EK-LP100-RM-001

Letterprinter 100 Programmer Reference Manual

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Letterprinter 100 Programmer Reference Manual

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INTRODUCTION

The Letterprinter 100 User Documentation Packages cover all of the Letterprinter 100 model terminals. This documentation is written for three general audiences:

- the hardware installer requiring specific installation and checkout information,
- the operator requiring general operating information,
- the applications programmer requiring interface and control function descriptions.

The documentation for the Letterprinter 100 is divided into three books:

- Installation Guide
- Operator Guide
- Programmer Reference Manual

The interface and character processing information you will need for your Letterprinter 100 terminal is described in this manual. The programmer writing application software should use this manual as a reference.

As the following chapter titles indicate, the emphasis in this manual is on the communication and character processing features of the Letterprinter 100 terminals.

Chapter 1 Communication -- describes the terminal interface and communication features.

Chapter 2 Character Processing -- generally describes the terminal response to printable characters, control characters, escape sequences, and control strings.

Chapter 3 Escape and Control Sequences -- describes in detail the Letterprinter 100 escape and control sequences.

Chapter 4 ANSI Control Strings -- describes how the Letterprinter 100 processes ANSI control strings. Describes in detail answerback message encoding and graphics processing.

WARNINGS, CAUTIONS, AND NOTES

In this manual, the warnings, cautions, and notes are used for specific purposes: warnings are used to highlight information used to prevent personal injury; cautions highlight information used to prevent damage to the terminal; and notes are used to highlight general information.

CHAPTER 1
COMMUNICATION

GENERAL

The Letterprinter 100 communication interfaces and terminal communication features are described in this chapter. These features are used to configure the Letterprinter 100 terminals to operate with specific computers. The methods of controlling data received by these terminals to avoid input buffer overflows are also described.

SERIAL CHARACTER FORMAT

The Letterprinter 100 communicates using serial characters (Figures 1-1 and 1-2). The serial character format for the terminal must match the character format used by the computer. Serial characters are transmitted from the Letterprinter 100 to the host using a start bit, 7 or 8 data bits, an optional, selectable parity bit and 2 stop bits.

Serial characters are received by the Letterprinter 100 using 1 start bit, 7 or 8 data bits, an optional, selectable parity bit and 1 stop bit.

Stop bits are a minimum guaranteed idle time between two characters. Your Letterprinter 100 Terminal will communicate without difficulty with any equipment requiring two or less stop bits in the terminal-to-host direction and one or more stop bits in the host-to-terminal direction.

When sending characters, your Letterprinter Terminal will always transmit two idle bit times between characters so that slower equipment can cope.

NOTE: Two idle bit times is a guaranteed minimum; the actual idle time may be far larger than two bit times. Because your Letterprinter 100 Terminal will not transmit more than 60 characters per second, at any baud rate greater than 600, the idle time between two characters when transmitting in the terminal-to-host direction will always be significantly larger than two bit times.

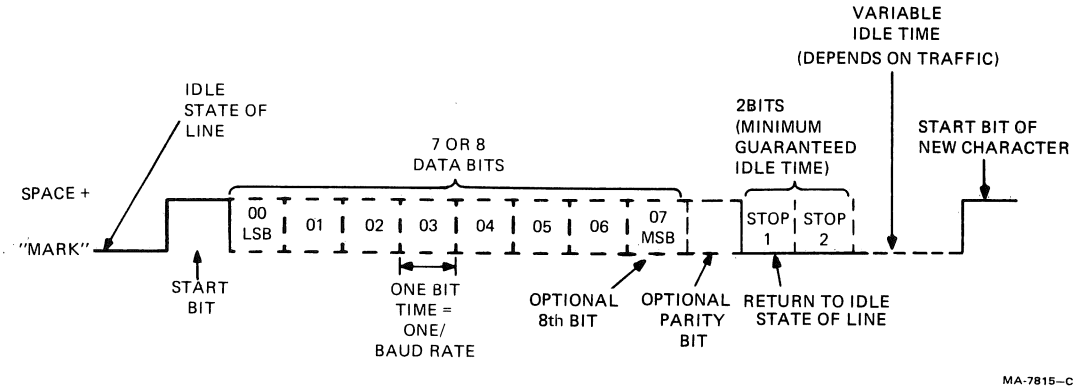

Figure 1-1 Serial Character Format in Terminal-to-Host Direction

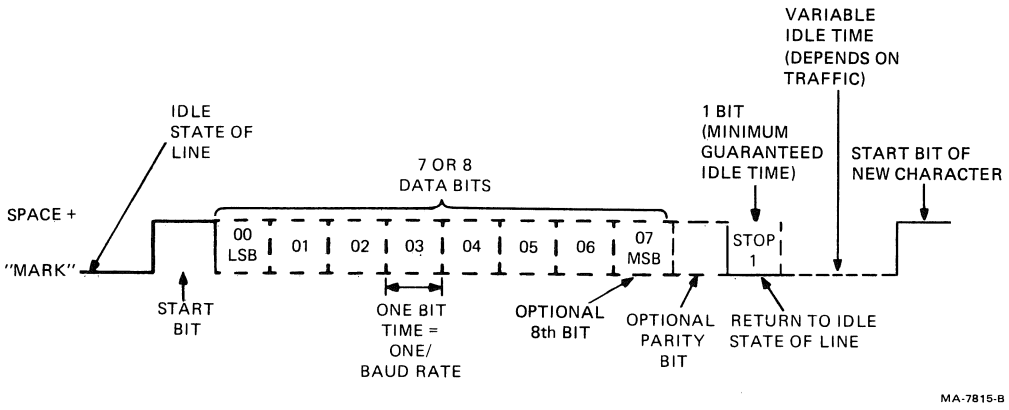

Figure 1-2 Serial Character Format in Host-to-Terminal Direction

When receiving characters, your terminal can accept data separated by only one idle bit time.

NOTE: One idle bit time is a minimum requirement; the actual idle time may be far larger.

NOTE: If you are using the LA1ØX-ED Parallel Interface option, refer to the option installation guide for character format information.

The data bits represent a 7 or 8 bit character, least significant bit leading. The parity bit is operator-selectable. For more detailed information, refer to the Letterprinter 1ØØ Operator Guide.

BREAK SIGNAL

A break signal is a transmitted space condition for Ø.275 seconds ±1Ø percent. The computer response to the break signal depends on the computer and the software used. If selected, your Letterprinter 1ØØ sends a break signal when a paper fault occurs.

EIA INTERFACE INFORMATION

The Letterprinter terminal operates on full-duplex, asynchronous communication lines. The EIA interface connector is a DB-25 male 25-pin connector mounted on the back of the terminal (see Figure 1-3). The terminal EIA interface signals meet the EIA specification requirements RS-232-C and the Consultative Committee on Telephony and Telegraphy (CCITT) recommendation V.24.

NOTE: The 2Ø mA current loop interface makes it possible to connect your terminal directly to a computer up to 3ØØ m (1ØØØ ft) away without the use of a modem.

The EIA connector signals are summarized in Table 1-1. Each signal, as used by the Letterprinter terminal, and the effects that the communication features have on the EIA control signals are also discussed in this section.

