the host computer, which will stop sending any data to the printer until the printer sends a DC1 (XON) to the host computer.

DEL (Delete 7FH)

The delete character causes the character at this location in the current character set to print. In graphics mode, the delete character is treated as data. If it is set to ignore by the panel, then the DEL will be ignored.

ESC (Escape 1BH)

Escape signals the beginning of a special sequence. Characters in a valid escape sequence are not printed.

FF (Form Feed 0CH)

Form Feed is a line terminator. All data received since the last line terminator are printed and the paper is advanced to the next top-of-form.

HT (Horizontal Tab 09H)

An HT causes one of two actions. If a horizontal tab table is present, each HT received is replaced by the number of space characters required to move the current print position to the next tab location. If a horizontal tab table is not present, a space is substituted for the HT character.

LF (Line Feed 0AH)

An LF code causes the line to be printed and the paper is advanced to the next line, and the print position will remain at the same character column.

If the LF code is received in the horizontal graphics mode, paper is advanced one or two dot rows depending on the vertical dot density.

If the LF is received in the vertical graphics format, paper is advanced after the six dot rows are printed.

Vertical graphics spacing is 12 LPI for low vertical density and 24 LPI for high vertical density.

VT (Vertical Tab 0BH)

A VT code causes the line to print and the paper to advance to the next tab stop if a vertical tab is set.

If a tab position is at the current line, the paper advances to the next tab position.

If there are no tab positions between the current line and the end of the form, the paper advances to the next line at the current line spacing.

If the current position is at the bottom margin and a VT is sent, the paper will advance to the next top-of-form.

NOTE: Channel 12 is always used with the VT character. See Chapter 3, "Vertical Page Formatting," for more details.

Format For Control Code Descriptions

The following information is listed for each control code (where applicable):

Name   The title or function of the command.

ASCII Code The ASCII mnemonic for the command is shown for the printer and the ANSI protocol. Command sequences are in 7-bit (ASCII) form.

Hex Code   The code or command sequence in hexadecimal numbers.

Dec Code   The code or command sequence in decimal numbers.

Expression The control codes used in the BASIC programming language.

Purpose   The function(s) of the control code.

Discussion A discussion of the uses of the code or command sequence, including exceptions or limitations to its use.

Example   A sample program written in BASIC programming language is provided when it is possible to illustrate the effect of a control code or if a specific syntax is required.

Examples are shown below of escape sequences as written in the text, shown with parameters filled in, and written in the BASIC program language.

Tab Clear	ESC [*p1* g ESC[3g LPRINT CHR$(27);"[3g"
Horizontal Tabs Set	ESC [*p1*;*p2...pn* u ESC[648;1386;2808u LPRINT CHR$(27);"[648;1386;2808u"
Expand Characters	ESC [*p1*;*p2* SP B ESC[200;200 B LPRINT CHR$(27);"[200;200 B"

NOTE: If you specify parameters for a control code other than the ones defined in the control code description, unpredictable results may occur.

NOTE: Throughout this chapter the term "decipoints" is used. A decipoint equals 1/720 inch and is used as a standard of measurement for parameters associated with distances.

Escape Control Codes Overview

Printer capability is greatly increased by the use of escape control code sequences. Escape sequences always begin with the ASCII escape sequence introducer, ESC (hex 1B). Many of the ASCII control codes described in this chapter are escape sequences.

IMPORTANT **An Escape code can occur anywhere in the data stream and is acted upon immediately if it precedes a valid command.**

An ESC sequence introducer in the data stream signals the printer to wait for special instructions, even if it is ready and printing. The character codes following the ESC character tell the printer what to do.

NOTE: For readability, code sequences appear in this manual with spaces inserted between command elements. Do not insert spaces between code characters when you are programming unless the ASCII space character (SP) is part of a code sequence. For example, a code sequence printed in this manual as ESC [1 is programmed as ESC[1.

An escape sequence uses two or more bytes to define a specific printer control function. The format for an escape sequence is

ASCII	**ESC**	**X**	*p*
Hex	1B	00 - 5F	0 - FF
	Escape Sequence Introducer	Character(s)	Numerical parameter(s)

After the ESC character are one or more characters which indicate the action of the control code. One or more numerical parameters may in turn follow these characters. For example, the sequence ESC [*p* g tells the printer to clear all horizontal tabs if *p* is a 3, or to clear all vertical tabs if *p* is a 4.

If the characters following the ESC code are not within the defined ranges, or if they are within the defined ranges but are not recognized as a function of this printer, the entire sequence is ignored.

Control Codes Index

The following index lists the control codes by ASCII sequence, function and page number. Some control code functions can also be selected at the control panel.

Character Sets, International

ASCII Code ESC [*p1* x

Hex Code 1B 5B *p1* 78

Dec Code 27 91 *p1* 120

Expression CHR$(27);"[*p1x*";

Purpose Selects the international character set specified by *p1*, which is shown in Table 3. When an international character set is selected, it is printed in whatever font style and enhancement mode may be in effect. The default set is Latin 1 8859-1.

Table 3. ANSI International Character Sets

p1	Country
0	USA (ISO standard)
1	German
2	French A
3	French B
4	French Canadian
5	Dutch (Netherlands)
6	Italian
7	United Kingdom
8	Spanish
9	Danish/Norwegian A
10	Danish/Norwegian B
11	Danish/Norwegian C
12	Danish/Norwegian D
13	Swedish/Finnish A
14	Swedish/Finnish B
15	Swedish/Finnish C
16	Swedish/Finnish D
17	Swiss
18	USA (ISO standard)
19	Yugoslavian
20	UK A (United Kingdom A)
21	Turkish
22	Greek

Table 3. ANSI International Character Sets (continued)

p1	Country
23	ISO Italian
24	ISO Spanish
8573	IBM PC set 2, Greek
8574	DEC Multinational
8575	Roman 8
8576	Polish Mazurka
8577	IBM PC-set 2 Turkish
8591	ISO 8895-1 Latin Alphabet #1
8592	ISO 8895-2 Latin Alphabet #2
8593	ISO 8895-3 Latin Alphabet #3
8594	ISO 8895-4 Latin Alphabet #4
8595	ISO 8895-5 Latin/Cyrillic
8596	ISO 8895-6 Latin Arabic
8597	ISO 8895-7 Latin Greek
8598	ISO 8895-8 Latin Hebrew
8599	ISO 8895-9 Latin South Europe II
437	IBM PC Set 2
850	IBM PC Multilingual SET 2
851	Microsoft Code Page 851 Greece
852	Microsoft Code Page 852 Slavic
853	Microsoft Code Page 853 Turkey 1
855	Microsoft Code Page 855 Cyrillic
860	Microsoft Code Page 860 Portugal
863	Microsoft Code Page 863 French Canadian
864	Microsoft Code Page 864 Arabic
865	Microsoft Code Page 865 Nordic
866	Microsoft Code Page 866 Russian
867	Microsoft Code Page 867 Turkey 2
5915	ISO 8859-15 Latin 0

Expanded Mode

ASCII Code ESC [*p1*;*p2* SP B

Hex Code 1B 5B *p1* 3B *p2* 20 42

Dec Code 27 91 *p1* 59 *p2* 32 66

Expression CHR$(27);"[*p1*;*p2* B";

Purpose Modifies the vertical (*p1*) and horizontal (*p2*) character size of all characters following the sequence and stays in effect until changed or canceled. Expansions of X3, X5, X6, and X7 are invalid for *p2.*

Discussion An invalid or zero parameter selects the normal (X1) expansion. If a parameter is missing, the former value is used. Valid *p1* and *p2* values are the following:

X1 0-199 (default)	X5 500-599*
X2 200-299	X6 600-699*
X3 300-399*	X7 700-799*
X4 400-499	X8 800-up

* Not valid for horizontal expansion

Horizontal and vertical expansion are independent, and different values can be mixed in a line. Mixed sizes within a line are top-justified. Since the line feed is based on the size of the characters in the final pass, the largest sized characters on a line should be printed last to avoid printing over other characters.

Examples:

ESC [;200 B	X1 Vert. expansion, X2 Horiz. expansion
ESC [200;200 B	X2 Vert. expansion, X2 Horiz. expansion
ESC [800;400 B	X8 Vert. expansion, X4 Horiz. expansion

When the printer is printing vertically expanded characters, blank lines (lines with non printed characters) are not expanded from the current LPI setting.

Forms Length, Top Margin, Bottom Margin

ASCII Code ESC [*p1*;*p2*;*p3* r

Hex Code 1B 5B *p1* 3B *p2* 3B *p3* 72

Dec Code 27 91 *p1* 59 *p2* 59 *p3* 114

Expression CHR$(27); "[*p1*;*p2*;*p3*r";

Purpose Defines the form.

p1 = Form length (in decipoints). Maximum allowable length is 22 inches (15,840 decipoints)

p2 = Top margin from top of page. Top of page to first print line.

p3 = Bottom margin from end of page. The last print line to bottom of page.

The default parameters are for a 12 inch long form with a top margin of zero and a bottom margin of zero.

Discussion The printer keeps track of these vertical positions to the nearest half point (5 decipoints).

1 decipoint = 1/720 inch

1 point = 10 decipoints (10/720 inch)

1/2 point = 5 decipoints (5/720 inch)

Examples

ESC [r default values of 12 inch form length, zero top and bottom margins

ESC [8280r 11.5 inch form length, default top and bottom margins of zero

ESC [;720r default length of 12 inches, top margin of one inch, default bottom margin of zero

ESC [;;720r default length of 12 inches, default top margin of zero and a one-inch bottom margin

ESC [7920;360;360r
11 inch form length, 1/2 inch top and bottom margins

Graphic Rendition

ASCII Code ESC [*p1*;*p2...*;*pn* m

Hex Code 1B 5B *p1* 3B *p2* ... 3B *pn* 6D

Dec Code 27 91 *p1* 59 *p2* ... 59 *pn* 109

Expression CHR$(27);"[*p1*;*p2...*;*pn* m";

Purpose Sets the character type and enhancements, such as boldface, underscore, expanded, or proportional. One font designator plus any number of enhancements can be entered in the escape sequence using the parameter values in Table 4.

Discussion If the requested font is not installed, the Data Processing font will be activated. When a new font is selected, the horizontal spacing is initially set to the default spacing (10 cpi).

This sequence is also valid in graphics.

Table 4. Character Types and Enhancements

Parameter	Enhancement
0	Normal Mode
1	Bold/shadow
4	Underline
5	2X horizontal expansion (**Note:** This mode cancels any horizontal or vertical expansion previously set. Can be cleared by either a parameter value of 0 in this sequence or by ESC[*p1*;*p2* SP B.)
6	Proportional printing (**Note:** This mode is valid for all cpi values, expansion values, print modes, and fonts except high speed draft and character graphics.)
10	Default font (Data Processing)
11	Gothic draft font
12	Character graphics/mathematical symbol font
13	Gothic NLQ font
14	Courier NLQ font
15	High speed draft font
16	OCR-A
17	OCR-B
18	Italic NLQ font
19	Correspondence

For Gothic NLQ font underlined:
ESC [4;13m

To cancel underlining and retain Gothic NLQ
send one of the following:
ESC [;13m
ESC [0m
ESC [0;13m
ESC [;m

Horizontal Position Absolute

ASCII Code ESC [*p1* '

Hex Code   1B 5B *p1* 60

Dec Code   27 91 *p1* 96

Purpose   Line terminator. Sets horizontal position to value specified by p1 in decipoints. If the parameter value is omitted or greater than 9504 decipoints, the command is ignored.

Horizontal Position Backward

ASCII Code ESC [*p1* j

Hex Code   1B 5B *p1* 6A

Dec Code   27 91 *p1* 106

Purpose   Line terminator. Moves the print position to the left of the current position by the number of decipoints specified in p1. If the parameter value is omitted, the command is ignored. If the parameter value exceeds the distance to the left margin, the new position will be the left margin.

Horizontal Positive Relative

ASCII Code ESC [*p1* a

Hex Code   B 5B *p1* 61

Dec Code   27 91 *p1* 97

Purpose   Line terminator. Moves the print position to the right of the current position by the number of decipoints specified in p1. If the parameter value is omitted, the command is ignored. If the parameter value exceeds the distance to the right margin, the new position will be the right margin.

Horizontal/Vertical Position Absolute

ASCII Code ESC [*p1*; *p2* f

Hex Code   1B 5B *p1* 3B *p2* 66

Dec Code   27 91 *p1* 59 *p2* 102

Purpose   Line terminator. Sets vertical position to value specified by p1, and the horizontal position to the value specified by p2 (both values are specified in decipoints. This command can also be used to set the print position inside margins. The vertical position cannot exceed the form length, and the horizontal position cannot exceed 9504 decipoints.

