EK-OLN03-RM-002

LN03

Programmer Reference Manual

Prepared by Educational Services
of
Digital Equipment Corporation

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INTRODUCTION

This manual describes how to use the LN03 printer with a host computer. The text provides information on how the printer communicates with the host, processes characters, and responds to escape and control sequences. You use escape and control sequences to send commands to the printer.

WHO SHOULD READ THIS MANUAL

The manual is intended for the application programmer. To use the manual, you should have some understanding of computer programming.

HOW TO USE THIS MANUAL

The following paragraphs provide a brief overview of the manual.

NOTE: The LN03 printer provides a variety of features, including several character sets and fonts. However, to take advantage of these features, your computer system must have software that can generate the commands in this manual.

Chapter 1 describes the general operating features and specifications of the printer. The chapter describes and shows the printer's components and controls.

Chapter 2 describes how the printer communicates with a host computer. The chapter also explains the functions of the printer's configuration switches. These switches let you set up the printer to communicate with your computer.

Chapter 3 describes how the printer processes characters. Among the topics covered are escape and control sequence formats, control characters, and 7-bit and 8-bit character sets.

Chapter 4 describes how to print from different character sets and fonts. The chapter describes the commands and procedures to load font files from the host computer.

Chapter 5 describes how to format your printed pages. The chapter lists and describes commands for features such as spacing, margins, tabs, line drawing, and justification.

Chapter 6 describes how you can print sixel graphics. You should have some understanding of sixel printing to use this information. The chapter explains how the printer converts binary data to sixel data.

Appendix A shows the different character sets the LN03 printer can print from.

Appendix B provides a summary of all the commands described in this manual. This appendix is a quick reference tool you can use after you become familiar with how LN03 commands work.

Appendix C compares the commands used by the LN03 and other Digital printers. The LN03 has a reasonable amount of compatibility with other Digital printers, such as the LA100 and LQP03. However, there are some differences in the way the printers handle the various control functions.

Appendix D describes how the LN03 identifies type families, fonts, and font files. This appendix also lists the IDs for the built-in type families, fonts, and font files.

Appendix E describes and shows a sample summary sheet you can print on your LN03. A summary sheet lists such information as fonts available in the printer and error codes. This appendix also lists the possible error codes.

Appendix F contains helpful hints, a problem-solving section, and examples of how to use basic LN03 control functions.

The glossary defines terms as they are used in this manual. Words that appear in the glossary are printed in *italic* type in the manual.

OTHER LN03 MANUALS

You can order the following LN03 manuals from Digital.

Title	Part Number
LN03 Programmer Reference Card	EK-LN03P-RC
LN03 Operator Reference Card	EK-0LN03-RC
Installing and Using the LN03	EK-0LN03-UG

CONVENTIONS USED IN THIS MANUAL

Standards

LN03 coding complies with the following ANSI (American National Standards Institute) and ISO (International Standards Organization) standards.

Standard	Topic
ANSI X3.98 – 1983	Page image format controls
ANSI X3.64 – 1979	Additional controls
ANSI X3.4	ASCII
ISO DIS 6937/3	Page image format controls
ISO 6429 – 1983	Additional controls

Character Codes

This manual follows the ANSI and ISO standards of column and row to represent coded characters from a character set. The column can be 0 to 15 (decimal) for the high-order 4-bits of an 8-bit byte. The row can be 0 to 15 (decimal) for the low-order 4-bits of the 8-bit byte. Chapter 3 describes this format in detail.

Control Codes

The LN03 can send and receive 8-bit data. When you use an 8-bit data format, you have more control codes available than in a 7-bit format. You can send 8-bit control codes as single 8-bit characters or as 7-bit sequences.

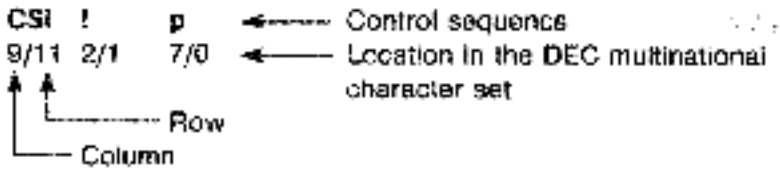
In this manual, 8-bit control codes appear as single 8-bit characters. Here are three important 8-bit control codes and their equivalent 7-bit sequences. Chapter 3 describes control codes in detail.

Control Code	8-Bit Character	7-Bit Sequence
Control sequence introducer	**CSI** 9/11	**ESC [** 1/11 5/11
Device control string introducer	**DCS** 9/0	**ESC P** 1/11 5/0
String terminator	**ST** 9/12	**ESC ** 1/11 5/12

Escape and Control Sequences

Escape and control sequences appear in their 8-bit format. The characters in the sequence are printed in **bold type.** Below each character is a number that shows you the character's column/row location in the DEC multinational character set. Chapter 3 describes this format in detail.

Example



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1.1 AN OVERVIEW

The LN03 laser printer is a tabletop, nonimpact page printer. An impact printer uses some mechanical method to strike a ribbon against the printed page. For example, a standard dot matrix printer uses a set of wires on a printhead. In place of a printhead, the LN03 uses laser imaging and xerographic printing techniques.

The LN03 prints letter-quality images on cut-sheet paper, at a rate of 8 pages per minute. You can use two sizes of paper, 8-1/2 x 11 or European A4.

1.1.1 Page Formats

The printer can print pages in two different orientations, portrait and landscape. In *portrait* orientation, characters print parallel to the short edge of the paper. For example, this page is printed in a portrait orientation. In *landscape* orientation, characters print parallel to the long edge of the paper. You can print in both orientations on the same page.

You can also select from 12 standard page formats, using the page format select command described in Chapter 5. These page formats let you change the size of the print area on the page.

1.1.2 Printing Styles

For each printing orientation, the printer has several monospaced fonts available. The printer comes with 4 fonts and 4 character sets permanently stored in read only memory (ROM). You select a font and a character set to print from.

The character set specifies the characters to print (for example, lowercase a). The font specifies the style used to print those characters (for example, elite). You can use any combination of font and character set, so you have 16 possible combinations to start with.

The four permanent fonts are called *ROM-resident* fonts. The ROM-resident fonts provide two different typefaces, or type families, to select from—courier and elite. Paragraph 1.3 lists these fonts.

Chapter 4 describes how to select different fonts and character sets for printing. If you are unfamiliar with printing terms such as *font*, *character set*, and *type family*, you should read the beginning of Chapter 4 and study the terms in the glossary.

The printer stores each ROM-resident font as a landscape font or a portrait font. The printer can automatically rotate a portrait or landscape font to the other orientation when needed, if enough random access memory (RAM) is available.

1.1.3 Loading Your Own Fonts and Character Sets

In addition to ROM-resident fonts, you can load other monospaced and proportionally spaced fonts from a host computer into the printer. This process is called *down-line-loading*. The printer stores these down-line-loaded fonts in RAM.

You can also install two memory cartridges in the printer's front panel. You can use ROM cartridges (for added fonts) or RAM cartridges (for added storage).

The printer supports 17 character sets for different nationalities (Appendix A). You can also down-line-load other sets from the host computer.

1.1.4 Printing Commands

The printer recognizes American National Standards Institute (ANSI) and International Standards Organization (ISO) control functions that let you select the following features.

character sets and fonts
tabs, margins, and spacing
subscripting and superscripting
overstriking, underlining, and italicizing
justification

The printer also provides these features.

error reporting
optional parity bit
variable baud rate

1.2 PRINTER COMPONENTS, CONTROLS, AND INDICATORS

Table 1-1 and Figure 1-1 describe and show the printer's components and controls. Table 1-2 and Figure 1-2 describe and show the indicator panel. Chapter 2 describes the configuration switches used in communicating with a host computer. For detailed operating and maintenance procedures, see your *Installing and Using the LN03* manual.

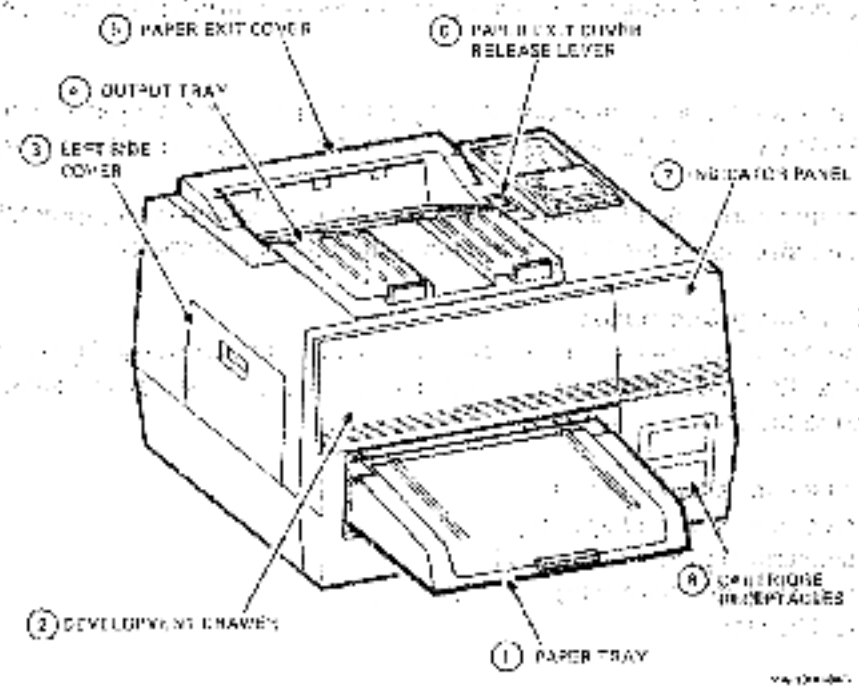

Figure 1-1 Printer Components (Part 1)

Table 1-1 LJ03 Printer Components

Component	Description
1 Paper tray	Holds up to 250 sheets of cut-sheet plain paper.
2 Print cartridge drawer	Opens to let you access toner cartridge and optional photo conductive (OPC) cartridge.
3 Left side cover	Opens to let you service the toner cartridge, photo conductive (OPC) cartridge, corona wire, fixing assembly, and registration roller.
4 Output tray	Printed sheets are automatically collected and stacked here.
5 Paper exit cover	Hinged cover; open only here. The cover cannot be removed. To remove jammed paper or service the fixing unit,
6 Paper exit cover extension	Lifts up to open the paper exit cover.
7 Indicator panel	Eight symbols on the panel turn on to indicate the printer's operating status.
8 Slot (cartridge)	You can install RAM or ROM cartridges in these slots. The cartridges provide additional memory and fonts.

CAUTION: If you remove cartridges while a page is being formatted or printed, you may lose data.

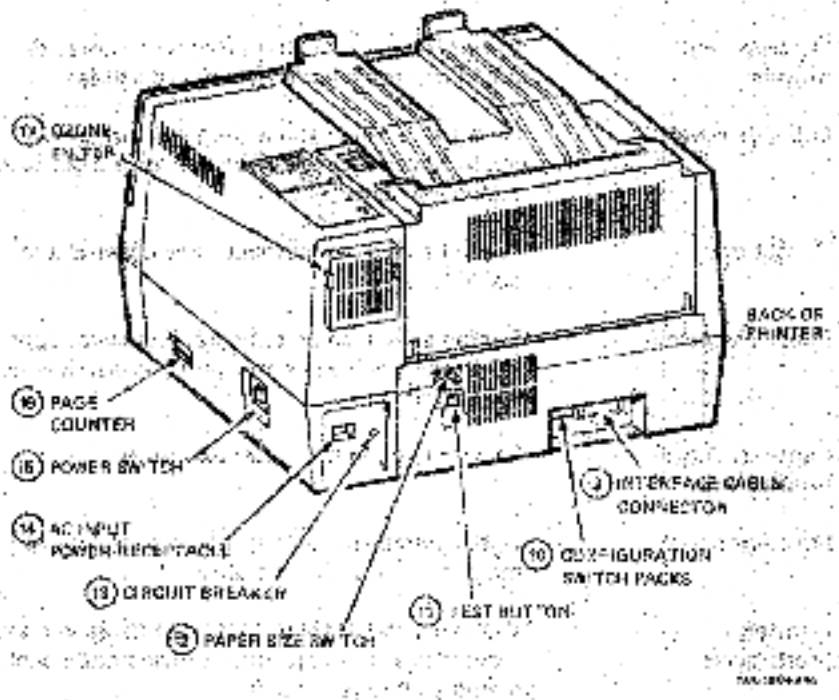

Figure 1-1 Printer Components (Part 2)

Table 1-1 Laser Printer Components (Cont'd)

Component	Description
9. Interface cable connector	Lets you connect the printer to a host computer.
10. Control panel and panel jacks	Lets you set the printer's operating state with your host computer.
11. Test button	Lets you turn the automatic self-test on the printer on or off.
12. Paper size switch	Lets you select letter-size (8.5 inch × 11 inch) or A4-size (210 mm × 297 mm) paper.
13. Drum cartridge	Contains the drum, developer, and primer under programming control. Prints the image.
14. AC input power receptacle	The AC power cord plugs into this receptacle.
15. Power switch	Turns the printer power on or off. Press	to turn power on. Press O to turn power off.
16. Paper output tray	Holds the number of sheets printed.
17. Cooling ventilator	Cools the printer during operation. Do not block the vents.

WARNING: Do not operate the printer without the ADF cover. Exposure to the printer laser beam could cause serious damage to your eyes.

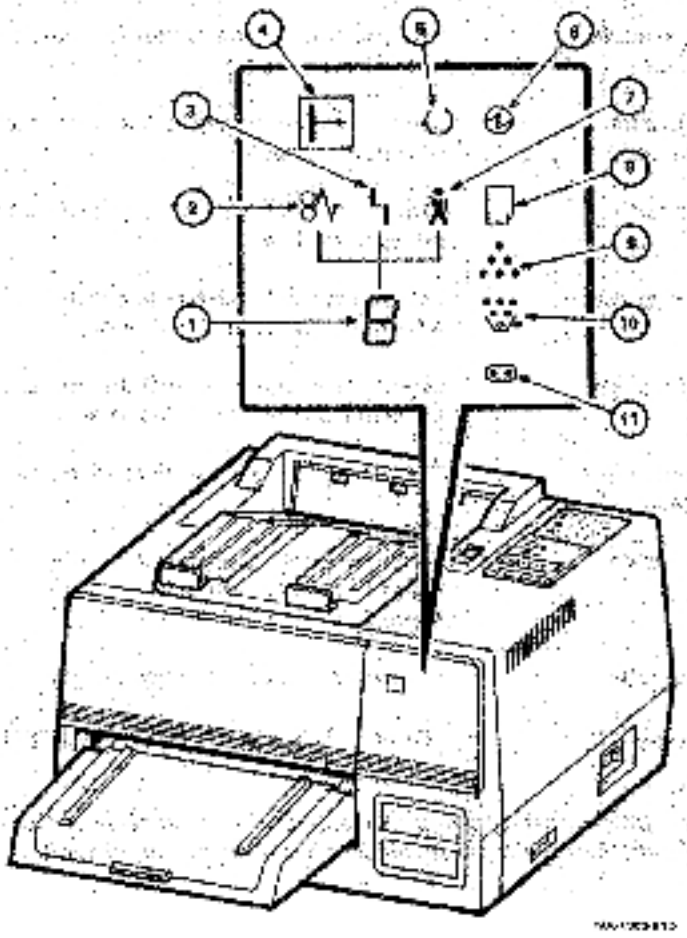

Figure 1-2 Indicator Panel

Table 1-2 Indicator Panel Symbols

Indicator	Description
1 Character display	Displays the number of the current page. Also displays page numbers when selecting from a printout.
	Displays the number of times you have tried to enter invalid data. Press the clear/cancel key to reset the display to zero.
	Displays a number to indicate a controller or port error. See the beginning of the self-help section, earlier in this chapter. See Appendix E for controller error codes.
	Displays the letter C when the calculator is ready to receive input or when you press the shift key.
2 Paper jam	Flashes while the character display shows the letter P or F. Indicates a paper jam in the printer or feed (F) error.
3 Controller error	Flashes with the character display indicator displays a number, indicating a controller error. See Appendix E for controller error codes.
4 On-line/attention button	Lets you place the printer on-line or return it to the off-line state. When the indicator light on the button is on, the printer is on-line.
	When the character display and color displays a prompt, press this button to send text to the printer.

NOTE: A flashing 8 indicates the display is busy.

Table 1-2. Indicator Panel Symbols (Cont)

Indicator	Description
9. Ready	Flashes to indicate the printer is warming up. When the ready/resume symbol is on, the printer is ready to print.
6. Power	Glows green as long as power is applied to the printer.
7. Cartridge error	Flashes while the character display shows a number or letter (listed below) indicating a toner cartridge error. May also flash while the cartridge error symbol is on, indicating a combination error. Character Error 1 Fuser 2 Optical system 3 Fuser and optical system 4 Optical error 5 Error 1 and 4 6 Error 2 and 4 7 Errors 1, 2, and 4 8 Motor error 9 Errors 1 and 8 A Errors 2 and 8 B Errors 1, 2, and 8 C Open cover F Failure to engage drive motor mainly
4. Add paper	Flashes to indicate you must add paper to the paper tray.
5. Add toner	Flashes to indicate you should remove the toner cartridge and mix the toner.
10. Clean overflow	Flashes to indicate the toner collection bottle is full or not installed.
11. Maintenance	Flashes to indicate the printer needs maintenance.

1.3 SPECIFICATIONS

The specifications for the LN03 printer are as follows.

Paper supply	single tray, 250-sheet capacity
Paper output	250-sheet hopper
Paper sizes	
Standard	8.5 in × 11 in (21.59 cm × 27.94 cm)
A4	21.0 cm × 29.7 cm (8.26 in × 11.7 in)
Paper weight	16 to 24 lb.*
Toner/developer	cartridge
Print speed	6 pages/minute
Print orientation	
Portrait	66 lines/page, 80 characters/line †
Landscape	66 lines/page, 132 characters/line †
Image area	
8-1/2 × 11 paper	2400 dots/scan line × 3225 scan lines
A4 paper	2400 dots/scan line × 3400 scan lines

* Use a high-quality paper such as Digital's LN03X-AF (standard size) or LN03X-AH (A4 size) to avoid paper jams caused by thin paper. You can also use transparency film designed for plain paper copiers, such as Digital's LN03X-AJ (standard size) or LN03X-AK (A4 size).

† These are typical pages. If you select fonts with a smaller point size or horizontal pitch, you can increase the number of lines per page and characters per line.

Resolution	300 dots per inch, 1-to-1 aspect ratio
Interface	EIA RS232-C and CCITT V.24
ROM-resident fonts	
Type family	
Courier	ASCII 10 point, 10 pitch DEC supplemental 10 point, 10 pitch DEC technical 10 point, 10 pitch VT100 line drawing 10 point, 10 pitch
	ASCII 10 point, 10.3 pitch DEC supplemental 10 point, 10.3 pitch DEC technical 10 point, 10.3 pitch VT100 line drawing 10 point, 10.3 pitch
	ASCII 6.7 point, 13.6 pitch DEC supplemental 6.7 point, 13.6 pitch DEC technical 6.7 point, 13.6 pitch VT100 line drawing 6.7 point, 13.6 pitch
Elite 12	ASCII 10 point, 12 pitch DEC supplemental 10 point, 12 pitch DEC technical 10 point, 12 pitch VT100 line drawing 10 point, 12 pitch
Pitch	
Horizontal	5, 6, 8, 10, 12, 16 characters/inch, plus any numeric value in 1-pixel increments and proportional fonts
Vertical	2, 3, 4, 6, 8, 12 lines/inch, plus any numeric value in 1-pixel increments and proportional fonts

Weight	60 lbs maximum
Dimensions	
Height	33.1 cm (13 in)
Width	53.4 cm (21 in)
Depth	40.7 cm (16 in)
Power requirements	1 kVA maximum
LN03-A2	100 V to 120 V, 50/60 Hz
LN03-A3	220 V to 240 V, 50 Hz

2 COMMUNICATION

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2.1 THE LN03 AND YOUR HOST COMPUTER

This chapter describes how the LN03 communicates with a host computer. The chapter also describes the configuration switches that control certain communication features on the printer.

2.2 DATA FORMAT

The LN03 communicates using a serial data interface and a serial character format that has 7 or 8 data bits. The serial character format has a start bit (space), 7 or 8 data bits (1 = mark, 0 = space), a selectable parity bit, and a stop bit (mark). Figure 2-1 shows this format.

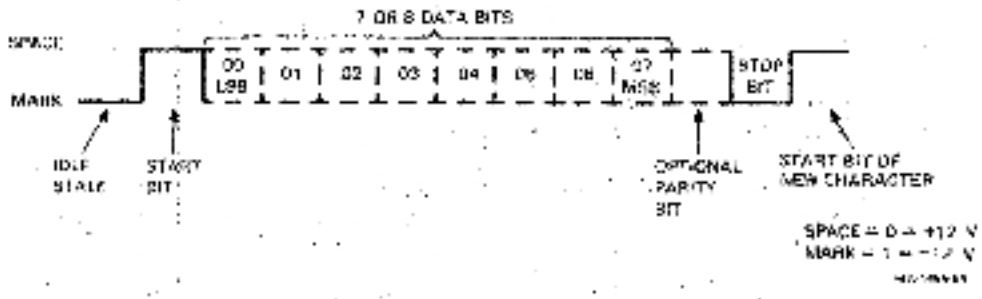

Figure 2-1 Serial Character Format

The printer can receive characters with one or more stop bits. The data bits represent character codes, with the least significant bit leading. You can select the parity bit by switch (Paragraph 2.4.2). You must enable parity error detection.

The printer recognizes the printable and control characters from 17 character sets (Appendix A).

2.3 DATA INTERFACE

The LN03 uses a serial data interface that conforms mechanically to Electronic Industries Association (EIA) standard RS232-C, functionally to a data subset of RS449, and electrically to RS423. The interface connector is a 25-pin, DB-25 male receptacle on the back of the printer's cabinet.

All LN03 interface signals conform to the electrical requirements of EIA standard RS232-C and International Telegraph and Telephone Consultative Committee (CCITT) recommendation V.24. Table 2-1 lists the printer's interface signals and describes their functions.

Table 2-1. LAN3 interface signals

Pin	Name (Mnemonic)	Circuit CCITT/EIA	Description
1	Protective ground (PGND)	101/AA	PGND connects the printer's chassis to external grounds (via the ground wire in the power cord).
2	Transmitted data (TXD)	103/BA	*Source: Printer* The printer sends serial-coded characters on TXD. You can select different baud rates via the configuration switches. (Paragraph 2.4.1)
3	Received data (RXD)	104/BB	*Source: User* The printer receives serial-coded data on RXD. The baud rate is the same as for transmitted data.
4	Request to send (RTS)	105/CA	*Source: Printer* The printer sets RTS to a steady on condition when ready to send data.
5	Clear to send (CTS)	106/CB	*Source: User* The host supplies CTS, so the printer can send data when ready.
6	Data set ready (DSR)	107/CC	*Source: User* The host asserts DSR when ready to send and receive data.
7	Signal ground (SGND)	102/AB	SGND establishes the common ground reference potential for all interface circuits.
8	Carrier detect (RLSD)	109/CF	*Source: User* The host asserts RLSD when receiving acceptable data from the printer. RLSD is also called receive line signal detect.

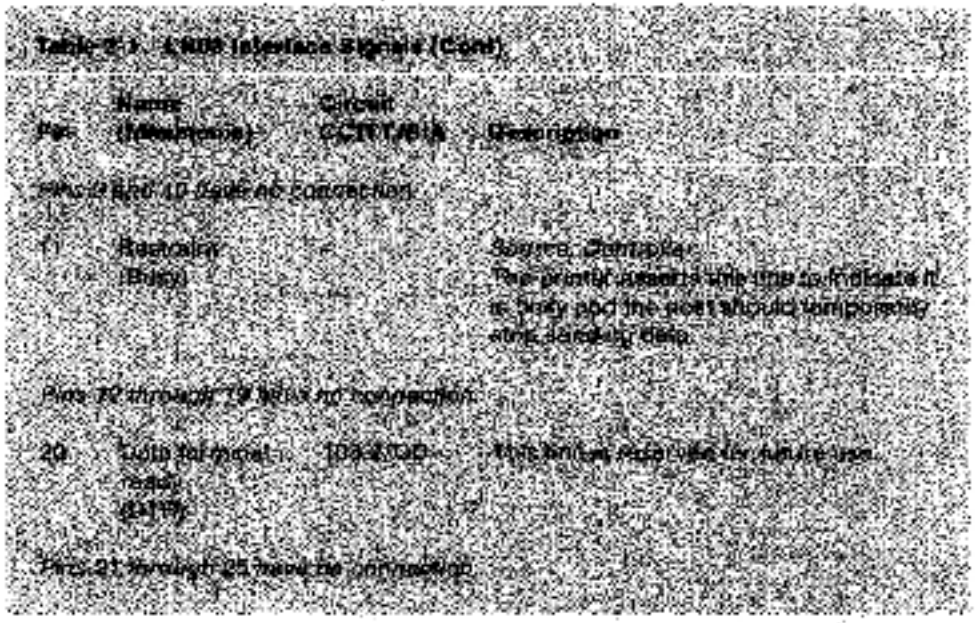

Table 2-1 LN03 Interface Signals (Cont)

Pin	Name (Mnemonic)	Circuit CCITT/EIA	Description
Pins 9 and 10 have no connection.			
11	Receiving (Busy)		Source: Computer The printer asserts this line to indicate it is busy and the host should temporarily stop sending data.
Pins 12 through 19 have no connection.			
20	Data terminal ready (DTR)	108.2/CD	This line is not used by the printer.
Pins 21 through 25 have no connection.			

2.4 CONFIGURATION SWITCH PACKS

The LN03 has two 6-position DIP switch packs that control the following operating features on the printer. These switch packs are on the back of the printer. The switches are preset to work with most Digital systems. You can set these switches to meet the requirements of your host computer. The printer checks the state of these switches only at power-up.

Interface type	Parity bit
Baud rate	Printer ID
7 or 8 data bits	Autowrap
Parity enable/disable	XON/XOFF or restraint protocol

You can check the switch settings by printing a summary sheet (test pattern similar to Figure 2-2. To print a summary sheet, perform these two steps.

1. Place the printer off-line by pressing the on-line/off-line indicator button on the front panel. The indicator should turn off.

2. Press the test button (marked T) on the back of the printer.

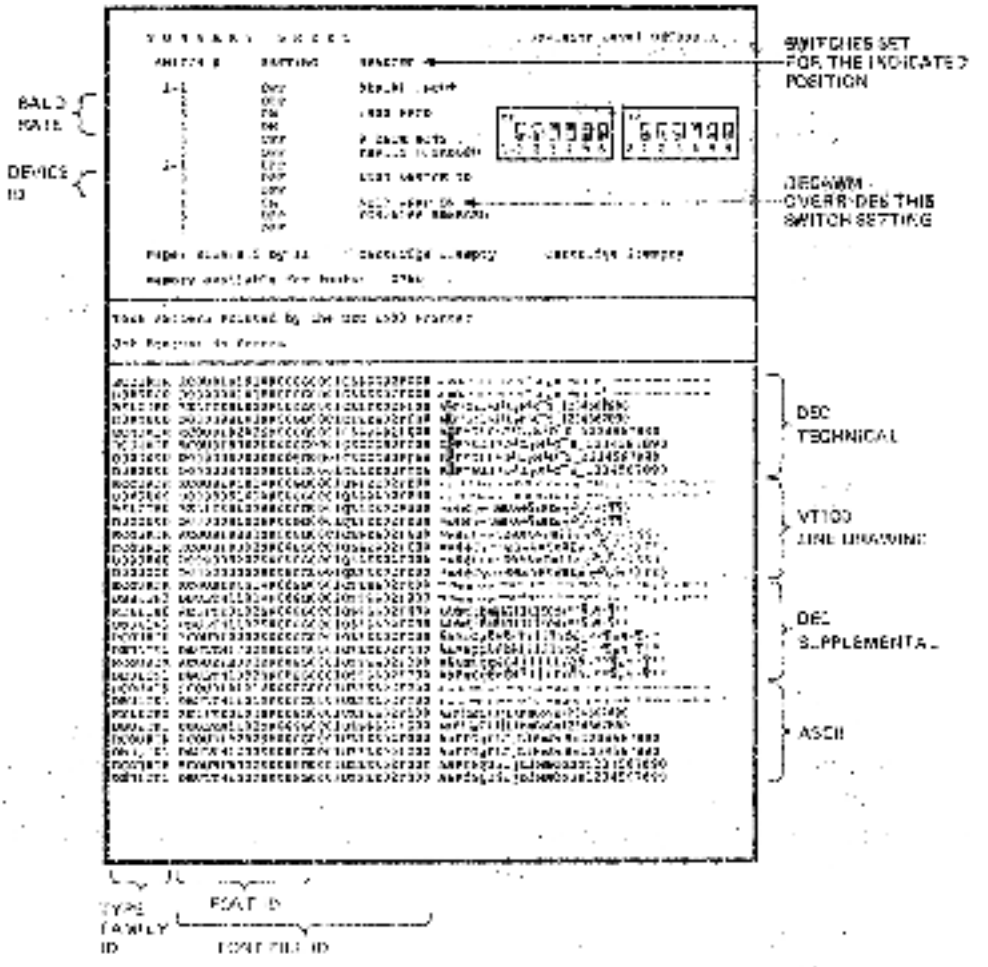

Figure 2-2 Summary Sheet Test Pattern

The summary sheet shows you the current switch settings (off or on) and explains their meaning. The sheet also lists the available fonts and any printer errors.

NOTE: The LN03 monitors switch settings only at power-up. Turn the power off before changing any switch setting.

The following paragraphs describe the function of each switch. Both switch packs have the **on** position labeled (Figure 2-3). Use a ball point pen or small screwdriver to change switch settings.

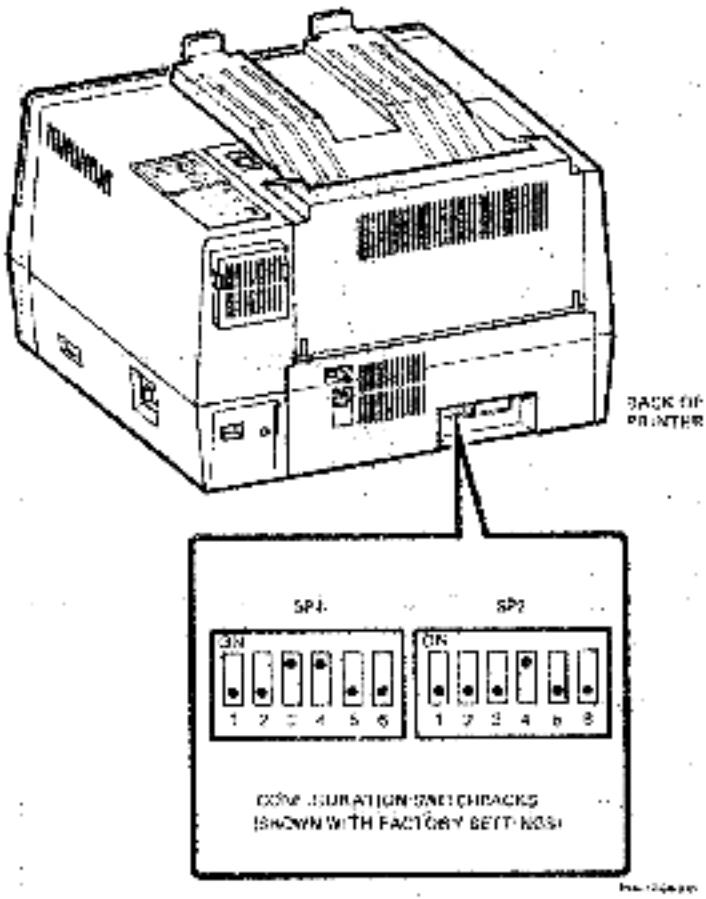

Figure 2-3 Configuration Switches

2.4.1 Switch Pack 1 (SP1)

Switch pack 1 controls the printer's interface type, baud rate, and data format (7 or 8 bits). Switch pack 1 also enables or disables parity checking.

Interface Type (SP1-1)

This switch is set to match the data communication interface, either serial or parallel (future option).

SP1	Function
On	Parallel interface
Off	**Serial interface (factory setting)**

Baud Rate (SP1-2, SP1-3, and SP1-4)

These switches select the transmit/receive speed the printer uses to communicate with the computer.

SP1-2	SP1-3	SP1-4	Baud Rate
Off	Off	Off	1200
Off	Off	On	2400
Off	On	Off	3600
Off	**On**	**On**	**4800 (factory setting)**
On	Off	Off	7200
On	Off	On	9600
On	On	Off	19200
On	On	On	19200

7 or 8 Data Bits (SP1-5)

This switch is set to match the character format used by the host computer, either 7 or 8 data bits.

SP1-5	Function
On	7 data bits
Off	**8 data bits (factory setting)**

Parity Enable (SP1-6)
This switch enables or disables parity. If enabled, the printer checks the parity bit selected by switch **SP2-1**.

SP1-6	Function
On	Parity enabled
Off	**Parity disabled (factory setting)**

2.4.2 Switch Pack 2 (SP2)

Switch pack 2 controls the type of parity bit checked, the printer's identification (ID) response, the autowrap feature, and XON/XOFF or restraint protocol.

Parity Bit (SP2-1)
If switch **SP1-6** is on, switch **SP2-1** selects the type of parity bit the printer checks for and sends.

In 7-bit mode, the printer can

- check for odd parity and send a space parity bit, or
- check for even parity and send a mark parity bit.

In 8-bit mode, the printer can only check and send even or odd parity. Switch **SP1-5** selects 7-bit or 8-bit mode.

SP2-1	Function	
	7-Bit Mode	*8-Bit Mode*
On	Check odd, send space parity.	Check and send odd parity.
Off	Check even, send mark parity.	Check and send even parity.

Device ID Select (SP2-2 and SP2-3)
These switches set the printer identification (ID) response to LN03, LQP02, or LA100. These switches are usually set for an LN03 ID response, except when the printer is connected to a system that requires an LQP02 or an LA100 ID response. These switches do not affect the printer's response to control functions.

SP2-2	SP2-3	Device ID
Off	**Off**	**LN03 (factory setting)**
Off	On	LQP02
On	Off	LA100
On	On	LN03 (same as factory setting)

Autowrap (SP2-4)
This switch selects the method of controlling a line of characters that exceed the right margin. If you select no wrap, the printer drops characters exceeding the right margin. If you select autowrap, the printer prints characters exceeding the right margin on the next line.

The printer remains in this state, unless you send an autowrap mode (DECAWM) sequence to override the switch setting. A soft terminal reset (DECSTR) or a reset to initial state (RIS) sequence resets the printer to the state selected by the switch setting. Chapter 5 describes the DECAWM, DECSTR, and RIS sequences.

SP2-4	Function
On	**Autowrap (factory setting)**
Off	No wrap

XON/XOFF or Restraint Protocol (SP2-5)
This switch selects XON/XOFF or restraint protocol for data transmission.

SP2-5	Function	Description
On	Restraint	Para. 2.5.4
Off	**XON/XOFF (factory setting)**	Para. 2.5.2

Restraint Polarity (SP2-6)
This switch selects the polarity of the restraint signal when you use restraint protocol (SP2-5) for data transmission.

SP2-6	Function
On	Inverted
Off	**Normal (factory setting)**

2.5 DATA SYNCHRONIZATION

The data flow between the printer and host computer must be synchronized. To synchronize the data flow, the LN03 uses an input buffer and either XON/XOFF protocol or a restraint line.

2.5.1 Input Buffer

The printer has an input buffer that can hold up to 1,000 characters. This buffer allows the printer and host computer to communicate independent of printing speed.

The printer temporarily stores all received characters (other than NUL and DEL) in the buffer before processing them. A SUB control character replaces any character received with an error (for example, a parity error). The printer reports these errors on the summary sheet (Figure 2-2) and prints a reverse question mark ⸮ in place of the character.

2.5.2 XON/XOFF Protocol

The XON/XOFF protocol lets the printer prevent the input buffer from overflowing. Otherwise, you might lose data if the printer stops (due to a paper-out condition, for example) or if the communication speed is greater than the print speed.

To control the input buffer, the printer sends XON and XOFF control characters to the host computer. An XON character informs the host it can send data to the printer. An XOFF character informs the host to temporarily stop sending data, because the input buffer is full. The printer also sends an XOFF character when an error occurs (for example, an open cover or paper jam) or when the printer is off-line.

After the printer is powered up and ready to operate, it sends an XON character to the host. The printer loads data from the host into the input buffer, until the buffer holds 750 characters. Then the printer sends an XOFF character to the host. If the host does not stop sending data, the printer sends a second XOFF character when the buffer holds 875 characters.

As the printer processes characters, the buffer empties. When the buffer holds less than 750 characters, the printer sends an XON character to the host. This method maintains the buffer within its capacity.

2.5.3 XON/XOFF Summary

The printer sends an XON control character following an XOFF condition if all the following conditions become true.

XON Conditions

- The printer is ready.
- All faults are cleared.
- There are less than 750 characters in the input buffer.

The printer sends an XOFF control character when any of the following conditions become true.

XOFF Conditions

- The printer is not ready.
- A fault condition occurs.
- There are 750 characters in the input buffer.
- There are 875 characters in the input buffer.
- The printer is ready to send a report.

2.5.4 Restraint Line

The printer can use a restraint line to tell the host computer to stop sending data. The printer must use a restraint line when the host or software does not recognize the XON/XOFF protocol. The restraint line is in addition to the normal data lines.

When the restraint line is asserted according to the restraint polarity (SP2-6), the host cannot send data. On some systems, the restraint line is called ready/busy.

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3.1 RECEIVING 7-BIT AND 8-BIT DATA

This chapter describes how the LN03 responds to received character codes. The printer processes received characters according to ANSI standard X3.4-1977 and ISO standard ISO DIS 2022-1984.

Received characters include printable characters and control functions. Control functions control how the printer processes, sends, and prints characters. Control functions include control characters, control strings, and escape and control sequences. Appendix C compares the control functions used in the LN03 and other Digital printers.

The printer can process 7-bit and 8-bit data. The following paragraphs explain how 7-bit and 8-bit character codes are represented in character set tables. Paragraphs 3.3.1 and 3.3.2 explain how to convert from a 7-bit to an 8-bit or from an 8-bit to a 7-bit environment.

3.1.1 7-Bit Code Table

A code table is a convenient way to represent 7-bit and 8-bit characters, because you can see groups of characters and their relative codes clearly. Figure 3-1 is the 7-bit ASCII code table. There are 128 character code positions arranged in a matrix of 8 columns and 16 rows.

	BITS	0	1	2	3	4	5	6	7
0		NUL		SP	0	@	P	`	p
1			DC1 (XON)	!	1	A	Q	a	q
2				"	2	B	R	b	r
3			DC3 (XOFF)	#	3	C	S	c	s
4				$	4	D	T	d	t
5				%	5	E	U	e	u
6				&	6	F	V	f	v
7				'	7	G	W	g	w
8		BS	CAN	(	8	H	X	h	x
9		HT		)	9	I	Y	i	y
10		LF	SUB	*	:	J	Z	j	z
11		VT	ESC	+	;	K	[	k	{
12		FF		,	<	L	\	l	|
13		CR		-	=	M	]	m	}
14		SO		.	>	N	^	n	~
15		SI		/	?	O	_	o	DEL

KEY

ESC	ASCII MNEMONIC
27	DECIMAL
33	OCTAL
1B	HEX

Figure 3-1 7-Bit ASCII Code Table

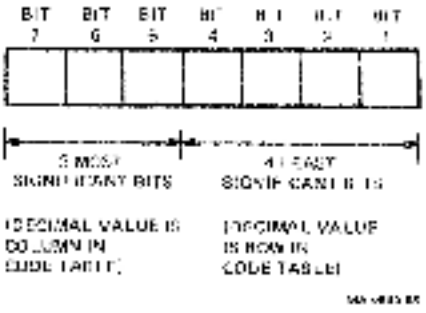

Figure 3-2 7-Bit Code

Each row represents a possible value of the four least significant bits of a 7-bit code (Figure 3-2). Each column represents a possible value of the three most significant bits.

Figure 3-1 shows shows each character with its binary, octal, decimal, and hexadecimal code. You can also represent any character by its position in the table. For example, the character H (column 4, row 8) can be represented as 4/8.

The printer processes received characters based on their ANSI character type, either printable or control. You can determine a character's type by its position in the standard character set.

Columns 2 through 7 of Figure 3-1 contain printable ASCII characters, except for the space (SP) and delete (DEL) characters. SP (2/0) can be considered a printable character or a control character, because it occupies space in memory and on paper. DEL (7/15) is always used as a control character.

Columns 0 and 1 of Figure 3-1 contain control characters.

3.1.2 8-Bit Code Table

In general, the conventions for 7-bit character codes also apply to 8-bit character codes. Figure 3-3 shows the layout of an 8-bit code table. It has twice as many columns as the 7-bit table and contains 256 (versus 128) character code positions.