Protective Ground (PGND) -- Pin 1

This circuit is connected to the chassis of the terminal. It is also connected to external grounds through the third wire of the power cord.

Transmitted Data (TXD) -- Pin 2

Direction: From terminal

Signals on this circuit represent serially encoded characters that are generated by the terminal.

Received Data (RXD) -- Pin 3

Direction: To terminal

Signals on this circuit represent serially encoded characters that are generated by the user's equipment.

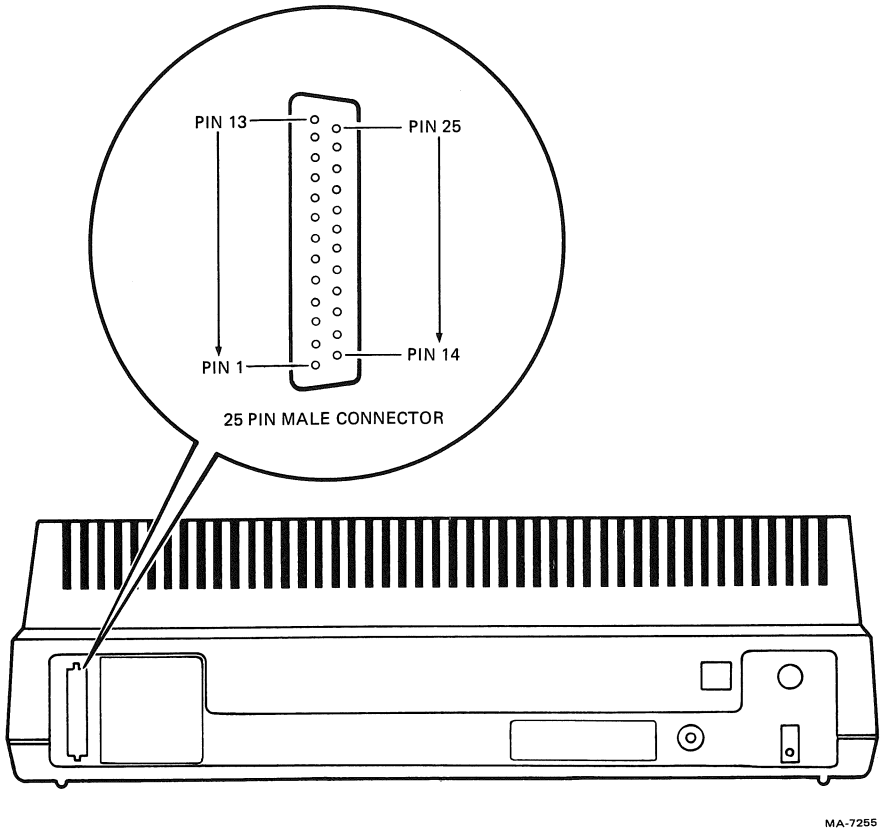

Figure 1-3 EIA Connector

Table 1-1 EIA Interface Signals

Pin	Name	CCITT/EIA Mnemonic	Designation	Source
1	Protective Ground	PGND	101/AA	
2	Transmitted Data	TXD	103/BA	LA100
3	Received Data	RXD	104/BB	User
4	Request to Send	RTS	105/CA	LA100
5	Clear to Send	CTS	106/CB	User
6	Data Set Ready	DSR	107/CC	User
7	Signal Ground	SGND	102/AB	
8	Receive Line Signal Detect	RLSD	109/CF	User
9	No Connection			
10	No Connection			
11	Restraint	BUSY		LA100
12	Speed Indicator	SPDI	CI	User
13	No Connection			
14	No Connection			
15	No Connection			
16	No Connection			
17	No Connection			
18	No Connection			
19	Secondary Request to Send	SRTS	120/SCA	LA100
20	Data Terminal Ready	DTR	108.2/CD	LA100
21	No Connection			
22	No Connection			
23	Speed Select	SPDS	111/CH	LA100
24	No Connection			
25	No Connection			

Request to Send (RTS) -- Pin 4
Direction: From terminal

When the RTS signal is on, the terminal is ready to send data.

Clear to Send (CTS) -- Pin 5
Direction: To terminal

This circuit monitors the CTS signal generated by the modem in response to RTS. With modem control selected, the Letterprinter terminal will not transmit any codes if CTS is not on. With no modem control selected, CTS is always assumed to be on.

Data Set Ready (DSR) -- Pin 6
Direction: To terminal

The DSR signal is on when the data set is ready. The terminal will not transmit or receive data until this signal is on. With no modem control selected, DSR is always assumed to be on. The DSR indicator light goes on when the DSR signal is received.

Signal Ground -- Pin 7

This circuit establishes a common ground reference potential for all interface circuits. This circuit is permanently connected to the protective ground circuit.

Receive Line Signal Detect (RLSD) -- Pin 8
Direction: To terminal

The RLSD signal is an indicator that the modem has received the data carrier signal. Your terminal will not receive data until this signal is on. With no modem control selected, RLSD is always assumed to be on.

Restraint (BUSY/READY) -- Pin 11
Direction: From terminal

With the restraint signal selected, the on condition of BUSY indicates that the computer should temporarily stop sending data. When BUSY goes off, the computer can resume sending data.

Speed Indicator (SPDI) -- Pin 12
Direction: To terminal

With speed mode disabled, your terminal ignores SPDI and operates at the operator selected baud rate. With the speed mode selected, your terminal operates at the operator selected baud rate when SPDI is off. However, your terminal will operate at 1200 baud ragardless of the rate you selected when SPDI is on. This feature is useful when using variable speed modems such as the Bell 212-A.

Secondary Request to Send (SRTS) -- Pin 19
Direction: From terminal

Same as Restraint (pin 11)

Data Terminal Ready (DTR) -- Pin 20
Direction: From terminal

When the DTR signal is on, your terminal is capable of receiving data. When DTR is off, your terminal is processing a disconnect, or the terminal is local.

Speed Indicator (SPDS) -- Pin 23
Direction: From terminal

With the speed mode selected, and the receive baud rate of your terminal at 1200 baud or higher, the terminal turns SPDS on. Otherwise SPDS is kept off.

EIA CIRCUIT JUMPERS
For special applications you can physically disconnect the following EIA circuits by removing a jumper:

Protective Ground -- EIA connector Pin 1
Busy -- EIA connector Pin 11
Speed Indicator -- EIA connector Pin 12
Secondary Request to Send -- EIA connector Pin 19
Speed Select -- EIA connector Pin 23

When any of the EIA circuit jumpers are removed, the loopback control line test fails. Refer to the jumper removal procedure in the Installation Guide before removing any of the EIA circuit jumpers.

CONNECTING THE LETTERPRINTER 100 TO THE COMPUTER

You can connect the Letterprinter 100 terminal to a computer directly or through a common carrier facility (telephone line) as shown in Figure 1-4. The EIA interface or optional 20 mA current loop interface can be used in both applications.

To connect your terminal to a computer through a telephone line, you will need a modem (data set). The modem changes the serial characters transmitted between the terminal and the computer into signals that can be transmitted over the telepone lines. Several types of modems can be used with your Letterprinter 100 terminal. However, the modem you select must be compatible with the modem used by the computer.