Line Spacing

ASCII Code ESC [*p1*;*p2* SP G

Hex Code   1B 5B *p1* 3B *p2* 20 47

Dec Code   27 91 *p1* 59 *p2* 32 71

Expression CHR$(27);"[*p1*;*p2* G";

Purpose   Sets line spacing (*p1*) and character spacing or pitch (*p2*) in decipoints.

Discussion Horizontal spacing (*p2*) is dependent on the font selected. Values outside the range of a particular font will be ignored. Commonly used line spacings are listed in Table 5 and Table 6.

Table 5. Common *p1* Values

LPI	*p1* (decipoints)
3	240
4	180
6	120
8	90

Table 6. Common *p2* Values

CPI	*p2* (decipoints)
10	72
12	60
13.3	54
15	48
16.7	43

Margins, Left and Right

ASCII Code ESC [*p1*;*p2* s

Hex Code 1B 5B *p1* 3B *p2* 73

Dec Code 27 91 *p1* 59 *p2* 115

Expression CHR$(27);"[*p1*;*p2*s";

Purpose The *p* parameters are distances from the left edge of the printable area of the paper in decipoints. They are internally converted to column positions based on the current CPI setting. The first print area will be one column to the right of the left margin.

NOTE: The margins set with this sequence begin at the first physical print position, not at the edge of the paper.

Discussion When operating at 10 CPI, the escape sequence ESC [720;8784s will produce a one-inch (10 column) left margin with column 11 as the first printable position. The print line length is 8784 decipoints minus 720, or 8064 decipoints (11.2 inches, 112 columns). If the normal print area of 13.2 inches is available, the right margin is one inch. The last column represented by *p2* is the last print position and the right margin begins in the next column.

Left and right margin default values are column zero and the highest column number in use depending on the CPI setting, shown below. This escape sequence is valid in graphics but does not apply to bar codes. Default margins may be set by using ESC [s.

Left Margin = column 0 minus Right Margin
10 CPI = column 136
12 CPI = column 163
13.3 CPI = column 181
15 CPI = column 204
16.7 CPI = column 226

When printing in proportional mode or line mixing, the margins are converted to absolute positions for that line. If the printer receives this command anywhere in a printable line, the command will affect that line and subsequent printable lines.

Private Mode, Disable

ASCII Code ESC [>5l   (lowercase "L")

Hex Code   1B 5B 3E 35 6C

Dec Code   27 91 62 53 108

Expression CHR$(27); "[>5l";

Purpose   Disables private mode.

Discussion Selects character set 1 of the selected 8 bit international character set. With non-ISO character sets, hex codes 20-7F and A0-FF are printable. Hex codes 80-9F are duplicates of 00-1F. For ISO character sets hex codes 80-9F are treated as Nulls.

Private Mode, Enable

ASCII Code ESC [>5h

Hex Code   1B 5B 3E 35 68

Dec Code   27 91 62 53 104

Expression CHR$(27): "[>5h";

Purpose   Enables private mode.

Discussion Selects character set 2 of the selected 8 bit international character set. Allows printing of hex codes 15, 20-7E and 80-FF.

Proportional Print Mode

ASCII Code ESC [6 m

Hex Code   1B 5B 36 6D

Dec Code   27 91 54 109

Expression CHR$(27);"[6m";

Purpose   Sets proportional printing where each character has its own width.

Discussion All fonts and modes allow proportional printing. The proportionalized character graphics font, however, is the same as the normal character graphics font.

Resetting

ASCII Code ESC c

Hex Code 1B 63

Dec Code 27 99

Expression CHR$(27);"c";

Purpose Resets the printer's configuration parameters. Depending on which option was selected in the "Reset Cmd CFG Ld" menu, the parameters are set to the factory default configuration, power-up configuration, or the current configuration. If "Reset Cmd CFG Ld" is disabled in the menu, the hardcoded parameters shown in Table 7 are set.

Discussion The following attributes, which are not part of the configuration, are also reset:

Character rotation is reset to no rotation.

Character expansions are set to 1x1.

Subscript and superscript are turned off.

Underscoring is turned off.

Plot mode is terminated.

The horizontal and vertical tabulation tables are cleared.

The default EVFU table is loaded.

Bar code parameters are set to default values.

Graphic line density is set to 60 horizontal DPI x 72 vertical DPI.

The current line is set as the top-of-form (TOF) position.

Table 7. Hardcoded Reset Values

Parameter	Setting
Font style	Data processing
Character size	1 x vertical; 1 x horizontal
Character pitch	10 CPI
Country selection	Latin 1 8859-1
Line spacing	6 LPI
Partial Line up	Reset
Partial Line down	Reset
Bold print	Disabled
Underline mode	Disabled
Expanded mode	Disabled
Proportional mode	Reset
Horizontal tab table	Empty
Left margin	None - column 0
Right margin	None - Maximum
Page size	7920 decipoints/ 66 lines/ 11 inches
Top margin	None
Bottom margin	None
Forms position	Top-of-form = current position
Vertical tab table	Empty
Vertical format unit	Default
Graphics density	60 Horizontal DPI, 72 Vertical DPI
VFU load in progress	Exit (nothing saved)
Bar code mode	Disabled
Dot graphics	Disabled

Subscript

ASCII Code ESC K

Hex Code   1B 4B

Dec Code   27 75

Expression CHR$(27);"K";

Purpose   Moves the print line down 3/72 inch for subscript printing. Also used to return to original print line if the Superscript printing command was sent.

Superscript

ASCII Code ESC L

Hex Code   1B 4C

Dec Code   72 76

Expression CHR$(27);"L";

Purpose   Moves the print line up 3/72 inch for superscript printing. Also used to return to original print line if the Subscript printing command was sent.

Discussion Both Superscript and Subscript can be printed on the same line. They cannot be used in succession to advance or reverse the paper to another line. They can be used in pairs to change from Superscript to Subscript or Subscript to Superscript.

NOTE: If you do not send a command to return the print position to the original baseline, subsequent lines will be misaligned.

The ESC K and L commands are ignored in graphics.

Tab, Clear

ASCII Code ESC [*p1* g

Hex Code   1B 5B *p1* 67

Dec Code   27 91 *p1* 103

Expression CHR$(27);"[*p1*g";

Purpose   Clears horizontal or vertical tab stops based on the *p1* value:
p1 = 3 Clear all horizontal tabs
p1 = 4 Clear all vertical tabs

This command is valid in graphics.

Tab Set, Multiple Horizontal

ASCII Code ESC [*p1*;*p2...*;*pn* u

Hex Code 1B 5B *p1* 3B *p2* ... 3B *pn* 75

Dec Code 27 91 *p1* 59 *p2* ... 59 *pn* 117

Expression CHR$(27);"[*p1*;*p2...*;*pn* u"

Purpose Sets up to 22 horizontal tabs. The *p* parameters are set in decipoints and are normally converted internally to the nearest equivalent column position based on the current CPI setting. The absolute decipoint value is used when the printer is printing proportional characters.

Table 8. Decipoints per Column

CPI	Spacing in Decipoints
10	72
12	60
13.3	54
15	48
16.7	43

Discussion Example: Placing tabs at columns 10, 20, and 40 at 10 CPI.

ESC [648;1386;2808u
p in decipoints = (column number minus 1) times (decipoints per column)
(10 - 1)(72) = 648 First printed character is in column 10
(20 - 1)(72) = 1368 First printed character is in column 20
(40 - 1)(72) = 2808 First printed character is in column 40

Appendix B contains a conversion table for decipoint calculations.

If more than 22 tabs are set, the highest numbered tabs (farthest right) will be pushed out of the table. Tabs set beyond the right margin are not usable. Moving the right margin beyond these settings will make them active.

Control code HT (09H) moves the print position to the next preset location. If no tabs are set, a space is substituted. If there are tabs set but none between the current position and the right margin, the current position will become the right margin.

Terminate Loading of Data

ASCII Code ESC \

Hex Code   1B 5C

Dec Code   27 92

Expression CHR$(27);"\";

Purpose   Terminates the loading of EVFU tables (described in Chapter 3) and the downloading of dot graphics strings.

Vertical Position Absolute

ASCII Code ESC [*p1* d

Hex Code   1B 5B *p1* 64

Dec Code   27 91 *p1* 100

Expression CHR$(27);"[*p1*d";

Purpose   Line terminator. Sets vertical position to specified *p1* value in decipoints, moving paper forward or backward to the new position. Can be used to print inside top and bottom margins.

The specified position must be set within the current page; otherwise, the command will be ignored. If the parameter value is omitted, is less than five decipoints, or is greater than 15,840 decipoints, the vertical position will move to the top-of-form position.

Vertical Position Backward

ASCII Code ESC [*p1* k

Hex Code   1B 5B *p1* 6B

Dec Code   27 91 *p1* 107

Purpose   Line terminator. Moves the paper in reverse by the distance in decipoints specified in p1. The paper position is set to the top margin if the p1 value would exceed the margin. A value of 5 or less decipoints for p1 is ignored.

Vertical Position Relative

ASCII Code ESC [*p1* e

Hex Code   1B 5B *p1* 65

Dec Code   27 91 *p1* 101

Expression CHR$(27);"[*p1*e";

Purpose   Line terminator. Moves the current vertical position by the
specified *p1* number of decipoints as shown in Table 9.

Table 9. Vertical Position

Decipoint Value	Movement in Inches
missing or 0-4	no movement
5-9	1/144 inch
10-14	2/144 inch
15-19	3/144 inch
... 15, 840 or greater	... 22 inches

Vertical Tab Set

ASCII Code ESC [*p1*;*p....*; v

Hex Code   1B 5B *p1* 3B p... 3B 76

Dec Code   27 91 *p1* 59 p... 59118

Purpose   Set up to 12 vertical tabs. The tabs values are in decipoints. If
more than 12 tabs are set, the 12 tabs nearest to the top of form
will be retained. If a tab is set in the top margin, it will be stored,
but not active until the margin is moved. If a tab is set beyond
the bottom margin, an attempt to move to that tab will move the
paper to the next top of form.

Graphics

The ANSI emulation graphics mode provides both horizontal and vertical dot placement plotting methods. These methods enable the printing of ASCII characters in their binary code form. Since each character has a unique pattern of 1's and 0's (dots and voids) that make up its binary code, the correct placement of these binary forms enables you to form larger images.

For clarity in the text, a binary 1 (a printed dot) will be shown as an X and a binary 0 (empty dot position) will be shown as a 0.

In the graphics mode, only the low order six bits of a seven-bit character are used (bits 1-6). Looking at an ASCII code chart, the question mark character (?) is represented by the binary number 0111111 (bit 7 - bit 1). Since only the first 6 bits are used, a "?" would print six dots on the paper. A lowercase "j" is represented by 101010 which would print the following:

> Horizontal Graphics / Vertical Graphics
>
> 0X0X0X0 LSB
> LSB MSBX
> 0
> X
> 0
> X MSB

NOTE: When plotting data, the Least Significant Bit (LSB), Bit 1, is printed first (left or top bit position) and the Most Significant Bit (MSB), Bit 6, is printed last (right or bottom bit position).

Notice that in the horizontal graphics mode, the characters are printed on a single horizontal dot row. In vertical graphics mode, the characters are printed six dots high, a character per dot column.

Using a series of question mark (that prints all dots) characters in a horizontal graphic produces a one dot high solid line across the paper. The same character in vertical graphics mode products a six dot high band across the paper.

Graphs, charts, and pictures can be produced by repeating, omitting, and mixing characters across a page.

Dot Patterns And Densities

Table 10 lists the dot patterns for each of the ASCII characters. Each ASCII character represents six dot positions (or dots) and their spacing is dependent on the density selected. With a density of 60 and 70 DPI, the dots are spaced 1/60 and 1/70 inch apart respectively. At 120 and 140 CPI, each character represents six dots spaced 1/120 and 1/140 inch apart. At 180 and 210 DPI densities, the dots are spaced 1/180 and 1/210 inch apart.

The ASCII characters needed to cover all dot/void combinations are listed in the chart below. Other valid character combinations (although repeat patterns of the characters in the chart) are hex 09-13 and hex 20-3E.

NOTE: In Table 10, x=dot and o=no dot.