COLUMN / ROW	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
00	NUL	DLE	SP							DCS	//					
01	SOH	DC1								PU1						
02	STX	DC2								PU2						
03	ETX	DC3								STS						
04	EOT	DC4							IND	CCH						
05	ENQ	NAK							NEL	MW						
06	ACK	SYN							SSA	SPA						
07	BEL	ETB							ESA	EPA						
08	BS	CAN							HTS							
09	HT	EM							HTJ							
10	LF	SUB							VTS							
11	VT	ESC							PLD	CS						
12	FF	FS							PLU	ST						
13	CR	GS							RI	OSC						
14	SO	RS							SS2	PM						
15	SI	US						DEL	SS3	APC						//

C0 CODES | GL CODES | C1 CODES | GR CODES

7-BIT CODE TABLE

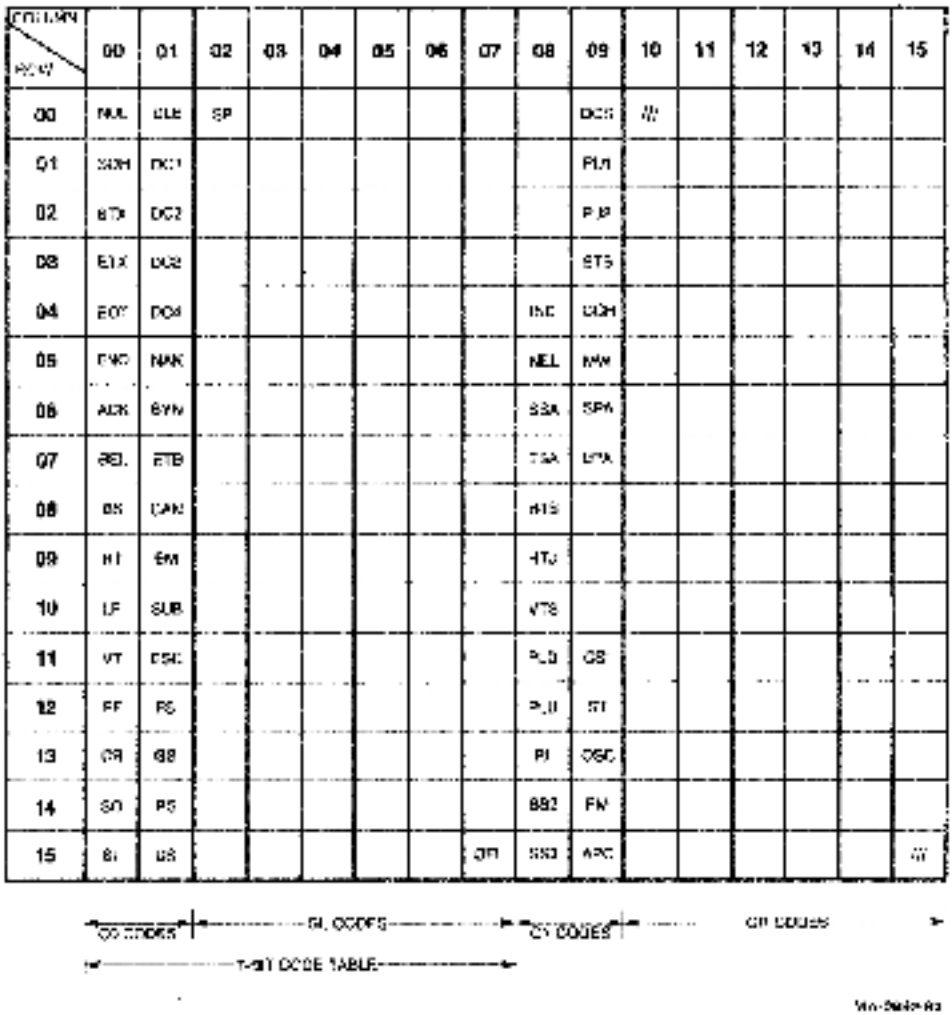

Figure 3-3 8-Bit ASCII Code Table

The 8-bit code table (Figure 3-3) has two sets of control characters, C0 (control 0) and C1 (control 1). The table also has two sets of printable or graphic characters, GL (graphic left) and GR (graphic right).

On the printer, the basic functions of the C0 and C1 control codes are defined by ANSI. C0 codes represent the ASCII control characters described earlier. The C0 codes are 7-bit compatible. The C1 codes represent 8-bit control characters that let you perform more functions than possible with the C0 codes. You can only use C1 codes directly in an 8-bit environment.

As with the 7-bit table, each row represents a possible value of the four least significant bits of an 8-bit code (Figure 3-4). Each column represents a possible value of the four most significant bits.

All codes on the left half of the 8-bit table (columns 0 through 7) are 7-bit compatible. Their eighth bit is not set and can be ignored or assumed to be 0. You can use these codes in either a 7-bit or 8-bit environment. All codes on the right half of the table (columns 8 through 15) have their eighth bit set. You can use these codes only in an 8-bit compatible environment.

The GL and GR sets of codes are reserved for printable characters. There are 94 GL codes in positions 2/1 through 7/14. There are 94 GR codes in positions 10/1 through 15/14. By ANSI standards, positions 10/0 and 15/15 are not used. You can use GL codes in 7-bit or 8-bit environments. You can use GR codes only in an 8-bit environment.

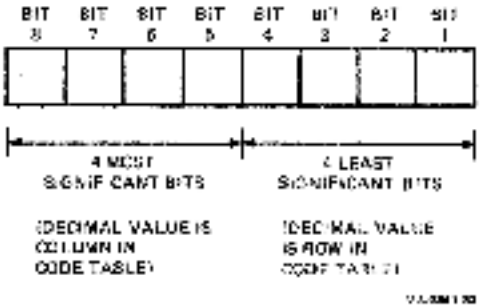

Figure 3-4 8-Bit Code

3.1.3 DEC Multinational Character Set

Figure 3-5 shows the DEC multinational character set. This 8-bit character set is the default character set when you turn the printer on.

The 7-bit compatible left half of the DEC multinational set is the ASCII graphic set. The C0 codes are the ASCII control characters, and the GL codes are the ASCII graphic (printable) characters.

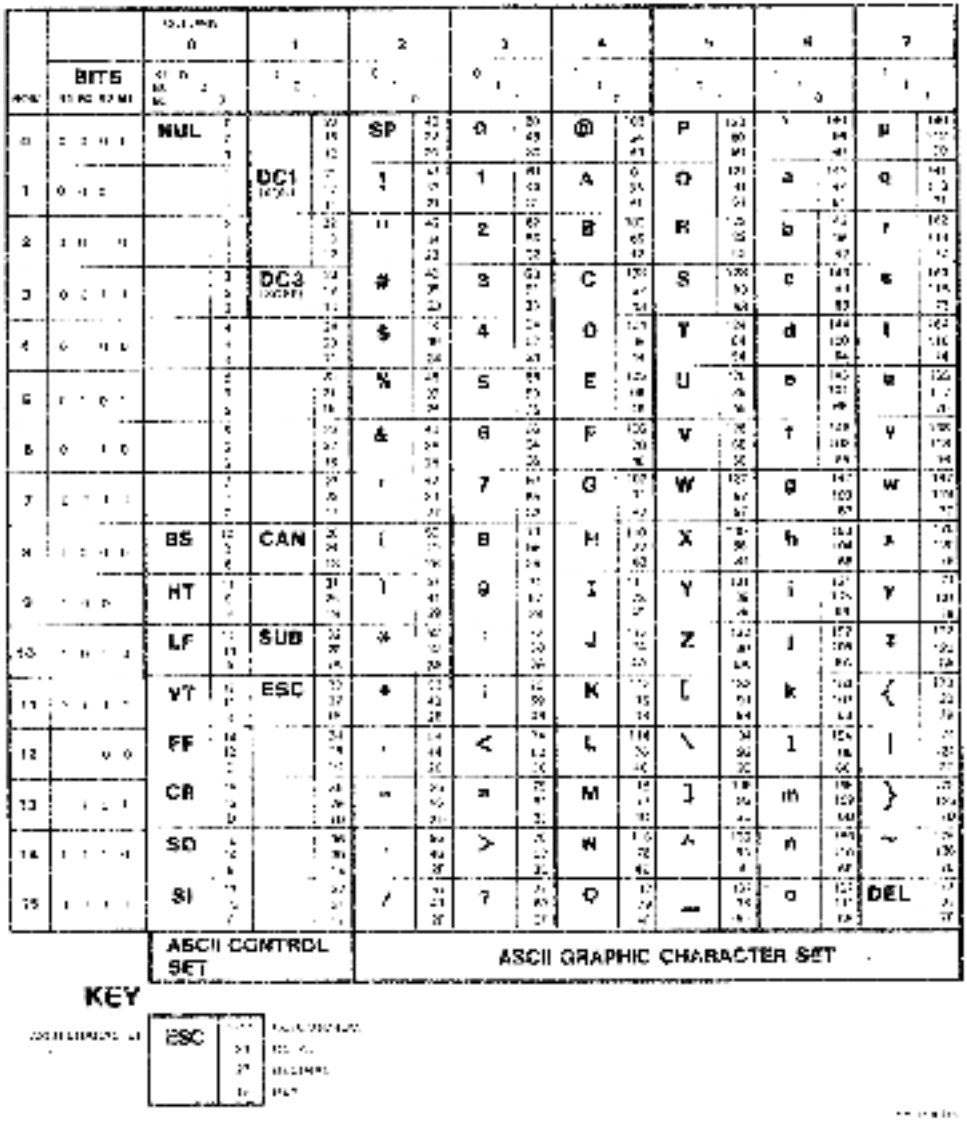

Figure 3-5 DEC Multinational Character Set (Left Half)

The 8-bit compatible right half of the DEC multinational set includes the C1 8-bit control characters in columns 8 and 9. The GR codes are the DEC supplemental graphic set. The DEC supplemental graphic set includes accented letters and other symbols not included in the ASCII graphic set.

The following paragraphs describe the various types of characters and how they control printer functions (such as setting margins and tabs).

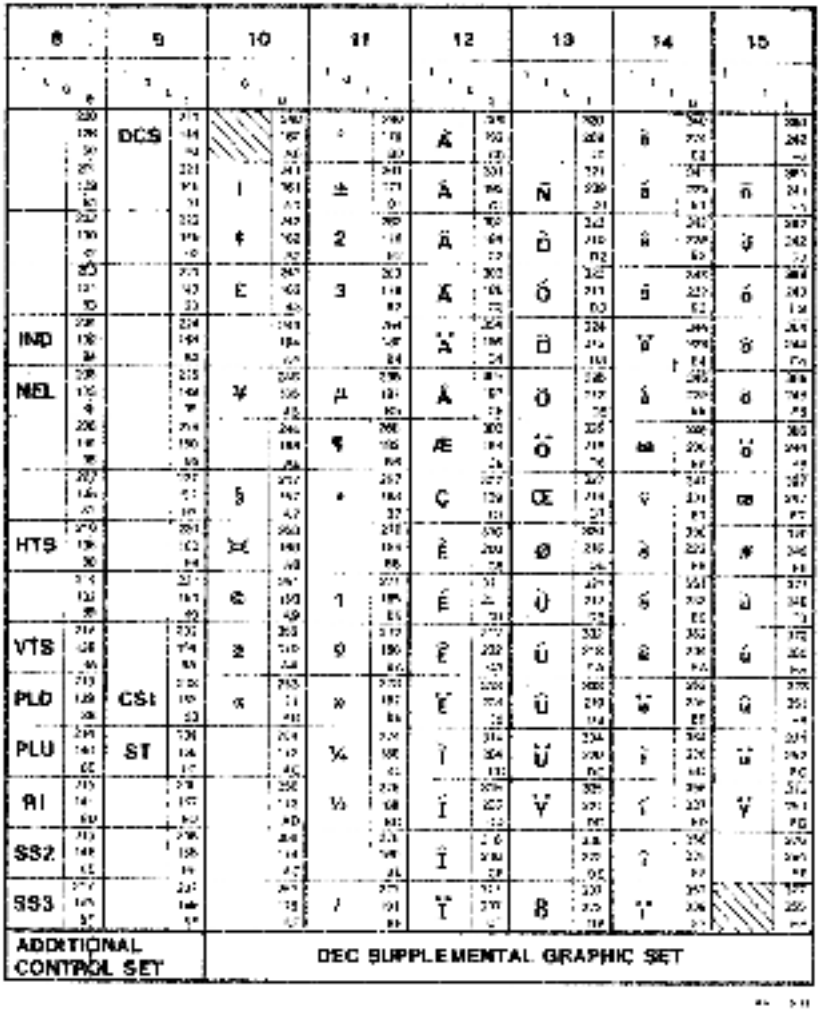

Figure 3-5 DEC Multinational Character Set (Right Half)

3.2 PRINTABLE CHARACTERS

The printer prints ASCII graphic characters as received. Characters from position 2/0 through position 7/14 in 7-bit character sets (and from position 10/0 through position 15/15 in 8-bit character sets) are usually interpreted as printable characters.

The printer prints characters at the *active position* on the current page. The active position is defined by an active column (horizontal position) and an active line (vertical position). After printing a character, the printer increments the active column. After printing a line, the printer increments the active line.

The size of these increments depends on the font you are using or any control functions you send before the printable characters.

NOTE: The actual characters printed depend on the printable character set used. Paragraph 4.3 explains how to select different character sets. Appendix B shows the character sets the printer can process.

If the spacing is based on the current font, each printable or space character increases the active column by one space increment (determined by the font). If the active position is within the printable region, each printable character or space character prints and the active column increases as required.

When the printer reaches the right margin, the autowrap feature determines what happens to printable characters. If you select the no wrap setting, characters are lost. If you select the autowrap setting, the printer performs an automatic carriage return and line feed before printing the next character. You can set the autowrap feature with configuration switch **SP2-4** (Paragraph 2.4.2) or the autowrap mode sequence (Paragraph 5.2.3).

3.3 CONTROL CHARACTERS

Control characters do not print. They usually cause the printer to perform some action. For example, the HTS control character sets a horizontal tab. There are two groups of control characters.

C0 (columns 0 and 1 in all character sets)
C1 (columns 8 and 9 in 8-bit character sets)

Table 3-1 lists the C0 control characters that the LN03 recognizes. Table 3-2 lists the C1 control characters that the printer recognizes. Both tables give column/row locations to help you find each character in the character sets. The printer ignores any control characters not listed in the tables.

You can use an alternative method to send C0 control characters from your input keyboard. To send a character from the keyboard, you hold down the **Ctrl** key and press a second key specified in Table 3-1.

NOTE: You do not convert printable characters.

Columns 8 and 9 of the DEC multinational character set (Figure 3-5) contain 8-bit C1 control characters. In 7-bit mode, these characters are coded as 2-character escape sequences of the form:

ESC Fe
1/11

where

ESC is the escape character
Fe is a final character from columns 4 and 5 from Figure 3-5.

Table 3-3 lists equivalent 8-bit and 7-bit control characters. The following paragraphs explain each conversion process.

Table 3-1 C0 Control Characters

Name	Mnemonic Column/Row	Key Pressed With Ctrl	Function
Null	NUL 0/0	2	NUL has no function ignored by the printer).
Backspace	BS 0/8	H	BS moves the active position back one character position on the active line.
Horizontal tab	HT 0/9	I	HT advances the active tab position to the next horizontal tab stop on the line or to the right margin if there are no more tab stops. Initially, the printer sets a horizontal tab stop every eight characters. Tab stops may be associated with column numbers, not physical positions on the paper. Changing the origin (Para. 5.2.6) changes the physical position of tab stops.
Line feed	LF 0/10	J	LF advances the active line vertically by one line. If less than one vertical line space remains on the page, LF sets the active line to the first active position on the next page. If line feed/new line mode (LNM) is set, LF also advances the active column to the left margin.
Vertical tab	VT 0/11	K	VT moves the active line to the next vertical tab stop. Initially, the printer sets a vertical tab stop for every line on the page.
Form feed	FF 0/12	L	FF advances the active line to the first printable position on the next page.
Carriage return	CR 0/13	M	CR returns the active column to the left margin. If carriage return/new line mode is set, CR also advances the active line to the next line.

Table 3-1 C0 Control Characters (Cont)

Name	Mnemonic Column/Row	Key Pressed With Ctrl	Function
Shift out	SO 0/14	N	SO locks character set G1 into GL.
Shift in	SI 0/15	O	SI locks character set G0 into GL.
Device control 1	DC1 (XON) 1/1	Q	DC1 tells the host that the printer is ready to receive data.
Device control 3	DC3 (XOFF) 1/3	S	DC3 tells the host to pause before sending more data, until the printer sends DC1.
Cancel	CAN 1/8	X	CAN immediately ends an escape or control sequence in progress. The printer interprets the characters following CAN as data. CAN also cancels a device control string (DCS) when received within the command string of the DCS.
Substitute	SUB 1/10	Z	SUB immediately ends an escape or control sequence in progress. SUB replaces a character received with an error in the sequence. SUB prints as a space character for invalid data.
Escape	ESC 1/11	[	ESC introduces an escape or control sequence. When received in the middle of a sequence, ESC immediately ends the sequence and starts a new sequence. ESC also immediately ends a device control string.
Delete	DEL 7/15		DEL is ignored and does not cause any printer action.

Table 3-2 C1 Control Characters

Name	Mnemonic Column/Row	Function
Index	IND 4/4	IND moves the active position down to the same position on the next line. If the new position is below the bottom margin, the active position moves to the top of the next page.
Next line	NEL 4/5	NEL moves the active position to the left margin on the next line. If the new position is below the bottom margin, the active position moves to the top of the next page.
Horizontal tab set	HTS 4/8	HTS sets a horizontal tab at the active column.
Vertical tab set	VTS 4/10	VTS sets a vertical tab at the active line.
Partial line down	PLD 4/11	PLD moves the active position down one-half line. The distance moved is specified as a parameter of the function (set by SVS, SPI, or DECAVEPP sequences).
Partial line up	PLU 4/12	PLU moves the active position up one-half line. The distance moved is specified as a parameter of the function (set by SVS, SPI, or DECAVEPP escape sequences in Chapter 5).
Reverse index	RI 4/13	RI moves the active position up to the same point on the preceding line.
Single shift 2	SS2 4/14	SS2 invokes character set G2 into GL to print one character.
Single shift 3	SS3 4/15	SS3 invokes character set G3 into GL to print one character.
Device control string	DCS 5/0	DCS introduces a device control string.
Control string introducer	CSI 5/11	CSI introduces a sequence of one or more bytes that defines a control function.
String terminator	ST 9/12	ST indicates the end of a device control string (DCS).

Table 3-3 Equivalent 7-Bit and 8-Bit Control Characters

Name	8-Bit Character	7-Bit Sequence
Index	IND 8/4	ESC D 1/11 5/4
New line	NEL 8/5	ESC E 1/11 4/5
Horizontal tab set	HTS 8/8	ESC H 1/11 4/8
Vertical tab set	VTS 8/10	ESC K 1/11 4/10
Partial line down	PLD 8/11	ESC L 1/11 4/11
Partial line up	PLU 8/12	ESC M 1/11 4/12
Reverse index	RI 8/13	ESC M 1/11 4/13
Single shift 2	SS2 8/14	ESC N 1/11 4/14
Single shift 3	SS3 8/15	ESC O 1/11 4/15
Device control string	DCS 9/0	ESC P 1/11 5/0
Control string introducer	CSI 9/11	ESC [1/11 5/11
String terminator	ST 9/12	ESC \ 1/11 5/12

NOTE: You do not convert the printable characters in columns 02 through 7/15 of 8-bit character sets.

3.3.1 7-Bit to 8-Bit Conversion

You can convert the 7-bit escape sequences in Table 3-3 to 8-bit control characters as follows.

1. Remove the ESC character.
2. Set the eighth bit and clear the seventh bit of the final character.

3.3.2 8-Bit to 7-Bit Conversion

You can convert the 8-bit control characters in Table 3-3 to 7-bit escape sequences as follows.

1. Insert an ESC character.
2. Clear the eighth bit and set the seventh bit of the 8-bit control character.

3.4 ESCAPE SEQUENCES, CONTROL SEQUENCES, AND DEVICE CONTROL STRINGS

Escape sequences, control sequences, and device control strings provide more control functions than control characters. These multiple-character sequences let you control many printing functions. Here are some examples.

Character sets
Fonts (loading, assigning, and selecting)
Character attributes (such as bolding and underlining)
Spacing (for monospace and proportional fonts)
Active column and line
Print area and page margins
Autowrapping
Tabs
Line feeds and carriage returns
Justification
Vectors for line drawing
Product identification
Printer status
Resetting or initializing the printer

Each escape sequence, control sequence, and control string performs a specific control function. Many control functions are automatically set to an initial value (Paragraph 5.14) when you power up or reset the printer.

3.4.1 Using Control Characters in Sequences

You can use control characters—ESC, CAN, and SUB—to interrupt or recover from errors in escape sequences, control sequences, and device control strings.

- You can send ESC (1/11) to cancel a sequence in progress and begin a new sequence.
- You can send CAN (1/8) to indicate the present data is in error or to cancel a sequence in progress. The printer interprets the characters following CAN as usual.
- You can send SUB (1/10) to cancel a sequence in progress. The printer interprets the characters following SUB as usual.

The printer does not lose data when errors occur in escape or control sequences and device control strings. The printer ignores unrecognized sequences and strings, unless they end a current escape sequence.

NOTE: At the beginning of each document you print, set the printer to a known state. You can use the reset to initial state (RIS) sequence. This sequence also clears the printer of any partial pages left in the buffer from a previous document.

If your printer is connected to the printer port of a video terminal, you probably have to use soft terminal reset (DECSTR) sequence instead of RIS. Paragraph 5.13 describes both sequences.

You should also send a form feed (FF) at the end of a document, so the last page of the document will eject from the printer.

3.4.2 Sequence Format

This manual shows escape and control sequences in their 8-bit format. You can also use equivalent 7-bit sequences (Table 3-3).

The 8-bit format uses the C0 and C1 control characters and ASCII characters from the DEC multinational character set (Figure 3-5). The sequences also show each character's column/row position in the character set, below the character. The column/row code eliminates confusion over similar looking characters such as 0 (3/0) and O (4/15).

Spaces appear between characters in a sequence for clarity; they are not part of the sequence. If a space is part of the sequence, the SP (2/0) character appears.

3.4.3 Escape Sequences

An escape sequence uses two or more bytes to define a specific control function. Escape sequences do not include variable parameters, but may include intermediate characters. Here is the format for an escape sequence.

ESC	**I**	F
1/11	2/0 to 2/15	3/0 to 7/14
Escape sequence introducer	Intermediate characters (zero or more characters)	Final character (one character)

The *escape sequence introducer* is the ESC control character. After receiving ESC, the printer stores (but does not print) the next received characters as part of the sequence.

Zero or more *intermediate characters* can follow the ESC character. Intermediate characters come from the 2/0 through 2/15 range.

The *final character* indicates the end of the sequence. The final character comes from the 3/0 through 7/14 range. The intermediate and final characters together define a single control function.

For example, the following escape sequence selects the French character set.

ESC	+	**R**
1/11	2/11	5/2

3.4.4 Control Sequences

A control sequence uses two or more bytes to define a specific control function. Control sequences usually include variable parameters. Here is the format for a control sequence.

CSI	P...P	I...I	F
9/11	3/0 to 3/15	2/0 to 2/15	4/0 to 7/14
Control sequence introducer	Parameter (zero or more characters)	Intermediate (zero or more characters)	Final (one character)

The *control sequence introducer* is the C1 control character CSI (9/11). You can also use the equivalent 7-bit sequence, ESC (1/11) [(5/11). After receiving CSI, the printer stores (but does not print) the next received characters as part of the sequence.

Parameter characters are characters received after CSI, in the 3/0 to 3/15 range. Parameter characters modify the action or interpretation of the sequence. You can use up to 16 parameters per sequence. You must use the ; (3/11) character to separate parameters.

All parameters are unsigned, positive decimal integers, with the most significant digit sent first. Any parameter greater than 9999 (decimal) is set to 9999 (decimal). If you do not specify a value, a 0 value is assumed. A 0 value or omitted parameter indicates a *default value* for the sequence; for most sequences, the default value is 1.

NOTE: All parameters must be positive decimal integers. Do not use a decimal point in a parameter—the printer will ignore the command.

If the first character in a parameter string is the ? (3/15) character, it indicates that DEC private parameters follow. The printer interprets private parameters according to ANSI X3.64 and ISO 6429.

The printer processes two types of parameters, numeric and selective. A numeric parameter indicates a numeric value such as a tab or margin location. In this manual, numeric parameters appear as actual values or as Pn, Pn1, Pn2, and so on.

Numeric Parameter Example

Control sequence introducer	First numeric parameter	Delimiter	Second numeric parameter		Final character
CSI	**6**	**;**	**7**	**0**	**s**
9/11	3/5	3/11	3/7	3/0	7/3

In this example, the left margin is set to column 5, and the right margin is set to column 70. The numeric parameters are 5 and 70. The ; (3/11) delimiter separates the two parameters.

A selective parameter selects an action associated with the specific parameter value. In this manual, selective parameters appear as Ps, Ps1, Ps2, and so on.

Selective Parameter Example

Control sequence introducer	First selective parameter	Delimiter	Second selective parameter	Final character
CSI	**1**	**;**	**4**	**m**
9/11	3/1	3/11	3/4	6/13

In this example, the first selective parameter selects bold printing, and the second selective parameter selects underlining. The ; (3/11) delimiter separates the two parameters.

Intermediate characters are characters received after CSI, in the 2/0 to 2/15 range.

The *final character* comes from the 4/0 to 7/14 range. The final character indicates the end of the sequence. The intermediate and final characters together define a control function. If there are no intermediate characters, the final character defines the function.

Control Sequence Examples

1. The following sequence clears all horizontal tab stops.

Control sequence introducer	Numeric parameter	Final character
CSI	**3**	**g**
9/11	3/3	6/7

2. The following sequence turns off justification.

Control sequence introducer	Numeric parameter	Intermediate character	Final character
CSI	**0**	**SP**	**F**
9/11	3/0	2/0	4/6

3.4.5 Device Control Strings

Device control strings (DCS), like control sequences, use two or more bytes to define specific control functions. However, a DCS also includes a command string. Here is the format for a device control string

DCS	**P...P**	**I...I**	**F**	**Command string**	**ST**
9/0	3/0 to 3/15	2/0 to 2/15	4/0 to 7/15	**********	9/12
Device control string introducer		Protocol selector		String	String terminator

The *device control string introducer* is the C1 control character DCS (9/0). You can also use the equivalent 7-bit sequence, ESC (1/11) P (5/0). After receiving DCS, the printer stores (but does not print) the next received characters as part of the string function.

The *protocol selector* follows DCS and includes parameter characters, intermediate characters, and a final character. The format is the same as a control sequence (except for the CSI character).

The *command string* follows the protocol selector and includes several records. Each record may be several characters in length. Records are separated by the ; (3/11) delimiter.

The *string terminator* ST (9/12) indicates the end of a string. You can also use the equivalent 7-bit sequence, ESC (1/11) \ (5/12).

3.5 SENDING AND RECEIVING 7-BIT AND 8-BIT DATA

You can select how the printer processes and codes data by using configuration switch **SP1-5** and the following escape sequences. **SP1-5** selects a 7-bit or 8-bit data format (Paragraph 2.4.1). The C1 receive and C1 transmit sequences enable or disable data transmission and reception in those formats.

When you power up or reset the printer (Paragraph 5.13), it uses C1 receive enabled and C1 transmit disabled.

Name	Sequence			Function
C1 receive enabled	**ESC** 1/11	**SP** 2/0	**7** 3/7	The printer receives 8-bit data and C1 control characters (as 7-bit ESC Fe sequences or single 8-bit bytes).
C1 receive disabled	**ESC** 1/11	**SP** 2/0	**6** 3/6	The printer receives 7-bit data and C1 control characters (as 7-bit ESC Fe sequences).
C1 transmit disabled	**ESC** 1/11	**SP** 2/0	**F** 4/6	The printer sends 7-bit data and C1 control characters (as 7-bit ESC Fe sequences).
C1 transmit enabled	**ESC** 1/11	**SP** 2/0	**G** 4/7	The printer sends 8-bit data and C1 control characters (as single 8-bit bytes).

The following paragraphs describe the different selections you can make using switch SP1-5 and the escape sequences.

3.5.1 Sending Characters

You can select three different methods for sending characters.

	Selection	Result
1.	You select 8-bit mode (by setting switch **SP1-5** to 8-bit) and enable its use (by using the C1 transmit enabled sequence).	The printer uses 8-bit coding to send all data.
2.	You select 8-bit mode (by setting switch **SP1-5** to 8-bit), but restrict its use (by using the C1 transmit disabled sequence).	The printer uses 8-bit coding to send data and uses 7-bit equivalent coding to send C1 control characters.
3.	You select 7-bit mode (by setting switch **SP1-5** to 7-bit).	The printer uses 7-bit coding to send all data (converting 8-bit data to a 7-bit equivalent).

3.5.2 Receiving Characters

You can select three different methods for receiving characters.

	Selection	Result
1.	You select 8-bit mode (by setting switch **SP1-5** to 8-bit) and enable its use (by using the C1 receive enabled sequence).	The printer treats any received byte as an 8-bit byte.
2.	You select 8-bit mode (by setting switch **SP1-5** to 8-bit), but restrict its use (by using the C1 receive disabled sequence).	The printer does not change data, but truncates C1 control characters (by setting the most significant bit to 0.
3.	You select 7-bit mode (by setting switch **SP1-5** to 7-bit).	The printer treats any received byte as an 8-bit byte with the most significant bit set to 0.

4 SELECTING CHARACTER SETS AND FONTS

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4.1 BEFORE YOU START

The LN03 uses character sets and fonts to create the characters you see on a printed page. You can use the character sets and fonts that come stored in the printer, or you can add others. You use font files to add character sets and fonts to the printer. There are two ways to add font files.

- Plug a font cartridge into the printer.
- Down-line-load a font file from the host computer.

This chapter explains how to select character sets and fonts. However, before you use these procedures, you should understand how the printer uses character sets and fonts. The next section describes some important terms.

Appendix F contains some helpful hints and examples using LN03 commands. The appendix also includes problem-solving information.

4.2 CHARACTER SETS, FONTS, AND FONT FILES

Character sets contain a set of codes that describe the general appearance of characters. For example, a character set might contain the code for an uppercase A or the number 1.

Fonts determine the size and style of printed characters. For example, a courier 10 point font describes a certain style (courier) and size (10 point) of printed character.

Fonts and character sets are independent of each other. You need both a font and a character set to print characters.

The LN03 stores the data for character sets and fonts in *font files*. Each font file contains the data for a unique combination of one font and one character set. You can assign a font to any character set available in the printer.

The font files that come with the printer are stored in ROM. If you load other font files from the host, they are stored in RAM. Font files must be in a standard Digital format.

4.2.1 Font Attributes

Each font has seven attributes that define the visual representation of characters, independent of any character set.

	Font Attributes	Example
1.	Type family	Courier, elite
2.	Spacing	Proportional or fixed (monospaced)
3.	Type size	10 point (1 point = 1/72 inch)
4.	Scale factor	1:1 (This describes a vertical to horizontal proportion.)
5.	Typestyle	Normal, italic
6.	Character weight	Normal, bold
7.	Character proportion	Normal, expanded, condensed

For example, one of the standard fonts used in the printer is courier 10 pitch, monospaced, 10 point, with 1:1 scaling, and normal typestyle, character weight, and character proportion.
You can assign this font to any available character set, such as the ASCII or DEC supplemental sets.

A *type family* (the first font attribute) identifies a group of fonts related in design, but differing in the six other attributes. For example, the two standard type families used in the printer are courier and elite.

4.2.2 Font File Attributes

Each font file has 12 attributes, including the 7 attributes for a single font and the character images for a single character set.

Font File Attributes

Font Attributes	+	Other Attributes
Type family		Character set
Spacing		Rotation
Type size		Character subset
Scale factor		File encoding
Typestyle		Resolution
Character weight		
Character proportion		

Each font file has a unique 31-character identification. This font file ID describes the character set as well as the the font attributes. Appendix D describes the standard font file IDs in the printer.

Figure 4-1 shows the character sets and fonts stored in ROM when you receive the printer. The DEC built-in-1 and pl font files are duplicates of the courier and elite font files. The figure does not include optional font files stored in cartridges or down-line-loaded from the host computer.

You can combine any available character set and font for printing. For example, you could use the ASCII character set with the courier 10 point, 10 pitch font.

CHARACTER SET	FONT											
	COURIER 10 POINT 10 PITCH	COURIER 10 POINT 10.3 PITCH	ELITE 10 POINT 12 PITCH	COURIER 8.7 POINT 13.6 PITCH	SOFT				DEC BUILT-IN			
					10 POINT 10 PITCH	10 POINT 10.3 PITCH	10 POINT 12 PITCH	8.7 POINT 13.6 PITCH	10 POINT 10 PITCH	10 POINT 10.3 PITCH	10 POINT 12 PITCH	8.7 POINT 13.6 PITCH
ASCII	X	X	X	X					X	X	X	X
DEC SUPPLEMENTAL	X	X	X	X					X	X	X	X
DEC TECHNICAL	X	X	X	X	X	X	X	X				
LINE DRAWING	X	X	X	X	X	X	X	X				

X = INDICATES ROM RESIDENT FONT FILE

Figure 4-1 ROM-Resident Character Sets and Fonts

The printer compares your selections with the character sets and fonts it has available, looking for an exact match (type family, character set, type size, proportions). If it does not find an exact match, the printer compares for the nearest match of attributes (spacing, type size, proportion, weight, style).

Using the font file data stored in the printer, you can select the characters to print from in two steps.

1. Select a character set (Paragraph 4.3).
2. Select a type family or font (Paragraph 4.4).

4.3 SELECTING GRAPHIC CHARACTER SETS

There are four graphic character sets stored in the LN03.

ASCII
DEC supplemental
DEC technical
VT100 line drawing

You select a character set for printing as follows (Figure 4-2).

1. Designate the set as G0, G1, G2, or G3.

2. Map the designated set into the graphic left (GL) or graphic right (GR) table in memory. You can then use the set for printing.

The graphic left (GL) table is used when the character code format is 7-bit, or when the the character code format is 8-bit and the graphic characters are in the 2/1 through 7/14 range. The graphic right (GR) table is used when the character code format is 8-bit and the graphic characters are in the 10/0 through 15/15 range.

You do not have to select a character set every time you use the printer. You can use the default character sets. When you power up or reset the printer, the ASCII set is designated as G0 and G1, and the DEC supplemental set is designated as G2 and G3. In other words, the default character set is the DEC multinational set (ASCII and DEC supplemental sets).

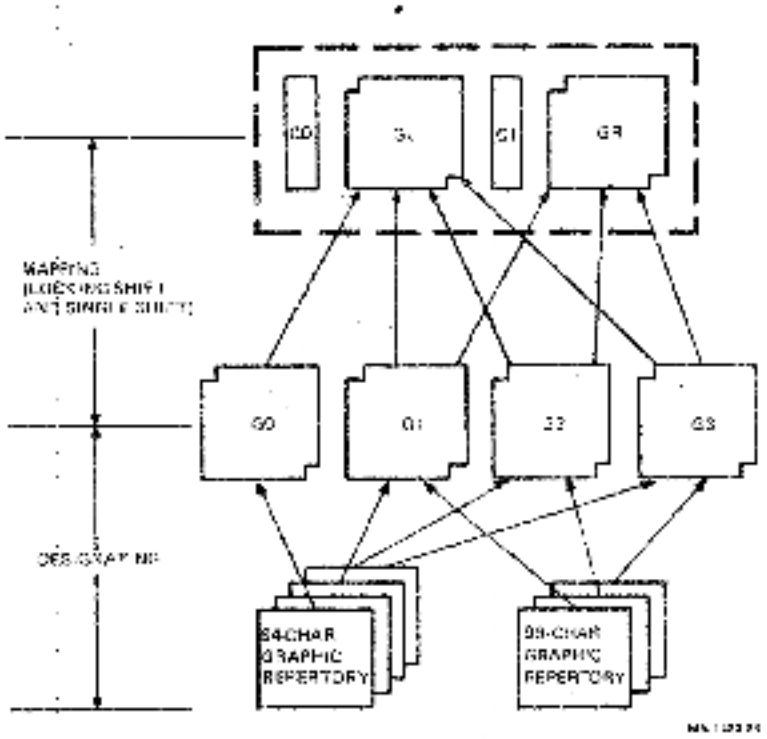

Figure 4-2 Selecting Character Sets

You can only designate a character set you have stored in the printer. You can designate any of the standard 16 character sets (Appendix B) by using the basic escape sequence in Table 4-1. The intermediate character selects G0, G1, G2, or G3. The final character selects the character set. For example, to designate the U.K. set as G0, you would use the following sequence.

ESC	**(**	**A**
1/11	2/8	4/2

You can lock (map) the G0, G1, G2, or G3 character set into GL or GR memory by using the locking-shift (LS) control functions in Table 4-2. Figures 4-3 and 4-4 show this process for 7-bit and 8-bit character sets. The character set remains available for printing until you lock another set into GL or GR.

You can print a single character from the G2 or G3 character set by using the single-shift (SS) control functions in Table 4-2. The SS functions temporarily store the G2 or G3 set in GL. After printing the single character, the printer returns to the previous set locked in GL.

Table 4-9 Designating Character Sets

ESC (4/14)	Intermediate	Final	
Intermediate	Selects	Final	Selects
For 94-Character Sets		A (4/1)	United Kingdom
((2/8)	G0 (default for GL)	B (4/2)	ASCII (default for G0 and G0)
) (2/9)	G1	4 (3/4)	DEC Dutch
* (2/10)	G2 (default for G2)	5 (3/5)	DEC Finnish
+ (2/11)	G3	C (4/3)	French
For 96-Character Sets		5 (3/5)	DEC French Canadian
- (2/13)	G1	K (4/11)	German
. (2/14)	G2	Y (5/9)	Italian
/ (2/15)	G3	` (6/0)	ISO Norwegian
		6 (3/6)	DEC Norwegian/Danish
		Z (5/10)	Spanish
		7 (3/7)	DEC Swedish
		= (3/13)	DEC Swiss

Table 4-1 Designating Character Sets (Cont'd)

ESC	Intermediate	Final	
Interpretation	Designation	Final	Returns
		6/0	ISO Norwegian/Danish
		6/2	DEC supplemental (graphic set moved from 2/14 to 6/2)
		6/4	DEC technical
		6/12	ISO Hebrew

NOTE: The VT340 line drawing character set is not designed for use with other alternate sets. You can use it if you simply want to draw boxes, graphs, and charts, for example.

Table 4-2 Locking Shift and Single Shift Control Functions

Name	Mnemonic	Code	Function
Locking shift G0	LS0	SI 0/15	Invoke G0 into GL
Locking shift G1	LS1	SO 0/14	Invoke G1 into GL
Locking shift G2 right	LS2R	ESC 7/13	Invoke G2 into GR
Locking shift G3	LS3	ESC 6/15	Invoke G3 into GL
Locking shift G3 right	LS3R	ESC 7/12	Invoke G3 into GR
Single shift G2	SS2	ESC 4/14	Invoke G2 into GL
Single shift G3	SS3	ESC 4/15	Invoke G3 into GL

Table 4-2 Locking Shift and Single Shift Control Functions (Cont)

Name	Mnemonic	Code		Function
Locking shift G3 right	LS3R	ESC 7/15	o	Invoke G3 into G2.
Single shift 2	SS2	ESC 4/14	N	Invoke G2 into G1 for one character.
Single shift 3	SS3	ESC 4/15	O	Invoke G3 into G1 for one character.

NOTE: You can also send a G2 control character from the keyboard by holding down **Ctrl** and pressing **N**. You can send a G3 control character by holding down **Ctrl** and pressing **O**.

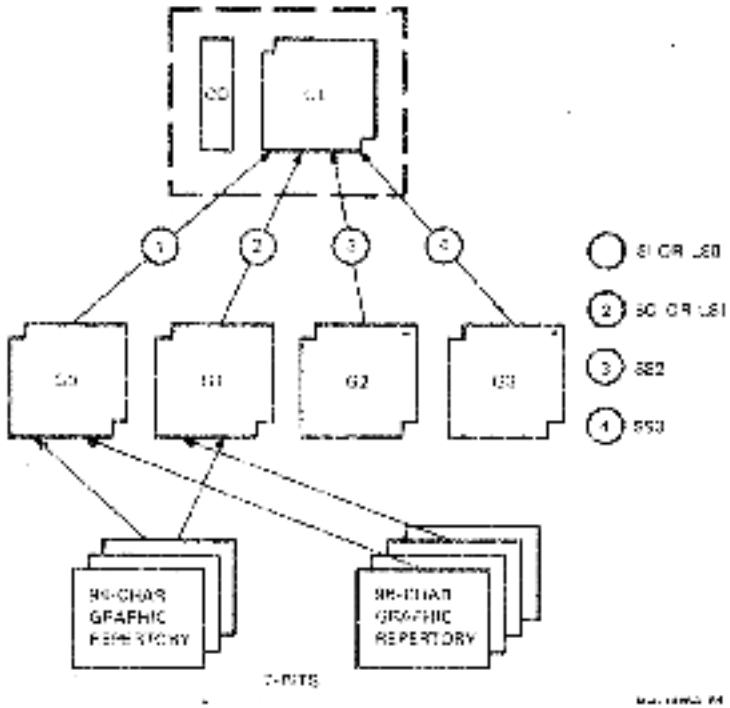

Figure 4-3 Invoking Character Sets (7-Bit Mode)

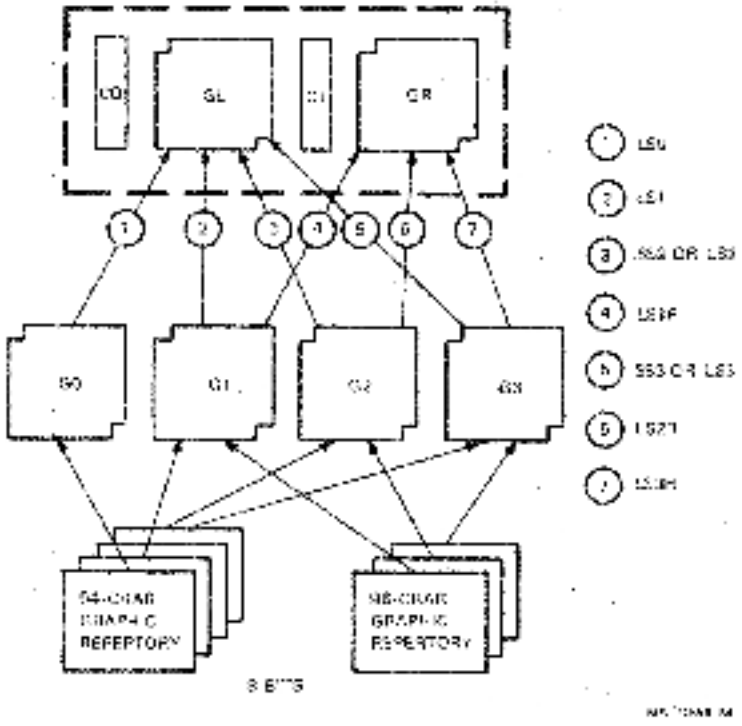

Figure 4-4 Invoking Character Sets (8-Bit Mode)

4.4 LOADING, ASSIGNING, AND SELECTING FONT FILES

The LN03 has 32 font files stored in ROM. Each font file includes data for one of the four standard character sets: ASCII, DEC supplemental, DEC technical, or VT100 line drawing. You can down-line-load up to 31 other font files from the host computer, if enough RAM memory (including cartridges) is available.

Each font file also includes the data for one font, which is part of a type family. You can identify font files by a type family ID, a font ID, and a font file ID.

The *type family ID* has seven characters. Here are the type family IDs for the four standard type families used with ROM-resident font files.

Type Family	Identification
Courier	RCOURIR
Elite	RELITEO
DEC builtin	DBULTN1
PI font	D000000

The *font ID* has 16 characters (no lowercase letters) and describes the seven basic font attributes (including type family) of the ROM fonts.

The *font file ID* has 31 characters. It describes the character set and the font attributes. Appendix D lists all standard type family, font, and font file IDs for the ROM font files.

To make a font file available for printing, you must assign a select graphic rendition (SGR) number to the file (Paragraph 4.4.2). You assign an SGR number to the type family ID or font ID. Then you can select the SGR number for printing. When you power up or reset the printer, it selects SGR number 10 for printing (Paragraph 5.14).

4.4.1 Loading Font Files (DECLFF)

Before loading font files in the printer, you should print a status sheet (Figure 2-2). The status sheet shows you what fonts are available. If necessary, you should delete unneeded font files in the printer, to make space for the new files.