NOTE: Some modems do not permit 8 data bits plus parity; they either permit 7 data bits plus parity or 8 data bits and no parity. Therefore, it is important to check the compatibility of your Letterprinter terminal and the modem settings.

Your terminal must also be compatible with the computer and the communication system. Operator-selectable communication switches are used to achieve this compatibility for the Letterprinter 100. Refer to the Letterprinter 100 Operator Guide for more details.

MODEM CONTROL

When on-line, the Letterprinter 100 is connected to the communication line and is capable of receiving and sending data. It communicates with EIA compatible devices on full-duplex asynchronous communication lines.

Your terminal supports two basic types of full-duplex communication -- with and without modem control. Both methods permit data to be transmitted and received at the same time. When you select full-duplex with no modem control, data transmission and reception is always enabled when not in local. Full-duplex with modem control requires that both your terminal and the modem recognize the proper EIA signals before transmitting data. Table 1-2 shows the effects that the modem/no modem feature has on the EIA control signals.

When you select no modem control, the terminal allows you to communicate directly with a computer (null modem configurations) or with full-duplex modems that do not support DSR (data set ready) or RLSD (receive line signal indicator).

Modem control permits your terminal to communicate through modems such as the Bell 103, the 212, the Vadic 3400, or equivalent modems.

NOTE: The terminal must be set to no modem control when operating with the 20 mA current loop communication option.

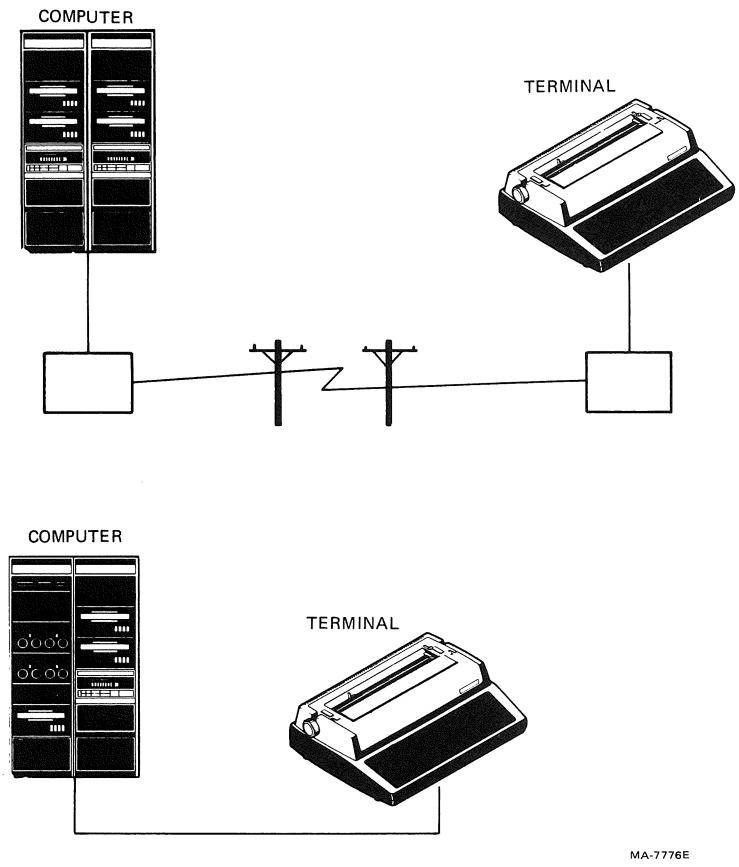

Figure 1-4 Connecting the Letterprinter 100 to the Computer

Table 1-2 Modem Control Effects on EIA Signals

EIA Signal	No Modem	Modem Control
DTR	active	active
RTS	active	active
TXD	active	active
RXD	active	active
DSR	inactive	active
CTS	inactive	active
RLSD	inactive	active

Key

OFF	Signal off at EIA connector
Active	Signal turns on or off depending on terminal state.
On	Signal on at EIA connector
Inactive	Signal ignored at EIA connector but terminal internally forces signal on.

FULL-DUPLEX DISCONNECT

A full-duplex disconnect is performed by the terminal by turning DTR (Data Terminal Ready) off for at least Ø.2 seconds plus the DSR (data set ready) delay time, but not longer than 2 seconds. The following conditions cause a full-duplex disconnect:

- DSR turns off after DTR is on
- RLSD turns off for more than two seconds
- Wrong number time out (DSR is on, then RLSD does not turn on within 2Ø seconds)
- If the paper fault switch is set to disconnect and a paper out condition occurs
- If your Letterprinter terminal is switched to local
- EOT control character received while coded disconnect is enabled.

INPUT BUFFER OVERFLOW PREVENTION

When your Letterprinter 1ØØ terminal receives a character (other than the NUL and DEL characters), it stores the character in its 4ØØ* character input buffer. When your terminal is ready, the characters are removed from the input buffer and printed. If the terminal falls behind by more than 4ØØ characters, the input buffer overflows. If an overflow occurs, the character is lost; a single SUB character is placed in the input buffer and the bell tone sounds.

There are three ways you can avoid input buffer overflows.

1. Use the XON/XOFF or restraint feature to signal the data source when to temporarily stop or to resume sending data. Using the XON/XOFF or restraint feature allows maximum throughput and eliminates the need for fill character calculations and message size limits. These features are explained in detail later in this chapter.

2. Send data only as fast as it can be printed. When receiving data at 24ØØ baud or less while in the low density mode or 3ØØ baud or less while in the high density mode, your terminal can keep up with the character reception. However, short lines and multiple form feeds are not processed this rapidly. Characters received at rates greater than 24ØØ baud cannot be processed as rapidly either. In such instances, you can use fill characters to slow down the effective data transmission rate. You will find fill time formulas in the following section entitled "Fill Time Formulas."

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* Note: When using the LA1ØX-EB 4K buffer option, this number is 4Ø96.

3. Limit the number of characters in the message to the input buffer size of your terminal. If the buffer is empty at the beginning of the transmission, the terminal can receive a message of 400* characters without a buffer overflow.

XON/XOFF and Restraint

The XON/XOFF and restraint features are used to prevent input buffer overflows. When you select the XON/XOFF and/or the restraint signal, your terminal constantly monitors the number of characters stored in the input buffer. The terminal signals the computer to stop sending data (sends XOFF control character or sets the BUSY signal to on) when any of the following conditions occur:

- Number of characters in the input buffer exceeds 200* characters
- Terminal transmits XOFF and then receives 60 characters.

The terminal signals the computer to resume data transmission (sends XON control character or sets the BUSY signal to off) when any of the following conditions occur:

- When the number of characters in the input buffer is less than 30 characters
- When the terminal is switched on-line (or powered up on-line).

XON/XOFF and restraint signal are operator-selectable features. Refer to the Letterprinter 100 Operator Guide for more details.

Fill Time Formulas

When receiving data at 2400 baud or less, your terminal can keep up with normal character reception. Short lines and multiple form feeds cannot be printed this rapidly. However, you may use fill characters. Fill characters do not enter the input buffer; they are stripped out of the data stream upon reception.

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* Note: When using the LA10X-EB 4K buffer option, this number is 3584.