Table 10. ASCII Character Dot Patterns

Char	Hex Value	Dots 654321	Char	Hex Value	Dots 654321
@	40	oooooo	.	60	xooooo
A	41	ooooox	a	61	xoooox
B	42	ooooxo	b	62	xoooxo
C	43	ooooxx	c	63	xoooxx
D	44	oooxoo	d	64	xooxoo
E	45	oooxox	e	65	xooxox
F	46	oooxxo	f	66	xooxxo
G	47	oooxxx	g	67	xooxxx
H	48	ooxooo	h	68	xoxooo
I	49	ooxoox	i	69	xoxoox
J	4A	ooxoxo	j	6A	xoxoxo
K	4B	ooxoxx	k	6B	xoxoxx
L	4C	ooxxoo	l	6C	xoxxoo
M	4D	ooxxox	m	6D	xoxxox
N	4E	ooxxxo	n	6E	xoxxxo
O	4F	ooxxxx	o	6F	xoxxxx
P	50	oxoooo	p	70	xxoooo
Q	51	oxooox	q	71	xxooox
R	52	oxooxo	r	72	xxooxo
S	53	oxooxx	s	73	xxooxx
T	54	oxoxoo	t	74	xxoxoo
U	55	oxoxox	u	75	xxoxox
V	56	oxoxxo	v	76	xxoxxo
W	57	oxoxxx	w	77	xxoxxx
X	58	oxxooo	x	78	xxxooo
Y	59	oxxoox	y	79	xxxoox
Z	5A	oxxoxo	z	7A	xxxoxo
[	5B	oxxoxx	{	7B	xxxoxx
\	5C	oxxxoo			7C	xxxxoo
]	5D	oxxxox	}	7D	xxxxox
^	5E	oxxxxo	~	7E	xxxxxo

Table 10. ASCII Character Dot Patterns (continued)

Char	Hex Value	Dots 654321	Char	Hex Value	Dots 654321
-	5F	oxxxxx	?	3F	xxxxxx

Horizontal Format

Graphics data printed in horizontal format comprise a stream of bytes from left to right across each dot row.

Table 11 shows that byte 1 (or character 1) in row 1 will print its six bits from left to right in a single dot row. The next byte (byte 2) prints its six bits, representing a character, in the same dot row across the page.

Table 11. Horizontal Format

Byte → Row ↓	Byte 1	Byte 2	Byte *n*
1	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6
2	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6
3	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6
.	.	.	.
.	.	.	.
6	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6

Vertical Format

In vertical format, each byte (or character) occupies six dot rows of one column. Each character is one dot wide and six dots high. The next character (byte 2) is printed beside the first moving from left to right across the page.

Table 12. Vertical Format

Byte →	1	2	3	... *n*
Row	bit	bit	bit	... bit
1	1	1	1	... 1
2	2	2	2	... 2
3	3	3	3	... 3
4	4	4	4	... 4
5	5	5	5	... 5
6	6	6	6	... 6

Other Graphics Considerations

- In horizontal format, an LF causes the paper to advance one or two dot rows based on the vertical dot density.

- In vertical format, the paper is advanced as the six dot rows are printed. Spacing is essentially 12 LPI for low density and 24 LPI for high density graphics.

- Escape sequences ending with the following characters are ignored in graphics mode:

  KLPQ q
  t}]!SP B

- Escape sequences ending with the following characters are valid while the printer is in graphics mode:

  Ggubmx
  dr!pes

Dot Graphics

ASCII Code ESC P

Hex Code 1B 50

Dec Code 27 80

Expression CHR$(27);"P";

Purpose   Enters dot graphics mode at the density and format previously selected by the ESC [*p1*;*p2*;*p3* q sequence.

Discussion Following this sequence the printer prints discrete dots and leaves spaces based on the 1's and 0's in the low order six bits of each byte received, forming graphic dot rows from left to right. Exit from dot graphics mode is via ESC \.

Repeat Graphics Character

ASCII Code ESC [*p1* b

Hex Code 1B 5B *p1* 62

Dec Code 27 91 *p1* 98

Expression CHR$(27);"[*p1*b";

Purpose   Repeats the single preceding character *p1* times.

Discussion If *p1* is 0 or unspecified, it is set to 1. The maximum value for *p1* is 32,767. Only valid in the dot graphics mode.

Select Graphics Mode

ASCII Code ESC [*p1*;*p2*;*p3* q

Hex Code   1B 5B *p1* 3B *p2* 3B *p3* 71

Dec Code   27 91 *p1* 59 *p2* 59 *p3* 113

Expression CHR$(27);"[*p1*;*p2*;*p3*q";

Purpose   Selects the graphics mode format and horizontal/vertical density for dot graphics.

               This sequence must be sent before entering the graphics mode with ESC P.

Discussion The first parameter selects the graphics mode (Table 13). The second parameter selects the vertical dot spacing (Table 14) and the third selects the horizontal dot spacing (Table 15).

Table 13. Select Graphics Mode

p1	Selects Graphics Mode
0	Vertical Format @ 70H x 72V DPI*
1	Invalid, default to 70H x 72V DPI
2	Vertical Format @ 140H x 144V DPI
3	Invalid, default to 70H x 72V DPI
4	Horizontal Format (plot mode)
*p2 and *p3* are ignored in this mode.	

Table 14. Select Vertical Dot Spacing

p2	Selects Vertical Density
0 through 6	144 DPI
7+	72 DPI

Table 15. Select Horizontal Dot Spacing

p3	Selects Horizontal Density
0 through 3	240 DPI - 544 characters per line
4	180 DPI - 408 characters per line
5	140 DPI - 317 characters per line
6 through 7	120 DPI - 272 characters per line
8 through 10	70 DPI - 158 characters per line
11+	60 DPI - 136 characters per line

Bar Codes

You can generate 17 different styles of bar codes and do the following:

- all except POSTNET can be rotated 90, 180, or 270 degrees
- print with or without a human readable line (HRL)
- adjust the symbol size
- adjust the density

The following examples show the correct control code syntax and the code written in the BASIC program language.

Entering And Exiting Bar Codes

To print bar codes, you must first activate the bar code mode:

```
ESC[3t
LPRINT CHR$(27);"[3t";
```

All data following this sequence will be interpreted and printed as bar codes. To exit:

```
ESC[0t
LPRINT CHR$(27);"[0t";
```

Setting Bar Code Parameters

You can set the style, height, spacing, orientation, and print density. There are 10 parameters (*p1* - *p10*) to specify. The default values are shown on the second line below and in Table 16.

```
ESC [p1;p2;p3;p4;p5;p6;p7;p8;p9;p10}
LPRINT CHR$(27);"[4;9;1;2;6;2;6;2;0;0}";
```

Table 16. Default Bar Code Parameters

If *pn* = Value	Enables
p1 = 4	Code 3/9
p2 = 9	3/4" high bar code
p3 = 1	Human readable line
p4 = 2	Narrow bar width 2/20"
p5 = 6	Wide bar width 6/120"
p6 = 2	Narrow space width 2/120"
p7 = 6	Wide space width 6/120"
p8 = 2	Intercharacter space width 2/120"
p9 = 0	No rotation. Use current font.
p10 = 0	Horizontal print density 60 dpi

NOTE: If no values are set for parameters *p2-p10*, the default values will be used. If you have sent a value from the host, this value is active until you replace it or the printer is reset.

In this example the following parameters are changed on Line 10:

> *p1* = style (Code 128)
> *p2* = height (3/12 inch)
> *p9* = human readable font (use special font)

The semicolons are "place holders" for the parameters not being changed.

```
10 LPRINT CHR$(27);"[16;3;;;;;;;1;}";
20 LPRINT CHR$(27);"[3t";
30 LPRINT "1234567890";
40 LPRINT CHR$(27);"[0t";
```


1234567890

A list of the 10 parameters and their values follows.

p1

Selects the style.

Table 17. *p1* Values

If *p1* =	Style
0	Interleaved 2/5
1	German PTT Interleaved 2 of 5
2	Matrix 2 of 5
3	IATA 2 of 5
4	Code 3/9
5	EAN-8
6	EAN-13
7	Code 11
8	Reserved
9	Codabar a/t
10	Codabar b/n
11	Codabar c/*
12	Codabar d/e
13	UPC A
14	UPC E

Table 17. *p1* Values *(continued)*

If *p1* =	Style
15	Code 93
16	Code 128
17	Reserved
18	Reserved
50	POSTNET

NOTE: Parameters *p2* through *p10* are invalid for POSTNET. Do not change the default values; otherwise, they will be retained in memory and will affect the other bar code styles.

NOTE: The dimensions that follow apply to bar codes that are printed at 0 and 180 degrees rotation. If you are printing bar codes that are rotated 90 or 270 degrees, the dimensions will be compressed by a 6:5 ratio.

p2

Bar code height in 1/12 inch increments. Does not include the human readable line.

> Min.:1 = 1/12 inch
> Max.:120 = 10 inch
> Default:9 = 9/12 inch (or 3/4 inch)

p3

Printing the human readable line.

> 0 = Do not print the human readable line
> 1 = Default. Print the human readable line

p4

Narrow bar width (number times 1/120").

> Range:2 - 126
> Default:2 (2/120 inch, or approximately .017 inch)

p5

NOTE: *p5, p7,* and *p8* are not programmable in some bar code styles.

Wide bar width (number times 1/120").

> Range:2 - 254
> Default:6 (6/120 inch, or approximately .050 inch)

p6

Narrow space width (number times 1/120 inch).

Range:2 - 126
Default:2 (2/120 inch, or approximately .017 inch)

p7

Wide space width (number times 1/120 inch).

Range:2 - 254
Default:6 (6/120 inch, or approximately .050 inch)

p8

Intercharacter space width (number times 1/120 inch).

Range:2 - 126
Default:2 (2/120 inch, or approximately .017 inch)

p9

Rotation and human readable line font.

Table 18. *p9* Values

If *p9* =	Rotation/Font
0	Default. No rotation. Use the current font, cpi, and lpi.
1	No rotation. Use special font.
2	Rotate 90 degrees. Use special font.
3	Rotate 180 degrees. Use special font.
4	Rotate 270 degrees. Use special font.

p10

Horizontal print density

0 = 60 dpi horizontal by 144 dpi vertical
1 = 120 dpi horizontal by 144 dpi vertical

120 dpi is the default for bar code styles 5, 6, 13, and 14. 60 dpi is the default for the other bar code styles.

Human Readable Line (HRL)

The human readable line, which is .10 inch below the bar code, will print in any of the available fonts as long as the bar code is not rotated. (Rotated bar codes use a special font.)

To enable bold, underlining or expanded print on the human readable line, you must first print the bar code without the line. Exit the bar code mode. Then, print the line in normal text mode with the specified enhancements.

Spacing Between Bar Codes

The space before and after a bar code is referred to as the "quiet zone" and equals .25 inch. If two horizontal bar codes are placed side by side, the designated minimum distance between them is .50 inch.

You can insert commas, spaces, and horizontal tabs as delimiters to separate the bar codes:

* comma - no extra space added
* space - adds .10 inch for a total .60 inch quiet zone
* tab - adds appropriate number of empty spaces to reach next tab

Examples

The comma does not add any space; therefore, only .50 inch separates the bar codes.

```
10 LPRINT CHR$(27);"[7}";
20 LPRINT CHR$(27);"[3t";
30 LPRINT "1234,56,7890";
40 LPRINT CHR$(27);"[0t";
```


A space character adds .1". You can insert multiple space characters.

```
10 LPRINT CHR$(27);"[3t";
20 LPRINT "1234      56 7890";
30 LPRINT CHR$(27);"[0t";
```

To space bar codes across a page, insert horizontal tabs. Line 10 sets horizontal tabs at 1440 and 2880 decipoints (2 and 4 inches). The Horizontal Tab codes in lines 40 and 60 cause a jump to the next tab.

```
10 LPRINT CHR$(27);"[1440;2880;u";
20 LPRINT CHR$(27);"[3t";
30 LPRINT "1234";
40 LPRINT CHR$(9);
50 LPRINT "5678";
60 LPRINT CHR$(9);
70 LPRINT "9012";
80 LPRINT CHR$(27);"[0t";
```

If horizontal tabs have not been set, a Horizontal Tab code is considered a space, adding .1 inch between the bar codes. Total separation is .6 inchwhen the Horizontal Tab is added to the quiet zones.

Line 10 clears all previously set horizontal tabs for this example.

```
10 LPRINT CHR$(27);"[3g";
20 LPRINT CHR$(27);"[3t";
30 LPRINT "1234";
40 LPRINT CHR$(9);
50 LPRINT "5678";
60 LPRINT CHR$(9);
70 LPRINT "9012";
80 LPRINT CHR$(27);"[0t";
```

Bar Code Readers

Use a bar code reader that can read medium or low density bar code symbols. Avoid readers with apertures less than 7 mils (.007 inch or .18mm).

Test Program

Run this test to check the printer's ability to print bar codes when more complicated programs are not producing results.

> Line 10 turns on the bar code mode
> Line 20 contains the bar code data
> Line 30 exits the bar code mode

```
10 LPRINT CHR$(27);"[3t";
20 LPRINT "1234567890";
30 LPRINT CHR$(27);"[0t";
```
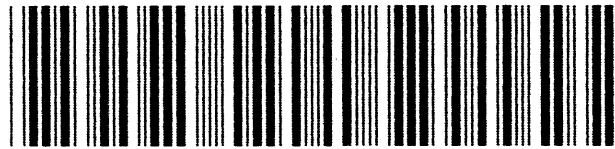
```
1234567890
```

Vertical Bar Codes

You can rotate bar codes. The following examples show various ways of creating bar codes and adjusting spacing.