Font files are loaded in memory with a specific orientation—portrait or landscape. All 10-, 10.3-, and 12-pitch fonts have portrait orientation, and all 13.6-pitch fonts have landscape orientation. The printer can change (rotate) the orientation, if enough memory is available.

NOTE: If you need to rotate the orientation of a font, you can reduce the memory needed by having the same character set in both GL and GR.

After you load font files in memory, they remain available for printing until one of the following events occurs.

- You load new fonts with a Ps3 parameter value of 0, to delete all down-line-loaded fonts. (See the following escape sequence description.)
- You load the same font file again.
- You shut off system power. The default built-in fonts are available at power-up (Paragraph 5.14).
- You remove the RAM cartridge that contains the font.

The format for the load font file (DECLFF) sequence is as follows.

							Font		Comment	
DCS	**Ps1**	**;**	**Ps2**	**;**	**Ps3**	**y**	**Record**	**;**	**Record**	**ST**
9/0	***	3/11	***	3/11	***	7/9	******	3/11	********	9/12

Ps1 Parameter
Ps1 is the font file indicator that specifies the font file format used in the command string. Ps1 must be 0, which indicates the file is in the Digital font file format. Otherwise, the printer ignores the load font set.

NOTE: You can only use font files that are in the Digital font file format. You cannot use LN01 font files with the LN03.

Ps2 Parameter
Ps2 specifies whether or not to print a summary sheet (Figure 2-2).

Ps2	Function
0	**Print summary sheet. (default)**
1	Do not print summary sheet.

If you use a numeric value other than 0 or 1, the printer assumes a 1 value.

Ps3 Parameter

Ps lets you select which font files to delete before the printer loads new font files.

Ps3	Function
0	Delete all font files.
1	Delete selected font files that have the same font file ID as a font file being loaded.

If there are several font files with the same font file ID, the last font file loaded replaces the previously loaded font file. If a font file loaded from the host has the same font file ID as a ROM-resident font file or cartridge font file, the host-loaded font file overrides but does not delete the other font file.

You can load font files in the middle of a page. Be careful, however, when you delete a font file in the middle of a page. An error will occur if one or more characters already imaged on the page need the deleted font file. The printer will eject the page in order to print at the same position on the new page.

Final Character

The final y (7/9) character identifies the DECLFF control function. The data between the y and the string terminator represents the font command string. This data comes from the 2/0 through 7/14 range.

NOTE: You can print a summary sheet and delete all font files previously loaded from the host, by sending the following sequence.

DCS	0	;	0	;	0	y	ST
9/0	3/0	3/11	3/0	3/11	3/0	7/9	9/12

Font Record

The font record contains data on one or more font files. Usually, each font file contains the character images for a particular character set in a particular font. The string introducer DCS Ps1 ; Ps2 ; Ps3 y indicates the beginning of the font record. The string terminator ST indicates the end of the font record.

The font record is in Digital font file format. This record contains binary data that has been converted to a sixel format, as described in Paragraph 6.3.

If the printer receives an escape or control sequence in the middle of a font record, the printer loads those fonts already received and makes them available for assignment and selection. Incomplete or partial fonts are ignored.

Comment record
The comment record is a list of user text, separated from the font record by a ; (9/11). The comment record is an optional parameter that is ignored by the printer.

4.4.2 Assign Type Family or Font (DECATFF)

To select fonts for printing, you must assign a select graphic rendition (SGR) number to the the type family ID (7 characters) or font ID (16 characters). Each font file contains an ID string as part of its font record.

The assign font number sequence assigns a type family ID or a font ID to the indicated SGR number. You can then use the select font escape sequence (Paragraph 4.4.3) to select the font for printing.

The format for the assign font number sequence is as follows.

CCS	Ps1	;	Ps2	}	ID String	ST
9/0	...	3/11	...	7/13	**********	9/12

Ps1 Parameter
Ps1 selects which font assignment to perform.

Ps1	Function
0	**Same as 1. (default)**
1	Assign font ID to SGR number.
2	Assign type family ID to SGR number.

Ps2 Parameter
Ps2 selects the SGR number to assign to the type family ID or font ID. The following table indicates the SGR number assignment at power-up.

Ps2 SGR	Assignment	ID	Font or Type Family
10	Type family	DBULTN1	DEC built-in-1 family
11	Type family	RCOURIR	Courier family
12	Type family	RELITE0	Elite family
13	Font	RCOURIRJ02SK00GG	Courier 10 point, 10 pitch
14	Font	RELITE0L02SK00GG	Elite 10 point, 12 pitch
15	Font	RCOURIR101VK00GG	Courier 8.7 point, 13.5 pitch
16	Font	RCOURIR202SK00GG	Courier 10 point, 10.3 pitch
17	Type family	DBULTN1	DEC built-in-1 family
18	Type family	DBULTN1	DEC built-in-1 family
19	Type family	DBULTN1	DEC built-in-1 family

NOTE: All font cartridges are assigned an SGR of 17, 18, or 19. They can override automatic assignments of ROM-resident fonts. If two cartridges have the same SGR, then you must assign a new SGR to one of them.

Type Family ID or Font ID String
The type family ID or font ID identifies which font file to assign to the SGR number (Ps2). You cannot use lowercase letters for a type family ID or font ID.

You can assign up to 10 fonts at one time. Font assignments can occur anywhere in the data stream. You can send an unlimited number of assign font number sequences to the printer.

The printer will accept an ID for a font file not currently stored. However, if you try to print a character from the missing font file, the printer prints a reverse question mark ⸮ instead. If you assign an ID to an SGR number that already has an ID assigned, the new assignment replaces the old one.

4.4.3 Selecting Fonts (SGR)
This sequence selects a font for printing. The format for the select font sequence is as follows.

CSI	Ps	m
9/11	***	6/13

NOTE: You can also use the SGR sequence to select several character attributes (Paragraphs 5.10). You can combine several SGR sequences by separating Ps values with semicolons.

Ps Parameter
Ps values in the range of 10 through 19 select the font or type family used for printing. (See Paragraph 4.4.2 for the initial SGR number assignments.) If you want to print more than 10 fonts or type families on a page, you must reassign other IDs to these SGR numbers.

If you select a type family, you have two choices for the other six font attributes (type size, spacing, and so on). You can use the default values for those attributes, or you can change one or more attributes by using control sequences. If you select a specific font, all seven font attributes are already defined. So, selecting a type family gives you more options.

NOTE: Some type families have both proportionally spaced and monospaced fonts. If you select a type family for proportional spacing, you must set the proportional spacing mode (Paragraph 5.2.5). The default is monospacing.

You can use the select font sequence anywhere in the data stream. The selected font remains in effect until the printer receives another select font sequence or a reset to initial state (RIS) sequence (Paragraph 5.14). After a power-up or RIS sequence, the printer uses SGR number 10.

If you send an assign type family or font (DECATFF) sequence for the current SGR number, the sequence takes effect immediately. You do not have to reselect the current SGR number.

You can select an SGR number that does not have a type family ID or a font ID assigned. However, when you try to print a character from that font, the reverse question mark ' error character will print.

4.5 DELETING TYPE FAMILY OR FONT FILES (DECDTFF)
This sequence lets you delete down-line-loaded fonts identified by a type family ID or font file ID. This sequence allows the host computer to control font memory storage. The format for the sequence is as follows.

DCS	Ps	~	ID String	ST
9/0	...	7/14	*********	9/12

Ps Parameter
Ps identifies the ID string as a type family ID or font file ID. The printer ignores this sequence if you use any values other than 0 or 1.

Ps	Function
0	The ID string is a type family ID.
1	The ID string is a font file ID.

The ID string identifies the type family or font to delete. The type family ID is 7 characters long, and the font file ID is 31 characters.

4.5 FONT STATUS

Font status sequences help the host computer to control and manage font memory. The host sends a request font status sequence, and the printer replies with a font status report. The report informs the host which fonts are currently available in the printer.

4.5.1 Request Font Status (DECRFS)

The host sends this sequence to request a status report of the fonts available for printing, the memory bytes available for loading new fonts, or both. The format for the sequence is as follows.

CSI	Ps	;	Ps	"	¡
9/11	***	3/11	***	2/2	7/11

Ps Parameter
This parameter selects the type of font status requested. You can use several Ps values in the sequence.

Ps	Function
0	**Send both reports (same as 1 and 2). (default)**
1	Send status of ROM fonts, down-line-loaded fonts, and cartridge fonts.
2	Send status of memory bytes available for down-line-loaded fonts.

NOTE: If you use more than one Ps value in the DECFSR sequence, separate the values with a semicolon. If you use only one Ps value, omit the semicolon. The printer would treat the semicolon as a 0 parameter.

4.5.2 Font Status Report (DECFSR)

The printer uses this sequence to report the font status requested. There is a separate report for the two types of status requests. The following sequences show the formats for both responses.

Response to a DECRFS request with a Ps parameter of 1

DCS	1	"	[	ID String	ST
9/0	3/1	2/2	7/11	*********	9/12

The ID string includes (in order) the type family name, the type family ID in parentheses, a colon (:), then a new line(s) with each font name. Each new type family starts on a new line after a semicolon. A blank line indicates the end of the previous family.

Example

type family name (type family ID):
font file ID,
font file ID;
type family name (type family ID):

font file ID;

Response to a DECRFS request with a Ps parameter of 2

DCS	2	"	{	nnn	ST
9/0	3/2	2/2	7/11	***	9/12

nnn is a decimal number that indicates the number of bytes available in memory for down-line-loaded font files.

4.7 SELECTING FONT SIZES

The following two sequences let you select the height (point size) and width of fonts when you select a type family ID for printing. If you also want to change the pitch (characters per inch), use the spacing pitch increment (SPI) sequence (Paragraph 5.4.1) or the select horizontal spacing (SHS) sequence (Paragraph 5.4.4).

NOTE: To use the graphic size selection (GSS) sequence to scale characters, you must have a font file in the printer that allows scaling.

4.7.1 Graphic Size Selection (GSS)

This sequence sets the height and width of all characters in the font selected after the sequence. The GSS sequence remains in effect until the printer receives another GSS sequence or a graphic size modification (GSM) sequence (Paragraph 4.7.2). The format for the sequence is as follows.

CSI	Pn	SP	C
9/11	***	2/0	4/3

Pn Parameter

Pn is a decimal value that specifies the height of the font in units determined by the select size unit (SSU) sequence (Paragraph 5.3). The width of the font is implicitly defined by the height. For example, the width for a 10 point font is 10 pitch.

Initial value: Pn = 100.

4.7.2 Graphic Size Modification (GSM)

This sequence lets you modify the height and width set by the graphic size selection (GSS) sequence for all designated fonts (Paragraph 4.7.1). The GSM sequence remains in effect until the the printer receives another GSM or GSS sequence. The format for the sequence is as follows.

CSI	Pn1	;	Pn2	SP	B
9/11	***	3/11	***	2/0	4/2

Pn Parameters

Default value: depends on the the paper size switch (Figure 1-1).

Paper Size Switch	Default
8-1/2 × 11	Pn1 = 100, Pn2 = 100
A4	Pn1 = 100, Pn2 = 83

Pn1 is a decimal value that specifies the height as a percentage of the height set by the GSS sequence.

Pn2 is a decimal value that specifies the width as a percentage of the width set by the GSS sequence.

NOTE: You can use GSM to select a different-size font from the fonts available in a type family. See Appendix F for an example of how to use GSM.

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5.1 PRINTING FEATURES YOU CAN CHANGE

This chapter describes the ANSI and ISO standard control functions you can use to control how the LN03 processes data. You can select from several standard page formats, change line and character spacing, change margins, add and delete tabs, and perform many other functions to create your printed page.

Appendix F contains some helpful hints and examples using LN03 commands. The appendix also includes some problem-solving information.

NOTE: When you power up the printer or send a reset sequence, the printer sets several control functions to an initial state. Paragraph 5.14 lists these initial states. The individual description of each control function also identifies the initial state of that function (if any). Paragraph 5.13 describes the two reset sequences.

5.2 SET/RESET MODE

Printer modes control some basic printing features, such as wrapping text at the end of a printed line. These features have only two settings—set or reset. For example, you can set autowrap mode (wrap text at the right margin of a page) or reset autowrap mode (lose text that exceeds the right margin). Paragraphs 5.2.1 through 5.2.7 describe each printer mode and explain their functions.

You can use one sequence to turn several printer modes on or turn several printer modes off. The set and reset mode sequences use Ps parameter values to select different printer modes.

There are two types of parameters for these sequences, ANSI and DEC private. When you use more than one parameter in a sequence, make sure all parameters are of the same type, all ANSI or all DEC private. A DEC private parameter string has a question mark ? (3/15) as the first character.

NOTE: The number 3/15 tells you that the ? character appears in column 3, row 15 of an ASCII character set table. See Paragraph 3.1.1 for more information.

The formats for the set and reset mode sequences are as follows.

Set Mode

CSI	Ps	h
9/11	***	6/8

Reset Mode

CSI	Ps	l
9/11	***	6/12

Ps Parameter
Ps selects the printer mode to set or reset. Each mode is described in the paragraph listed.

Ps	Printer Mode	Paragraph
ANSI		
11	Position unit mode (PUM)	5.2.7
20	Line feed/new line mode (LNM)	5.2.1
DEC Private		
?7	Autowrap mode (DECAWM)	5.2.3
?27	Proportional spacing mode (DECPSP)	5.2.5
?29	Pitch select mode (DECPSM)	5.2.4
?40	Carriage return/new line mode (DECCRNLM)	5.2.2
?52	Origin placement mode (DECOPM)	5.2.6

5.2.1 Line Feed/New Line Mode (LNM)

This mode defines the printer's response to the line feed (LF) control character.

When line feed/new line mode is reset (off) and the printer receives the LF character, the printer advances the paper one line. The active column does not move to the left margin.

When line feed/new line mode is set (on) and the printer receives the LF character, the printer advances the paper one line and returns the active column to the left margin.

The formats for the LNM sequence are as follows.

Initial state: LNM reset.

LNM Reset Mode

CSI	2	0	l
9/11	3/2	3/0	6/12

Turns line feed/new line mode off. An LF character advances the active line only

LNM Set Mode

CSI	2	0	h
9/11	3/2	3/0	6/8

Turns line feed/new line mode on. An LF character advances the active line and returns the active column to the left margin.

5.2.2 Carriage Return/New Line Mode (DECCRNLM)

This mode defines the printer's response to the carriage return (CR) control character.

When carriage return/new line mode is reset (off) and the printer receives a CR character, the printer returns the active column to the left margin without advancing the active line.

When carriage return/new line mode is set (on) and the printer receives the CR character, the printer returns the active column to the left margin and advances the paper one line.

The formats for the DECCRNLM sequence are as follows.

Initial state: DECCRNLM reset.

DECCRNLM Reset Mode

CSI	?	4	0	l
9/11	3/15	3/4	3/0	6/12

Turns carriage return/new line mode off. A CR character returns the active column to the left margin, without advancing to a new line.

DECCRNLM Set Mode

CSI	?	4	0	h
9/11	3/15	3/4	3/0	6/8

Turns carriage return/new line mode on. A CR character returns the active column to the left margin and advances the paper one line.

5.2.3 Autowrap Mode (DECAWM)

This mode determines what happens when text exceeds the right margin.

When the autowrap mode is set (on) and text exceeds the right margin, the active position moves to the left margin on the next line.

When the autowrap mode is reset (off) and text exceeds the right margin, the text is lost. The formats for the DECAWM sequence are as follows.

NOTE: This sequence overrides the autowrap mode switch **SP2:4** *(Paragraph 2.4.2).*

Initial state: depends on the **SP2:4** switch setting.

DECAWM Set Mode

CSI	**?**	*7*	h
9/11	3/15	3/7	6/8

Turns autowrap mode on. Text exceeding the right margin wraps to the left margin on the next line.

DECAWM Reset Mode

CSI	**?**	*7*	l
9/11	3/15	3/7	6/12

Turns autowrap mode off. Text exceeding the right margin is lost.

5.2.4 Pitch Select Mode (DECPSM)

This mode controls the set horizontal pitch (DECSHORP) sequence Paragraph 5.4.5).

When pitch select mode is reset (off), the printer uses the horizontal pitch selected by the DECSHORP sequence.

When pitch select mode is set (on), the printer uses the default horizontal pitch of the current font.

The formats for the DECPSM sequence are as follows.

Initial state: DECPSM reset.

DECPSM Reset Mode

CSI	?	2	9	l
9/11	3/15	3/2	3/9	6/12

Turns pitch select mode off. DECSHORP selects the horizontal pitch.

DECPSM Set Mode

CSI	?	2	9	h
9/11	3/15	3/2	3/9	6/8

Turns pitch select mode on. The current font determines the horizontal pitch.

5.2.5 Proportional Spacing (DECPSP)

This mode is for use with proportional fonts. DECPSP lets you select proportional spacing or monospacing of characters.

When proportional spacing mode is set, the printer uses proportional spacing based on the current font. When proportional spacing mode is reset, the printer returns to the monospacing it was using before proportional printing.

The formats for the DECPSP sequence are as follows.

Initial state: DECPSP reset.

Reset Mode

CSI	?	2	7	l
9/11	3/15	3/2	3/7	6/12

Turns proportional spacing mode off. The printer returns to monospaced printing.

Set Mode

CSI	?	2	7	h
9/11	3/15	3/2	3/7	6/8

Turns proportional spacing mode on.

NOTE: To use proportional spacing, you must first select a proportional font.

5.2.6 Origin Placement Mode (DECOPM)

This mode selects the starting point for printing on the page. You can select either the corner of the printable area or the corner of the physical page (Figure 5-4). DECOPM is a convenient method of converting any existing software that addresses the edge of the paper.

When origin placement mode is reset (off), the origin is set 0.25 inches in from the upper-left corner of the physical page. When origin placement mode is set (on), the origin is set to the upper-left corner of the physical page.

The formats for the DECOPM sequence are as follows.

Initial state: DECOPM reset.

DECOPM Reset Mode

CSI	?	5	2	l
9/11	3/15	3/5	3/2	6/12

Turns origin placement mode off. Printing starts 0.25 inches from the upper-left corner of the physical page.

DECOPM Set Mode

CSI	?	5	2	h
9/11	3/15	3/5	3/2	6/8

Turns origin placement mode on. Printing starts at the upper-left corner of the physical page.

5.2.7 Position Unit Mode (PUM)

This sequence selects a unit of measurement used with escape sequences that control spacing parameters. Table 5-1 lists the escape sequences affected by PUM.

The formats for the PUM sequence are as follows.

Initial state: PUM reset.

PUM Reset Mode

CSI	1	1	l
9/11	3/1	3/1	6/12

Selects a spacing unit equal to one character position, called a *character cell*. The height of a character cell equals the current horizontal spacing increment, and the width equals the current vertical spacing increment. To set horizontal and vertical spacing, see Paragraph 5.4.

PUM Set Mode

CSI	1	1	h
9/11	3/1	3/1	6/8

Selects either decipoints or pixels, depending on the setting of the select size unit (SSU) sequence (Paragraph 5.3).

Table 5-1 Commands With Spacing Parameters

Name	Mnemonic	Paragraph
Space (CR+Enter)*	SPC	5.4.1
Set lines per vertical page	DECSLPP	5.6.2
Set top and bottom margins	DECSTBM	5.6.3
Set left and right margins	DECSLRM	5.5.6
Horizontal position absolute	HPA	5.6.1
Horizontal position relative	HPR	5.6.2
Horizontal position backward	HPB	5.6.3
Vertical position absolute	VPA	5.6.4
Vertical position relative	VPR	5.6.5
Vertical position backward	VPB	5.6.6
Set / reset horiz. tab stops	DECSHTS	5.7.1
Set / reset vertical tab stops	DECSVTS	5.7.2
Draw vectors*	DRAVEC	5.12

* Not affected by position unit mode (PUM) setting (See paragraph 5.2.7).

5.3 SELECT SIZE UNIT (SSU)

This sequence works with the position unit mode (PUM) sequence (Paragraph 5.2.7) to select a unit of measurement for spacing parameters (Table 5-1). When PUM is set, SSU selects either decipoints or pixels for a unit.

If the printer receives an SSU while PUM is reset, the selected unit takes effect when PUM is set. The unit remains in effect until the printer receives another SSU or a reset sequence.

After a power-up or reset, the printer uses decipoint units. The format for the SSU sequence is as follows.

CSI	Ps	SP	I
9/11	***	2/0	4/9

Ps Parameter

Ps selects decipoint or pixel units. The printer ignores any values other than 2 or 7.

Ps	Spacing Unit	
2	Decipoint	(1/720 inch)
7	Pixel	(1/300 inch)

NOTE: The printer converts decipoints (D) into pixel (P) values by using the following formula and rounding off the result to the nearest integer.

$$P = \frac{D \times 5}{12}$$

All arithmetic operations are performed using integer instructions. The printer converts 1 decipoint to 0 pixels and 2 decipoints to 1 pixel.

If you select decipoint units, do not use the horizontal position relative (HPR) and vertical position relative (VPR) sequences (Paragraphs 5.6.2 and 5.6.5). HPR and VPR both cause a cumulative positioning error, due to rounding.

5.4 SPACING

This section describes five sequences that affect the spacing of lines and characters. Spacing depends on horizontal and vertical pitch. Horizontal pitch affects character spacing (characters per inch), and vertical pitch affects line spacing (lines per inch).

NOTE: The spacing sequences do not affect character size.

You can change horizontal and vertical pitch values with the select character spacing (SHS) and select vertical spacing (SVS) sequences, or with the spacing increment (SPI) sequence. These three sequences can use different units of measurement—character size, decipoints, or pixels. To select the unit of measurement, you use the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

As an alternative, you can use the set horizontal pitch (DECSHORP) and set vertical pitch (DECVERP) sequences to change spacing.

NOTE: The printer executes all spacing commands (except DECSHORP) when they are received. The new spacing increment takes effect immediately.

5.4.1 Spacing Pitch Increment (SPI)

This sequence sets the vertical and horizontal spacing increments for all characters that follow in the data stream. You can set one or both increments with one SPI sequence. SPI gives you maximum flexibility in adjusting character and line spacing.

SPI uses decipoints or pixels for a unit of measurement. You select the unit with the select size unit (SSU) sequence (Paragraph 5.3). SPI is not affected by the position unit mode (PUM) sequence (Paragraph 5.2.7) or by the page orientation. For example, if you set a vertical increment of 50 pixels (1/6 inch), the printer uses this setting for both portrait and landscape pages.

You can change the SPI setting for horizontal spacing by using one of the following sequences.

- Another SPI sequence
- Most combinations of the pitch select mode (DECPSM) sequence (Paragraph 5.2.4) and set horizontal pitch (DECSHORP) sequence (Paragraph 5.4.5)
- A set horizontal space (SHS) sequence (Paragraph 5.4.4)

You can change the SPI setting for vertical spacing by using one of the following sequences.

- A set vertical spacing (SVS) sequence (Paragraph 5.4.2)
- A set vertical pitch (DECVERP) sequence (Paragraph 5.4.3)

The format for the SPI sequence is as follows.

CSI	Pn1	;	Pn2	SP	G
9/11	***	3/11	***	2/0	4/7

NOTE: You should use SPI to set pitch. If Pn1 or Pn2 is 0 (or omitted), the printer uses the font file pitch for that setting.

Pn Parameters

Initial value: Pn1 = 0, Pn2 = 0.

Pn1 selects the vertical spacing increment and Pn2 selects the horizontal spacing increment.

NOTE: Parameters must be positive decimal integers. Do not use a parameter with a decimal point. The printer will ignore the command.

If a position command does not precede a graphic character, then the printer automatically places that character to the right of the previously received character. The distance between characters depends on the values of Pn1 and Pn2 in the most recent SPI sequence.

If you do not send an SPI, or you set the Pn1 or Pn2 value to 0, then the printer uses the default vertical and horizontal spacing for the current font. For monospaced fonts, the horizontal spacing is the same for all characters. For proportional fonts, the horizontal spacing is based on the widths of the characters (stored as part of the font attributes).

5.4.2 Select Vertical (Line) Spacing (SVS)

This sequence selects the line spacing (vertical pitch) used with all fonts. The format of the SVS sequence is as follows.

CSI	Ps	SP	L
9/11	...	2/0	4/12

Ps Parameter

Ps selects the vertical pitch and vertical character position unit. Figure 5-1 shows an example of different vertical pitches.

Ps	Vertical Pitch	Vertical Character Positioning Unit
0	**6 lines per inch**	**1/6 inch (default)**
1	4 lines per inch	1/4 inch
2	3 lines per inch	1/3 inch
3	12 lines per inch	1/12 inch
4	8 lines per inch	1/8 inch
5	6 lines per 30 mm	5 mm
6	4 lines per 30 mm	7.5 mm
7	3 lines per 30 mm	10 mm
8	12 lines per 30 mm	2.5 mm
9	2 lines per inch	1/2 inch

```
THESE LINES SHOULD BE PRINTED AT 4 LINES PER INCH

THESE LINES SHOULD BE PRINTED AT 4 LINES PER INCH

THESE LINES SHOULD BE PRINTED AT 4 LINES PER INCH

THESE LINES SHOULD BE PRINTED AT 4 LINES PER INCH

THESE LINES SHOULD BE PRINTED AT 6 LINES PER INCH
THESE LINES SHOULD BE PRINTED AT 6 LINES PER INCH
THESE LINES SHOULD BE PRINTED AT 6 LINES PER INCH
THESE LINES SHOULD BE PRINTED AT 6 LINES PER INCH
THESE LINES SHOULD BE PRINTED AT 6 LINES PER INCH
THESE LINES SHOULD BE PRINTED AT 6 LINES PER INCH

THESE LINES SHOULD BE PRINTED AT 8 LINES PER INCH
THESE LINES SHOULD BE PRINTED AT 8 LINES PER INCH
```

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Figure 5-1 Vertical Pitch Example

5.4.3 Set Vertical Pitch (DECVERP)

This sequence selects the number of lines printed per inch on a page. When you change the vertical pitch, the white space between lines changes. For example, if you increase the number of lines printed per inch, you decrease the amount of white space between the lines. Vertical pitch does not affect character size.

Unlike some Digital printers, the LN03 printer does not reset the top and bottom margins to the limits of the printed page after receiving a DECVERP sequence. However, DECVERP does change the position of the current vertical tabs. Each vertical tab stop value is multiplied by the new line height divided by the old line height. This method keeps a constant number of lines between vertical tabs. Print lines set by vertical tabs will move up or down according to the DECVERP value.

The format for the DECVERP sequence is as follows.

CSI	Ps	z
9/11	***	7/10

Ps Parameter

Ps selects the vertical pitch (lines per inch).

Ps	Pitch
0	**Determined by current font. (default)** (The DEC built-in-1 font selects 6.25 lines/inch)
1	6
2	8
3	12
4	2
5	3
6	4
11	Selects pitch to fit 66 lines on 8-1/2 × 11 paper. For the LN03 printer, selects 6.25 lines/inch. This setting is not affected by the DECSLPP sequence (Paragraph 5.5.2) or the page size.

5.4.4 Select Horizontal (Character) Spacing (SHS)

This sequence selects the character spacing (horizontal pitch) and character size for fixed-width (monospace) fonts. SHS has no effect on proportional fonts when you use proportional spacing(Paragraph 5.2.5). The format of the SHS sequence is as follows.

CSI	Ps	SP	K
9/11	***	2/0	4/11

Ps Parameter

Ps selects the horizontal pitch and the horizontal character position unit. Figure 5-2 shows an example of different horizontal pitches.

Ps	Horizontal Pitch	Horizontal Character Position Unit
0	**10 characters per inch**	**1/10 inch (default)**
1	12 characters per inch	1/12 inch
2	15 characters per inch	1/15 inch
3	6 characters per inch	1/6 inch

```
| | 5 characters per inch;
| | 6 characters per inch;
| | 6.6 characters per inch;
| |8.25 characters per inch;
| |10 characters per inch;
| |12 characters per inch;
| |13.3 characters per inch;
| |16.5 characters per inch;
```

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Figure 5-2 Horizontal Pitch Example

5.4.5 Set Horizontal Pitch (DECSHORP)

This sequence selects the character width and character spacing for fixed-width (monospace) fonts. To set character width, DECSHORP selects a horizontal pitch (the number of characters printed per inch on a line).

The pitch select mode (DECPSM) controls the execution of the DECSHORP sequence (Paragraph 5.2.4). When DECPSM is set, the printer uses the horizontal pitch of the current font. When DECPSM is reset, the printer uses the horizontal pitch selected by the last DECSHORP. DECPSM lets you switch between the DECSHORP value and the current font value.

Changing the horizontal pitch changes the white space around characters. Figure 5-2 shows an example. DECSHORP also changes the following settings:

- Resets the left and right margins to the printable limits.
- Resets the line home and line end positions to the printable limits (Paragraph 5.5.1)
- Changes current horizontal tab stops. Each tab stop value is multiplied by the new horizontal pitch divided by the old horizontal pitch. This process keeps a constant number of character widths between tab stops. Both DECSHORP and DECPSM change the print positions set by tab characters.

The format for the DECSHORP sequence is as follows:

CSI	Ps	w
9/11	***	7/7

Ps Parameter
Ps selects the horizontal pitch (characters per inch).

Ps	Horizontal Pitch (Characters per Inch)
0	**Determined by current font. (default)**
1	10
2	12
3	13.2
4	16.5
5	5
6	6
7	6.6
8	8.25
9	15

5.5 PAGE PRINT AREA AND MARGINS

Two factors define the size of your printed page.

- The printer's scanning limitations determine the maximum printable area on a page.
- The margins determine the actual printable area on a page.

The LN03 can scan an area of 2400 pixels by 3400 pixels, or 8 inches by 11.3 inches.

For portrait printing, the top scan line is 0.25 inches from the top of the paper. All scan lines start 0.25 inches from the left edge of the paper.

For landscape printing, the top scan line also starts 0.25 inches from the top of the paper. However, all scan lines stop 0.25 inches from the right edge of the paper.

Figure 5-3 shows the two types of printing orientation. Table 5-2 lists the maximum form length in pixels for each orientation. Figure 5-4 shows the different printed page areas you can select, using the origin placement mode (DECOPM) sequence (Paragraph 5.2.5).

The initial values for page printing (Paragraph 5.14) produce the following page areas for ROM-resident fonts.

Initial Page Areas

Landscape font	66 lines per page 132 characters per line
Portrait font	66 lines per page 80 characters per line

Table 5-2 Maximum Form Length

Paper	Origin	Orientation	Maximum Length (Pixels)
8.5 × 11	Physical page	Portrait	3225
		Landscape	2400
	Print area	Portrait	3150
		Landscape	2400
A4	Physical page	Portrait	3400
		Landscape	2400
	Print area	Portrait	3400
		Landscape	2400

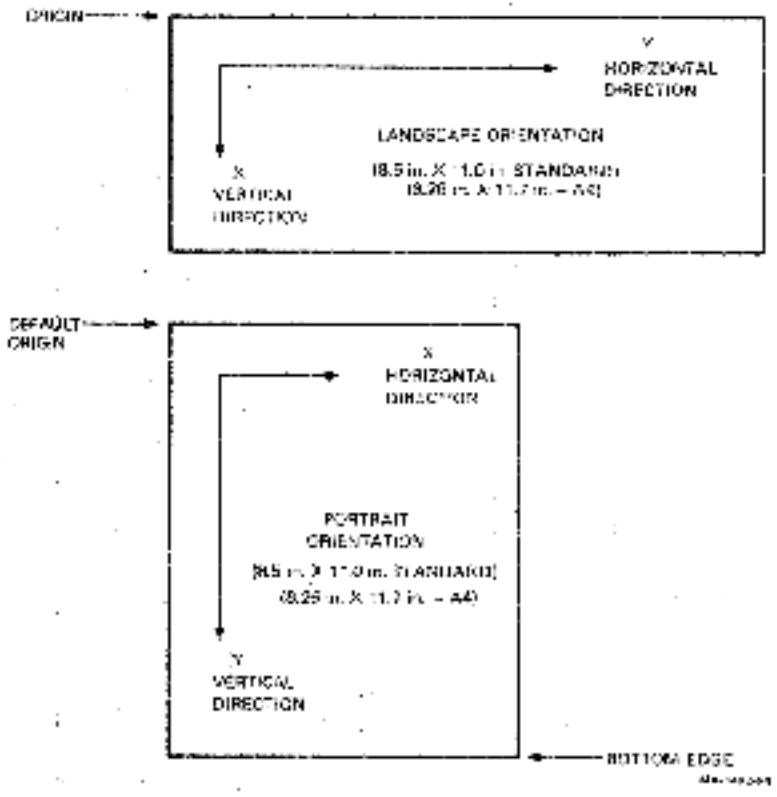

Figure 5-3 Page Printing Orientation

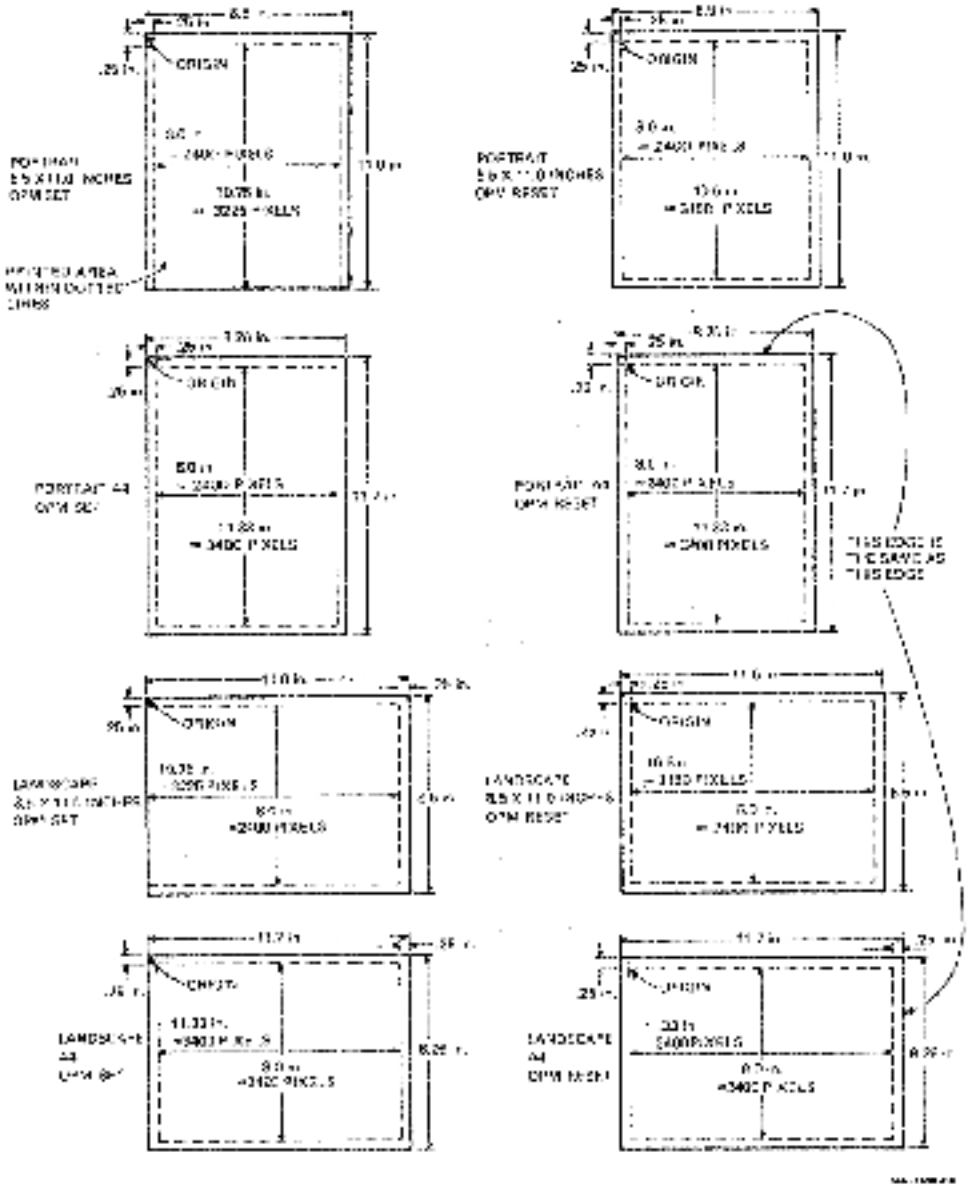

Figure 5-4 Page Printing Area

Changing the Printing Area

There are two methods you can use to change the printing area.

1. You can set the printed page to one of several predefined formats with the page format select (PFS) sequence (Paragraph 5.5.1).

2. You can change the page margins and the number of lines per page with the following sequences.

   Set lines per physical page (DECSLPP, Paragraph 5.5.2)
   Set top and bottom margins (DECSTBM, Paragraph 5.5.3)
   Set left and right margins (DECSLRM, Paragraph 5.5.4)

By using the PFS sequence, you can set your page format with one command.

5.5.1 Page Format Select (PFS)

This sequence lets you select a page format from a list of standard formats. The PFS formats set the following parameters.

- Origin – This is always set 0.25 inches down and in from the upper-left corner of the page.
- Print orientation
- Top, bottom, left, and right margins
- Line home, line end, page home and page end positions (defined below)
- Form length

The printer uses the format you select until you change the format. There are two ways you can change a PFS format.

1. Send another PFS sequence.
2. Change the margins or lines per page (Paragraphs 5.5.2 through 5.5.4)

The *line home position* is the active position after a carriage return (CR). The line home position and *line end position* serve as the left and right edges of the printed page for justified text (Paragraph 5.11). A CR may move the active position forward or backward in order to reach the line home position.

The *page home line* is the active line after a form feed (FF). The index (IND), next line (NL), and CR (in carriage return/new line mode) characters all cause a form feed when they pass the *page end line*.

You should use the vertical position absolute and relative (VPA and VPR) sequences to move below the page end line (Paragraphs 5.6.4 and 5.6.5). If a line feed (LF) passes the page end line, then the printer prints the current page and performs an FF to get to the next page.

Public and Private Parameters
PFS has two types of parameter values, public and DEC private.

Public parameters are defined by ANSI and have a value in the 0 through 7 range. The DEC private parameters are defined by Digital and start with a question mark ? (3/15) character.

The format for the PFS sequence is as follows.

CSI	Ps	SP	J
9/11	***	2/0	4/10

Ps Parameter

Initial value: Ps = ?20
Default value: Ps = 0

Ps selects 1 of 12 page formats. These formats are divided into two types, a normal page format and an extended page format.

In *normal format*, the page home line is 1/2 inch below the top margin and the page end line is 5/6 inch above the bottom margin.

In *extended page format*, the page home line is at the top margin and the page end line is at the bottom margin.

NOTE: If you select a portrait (tall) format, you should also select a portrait font. Likewise, if you select a landscape (wide) format, you should select a landscape font.

Ps	Format Description
Normal Page Formats	
0	**Tall text communication (default)**
1	Wide text communication
2	Tall A4 (210 mm × 297 mm)
3	Wide A4
4	Tall North American (NA) letter
5	Wide North American letter
Extended Page Formats	
6	Tall A4
7	Wide A4
?20	**Tall North American DEC private (initial)**
?21	Wide North American DEC private
?22	Tall A4 DEC private
?23	Wide A4 DEC private

Tables 5-3 shows the printable area selected by each PFS format. The text area is for justified text. Table 5-4 shows the pixel values set for the margins and page positions.

Table 5-5 shows some typical page formats (lines per page and characters per line) created with PFS and the spacing sequences (Paragraph 5.4). You use the spacing sequences to select lines per inch and characters per inch.

Table 6-3 Minimum Paper Dimensions (PCL Formats)

Pa	Minimum Paper Dimensions (inches) Width	Length	Printable Area (inches) Width	Length	Text Area (inches) Width	Length	Default Lines*	Nominal Paper Size
Normal Page Formats								
0	8.0	11.0	7.7	10.5	7.2	6.17	57	Letter
1	11.0	8.5	10.5	7.7	10.0	6.34	39	Letter
2	8.2	11.5	7.7	11.0	7.2	6.83	62	A4
3	11.5	8.2	11.0	7.7	10.5	6.34	39	A4
4	8.5	11.0	8.0	10.5	7.5	6.17	57	Letter
5	11.0	8.5	10.5	8.0	10.0	6.5	40	Letter
Extended Page Formats								
6	8.2	11.5	7.7	11.0	7.2	6.0	43	A4
7	11.5	8.2	11.0	7.7	10.5	6.34	39	A4
20	8.5	11.0	8.0	11.0	7.5	6.0	61	Letter
21	11.0	8.5	10.5	8.5	10.0	6.0	43	Letter
22	8.2	11.5	7.7	11.0	7.2	6.83	66	A4
23	11.5	8.2	11.0	8.2	10.5	7.04	48	A4

*The number of lines available at this initial vertical spacing of 6 LPI (lines per inch)

Table 5-1 PPS Print Values for Margins and Page Positions

By	Left Margin	Page Header	Right Margin	Top Margin	Page Height	Page End	Bottom Margin
0	0	150	2500	0	150	3000	0149
1	0	150	2500	0	150	3000	0299
2	0	150	2500	0	150	3000	0449
3	0	150	2500	0	150	3000	0599
4	0	150	2500	0	150	3000	0749
5	0	150	2500	0	150	3000	0899
6	0	150	2500	0	150	3000	1049
7	0	150	2500	0	150	3000	1199
8	0	150	2500	0	150	3000	1349
9	0	150	2500	0	150	3000	1499
10	0	150	2500	0	150	3000	1649
11	0	150	2500	0	150	3000	1799
12	0	150	2500	0	150	3000	1949
13	0	150	2500	0	150	3000	2099
14	0	150	2500	0	150	3000	2249
15	0	150	2500	0	150	3000	2399
16	0	150	2500	0	150	3000	2549
17	0	150	2500	0	150	3000	2699
18	0	150	2500	0	150	3000	2849
19	0	150	2500	0	150	3000	2999
20	0	150	2500	0	150	3000	3149
21	0	150	2500	0	150	3000	3299
22	0	150	2500	0	150	3000	3449
23	0	150	2500	0	150	3000	3599
24	0	150	2500	0	150	3000	3749
25	0	150	2500	0	150	3000	3899
26	0	150	2500	0	150	3000	4049
27	0	150	2500	0	150	3000	4199
28	0	150	2500	0	150	3000	4349
29	0	150	2500	0	150	3000	4499
30	0	150	2500	0	150	3000	4649
31	0	150	2500	0	150	3000	4799
32	0	150	2500	0	150	3000	4949
33	0	150	2500	0	150	3000	5099
34	0	150	2500	0	150	3000	5249
35	0	150	2500	0	150	3000	5399
36	0	150	2500	0	150	3000	5549
37	0	150	2500	0	150	3000	5699
38	0	150	2500	0	150	3000	5849
39	0	150	2500	0	150	3000	5999
40	0	150	2500	0	150	3000	6149
41	0	150	2500	0	150	3000	6299
42	0	150	2500	0	150	3000	6449
43	0	150	2500	0	150	3000	6599
44	0	150	2500	0	150	3000	6749
45	0	150	2500	0	150	3000	6899
46	0	150	2500	0	150	3000	7049
47	0	150	2500	0	150	3000	7199
48	0	150	2500	0	150	3000	7349
49	0	150	2500	0	150	3000	7499
50	0	150	2500	0	150	3000	7649
51	0	150	2500	0	150	3000	7799
52	0	150	2500	0	150	3000	7949
53	0	150	2500	0	150	3000	8099
54	0	150	2500	0	150	3000	8249
55	0	150	2500	0	150	3000	8399
56	0	150	2500	0	150	3000	8549
57	0	150	2500	0	150	3000	8699
58	0	150	2500	0	150	3000	8849
59	0	150	2500	0	150	3000	8999
60	0	150	2500	0	150	3000	9149
61	0	150	2500	0	150	3000	9299
62	0	150	2500	0	150	3000	9449
63	0	150	2500	0	150	3000	9599

Table 4-5 Typical Page Formats with PFS and Spacing Sequences

Ps	Format Description	Lines per Page in Text Area (Lines per Inch) 6	8	4	3	Characters per Line in Text Area (Characters per Inch) 10	12	15	8
Normal Page Formats									
0	Tall text option	74	100	66	27	78	96	108	43
1	Wide text option	51	38	25	19	100	120	150	60
2	Tall A4	79	59	39	29	77	96	105	42
3	Wide A4	51	38	25	19	100	120	147	60
4	Tall NA letter	74	55	36	27	75	90	112	45
5	Wide NA letter	52	39	26	19	100	120	150	60
Extended Page Formats									
6	Tall A4	89	59	44	29	72	86	108	43
7	Wide A4	59	44	29	22	105	126	157	63
720	Tall NA DEC	65	53	42	31	80	96	120	48
721	Wide NA DEC	64	47	31	23	96	116	145	58
722	Tall A4 DEC	65	53	42	31	77	92	116	46
723	Wide A4 DEC	64	47	31	23	96	116	145	58

Tall = Portrait, Wide = Landscape

PFS Examples

1. *Selecting a compatible font*

   You should select an appropriate size font for the printing orientation you are using, portrait or landscape. The following examples show some typical selections, using three sequences: PFS, font select (SGR, Paragraph 4.4.3), and set top and bottom margins (DECSTBM, 5.5.3).