The Letterprinter 100's printhead and form movements (horizontal and vertical) are directly related to the fill time required to slow down the effective data transmission rate. The fill time required to compensate for these movements can be converted to the number of fill characters needed using the following formula.

$$\text{Number of Fill Characters} = \frac{\text{Fill Time Required}}{\text{Character Execution Time}}$$

NOTE: NUL is the only recommended fill character even though some other characters may seem to achieve the same result in special cases.

Determining Fill Time Required

You can determine the required fill time for horizontal movement (including tabs and positioning sequences) in the following way.

First, determine the actual number of columns moved. Then, allow 15 ms for each of the first 10 columns (30 ms in double-width pitches: 5, 6, 6.6, 8.25) and 5.5 ms for each additional column (11 ms in double-width pitches).

You can determine the required fill time for vertical movement (includes line feeds, vertical tabs, form feeds, and vertical positioning sequences) in the following way.

First, convert the number of lines moved to actual distance moved using the following formula.

$$\text{Inches Moved} = \frac{\text{Number of Lines Moved}}{\text{Vertical pitch}}$$

Then allow 38 ms for the first line moved up 1/6 inch, and 200 ms for each additional inch.

Character Transmission Time

The character transmission time is given in milliseconds and is based on a given baud rate. It is the time it takes to transmit a character to the terminal. Character transmission times at the applicable baud rates are shown in Table 1-3.

Table 1-3 Character Transmission Times

Baud Rate	Transmission Times (msec)
110	90.0
300	33.3
600	16.6
1200	8.3
1800	5.5
2400	4.1
4800	2.0
9600	1.0

NOTE: Character transmission times are provided for calculation of fill times only.

Fill Time Formula Examples

1. Horizontal movement
Assumed values: Baud Rate = 1200, Horizontal Pitch = any single width pitch (10, 12, 13.2, 16.5). Also assume that horizontal tab stops are set at columns 9, 17, and 25 and printing begins at column 9. If the next two characters received are TAB TAB, calculate the number of fill characters required in the following way.

   First, calculate the number of columns moved using the following formula.

   Final column - Current Column = Number of Columns Moved

   $$25 - 9 = 16$$

   Then allow 15 ms per column for the first 10 columns and 5.5 ms per column for the remaining columns.

   15 ms X 10 = 150 ms
   5.5 ms X 6 = 33 ms
   150 + 33 ms = 183 ms

   The fill time required is 183 ms.

   Next, divide the fill time required by the character transmission time found in Table 1-3.

   $$\text{Number of Fill Characters Required} = \frac{183 \text{ ms}}{8.3 \text{ ms}}$$

   The number of fill characters required is 22.04. Round this number to the next whole number, which is 23. Twenty-three (23) fill characters (NUL) should follow the two tabs.

2. Vertical Movement
Assumed values: Baud Rate = 1200 baud, Vertical Pitch = 6 lines per inch and paper is set to line 10. Also assume that the next characters received are nine line feeds.

   First, calculate the actual distance moved using the following

   $$\text{Number of Inches Moved} = \frac{\text{Lines moved}}{\text{Vertical Pitch}}$$

   $$11/2 \text{ inches} = \frac{9}{6}$$

Then allow 38 ms for the first 1/6 inch moved and 200 ms for the remaining number of inches moved.

200 ms X 1 2/6 inches = 266 ms
266 ms + 38 ms = 304 ms
The fill time required is 304 ms.

Next, divide the fill time required by the character transmission time found in Table 1-3.

$$\text{Number of fill characters required} = \frac{266 \text{ ms}}{8.3 \text{ ms}}$$

The number of fill characters required is 32.04. Round this number to the next whole number, which is 33. Thirty-three (33) fill characters (NUL) should follow the nine line feeds.

CHAPTER 2
CHARACTER PROCESSING

GENERAL

The response of your Letterprinter 100 Terminal to character reception is described in this chapter. The Letterprinter 100 processes characters in accordance with the following standards from the American National Standards Institute (ANSI): X3.64--1979, X3.4--1977, and X3.41--1974. The ANSI system defines a standard character chart shown in Figure 2-1. Figure 2-1 shows each character with its binary, octal, decimal and hexadecimal values.

NOTE: The character chart corresponds to the International Standards Organization (ISO) Standard 646, and the Consultative Committee for International Telephony and Telegraphy (CCITT) ALPHABET 5.

The terminal processes a received character based on the type of character as defined by ANSI. The position of the character in the character chart determines the type of character as either a printable character or control character.

In addition to the printable characters and control characters, this section defines escape and control sequences. These sequences are used to provide additional controls.

Previous DEC terminals functioned with 7 data bits only. The 8th bit when present either was ignored or set to an irrelevant value. Your Letterprinter 100 Terminal, however, can function in a full 8-bit mode with a repertory of 256 character codes. It can also function in the 7-bit mode (128 codes) if necessary.

CHARACTER HANDLING

A character sent from the computer to the terminal, first goes through the application program, then through the terminal handler of the computer, then through the character processor of the terminal, then finally creates a terminal action.

To know exactly what action is caused by a character sent from your application program, you have to make sure that all of the following parts of the system are set properly:

Application program
Transmitting part of the terminal handler
Receiving part of the terminal
General terminal settings

To set the terminal, refer to this book and the Letterprinter 100 Operator Guide; to set the terminal handler, refer to your operating system guide; to set the application program, refer to your application guide.

For example:

A form feed control character (octal 014) sent from the application program may not be executed by the terminal because the terminal is not set for form handling, or because the terminal handler is set to change form feeds into multiple line feeds. An escape control character (octal 033) may be changed into a dollar sign by the terminal handler or the application program.

Horizontal tab control character (octal 011) may be changed into spaces by the application program or the terminal handler, or may not be executed because no tab is set in the terminal.

Lowercase characters may be changed into uppercase characters.

CODING ENVIRONMENTS

Previous DEC terminals functioned with 7 data bits only. The 8th bit when present either was ignored or set to an irrelevant value. Your Letterprinter 100 terminal can function in this 7-bit mode with a repertory of 128 codes (Figure 2-2). The terminal can also function in a full 8-bit mode with a repertory of 256 character codes (Figure 2-1).

Character codes in the octal range of 000 to 037 are collectively known as the control set C0. Character codes in the octal range of 200 to 237 are collectively known as the control set C1. Character codes in the octal range of 041 to 176 are collectively known as the graphic set GL. Character codes in the octal range of 241 to 276 are collectively known as the graphic set GR.

Accordingly, in addition to the 7-bit GL graphic codes and C0 control codes, your Letterprinter 100 terminal can receive and process 8-bit GR graphic codes and C1 control codes. The graphic codes represent printable characters. The control characters are not printable; they start, modify, or stop terminal operation.