> Line 10 sets parameter *p9* for 90 degree rotation using the special font for the HRL
> Line 20 turns on the bar code mode
> Line 30 contains bar code data
> Line 40 turns off the bar code mode

```
10 LPRINT CHR$(27);"[;;;;;;;2}";
20 LPRINT CHR$(27);"[3t";
30 LPRINT "12345";
40 LPRINT CHR$(27);"[0t";
```

```
12345
```

Commas and spaces function as they do for horizontal bar codes. A comma does not add any space, and a space adds .1" between the bar codes. The quiet zones rotate with the symbol leaving almost no horizontal separation between bar codes on the same line.

Line 10 either enables or disables printing of the human readable line.

Commas With Human Readable Line:

```
10 LPRINT CHR$(27);"[;;1}";
20 LPRINT CHR$(27);"[3t";
30 LPRINT "1234,5678,9012";
40 LPRINT CHR$(27);"[0t";
```
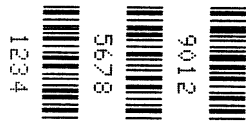
Commas Without Human Readable Line:

```
10 LPRINT CHR$(27);"[;;0}";
20 LPRINT CHR$(27);"[3t";
30 LPRINT "1234,5678,9012";
40 LPRINT CHR$(27);"[0t";
```

Spaces With Human Readable Line:

```
10 LPRINT CHR$(27);"[;;1}";
20 LPRINT CHR$(27);"[3t";
30 LPRINT "1234       5678 9012";
40 LPRINT CHR$(27);"[0t";
```

Spaces Without Human Readable Line:

```
10 LPRINT CHR$(27);"[;;0}";
20 LPRINT CHR$(27);"[3t";
30 LPRINT "1234       5678 9012";
40 LPRINT CHR$(27);"[0t";
```

Oversize Character Font Option

The optional oversize font is composed with scalable characters that can be expanded 156 times the size of standard fonts. This will accommodate letters up to 15.25 inches (388mm) high by 13 inches (330mm) wide. The minimum character size (default setting) is two times the size of standard characters. Oversize characters can also be rotated 90, 180, or 270 degrees.

Do not mistake oversize characters with expanded characters. The expanded character feature (standard in your printer) expands all existing fonts (except high speed) up to 8 times the normal size and cannot be rotated.

The oversize character feature works with only the ANSI protocol.

NOTE: Control sequences displayed in the following examples show the proper syntax required from the host.

The program examples provided will help you to become familiar with the oversized feature. All characters are printed in actual size.

Entering And Exiting Oversize

The following sequences are used to enter, rotate, and exit oversize printing.

> ESC [0l Exit oversize Printing.
> ESC [1l Select oversize font with no rotation.
> ESC [300; 300 BSize 3x3 : ABCD
> ESC [2l Select oversize font with 90-degree rotation.
> ESC [300 ; 300 BSize 3x3 : ABCD
> ESC [3l Select oversize font with 180-degree rotation.
> ESC [300 ; 300 BSize 3x3 : ABCD
> ESC [4l Select oversize font with 270-degree rotation
> ESC [300 ; 300 BSize 3x3 : ABCD.

Text can be rotated in the following order from top to bottom: no rotation, 90 degrees, 180 degrees, 270 degrees.

Selecting Size

ESC [*p1*;*p2* B is the sequence used to set the vertical (*p1*) and horizontal (*p2*) size of the oversize characters. A *p1* value of 300 would increase the vertical size of the character 300% or 3 times.

> ESC[*p1*;*p2* B
> CHR$(27);"[300;300 B;

The last two digits of each parameter are necessary to comply with the ANSI standard, but are ignored by the printer. Using the above example for *p1*, any three digit number starting with 3 (300-399) will be interpreted as 3 times normal size. Likewise, 400-499 equals 4 times, 1200-1299 equals 12 times increase in size, and so on. The maximum size is 15600; 15600 (156 times) and the minimum or default is 200;200 (2 times).

IMPORTANT **Times 1 expansion is not permitted with the oversize option. If you have selected times 1 with the ESC[100;100 B sequence and have activated oversize, the expansion value defaults to times 2.**

Since this same sequence is used to change size in the expanded mode, the parameters must be cleared to normal size, ESC[100;100 B, to prevent entering expanded mode when oversize is turned off. Oversize defaults to double-sized, 200;200, (even when 100;100 is sent) so the 100;100 sequence must be sent *after* the oversize characters have been printed.

Size Parameters for Rotation

The *p1* and *p2* size parameters are always relative to a rotation angle of zero degrees. That is, the characters are expanded first and then rotated.

Spacing Between Characters

For unrotated characters and characters rotated 180 degrees, the horizontal spacing between characters is 1/60 inch times the *p2* parameter.

For characters rotated 90 or 270 degrees, the horizontal spacing between characters is 3/60 inch times the *p1* parameter.

Vertical spacing is dependent on vertical paper move commands (LF, CR, VPR, etc.) and the character size and line spacing currently in effect.

3 *Vertical Page Formatting*

Overview

Rapid vertical paper movement is called slewing. A vertical format unit (VFU) is a program you load into the printer that enables it to slew paper to preset locations on a page.

On your printer, LF commands and other commands that produce blank lines are accumulated and moved in one efficient paper motion. The VFUs are maintained for compatibility with earlier applications.

Following an introductory overview of how to plan a vertical page format, the following two methods of vertical formatting are described in this chapter:

- **Vertical tab table.** The IBM Proprinter® III XL and the Epson® FX-1050 emulations each contain a vertical tab table. It is a set of programmed vertical tabs.

- **Electronic Vertical Format Unit (EVFU).** Only the P-Series emulation provides the EVFU capability.

Information regarding ANSI EVFU starts on page 68.

Planning A Vertical Page Format

Vertical page formatting with a VFU comprises four steps:

1. Select the type of vertical format you want to use. This is covered in the next section.

2. Design the form, determining the spacing and channel assignments for every line. Channel assignments are discussed in the VFU sections.

3. Determine the programming sequence. The format of the sequence depends on the type of VFU you select and is discussed in each VFU section of this chapter.

4. Send the programming sequence to the printer in the host data stream. This loads the VFU program.

Some VFUs require the PI line normally associated with the Dataproducts® parallel interface.

VFU Characteristics

Keep in mind the following information when programming and using a VFU:

Elongated Characters. You can use elongated (double high) characters in VFU programs. The VFU automatically counts one line of elongated characters as two character lines.

VFU Not Loaded. If the VFU is not loaded, the printer performs a single line feed in response to VFU commands.

Paper Runaway Protection. If the VFU memory is loaded and a channel code is sent that was not previously loaded, the printer moves the paper a single line feed.

Line Spacing. The printer can use either 6 or 8 lines per inch (lpi) spacing. These VFUs calculate the forms length by line density selected. The 6 and 8 lpi spacing may be mixed on the same form, but should be done carefully.

Form Feed. A form feed sent from the control panel or a command from the host moves the paper to the first channel 1, which is the top of form.

Vertical Tab. A VT command moves the paper to the next channel 12. If a channel 12 is not loaded, a line feed will occur.

Proprinter And Epson Vertical Tab Table

The IBM Proprinter III XL and the Epson FX-1050 emulations each contain a vertical tab table. It is a set of programmed vertical tabs. Various lines of the form are assigned vertical tabs, which are then accessed by control code for rapid paper advancement to the tab position.

Two control codes are used for vertical tabbing: ESC B sets single channel vertical tabs, and VT executes a vertical tab. The Epson emulation also has ESC / to select one of eight tab channels and ESC b to set the tabs in a particular channel.

Executing Vertical Tabs

The vertical tab execute code is VT. If there is any data in the print buffer, it is printed and the paper moves to the next predefined vertical tab position. If a tab position is not defined, the paper is moved to the next line at the current line spacing. If a tab position is at the current line, the paper is moved to the next tab position. If no tab positions are defined between the current line and the end of the form, the paper moves to the next TOF.

Vertical Tab Positions

Vertical tab positions are set by line number. A maximum of 16 vertical tab positions can be set on the form. A sample format is shown in Figure 4.

The first vertical tab is set at line 6 for part number data, a second tab is set at line 8 for part name data, and a third tab is set at line 14 for quantity data. The ESC B code assigns the vertical tabs to the lines of the form. Once the tab positions are set, sending the vertical tab execute code (VT) causes the paper

(currently at the top-of-form position) to advance to the first tab position for PART NUMBER data. Sending another VT moves the paper to the second tab position for PART NAME, followed by a third VT to access the third tab position for QUANTITY data.

Form Data	Form Line Number	Vertical Tabs
	1	Top of Form
	2	
	3	
	4	
	5	
PART NUMBER	6	Tab 1
	7	
PART NAME	8	Tab 2
	9	
	10	
	11	
	12	
	13	
QUANTITY	14	Tab 3
	15	
	20	

Figure 4. Example of Vertical Tab Positions

P-Series EVFU

The EVFU may be selected in P-Series protocol. The EVFU provides 14 or 16 channels to identify up to 192 lines depending on the paper instruction. The programming sequence is 1) start load code; 2) line identification code; and 3) end load code.

Start Load Code - 1E or 6E Hex

The start load code clears and initializes the EVFU memory for the memory load program. The start load code is 1E hex when the PI line is disabled (low) or 6E hex when the PI line is enabled (high).

Channel Assignment

The EVFU memory has the capacity for 192-line forms. The first line identification code (channel code) in the memory load program defines the first line on the form; the second line identification code defines the second line on the form, etc. Each line must have a line identification code. Filler channel codes are used for lines that will not be accessed by the print program. Any channel code can be used as a filler except channel code 1, which is reserved for the top-of-form, and channel code 12, which is reserved as the vertical tab channel. The same filler channel code can be repeated as necessary for any number of lines.

Channel 1. The top-of-form code, reserved as the first line on the form or the first line printed (top-of-form position). The operating program sends the channel 1 code to advance to the top of the next form. After the memory is loaded, a Form Feed code (FF, 0C hex) will move the paper to the next channel 1 (top-of-form).

Channels 2 through 11, 13 and 14. Used as general channel codes (line identification codes) or filler channels. Each line on the form must be identified by a channel code. When the operating program sends the channel code, the paper advances to the line identified by the channel code. Lines not used by the operating program must be identified by filler channels (unused channel codes).

Channel 12. Reserved as the Vertical Tab channel. The Vertical Tab code (VT, 0B hex) prints any data in the print buffer and rapidly slews the paper to the next line identified by the channel 12 code. If channel 12 is not loaded in the EVFU memory, a single line feed will be executed when a VT code is sent.

Channel 15 and 16. Used as general channel codes or filler channels only when the VFU is accessed by the PI line. In an EVFU form that does not use the PI line, the codes for Channels 15 and 16 function as the Start Load and End Load codes.

End Load - 1F or 6F Hex

The end load code terminates the memory load program. The end load code is 1F hex when the PI line is disabled (low) or 6F hex when the PI line is high.

Channel codes in excess of 192 channels received prior to the end load code are discarded.

Using The EVFU

Once the EVFU program has been enabled and loaded, sending the appropriate channel code to the printer will cause any data in the buffer to print and will position the paper to the next line on the form having the specified channel number assigned in EVFU memory.

For a data byte to be recognized as an EVFU instruction, the following criteria must be met:

1. PI line must be enabled and set high; and

2. Data bit 5 must be 0 (not set).

3. Data bits 6-8 must be 0 (not set).

or:

1. PI line must be disabled or low; and

2. Data bit 5 must be 1 (set).

Given these conditions, the lower four bits of a byte will specify the EVFU channel number. Table 19 lists the EVFU channels and their equivalent data bytes with the PI line enabled; Table 20 lists the EVFU channel and their equivalent data bytes with the PI line disabled.