For This Page Format...	Use These Sequences	
8.5-inch × 11-inch paper		
Portrait (80 columns)	PFS:	CSI 720 SP J
DEC built-in-1 font	SGR:	CSI 10 m
66 lines	DECSTBM:	CSI 1 ; 66 r
Landscape (132 columns)	PFS:	CSI 721 SP J
Courier 6.7 point font	SGR:	CSI 15 m
66 lines	DECSTBM:	CSI 1 ; 66 r
A4 paper		
Portrait (132 columns)	PFS:	CSI 722 SP J
DEC built-in-1 font	SGR:	CSI 10 m
70 lines	DECSTBM:	CSI 1 ; 70 r

The following examples compares two procedures. The left column is for the LN03 printer. The right column is for previous Digital printers. Both procedures list a series of escape sequences to use, the correct parameter values for those sequences (in parentheses), and the effect of each sequence.

LN03 Printer	Previous Digital Printers
1. *Reset the printer.*	
	RIS
DECSTR (Para. 5.13)	DECSTR Has no effect in old printers.

LN03 Printer	Previous Digital Printers
2. *Set page format*	
	DECVERP (2) Selects 6 lines per inch. Sets size unit for the following DECSLPP sequence.
	DECSLPP (66) Selects 66 lines for an 8-inch form length. Declares 8.5-inch page length (similar to PFS).
	DECHPWA (0 ; 120) Sets printable area to 10 inches with 0.25-inch left margin and 0.75-inch right margin.
PFS (Para. 5.5.1) (?21) Selects 8.5-inch page length (like DECSLPP). Selects 11-inch page width (like DECHPWA).	PFS (?21) Has no effect.
3. *Set type size, character proportion, and spacing.*	
	DECSHORP (3) Selects 13.2 characters/inch. Sets type size to 10 point. Sets character proportion to 100 × (10/13.2) percent, which yields 13.2 characters/inch.

LN03 Printer	Previous Digital Printers
GSM (Para. 4.7.2) (100 ; 76) Does not change type size. Sets character proportion to 100 × (10/13.2) = 76 percent, rounded to the next highest integer.	GSM (100 ; 76) Has no effect.
SPI (Para. 5.4.1) (87 ; 54) Sets character position units to the largest values that provide at least 132 columns in 10 inches (54 decipoints) and 66 lines in 8 inches (87 decipoints).	SPI (87 ; 54) Has no effect.

NOTE: The 54 parameter value creates 133 character positions per line. A 55 value would create 130 character positions. On the LN03 printer, 54 decipoints becomes 22 pixels, which creates 136 columns.

The 87 parameter value creates 66 lines per page. On the LN03 printer, when 87 decipoints become 35 pixels, there are still only 66 lines.

4. *Set the margins.*

DECSLRM (Para. 5.5.4) (5 ; 136) Selects first 132 columns for printing.	DECSLRM (5 ; 136) Same.
DECSTBM (Para. 5.5.3) (1 ; 66) Selects first 66 lines for printing.	DECSTBM (1 ; 66) Same.

LN03 Printer	Previous Digital Printers
5. *Clear and set tab stops.*	
TBC (Para. 5.7.3) (4) Clears all vertical tab stops.	TBC (4) Same.
DECSVTS (Para. 5.7.2) (9 ; 17 ; 25 ; 33 ; 41 ; 49 ; 57 ; 65) Sets vertical tab stops that fall within margins.	DECSVTS (9 ; 17 ; 25 ; 33 ; 41 ; 49 ; 57 ; 65) Same.
TBC (Para. 5.7.3) (3) Clears all horizontal tab stops.	TBC (3) Same.
DECSHTS (Para. 5.7.1) (9 ; 17 ; 25 ; 33 ;41 ; 49 ; 57 ; 65 ; 73 ; 81 ; 89 ; 97 ; 105 ; 113 ; 121 ; 129) Sets standard (8-column) horizontal tab stops that fall within margins.	DECSHTS (9 ; 17 ; 25 ; 33 ;41 ; 49 ; 57 ; 65 ; 73 ; 81 ; 89 ; 97 ; 105 ; 113 ; 121 ; 129) Same.

5.5.2 Set Lines per Physical Page (DECSLPP)

This sequence defines the form length. The maximum form length depends on the setting of the paper size switch, the origin point for page coordinates (Paragraph 5.2.6), and the page orientation.

If the origin is set to the upper-left corner of the paper, the maximum form lengths are

- 3225 pixels for 8.5-inch × 11-inch paper and
- 3400 pixels for A4 paper.

If the origin is set to the upper-left corner of the printable area, the maximum form lengths are

- 3150 pixels for 8.5-inch × 11-inch paper and
- 3400 pixels for A4 paper.

DECSLPP sets the top margin to 1 and the bottom margin to the form length. In general, the form length limits the range of possible settings for the set top and bottom margins (DECSTBM) sequence. The format for the DECSLPP sequence is as follows.

CSI	Pn	t
9/11	...	7/4

Pn Parameter

Initial value: Pn = 0.

Pn sets the form length within the limits described above. If the Pn parameter is 0, or if Pn is greater than the maximum size for the paper and origin, then the form length is set to the maximum for the paper and origin.

The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the height of each cell equals the current line-height setting. You can change the line height by changing the vertical spacing (Paragraph 5.4).

5.5.3 Set Top and Bottom Margins (DECSTBM)

This sequence sets the top and bottom margins and the page home line. These settings are relative to the current origin point for page coordinates (Paragraph 5.2.6).

The *top vertical margin* specifies the first printable line on a page. The *bottom vertical margin* specifies the last printable line. These margins are called *hard margins*, because you cannot print outside the area defined by the margins.

NOTE: You can use the drawing vectors (DECVEC) sequence to draw lines outside the margins. See Paragraph 5.12.

The *page home line* specifies where a form feed (FF) positions the first printable line on the page.

The format for the DECSTBM sequence is as follows.

CSI	Pn1	;	Pn2	r
9/11	***	3/11	***	7/2

Pn Parameters

Initial value: depends on the paper size switch.

Paper Size Switch	Initial Value
8-1/2 × 11	Pn1 = 1, Pn2 = 66
A4	Pn1 = 3, Pn2 = 69

Pn1 sets the top margin and page home line. Pn2 sets the bottom margin. If the first parameter is greater than the second parameter, the printer ignores the sequence.

The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the height of each cell equals the current line-height setting. You can change the line height by changing the vertical spacing (Paragraph 5.4).

NOTE: Margin settings are relative to the current origin point (Paragraph 5.2.6).

Margin settings take effect when received. The printer sets margins exactly where specified, with the following exceptions.

- If Pn1 is 0 or omitted, the top margin is unchanged.
- If Pn2 is 0 or omitted, the bottom margin is unchanged.
- If Pn2 is greater than the form length, the bottom margin is set at the bottom of the form.
- If the sequence tries to set the top margin below the bottom margin, the command is ignored.

If the active position is less than the the new top margin, the active position is set to the new top margin. If the active position is greater than the new bottom margin, the next attempt to print a character causes a form feed (FF).

NOTE: When you change the form length, the printer (1) clears the top and bottom margins, and (2) sets the top margin to 1 and sets the bottom margin to the form length.

Margins measured from the edge of the paper may vary by plus or minus 1/16 inch, due to paper alignment tolerances.

Example

Assume Pn1 has a value of 300 (pixels) and Pn2 has a value of 3000 (pixels).

- If the origin point is at the corner of the paper, the printer sets the top margin 1 inch from the top of the paper and the bottom margin 10 inches from the top of the paper.
- If the origin is at the top corner of the printable area, the printer sets the top margin 1.25 inches from the top of the paper and the bottom margin 10.25 inches from the top of the paper.

5.5.4 Set Left and Right Margins (DECSLRM)

This sequence sets the left and right margins and the line home position. The *left horizontal margin* specifies the first printable position on a line. The *right horizontal margin* specifies the last printable position on a line. The *line home position* specifies where a carriage return (CR) moves the active column.

These margins are defined as *hard margins*, because you cannot print outside the area defined by the margins. There are two exceptions.

1. You can use the drawing vectors (DECVEC) sequence to draw lines outside the margins (Paragraph 5.12).

2. If you are justifying text (Paragraph 5.11), but the spacing between words is less than the minimum specified width of the space character, the text is printed unjustified. This text will exceed the right margin.

The format for the DECSLRM sequence is as follows.

CSI	Pn1	;	Pn2	s
9/11	...	3/11	...	7/3

Pn Parameters

Initial value: Pn1 = 1, Pn2 = 80.

Pn1 sets the left margin and line home position. Pn2 sets the right margin. If the first parameter is greater than the the second parameter, the printer ignores the sequence.

The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the width of each cell equals the current character-width setting. You can change character width by changing the horizontal spacing (Paragraph 5.4).

Margin settings take effect when received. The printer sets margins exactly where specified, with the following exceptions.

- If Pn1 is 0 or omitted, the left margin is unchanged.
- If Pn2 is 0 or omitted, the right margin is unchanged.
- If Pn2 is greater than the printable width, the right margin is set to the right printable limit.
- If the sequence tries to set the left margin to the right of the right margin, the printer ignores the sequence.

If the active position is less than the new left margin, the active position is set to the new left margin. If the active position is greater than the new right margin, the next attempt to print a character causes a carriage return and line feed (CR LF).

Example

Assume Pn1 has a value of 450 (pixels) and Pn2 has a value of 2100 (pixels).

- If the origin point is the top corner of the paper (Paragraph 5.2.6), the printer sets the left margin at 1.5 inches and the right margin at 7 inches from the left edge of the paper.
- If the origin point is the top corner of the printable area, the printer sets the left margin to 1.75 inches and the right margin to 7.25 inches from the left edge of the paper.

5.6 ACTIVE COLUMN AND ACTIVE LINE

The active column and active line represent an absolute position on the paper where the next character prints. The following control functions use the active position as a reference point.

The following sequences set column positions.

Horizontal position absolute (HPA)	Para. 5.6.1
Horizontal position relative (HPR)	Para. 5.6.2
Horizontal position backward (HPB)	Para. 5.6.3

The following sequences set the line positions.

Vertical position absolute (VPA)	Para. 5.6.4
Vertical position relative (VPR)	Para. 5.6.5
Vertical position backward (VPB)	Para. 5.6.6
Cursor up (CUU)	Para. 5.6.7

The following sequences set half-line increments for superscripting and subscripting.

Partial line up (PLU)	Para. 5.6.8
Partial line down (PLD)	Para. 5.6.9

The next line (NEL), reverse index (RI), and index (IND) control characters also move the active position. (See Table 3-2.)

5.6.1 Horizontal Position Absolute (HPA)

This sequence selects the active column on the active vertical line. If you try to move the active column to the right of the last position on the line, the active position stops at the last position on the line. The format for the HPA sequence is as follows.

CSI	Pn	
9/11	***	6/0

Pn Parameter

Pn is the new active column. The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the width of each cell is equal to the current character-width setting. You can change character width by changing the horizontal spacing (Paragraph 5.4).

Default value: Pn = 1.

5.6.2 Horizontal Position Relative (HPR)

This sequence moves the active column by adding Pn to the current active column. If you try to move the active column to the right of the last position on the line, the active position stops at the last position on the line. The format for the HPR sequence is as follows.

CSI	Pn	a
9/11	...	6/11

Pn Parameter

Default value: Pn = 1.

Pn is the value added to the current active column. The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the width of each cell equals the current character-width setting. You can change character width by changing the horizontal spacing (Paragraph 5.4).

NOTE: If you select decipoints and send the HPR sequence with a Pn value of 1, the active position will not move. The printer converts 1 decipoint to 0 pixels. (See Paragraph 5.3.)

5.8.3 Horizontal Position Backward (HPB)

This sequence moves the active column backward by subtracting Pn from the current active column. If you try to move the active column to the left of the first position on a line, the active position stops at the first position. The format for the HPB sequence is as follows.

CSI	Pn	j
9/11	***	6/10

Pn Parameter

Default value: Pn = 1.

Pn is the value subtracted from the current active column. The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the width of each character cell equals the current character-width setting. You can change character width by changing the horizontal spacing (Paragraph 5.4).

5.8.4 Vertical Position Absolute (VPA)

This sequence selects the active line without changing the current active column. If you try to move the active line below the bottom line, the active position stops at the bottom. The format for the VPA sequence is as follows.

CSI	Pn	d
9/11	***	6/4

Pn Parameter

Default value: depends on the paper size switch.

Paper Size Switch	Default Value
8-1/2 × 11	Pn = 1
A4	Pn = 3

Pn is the new active line at the current active column. The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the height of each cell equals the current line-height setting. You can change the line height by changing the vertical spacing (Paragraph 5.4).

NOTE: If Pn is less than the current active line, the active line moves backward on the current page.

5.6.5 Vertical Position Relative (VPR)

This sequence moves the active line by adding Pn to the current active line. If you try to move the active line below the bottom line, the active position stops at the bottom line. The format for the VPR sequence is as follows.

CSI	Pn	e
9/11	...	6/5

Pn Parameter

Default value: Pn = 1.

Pn is the value added to the current active line. The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the height of each cell equals the current line-height setting. You can change the line height by changing the vertical spacing (Paragraph 5.4).

NOTE: If you select decipoints and send the vertical relative position sequence with a Pn value of 1, the active position will not move. The printer converts 1 decipoint to 0 pixels. (See Paragraph 5.3.)

If PUM is set (decipoints or pixels selected), you have to adjust for the offset between the top of characters and the baseline.

5.6.6 Vertical Position Backward (VPB)

This sequence moves the active line backward by subtracting Pn from the current active line. The active column does not change. If you try to move the active line above the top line, the active position stops at the top line. The format for the VPB sequence is as follows.

CSI	Pn	k
9/11	...	6/11

Pn Parameter

Default value: Pn = 1.

Pn is the value subtracted from the current active line. The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the height of each cell equals the current line-height setting. You can change the line height by changing the vertical spacing (Paragraph 5.4).

5.6.7 Cursor Up (CUU)

This sequence moves the active line up Pn lines without changing the active column. If you try to move the active line above the top line, the active position stops at the top line. The format for the CUU sequence is as follows.

CSI	Pn	A
9/11	...	4/1

Pn Parameter

Default value: Pn = 1.

Pn is the number of lines that the active line moves up at the current active column.

5.8.8 Partial Line Up (PLU) – Superscripting

This sequence lets you print superscript characters. The PLU sequence moves the active position up a predefined distance. The distance moved is one-half a vertical line increment, as determined by the currently selected font.

The partial line down (PLD) sequence returns the active position to the previous baseline. Other positioning sequences will also move the active position. The format for the PLU sequence is as follows.

PLU
8/12

5.8.9 Partial Line Down (PLD) – Subscripting

This sequence lets you print subscript characters. The PLD sequence moves the active position down a predefined distance. The distance moved is one-half a vertical line increment, as determined by the currently selected font.

The partial line up (PLU) sequence returns the active position to the previous baseline. Other positioning sequences will also move the active position. The format for the PLD sequence is as follows.

PLD
8/11

NOTE: If the active position is near the top margin when you send PLU (or the bottom margin when you send PLD) and the margin is not set to the edge of the printable area, the superscripted (or subscripted) character may exceed the margin.

Although the character exceeds the margin, the complete character cell will print; the printer does not clip the character at the margin. However, if the top margin is at the edge of the printable area, superscript characters do not print; the printer leaves a blank space.

5.7 TAB STOPS

A tab stop is a preselected point that the active position moves to when you send a tab control character (Paragraph 3.3). The active position is where the next character prints.

You can set horizontal and vertical tabs. Setting a tab already set has no effect; the same is true for clearing a tab already cleared. Tabs are set relative to the current origin point for printing (Paragraph 5.2.6). Also, tabs are set at the selected position, regardless of margins.

You can set tabs with the following two sequences.

Set horizontal tabulation stops (DECSHTS)	Para. 5.7.1
Set vertical tabulation stops (DECSVTS)	Para. 5.7.2

You can clear tabs with the following sequence.

Tabulation clear (TBC)	Para. 5.7.3

5.7.1 Set Horizontal Tabulation Stops (DECSHTS)

This sequence lets you select up to 16 horizontal tabs at one time. A horizontal tab is a preselected point on a line. When the printer receives a horizontal tab (HT) control character, the active position moves to the next horizontal tab.

There are 32 possible horizontal tab stops, and you can set each tab independently. The format for the DECSHTS sequence is as follows.

CSI	Pn	;	...	;	Pn	u
9/11	***	3/11	...	3/11	***	7/5

Pn Parameter

Each Pn is a selected horizontal tab stop. You can select up to 16 tabs in one sequence. The Pn values may be in any order in the escape sequence.

The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you select character cells, the width of each cell equals the current character-width setting. You can change character width by changing the horizontal spacing (Paragraph 5.4).

When the number of new tab settings is more then the number of available positions you can assign, the printer sets the new tabs as follows.

The printer inserts each new tab stop value into the current tab stop list, starting after the old tab stop with the next lower value. If more than the allowed number of tab stops have been set, the printer discards the old tab stop with the highest value before entering each additional new tab stop. If the new tab stop has the highest value and the allowed number of tab stops has been set, then the printer ignores the new tab stop.

HINT: Use half as many tab settings for proportional spacing. This makes it easier to position the printer correctly at the next column.

5.7.2 Setting Vertical Tabulation Stops (DECSVTS)

This sequence lets you set up to 16 vertical tabs at one time. A vertical tab is a preselected position that the active position moves to when the printer receives a vertical tab (VT) control character. The printer has 67 possible vertical tab positions. You can set each tab independently. The format for the DECSVTS sequence is as follows.

CSI	**Pn**	;	...	;	**Pn**	v
9/11	***	3/11	...	3/11	***	7/6

Pn Parameter

Each Pn is a selected vertical tab stop. You can select up to 16 tabs in one sequence. The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

If you use character cells, the height of each cell equals the current line-height setting. You can change the line height by changing the vertical spacing (Paragraph 5.4).

The printer sets vertical tab stops at the selected positions. New tab stop values are added to the current tab stop list, starting with the lowest value. If you exceed 67 tab stops, the printer stores the first 67 tab stops and discards the highest-value tab stops.

5.7.3 Tabulation Clear (TBC)

This sequence clears one or all horizontal or vertical tabulation stops. The format for the tabulation clear sequence is as follows.

CSI	Ps	g
9/11	***	6/7

Ps Parameter

Ps is a decimal value that selects which tab stops to clear.

Ps	Action
0	Clear one horizontal tab stop at active column.
1	Clear one vertical tab stop at active line.
2 or 3	Clear all horizontal tab stops.
4	Clear all vertical tab stops.

5.8 PRODUCT IDENTIFICATION (DA)

The host computer sends a device attributes (DA) sequence to request a device's product identification. The printer automatically sends its product identification after receiving a DA sequence. There are two formats for the DA sequence from the host.

CSI	c	or	CSI	0	c
9/11	6/3		9/11	3/0	6/3

The printer responds to the DA sequence by sending one of the following identifying sequences. You select the response by setting configuration switches **SP2-2** and **SP2-3** (Paragraph 2.4.2).

Sequence					Switch Setting
CSI	?	2	6	c	Set for LN03 ID response.
9/11	6/3	3/2	3/6	6/3	
CSI	?	1	3	c	Set for LQP02 ID response.
9/11	6/3	3/1	3/3	6/3	
CSI	?	1	0	c	Set for LA100 ID response.
9/11	6/3	3/1	3/0	6/3	

5.9 PRINTER STATUS

The printer uses device status reports to inform the host computer about the printer's operating status, including errors. The host can request two types of status reports, brief and extended.

NOTE: For information on font status reports, see Paragraph 4.6.

5.9.1 Device Status Request (DSR)

The host uses the following sequences to request an extended printer status report, request a cursor position report, and enable or disable unsolicited printer status reports.

Sequence	Request
CSI n 9/11 6/14	Send an extended status report
CSI 0 n 9/11 3/0 6/14	Send an extended status report
CSI 6 n 9/11 3/6 6/14	Send a cursor position report (active column and active line).
CSI ? 1 n 9/11 3/15 3/1 6/14	Disable all unsolicited status reports from printer.
CSI ? 2 n 9/11 3/15 3/2 6/14	Enable brief, unsolicited status reports and send an extended status report.
CSI ? 3 n 9/11 3/15 3/3 6/14	Enable extended, unsolicited status reports and send an extended status report.

NOTE: The printer sends unsolicited reports only when an error occurs. The printer does not report errors that occur before you enable unsolicited reports. For more information, see Paragraph 5.9.2.

5.9.2 Device Status Report

The printer can send brief and extended status reports (solicited or unsolicited), as well as the cursor position report. The printer sends unsolicited reports (if enabled) when a change occurs in any reportable status condition. Unsolicited status reports are initially disabled.

NOTE: Unsolicited reports are always sent after the current page. When errors occur on a page, the unsolicited report lists each type of error only once—even if an error occurred several times on that page.

It would be time consuming and redundant to send reports throughout a page, for each occurrence of an error. Also, it is easier for applications to handle reports in one place—after a page is printed.

Device Status Report (Brief)

The formats for the brief status reports are as follows.

Sequence	Meaning
CSI 0 n 9/11 3/0 6/14	No malfunction detected.

followed by

CSI	?	2	0	n
9/11	3/15	3/2	3/0	6/14

Device Status Report (Extended)

For extended status reports, the printer sends two sequences—one of the brief sequences, followed by a longer sequence. The formats for the extended status reports are as follows.

Sequence	Meaning
CSI 0 n 9/11 3/0 6/14	No malfunction detected.

followed by

CSI	?	2	0	n
9/11	3/15	3/2	3/0	6/14

Sequence			Meaning
CSI	3	n	Malfunction detected.
9/11	3/3	6/14	

followed by

CSI	?	Pn	;	...	Pn	n
9/11	3/15	***	3/11	...	***	6/14

Pn Parameter
Each Pn value is an error code of up to three digits. Table 5-6 lists the error codes. The printer reports error codes in pairs—a generic code, followed by a specific code.

NOTE: The ?(3/15) occurs only once per DSR sequence.

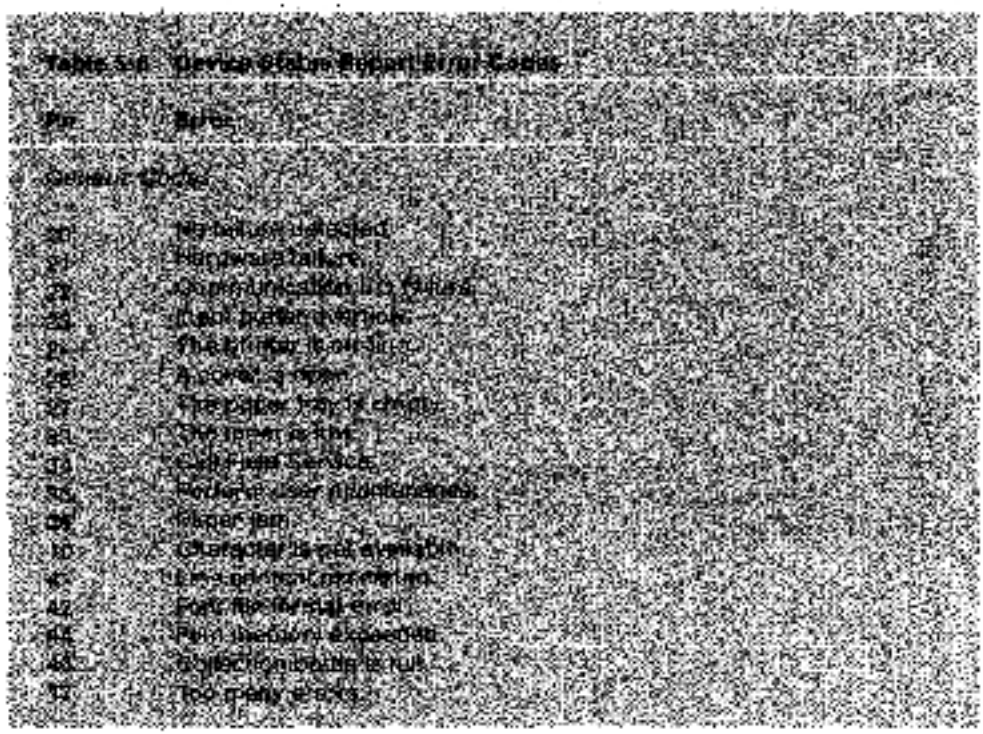

Table 5-6 Device Status Report Error Codes (Cont)

No	Error
Specific Controller Error Codes	
101	Band is too complex.
102	Lost characters or part of ruling line width.
103	Font memory exceeded – error corrected if font loaded.
104	Escape font not loaded in font memory.
105	Page data has exceeded available page memory.
	Data will print on page.
112	Illegal codes, format failed font.
114	300 or more errors were detected on the page.
116	Invalid parameter used.
124	Character not defined in selected font.
125	Text bump occurred while loading font from host.
131	Communication error on received character.
132	Serial/parallel error – input buffer overflow.
150	Font cartridge removed while printing.
151	RAM cartridge removed while printing.
Specific Print Engine Error Codes	
201	Fuser error.
202	Optical system error.
203	Toner is low.
204	Optical synchronization error.
205	Replace QPC belt.
206	Paper tray is empty.
207	Duplex buffer overflowed.
208	Main motor error.
210	Engine memory error.
212	A cover is open.
213	Printer is off-line.
214	Paper jam in feed, eraser, exit area.
215	Paper misfeed error.

Cursor Position Report

The format for the cursor position report is as follows.

CSI	Pn1	;	Pn2	R
9/11	***	3/11	***	5/2

Pn Parameters

Pn1 is the active line and Pn2 is the active column. The unit of measurement can be character cells, decipoints, or pixels. You select the unit by using the position unit mode (PUM) and select size unit (SSU) sequences (Paragraphs 5.2.7 and 5.3).

5.10 SELECTING CHARACTER ATTRIBUTES

You can select four different character attributes by using select graphic rendition (SGR) sequences. Character attributes let you highlight your printed text.

Underlining	Para. 5.10.1
Bold printing	Para. 5.10.2
Italic printing	Para. 5.10.3
Strike through	Para. 5.10.4

NOTE: The strike-through attribute is often used in legal documents, to indicate words deleted from a previous version of the document.

The four character attribute sequences and the select font sequence (Paragraph 4.3.3) use the same basic SGR sequence.

CSI	Ps	m
9/11	***	6/13

You can select one or more of these attributes in the same sequence, by including several Ps values separated by semicolons (3/11).

CSI	Ps	;	Ps	;	Ps	m
9/11	***	3/11	***	3/11	***	6/13

The printer uses a selected attribute until you turn the attribute off or reset the printer.

A Ps value of 0 turns off all attributes: underlining, bold printing, italic printing, and strike through.

5.10.1 Underlining

This sequence lets you turn the underlining feature on or off. When you turn underlining on, the printer underlines all printable characters that follow, including spaces. Underlining remains in effect across line and page boundaries, until you turn underlining off.

The thickness of the underline and the distance below the *baseline* depend on the font you use. The baseline is the imaginary line that each printed line of characters rests on. The format for the underline sequence is as follows.

CSI	Ps	m
9/11	***	6/13

PS Parameter

Ps turns underlining on or off.

Ps	Function
4	Turn underlining on.
24	Turn underlining off.

5.10.2 Bold Printing

This sequence lets you turn bold printing on or off. When you select bold printing, the printer either uses a bold (darker) font from the current type family or uses shadow printing to produce darker characters (if no bold font is available).

NOTE: The printer performs shadow printing by imaging each character twice. The second image is offset from the first by 2 or more pixels in the horizontal direction, as specified in the font file.

The format for the bold printing sequence is as follows.

CSI	Ps	m
9/11	***	6/13

Ps Parameter
Ps turns bold printing on or off.

Ps	Function
1	Turn bold printing on.
22	Turn bold printing off.

5.10.3 Italic Printing

This sequence turns italic printing on or off. When you turn on italic printing, the printer uses italic characters (if available) for the printable characters that follow the sequence.Otherwise, the printer underlines printable characters.

NOTE: The printer does not have any built-in italic or bold fonts. You should use this sequence with italic fonts loaded from the host computer or on a ROM cartridge.

The format for the italic printing sequence is as follows.

CSI	Ps	m
9/11	***	6/13

Ps Parameter
Ps turns italic printing on or off.

Ps	Function
3	Turn italic printing on.
23	Turn italic printing off.

5.10.4 Strike Through

This sequence lets you mark characters that you want to delete. The printer draws a line (similar to underlining) through the marked characters. The format for the strike-through sequence is as follows.

CSI	Ps	m
9/11	...	6/13

Ps Parameter

Ps turns the strike-through attribute on or off.

Ps	Function
9	Turn the strike-through attribute on.
29	Turn the strike-through attribute off.

5.11 JUSTIFICATION (JFY)

This sequence lets you align printed text at the right margin. When you justify text, you change the spacing between words. Justified lines have the first character of the first word at the left margin (or at the line home position, if different), and the last character of the last word at the right margin. When you turn JFY on, the LN03 justifies all text that follows, until you turn JFY off.

The printer spaces words evenly on each justified line. The SP (2/0) character indicates a word space to the printer. You can control the limits for word spacing with the Ps parameter for the justification sequence. (See the Ps parameter description.)

The printer does not make end-of-line or hyphenation decisions. The following control characters and escape sequences determine where lines end.

Carriage return (CR)
Form feed (FF)
Line feed (LF)
Vertical tab (VT)
Next line (NEL)
Forward index (IND)
Reverse index (RI)
Vertical position absolute (VPA)

The active font determines the spacing between characters in a word. Text that exceeds the printable area is lost, because the printer does not autowrap text during justification.

The printer does not justify leading spaces, but sets them to the "normal" width of the SP (2/0) character (that is, the width of SP if you did not use the JFY sequence). Also, the printer does not shrink or expand the value of horizontal position relative (HPR) sequences in the text. If a line contains a horizontal tab (HT) or horizontal position absolute (HPA), the printer only justifies the text between the last HT or HPA and the end of the line.

The format for the JFY sequence is as follows.

CSI	Ps	SP	F
9/11	...	2/0	4/6

Ps Parameter
Ps turns justification on or off.

Ps	Function
0	**Turn justification off. (default)**
2	Turn justification with limits on.
?2	Turn justification without limits on.

When you select justification with limits (Ps = 2), the printer will not shrink or expand the SP (2/0) character beyond the limits determined by the current font. Usually, these limits are in the range of 50 percent to 200 percent.

When you select justification without limits (Ps = ?2), the printer can shrink SP to zero size or expand SP to any size.

5.12 DRAWING VECTORS (DECVEC)

This sequence lets you draw horizontal or vertical lines with length and width. Margins do not affect line drawing. If you try to draw a line beyond the physical limits of the page, the printer will print the part of the line that occurs within the page.

NOTE: The printer draws lines without modifying the active position.

The format for the drawing vectors sequence is as follows.

CSI	Pn1	;	Pn2	;	Pn3	;	Pn4	;	Pn5	!	'
9/11	***	3/11	***	3/11	***	3/11	***	3/11	***	2/1	7/12

Pn Parameters

The Pn parameters select the length, width, and direction of the line. The select size unit (SSU) sequence (Paragraph 5.3) determines the unit of measurement for Pn2 through Pn5.

- Pn1 selects a horizontal (x) or vertical (y) line.

Pn1	Function
0	**Draw an x line—horizontal with respect to the page orientation. (default)**
1	Draw a y line—vertical with respect to the page orientation.
Other	Perform no action.

- Pn2 selects the x start position.
  Default value: Pn2 = 0.

- Pn3 selects the y start position.
  Default value: Pn3 = 0.

- Pn4 selects the line length. If the requested line is less than 1 pixel long, the printer draws a line 1 pixel long.
  Default value: Pn4 = 1.

- Pn5 selects the line width. If the requested line is less than 1 pixel wide, the printer draws a line 1 pixel wide.
  Default value: Pn5 = **1**.

NOTE: For an x line, Pn4 specifies length in the x direction and Pn5 specifies width in the y direction. For a y line, Pn4 specifies length in the y direction and the Pn5 specifies width in the x direction.

5.13 RESET

When you send a reset sequence, the printer resets the value or state of several operating features (Paragraph 5.14). There are two sequences you can use to reset the printer to its initial state.

Reset to Initial state (RIS)
Soft terminal reset (DECSTR)

These two sequences perform the same function. Each sequence resets all state variables to the initial values.

Reset to Initial State (RIS)

ESC	**c**
1/11	6/3

Soft Terminal Reset (DECSTR)

CSI	**!**	**p**
9/11	2/1	7/0

NOTE: You can send DECSTR to the printer port of a VT100 or VT125 video terminal.

5.14 INITIAL VALUES AND STATES

The LN03 has a set of initial values permanently stored in memory for some escape sequences. The printer uses these initial values after you power up the printer or send a reset sequence (Paragraph 5.12).

Table 5-7 shows the initial values the printer uses when you turn power on (power-up) or send a reset sequence. These values are typical selections for operating the printer. You cannot change the designation of initial values.

Table 5-7 Initial Operating Values*

Feature	State
Receiving and Sending Data	
7-bits or 8-bits	The printer uses the following formats: • Receives 8-bit data and C1 control characters (C1 receive sequence enabled) • sends 7-bit data and C1 control characters (C1 transmit sequence disabled)
Fonts	
Loaded fonts	At power-up, the ROM-resident landscape and portrait fonts are available for printing. After a reset sequence, all currently loaded fonts are available.
Assigned fonts	The default ROM-resident portrait fonts are available. (See "Selected Fonts" below.)
Selected fonts (SGR)	The printer assigns SGR numbers to type families and fonts, as follows:

SGR	Assignment	ID	Name
10	type family	DEFAULTN1	DEC built-in-1 family
11	type family	PCCOURIR	Courier family
12	type family	RELITE0	Elite family
13	font	PCCOURIR[illegible]Q0G	Courier 10 point, 10 pitch
14	font	RELITE0[illegible]0	Elite 10 point, 12 pitch
15	font	PCCOURIR[illegible]C0G	Courier 8.7 point, 13.0 pitch
16	font	PCCOURIR[illegible]0G	Courier 10 point, 10.3 pitch
17	type family	DEFAULTN1	DEC built-in-1 family
18	type family	DEFAULTN1	DEC built-in-1 family
19	type family	DEFAULTN1	DEC built-in-1 family

NOTE: ROM font cartridges can override some or all of the automatic assignments of ROM-resident fonts.

*The printer uses the settings in this table at power-up or after a reset sequence, unless noted.

Table 5-7 Initial Operating Values (Cont)

Feature	State
Font	The initial font family selected for printing is Set number 10. The printer uses one of two fonts from that family, depending on the paper size switch on the printer's back panel.
	Paper — **Font** 8.5 X 11 — Portrait DEC multinational 10 pitch, 10 point A4 — Portrait DEC multinational 10 pitch, 10 point
Margins	
Set top and bottom margins (DECSTBM)	The printer sets top and bottom margins based on the initial font.

NOTE: All measurements are from the top edge of the printable area (0.25 inches from the edge of the paper).

Font	Top margin	Bottom margin
Portrait (8.5 X 11)	0.00 inches	10.50 inches
Portrait (A4)	0.32 inches	10.68 inches

These margins produce a page size of 66 lines per page for 8.5 X 11 and A4 paper.

Set left and right margins (DECSLRM)	The printer sets left and right margins based on the initial font as follows:

NOTE: All measurements are from the left edge of the printable area (0.25 inches from the edge of the paper).

Font	Left margin	Right margin
Portrait (8.5 X 11)	0.00 inches	8.00 inches
Portrait (A4)	0.00 inches	7.75 inches

Table 5-7 Initial Operating Values (Cont)

Feature	State
Tabs	
Set horizontal tab stops (DECSHTS)	At power-up, the printer sets a tab stop every 8 character spaces. The first tab stop is 8 character spaces from the left margin. The initial font determines the size of a character space, as follows:
	Font — **Distance between horizontal tabs**
	Portrait (8.5 × 11) — 0.800 inches — 240 pixels
	Portrait (A4) — 0.730 inches — 252 pixels
	After a reset sequence, the printer clears all tab settings and resets tabs to the initial values.
Set vertical tab stops (DECSVTS)	At power-on, the printer sets tabs every line. The first tab is set one line down from the top of the page. The initial font determines the distance between lines, as follows:
	Font — **Distance between tab stops**
	Portrait (8.5 × 11 in and A4) — 0.167 inches — 48 pixels
	After a reset sequence, the printer clears all tab settings and resets tabs to the initial values.
Page format	
Page format select (PFS)	The printer sets the page format to 8.5 × 11 portrait page.
Set lines per physical page (DECSLPP)	The printer sets the form length based on the font, as follows:
	Font — **Form length**
	Portrait (8.5 × 11) — 11.00 inches — 3025 pixels
	Portrait (A4) — 11.69 inches — 3400 pixels
Origin mode (DECOM)	The printer sets the origin at the upper-left corner of the printable area (0.25 inches from the edge of the paper).

Table 5-7 Initial Operating Values (Cont)

Feature	State
CR/LF placement mode (DECCRM)	The printer sets the origin at the upper-left corner of the print area (0.25 inches from the edge of the paper).
Spacing (SPI)	The printer sets the following characteristics:

Paper	Vertical	Horizontal
8.5"x11"	10 pitch (6.35 dots/mm/0.25")	80 pitch (10 characters/inch)
A4	12 pitch (5.05 dots/mm)	96 pitch (10.4 characters/inch)

Horizontal position of print head (HPA) and Vertical position of print head (VPA)	The printer sets the print head position to the upper-left corner of the printable area (0.25 inches from the edge of the paper). The printer's settings are the printer power-on line and page.
Printing Format	
Justification (JUS)	Justification is off.
Select graphic rendition (SGR)	Character attributes (underline, bold, print, italic, shift, and blink) are off.
Backspace/cursor left mode (DECBKM)	This mode is set when a backspace moves the cursor one character left (when required) to the left margin, but does not advance to a new line.
Line feed/new line mode (LNM)	This mode is off. When it is set, a line feed (or form feed) moves the printer's position to the first line and carriage return to the left margin.
Setting and Positioning Unit	
Select size unit (SSU)	The printer uses decipoints.
Pointer unit mode (PUM)	The unit of setting for PUM is relative to the unit of measure in character cell size.

6 PROCESSING SIXEL GRAPHICS

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6.1 PRINTING GRAPHS AND DRAWINGS

This chapter describes how to select sixel mode. In sixel mode, you can print graphs and other drawings. The chapter also describes

- how the host computer must encode the sixel data it sends to the LN03, and
- how the LN03 decodes the data and prints the graphic image.

A *sixel* is a group of six vertical pixels that represents bit map data for a graphic image. A *pixel* represents the individual dots of ink you see on a printed page. The printer processes sixel data as bits of information. A bit value of 1 means print a dot (pixel). A bit value of 0 means leave a space.

Sixels are coded as 8-bit bytes. Each byte is an ASCII character code. Paragraphs 6.3 and 6.4 describe the coding process. You can send sixel data to the printer after placing the printer in sixel mode. When you select sixel mode, the printer interprets the ASCII character codes as sixel data and prints a graphic image.

6.2 SELECTING SIXEL MODE

You select sixel mode by sending the following device control string (DCS). You also include all your sixel graphic data and formatting information in the DCS. The formatting section of the DCS is called the sixel protocol. This section describes the features you can select with the sixel protocol. The DCS is the only method to enter sixel mode. You can exit and reenter sixel mode, but you cannot reset it.

In sixel mode, the LN03 assembles the sixel dot patterns when it receives the ASCII character codes. You send the sixel data in the same device control string used to select sixel mode.

DCS	Ps1	;	Ps2	;	Ps3	q	sixel data	ST
9/0	***	3/11	***	3/11	***	7/1	********	9/12

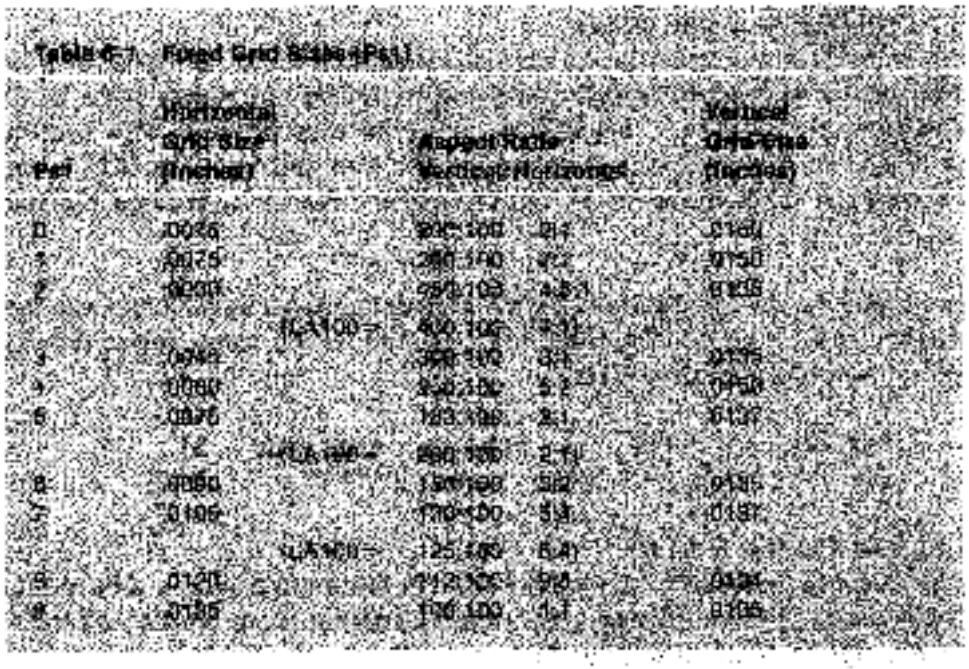
DCS and Protocol Selector

The DCS introducer and the protocol selector place the printer in sixel mode. The protocol does not have an initial state. The printer interprets the Ps parameters in the protocol selector as follows.