BITS B8 B7 B6 B5 / B4 B3 B2 B1	ROW	COLUMN 0 (0 0 0 0)	COLUMN 1 (0 0 0 1)	COLUMN 2 (0 0 1 0)	COLUMN 3 (0 0 1 1)	COLUMN 4 (0 1 0 0)	COLUMN 5 (0 1 0 1)	COLUMN 6 (0 1 1 0)	COLUMN 7 (0 1 1 1)	COLUMN 8 (1 0 0 0)	COLUMN 9 (1 0 0 1)	COLUMN 10 (1 0 1 0)	COLUMN 11 (1 0 1 1)	COLUMN 12 (1 1 0 0)	COLUMN 13 (1 1 0 1)	COLUMN 14 (1 1 1 0)	COLUMN 15 (1 1 1 1)
0 0 0 0	0	NUL 0 0 0	20 16 10	SP 40 32 20	0 60 48 30	@ 100 64 40	P 120 80 50	` 140 96 60	p 160 112 70	200 128 80	DCS 220 144 90	240 160 A0	° 260 176 B0	À 300 192 C0	320 208 D0	à 340 224 E0	360 240 F0
0 0 0 1	1	1 1 1	DC1 (XON) 21 17 11	! 41 33 21	1 61 49 31	A 101 65 41	Q 121 81 51	a 141 97 61	q 161 113 71	201 129 81	221 145 91	¡ 241 161 A1	± 261 177 B1	Á 301 193 C1	Ñ 321 209 D1	á 341 225 E1	ñ 361 241 F1
0 0 1 0	2	2 2 2	22 18 12	" 42 34 22	2 62 50 32	B 102 66 42	R 122 82 52	b 142 98 62	r 162 114 72	202 130 82	222 146 92	¢ 242 162 A2	2 262 178 B2	Â 302 194 C2	Ò 322 210 D2	â 342 226 E2	ò 362 242 F2
0 0 1 1	3	3 3 3	DC3 (XOFF) 23 19 13	# 43 35 23	3 63 51 33	C 103 67 43	S 123 83 53	c 143 99 63	s 163 115 73	203 131 83	223 147 93	£ 243 163 A3	3 263 179 B3	Ã 303 195 C3	Ó 323 211 D3	ã 343 227 E3	ó 363 243 F3
0 1 0 0	4	4 4 4	24 20 14	$ 44 36 24	4 64 52 34	D 104 68 44	T 124 84 54	d 144 100 64	t 164 116 74	204 132 84 IND	224 148 94	244 164 A4	264 180 B4	Ä 304 196 C4	Ô 324 212 D4	ä 344 228 E4	ô 364 244 F4
0 1 0 1	5	ENQ 5 5 5	25 21 15	% 45 37 25	5 65 53 35	E 105 69 45	U 125 85 55	e 145 101 65	u 165 117 75	205 133 85 NEL	225 149 95	¥ 245 165 A5	µ 265 181 B5	Å 305 197 C5	Õ 325 213 D5	å 345 229 E5	õ 365 245 F5
0 1 1 0	6	6 6 6	26 22 16	& 46 38 26	6 66 54 36	F 106 70 46	V 126 86 56	f 146 102 66	v 166 118 76	206 134 86	226 150 96	246 166 A6	¶ 266 182 B6	Æ 306 198 C6	Ö 326 214 D6	æ 346 230 E6	ö 366 246 F6
0 1 1 1	7	BEL 7 7 7	27 23 17	' 47 39 27	7 67 55 37	G 107 71 47	W 127 87 57	g 147 103 67	w 167 119 77	207 135 87	227 151 97	§ 247 167 A7	• 267 183 B7	Ç 307 199 C7	Œ 327 215 D7	ç 347 231 E7	œ 367 247 F7
1 0 0 0	8	BS 10 8 8	CAN 30 24 18	(50 40 28	8 70 56 38	H 110 72 48	X 130 88 58	h 150 104 68	x 170 120 78	210 136 88 HTS	230 152 98	¤ 250 168 A8	270 184 B8	È 310 200 C8	Ø 330 216 D8	è 350 232 E8	ø 370 248 F8
1 0 0 1	9	HT 11 9 9	31 25 19	) 51 41 29	9 71 57 39	I 111 73 49	Y 131 89 59	i 151 105 69	y 171 121 79	211 137 89	231 153 99	© 251 169 A9	1 271 185 B9	É 311 201 C9	Ù 331 217 D9	é 351 233 E9	ù 371 249 F9
1 0 1 0	10	LF 12 10 A	SUB 32 26 1A	* 52 42 2A	: 72 58 3A	J 112 74 4A	Z 132 90 5A	j 152 106 6A	z 172 122 7A	212 138 8A VTS	232 154 9A	ª 252 170 AA	º 272 186 BA	Ê 312 202 CA	Ú 332 218 DA	ê 352 234 EA	ú 372 250 FA
1 0 1 1	11	VT 13 11 B	ESC 33 27 1B	+ 53 43 2B	; 73 59 3B	K 113 75 4B	[133 91 5B	k 153 107 6B	{ 173 123 7B	213 139 8B PLD	CS1 233 155 9B	« 253 171 AB	» 273 187 BB	Ë 313 203 CB	Û 333 219 DB	ë 353 235 EB	û 373 251 FB
1 1 0 0	12	FF 14 12 C	34 28 1C	, 54 44 2C	< 74 60 3C	L 114 76 4C	\ 134 92 5C	l 154 108 6C	| 174 124 7C	214 140 8C PLU	ST 234 156 9C	254 172 AC	¼ 274 188 BC	Ì 314 204 CC	Ü 334 220 DC	ì 354 236 EC	ü 374 252 FC
1 1 0 1	13	CR 15 13 D	35 29 1D	- 55 45 2D	= 75 61 3D	M 115 77 4D	] 135 93 5D	m 155 109 6D	} 175 125 7D	215 141 8D R1	OSC 235 157 9D	255 173 AD	½ 275 189 BD	Í 315 205 CD	Ý 335 221 DD	í 355 237 ED	ý 375 253 FD
1 1 1 0	14	SO 16 14 E	36 30 1E	. 56 46 2E	> 76 62 3E	N 116 78 4E	^ 136 94 5E	n 156 110 6E	~ 176 126 7E	216 142 8E SS2	PM 236 158 9E	256 174 AE	276 190 BE	Î 316 206 CE	336 222 DE	î 356 238 EE	376 254 FE
1 1 1 1	15	SI 17 15 F	37 31 1F	/ 57 47 2F	? 77 63 3F	O 117 79 4F	_ 137 95 5F	o 157 111 6F	DEL 177 127 7F	217 143 8F SS3	APC 237 159 9F	257 175 AF	¿ 277 191 BF	Ï 317 207 CF	ß 337 223 DF	ï 357 239 EF	377 255 FF
		ASCII CONTROL SET		ASCII GRAPHIC CHARACTER SET						ADD'L CONTROL SET		DEC SUPPLIMENTAL GRAPHIC SET					

KEY

DEC MULTINATIONAL CHARACTER SET

ASCII CHARACTER: ESC — 33 OCTAL, 27 DECIMAL, 1B HEX

MA-10,087A

Figure 2-1 Standard Character Chart (8 Bit)

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

KEY

ASCII CHARACTER — ESC — 33 OCTAL / 27 DECIMAL / 1B HEX

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Figure 2-2 Standard Character Chart (7 Bit)

Note that all of the functions are available in either mode, but in the 7-bit environment, coding is less efficient in that more codes are required to achieve the same results.