Table 19. P-Series EVFU Codes - PI Line Enabled

ASCII			Data Bits									Channel
Hex	Dec.	Code	PI	8	7	6	5	4	3	2	1	
00	0	NUL	1	X	X	X	0	0	0	0	0	1 (TOF)
01	1	SOH	1	X	X	X	0	0	0	0	1	2
02	2	STX	1	X	X	X	0	0	0	1	0	3
03	3	ETX	1	X	X	X	0	0	0	1	1	4
04	4	EOT	1	X	X	X	0	0	1	0	0	5
05	5	ENQ	1	X	X	X	0	0	1	0	1	6
06	6	ACK	1	X	X	X	0	0	1	1	0	7
07	7	BEL	1	X	X	X	0	0	1	1	1	8
08	8	BS	1	X	X	X	0	1	0	0	0	9
09	9	HT	1	X	X	X	0	1	0	0	1	10
0A	10	LF	1	X	X	X	0	1	0	1	0	11
0B	11	VT	1	X	X	X	0	1	0	1	1	12 (VT)

Table 19. P-Series EVFU Codes - PI Line Enabled

ASCII			Data Bits									Channel
Hex	Dec.	Code	PI	8	7	6	5	4	3	2	1	
0C	12	FF	1	X	X	X	0	1	1	0	0	13
0D	13	CR	1	X	X	X	0	1	1	0	1	14
0E	14	SO	1	X	0	0	0	1	1	1	0	15
0F	15	SI	1	X	0	0	0	1	1	1	1	16
6E	110	n	1	X	1	1	0	1	1	1	0	Start Load
6F	111	o	1	X	1	1	0	1	1	1	1	End Load
(X = Undefined, 0, or 1) (1 = High) (0 = Low)												

Table 20. P-Series EVFU Codes - PI Line Disabled or Not Used

ASCII			Data Bits								Channel
Hex	Dec.	Code	8	7	6	5	4	3	2	1	
10	16	DLE	0	0	0	1	0	0	0	0	1 (TOF)
11	17	DC1	0	0	0	1	0	0	0	1	2
12	18	DC2	0	0	0	1	0	0	1	0	3
13	19	DC3	0	0	0	1	0	0	1	1	4
14	20	DC4	0	0	0	1	0	1	0	0	5
15	21	NAK	0	0	0	1	0	1	0	1	6
16	22	SYN	0	0	0	1	0	1	1	0	7
17	23	ETB	0	0	0	1	0	1	1	1	8
18	24	CAN	0	0	0	1	1	0	0	0	9
19	25	EM	0	0	0	1	1	0	0	1	10
1A	26	SUB	0	0	0	1	1	0	1	0	11
1B	27	ESC	0	0	0	1	1	0	1	1	12 (VT)
1C	28	FS	0	0	0	1	1	1	0	0	13
1D	29	GS	0	0	0	1	1	1	0	1	14
1E	30	RS	0	0	0	1	1	1	1	0	Start Load

Table 20. P-Series EVFU Codes - PI Line Disabled or Not Used

ASCII			Data Bits								Channel
Hex	**Dec.**	**Code**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
1F	31	US	0	0	0	1	1	1	1	1	End Load
(X = Undefined, 0, or 1) (1 = High) (0 = Low)											

NOTE: The ESC code cannot be used simultaneously as the EVFU VT code and the Special Function Control Code (SFCC). If ESC is used as the SFCC, the EVFU must be used with the PI line enabled and set high. Refer to the appropriate LinePrinter Plus, PGL, and VGL *Programmer's Reference Manual* for more information on the SFCC.

Clearing The EVFU Memory

The following actions will reset (clear) the EVFU memory:

1. Sending only the start load code.

2. Sending a start load code followed immediately by an end load code.

3. A second start load code is received, resulting in reinitialization of the EVFU. (This allows the host data to be restarted.)

When the EVFU memory is cleared, the forms length returns to the previously set value and the current print position becomes the top-of-form (TOF).

Relative Line Slewing

Another method of moving paper using the PI line results in vertical slews of a specified number of lines within the form relative to the current print line (rather than slewing to a specific line). For this to occur, three criteria must be met:

1. The PI line must be enabled and set high;

2. Data bit 5 must be 1 (set); and

3. The EVFU must be the selected Vertical Format Unit.

The Slew Relative configuration and the status of data bits 1-4 determine the number of lines slewed as described in Table 21. (Note that the state of data bit 5 is the difference between line slewing and using the interface lines as EVFU channel codes.) As long as the EVFU is selected, this type of vertical paper motion will occur regardless of whether the EVFU memory is loaded or not.

If the Double High for One Line attribute is active, $n + 1$ lines will be slewed rather than n lines.

Table 21. P-Series EVFU Line Slewing

ASCII			Data Bits									Lines Slewed
Hex	**Dec.**	**Code**	**PI**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
10	16	DLE	1	X	X	X	1	0	0	0	0	1
11	17	DC1	1	X	X	X	1	0	0	0	1	2
12	18	DC2	1	X	X	X	1	0	0	1	0	3
13	19	DC3	1	X	X	X	1	0	0	1	1	4
14	20	DC4	1	X	X	X	1	0	1	0	0	5
15	21	NAK	1	X	X	X	1	0	1	0	1	6
16	22	SYN	1	X	X	X	1	0	1	1	0	7
17	23	ETB	1	X	X	X	1	0	1	1	1	8
18	24	CAN	1	X	X	X	1	1	0	0	0	9
19	25	EM	1	X	X	X	1	1	0	0	1	10
1A	26	SUB	1	X	X	X	1	1	0	1	0	11
1B	27	ESC	1	X	X	X	1	1	0	1	1	12
1C	28	FS	1	X	X	X	1	1	1	0	0	13
1D	29	GS	1	X	X	X	1	1	1	0	1	14
1E	30	RS	1	X	0	0	1	1	1	1	0	15
1F	31	US	1	X	0	0	1	1	1	1	1	16
(X = Undefined, 0, or 1) (1 = High) (0 = Low)												

ANSI EVFU

Rapid vertical paper movement is called slewing. A vertical format unit (VFU) is a table, or program, of vertical tabs that enable the printer to slew paper to preset locations on a page.

The preset locations are identified by codes, or channels. The first line channel code defines the first line on the form; the second line channel defines the second line on the form, etc. Each line must have a channel. Filler channel codes are used for lines that will not be accessed by the print program. Two bytes are required for each line of the form.

Any channel code can be used as a filler except channel code 1, which is reserved for the top-of-form, and channel code 12, which is reserved as the vertical tab channel. The same filler channel code can be repeated as necessary for any number of lines.

The EVFU allows loading a table with a minimum form length of .33 inches (240 decipoints) and a maximum length of 22 inches (15,840 decipoints). Since the maximum length is 22 inches, the number of lines is dependent on the LPI setting. 3 LPI - 66 lines, 4 LPI - 88 lines, 6 LPI - 132 lines, and 8 LPI - 176 lines. Exceeding the maximum causes a fault.

The EVFU can be loaded using ANSI ESC sequences, or by using the paper instruction (PI) line. The following pages describe the use of the EVFU without using the PI line.

ASCII Code ESC]!

Hex Code 1B 5D 21

Dec Code 27 93 33

Expression CHR$(27);"]!"

Loading is terminated by the ESC \ sequence.

Loading the Table

The first table location is always loaded with the channel 1 code. This is defined as the top of form (TOF) channel. The table may be left without channel 1 and a command to skip to channel 1 will cause a normal formfeed as though there were no VFU.

Two bytes are loaded for each line of the form to be controlled. One or more channel numbers may be indicated in the two byte code.

The format of two byte channel control codes is shown in Table 22.

Table 22. Two Byte Channel Control Code Format

Bit Number	8	7	6	5	4	3	2	1
Channel Number	x	x	6	5	4	3	2	1
first byte	x	x	y	y	y	y	y	y
Bit Number	8	7	6	5	4	3	2	1
Channel Number	x	x	12	11	10	9	8	7
second byte	x	x	y	y	y	y	y	y
y: 0 - no stop in channel, 1 - stop in channel x: bit has no meaning								

NOTE: To make characters acceptable, bit 7 must be set.

Each "channel control code" pair of bytes has the capability to indicate multiple channels since each channel indication has a unique bit position which is either ON - 1 or OFF - 0.

Table 23. Channel Control Codes

Decimal Value		Binary Value		ASCII Character		Remarks
1	2	1	2	1	2	
64	64	1000000	1000000	@	@	Fillers
65	64	1000001	1000000	A	@	Channel 1
66	64	1000010	1000000	B	@	Channel 2
68	64	1000100	1000000	D	@	Channel 3
72	64	1001000	1000000	H	@	Channel 4
80	64	1010000	1000000	P	@	Channel 5
96	64	1100000	1000000	'	@	Channel 6
64	65	1000000	1000001	@	A	Channel 7
64	66	1000000	1000010	@	B	Channel 8
64	68	1000000	1000100	@	D	Channel 9
64	72	1000000	1001000	@	H	Channel 10
64	80	1000000	1010000	@	P	Channel 11
64	96	1000000	1100000	@	'	Channel 12

Table 24 is a sample program to load an EVFU table.

Table 24. Sample EVFU Loading Program

Program Instruction	Remarks
1500 WIDTH "LPT1:",255	Required by some BASIC languages to avoid auto LF at column 80
1510 LPRINT CHR$(27);"]!";	Enables EVFU loading.
1520 LPRINT CHR$(65);CHR$(64);	Resets TOF, Channel 1. See Table 23.
1530 FOR I=1 TO 4 1531 LPRINT CHR$(64);CHR$(64); 1532 NEXT I	4 filler lines
1540 LPRINT CHR$(68);CHR$(64);	Selects Channel 3. See Table 23.
1550 FOR I=1 TO 18 1551 LPRINT CHR$(64);CHR$(64); 1552 NEXT I	18 filler lines

Table 24. Sample EVFU Loading Program

Program Instruction	Remarks
1560 LPRINT CHR$(72);CHR$(64);	Selects Channel 4. See Table 23.
1570 FOR I=1 TO 31 1571 LPRINT CHR$(64);CHR$(64); 1572 NEXT I	31 filler lines
1580 LPRINT CHR$(80);CHR$(64);	Selects Channel 5. See Table 23.
1590 FOR I=1 TO 8 1591 LPRINT CHR$(64);CHR$(64); 1592 NEXT I	8 filler lines
1600 LPRINT CHR$(64);CHR$(66);	Selects Channel 8. See Table 23.
1610 LPRINT CHR$(27);"\";	Exit EVFU loading
1620 END	

Once the EVFU program has been enabled and loaded, sending the appropriate channel code to the printer will cause any data in the buffer to print and will move the paper to the next line on the form having the specified channel number assigned in EVFU memory.

The Default

The default EVFU will be generated based on the current forms length and LPI setting under the following conditions:

- When the printer is initialized.

- When either the forms definition or LPI setting is changed.

- When the start EVFU load escape sequence ESC]! is immediately followed by the end load sequence ESC \.

- When the clear vertical tabs ESC [4g sequence is received.

Table 25 shows how the default EVFU table is defined.

Table 25. Default EVFU Table

Channel	Description
1	Top Margin (first line)
2	Bottom Margin (last line)
3	Single Spacing
4	Double Spacing
5	Triple Spacing
6	Half Form

Table 25. Default EVFU Table

Channel	Description
7	Quarter Form
8	Tenth Line
9	Bottom of Form (bottom margin)
10	Bottom of Form minus 1 line
11	Top of Form minus 1 line (last line this form)
12	Top of Form

The Skip to Channel Command

ESC [*p1;p2* ! p

Commands vertical paper movement to the channel specified by the number formed by *p1* and *p2*. Valid channel numbers are in the range 1-12.

0;1 - selects channel 1
0;9 - selects channel 9
1;1 - selects channel 11

Channel 1 is always used for TOF; channel 12 is always used with the vertical tab character (VT OBH). If the channel number is greater than 12 then the program defaults to channel 1. If the table has not been loaded and a channel command is received, it is ignored.

The following example illustrates the skip to channel command.

Table 26. Skip To Channel Example

Program Instruction	Remarks	Output
10 WIDTH "LPT1:",255	Required by some BASIC languages to avoid auto LF at column 80	
20 LPRINT CHR$(27);"[0;1!p";	Go to top of form (channel 1)	
30 LPRINT "TOP OF FORM"	Print indicated words	
40 LPRINT CHR$(27);"[0;3!p";	Go to channel 3	
50 LPRINT "LINE 6";	Print indicated words	
60 LPRINT CHR$(27);"[0;4!p";	Go to channel 4	
70 LPRINT "LINE 25";	Print indicated words	
80 LPRINT CHR$(27);"[0;5!p";	Go to channel 5	
90 LPRINT "LINE 57";	Print indicated words	
100 LPRINT CHR$(27);"[0;8!p";	Go to channel 8	
110 LPRINT "END OF FORM";	Print indicated words	
120 END		

NOTE: Set the top-of-form first. When you execute the EVFU, the paper will move to the top-of-form on the next page and then begin printing.

Downloading The EVFU (Using The PI Line)

The PI-EVFU is identical to the ESC sequence-EVFU, except for the EVFU load and command sequences. The PI-EVFU is used exclusively with the Dataproducts parallel interface option.

NOTE: The PI-line must be enabled in the interface menu.

Start load command:6C (hex) selects 6 LPI linespacing
    6D (hex) selects 8 LPI linespacing
    6E (hex) selects current linespacing

End load command:6F (hex)

The format of the two byte channel control code is shown in Table 27.