Ps1 Parameter

Ps1 selects the horizontal grid size, vertical grid size, and pixel aspect ratio. The grid size defines the size of the area where you can place a single pixel. You should select the Ps1 value that most closely matches the device you are using to develop the sixel data.

Table 6-1 lists the Ps1 values. You can override the Ps1 value with the Ps3 parameter.



Ps2 Parameter
Ps2 selects a background color. The printer ignores this parameter.

Ps3 Parameter
Ps3 lets you select a horizontal grid size other than the standard sizes for Ps1. Any Ps3 value other than 0 overrides the Ps1 value. The Ps3 value can be in decipoints or pixels, selected by the select size unit (SSU) sequence (Paragraph 5.3).

When you use Ps3, you must enter a pixel aspect ratio as the first character in the sixel data stream. The Ps3 value and the pixel aspect ratio define the grid size (including the vertical grid size).

Sixel Data
You can embed control characters and printable characters in the sixel data stream. The printer responds to the control characters listed in Tables 6-2 and 6-3. The printer responds to printable sixel codes in the 3/15 to 7/14 range. Paragraph 6.4 describes how the printer interprets character codes.

After entering sixel mode, the printer determines the current sixel position from the text position. This position is called the *graphic left margin*. The horizontal and vertical directions are the ANSI text horizontal and vertical directions at the time you entered sixel mode.

As each sixel prints, the active position advances to the next horizontal grid position. The distance moved is equal to the horizontal grid size selected by Ps1 or Ps3.

Positioning is always relative to the active position. You cannot move backward, except by using the graphic carriage return and graphic new line control characters (Table 6-3).

ST (String Terminator)
ST causes the printer to leave sixel mode and return to text mode.

Table 6-2 ANSI Graphic Control Characters

Name	Mnemonic	Column/Row	Function
Cancel	CAN	1/8	CAN causes the printer to leave sixel mode.
Substitute	SUB	1/10	SUB is processed as a blank space (1/0).
Escape	ESC	1/11	ESC causes the printer to leave sixel mode and it causes ESC as the start of a new escape sequence.
All C1 control codes		8/0 through 9/15	Any C1 code causes the printer to leave sixel mode and executes that C1 code.

NOTE: The printer treats other control codes in the 0/0 through 1/15 range as errors.

Table 6-3 Private Graphic Control Characters

Name	Mnemonic	Code	Function
Graphics repeat introducer	DECGRI	! 21/3	DECGRI starts a repeat sequence. This is followed by a number that indicates how many times to repeat the next sixel code. The maximum DECGRI value is 32767.
Raster attributes	DECGRA	" 22/2	DECGRA defines the pixel aspect ratio and the size of the picture. The first parameter is the ratio of the vertical pixel size to the horizontal pixel size. The second parameter is the number of pixels in a line. The third parameter is the number of lines in the picture. The default value for the first parameter is 2. The default value for the second parameter is 1. The default value for the third parameter is 0. The above default values are used if the parameters are omitted or if the parameter is 0.
Graphics repeat cancel	DECGRC	# 23/3	DECGRC terminates the sixel graphics data string.
Graphics new line	DECGNL	- 2D/2	DECGNL causes the active position to move to the left margin of the next sixel band.

6.3 HOW THE HOST COMPUTER SENDS SIXEL DATA

To create a sixel, you take a 6-bit data packet and add 077 octal to form an 8-bit byte. The byte represents an ASCII character between 077 and 176 octal.

The host computer creates the sixel by adding 077 octal to the binary bit map data. The LN03 decodes the sixel by subtracting 077 octal to reform the binary data. The following paragraphs describe the procedure for encoding binary data into sixels.

Data bits are arranged in the data stream in a specific order. Essentially, the order is from the most significant bit to the least significant bit. For example, assume the host is sending a buffer with 3 bytes of data, and a pointer is pointing to the first byte in the buffer.

The host sends 6 bits at a time, in the following order.

1. Bits 7 through 2 from byte 0
2. Bits 1 and 0 from byte 0, and bits 7 through 4 from byte 1
3. Bits 3 through 0 from byte 1, and bits 7 and 6 from byte 2
4. Bits 5 through 0 from byte 2

In this example, the host sends 3 bytes of data as 4 characters.

If the data buffer does not contain an even multiple of 6-bit groups, the host must send extra bits. For example, to send 2 bytes of data, the host must convert 16 bits. The host converts two 6-bit groups to sixels, leaving 4 bits. The host converts these 4 bits by adding 2 extra bits with undefined values. When the printer detects the end of record, the extra bits are discarded.

The following example shows step by step how the host would remove 3 bytes from the data buffer and convert them to sixels. Figure 6-1 shows the 3 bytes in the data buffer.

Figure 6-1 Three Bytes of Data in Buffer

1. Removes bits 7 through 2 of byte 0 from the buffer.

   000110(2) = 006(8)

2. Adds 077 octal. The sum equals the ASCII character code used for the sixel—in this case, an uppercase E.

   ```
     006(8)
   + 077(8)
   --------
     105(8) = E
   ```

3. Places the ASCII character code for the sixel in a buffer that will be sent to the printer.

   ```
   E
   105
   ```

4. Removes bits 1 and 0 of byte 0, and bits 7 through 4 of byte 1 from the buffer.

   000101(2) = 005(8)

5. Adds 077 octal. The sum is the ASCII character code used for the second sixel—an uppercase D.

   ```
     005(8)
   - 077(8)
   --------
     104(8) = D
   ```

6. Places the second sixel in the buffer that will be sent to the printer.

```
 E   D
105 104
```

7. Removes bits 3 through 0 of byte 1, and bits 7 and 6 of byte 2 from the buffer.

   010100(2) = 024(8)

8. Adds 077 octal. The sum is the ASCII character code used for the third sixel—an uppercase S.

```
  024(8)
+ 077(8)
--------
  123(8) = S
```

9. Places the third sixel in the buffer that will be sent to the printer.

```
 E   D   S
105 104 123
```

10. Removes bits 5 through 0 of byte 2 from the buffer.

    000000(2) = 000(8)

11. Adds 077 octal. The sum is the ASCII character code for the fourth sixel—a question mark (?).

```
  000(8)
+ 077(8)
--------
  077(8) = ?
```

12. Places the fourth sixel in the buffer and sends the characters to the printer.

```
 E   D   S   ?
105 104 123 077
```

5.4 HOW THE PRINTER DECODES SIXEL DATA

The LN03 receives sixel data as ASCII character codes in the 3/15 through 7/14 range. The printer processes 8-bit codes in the 11/15 to 15/14 range by converting the eighth bit to a 0, then processing the data as 7-bit codes.

Because the column codes are restricted to the 3/15 (octal 077) through 7/14 (octal 176) range, the host computer adds an offset of octal 077 to each sixel column octal code.

The printer determines which of the 6 pixels to print as follows.

1. Subtracts the offset (077 octal) from the received code.

2. Assigns each of the low-order 6 bits to a grid position. The 6 pixels are arranged vertically as follows.

Top pixel	Bit 0 (LSB)
	Bit 1
	Bit 2
	Bit 3
	Bit 4
Bottom pixel	Bit 5 (MSB)

For example, if the printer receives the code value 105 octal,

ASCII code	7 6 5 4 3 2 1 0
	0 1 0 0 0 1 0 1

it subtracts the offset value (077 octal) from the code value. Then the printer maps the resulting value of 8 into memory as follows.

Data bits	5 4 3 2 1 0
	0 0 0 1 1 0

Memory	1 o
	2 •
	3 •
	4 o
	5 o
	6 o

A * indicates the dot will print and o indicates the dot will not print. The printer develops a bit map of the image by grouping the sixel dots to print.

Table 6-4 shows the printable dot patterns used for each character code in the 3/15 (octal 77) through 7/14 (octal 176) range. The table lists the octal values of the codes received by the printer. The printer creates the dot patterns shown by subtracting 077 octal from the received code.

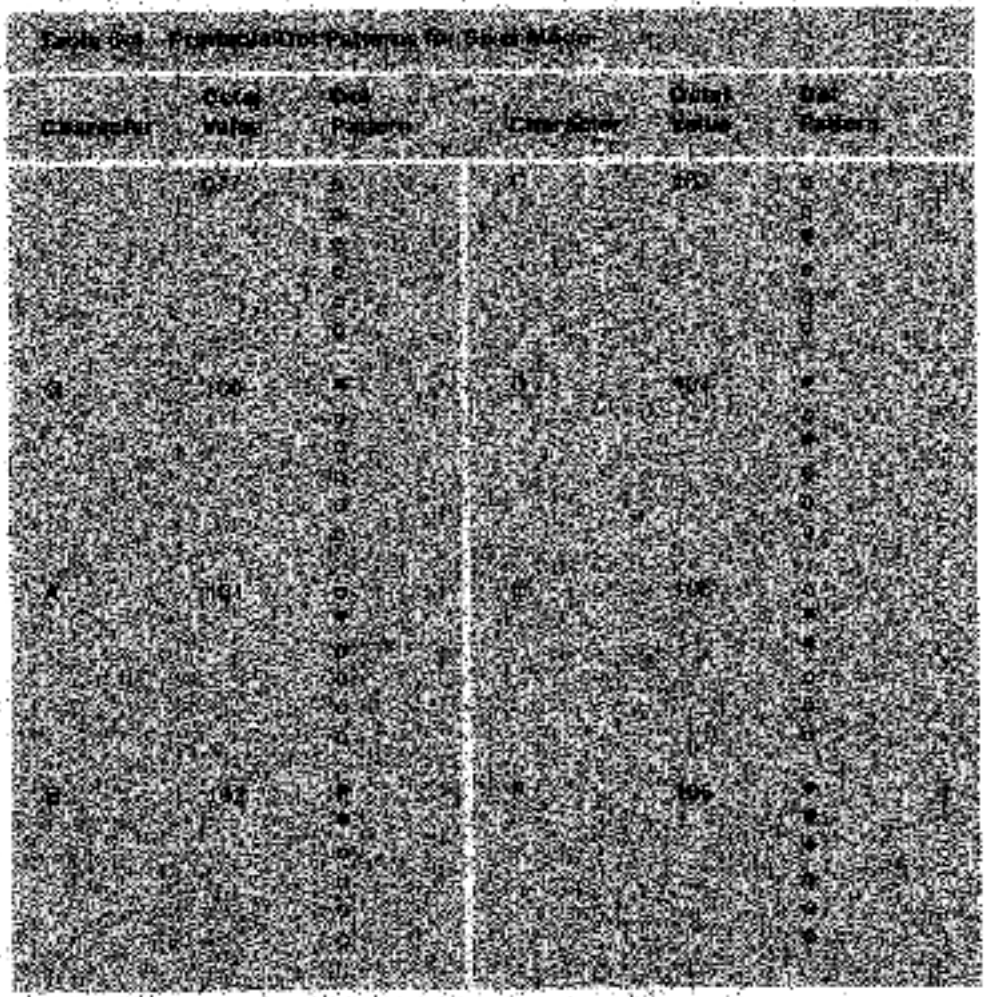
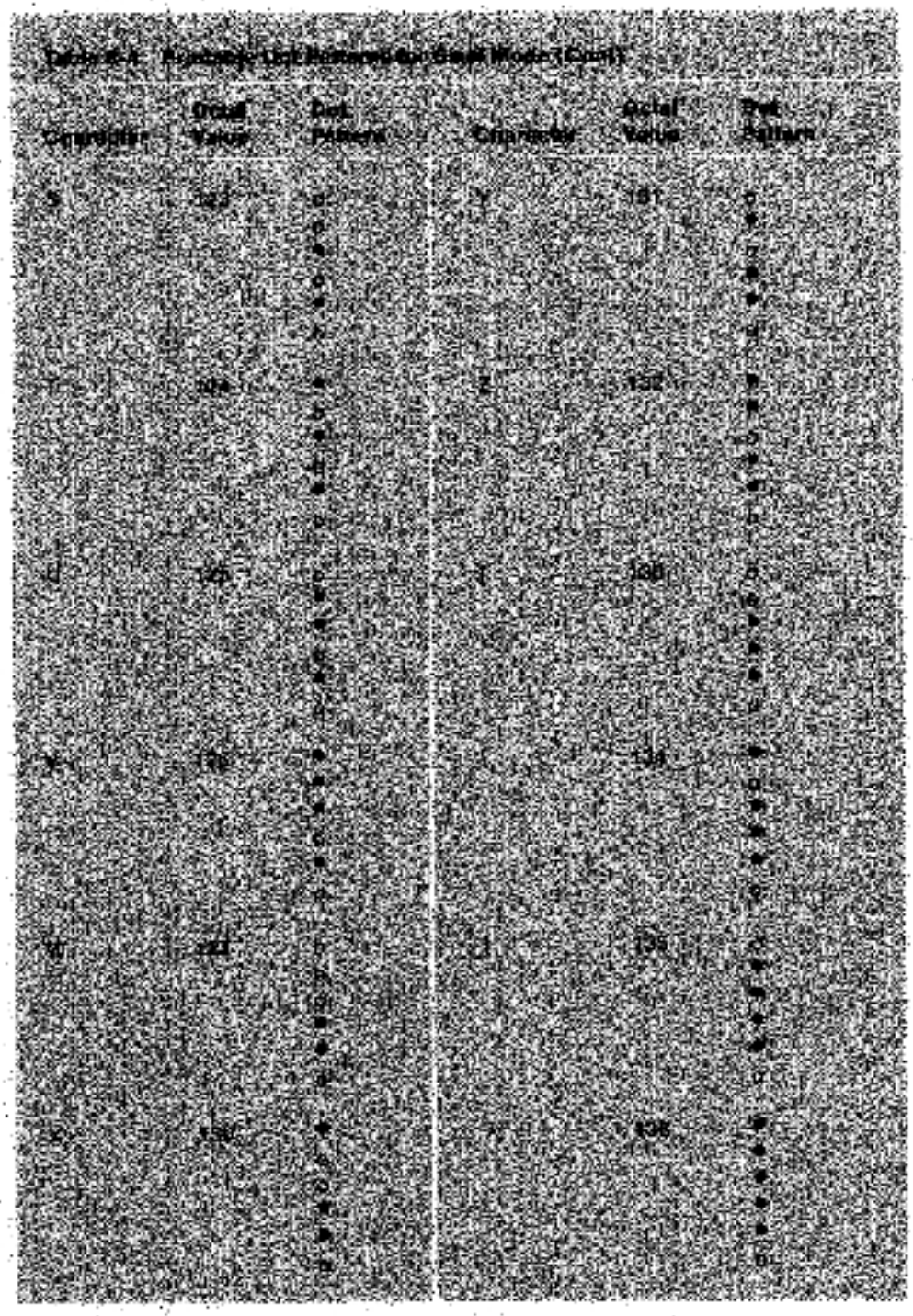
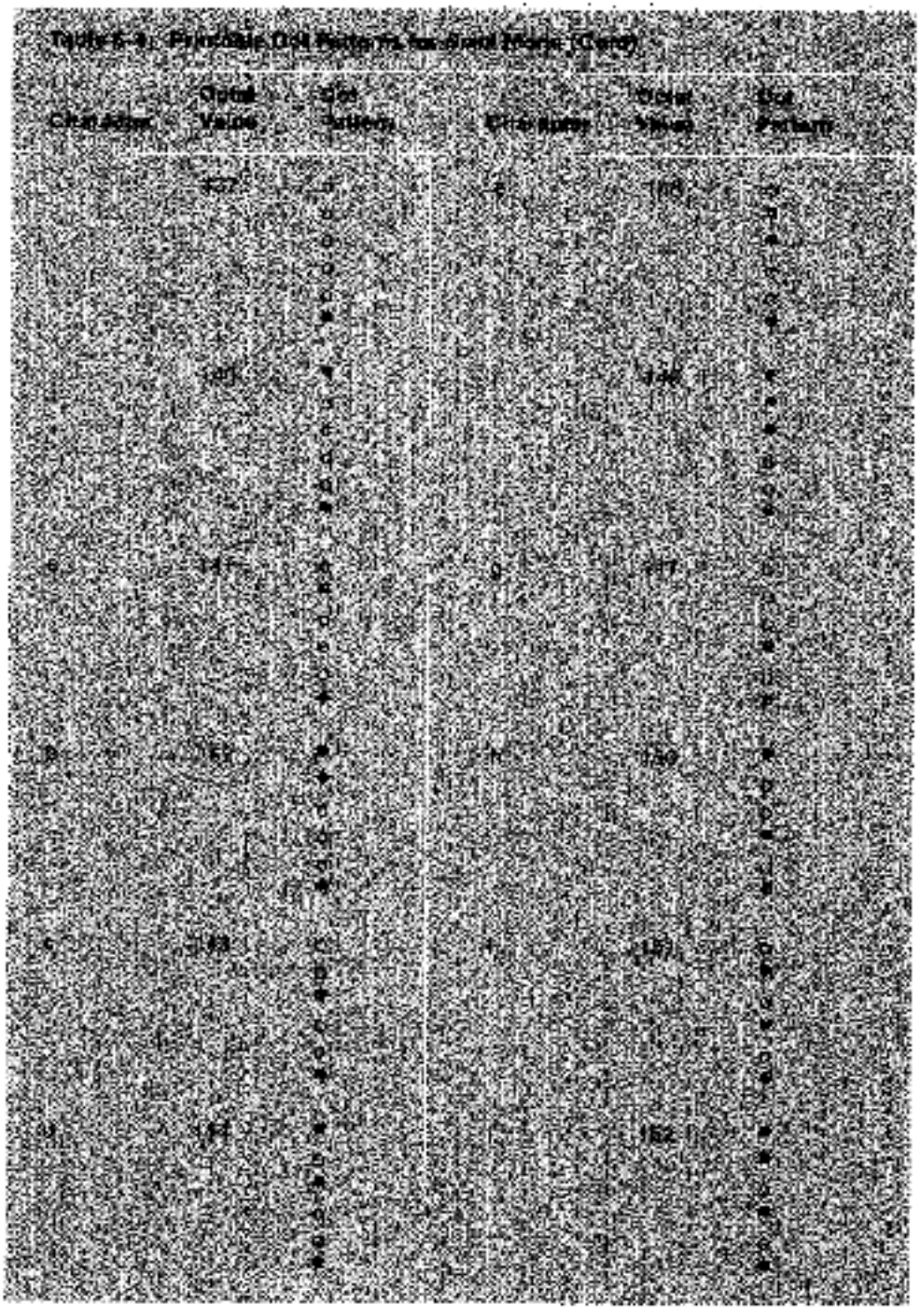
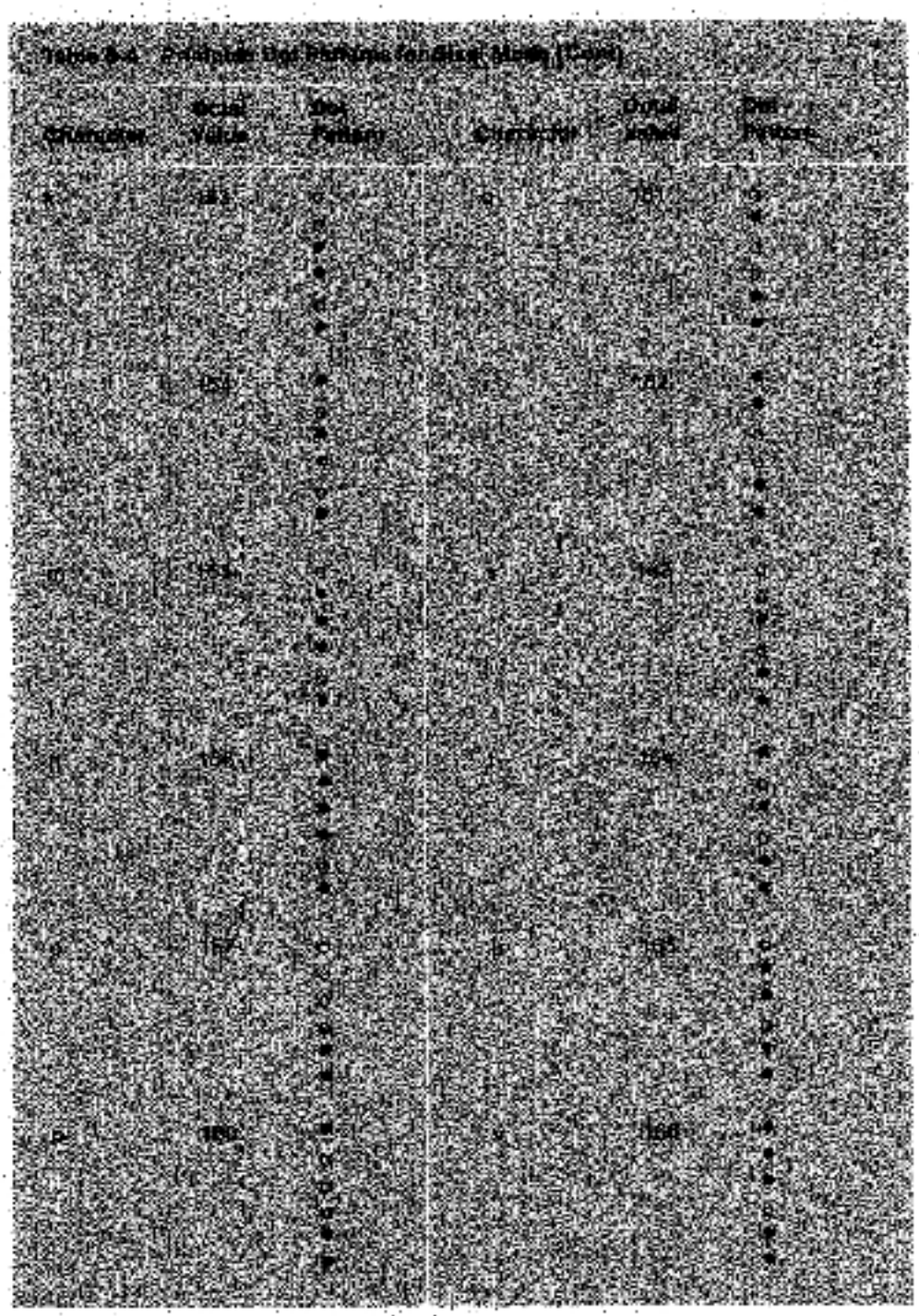


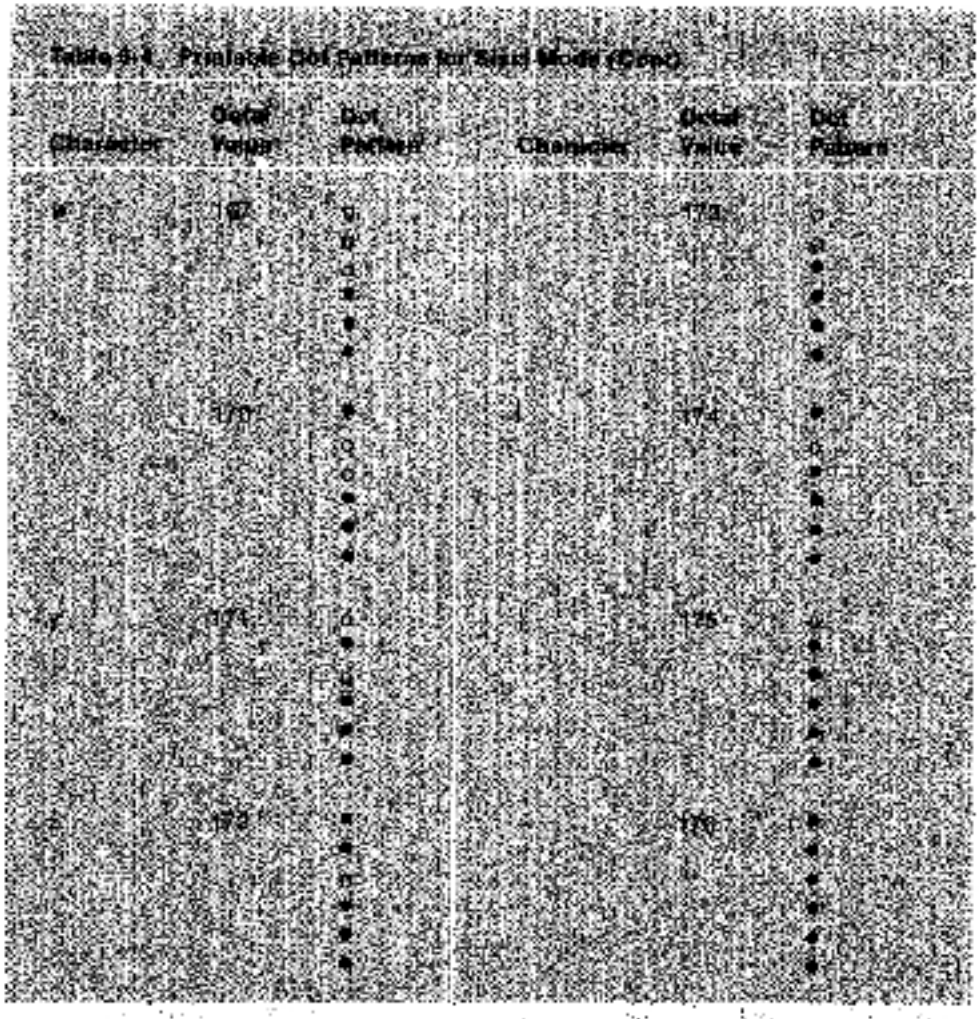
Table 5-4 Printable Dot Patterns for Sixel Mode (Cont'd)

Character	Octal Value	Dot Pattern	Character	Octal Value	Dot Pattern
G	107		M	115	
H	110		N	116	
I	111		O	117	
J	112		P	120	
K	113		Q	121	
L	114		R	122	









CHARACTER SETS A

This appendix shows the 17 character sets supported by the LN03 printer.

Character Set	Page
7-bit ASCII	142
United Kingdom	143
Dutch	144
Finnish	145
French	146
French Canadian	147
German	148
Italian	149
Japanese (JIS Roman)	150
Norwegian/Danish	151
Spanish	152
DEC Supplemental	153
Swedish	154
Swiss	155
DEC Technical	156
VT100 Line Drawing	157
ISO Norwegian/Danish	158

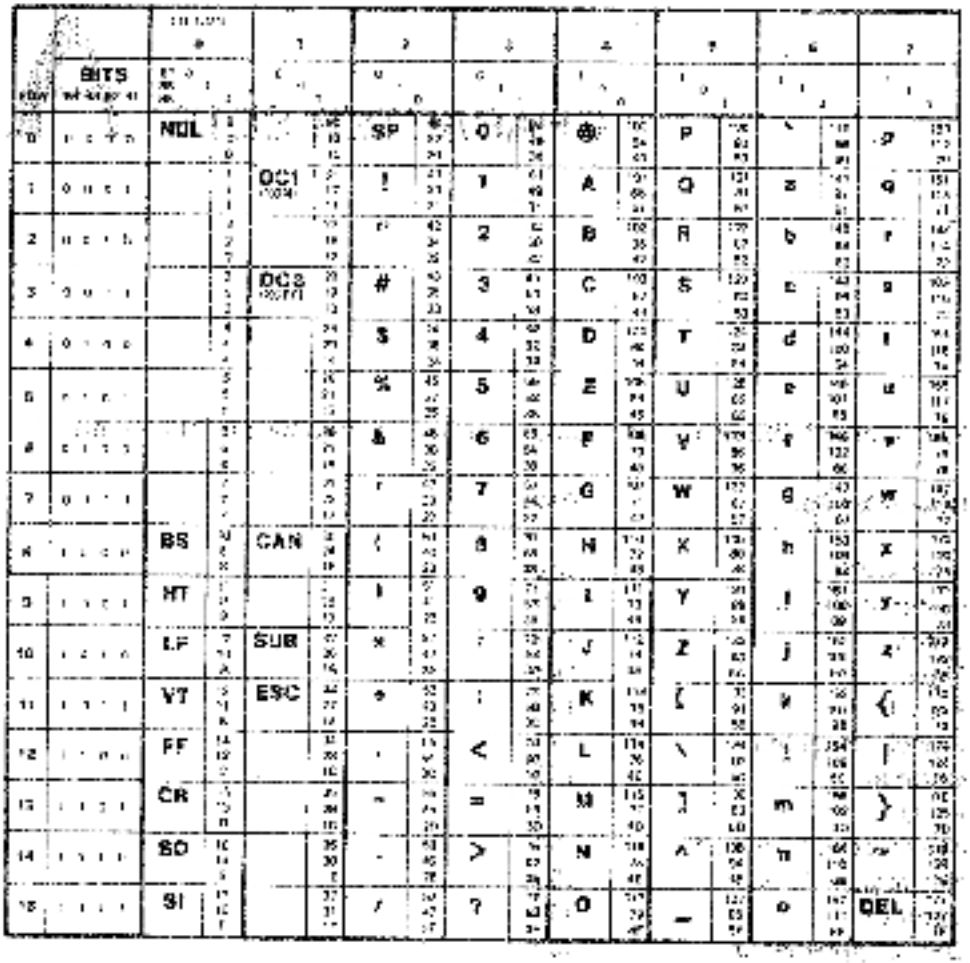


Figure A-1 7-Bit ASCII Character Set

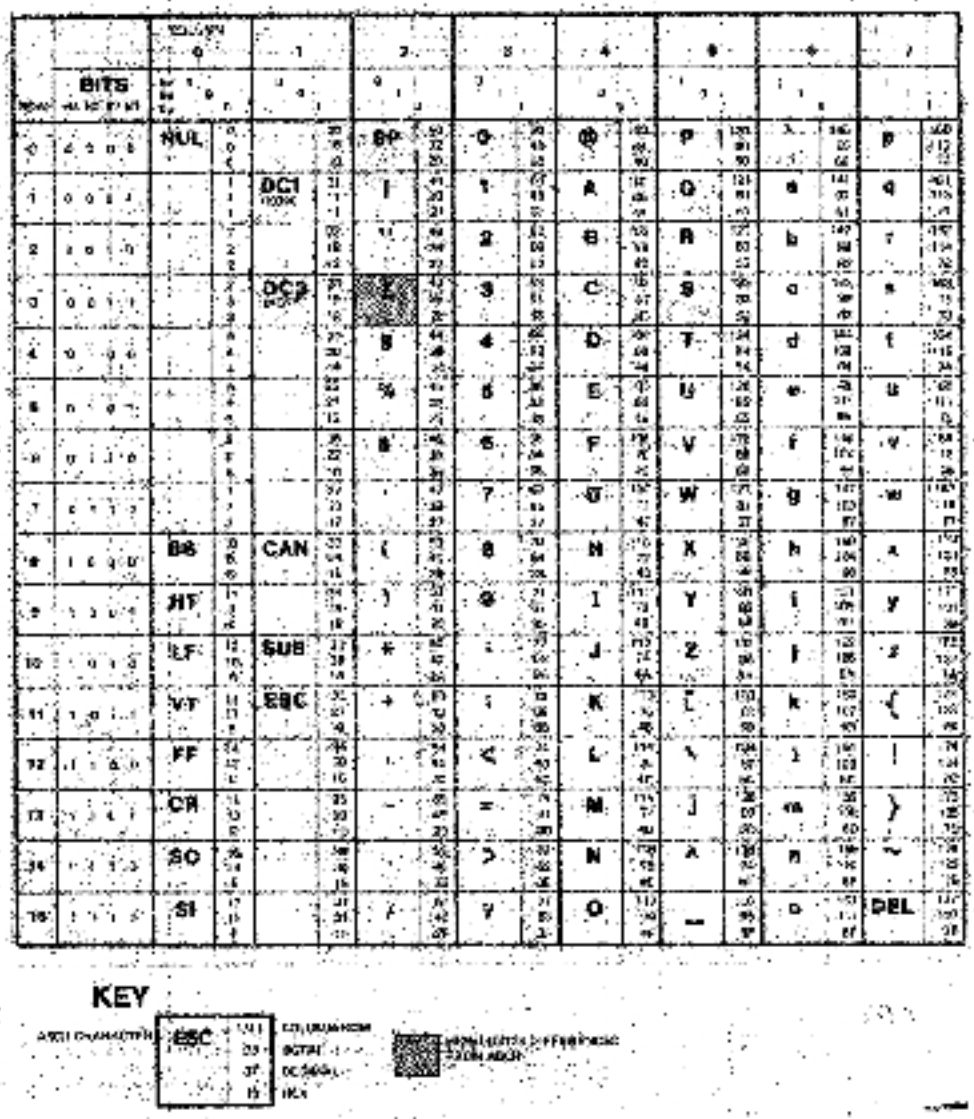
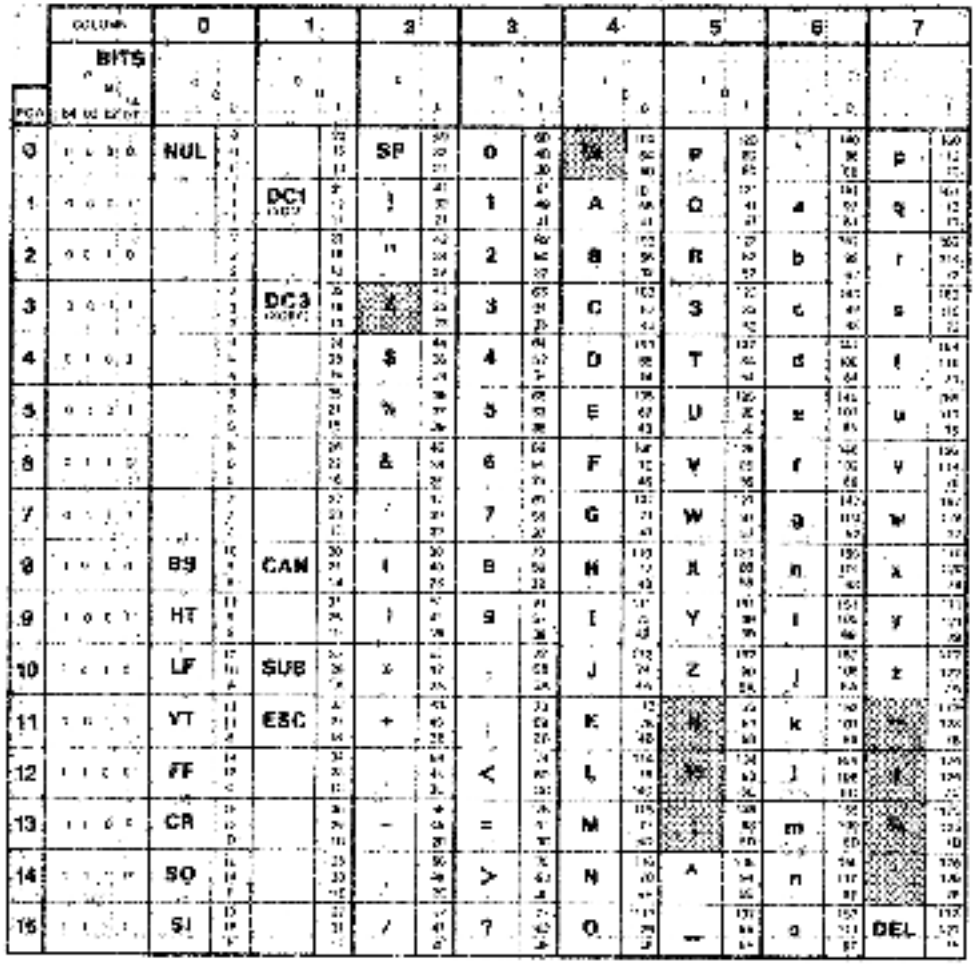


Figure A-2 United Kingdom Character Set



NOTE

THE FOLLOWING TABLE MIGHT SHOW THE APPROXIMATIONS THAT ARE USED TO REPRESENT THE DUTCH CHARACTERS THAT ARE NOT AVAILABLE IN THE DEC MCS SET. (THESE APPROXIMATIONS ARE TO BE COMPATIBLE WITH THE VT220 AND VT240.) THE CHARACTER POSITION IN THE CHART IS LISTED BY COLUMN/ROW.