There are three features that select the coding environment. These features govern the processing of received data and the encoding of transmitted data:

Data Bit Selection (communication switch selectable)
C1 Transmit Enable (escape sequence selectable mode)
C1 Receive Enable (escape sequence selectable mode)

These features are described in detail in the C1 Transmit Enable and C1 Receive Enable sections.

PRINTABLE CHARACTERS

Characters in the GL graphic set (octal range of 041 to 176) and characters in the GR graphic set (octal range of 241 to 376) usually cause the Letterprinter 100 to display (print) a character on the paper. Your terminal receives these printable characters and stores them in a line buffer. These characters are printed when one of the following conditions occur:

- no character received for more than 30 ms
- paper motion
- overprint command (except underline)

If the active column is not greater than the right margin, each received character is printed and the active column is incremented. The actual character printed depends on the character code received, the font selected, and the character set selected.

CONTROL CHARACTERS

Characters in the C0 control set (octal range of 000 to 037) and the C1 control set (octal range of 200 to 237) usually cause the Letterprinter 100 to perform some action. Control characters are not printed. When your Letterprinter 100 Terminal receives a control character, it responds by performing the action associated with the control character. The Letterprinter 100 responds to the control characters listed in Tables 2-1 and 2-2. The mnemonic and function of each control character are also listed in these tables. All other control characters received by the terminal cause no action.

NOTE: Each control function mentioned in this manual has a mnemonic. The mnemonic is an abbreviation of the control function name.

Table 2-1 CØ Control Characters

Name	Mnemonic	Octal Code	Function
Null	NUL	ØØØ	Used as fill characters (see Chapter 1, communications).
Start of heading	SOH	ØØ1	No action
Start of text	STX	ØØ2	No action
End of text	ETX	ØØ3	No action
End of transmission	EOT	ØØ4	Used as disconnect character if enabled.
Enquiry	ENQ	ØØ5	Request answerback message.
Acknowledge	ACK	ØØ6	No action
BELL	BEL	ØØ7	Sounds audible bell tone.
Backspace	BS	Ø1Ø	Moves the active column left one column (except in graphic mode).
Horizontal tab	HT	Ø11	Advances to next horizontal tab stop (except in graphic mode).
Linefeed	LF	Ø12	Advances to next line. Performs carriage return if enabled (except in graphic mode).
Vertical tab	VT	Ø13	Advances to next vertical tab stop (except in graphic mode).
Form feed	FF	Ø14	Advances to next top margin (except in graphic mode).
Carriage return	CR	Ø15	Returns to left margin. Performs line feed if enabled (except in graphic mode).

Table 2-1 CØ Control Characters (Cont)

Name	Mnemonic	Octal Code	Function
Shift out	SO	Ø16	Maps GØ to GL printer character set.
Shift in	SI	Ø17	Maps Gl to GR printer character set.
Data link escape	DLE	Ø2Ø	No action
Device control 1 (XON)	DC1	Ø21	No action
Device control 2	DC2	Ø22	No action
Device control 3 (XOFF)	DC3	Ø23	No action
Device control 4	DC4	Ø24	No action
Negative acknowledge	NAK	Ø25	No action
Synchronous idle	SYN	Ø26	No action
End of transmission block	ETB	Ø27	No action
Cancel	CAN	Ø3Ø	Immediately ends any control or escape sequence.
End of medium	EM	Ø31	No action
Substitute	SUB	Ø32	Immediately ends any control or escape sequence. Characters received with errors are replaced by SUB if enabled. SUB is printed as " " or as " ".
Escape	ESC	Ø33	Introduces an escape sequence.
File separator	FS	Ø34	No action
Group separator	GS	Ø35	No action
Record separator	RS	Ø36	No action
Unit separator	US	Ø37	No action
Delete	DEL	177	No operation (Not stored in input buffer. Not to be used as filler).

Table 2-2 C1 Control Characters

Name	Mnemonic	Octal Code	Function
Same as ESC @	reserved	200	Reset parser with no action
Same as ESC A	reserved	201	Reset parser with no action
Same as ESC B	reserved	202	Reset parser with no action
Same as ESC C	reserved	203	Reset parser with no action
Index	IND	204	Increment active line and advance paper -- line feed new line mode has no effect on this feature.
Next line	NEL	205	Set active column to left margin and increment active line
Start of selected area	SSA	206	Reset parser with no action
End of selected area	ESA	207	Reset parser with no action
Horizontal tabulation set	HTS	210	Set horizontal tab stop at active column.
Horizontal tabulation with justification	HTJ	211	Reset parser with no action
Vertical tabulation set	VTS	212	Set vertical tab stop at active line
Partial line down	*PLD	213	Index paper up .212 cm (1/12 inch) -- line feed new line mode has no effect on this sequence.
Partial line up	*PLU	214	Index paper down .212 cm (1/12 inch) -- line feed new line mode has no effect on this sequence.

Table 2-2 C1 Control Characters (Cont)

Name	Mnemonic	Octal Code	Function
Reverse index	RI	215	Decrement active line and move paper down one line -- line feed new line feed had no effect on this sequence.
Single shift 2	SS2	216	Activates G2 character set for 1 character
Single shift 3	SS3	217	Activates G3 character set for 1 character
Device control string	DCS	220	Device control string introducer (Refer to DCS processing)
Private use 1	PU1	221	Reset parser with no action
Private use 2	PU2	222	Reset parser with no action
Set transmit state	STS	223	Reset parser with no action
Cancel character	CCH	224	Reset parser with no action
Message waiting	MW	225	Reset parser with no action
Start of protected area	SPA	226	Reset parser with no action
End of protected area	EPA	227	Reset parser with no action
Same as ESC X	reserved	230	Reset parser with no action
Same as ESC Y	reserved	231	Reset parser with no action
Same as ESC Z	reserved	232	Reset parser with no action
Control sequence introducer	CSI	233	Used to gain extended functionality through control sequencing.

Table 2-2 C1 Control Characters (Cont)

Name	Mnemonic	Octal Code	Function
String terminator	ST	234	Ends any pending ANSI string, reverts to text processing mode.
Operating system command	OSC	235	Start OSC string. (See string processing)
Privacy message	PM	236	Start privacy message. (See string processing)
Application program command	APC	237	Start application program command. (See string processing)

* NOTE: PLD and PLU do not modify active line or the position counter. To maintain proper vertical form handling, send as many PLDs as PLUs.

ESCAPE AND CONTROL SEQUENCES

Escape and control sequences are used to provide additional controls not provided by the control characters in the character set. These sequences are multiple character control functions that are not printed but are used to control the printing and processing of characters. Escape and control sequences are defined in ANSI standards X3.41 1974 and X3.64 1979. Refer to Appendix A for more detailed information on escape and control sequence processing. Definitions of the Letterprinter 100 escape and control sequence functions are provided in Chapter 3.

NOTE: If an escape or control sequence is aborted in the middle of the sequence, it is not clear what action the following character will have. It is recommended therefore that any abort be followed by a cancel control character or the no action escape sequence. ESC \ (octal 033 127).