Table 27. Two Byte Channel Control Code Format

Bit Number	8	7	6	5	4	3	2	1
Channel Number	x	x	6	5	4	3	2	1
first byte	x	x	y	y	y	y	y	y

Table 27. Two Byte Channel Control Code Format

Bit Number	8	7	6	5	4	3	2	1
Channel Number	x	x	12	11	10	9	8	7
second byte	x	x	y	y	y	y	y	y
y: 0 - no stop in channel, 1 - stop in channel x: bit has no meaning								

NOTE: Each "channel control code" pair of bytes has the capability to indicate multiple channels since each channel indication has a unique bit position which is either ON =1 or OFF = 0.

Table 28. Channel Control Codes

Decimal Value		Binary Value		ASCII Character		Remarks
1	2	1	2	1	2	
64	64	1000000	1000000	@	@	Fillers
65	64	1000001	1000000	A	@	Channel 1
66	64	1000010	1000000	B	@	Channel 2
68	64	1000100	1000000	D	@	Channel 3
72	64	1001000	1000000	H	@	Channel 4
80	64	1010000	1000000	P	@	Channel 5
96	64	1100000	1000000	'	@	Channel 6
64	65	1000000	1000001	@	A	Channel 7
64	66	1000000	1000010	@	B	Channel 8
64	68	1000000	1000100	@	D	Channel 9
64	72	1000000	1001000	@	H	Channel 10
64	80	1000000	1010000	@	P	Channel 11
64	96	1000000	1100000	@	'	Channel 12

NOTE: Since LF is not recognized during EVFU loading, filler codes are used to tab the required number of vertical lines.

The Skip to Channel Command

The skip to channel command has the following format:

Bit NumberFunction

PI76543210
1XXX0CCCCSkip to channel CCCC
(X bits not used)

CCCC:0000 = Channel 10110 = Channel 7
0001 = Channel 20111 = Channel 8
0010 = Channel 31000 = Channel 9
0011 = Channel 41001 = Channel 10
0100 = Channel 51010 = Channel 11
0101 = Channel 61011 = Channel 12

Slew "N" Lines

Bit NumberFunction

PI76543210
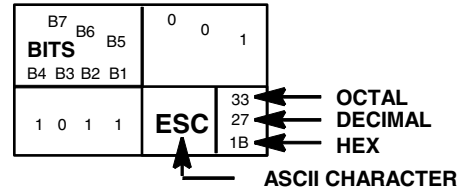1XEE1NNNNAdvance paper the number
of lines specified by NNNN
or EENNNN,

Up to 63 lines (all bits EENNNN are 1) can be slewed. If the number of lines is 63, and the option "Truncate PI slew" is set to "Truncate at TOF," the slew will be aborted at Top of Form, if the distance from the current position to the next Top of Form is less than 63 lines.

A *Standard ASCII Character Set*

KEY

BITS B7 B6 B5 / B4 B3 B2 B1	0 0 1
	33 OCTAL
1 0 1 1	ESC — 27 DECIMAL
	1B HEX

ASCII CHARACTER

B7 B6 B5 / BITS / B4 B3 B2 B1	ROW	0 0 0 COLUMN 0	0 0 1 1	0 1 0 2	0 1 1 3	1 0 0 4	1 0 1 5	1 1 0 6	1 1 1 7
0 0 0 0	0	NUL (0/0/0)	DLE (20/16/10)	SP (40/32/20)	0 (60/48/30)	@ (100/64/40)	P (120/80/50)	` (140/96/60)	p (160/112/70)
0 0 0 1	1	SOH (1/1/1)	DC1 (XON) (21/17/11)	! (41/33/21)	1 (61/49/31)	A (101/65/41)	Q (121/81/51)	a (141/97/61)	q (161/113/71)
0 0 1 0	2	STX (2/2/2)	DC2 (22/18/12)	" (42/34/22)	2 (62/50/32)	B (102/66/42)	R (122/82/52)	b (142/98/62)	r (162/114/72)
0 0 1 1	3	ETX (3/3/3)	DC3 (XOFF) (23/19/13)	# (43/35/23)	3 (63/51/33)	C (103/67/43)	S (123/83/53)	c (143/99/63)	s (163/115/73)
0 1 0 0	4	EOT (4/4/4)	DC4 (24/20/14)	$ (44/36/24)	4 (64/52/34)	D (104/68/44)	T (124/84/54)	d (144/100/64)	t (164/116/74)
0 1 0 1	5	ENQ (5/5/5)	NAK (25/21/15)	% (45/37/25)	5 (65/53/35)	E (105/69/45)	U (125/85/55)	e (145/101/65)	u (165/117/75)
0 1 1 0	6	ACK (6/6/6)	SYN (26/22/16)	& (46/38/26)	6 (66/54/36)	F (106/70/46)	V (126/86/56)	f (146/102/66)	v (166/118/76)
0 1 1 1	7	BEL (7/7/7)	ETB (27/23/17)	' (47/39/27)	7 (67/55/37)	G (107/71/47)	W (127/87/57)	g (147/103/67)	w (167/119/77)
1 0 0 0	8	BS (10/8/8)	CAN (30/24/18)	((50/40/28)	8 (70/56/38)	H (110/72/48)	X (130/88/58)	h (150/104/68)	x (170/120/78)
1 0 0 1	9	HT (11/9/9)	EM (31/25/19)	) (51/41/29)	9 (71/57/39)	I (111/73/49)	Y (131/89/59)	i (151/105/69)	y (171/121/79)
1 0 1 0	10	LF (12/10/0A)	SUB (32/26/1A)	* (52/42/2A)	: (72/58/3A)	J (112/74/4A)	Z (132/90/5A)	j (152/106/6A)	z (172/122/7A)
1 0 1 1	11	VT (13/11/0B)	ESC (33/27/1B)	+ (53/43/2B)	; (73/59/3B)	K (113/75/4B)	[(133/91/5B)	k (153/107/6B)	{ (173/123/7B)
1 1 0 0	12	FF (14/12/0C)	FS (34/28/1C)	, (54/44/2C)	< (74/60/3C)	L (114/76/4C)	\ (134/92/5C)	l (154/108/6C)		(174/124/7C)
1 1 0 1	13	CR (15/13/0D)	GS (35/29/1D)	- (55/45/2D)	= (75/61/3D)	M (115/77/4D)	] (135/93/5D)	m (155/109/6D)	} (175/125/7D)
1 1 1 0	14	SO (16/14/0E)	RS (36/30/1E)	. (56/46/2E)	> (76/62/3E)	N (116/78/4E)	^ (136/94/5E)	n (156/110/6E)	~ (176/126/7E)
1 1 1 1	15	SI (17/15/0F)	US (37/31/1F)	/ (57/47/2F)	? (77/63/3F)	O (117/79/4F)	_ (137/95/5F)	o (157/111/6F)	DEL (177/127/7F)

Note: each cell shows the character with its octal / decimal / hex values.

B *Conversion Tables*

Table 29. Equivalent Columns Conversion Table

Inches		CPI				
		10	**12**	**13.3**	**15**	**16.7**
1/16	0.0625	1	1	1	1	1
1/8	0.1250	1	2	2	2	2
3/16	0.1875	2	2	2	3	3
1/4	0.2500	3	3	3	4	4
5/16	0.3125	3	4	4	5	5
3/8	0.3750	4	5	5	6	6
7/16	0.4375	4	5	6	7	7
1/2	0.5000	5	6	7	8	8
9/16	0.5625	6	7	7	8	9
5/8	0.6250	6	8	8	9	10
11/16	0.6875	7	8	9	10	11
3/4	0.7500	8	9	10	11	13
13/16	0.8125	8	10	11	12	14
7/8	0.8750	9	11	12	13	15
15/16	0.9375	9	11	12	14	16
1		10	12	13	15	17
2		20	24	27	30	33
3		30	36	40	45	50
4		40	48	53	60	67
5		50	60	67	75	84
6		60	72	80	90	100
7		70	84	93	105	117
8		80	96	106	120	134
9		90	108	120	135	150
10		100	120	133	150	167

Use this table with the Decipoints Table on the next page.

To create a 4-9/16 inch left margin with a 13.3 CPI, do the following:

> In the 13.3 CPI column, add the column value in the 9/16 inch line (7) to the column value in the 4 inch line.
> 7 + 53 = **60** is the column count for the new left margin

Refer to Table 30 and find line 60 and read across to the 13.3 CPI column. The decipoint value is 3240 for the left margin. The first print column is the one following the left margin or column 61.

The decipoint values in Table 30 represent the beginning of the range of each column value. For example, the range of the decipoint value for margin column 2 at 13.3 CPI is 108 - 161. Any number within this range will achieve the same results.

Table 30. Decipoints for Column vs. CPI Values

MARGIN COLUMN*	CPI				
	10	12	13.3	15	16.7
0	0	0	0	0	0
1	72	60	54	48	43
2	144	120	108	96	86
3	216	180	162	144	129
4	288	240	216	192	172
5	360	300	270	240	215
6	432	360	324	288	258
7	504	420	378	336	301
8	576	480	432	384	344
9	648	540	486	432	387
10	720	600	540	480	430
11	792	660	594	528	473
12	864	720	648	576	516
13	936	780	702	624	559
14	1008	840	756	672	602
15	1080	900	810	720	645
16	1152	960	864	768	688
17	1224	1020	918	816	731
18	1296	1080	972	864	774
19	1368	1140	1026	912	817
20	1440	1200	1080	960	860
21	1512	1260	1134	1008	903
22	1584	1320	1188	1056	946
23	1656	1380	1242	1104	989
24	1728	1440	1296	1152	1032
25	1800	1500	1350	1200	1075
26	1872	1560	1404	1248	1118
27	1944	1620	1458	1296	1161
28	2016	1680	1512	1344	1204
29	2088	1740	1566	1392	1247
30	2160	1800	1620	1440	1290
31	2232	1860	1674	1488	1333
32	2304	1920	1728	1536	1376
33	2376	1980	1782	1584	1419

Table 30. Decipoints for Column vs. CPI Values (continued)

MARGIN COLUMN*	CPI				
	10	12	13.3	15	16.7
34	2448	2040	1836	1632	1462
35	2520	2100	1890	1680	1505
36	2592	2160	1944	1728	1548
37	2664	2220	1998	1776	1591
38	2736	2280	2052	1824	1634
39	2808	2340	2106	1872	1677
40	2880	2400	2160	1920	1720
41	2952	2460	2214	1968	1763
42	3024	2520	2268	2016	1806
43	3096	2580	2322	2064	1849
44	3168	2640	2376	2112	1892
45	3240	2700	2430	2160	1935
46	3312	2760	2484	2208	1978
47	3384	2820	2538	2256	2021
48	3456	2880	2592	2304	2064
49	3528	2940	2646	2352	2107
50	3600	3000	2700	2400	2150
51	3672	3060	2754	2448	2193
52	3744	3120	2808	2496	2236
53	3816	3180	2862	2544	2279
54	3888	3240	2916	2592	2322
55	3960	3300	2970	2640	2365
56	4032	3360	3024	2688	2408
57	4104	3420	3078	2736	2451
58	4176	3480	3132	2784	2494
59	4248	3540	3186	2832	2537
60	4320	3600	3240	2880	2580
61	4392	3660	3294	2928	2623
62	4464	3720	3348	2976	2666
63	4536	3780	3402	3024	2709
64	4608	3840	3456	3072	2752
65	4680	3900	3510	3120	2795
66	4752	3960	3564	3168	2838
67	4824	4020	3618	3216	2881
68	4896	4080	2672	3264	2924
69	4968	4140	3726	3312	2967
70	5040	4200	3780	3360	3010
71	5112	4260	3834	3408	3053
72	5184	4320	3888	3456	3096
73	5256	4380	3942	3504	3139
74	5328	4440	3996	3552	3182

Table 30. Decipoints for Column vs. CPI Values (continued)

MARGIN COLUMN*	CPI				
	10	12	13.3	15	16.7
75	5400	4500	4050	3600	3225
76	5472	4560	4104	3648	3268
77	5544	4620	4158	3696	3311
78	5616	4680	4212	3744	3354
79	5688	4740	4266	3792	3397
80	5760	4800	4320	3840	3440
81	5832	4860	4374	3888	3483
82	5904	4920	4428	3936	3526
83	5976	4980	4482	3984	3569
84	6048	5040	4536	4032	3612
85	6120	5100	4590	4080	3655
86	6192	5160	4644	4128	3698
87	6264	5220	4698	4176	3741
88	6336	5280	4752	4224	3184
89	6408	5340	4806	4272	3827
90	6480	5400	4860	4320	3870
91	6552	5460	4914	4368	3913
92	6624	5520	4968	4416	3956
93	6696	5580	5022	4464	3999
94	6768	5640	5076	4512	4042
95	6840	5700	5130	4560	4085
96	6912	5760	5184	4608	4128
97	6984	5820	5238	4656	4171
98	7056	5880	5292	4704	4214
99	7128	5940	5346	4752	4257
100	7200	6000	5400	4800	4300
101	7272	6060	5454	4848	4343
102	7344	6120	5508	4896	4386
103	7416	6180	5562	4944	4429
104	7488	6240	5616	4992	4472
105	7560	6300	5670	5040	4515
106	7632	6360	5724	5088	4558
107	7704	6420	5778	5136	4601
108	7776	6480	5832	5184	4644
109	7848	6540	5886	5232	4687
110	7920	6600	5940	5280	4730
111	7992	6660	5994	5328	4773
112	8064	6720	6048	5376	4816
113	8136	6780	6102	5424	4859
114	8208	6840	6156	5472	4902
115	8280	6900	6210	5520	4945