COLUMN/ROW	CHARACTER SET NAME (SYMBOL)	APPROXIMATION NAME (SYMBOL)
4/0	THREE QUARTERS (¾)	SUPERSCRIPT 3 (³)
5/11	LIGATURE (IJ)	LOWERCASE y WITH DIAERESIS (ÿ)
7/11	DIAERESIS (¨)	QUOTATION MARK (")
7/12	LIGATURE (ij)	LOWERCASE i (i)
7/14	ACUTE ACCENT (´)	APOSTROPHE (SINGLE QUOTATION MARK, ASCII 39) OR ACUTE ACCENT (´)

MA-0803-89.3

Figure A-8 Dutch Character Set

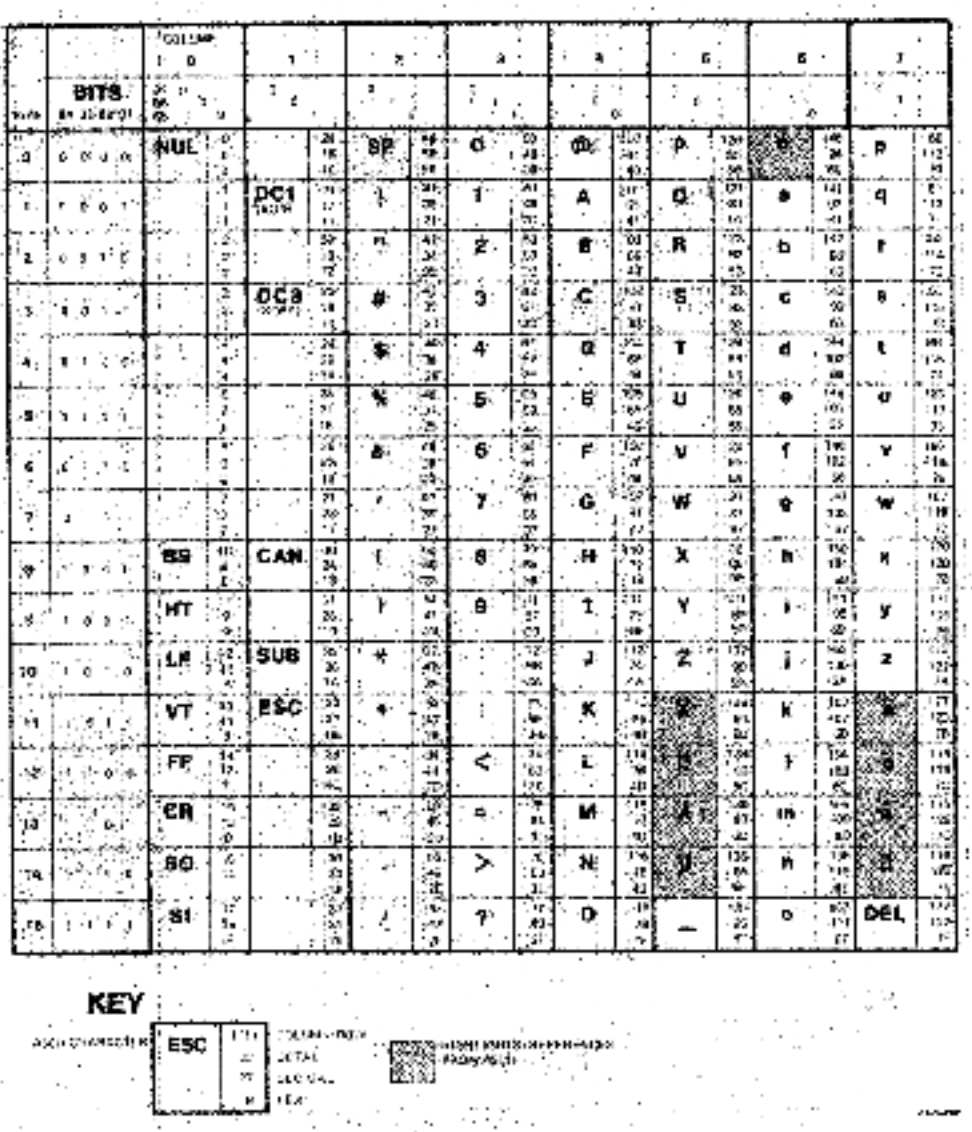


Figure A-4 Finnish Character Set

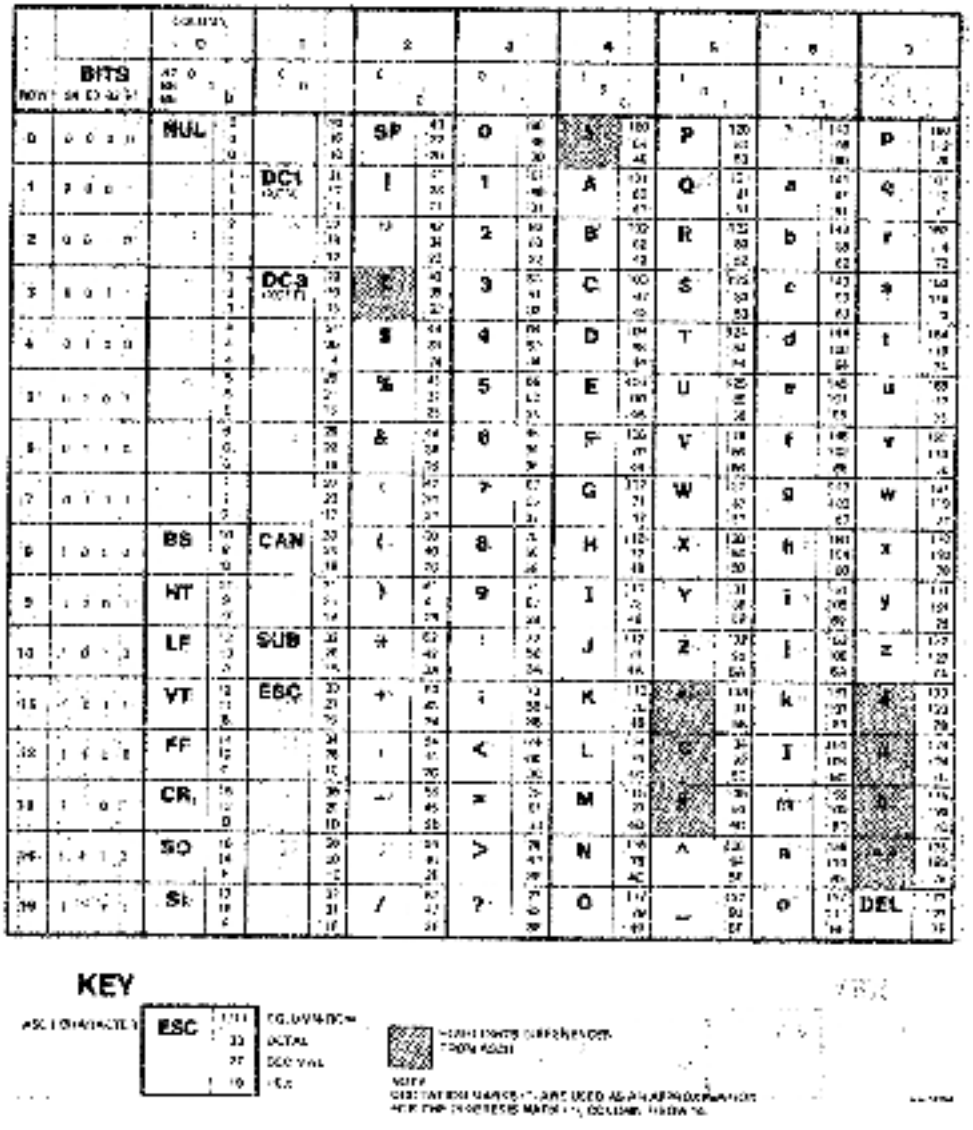


Figure A-6 French Character Set

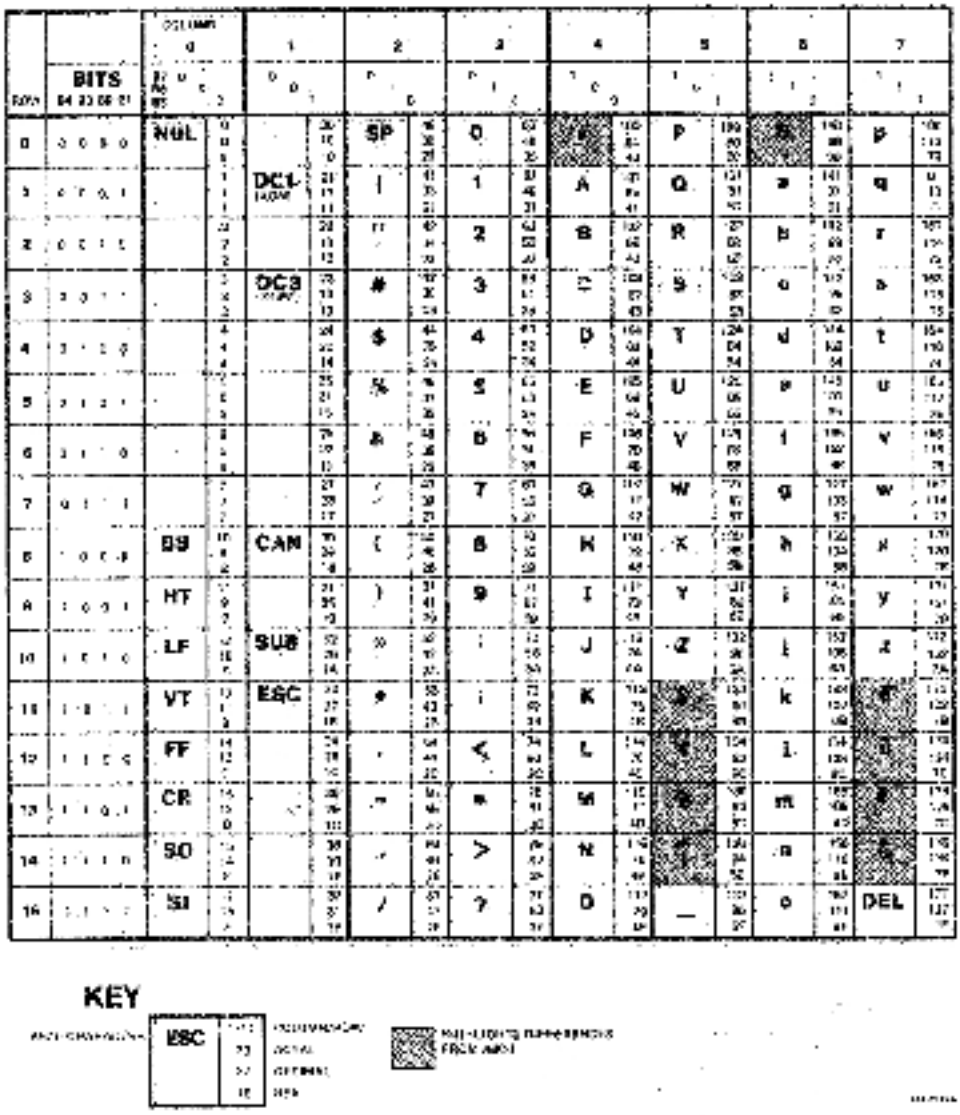


Figure A-6 French Canadian Character Set

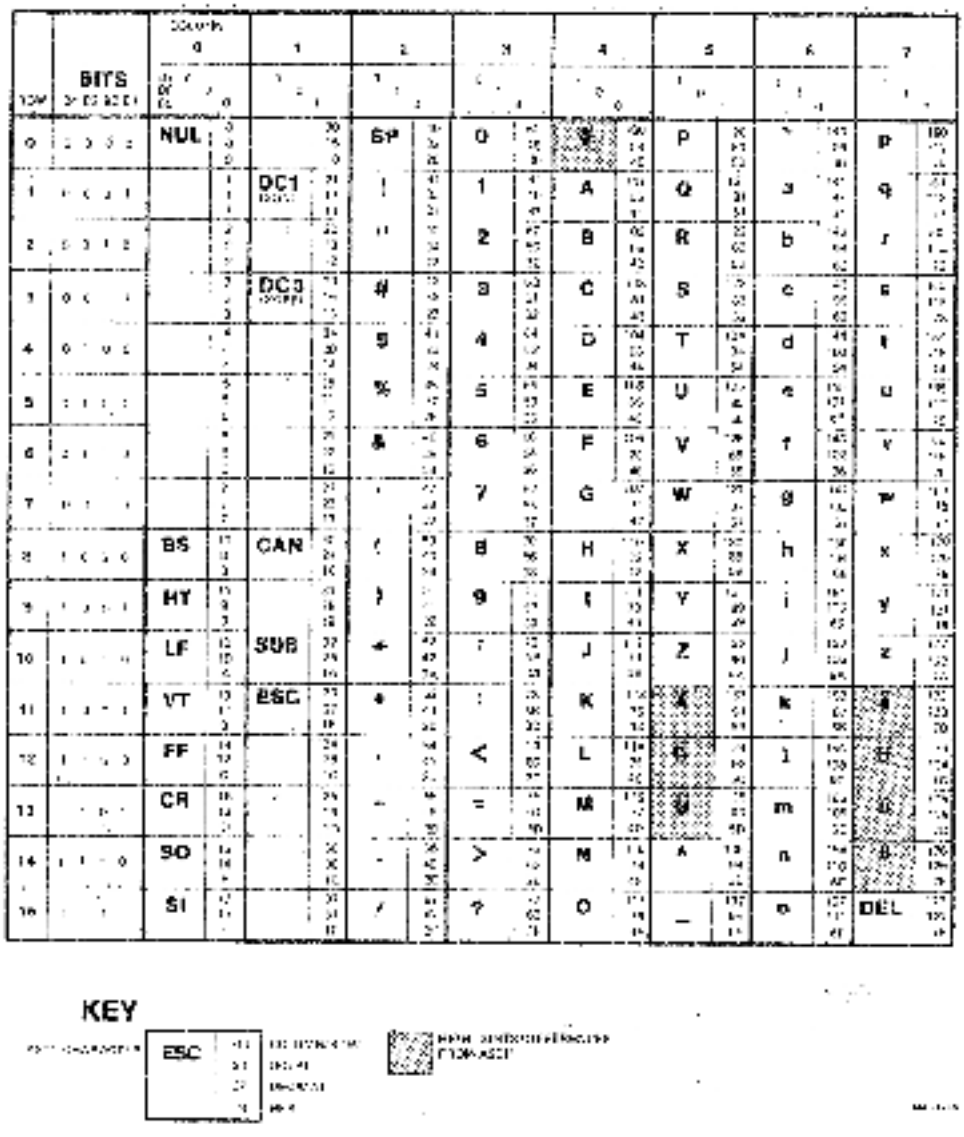


Figure A-7 German Character Set

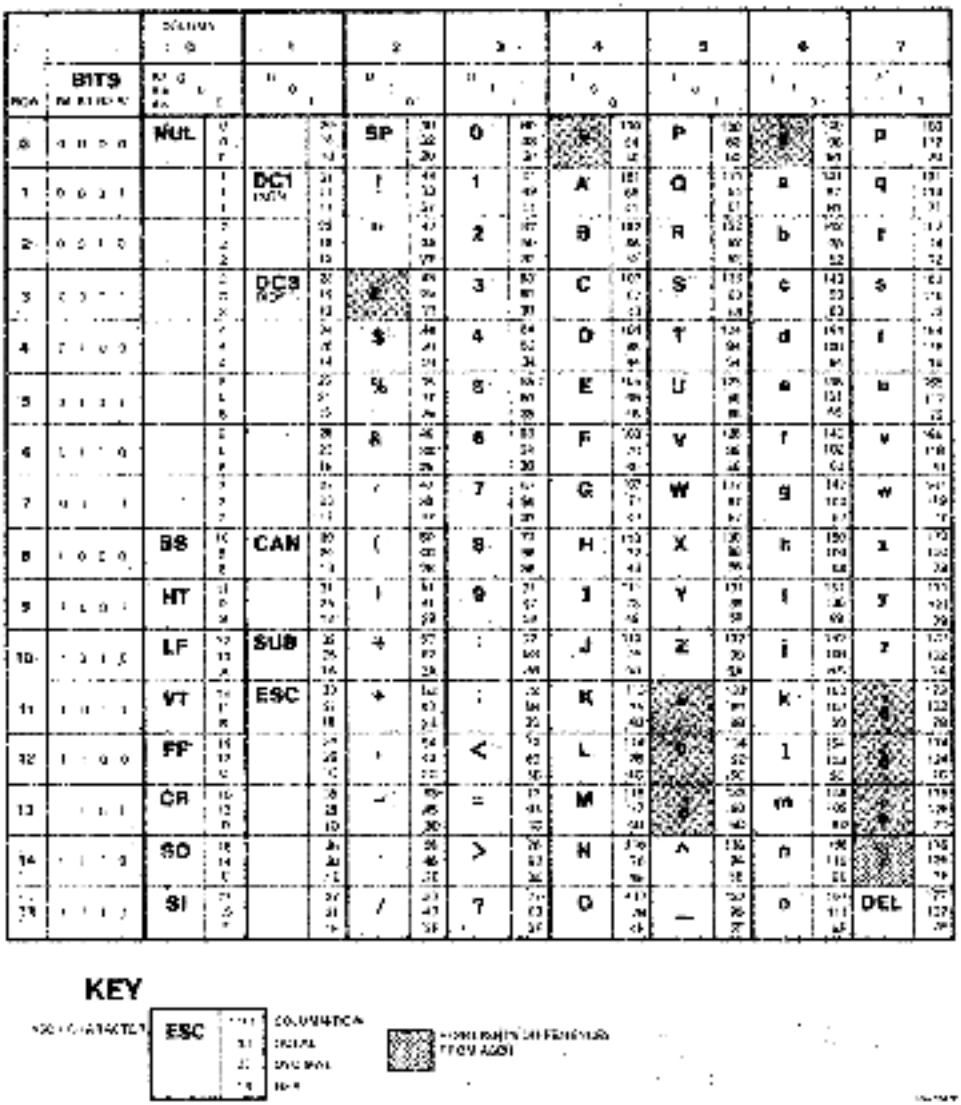


Figure A-8 Italian Character Set

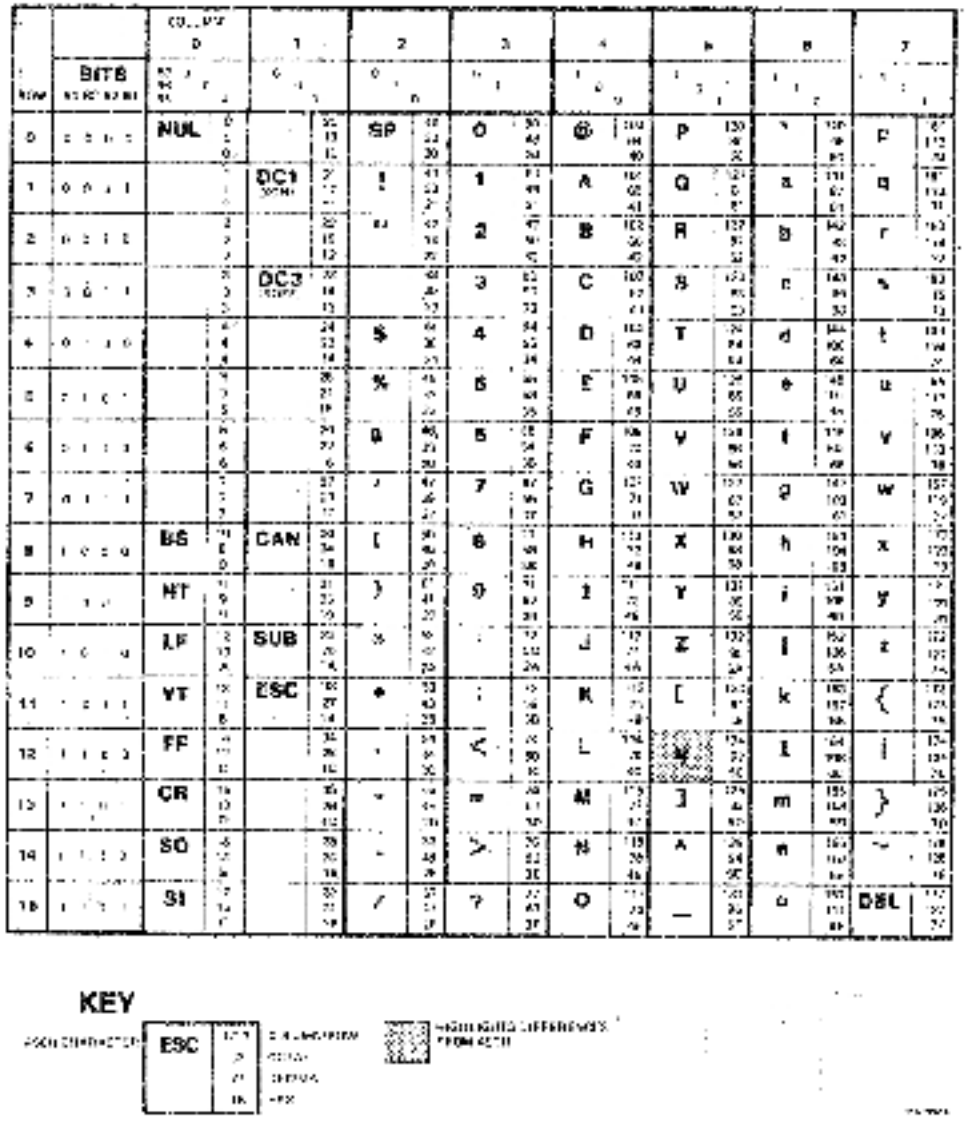


Figure A-8 Japanese (JIS Roman) Character Set

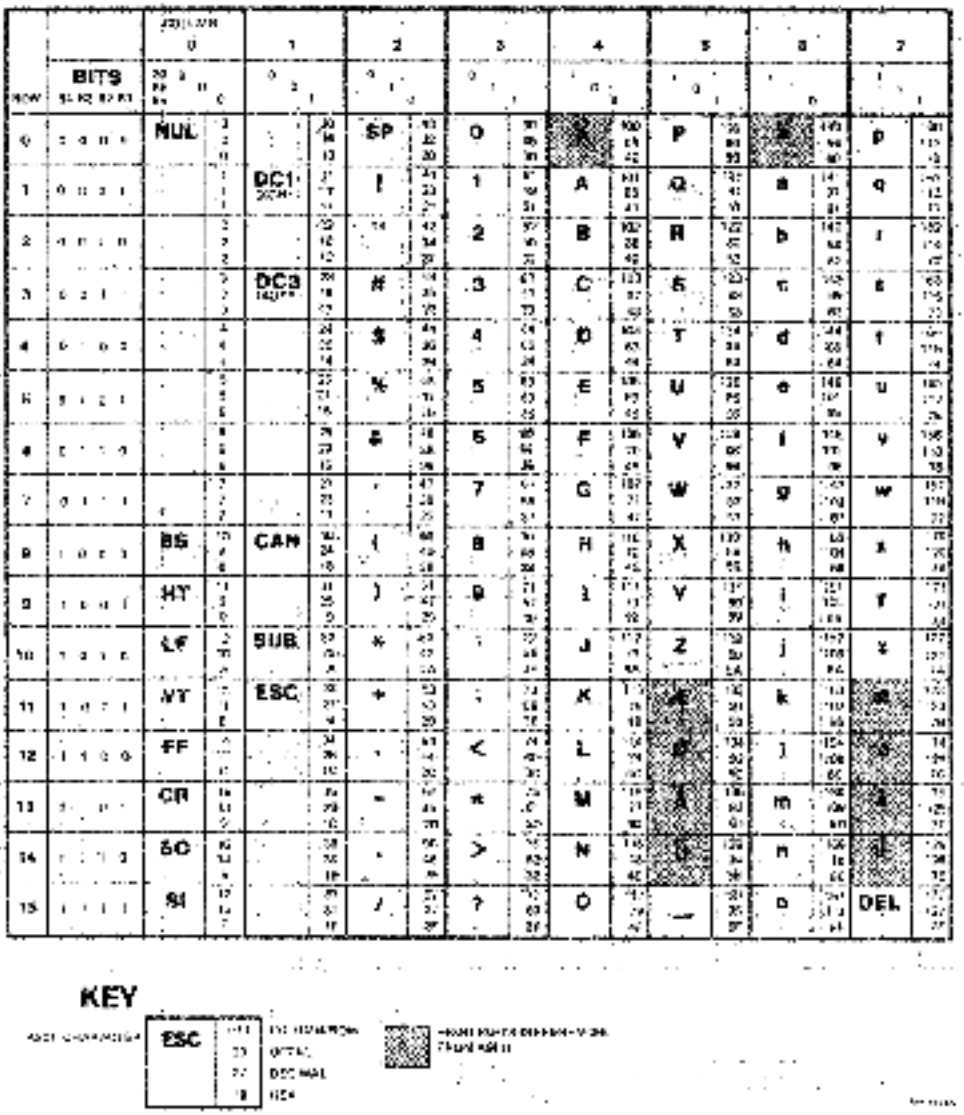


Figure A-10 Norwegian/Danish Character Set

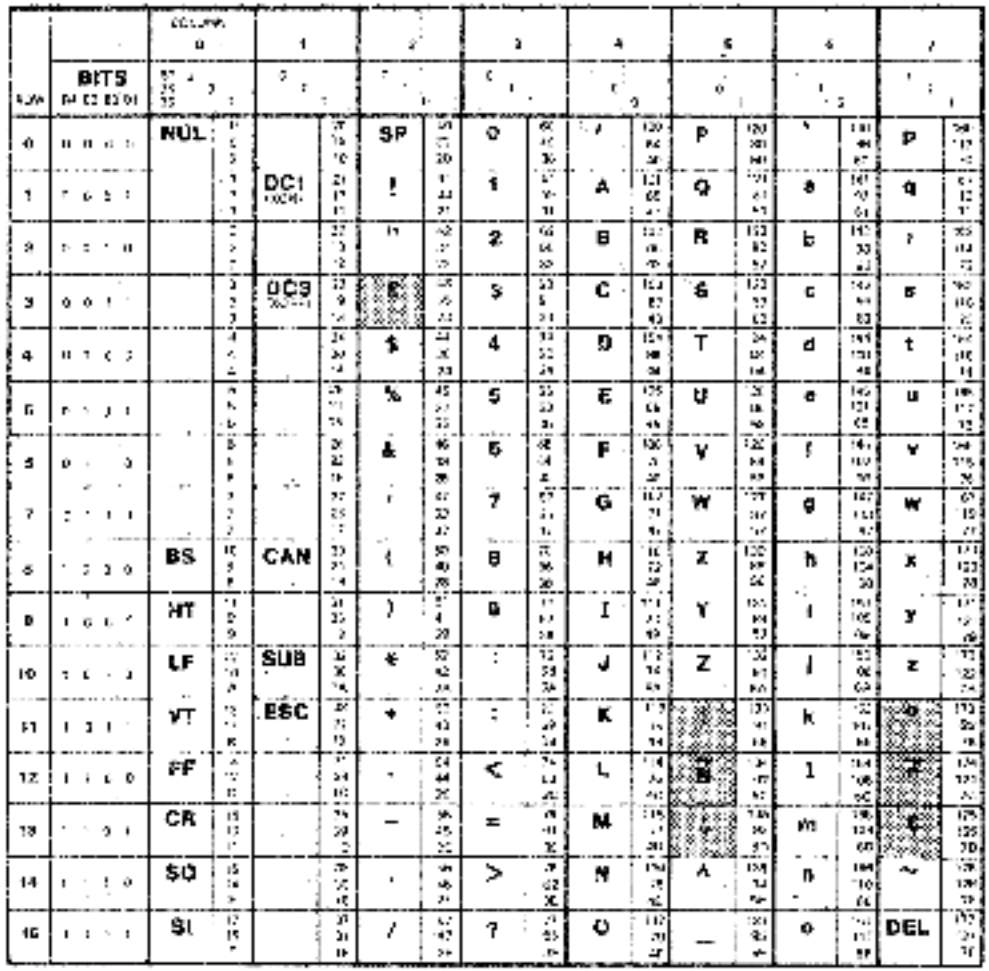


Figure A-11 Spanish Character Set

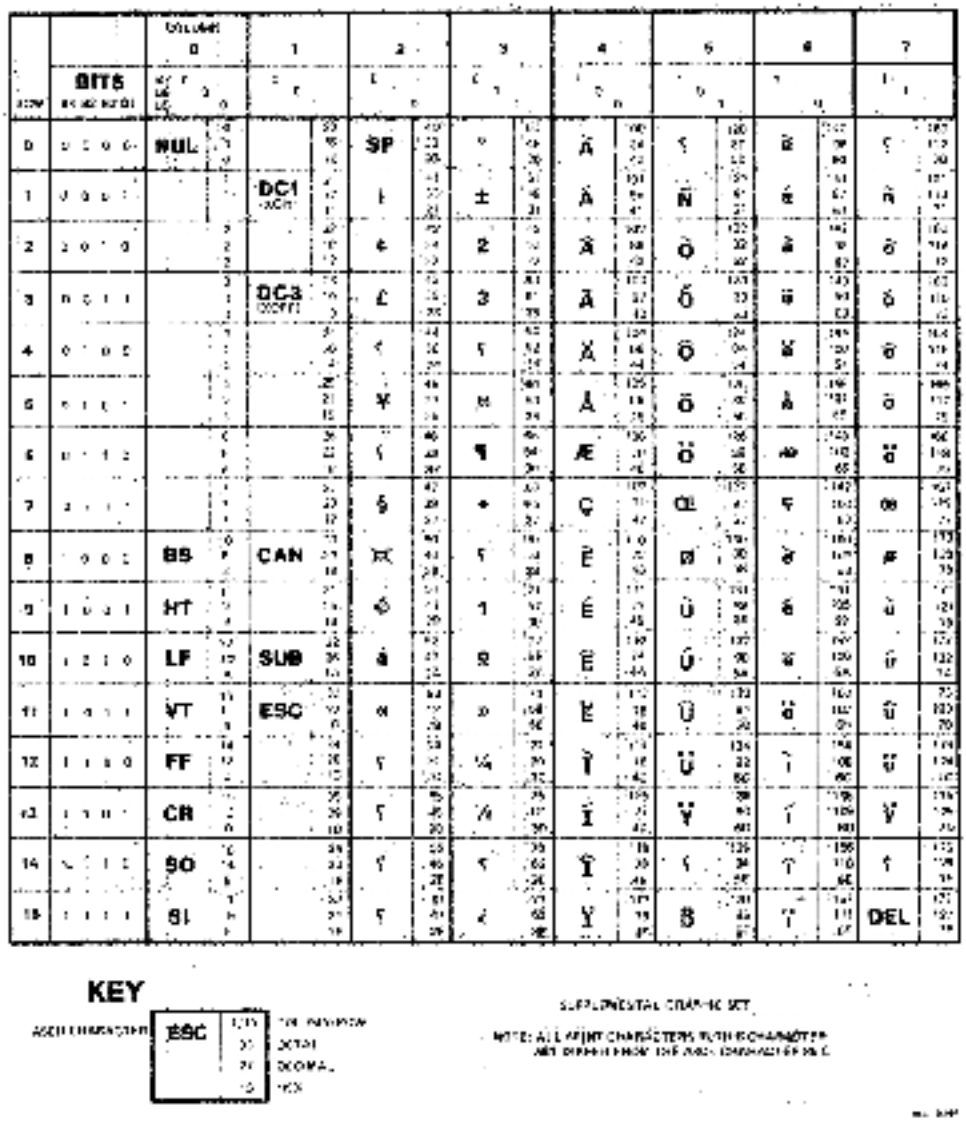


Figure A-12 DEC Supplemental Character Set

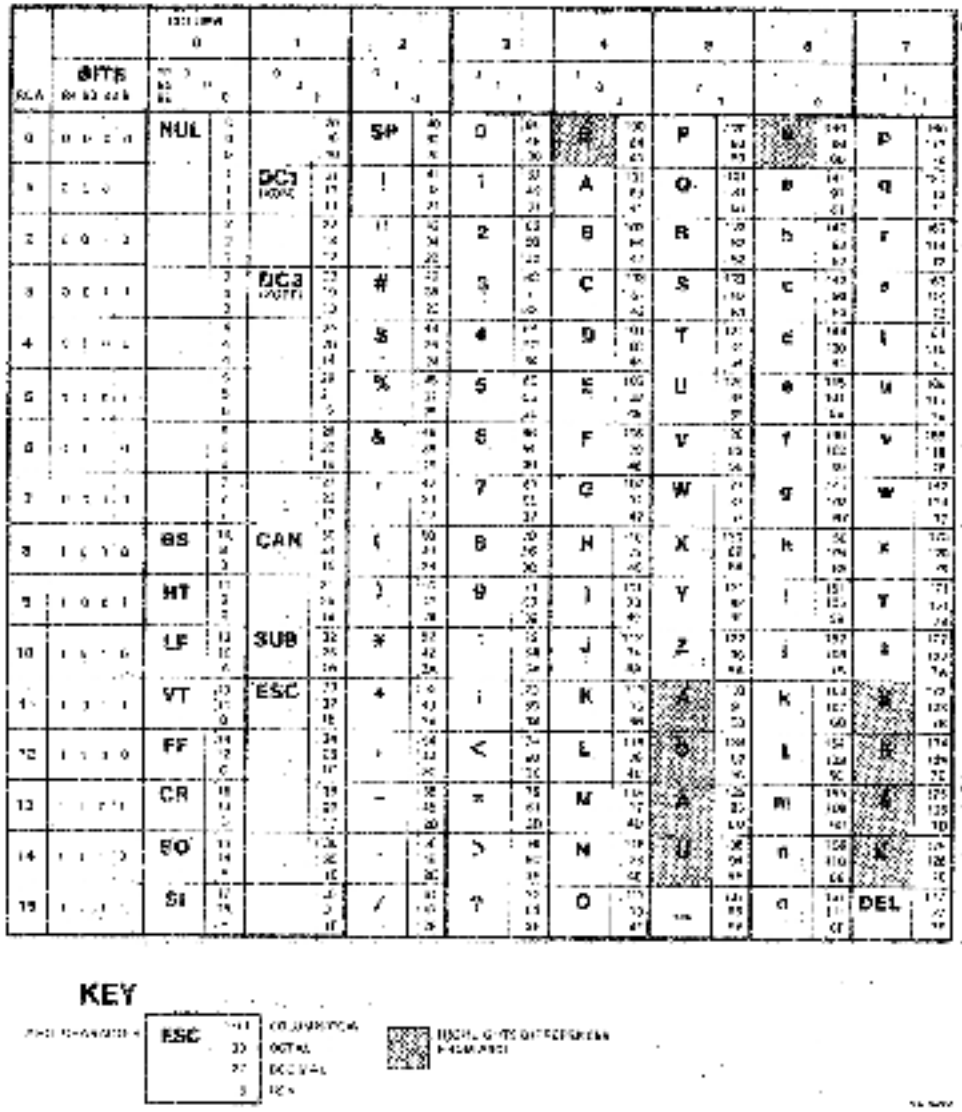


Figure A-13 Swedish Character Set

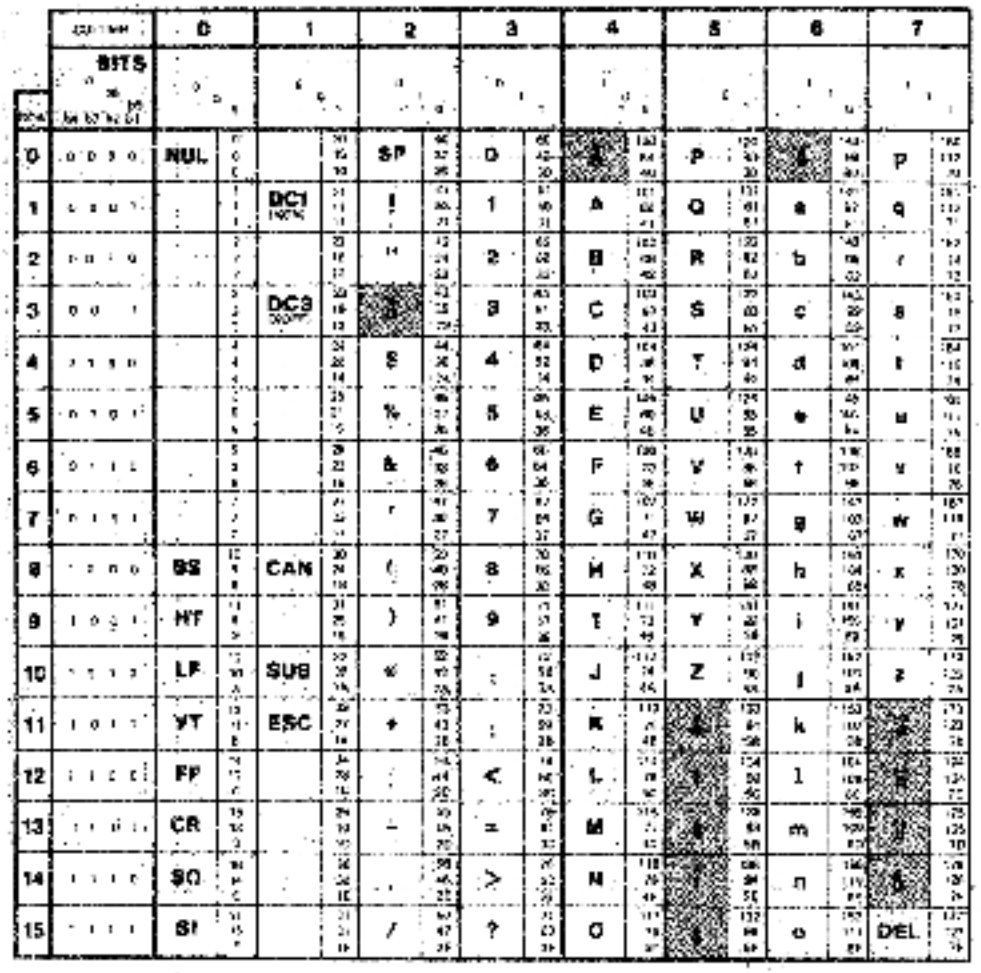


Figure A-14 Swiss Character Set

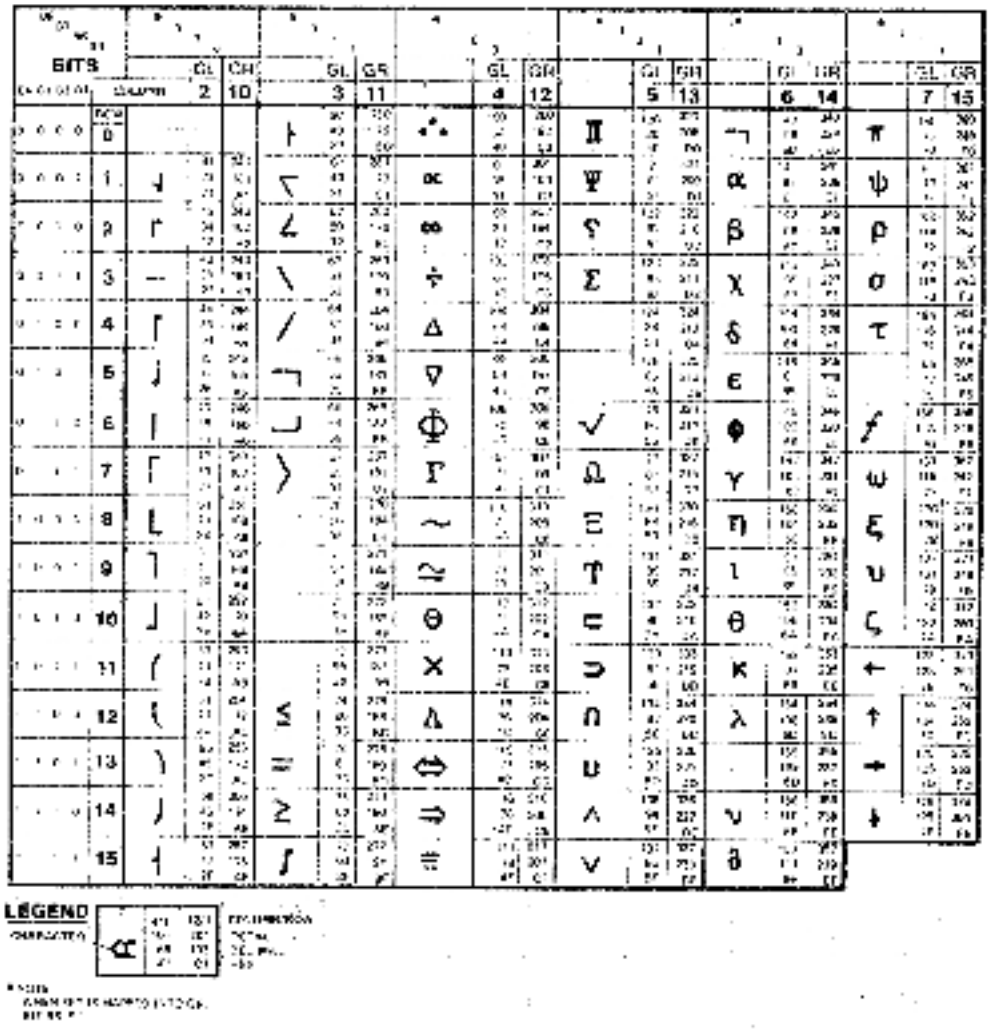


Figura A-15 DEC Technical Character Set

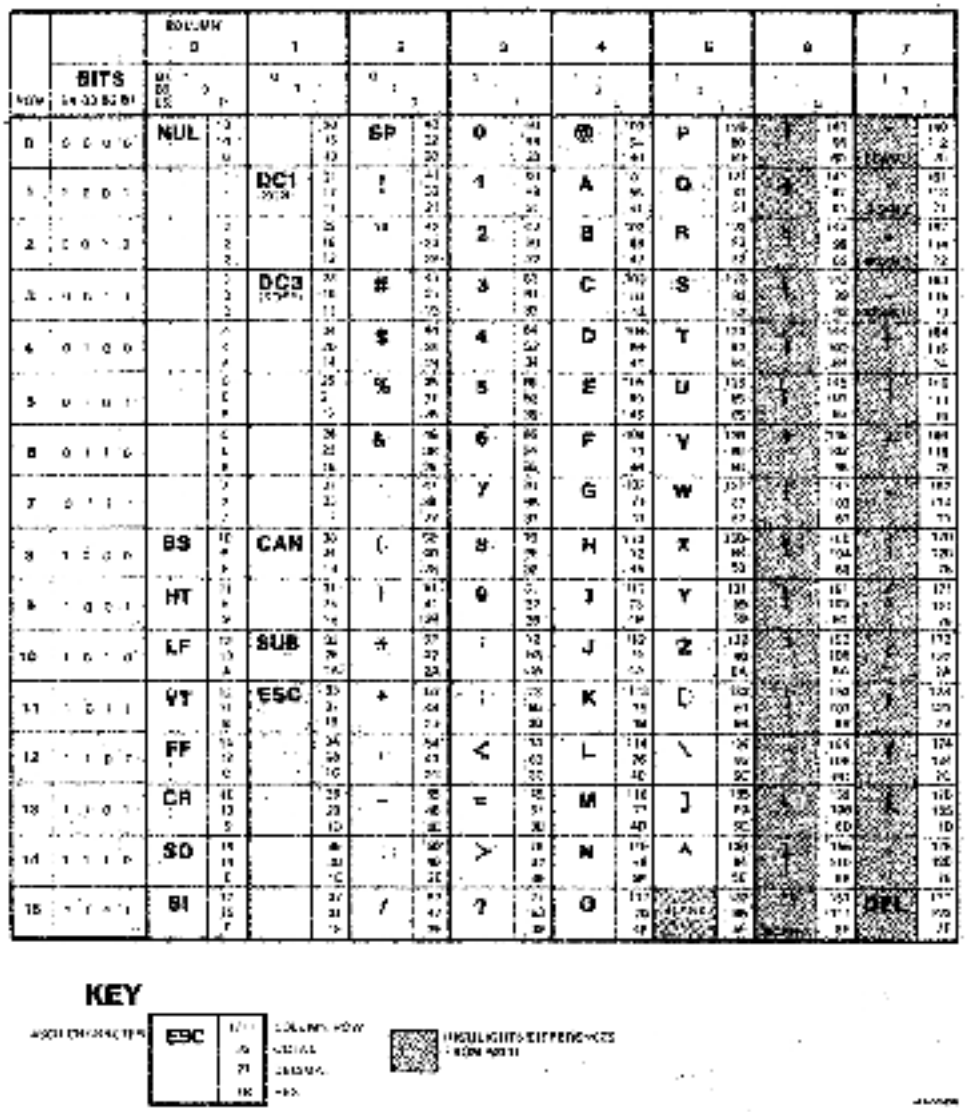


Figure A-16 VT100 Line Drawing (DEC Special Graphics) Character Set

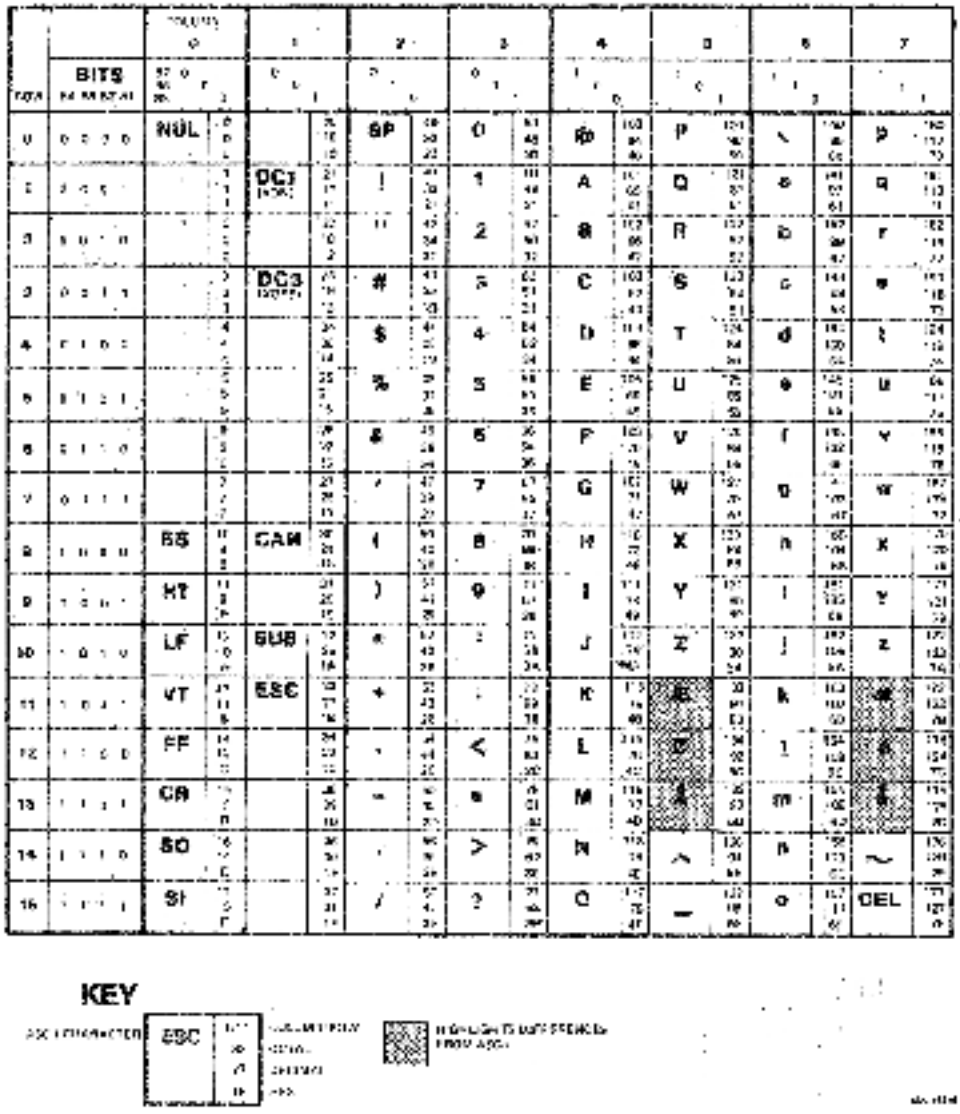


Figure A-17 ISO Norwegian/Danish Character Set

ESCAPE SEQUENCE AND CONTROL SEQUENCE SUMMARY B

This appendix lists the escape sequences and control sequences explained in this manual. (See Paragraph 4.3 for the sequences to designate character sets.)

The sequences are listed in alphabetical order, according to function. You can find a complete description of any sequence by going to the paragraph listed in column one.

NOTE: The sequences are shown in 8-bit format. Sequence characters are spaced for clarity. The spaces are not part of the format code. The row/column number below each character indicates the character's position in the 8-bit DEC multinational character set (Figure 3-5).