For example, some operating systems echo CTL (control) C as ↑ C. The sequence ESC CTL C then becomes ESC ↑ C, which puts the terminal in the ANSI string processing mode. If this condition occurs and if the host does not send the cancel control character, the Letterprinter 100 will discard all printable characters (see ANSI string processing). To recover from this mode, should the host not send the cancel control character, you must enter and exit SELF TEST.

SPECIAL CHARACTERS

The following characters are special characters:

SP character (octal 040)
DEL character (octal 177)
character represented by octal 240
character represented by octal 377

While in the text mode, the space character will increment the active column (subject to margins) but will not reset the single shift flags. While in the escape mode, SP will be processed as an intermediate character.

The DEL character is stripped from the received data stream. It is not recommended as a fill character.

While in text mode, the character represented by octal 240 is processed as an unspecified printable character (printed using the error character). It will reset the single shift flag in the same way as the GR codes. While in escape mode, it will be equivalent to a space (octal 040).

The character represented by octal 377 is stripped from the received data stream. It is not recommended as a fill character.

CHARACTER SETS

Ninety four codes are reserved for GL in the 7-bit environment; one hundred eighty eight codes reserved for GL and GR in the 8-bit environment. They are not sufficient to access all of the characters that may be required for a particular application.

So, characters are grouped in sets of 94, and any set can be called into GL or GR. To further improve processing speed, up to 4 sets can be preselected. They are then known GØ, Gl, G2 or G3. Figure 2-3 and 2-4 show how any set from an infinite repertory can be designated as GØ-G3 and how GØ-G3 can be invoked into either GL or GR.

Refer to the character set section in Chapter 3 for more detail.

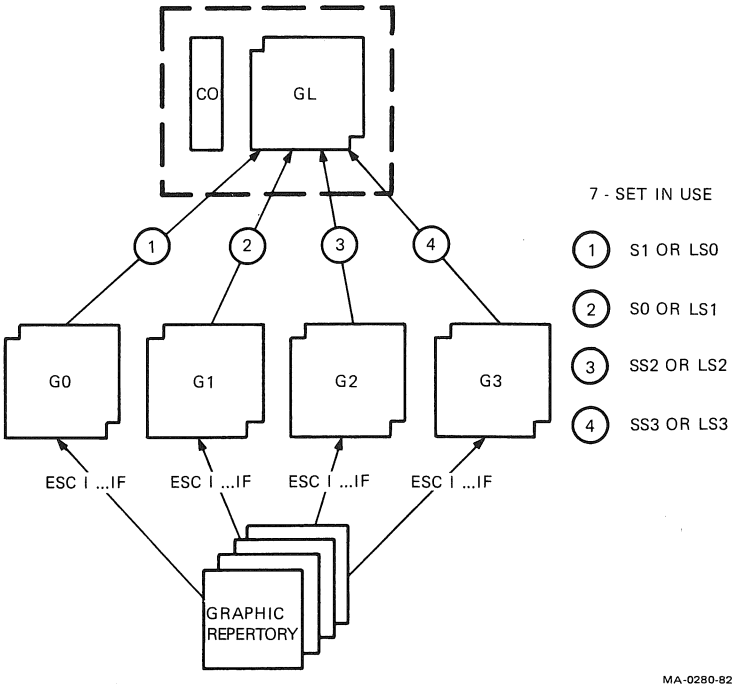

Figure 2-3 Code Extension in a 7-Bit Environment

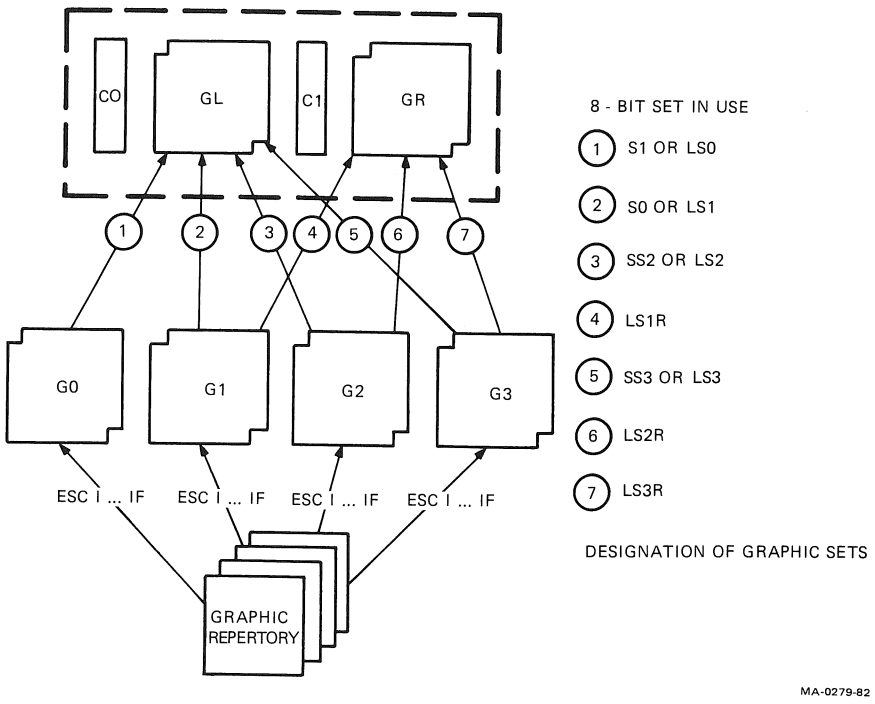

Figure 2-4 Code Extension in an 8-Bit Environment

CHAPTER 3
ESCAPE AND CONTROL SEQUENCE DEFINITIONS

GENERAL

This chapter descibes in detail all of the Letterprinter 100 escape and control sequences. Information concerning generic escape sequence processing is described in Appendix A. A general description of control characters is provided in Chapter 2 and should be read before using this section.

NOTE: The escape and control sequences are defined by their eight bit octal encoding. They are illustrated using C0/C1 mnemonics and ASCII characters. The illustration will vary with the character set selected; use only the octal encoding as a reference. Although the sequences are defined with an eight bit encoding, the seven bit equivalent encoding will have the same effect.

DETAILED SEQUENCE DEFINITIONS

The following section describes in detail the escape and control sequences to which your terminal responds. These sequences are described in the following order:

7/8 Bit Environment Selection
    Introduction
    C1 Transmit Enable/Disable
    C1 Receive Enable/Disable
Line Feed New Line Mode
Auto Wraparound Mode
Active Column and Active Line
Horizontal Forms Handling
    Print Area
    Horizontal Margins
    Horizontal Pitch Select Mode
    Horizontal Pitch (Characters per Inch)
    Horizontal Tabs
Vertical Forms Handling
    Vertical Pitch (Lines per Inch)
    Form Length
    Vertical Margins
    Vertical Tabs

Character Style
    Quality Select Mode
    Select Graphic Rendition
    Character Set Designation
    Character Set Invocation
Reports
    Request Font Configuration
    Report Font Configuration
    Request Product Identification
    Report Product Identification

7/8 BIT ENVIRONMENT SELECTION

This section describes how to select your coding environment and how to translate the data for each environment.

Environment Selection
There are three variables governing the processing of received data and the encoding of transmitted data:

- Data Bit Selection (communication switch selectable -- to change the data bit feature, refer to the Letterprinter 100 operator Guide)
- C1 Transmit Enable (escape sequence selectable mode)
- C1 Receive Enable (escape sequence selectable mode)

The factors governing character processing are described below.