Table 30. Decipoints for Column vs. CPI Values (continued)

MARGIN COLUMN*	CPI				
	10	12	13.3	15	16.7
119	8568	7140	6426	5712	5117
120	8640	7200	6480	5760	5160
116	8352	6960	6264	5568	4988
117	8424	7020	6318	5616	5031
118	8496	7080	6372	5664	5074
121	8712	7260	6534	5808	5203
122	8784	7320	6588	5856	5246
123	8856	7380	6642	5904	5289
124	8928	7440	6696	5952	5332
125	9000	7500	6750	6000	5375
126	9072	7560	6804	6048	5418
127	9144	7620	6858	6096	5461
128	9216	7680	6912	6144	5504
129	9288	7740	6966	6192	5547
130	9360	7800	7020	6240	5590
131	9432	7860	7074	6288	5633
132	9504	7920	7128	6336	5676
133	-	7980	7182	6384	5719
134		8040	7236	6432	5762
135		8100	7290	6480	5805
136		8160	7344	6528	5848
137		8220	7398	6576	5891
138		8280	7452	6624	5934
139		8340	7506	6672	5977
140		8400	7560	6720	6020
141		8460	7614	6768	6063
142		8520	7668	6816	6106
143		8580	7722	6864	6149
144		8640	7776	6912	6192
145		8700	7830	6960	6235
146		8760	7884	7008	6278
147		8820	7938	7056	6321
148		8880	7992	7104	6364
149		8940	8046	7152	6407
150		9000	8100	7200	6450
151		9060	8154	7248	6493
152		9120	8208	7296	6536
153		9180	8262	7344	6579
154		9240	8316	7392	6622
155		9300	8370	7440	6665
156		9360	8424	7488	6708

Table 30. Decipoints for Column vs. CPI Values (continued)

MARGIN COLUMN*	CPI				
	10	12	13.3	15	16.7
157		9420	8478	7536	6751
158		9480	8532	7584	6794
159		-	8586	7632	6837
160			8640	7680	6880
161			8694	7728	6923
162			8748	7776	6966
163			8802	7824	7009
164			8856	7872	7052
165			8910	7920	7095
166			8964	7968	7138
167			9018	8016	7181
168			9072	8064	7224
169			9126	8112	7267
170			9180	8160	7310
171			9234	8208	7353
172			9288	8256	7396
173			9342	8304	7439
174			9396	8352	7482
175			9450	8400	7525
176			9504	8448	7568
177			-	8496	7611
178				8544	7654
179				8592	7697
180				8640	7740
181				8688	7783
182				8736	7826
183				8784	7869
184				8832	7912
185				8880	7955
186				8928	7998
187				8976	8041
188				9024	8084
189				9072	8127
190				9120	8170
191				9168	8213
192				9216	8256
193				9264	8299
194				9312	8342
195				9360	8385
196				9408	8428
197				9456	8471

Table 30. Decipoints for Column vs. CPI Values (continued)

MARGIN COLUMN*	CPI				
	10	12	13.3	15	16.7
198				9504	8514
199				-	8551
200					8600
201					8643
202					8686
203					8729
204					8772
205					8815
206					8858
207					8901
208					8944
209					8987
210					9030
211					9073
212					9116
213					9159
214					9202
215					9245
216					9288
217					9331
218					9374
219					9417
220					9460
221					9503
222					9546
223					9589
224					9632
225					9675
226					9718
227					9761
228					-

*First print column=margin column + 1

C *Glossary*

A

A to D	Analog to Digital
ACIA	Asynchronous Communication Interface Adapter
ACK	Acknowledge character. A transmission control character transmitted by the printer as an affirmative response to an inquiry from the host.
active column	The horizontal location on the paper where the next character will print.
active line	The vertical location on the paper where the next character will print.
active position	The position on the paper where the next character will print. The intersection of the active column and the active line.
ASCII	American Standard Code for Information Interchange. A standard character encoding scheme introduced in 1963 and used widely on many computers and printers. It is a 7-bit code with 128 different bit patterns. There is no parity recommendation.
attributes, print	Operations performed on text that alter its appearance but do not change the font. Examples: underlining, superscripting, bold, etc.

B

bar code	A printed code consisting of parallel bars of varied width and spacing and designed to be read by a one-dimensional scanning device.
baud	A unit of speed that measures the rate at which information is transferred. Baud rate is the reciprocal of the duration in seconds of the shortest pulse used to carry data. For example, a system in which the shortest pulse is 1/1200 second operates at 1200 baud. On RS-232 serial lines, the baud rate equals the data flow rate in bits per second (bps). To

communicate properly, a printer must be configured to operate at the same baud rate as its host computer.

bit

Contraction of binary digit. A bit is a digit in the binary number system, represented by a 0 or a 1. A bit is the smallest unit of storage in a digital computer, where 0 and 1 are represented by different voltages. Groups of bits form other units of storage called nibbles, bytes, and words.

bold

A print attribute specifying text of a heavy line thickness. *See also* character weight.

Boot-up

The start-up procedure which causes a computer operating system to be loaded into main memory.

buffer

A reserved area in memory that data is written to and read from during data transfers.

bus

A circuit for the transfer of data or electrical signals between two devices.

byte

A group of consecutive bits forming a unit of storage in a digital computer and used to represent one alphanumeric character. A byte usually consists of 8 bits, but may contain more or fewer bits, depending on the computer or protocol.

C

character cell

The invisible rectangular space occupied by a character, including the white space around the character. The height of a cell remains constant even with changes in the current line spacing, and the width is equal to the current character spacing. Used as a unit of spacing.

character proportion

The ratio of character height to character width. *See also* compressed and expanded.

character set

A set of codes, each of which represents a control or printable character, including symbols, punctuation, numbers, diacritical markings, and alphabet characters. Each character is assigned a unique address in memory.

character weight

The degree of lightness and thickness of printed text. For example: **"Bold" refers to a heavy or thick character weight, as shown in this sentence.** "Medium," "normal," or "book weight" refer to the character weight used in this sentence.

checksum

A value used to verify microcode correctness.

coax

Coaxial cable. An electrical signal conductor consisting of a single wire surrounded by insulation

	and a braided shield. Used to connect computers to input or output devices.
Code V™	An optional QMS® emulation that allows you to create and store forms: generate logos, bar codes, and expanded characters; create other graphics, and merge graphics with alphanumeric data as a document is printed.
command	An operating instruction (e.g., form feed, or FF) sent from a computer to the printer. Also called a control code or non-printable character. Commands are opposed to data, which is printed.
command delimiter	An ASCII character used to begin a command string (same as SFCC). Commonly used command delimiters are ESC (1B hex) and SOH (01 hex).
command sequence	Two or more bytes that instruct the printer to perform a special function. The first character in the sequence is a special function control character (SFCC). This character alerts the printer that the string which follows is a command sequence, not a character or graphic code. *See also* escape sequence, SFCC, SSCC.
compatibility	The ability of one printer to accept and properly process commands meant for a different printer. *See also* emulation and protocol.
compressed	Refers to a typeface with a font width approximately 60% smaller than normal. Character height is not changed.
configuration	Refers to the operating properties that define how the printer responds to signals and commands received from the host computer at the printer interface. These properties are called configuration parameters and are set to match the operating characteristics of the host computer system.
controller	An independent logic unit in a data processing system that controls data paths between one or more units of peripheral equipment.
cpi	characters per inch. A measurement of monospaced fonts indicating the horizontal character density. For example, 10 cpi means 10 characters can be printed in one horizontal inch. *See also* pitch.
cps	characters per second. A measurement of the print speed of a serial (character) printer.
CPU	Central Processing Unit
CR	Carriage Return
CT+	Coax/Twinax only: a model available in a previous generation of the IBM Line Matrix Printer.
CTA	Coax/Twinax/ASCII

CTS	Clear To Send. Status signal to the printer indicating the host is ready to receive data/status signals from the printer.
CVFU	Centronics® direct access Vertical Format Unit.

D

data bits	Binary information sent to the printer; a character set grouping containing letters, digits, and punctuation marks to be printed, or control codes to move paper, format text and graphics, and position the text and graphics on the page.
DAVFU	Direct Access Vertical Format Unit. Also known as NVFU. *See also* NVFU.
DC	Data Controller.
DCD	Data Carrier Detect. Status signal to the printer. The ON condition is required for the printer to receive data.
decipoint	One tenth of a point. A unit of length equal to 1/720 inch. *See also* point.
default	A value, parameter, attribute, or option assigned by a program or system if another is not specified by the user.
descender	The portion of a printed, lowercase character that appears below the base line. For example, /g/ /j/ /p/ /q/ and /y/ all are characters with lowercase descenders.
diagnostic	Pertains to the detection and isolation of printer malfunctions or mistakes.
DIP	Dual In-line Package. A method of packaging semiconductor components in rectangular cases with parallel rows of electrical contacts.
DIP switch	A DIP equipped with switches. A typical DIP switch has from four to ten individual switches mounted in its package. The individual switches are typically toggle, rocker, or slide switches.
disable	To deactivate or set to OFF.
diskette	A thin, flexible magnetic disk containing software such as test and diagnostic programs, initialization files, and all font specifications for the printer.
DP	Data Processing. (*See also* HS for Draft Print).
draft	A limited dot font used for rough copy; characterized by low print quality but fast printing speed.
DRAM	Dynamic Random Access Memory.

DSR	Data Set Ready. Status signal to the printer indicating the host is in a ready condition.
DTR	Data Terminal Ready. Control signal from the printer indicating it is in a ready condition.
DVFU	Dataproducts direct access Vertical Format Unit.

E

EBCDIC	Extended Binary Coded Data for Information Communication.
EC	Engine Controller
ECMA	European Computer Manufacturers Association.
EEPROM	Electrically Erasable Programmable Read Only Memory.
EIA/TIA	Electronic Industries Association/ Telecommunications Industry Association
Elite	A name indicating a monospaced font with a pitch of 12 cpi (and usually 10 points in height).
em	A unit of measure in typesetting: the width of a piece of type about as wide as it is tall. (Derived from uppercase M, usually the widest character in a set.)
emulation	Refers to the ability of a printer to execute the commands of another printer protocol. When used as a proper noun (e.g., Proprinter III XL Emulation), it means printer protocol. *See also* compatibility and protocol.
en	A unit of measure in typesetting equal to half the width of an em.
enable	To activate, make true (1), or set to on.
escape sequence	A command sequence in which the first byte is always the ASCII ESC character. Same as "escape code." *See also* command sequence, SFCC, SSCC.
ETX	End of Text. A transmission control character sent from the host to the printer, indicating the end of transmission of a block of data.
EVFU	Electronic Vertical Format Unit. Relates to the ability to slew (skip quickly a specified number of lines).
expanded	A font enhancement referring to larger-than-normal character width with no change in character height.

F

false	Off or zero. *Compare* true.

family (or type)	A set of all variations and sizes of a type style.
FF	Form Feed.
FIFO	First In, First Out.
fixed-pitch fonts	*See* font, monospaced.
flash memory	A rugged, high-density non-volatile memory used to store programs, instructions, and routines in PSA® printers. *Compare* NVRAM.
FM Header	Format Header. Command strings used to switch between SCS and IPDS.
font	The complete set of a given size of type, including characters, symbols, figures, punctuation marks, ligatures, signs, and accents. To fully describe a font, you must specify seven characteristics: 1) typeface 2) spacing (proportional or monospaced) 3) type size (12 point, 14 point, etc.) 4) scale factor (character height/width ratio) 5) type style 6) character weight 7) character proportion (normal, condensed, expanded).
font, landscape	A font printed parallel to the long edge of a page.
font, monospaced	Also called fixed-pitch fonts. Every character, regardless of horizontal size, occupies the same amount of font pattern space. All monospaced fonts use specific pitch size settings. Monospaced fonts are sometimes used when strict character alignment is desired (tables, charts, spreadsheets, etc.).
font name	*See* typeface.
font pattern	The matrix of pixels which represents a character, symbol, or image.
font, portrait	A font printed parallel to the short edge of a page.
font, proportional	A font in which the width of a character cell varies with the width of the character. For example, /i/ takes less space to print than /m/. Using proportional fonts generally increases the readability of printed documents, giving text a typeset appearance.
font weight	The thickness of the lines making up a character. For example, **"bold"** and "light" are different font weights.
font width	The measurement of the width of a character cell in dots.