Table B-1 LN03 Escape and Control Sequences

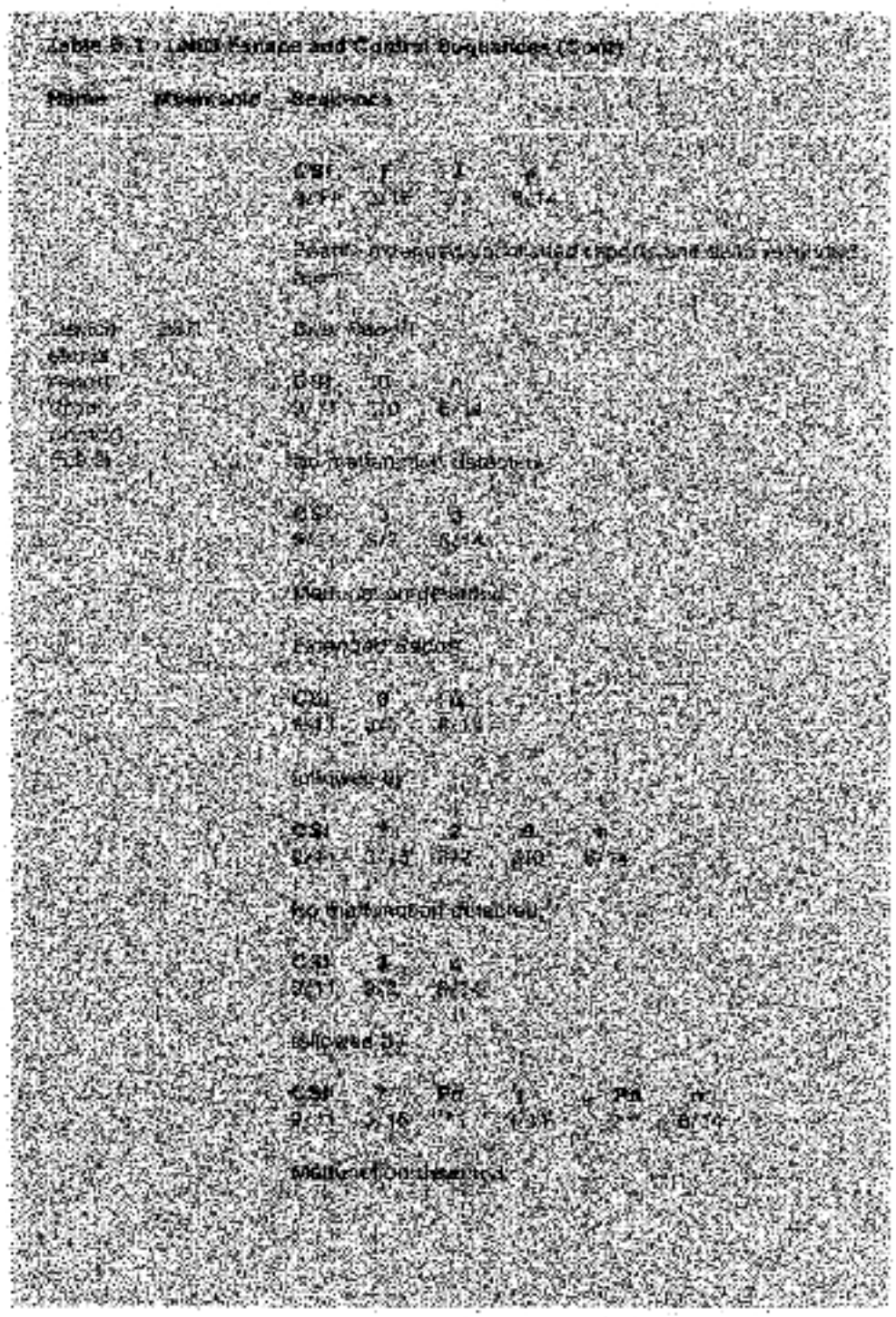
Name	Mnemonic	Sequence
Assign font set (4.4.3)	DECATFF	DCS Ps1 ; Ps2 } ID String ST 9/0 3/? 3/11 3/? 7/13 .... 9/12 **Ps1 Function** 0 Assign SGR number as font ID (default) 1 Same as 0 2 Assign SGR number as type family ID **Ps2 Function** 10 DEC built-in 1 family 11 Courier family 12 Elite family 13 Courier 10 point, 10 pitch 14 Elite 10 point, 12 pitch 15 Courier 6.7 point, 16.5 pitch 16 Courier 10 point, 10.3 pitch 17 DEC built-in 2 family 18 DEC built-in 4 family 19 DEC built-in 3 family **ID String** Name associated with SGR number.
Autowrap mode (3.2.3)	DECAWM	CSI ? 7 h 9/11 3/15 3/7 6/8 Turns autowrap mode on. CSI ? 7 l 9/11 3/15 3/7 6/12 Turns autowrap mode off.

Table B-1 LA50 Escape and Control Sequences (Cont)

Name	Mnemonic	Sequence
Print printer (5.10.2)	ESC	CSI Ps m 5/11 3/13
		Ps Function 0 All attributes off 1 Turns bold on (2 Turns bold off
Carriage return/ new line mode (5.2.4)	DECSNLM	CSI ? h l 5/11 3/13 7/4 3/0 6/12
		Turns carriage return/new line mode on (default)
		CSI ? h l 5/11 3/15 3/4 3/0 6/8
		Turns carriage return/new line mode on
Cursor up (5.6.7)	CUU	CSI Pn A 5/11 4/1
		Pn Function 0 Default n Number of lines to move up
Delete type family or font file (1.5)	DECSTFF	DCS Ps ; Ps ; Ps ; Ps SP 5/0 2/14 3/13 2/0
		Ps Function 0 Delete type family 1 Delete font
		ID String
		Specifies type family ID or font file ID

Table 5-1 ANSI Escape and Control Sequences (Cont'd)

Name	Mnemonic	Sequence
Device attributes (DA)	DA	Request from host CSI c 9/11 6/3 Response from printer CSI ? 1 ; 2 c 9/11 3/15 3/1 3/2 6/3 ENQ (^E) CSI ? 1 ; 1 ; 2 c 9/11 3/15 3/1 3/1 3/2 6/3 LDP02 (^B) CSI ? 1 ; 1 ; 0 c 9/11 3/15 3/1 3/1 3/0 6/3 LDP03 (^C) CSI ? n ; n ; n c 9/11 3/15 3/n 3/n 3/n 6/3
Device status report (from host) (DSR)	DSR	CSI n n ; n n R 9/11 3/n 3/n 3/11 3/n 3/n 6/13 Send extended report CSI 6 n 9/11 3/6 6/14 Send a cursor position report (active column and active line) CSI ? 6 n 9/11 3/15 3/6 6/14 Disable unsolicited reports CSI ? 5 n 9/11 3/15 3/5 6/14 Enable brief unsolicited reports and send extended report



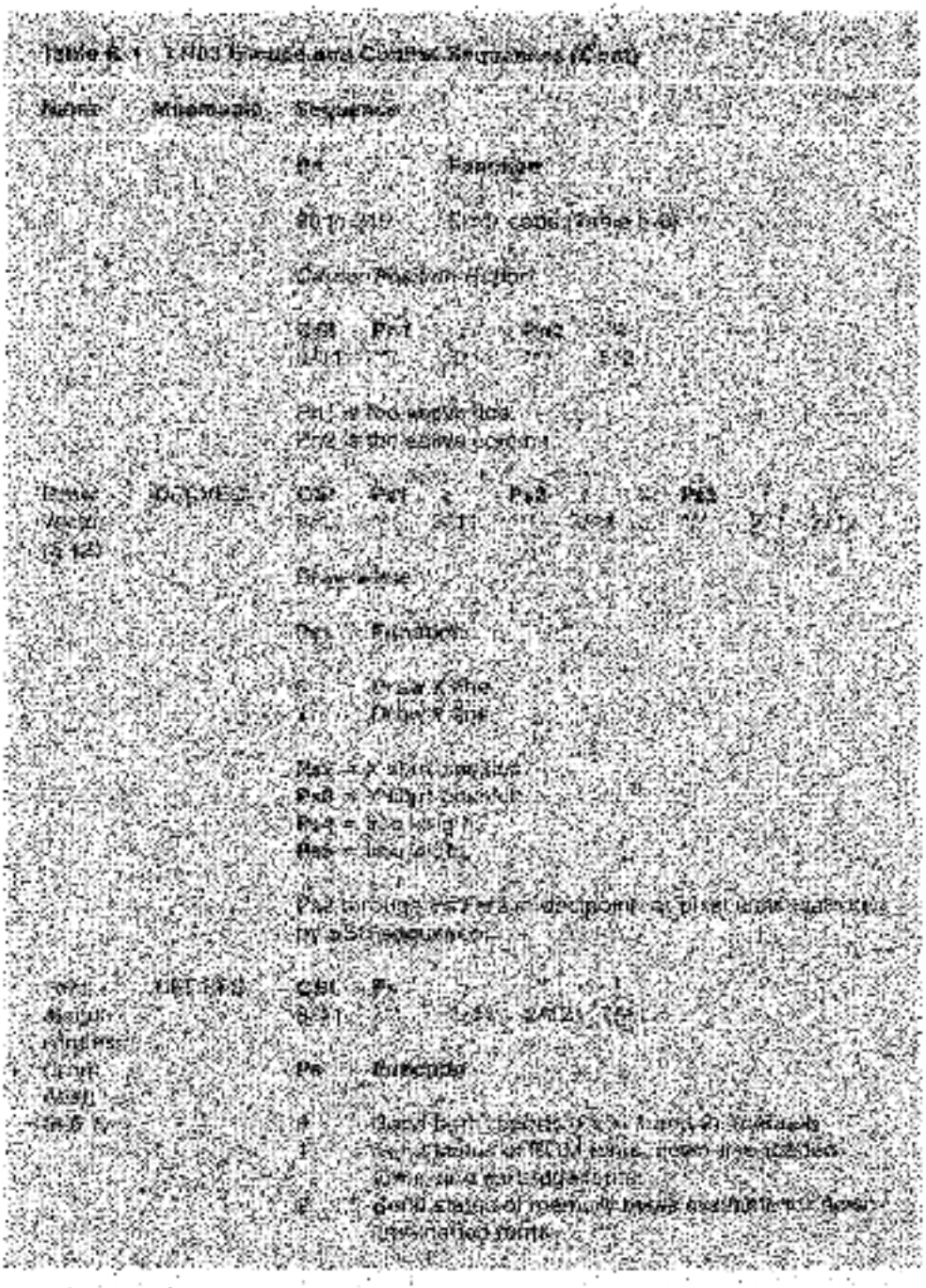


Table B-1 (Cont.) VT100 Escape and Control Sequences

Name	Mnemonic	Sequence
[illegible]	DECDLD	DCS 1 [illegible] Dscs / ST

Downloads one or more characters into the user-defined set.

Dscs: two bytes identifying the character set.

CSI	Ps	SP	q

Ps: number in the range 0 to 4 that selects the cursor style.

0 or 1 = blinking block
2 = steady block
3 = blinking underline
4 = steady underline

Graphics Size Select	DECGSS	CSI [illegible]	SP	q

Selects the graphics character size.

Pn = [illegible]

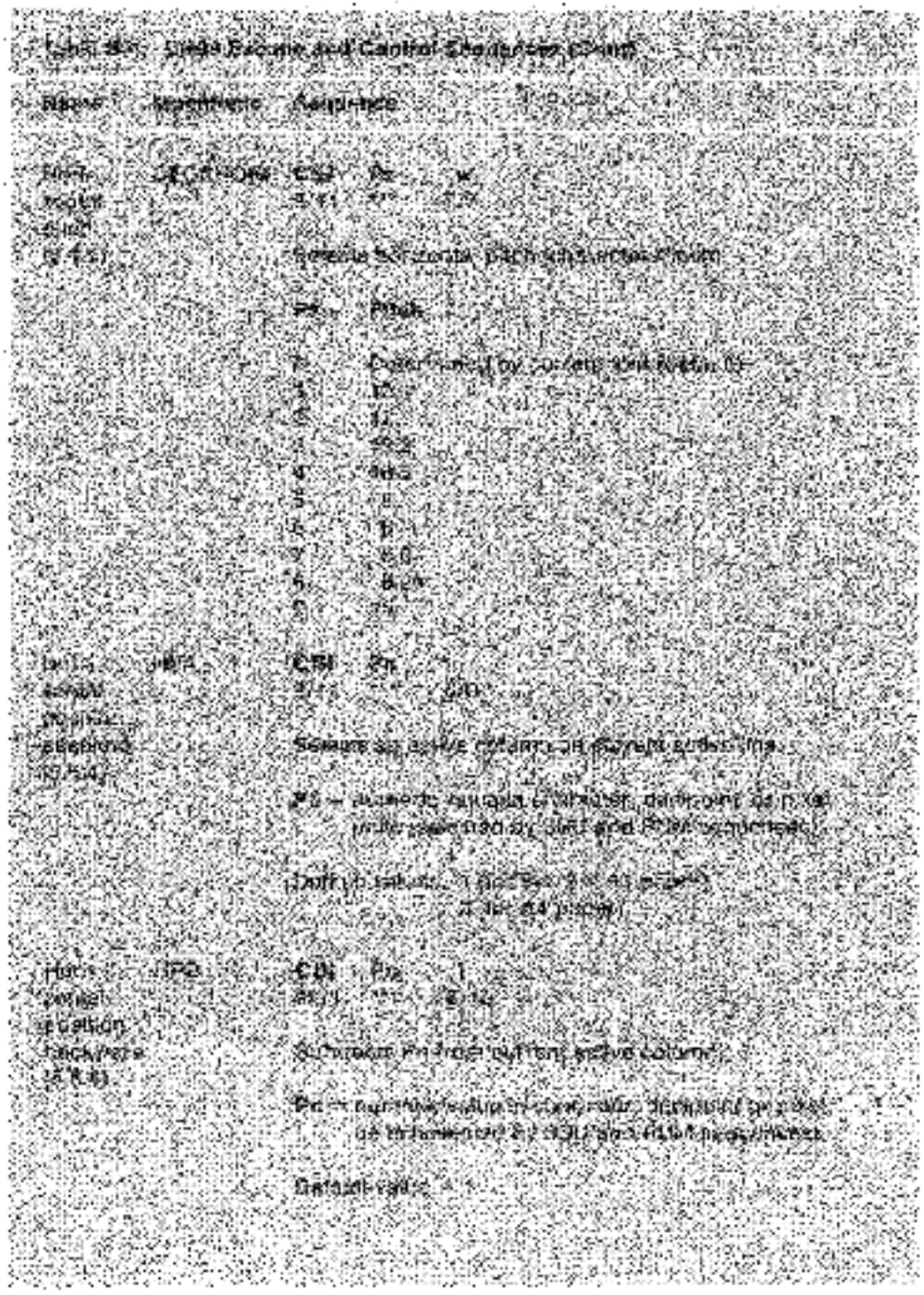


Table B-1. Linux Escape and Control Sequences (Cont.)

Name	Mnemonic	Sequence
Horizontal position relative (ESC.a)	HPR	CSI Pn a 9/11 3/0-3/9 6/1 Pn = number of columns to move right (default = 1) Default value = 1.
Horizontal spacing adjust (ESC.X)	SHS	CSI Ps 2/0 SP 4/11 9/11 3/0-3/9 2/0 4/11 Selects character spacing for the entire text. Ps = Horizontal Character Pitch 0 = 10 characters/inch 1 = 12 characters/inch 2 = 15 characters/inch 3 = 5 characters/inch Horizontal Character Position Unit 1/10 inch (default) 1/12 inch 1/15 inch 1/4 inch
Horizontal tab set (ESC.1.5)	CBT CSI Ps1 ... Psn 2/0 7/5 9/11 3/0-3/9 3/11 3/0-3/9 2/0 7/5 Sets up to 16 horizontal tabs. Ps = tab stop in character position to set, up to a maximum of 16 parameters. Default value: 0 (clear all tab stops). Ps values must be in ascending order.
Line printing (ESC.0.9)	DQA	CSI Ps SP 6/13 9/11 3/0-3/9 2/0 6/13 Selects the quality of print the line has been allocated. Ps = Printing 0 = All attributes off 1 = Italic printing on 2 = Italic printing off

Table B-1 (Cont.) Escape and Control Sequences (Cont.)

Name	Mnemonic	Sequence
Identify Terminal (DA)	DA	CSI Ps c 9/11 3/0 6/3 Send the device attributes (DA) control sequence. Ps Function 0 Request device attributes from terminal (default) >0 Ignored >7 Ignored
Line Feed/New Line Mode	LNM	CSI 2 0 h 9/11 3/2 3/0 6/8 Line feed advances the cursor to the first column on the next line. CSI 2 0 l 9/11 3/2 3/0 6/12 Line feed advances the cursor to the next line. The cursor returns to the left margin. (Default)
Lines per Physical Page	DECSLPP	CSI Ps t 9/11 2/0 7/4 Set the page length. Based on origin, regardless of top and bottom margins. Ps is the page length in physical lines, or pixel units (selected by SSU and DSIMP sequences).
Load Font	DECLFF	DCS Pn1 ; Pn2 ; Pn3 ; Pn4 ; Pn5 Font Record ST 9/0 2/0 3/1 3/0 3/11 3/0 3/5 3/0 3/12 3/0 3/11 Font Record 9/12 Pn1 Command Number Pn2 Font Number Pn3 Starting Character Pn4 Total Characters Pn5 Font Set Name

Table B-1 (Until Escape and Control Sequences (Cont))

Name	Mnemonic	Sequence

Ps1 = Function

0 = Original cell file format

Ps2 = Function

0 = Print Formatter screen as currently
Defined and save new cell file
1 = Print Formatter screen as currently
Defined and save new cell file

Ps3 = Function

0 = Continue processing
1 = Display a text line with cursor at home position and then halt processing

Send Record = goes for next line

Carriage Return = goes to previous line

(Margins, Left and Right [9.3.4])	DECSLRM	CSI Ps1 ; Ps2 s 9/11 3/11 3/11 3/11 7/3

Sets left and right margins in character increments or pixel units selected by DSCS and PUM sequences.

Ps1 = left margin setting

Ps2 = right margin setting

(Margins, Top and Bottom [9.3.5])	DECSTBM	CSI Ps1 ; Ps2 r 9/11 3/11 3/11 7/2

Sets top and bottom margins in character increments or pixel units selected by DSCS and PUM sequences.

Ps1 = top margin setting

Ps2 = bottom margin setting

Table B-1: LN03 Escape and Control Sequences (Cont'd)

Name	Mnemonic	Sequence
Logic pen movement mode (6.2.2)	DECLOPM	CSI ? 6 p 9/11 3/15 3/6 7/0 2/0 7/0 Printing starts 0.25 inches from upper left corner (default) CSI ? 6 h 9/11 3/15 3/6 6/8 Printing starts at upper left corner
Page format select (6.2.1)	PFS	CSI Ps SP 4 9/11 ... 2/0 3/4 Selects a standard page format Ps Format Normal 0 Tall text communication 1 Wide text communication 2 Tall A4 3 Wide A4 4 Tall North American letter 5 Wide North American letter Extended 6 Tall A4 7 Wide A4 120 Tall North American letter 121 Wide North American letter 122 Tall A4 123 Wide A4
Partial line down (6.5.9)	PLD	PLD 9/11 Moves down 1/2 line for subscripting

Table B-1 LN03 Escape and Control Sequences (Cont'd)

Name	Mnemonic	Sequence
Partial line up (1.6.4)	PLU	PLU 8/12 Moves up 1/2 line for superscripting
Push position/ select size (5.2.4)	DECPSP	CSI ; 2 ; 2 ; 0 ; 9/11 3/15 3/2 3/2 3/12 Selects pitch set by DECSCHR? sequence CSI ; 1 ; 4 ; 3 ; 9/11 3/15 3/2 3/4 3/3 Selects 4/3 point pitch (default)
Position unit mode (1.3.7)	PUM	CSI ; 1 ; 1 ; 9/11 3/15 3/1 3/12 Selects 1/4 character unit for spacing (default) CSI ; 1 ; 1 ; h 9/11 3/15 3/1 6/8 Selects spacing unit (selected by the SUU sequence)
Proportional spacing (5.2.5)	DECPSP	CSI ; 1 ; 2 ; 7 ; 9/11 3/15 3/2 3/7 3/12 Selects proportional (default) CSI ; 1 ; 2 ; 7 ; h 9/11 3/15 3/2 3/7 6/8 Selects proportional spacing
Return to initial state (5.1.0)	RIS	ESC c 1/11 6/3 Resets the printer's operating features to initial values

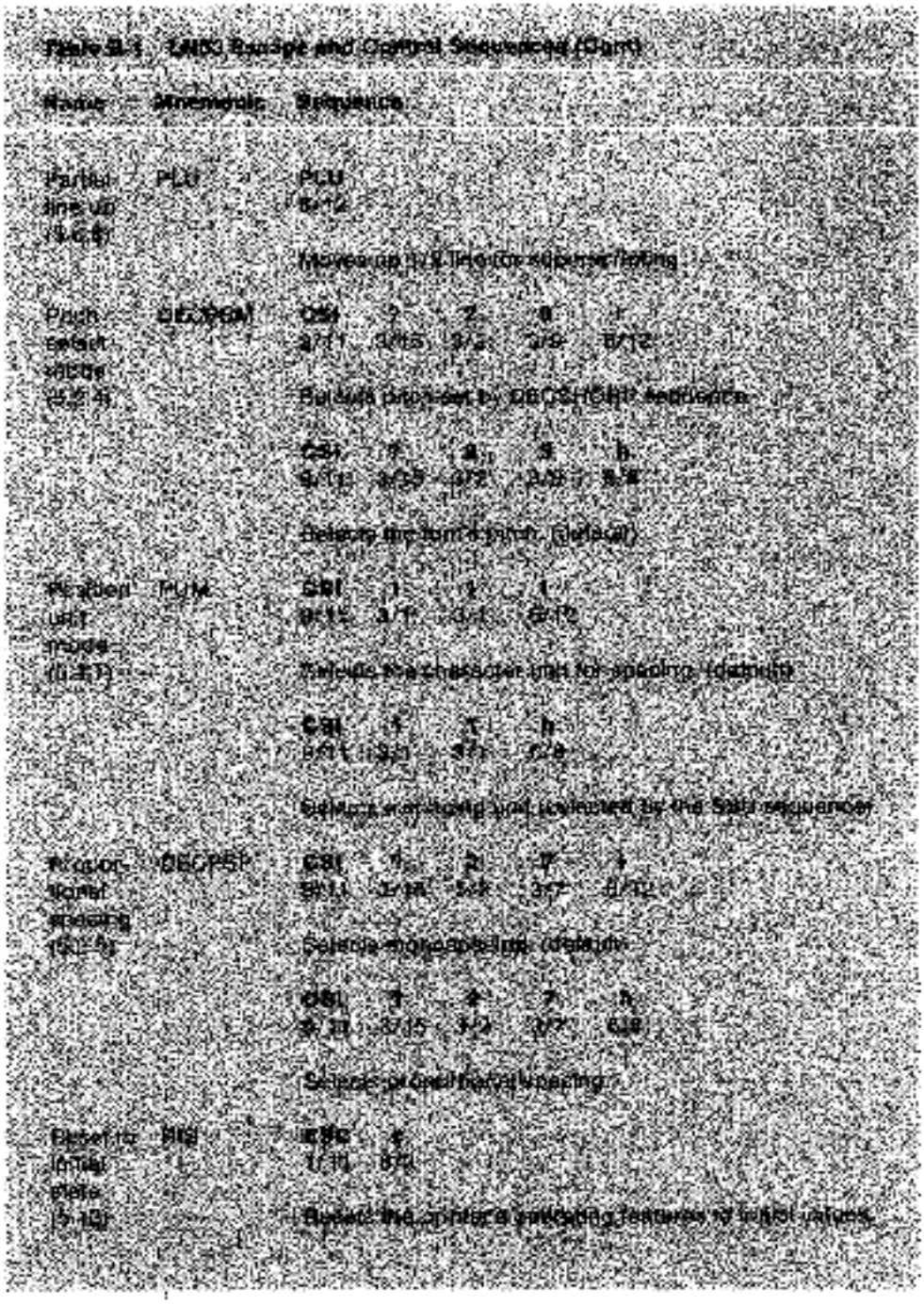


Table B-1: UNIX Escape and Control Sequences (Cont'd)

Name	Mnemonic	Sequence
Select font (4.3BSD)	SFNT	CSI Ps SP m 9/11 2/0 2/13 Selects a font for printing. Ps Function 10 DEC Cyrillic family 11 Courier family 12 Elite family 13 Courier 12 point, 10 pitch 14 Elite 10 point, 12 pitch 15 Courier 9.0 point, 13.5 pitch 16 Courier 10 point, 10.5 pitch 17 DEC Cyrillic family 18 DEC Cyrillic family 19 DEC Cyrillic family
Select graphic position (4.1BSD)	SGP	CSI Ps m 9/11 3/0 6/13 Selects character attributes. Ps Function 0 All attributes off 1 Bold printing on 2 Italic printing on 3 Underlining on 20 Shadow printing on 22 Bold printing off 23 Italic printing off 24 Underlining off 29 Shadow printing off
Select size (4.3BSD)	SESZ	CSI Ps SP t 9/11 3/0 2/0 7/4 When Ps is set, selects the current unit for other sequences.

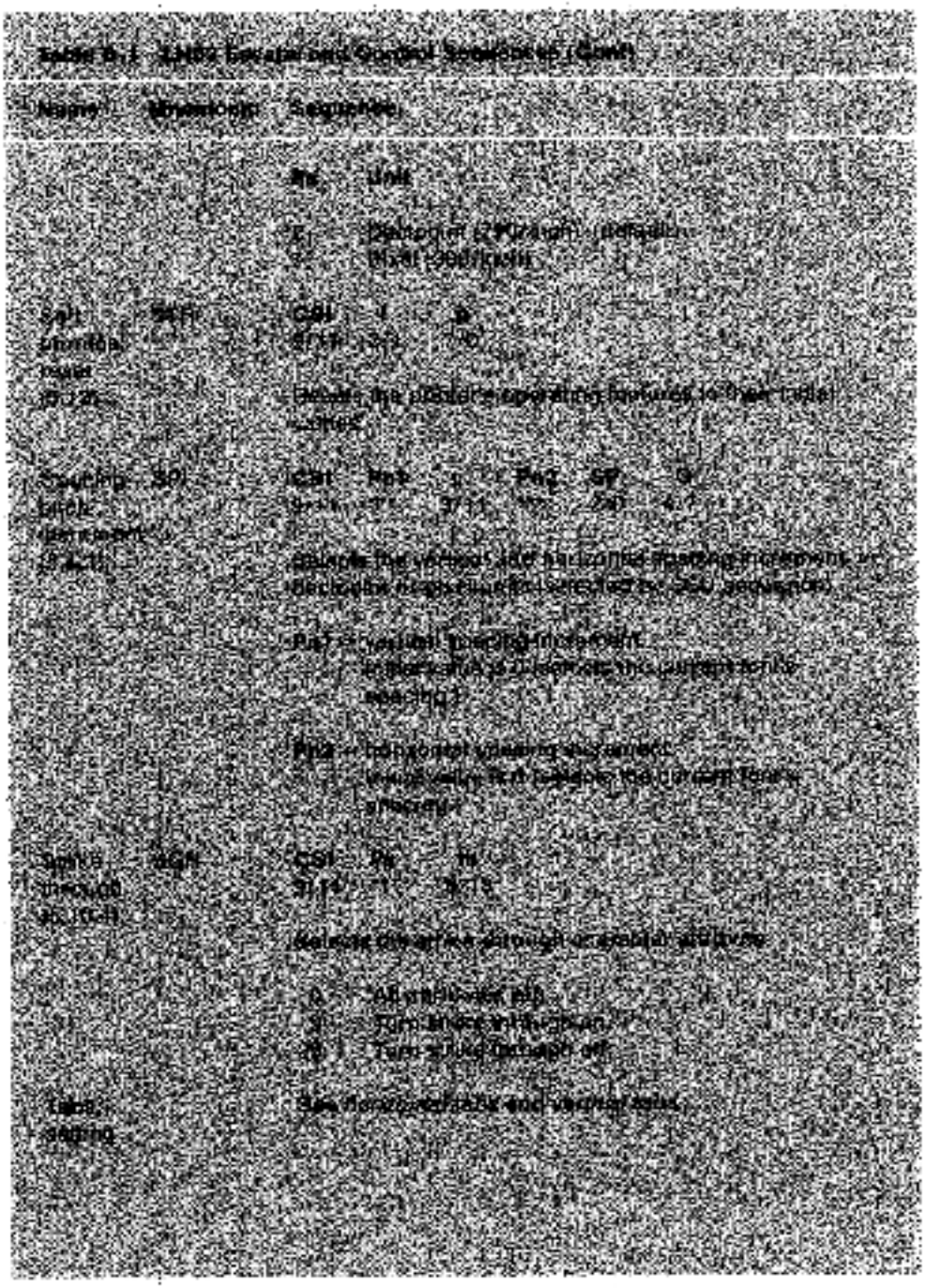


Table B-1 ANSI Escape and Control Sequences (Cont'd)

Name	Mnemonic	Sequence
Tabs clearing [5.7.3]	TBC	CSI Ps g 9/11 ... 6/7
		Clears horizontal or vertical tabs. Ps Function 0 Clears one horizontal tab at active position. 1 Clears one vertical tab at active position. 2 Clears all horizontal tabs. 3 Clears all vertical tabs. 4 Clears all tabs.
Character path [5.10.1]	SGR	CSI Ps m 9/11 ... 6/13
		Selects color/intensity. Ps Function 0 All are turned off. 4 Sets underlining on. 24 Turns underlining off.
Vertical pitch [5.4.3]	DECVERP	CSI Ps x 9/11 ... 7/10
		Selects the vertical pitch (lines per inch). Ps Pitch 0 Determined by current font (default) 1 6 2 8 3 12 4 4 5 9 6 7
Vertical position absolute [5.6.4]	VPA	CSI Pn d 9/11 ... 6/4
		Advances vertical line without changing the active column.

Table B-1 (Part 2 of 3) Escape and Control Sequences (Cont.)

Name	Mnemonic	Sequence

Pn = new vertical line, character, composite or pixel position selected by SSU and PUM sequences.

Default values: 1 (for 6 LPI, 8 LPI paper)
3 (for 12 pitch)

Vertical position backward (5.6.6)	VPB	CSI 9/11	Pn ...	a 6/13	

Subtracts Pn from active vertical line.

Pn = value in character, composite or pixel units selected by SSU and PUM sequences.

Default value = 1.

Vertical position relative (5.6.5)	VPR	CSI 9/11	Pn ...	a 6/13	

Adds Pn to active vertical line.

Pn = value in character, composite or pixel units selected by SSU and PUM sequences.

Default value = 1.

Vertical spacing, select (5.3.2)	SVS	CSI 9/11	Ps ...	SP 2/0	L 4/12	

Selects the vertical line spacing.

Ps	Vertical Character Pitch	Vertical Character Positioning Unit
0	6 lines/inch	1/6 inch (default)
1	4 lines/inch	1/4 inch
2	3 lines/inch	1/3 inch
3	12 lines/inch	1/12 inch
4	8 lines/inch	1/8 inch
5	9 lines/30 mm	3.3 mm
6	4 lines/30 mm	7.5 mm
7	3 lines/30 mm	10.0 mm
8	12 lines/30 mm	2.1 mm
9	7 lines/inch	1/7 inch

Table B-1 ANSI Escape and Control Sequences (Cont)

Name	Mnemonic	Sequence
Vertical Position Absolute (VPA)		CSI Pn d

Sets up to 16 vertical tabs.

Pn = vertical tab stop in characters, decimal, or (rad unit) (ignored by SCO and PWB screen calls)

COMPARING LN03 CONTROL FUNCTIONS WITH OTHER DIGITAL PRINTERS

C

This appendix is an alphabetical list of the ASCII-coded control functions used in the LN03 and other Digital printers. The list includes standard ANSI and ISO control functions, as well as private Digital control functions (marked by a DEC prefix).

All printers do not use the same control functions. Even when printers do use the same function, they do not always implement the function the same way. A o in the list indicates the particular printer uses that control function.

Chapters 3 through 5 describe the specific control functions used in the LN03. See the index for the page that describes a particular function.

Table C–1 Comparing the LN03 Printer With Other Digital Printers

Escape Sequence		LA50	LA75	LA100	LA210	LN03
BS	Backspace	•	•	•	•	•
CAN	Cancel	•	•	•	•	•
DA	Dash control (primary font)		•		•	•
DAK	Dash	•	•	•	•	•
DE	Dash right	•	•	•	•	•
DECBI	Bidirectional				•	•
DH	Dash control (secondary font)		•		•	•
DECALT	Alternate					•
DECAPH	Alternate phase					•
DECAPM	Alternate mode					•
DA	Dash control (primary font)		•		•	•
DECAUDC	Audio control				•	•
DECBI	Bidirectional				•	•
DECBPM	Bidirectional print mode				•	•
DECCARA	Change attributes in rectangular area					•
DECCRA	Copy rectangular area					•
DECDHL	Double-height line				•	•
DECDWL	Double-width line				•	•
DECEDM	Set edit extent mode					•
DECERA	Erase rectangular area					•
DECFRA	Fill rectangular area					•
DECFWM	Set font width mode					•
DECIC	Insert column					•
DECID	Identify terminal				•	•
DECINLM	Set inquire mode					•
DECKBD	Keyboard usage					•
DECKPAM	Keypad application mode				•	•
DECKPNM	Keypad numeric mode				•	•
DECLANS	Load answerback message					•
DECLBAN	Load answerback message					•
DECLKS	Load key strings					•
DECLTOUT	Load terminal-to-host timeout					•
DECMSR	Mouse sub-resolution					•
DECNKM	Numeric keypad mode				•	•
DECNRCM	National replacement character set				•	•
DECPAK	Program alphanumeric keyboard					•
DECPCTERM	Set terminal parameters					•
DECPEX	Print extent					•
DECPFF	Print form feed					•
DECPKA	Program keyboard action					•
DECPKFMR	Program key format					•
DECPLM	Set left margin					•
DECPS	Play sound					•
DECPSM	Set page size mode					•
DECRARA	Reverse attributes in rectangular area					•
DECRPKT	Report key type					•
DECRQCRA	Request checksum of rectangular area					•
DECRQDE	Request display extent					•
DECRQKD	Request keyboard dialect					•
DECRQLP	Request locator position					•
DECRQPKFM	Request program key format					•
DECRQPSR	Request presentation state report					•
DECRQTSR	Request terminal state report					•
DECRQUPSS	Request user-preferred supplemental set					•
DECSACE	Select attribute change extent					•
DECSASD	Select active status display					•
DECSCA	Select character attribute				•	•
DECSCL	Select conformance level				•	•
DECSCP	Select communication port					•
DECSCPP	Set columns per page					•
DECSCS	Select communication speed					•
DECSCS	Select communication speed					•
DECSDDT	Select disconnect delay timer					•
DECSDPT	Select digital printed data type					•
DECSED	Selective erase in display				•	•
DECSEL	Selective erase in line				•	•
DECSFC	Select flow control					•
DECSLE	Select locator events					•
DECSLPP	Set lines per page					•
DECSLRM	Set left and right margins					•
DECSMBV	Set margin bell volume					•
DECSNLS	Set number of lines per screen					•
DECSPP	Set port parameter					•
DECSPPCS	Select printer PC character set					•
DECSPRTT	Select printer type					•
DECSR	Secure reset					•
DECSSDT	Select status display line type					•
DECSSL	Select setup language					•
DECSTBM	Set top and bottom margins				•	•
DECSTR	Soft terminal reset				•	•
DECSWBV	Set warning bell volume					•
DECTID	Select terminal ID					•
DECTME	Terminal mode emulation					•
DECTST	Invoke confidence test					•
DECUDK	User-defined keys				•	•
DECXCPR	Extended cursor position report					•
DL	Delete line	•	•	•	•	•
DSR	Device status report	•	•	•	•	•
EA	Erase in area				•	•
ED	Erase in display	•	•	•	•	•
EL	Erase in line	•	•	•	•	•
ENQ	Enquire	•	•	•	•	•
EPA	End of protected area				•	•
ESA	End of selected area				•	•
FF	Form feed	•	•	•	•	•
HPA	Horizontal position absolute				•	•
HPR	Horizontal position relative				•	•
HT	Horizontal tab	•	•	•	•	•
HTS	Horizontal tabulation set	•	•	•	•	•
HVP	Horizontal and vertical position				•	•
ICH	Insert character				•	•
IL	Insert line	•	•	•	•	•
IND	Index				•	•
LF	Line feed	•	•	•	•	•
LS1R	Locking shift 1 right				•	•
LS2	Locking shift 2				•	•
LS2R	Locking shift 2 right				•	•
LS3	Locking shift 3				•	•
LS3R	Locking shift 3 right				•	•
MC	Media copy	•	•	•	•	•
NEL	Next line				•	•
NP	Next page				•	•
PP	Preceding page				•	•
PPA	Page position absolute				•	•
PPB	Page position backward				•	•
PPR	Page position relative				•	•
RI	Reverse index				•	•
RIS	Reset to initial state				•	•
SCS	Select character set				•	•
SGR	Select graphic rendition				•	•
SI	Shift in	•	•	•	•	•
SO	Shift out	•	•	•	•	•
SPA	Start of protected area				•	•
SS2	Single shift 2				•	•
SS3	Single shift 3				•	•
SSA	Start of selected area				•	•
ST	String terminator				•	•
TBC	Tabulation clear				•	•
VPA	Vertical position absolute				•	•
VPR	Vertical position relative				•	•
VT	Vertical tab	•	•	•	•	•

Table C-1 Comparing the LN03 Printer With Other Digital Printers (Cont.)

Control Function	LA50	LA75	LN03	LA100	LN03 PLUS
DECCPP	Print number 3				
DECNPWA	Horizontal page width and margin				
DECHTS	Set horizontal tab (= HTS)				
DECID	Request ID				
DECLP	Load units				
DECOPM	Origin placement mode				
DECPSM	Horizontal pitch select (set/reset)				
DECPSP	Proportional spacing (set/reset)				
DECRPP	Print, specified permanent position				
DECPTS	Proportional tabs (select)				
0 or 1	Select table 1				
2	Select table 2				
DECSBS	Request set status				
DECSHORC	Set horizontal origin to selected value				
DECSHTS	Set horizontal tab stops				
DECSLPP	Set lines per page (= DEC SCLP)				
DECSLRM	Set left and right margins				
DECSS	Set space size				
DECSTP	Store print format				
DECSTBM	Set top and bottom margins				
DECSVTS	Set vertical tabs				
DECUND	Programmable underline character				
DECVEC	Draw vector				
DECVERP	Set vertical place to selected value				
DECVTS	Vertical tab set (= VTS)				
DEL	Delete				
DSR	Device status report				
0	Ready, no malfunctions				
3	Some malfunction				
NOTE:	Sixel codes are not entered.				
DSR	Device status				
8 or 9	Request DSR 7 words				
10	Disable on unsolicited DSR				
11	Enable brief unsolicited DSR				
12	Enable full unsolicited DSR				
EDT	Edit or format sheet				

Table C–1 Comparing the LN03 Printer With Other Digital Printers (Cont.)

Control Function	LCP02	LCP03	LN03	LA12	LN03+
ESC Escape 7-bit C1 ESC Fe sequences	•	•	•	•	•

NOTE: These sequences describe graphic characters for G0, G1, G2, and G3. Designations and/or the current SCS extension (—)

ESC	(	02/08	04/02	ASCII	•	•	•	•
ESC	4	02/08	03/04	DEC Dutch			•	•
ESC	4	02/08	03/05	DEC Finnish			•	•
ESC	(	02/08	03/06	DEC French			•	•
ESC	(	02/08	03/07	French			•	•
ESC	(	02/08	03/08	DEC French Canadian			•	•
ESC	(	02/08	03/09	German			•	•
ESC	(	02/08	03/10	Italian			•	•
ESC	(	02/08	03/11	Norwegian/Danish			•	•
ESC	(	02/08	03/12	Spanish			•	•
ESC	(	02/08	03/13	DEC Swedish			•	•
ESC	(	02/08	03/14	DEC Swiss			•	•
ESC	(	02/08	03/15	DEC Supplemental			•	•
ESC	(	02/08	04/12	DEC Hebrew			•	•
ESC	(	02/08	04/13	DEC Greek			•	•
ESC	(	02/08	04/14	DEC Cyrillic			•	•
ESC	(	02/08	04/15	DEC Technical			•	•
ESC	(	02/08	04/16	ISO Hebrew			•	•
ESC	(	02/08	04/17	ISO Greek Supplemental			•	•
DSM	Graphic size modification							
GSS	Graphic size select							
HPA	Horizontal position absolute				•	•	•	•
HPB	Horizontal position backward				•	•	•	•
HPR	Horizontal position relative				•	•	•	•
HT	Horizontal tab				•	•	•	•
HTS	Horizontal tab set				•	•	•	•
IND	Forward index				•	•	•	•
JFY	Justify						•	•
LF	Line feed				•	•	•	•
LNM	Line feed/new line mode (set/reset)				•	•	•	•
Reset	(Transmit) only				•	•	•	•
Set	LF is new line (CR LF)				•	•	•	•

Table C-1 Comparing the LN03 Printer with Other Digital Printers (Cont'd)

| Control Function | | |

Table C-1: Comparing the LN03 Printer With Other Digital Printers (Cont.)

Control Function			LQP02	LQP03	LN03	LA50	LN03
SHS		Set horizontal spacing					✓
SP		Space	✓	✓	✓	✓	✓
SPI		Spacing (increment)	✓	✓			✓
SS2		Single shift 2	✓	✓	✓	✓	
SS3		Single shift 3	✓	✓	✓	✓	
SSU		Select size unit	✓	✓		✓	
	0	(privacy)			✓		✓
	2	Decipoint (1/720 inch)	✓	✓			✓
	3	Inch (1/300 inch)			✓		✓
SUB		Substitute	✓	✓	✓	✓	✓
SVS		Set vertical spacing					✓
TBC		Tabulation clear					
	0	Clear one HT at active position	✓	✓	✓	✓	✓
	1	Clear one VT at active line	✓	✓		✓	✓
	2	Clear all HTs in active line	✓	✓		✓	
	3	Clear all horizontal tabs	✓	✓	✓	✓	✓
	4	Clear all vertical tabs	✓	✓	✓	✓	✓
VPA		Vertical position absolute	✓	✓	✓	✓	✓
VPB		Vertical position backward	✓	✓			✓
VPR		Vertical position relative	✓	✓	✓	✓	✓
VT		Vertical tab	✓	✓	✓	✓	✓
VTS		Vertical tab set	✓	✓		✓	✓
Modes (not listed above)							
DECAWM		Autowrap mode			✓		✓
LNM		Line feed/new line mode - Affects LF					
	Reset	LF as local motion only	✓	✓	✓	✓	✓
	Set	LF as new line (+ CR if	✓	✓	✓	✓	✓
PUM		Positioning unit mode - Affects the units used for cursor movement at DECSHORP, DECSVTS, DECSLPP, DECSTBM, DECSLRM, HPA, HPB, HPR, VPA, VPB, and VPR					
	Reset	One character position	✓	✓			✓
	Set	One decipoint (see SSU)	✓	✓			✓

Table C–1 Comparing the LN03 Printer With Other Digital Printers (Cont.)

Control Function		LQP02	LQP03	LA34	LN03
SSU	Select size unit. When PUM is set, selects the unit used with numeric parameters of: DECSHTB, DECSVTB, DECSLPP, DECSTBM, DECSLRM, DECVEC, HPA, HPB, HPR, SPI, VPA, VTB, VPR.				
SSU = 0	Ignore.	✓	✓	✓	✓
SSU = 2	Decipoints (1/720 inch).	✓	✓	✓	✓
SSU = 7	Pixels (1/300 inch).			✓	✓
SPI	Spacing increment. Specifies the inter-line spacing and the number of horizontal spaces for characters that follow in the same string.	✓	✓	✓	✓
	Affects the following vertical controls: IND, VPT, NEL, PLD, PLU, RI.				
	Affects the following horizontal controls: BS, SP, imaging characters.				
	Affects the following controls when PUM is set: DECSHTB, DECSVTB, DECSLPP, DECSTBM, DECSLRM, DECVEC, HPA, HPB, HPR, VPA, VPB, VPR.				
SSU = 2	Decipoints (1/720 inch).	✓	✓	✓	✓
SSU = 7	Pixels (1/300 inch).	✓	✓	✓	✓

Table C-1: Comparing the LN03 Printer With Other Digital Printers (Cont)

Control Function	LA50	LA75	LA100	LA210	LN03
Miscellaneous Features					
Built-in graphic character sets:					
ASCII	*	*	*	*	*
DEC supplemental		*	*		*
DEC technical					*
VT100 line drawing					*
Font storage (if extra):					
base space (in RAM)					90K
Option RAM cartridge					128K
Plug-n-print ROM cartridge				*	128K
Number of printable characters	256	256	4K	4K	4K
Modem signals	*	*	*	*	
Portrait page orientation	*	*	*	*	*
Landscape page orientation	*	*	*	*	*
Number of trays	1	1-3	1	1	1

* The LN03 printer uses RAM for a page composition buffer and for font storage.

LN03 BUILT-IN TYPE FAMILY IDs, FONT IDs, and FONT FILE IDs

D

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D.1 BUILT-IN FONT FILE IDS FOR THE LN03

This appendix explains the values used in the font file IDs for the font files built into the LN03 printer. In Table D-1, the Field column lists the location of a value in an LN03 *font file ID*. Values are base 36 values (0-9, A-Z).

The *type family ID* is field 1 (first 7 characters) of the 31-character font file ID.

The *font ID* is fields 1 through 7 (first 16 characters) of the 31-character font file ID.

D.2 TYPE FAMILY NAMES

The type families built into the LN03 printer use the following names.

Type Family Name	Type Family ID (7 characters)
DEC BUILTIN1	DBULTN1
COURIER	RCOURIR
ELITE 12	RELITE0
PI FONT	D000000

The "D" in the type family ID for DEC BUILTIN1 indicates the name DEC BUILTIN1 is registered with Digital, but is not registered internationally.

The "R" in the type family IDs for COURIER and ELITE 12 indicate these names are registered internationally or are in the public domain.

Table D-3 Font Selection Fields

Field	Bytes	Field Name	Values	Meanings
1	2 bytes	Font Family ID	0	Font Family ID is specified in the previous command
			1	Default font selection
2	2	Spacing	0	10 cpi
			1	16.8 cpi
			2	5 cpi
			3	Font width
3	2 bytes	Type size	0.5	Font size 0.5 points
4	2	Style selection	0	No selection
5	2 bytes	Weight	0	Medium
6	2	Typeface	0	Default
7	2	Posture	0	Default
8	2 bytes	Reserved	00	Reserved
9	10 to 21	Character set	0 (0)	ASCII
			1 (1)	DEC supplemental
			2 (2)	DEC technical
			3 (3)	ISO Latin-1 supplemental
10	22 to 25	Font selection	4 (4)	Full character set (all 4 bytes)
11	26 to 27	Font selection	0-2	Default font number
12	28	Pitch value	0	360 pitch per inch
13	29	Reserved	0	Reserved
14	30	Style variety	0	Reserved
15	31	Undefined	0	Undefined

NOTE: The bold-italic and bold-italic-condensed fonts are not available in the LN03 printer. If you select one of these fonts, the printer substitutes the bold font.

D.3 BUILT-IN LN03 TYPE FAMILY NAMES, TYPE FAMILY IDS, FONT IDS, AND FONT FILE IDS

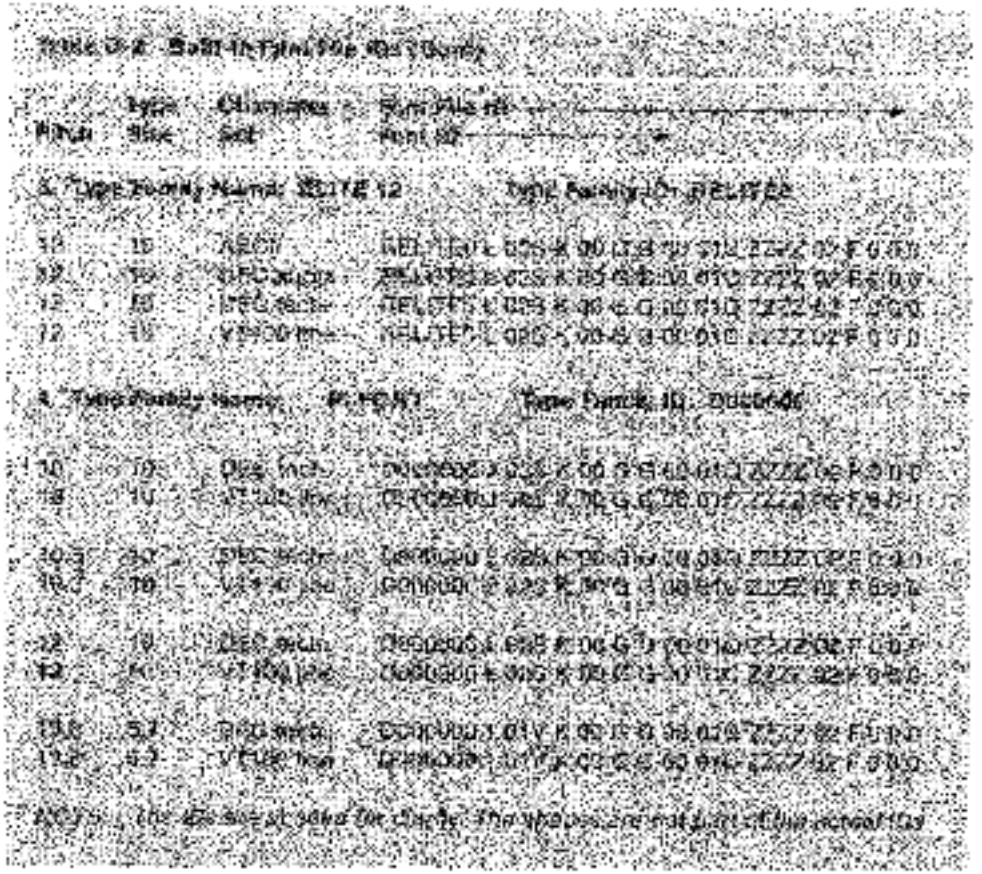
Table D-2 lists all type family names, type family IDs, font IDs, and font file IDs built-in into the LN03 printer.

The *type family ID* is field 1 (first 7 characters) of the 31-character font file ID.

The *font ID* is fields 4 through 7 (last 16 characters) of the 31-character font file ID.

Table D-2 Built-in Font File IDs

Pitch	Type Style	Character Set	Font File ID Font ID
1. Type Family Name: COURIER			Type Family ID: 8COURIER
10	0	ASCII	8COURIER.0285K0U3Q00U0Z222U5F0U0U
10	16	DEC Supp.	8COURIER.0285K0U3Q00U0Z222U5F0U1U
10.5	0	ASCII	8COURIER.0285K0U3Q00U0Z222U5F0U0U
10.5	16	DEC Supp.	8COURIER.0285K0U3Q00U0Z222U5F0U1U
12	0	ASCII	8COURIER.0285K0U3Q00U0Z222U5F0U0U
12	16	DEC Supp.	8COURIER.0285K0U3Q00U0Z222U5F0U1U
13.2	0	ASCII	8COURIER.0285K0U3Q00U0Z222U5F0U0U
13.2	16	DEC Supp.	8COURIER.0285K0U3Q00U0Z222U5F0U1U
2. Type Family Name: COURIER			Type Family ID: 8COURIER
10	0	ASCII	8COURIER.0285K0U3Q00U0Z222U5F0U0U
10	16	DEC Supp.	8COURIER.0285K0U3Q00U0Z222U5F0U1U
10.5	0	ASCII	8COURIER.0285K0U3Q00U0Z222U5F0U0U
10.5	16	DEC Supp.	8COURIER.0285K0U3Q00U0Z222U5F0U1U
12	0	ASCII	8COURIER.0285K0U3Q00U0Z222U5F0U0U
12	16	DEC Supp.	8COURIER.0285K0U3Q00U0Z222U5F0U1U
13.2	0	ASCII	8COURIER.0285K0U3Q00U0Z222U5F0U0U
13.2	16	DEC Supp.	8COURIER.0285K0U3Q00U0Z222U5F0U1U



SUMMARY SHEET E

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E.3 Sample Summary Sheet 190

E.1 PRINTING THE SUMMARY SHEET

The summary sheet is a printout of the current status of the LN03. There are two ways to print the summary sheet.

1. Use the load font files (DECLFF) sequence (Paragraph 4.4.1), or
2. Place the printer off-line and press the test (**T**) switch.

E.2 SUMMARY SHEET CONTENTS

The summary sheet identifies the following items.

Revision level of the printer software
Status of the configuration switches
Currently available fonts
Memory available for additional fonts
Status of any cartridges
Paper switch setting
Up to 30 error codes

The summary sheet also lists the available fonts by their font file IDs, in the following order.

Down-line-loaded fonts
Font cartridges
ROM-resident fonts

The summary sheet cannot list 30 error codes and all possible font file IDs at the same time. Error codes have priority. So, if a large number of error codes are listed, some font file IDs may be omitted.

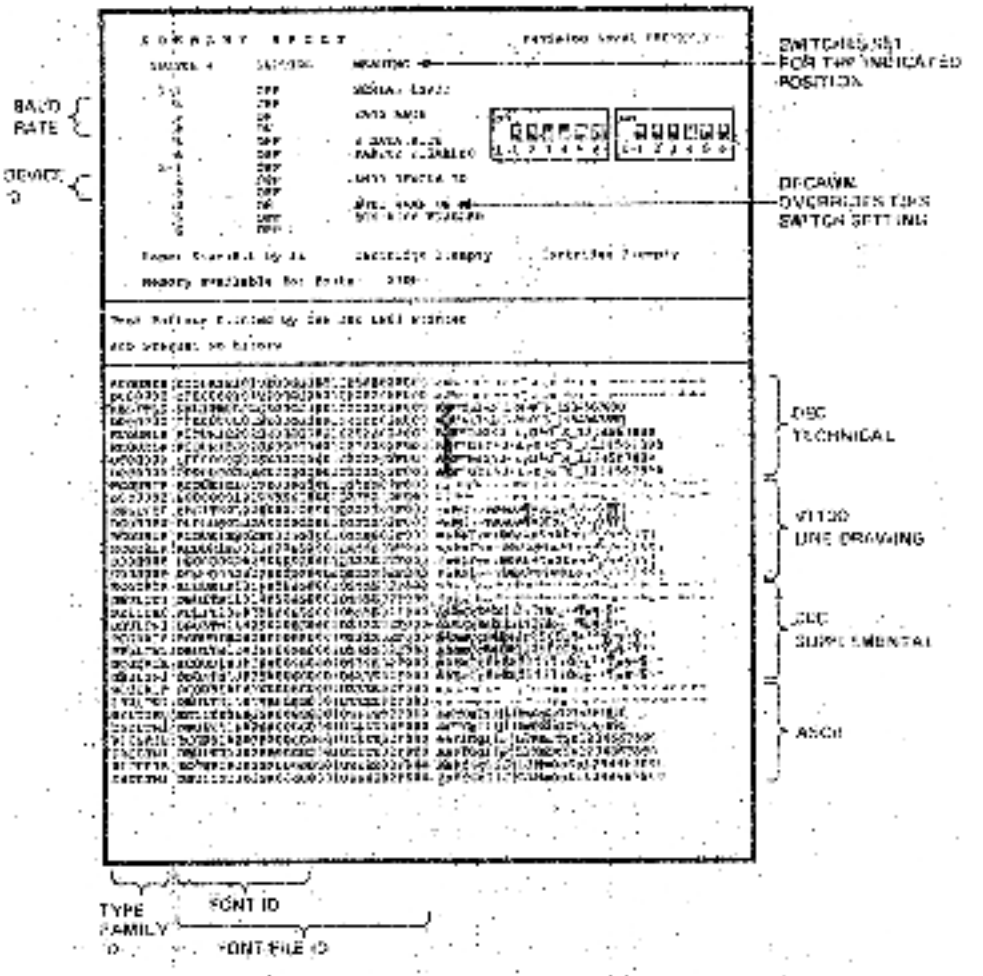
E.3 SAMPLE SUMMARY SHEET

Figure E-1 is a sample summary sheet. Tables E-1 and E-2 list error codes that may appear on the summary sheet. These codes also appear on the front panel character display indicator.

Table E-1 lists the codes for controller errors that may occur while the printer is operating. Table E-2 lists the codes for errors that may occur during the communication and loopback diagnostic tests.

Table E-3 lists the codes for fatal errors that will stop the printer during the self-test diagnostics. Fatal errors are reported on the front panel character display indicator only.

NOTE: Engine errors also appear on the front panel indicators.



NOTE

The sequence for the ReGIS printout is dependent upon resident fonts, cartridge fonts, resident fonts. Also, if there are a lot of errors on the printout, there may not be enough space on the screen to form out an incident hard disk.

Figure E-1 Summary Sheet Test Pattern

Table E-1 Operational Error Codes and Conditions

Indicator	Error Code	Error Condition	Suggested Solution
	1	Data too complex.	Try landscape orientation.
	2	Lost characters or part of vector for line heading.	Turn on extended mode.
	3	Font memory has overflowed, or only complete soft fonts loaded.	Add memory cartridge.
	4	Excess fonts not loaded in font memory.	Add memory cartridge.
	5	Page data has exceeded available page memory. Data will print on next page.	Add memory cartridge.
	12	Illegal codes in downloaded font.	Use font files in Digital format.
	13	30 or more errors were detected on this page.	Recopy the data.
	16	Invalid parameter.	Recopy the data.
	24	Character not defined in selected font.	Select another font.
	26	Text button pressed during font load.	Reload the font.
	31	Communication error on received data.	Make sure the host and printer specified compatible baud rates.
	32	Communication error; input buffer overflow.	Make sure the host and printer are using XON/XOFF protocol.

Table E-1 Operational Error Codes and Conditions (Cont)

Indicator	Error Code	Error Condition	Suggested Solution
	04	Form removed while printing	Make sure a form is present in the printer before recovering or restarting ROM operations.
	05	Form removed while printing	Make sure the printer is on and ready before recovering or restarting RAM operations.

Table E-2 Computer Diagnostic Error Codes

Indicator	Error Code	Error Condition	Suggested Solution
	03	Computer test failure - digital test	Call Digital Field Service
	04	Computer test failure - character generator test	
	05	Computer test failure - read/write ram test	

Table E.3 Self-Test Diagnostics: Fatal Error Codes

In Service	Error Code	Error Condition	Suggested Solution
	47	I/O device failure at powerup	Call Digital Field Service
	67	Baud rate error	
	11	Program ROM failure	
	72	Counter or RAM failure	
	75	No faults in system	
	71	Ram buffer too slow	
	76	Font in wrong state	

NOTE: Fatal errors are only reported on the front panel character display.

HELPFUL HINTS, PROBLEMS AND SOLUTIONS, AND PROGRAMMING EXAMPLES

F

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F.2 Problems and Solutions 198
F.3 Examples of LN03 Control Functions 200

This appendix has three sections. The first section provides helpful hints. The second lists typical problems and suggested solutions. The third shows examples of important LN03 control functions.

F.1 HELPFUL HINTS

General

- Always send a reset command before you start a document. The reset command places the printer in a known state. However, the reset command does not clear font memory. Make sure you have enough font memory available to do the document.

- Do not insert or remove ROM or RAM cartridges while the printer is printing. You can insert and remove cartridges when the printer is off-line or idle.

- The LN03 does *not* operate as an LA100 or LQP02. When you set the device ID switches (SW2-2 and 2-3) to respond as an LA100 or LQP02, the printer still operates as an LN03. Only the ID response changes.

- The LN03 prints unsolicited reports *after* the printed page on which an error occurs.

- All parameters in escape and control sequences must be unsigned, positive decimal integers. Do not use decimal points in parameter values.

- Equivalent measurements

  1 point = 1/72 inch (approximately)
  1 decipoint = 1/720 inch
  1 pixel = 1/300 inch (on the LN03)

  For example, A 10-point type size equals approximately 10 × 1/72 inch.

Paper

- Always load paper against the left side of the tray. Make sure the paper guide is firmly against the right edge of the paper. Otherwise, your printing may not align with the edges of the paper.

- Use only the paper recommended by Digital. Thin paper may cause a paper jam.

  - Recommended paper weight: 16 to 24 pounds.
  - Paper sizes: 8-1/2 × 11 inches and A4.
  - Part numbers for ordering the recommended paper:

8-1/2 × 11 paper	LN03X-AF
A4 paper	LN03X-AH

Page Format

- Use the page format select sequence (CSI Ps sp J) to select the printing orientation, either portrait or landscape. When you power up the LN03, the printer uses the portrait orientation.

- Always use the upper-left corner of the printable area as the origin point for printed pages. To select the upper-left corner, set the origin placement mode (OPM).

  If you reset OPM, the LN03 places the origin at the upper-left corner of the physical page. However, the printer cannot start printing until 0.25 inches in from the edge of the paper.

- When you set new tabs or margins, clear all tabs or margins you do not want. Also, make sure you select the correct unit of measurement: decipoints, pixels, or character cells. Otherwise, the printer may not set your tabs or margins in the desired location.

When the LN03 is Off-Line

- The printer and the host computer cannot exchange data.

- The printer cannot report its status.

Font Files

- The LN03 only recognizes font files in the Digital font file format. You cannot use LN01 font files in the LN03.
- For font files with the same font ID or type family ID but with different character sets, you must designate the appropriate character set.
- You assign font files with the 7-character type family ID or the 16-character font ID. Use uppercase letters only for both IDs. You do not assign font files with the 31-character font file ID.

Fonts and Character Sets

- To use proportional spacing, you must use a proportional font and select proportional spacing with the DECPSP sequence.
- Do not use VT100 line drawing characters with other character sets. Otherwise, your printed characters will have inconsistent line weights (widths).
- You cannot scale character sizes. However, you can use GSM to select the closest, smaller available size. GSM selects from the available fonts in the type family. If font files are assigned by type family ID, you can use GSM to select from the available point sizes in that family.

  For example, suppose you are using a 10-point font from the DBULTN1 family. You want to use a smaller point size.

  - If you send a GSM with a parameter of 70 percent for height, the LN03 selects the 6.7-point DBULTN1 font—the closest, smaller available size.
  - If you send a GSM with a parameter of 50 percent for height, the LN03 will not find any DBULTN1 font smaller than the desired size. As a result, the printer will print blobs.

  See the GSM example in Paragraph F.3.

Graphics

- The graphics you print on the LN03 will probably be smaller than the same graphics displayed on your video terminal.

The LN03 as a Dedicated or System Printer

- To use the LN03 as a dedicated printer, connect the printer to the auxiliary or printer port of your video terminal.
- To use the LN03 as a system printer, you must assign the printer a terminal number and a queue name (if there is a spooler involved). The specific commands to use depend on the software used.

F.2 PROBLEMS AND SOLUTIONS

I can only down-line-load two font files.

Add RAM cartridges. A typical font file requires 15 Kbytes of memory.

Some of my graphs do not print.

You can print small graphs, but some graphs may be too complex for the printer. The LN03 uses a band buffer 6 pixels deep. The printer processes a maximum of 150 characters or vectors (including spaces) in a band at a time.

I get a blank page for each line of my source document.

The current margins may specify a page that is smaller than a line height or width. Check your PUM and SSU settings. You may be using the wrong unit of measure.

I cannot load my LN01 font files in the LN03.

The LN03 does not support LN01 font files. The font files you use with the LN03 must be in the Digital font file format.

I cannot print landscape pages.

Send a PFS sequence to select the landscape format (ESC [?21 J) before you send the text. Do not send an RIS or DECSTR sequence after PFS, because the format will return to portrait.

When I set the device ID switches to LA100 or LQP02, I have spacing problems.

The LN03 does not operate as an LA100 or LQP02. The printer always operates as an LN03—only the ID changes. Use the correct LN03 commands for spacing.

My ReGIS files do not print.

The LN03 does not support ReGIS protocol. Convert the ReGIS files to sixel files.

The printer does not set tabs and margins where I want them.

The printer may have other tabs and margins already stored. Clear all tabs and margins before you set new ones.

Also, check the unit of measure (pixels, decipoints, or character cell) you are using. The LN03 stores tabs and margins at pixel locations.

The quality of my transparencies is poor.

Use the recommended transparency film for plain paper copiers.

Size	Part Number
8-1/2 × 11	LN03X-AK
A4	LN03X-AJ

F.3 EXAMPLES OF LN03 CONTROL FUNCTIONS

This section contains examples of some basic LN03 control functions that you will use most often.

Changing Pitch (Line and Character Spacing)

The spacing pitch increment (SPI) sequence is the most flexible sequence you can use for changing pitch. You can change both the horizontal and vertical spacing with one SPI sequence. You use the select size unit (SSU) sequence to select the unit of measure—decipoints or pixels.

NOTE: Pixels are the recommended unit of measure. On the LN03, a pixel equals 1/300 inch.

Changing Horizontal Pitch

In the following example, the horizontal pitch changes, but the vertical pitch remains the same. First, the SSU sequence selects pixels (ESC [7 I) as the unit of measurement. Then the three SPI sequences select different horizontal pitches. The horizontal pitch affects character spacing—not character size. The vertical pitch is set to 0 in each sequence, so the current font determines the vertical spacing.

You enter:

```
<ESC>[7 I   = set for pixels  (SPI)

<ESC>[0;60 G = spacing pitch (6) characters per inch.
<ESC>[0;30 G = spacing pitch (10) characters per inch.
<ESC>[0;25 G = spacing pitch (12) characters per inch.
```

The LN03 prints:

```
  = set for pixels  (SPI)

 =  spacing  pitch  (6)  characters
= spacing pitch (10) characters per inch.
= spacing pitch (12) characters per inch.
```

Changing Vertical Pitch

In this example, the vertical pitch changes, but the horizontal pitch remains the same. First, the SSU sequence selects pixels (ESC [7 I) as the unit of measure. Then the three SPI sequences select different vertical pitches. The vertical pitch affects line spacing—not character size. The horizontal pitch is set to 0 in each sequence, so the current font determines the horizontal spacing.

You enter:

```
<ESC>[7 I    = set for pixels  (SPI)

<ESC>[50;0 G  = line spacing, (6) lines per inch.
              aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
              bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb

<ESC>[30;0 G  = line spacing, (10) lines per inch.
              aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
              bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb

<ESC>[25;0 G  = line spacing, (12) lines per inch.
              aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
              bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb
```

The LN03 prints:

```
  = set for pixels  (SPI)

= line spacing, (6) lines per inch.
              aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
              bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb

= line spacing, (10) lines per inch.
              aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
              bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb

= line spacing, (12) lines per inch.
              aaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaaa
              bbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbbb
```

Changing Character Size (Graphic Size Select)

You cannot scale characters with the graphic size select (GSS) sequence, because there are no font files currently available that allow scaling. However, you can use the graphic size modification (GSM) sequence to select a different-size font from the fonts available in the type family.

In the following example, a soft terminal reset (STR) sequence first resets the printer (ESC [! p). When you reset the printer, you select the following initial values.

standard page size
portrait orientation
10-point, 10-pitch font from the DEC built-in-1 type family
GSS set to 100
SSU set to pixels

Then, the GSM sequence (ESC [70 ; 100 B) changes the character size. GSM changes the character width and height by percentages. The LN03 selects the closest, smaller font available in the current type family.

In this example, the character width does not change, because the width parameter is 100. The height parameter tries to select a font that is 70 percent of the current font. The height changes to 6.7 point, because 6.7 point is the closest, smaller font available in the DEC built-in-1 family.

You enter:

```
<ESC>[!p
This is a sample of  type before GSM.

<ESC>[70;100 B   This sequence results in the font height
                 being changed to 6.7 point (approximately 70%
                 of its normal height) which is available in the
                 font family.
```

The LN03 prints:

```
This is a sample of  type before GSM.

   This sequence results in the font height
                being changed to 6.7 point (approximately 70%
                of its normal height) which is available in the
                font family.
```

Selecting Portrait or Landscape Printing

You use the page format select (PFS) sequence to select portrait or landscape printing. There are 12 standard page formats, 6 in portrait and 6 in landscape. Even parameter values select portrait orientations and the odd values select landscape orientations.

Each PFS value also selects a fixed printing area, including form length and margins. The PFS form length and margins do not change, until you send another PFS or one of the following sequences.

Set lines per physical page (DECSLPP)
Set left and right margains (DECSLRM)
Set top and bottom margins (DECSTBM)

You must select the lines per inch and characters per inch, if you want to change the initial values in effect when the printer is reset.

In the following example, a soft terminal reset (STR) sequence resets the printer after each PFS sequence.

You enter:

```
<ESC>[5i<ESC>[1 J This sequence selects portrait orientation (normal
format).<ESC>[1;p<FF><FF>

<ESC>[1 J This sequence selects landscape orientation (normal format.)
<ESC>[1p<FF><FF>

<ESC>[?3I J This sequence selects portrait orientation. (extended DEC format).
<ESC>[1p<FF><FF>

<ESC>[?2I J This sequence selects landscape orientation (extended DEC format).
```

Font Files

You use the following sequences to control font files.

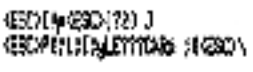
Down-line-load font (DECLFF)
Assign font (DECATFF)
Select font (SGR)
Delete font (DECDTFF)

NOTE: Before you make changes to font files, you should print a status sheet to see what font files are currently available in the printer.

Load a Font File (DECLFF)

This is an example of how to use DECLFF to load a new font file in your printer. The first two sequences are STR and PFS.

You enter:



In the above example, the DECLFF sequence selects the following settings.

0	indicates the font file is in DEC Font File Format.
1	indicates not to print a summary sheet.
1	indicates to replace any font file in the printer that has the same font file ID as the font file being loaded.
IE???CXRd	is the sixel data for the font file.
0	indicates there are no comments. You can include comments, but the LN03 ignores them.

Assign a Font File (DECATFF)

This is an example of how to use DECATFF to assign fonts for printing. You must use this sequence to assign an SGR number to a font file. To use DECATFF, you must know the type family ID (7 characters) or the font ID (16 characters) of the font file.

The following example shows both ways to assign a font file—with the font ID and with the type family ID. The first sequence assigns an elite font in a specific type size and pitch. (ESC [14 m selects the elite font for printing.) The second sequence selects assigns the elite font family, which may have several type sizes and pitches available.

You enter:

```
[illegible] = This sequence assigns the font to SGR 14
by using the "Font ID".[illegible]

[illegible] = This sequence assigns the font to SGR 14 by
using the "type family ID".
```

The LN03 prints:

```
 = This sequence assigns the font to SGR 14
by using the "Font ID".

 = This sequence assigns the font to SGR 14 by
using the "type family ID".
```

NOTE: To print text in the assigned font, you must select the font as follows.

Select a Font File (SGR)

This example shows how to use SGR to select a font for printing. You can select one of the fonts assigned an SGR number from 10 to 19. If you do not select a font with SGR, the LN03 uses the default font assigned at power-up or after a reset sequence.

This example selects the elite font assigned to SGR 14 in the previous example.

You enter:

```
ESC[!!This sequence selects the font assigned to SGR 14 to be used for
printing.
```

The LN03 prints:

```
This sequence selects the font assigned to SGR 14 to be used
for printing.
```

Delete a Font File (DECDTFF)

This example shows how to delete font files with DECDTFF, using either the type family ID or font file ID. When you use the type family ID, you delete all the font files for that family. When you use the font file ID, you delete a specific file.

In the following example, the first sequence use a type family ID for the elite family. The second sequence deletes a specific elite font file.

NOTE: You can print a summary sheet to check that a file is deleted.

You enter:

```
ESC[P1;KELITE0;KESC\ This sequence deletes the Elite family of files stored
in the printer.

ESC[P1;KELITE0;1234567890123456789012345678901;KESC\ This sequence deletes one \
specific font file. You must use the 31 character "font file id".
```

The LN03 prints:

```
This sequence deletes the Elite family of files stored
in the printer. print summary sheet and replace all font files

This sequence deletes one \
specific font file. You must use the 31 character "font file
id".
```

Designating and Invoking a Character Set

To print characters, you use one font and one character set. The font selects the type style, and the character set contains the characters to print in that style. You can select any of the fonts and character sets available in the printer.

1. First, select a font (unless you want to use the default font).
2. Then designate and invoke a character set.

The following example selects a font, then designates and invokes two character sets.

You enter:

```
<ESC>[13m (courier 10 point /10 pitch) <ESC>(B (designate ASCII as G0)
invoke G0 to GL.  <ESC>(0 (change the character set to VT100 as G0)
  abcdefg  <ESC>[0m reset
```

The first sequence selects a courier font file (SGR 13) by type family. The second sequence designates and invokes the ASCII character set into the printer's GL memory table. Notice that the LN03 prints characters from the ASCII set until the third sequence.

The third sequence designates and invokes the VT100 line drawing character set into the GL memory table. The LN03 then prints characters from the VT100 line drawing set. The VT100 line drawing characters replace the lowercase letters typed in.

```
 (courier 10 point /10 pitch)  (designate ASCII as G0)
invoke G0 to GL.  (▒▒▒
```

Highlighting Characters (SGR)

You can use the select graphic rendition (SGR) sequence for bolding, italics, underlining, and strike-through characters.

To use bolding or italics, you must have a bold or italic font file in the printer. If you select bolding and there is no bold font available, the LN03 performs shadow printing. If you select italics and there is no italic font available, the printer underscores each character.

An SGR sequence remains in effect until you send another SGR sequence.

NOTE: In the following examples, the LN03 is first reset. Resetting the printer selects the standard page size, portrait printing, and the 10-point, 10-pitch font from the DEC built-in-1 family.

Bolding

This example shows how to use SGR for bolding. The example has five escape sequences.

You enter:

```
[illegible] BOLDED CHARACTERS USED BY SGR ASSIGNMENT
WITH CG TIMES FONT. [illegible] BUILT IN FAMILY. [illegible]bold bold on
and off.
```

The LN03 prints:

BOLDED CHARACTERS USED BY SGR ASSIGNMENT WITH CG TIMES FONT. BUILT IN FAMILY. **bold** bold on and off.

The first sequence assigns a bold font to SGR 15 for printing. The second sequence selects SGR 15 for printing. Notice that the LN03 prints some bold words in that font.

The third sequence selects the DEC built-in-1 type family. The fourth sequence turns bold printing on. However, the DEC built-in-1 family does not have a bold font. So the LN03 prints the word "bold" by using shadow printing. The fifth sequence turns bolding off.

Italics

This example shows how to use SGR for italics. The example has five escape sequences.

You enter:

```
<ESC>P1;1|0;1STHIS IS AN EXAMPLE OF THE USE OF\<ESC>[1m THIS IS AN EXAMPLE OF THE USE OF
SGR FOR ITALICS. <ESC>[10m <ESC>[3m italics <ESC>[23m "italics on and off"
<ESC>[10m
```

The LN03 prints:

THIS IS AN EXAMPLE OF THE USE OF
SGR FOR ITALICS. italics "italics on and off"

The first sequence assigns an italic font to SGR 14. The second sequence selects SGR 14 for printing. Notice that the LN03 prints text in italics, until the third sequence.

The third sequence selects the DEC built-in-1 family. The fourth sequence turns italic printing on. However, the DEC built-in-1 family does not have an italic font. So the LN03 underlines characters instead. The fifth sequence turns italic printing off.

Underlining

This example shows how to use SGR for underlining. The example has two escape sequences.

You enter:

```
<ESC>[4m underline on <ESC>[24m underline off.
```

The LN03 prints:

underline on underline off.

The first sequence turns underlining on. Notice that the LN03 also underlines spaces also. The second sequence turns underlining off.

Strike-Through

This example shows how to use SGR to print strike-through characters. The example has two escape sequences.

You enter:

```
CSI1m examples of type with strikethrough on CSI22m strikethrough turned off.
```

The LN03 prints:

~~examples of type with strikethrough on~~
strikethrough turned off.

The first sequence turns the strike-through attribute on. Notice that the LN03 prints strike-through characters in spaces also. The second sequence turns the strike-through attribute off.

GLOSSARY

Active column
The horizontal position on the paper where the next character will print. After printing a character, the printer increments the active column.

Active line
The vertical position on the paper where the next character will print. After printing a character, the printer increments the active line.

Active position
The absolute position on the paper where the next character will print. The active position is defined by the active column (horizontal position) and active line (vertical position).

ANSI
American National Standards Institute

Autowrap mode
An operating feature of the printer that lets you control what happens to print characters that exceed the right margin on the page.

Baud rate
The speed at which the printer communicates with the host computer.

Character attribute
A feature of a highlighted character. You can select underlining, bold printing, italic printing, and strike-through attributes.

Character cell
An imaginary rectangle used as a unit of spacing. The height of a cell is equal to the current line spacing, and the width is equal to the current character spacing.

Character set
A set of codes that describe the general appearance of a set of characters. For example, a character set might contain the code for an uppercase A or the number 1. Character sets do not describe the style of a printed character. See *Font*.

Code table
A list of the characters and codes for a specific character set. The table is divided into columns and rows that show each character with its binary, octal, decimal, and hexadecimal code. An 8-bit code table has twice as many columns as the 7-bit table.

Command string
A data record included in a device control string. Examples are a type family identification or font identification.

Configuration switch packs
Two 6-position DIP switch packs on the back of the printer that control certain operating features. The switches are preset to work with most Digital systems. You can set these switches to meet the requirements of your host computer.

Control characters
Characters that do not print, but cause the printer to perform some action. For example, the HTS control character sets a horizontal tab. There are two groups of control characters, C0 and C1.

C0 (control 0) and C1 (control 1) codes
C0 codes represent 7-bit ASCII control characters. C1 codes represent 8-bit control characters that let you perform more functions than possible with C0 codes. You can only use C1 codes directly in an 8-bit environment.

Control function
A method of controlling how the printer processes, sends, and prints characters. Control functions include control characters, control strings, and escape and control sequences. Appendix C compares the control functions used in the LN03 printer and other Digital printers.

Control sequence
Two or more bytes that define a specific control function. Control sequences usually include variable parameters. Paragraph 3.4.3 shows the format for a control sequence.

Decipoint
A unit of measure equal to 1/720 inch.

DEC multinational character set
This 8-bit character set is the default character set when you turn the printer on. The left half of this set is the ASCII graphic set (7-bit compatible). The right half includes the C1 control characters and DEC supplemental graphic set (8-bit compatible).

Default values (for escape sequences)
Standard values used for parameters. The printer uses a default value when you specify a 0 value or omit a value. For most sequences the default value is 1.

Device control strings (DCS)
Like control sequences, a DCS uses two or more bytes to define a specific control function. However, a DCS also includes a command string. Paragraph 3.4.4 shows the format for a device control string.

Down-line-loading
Loading data from a host computer into another device. You can load fonts from a computer into the printer. The printer stores these fonts in RAM.

Error code
A numeric code of up to three digits, used to report printer problems. The printer reports error codes in pairs – a generic code, followed by a specific code. Table 5-6 lists the error codes.

Escape sequence
Two or more bytes that define a specific control function. Escape sequences do not include variable parameters, but may include intermediate characters. Paragraph 3i4.2 shows the format for an escape sequence.

Font
A size and style of type to use for printed characters. For example, a courier 10 point font describes a certain style (courier) and size (10 point) of printed character. Fonts and character sets are independent of each other. You need both a font and a character set to print characters.

Font attributes
The seven characteristics of a font that define how printed characters will look when you use that font: type family, spacing, type size, scale factor, typestyle, character weight, and character proportion. These attributes are not affected by the character set you use.

Font file
The data for a unique combination of one font and one character set. You can assign a font to any character set available in the printer. The font files that come with the printer are stored in ROM. If you load other font files from the host, they are stored in RAM. Font files must be in a standard Digital format.

Font file attributes
A set of 12 characteristics for the font and character set in a given font file. These include the seven font attributes plus the character set images, rotation, character subset, file encoding, and resolution.

Font ID
A 16-character code (no lowercase letters) that describes the seven basic font attributes (including type family) of the ROM fonts.

Font file ID
A 31-character code that describes the character set and font attributes for a given font file. Appendix D lists all standard type family, font, and font file IDs for the ROM font files.

Form length
The vertical size of the printed area on a page. The maximum form length depends on the setting of the paper size switch, the origin point for page coordinates, and the page orientation.

GL (graphic left) and GR (graphic right) codes
Two code tables in memory, reserved for printable characters. You store the character sets you want to print from in GL and GR.

The printer uses the graphic left (GL) table in memory when the character code format is 7-bit, or when the the character code format is 8-bit and the graphic characters are in the 2/1 through 7/14 range.

The printer uses the graphic right (GR) table in memory when the character code format is 8-bit and the graphic characters are in the 10/0 through 15/15 range.

Hard margin
A setting that defines the printing area on the page. The printer cannot print outside a hard margin, except when drawing vectors or doing justification.

Horizontal margin
The *left horizontal margin* specifies the first printable position on a line. The *right horizontal margin* specifies the last printable position on a line.

Image area
The printable part of a page. On the LN03 (and most printers), you cannot print to the physical edge of the page.

Input buffer
An area in the printer that can hold up to 1,000 characters received from the host computer before printing them. This buffer allows the printer and host computer to communicate independent of printing speed.

Initial values (for escape sequences)
The LN03 has permanently stored values for some escape sequences that control basic printing functions. The printer uses these initial values after you power up the printer or send a reset sequence (Paragraph 6.12).

ISO
International Standards Organization

Justification
The alignment of printed text at the right margin. When you justify text, you change the spacing between words. Justified lines have the first character of the first word at the left margin (or the line home position, if different), and the last character of the last word at the right margin.

Landscape printing
A method of printing characters parallel to the long edge of the paper.

Line home position
The active position on the printed page after a carriage return (CR). The line home position serves as the left edge of the page for justified text. A CR may move the active position forward or backward in order to reach the line home position.

Line end position
The right edge of the printed page for justified text.

Memory cartridges
Optional ROM cartridges (for added fonts) or RAM cartridges (for added storage). You can insert cartridges in the printer's front panel.

Origin
The starting point for printing on the page. You can select either the corner of the printable area or the corner of the physical page (Figure 5-4).

Normal page format
The page home line is 1/2 inch below the top margin and the page end line is 5/6 inch above the bottom margin.

Extended page format
The page home line is at the top margin and the page end line is at the bottom margin.

Page format select (PFS)
An escape sequence that lets you select a page format from a list of standard formats. These formats select the character size, characters per line, and lines per page.

The active line on the page after a form feed (FF). The page home line specifies where a form feed positions the first printable line on the page.

Page end line
Usually, the last printable line on a page. When the printer receives a line feed (LF) on the page end line, the active position moves to the page home line on the next page.

Parameter
A character that modifies the action or interpretation of a control sequence. All parameters are unsigned, positive decimal integers, with the most significant digit sent first.

- A *numeric parameter* indicates a numeric value such as a tab or margin location. In this manual, numeric parameters appear as actual values or as Pn, Pn1, Pn2, and so on.
- A *selective parameter* selects an action associated with the specific parameter value. In this manual, selective parameters appear as Ps, Ps1, Ps2, and so on.

Pixel
The smallest displayable picture element on a video screen. The printer prints pixels as dots.

Portrait printing
A method of printing characters parallel to the short edge of the paper. This is the normal page orientation for printing. For example, this page is printed in a portrait orientation.

RAM
Random access memory

Received characters
Printable characters and control functions that the printer receives from the host computer. The printer can process 7-bit and 8-bit data.

Reset sequence

An escape sequence that resets several printer operating features to an *initial state*. There are two sequences you can use to reset the LN03 (Paragraph 5.13).

Resolution
The number of dots printed in a defined area. The resolution of the LN03 is 300 dots per inch.

ROM-resident fonts
The standard fonts that come with the printer. These fonts are permanently stored in the printer's read only memory (ROM). Paragraph 1.3 lists these fonts.

Select graphic rendition (SGR) number
A number you must assign to a font file to make it available for printing (Paragraph 4.4.2).

Serial character format
The sequential arrangement of the bits of a data character. The printer sends and receives characters in this format. A serial character has a start bit (space), 7 or 8 data bits (1 = mark, 0 = space), a selectable parity bit, and a stop bit (mark). Figure 2-1 shows this format.

Tab stop
A preselected point that the active position moves to when you send the printer a tab control character (Paragraph 3.3). The active position is where the next character prints.

Type family
A group of fonts with a similar design, but differing in the six other *font attributes*. For example, courier is a type family used in the LN03.

Type family ID
A 7-character code that identifies a given type family. For example, here are the type family IDs for the four standard type families used with ROM-resident font files.

Type Family	Identification
Courier	RCOURIR
Elite	RELITEO
DEC builtin	DBULTN1
PI font	D000000

Vectors
Lines drawn with length, width, and direction. Margins do not affect line drawing. If you try to draw a line beyond the physical limits of the page, the printer will print the part of the line that occurs within the page. The printer draws lines without modifying the active position.

Vertical margin
The top vertical margin specifies the first printable line on a page.

The bottom vertical margin specifies the last printable line. These margins are called *hard margins*, because you cannot print outside the area defined by the margins.

XON/XOFF protocol
A method of synchronizing data communication between the printer and the computer. The printer sends XON AND XOFF signals to tell the computer when to start or stop sending data. The XON/XOFF protocol prevents the printer's *input buffer* from overflowing. Otherwise, you might lose data if the printer stops for some reason (a paper-out condition, for example) or if the communication speed is greater than the print speed.

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