G

GL Characters | Graphic left: Graphic left characters map half of the character set table. The GL characters reside at 0 - 127 hex and comprise the ASCII portion of the table.

GR Characters | Graphic right: Graphic right characters map half of the character set table. The GR characters reside at 128 - 255 hex and comprise the graphics portion of the table.

H

hammer | An assembly consisting of a hammer spring and a hammer tip.

hammer spring | The flat piece of metal, made of spring steel, which supports and pushes the hammer tip.

hammer tip | The small, round point, located near the end of the hammer spring, which strikes the ribbon and leaves a dot on the paper.

hex codes | Based on a numeral system with a radix of 16.

hex dump | A hex dump is a translation of all host interface data to its hexadecimal equivalent. A hex dump is a printer self-test typically used to troubleshoot printer data reception problems.

HGS | Horizontal Grid Size

host computer | The computer that stores, processes, and sends data to be printed, and which communicates directly with the printer. The term "host" indicates the controlling computer, since modern printers are themselves microprocessor-controlled computer systems.

HS | High Speed or Draft Print characters.

HT | Horizontal Tab.

Hz | Hertz. Cycles per second. Frequency.

I

IEEE | Institute of Electrical and Electronic Engineers, Inc.

IGP | Intelligent Graphics Processor. An interface that converts graphics commands received from the host computer to binary plot data that is usable by the printer. The IGP is the board-installed Intelligent Graphics Processor. The IGP provides on-line forms,

bar codes, and many alphanumeric text-generation capabilities.

initialization	A series of processes and self-tests to set power-up default conditions and parameters.
interface	The hardware components used to link two devices by common physical interconnection, signal, and functional characteristics.
invoke	To put into effect or operation.
ipm	inches per minute. A measurement of the speed of a printer printing in graphics print mode (plotting speed).
italic	A slanted type style. *This sentence is printed in an italic type style.*

L

LAC	Load Alternate Characters.
LF	Line Feed.
landscape	Printed perpendicular to the paper motion.
LCD	Liquid-Crystal Display. The LCD is located on the operator panel. Its purpose is to communicate information to the operator concerning the operating state of the printer.
LED	Light Emitting Diode.
logical link	The parameters that specify data transfer, control, or communication operations.
lpi	lines per inch. A measurement indicating the vertical spacing between successive lines of text. For example, 8 lpi means 8 lines of text for every vertical inch.
lpm	lines per minute: A speed measurement indicating the number of lines printed every minute. (lpm usually defines the speed at which text prints.)

M

monospaced	*See* font, monospaced.
MM	Millimeter.
MPL	Maximum Page Length. Also known as forms length. The number of lines that can be printed on a page.
MPP	Maximum Print Position. Also called line length.

N

N/A	Not available or not applicable.
NACK	Negative-Acknowledge reply. A reply from the printer to the host indicating that an exception has occurred. Contrast with acknowledge character.
NAK	Negative-Acknowledge character. A transmission control character transmitted by the printer as a negative response to an enquiry from the host.
NL	New Line (3287 only).
nibble	A unit of storage containing half of a byte, usually four bits.
NLQ	Near Letter Quality.
Not Ready mode	Offline. The printer is not ready to receive and process commands and data.
nS	Nanosecond (one billionth of a second)
NVFU	Direct Access Vertical Format Unit. *See also DAVFU.*
NVRAM	NonVolatile Random-Access Memory. A type of RAM in which stored data are not lost when the power is interrupted or turned off. A battery supplies power to NVRAM when the system does not. Unlike ROM (another type of nonvolatile memory), NVRAM is accessible and its contents can be altered.

O

OCR	Optical Character Recognition. A process by which a machine can "read" characters printed in a special standardized font. Data are read by a photoelectric optical scanner and recorded on magnetic tape or disk. OCR-A and OCR-B are two widely used OCR fonts.
off-line	An operational state in which the printer cannot accept commands or data from the host computer, but can perform self-tests, form settings, and record configuration changes.
Ohm	A unit of measurement for electrical resistance.
on-line	An operational state in which the printer is under direct control of the host computer. In this state, the printer accepts commands and data sent from the host computer, and acts on them immediately.

P

PA	Program Attention. Used in applications programs.
PAL	Programmable Array Logic
parity (check)	Parity checking is the addition of non-data bits to data, resulting in the number of 1 bits being either always even or always odd. Parity is used to detect transmission errors. Parity represents the value in the check digit of the received or transmitted data.
parsing	Parsing is the process of separating a programming statement into basic units that can be translated into machine instructions. A printer can recover from an erroneous code sequence by performing as much of the function as possible or, parsing the valid parameter from the invalid.
PC	Personal Computer.
PCB	Printed Circuit Board. A PCB is an insulating board on which circuit paths have been printed or etched.
PCBA	Printed Circuit Board Assembly. A PCBA is a PCB that has all of the electrical and mechanical components (resistors, capacitors, ICs, sockets, etc.) mounted on it.
PGL	Printronix Graphics Language. The software version of the old hardware based IGP that is used in the Printronix PSA line of printers. It provides the same forms and barcode generation capabilities as the IGP.
PI	Paper Instruction: A signal from the host with the same timing and polarity as the data lines.
pica	A name indicating a monospaced font with a pitch of 10 cpi and usually a 12 point height. Pica is used in typography as a unit of measurement equal to 1/6 inch.
pin configuration	Establishes the physical attachment and protocol conversion connections for the host interface.
pitch	The number of text characters printed per horizontal inch. Specified in characters per inch (cpi).
pixel	Derived from picture (PIX) ELement. The smallest displayable picture element on a video monitor or printable unit. In printing, a pixel is a dot.
PMPP	Physical Maximum Print Position. The longest line the printer is capable of printing. This differs from MPP in that the printer may be capable of printing lines 132 characters wide (PMPP), but the print job is only 80 characters wide (MPP). (*See also* MPP.)

point	A unit of length in printing and typography, used to specify type sizes, heights of font characters, etc. There are 72 points in a vertical inch; thus, one point equals 1/72 inch, or approximately 0.0138 inch. Some examples of point sizes are: This is 8 point type. This manual is printed in 10 point type. This is 14 point type.
POR	Power On Reset.
port	A channel used for receiving data from or transmitting data to one or more external devices.
portrait	Printed parallel to the short edge of a page.
Postnet	A bar code standard defined by the United States Postal Service.
print mode	Synonym for print attribute. Includes character attributes such as italic, underlining, super/subscript, as well as Draft, NLQ, and DP.
protocol	In general, a set of rules governing the exchange of information between computer systems. For printers, a protocol is the coding system used to convey and print characters and graphics. A printer protocol includes character codes, printer function codes, and machine-to-machine communication codes. In this manual, protocol and emulation mean the same thing. *See also* compatibility and emulation.
PSA	Printronix System Architecture. A print engine design that puts all data and electro-mechanical control logic on one circuit board. The use of flash memory on this board permits rapid access to stored printer emulations and fast processing of print data.

R

RAM	Random-Access Memory. Also called "main memory" or "working memory," this is the active memory of a printer, into which programs are loaded. This memory can be read from or written to at any time-hence the term "random-access." RAM is also termed "volatile" because whatever is in RAM is lost when power is turned off or interrupted. *See also* ROM.
RD	Receive Data. Serial data stream to the printer.
read	To retrieve data from memory (RAM, NVRAM) or mass storage (hard disk, floppy diskette, etc.).
Ready mode	Online. The printer is ready to receive and process commands and data.

reset	To turn off, deactivate, disable, or return to a previously determined state.
resolution	A measure expressing the number of units in a given range used to create an image. In printing, this is expressed as the number of dots per inch (dpi) horizontally and vertically.
ROM	Read-Only Memory. Programs, instructions, and routines permanently stored in the printer. ROM is not lost when power is turned off and cannot be written to-hence the term "read-only." ROM-resident fonts are fonts permanently stored in a printer and available at any time. *See also* RAM.
roman	A type style in which the characters are upright. This is sentence is printed in a roman type style.
RTS	Request To Send. Control signal from the printer.

S

SA	Set Attribute
SAA	Systems Application Architecture
sans serif	A typeface or font in which the characters do not have serifs. This font is sans serif.
SCS	System Network Architecture (SNA) Character String. Usually commands to set printer format, etc.
serial communications	The sequential transmission of data, in which each element is transferred in succession.
serial matrix	A type of printing technology used in some impact printers. Data are sent to the printer through either a serial or a parallel interface, but the print head must receive the data *serially* in order to form each character. The moving print head uses pins to form whole characters one at a time and one after the other. The pins print dots according to programmed *matrix* patterns. A *line matrix* printer also forms characters with dots in matrix patterns, but it feeds print data in parallel to many hammers mounted on a rapidly oscillating shuttle. The hammers fire simultaneously to print entire lines at a time.
serif	A short line stemming from and at an angle to the upper or lower end of the stroke of a letter or number character.

$$A \swarrow \text{ serif}$$
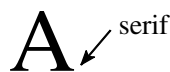
set	To turn on, activate, invoke, or enable.

SFCC	Special Function Control Character. The first character in a printer command sequence. In Proprinter III XL emulation mode, you can select one of five characters as the SFCC. In Epson emulation mode, the SFCC must always be the ASCII escape character (ESC). *See also* command sequence and escape sequence.
shadow printing	A typeface with a heavy line thickness produced by doublestriking. The printer forms a character, then prints it again, but fractionally offset from the first position. *See also* bold, character weight.
shuttle	The subassembly in a line matrix printer that includes the hammer bank assembly and some or all of the drive mechanism.
sixel	A vertical column consisting of six pixels and treated as a unit in graphics applications.
size, type	*See* point.
SLD	Set Line Density
slewing	Rapid vertical paper movement.
SNA	Systems Network Architecture. A hardware and software protocol used on IBM mainframe networks.
soft reset	*See* warm start.
SOH	Start Of Header
spacing	*See* font, proportional and font, monospaced.
SSCC	SuperSet Control Code. It is of the form SFCC	} ; and is used to execute superset commands.
start bit	The signal that indicates the start of a character or element in a serial data stream.
stop bit	The signal that indicates the end of a character or element in a serial data stream.
string	Two or more bytes of data or code treated as a unit.
style, type	*See* type style.
superset commands	Commands which are an extension to the base LinePrinter+ printer protocol, such as the bar code commands for the Epson FX protocol. *See also* SSCC.
symbol set	*See* character set.

T

TCB	Task Control Block

TD	Transmit Data. Serial data stream from the printer for transmitting status and control information to the host.
TOF	Top Of Form
TTL	Transistor-Transistor Logic.
true	On or 1. "High true" refers to a positive relative voltage representing the ON state; "low true" refers to a zero or negative relative voltage representing the ON state.
twinax	Twinaxial cable. An electrical signal conductor consisting of two wires surrounded by insulation and a braided shield. Used to connect computers to input or output devices.
type family	*See* typeface.
type size	*See* point.
type style	Refers to either the upright or italic character style in a specific font family. Roman is upright like this, *italic is slanted like this.*
typeface	A descriptive name or brand name that identifies a particular design of type. Also called type family.
typographic font	*See* font, proportional.

U

UPC	Universal Product Code.
USET	User-defined Set: An IGP command that creates custom character sets (except OCR fonts) from existing characters stored in memory.

V

VFU	Vertical Format Unit
VGL	Code V Graphics Language. An emulation of the QMS Code V Magnum firmware. The software version of the old hardware based IGP that is used in the Printronix PSA line of printers. It provides the same forms and barcode generation capabilities as the IGP.
VT	Vertical Tab

W

warm start	A reboot or soft reset. The following occurs: 1) data are cleared from all buffers (I/O and internal print buffers); 2) all internal system variables are reset to default values, which is transparent to the user; and 3) the power-up configuration values-except the host I/O selection-are loaded. If the user has not defined power-up configuration values, the printer resets to the factory default configuration values.
weight	*See* character weight.
word	1. A storage unit consisting of the number of bits that comprise one storage location in main memory. 2. The name used for a variable or constant in a program. 3. The data value occupying a storage location.
write	To place data in memory (RAM, NVRAM) or in mass storage (hard disk, floppy diskette, etc.).

X

X-OFF	A character transmitted by the printer announcing that the printer is off-line or the buffer is almost full.
X-ON	A character transmitted by the printer announcing that the printer is on-line or the buffer is almost empty.

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