Transmitting Characters

1. Whenever the 8 data bits is selected, (communication switch set to 8-bit data), and its use is allowed (C1 Transmit Enable mode is selected), data will be transmitted using 8-bit coding.

2. Whenever the 8 data bits is selected, (communication switch set to 8-bit data), and its use is restricted (C1 Transmit Disable mode is selected), GR data will be transmitted using 8-bit coding, C1 control data will be transmitted using 7 bit equivalent coding.

3. Whenever 7 data bits is selected (communication switch set to 7-bit data), any code transmitted will be tanslated into a 7-bit code equivalent.

   NOTE: An exception to these rules does NOT permit an answerback message to be translated. If an answerback message containing 8-bit data is to be sent without using the 8th bit, the MSB will be truncated and the coding will not be converted.

BITS B8 B7 B6 B5 / B4 B3 B2 B1 ROW	COLUMN 0 (0 0 0 0)	1 (0 0 0 1)	2 (0 0 1 0)	3 (0 0 1 1)	4 (0 1 0 0)	5 (0 1 0 1)	6 (0 1 1 0)	7 (0 1 1 1)	8 (1 0 0 0)	9 (1 0 0 1)	10 (1 0 1 0)	11 (1 0 1 1)	12 (1 1 0 0)	13 (1 1 0 1)	14 (1 1 1 0)	15 (1 1 1 1)
0 0 0 0 0	NUL 0 0 0	20 16 10	SP 40 32 20	0 60 48 30	@ 100 64 40	P 120 80 50	` 140 96 60	p 160 112 70	200 128 80	DCS 220 144 90	240 160 A0	° 260 176 B0	À 300 192 C0	320 208 D0	à 340 224 E0	360 240 F0
0 0 0 1 1	1 1 1	DC1 (XON) 21 17 11	! 41 33 21	1 61 49 31	A 101 65 41	Q 121 81 51	a 141 97 61	q 161 113 71	201 129 81	221 145 91	¡ 241 161 A1	± 261 177 B1	Á 301 193 C1	Ñ 321 209 D1	á 341 225 E1	ñ 361 241 F1
0 0 1 0 2	2 2 2	22 18 12	" 42 34 22	2 62 50 32	B 102 66 42	R 122 82 52	b 142 98 62	r 162 114 72	202 130 82	222 146 92	¢ 242 162 A2	2 262 178 B2	Â 302 194 C2	Ò 322 210 D2	â 342 226 E2	ò 362 242 F2
0 0 1 1 3	3 3 3	DC3 (XOFF) 23 19 13	# 43 35 23	3 63 51 33	C 103 67 43	S 123 83 53	c 143 99 63	s 163 115 73	203 131 83	223 147 93	£ 243 163 A3	3 263 179 B3	Ã 303 195 C3	Ó 323 211 D3	ã 343 227 E3	ó 363 243 F3
0 1 0 0 4	4 4 4	24 20 14	$ 44 36 24	4 64 52 34	D 104 68 44	T 124 84 54	d 144 100 64	t 164 116 74	IND 204 132 84	224 148 94	244 164 A4	264 180 B4	Ä 304 196 C4	Ô 324 212 D4	ä 344 228 E4	ô 364 244 F4
0 1 0 1 5	ENQ 5 5 5	25 21 15	% 45 37 25	5 65 53 35	E 105 69 45	U 125 85 55	e 145 101 65	u 165 117 75	NEL 205 133 85	225 149 95	¥ 245 165 A5	µ 265 181 B5	Å 305 197 C5	Õ 325 213 D5	å 345 229 E5	õ 365 245 F5
0 1 1 0 6	6 6 6	26 22 16	& 46 38 26	6 66 54 36	F 106 70 46	V 126 86 56	f 146 102 66	v 166 118 76	206 134 86	226 150 96	246 166 A6	¶ 266 182 B6	Æ 306 198 C6	Ö 326 214 D6	æ 346 230 E6	ö 366 246 F6
0 1 1 1 7	BEL 7 7 7	27 23 17	' 47 39 27	7 67 55 37	G 107 71 47	W 127 87 57	g 147 103 67	w 167 119 77	207 135 87	227 151 97	§ 247 167 A7	• 267 183 B7	Ç 307 199 C7	Œ 327 215 D7	ç 347 231 E7	œ 367 247 F7
1 0 0 0 8	BS 10 8 8	CAN 30 24 18	(50 40 28	8 70 56 38	H 110 72 48	X 130 88 58	h 150 104 68	x 170 120 78	HTS 210 136 88	230 152 98	¤ 250 168 A8	270 184 B8	È 310 200 C8	Ø 330 216 D8	è 350 232 E8	ø 370 248 F8
1 0 0 1 9	HT 11 9 9	31 25 19	) 51 41 29	9 71 57 39	I 111 73 49	Y 131 89 59	i 151 105 69	y 171 121 79	211 137 89	231 153 99	© 251 169 A9	1 271 185 B9	É 311 201 C9	Ù 331 217 D9	é 351 233 E9	ù 371 249 F9
1 0 1 0 10	LF 12 10 A	SUB 32 26 1A	* 52 42 2A	: 72 58 3A	J 112 74 4A	Z 132 90 5A	j 152 106 6A	z 172 122 7A	VTS 212 138 8A	232 154 9A	a 252 170 AA	o 272 186 BA	Ê 312 202 CA	Ú 332 218 DA	ê 352 234 EA	ú 372 250 FA
1 0 1 1 11	VT 13 11 B	ESC 33 27 1B	+ 53 43 2B	; 73 59 3B	K 113 75 4B	[133 91 5B	k 153 107 6B	{ 173 123 7B	PLD 213 139 8B	CS1 233 155 9B	« 253 171 AB	» 273 187 BB	Ë 313 203 CB	Û 333 219 DB	ë 353 235 EB	û 373 251 FB
1 1 0 0 12	FF 14 12 C	34 28 1C	, 54 44 2C	< 74 60 3C	L 114 76 4C	\ 134 92 5C	l 154 108 6C	| 174 124 7C	PLU 214 140 8C	ST 234 156 9C	254 172 AC	¼ 274 188 BC	Ì 314 204 CC	Ü 334 220 DC	ì 354 236 EC	ü 374 252 FC
1 1 0 1 13	CR 15 13 D	35 29 1D	- 55 45 2D	= 75 61 3D	M 115 77 4D	] 135 93 5D	m 155 109 6D	} 175 125 7D	R1 215 141 8D	OSC 235 157 9D	255 173 AD	½ 275 189 BD	Í 315 205 CD	Ÿ 335 221 DD	í 355 237 ED	ÿ 375 253 FD
1 1 1 0 14	SO 16 14 E	36 30 1E	. 56 46 2E	> 76 62 3E	N 116 78 4E	^ 136 94 5E	n 156 110 6E	~ 176 126 7E	SS2 216 142 8E	PM 236 158 9E	256 174 AE	276 190 BE	Î 316 206 CE	336 222 DE	ì 356 238 EE	376 254 FE
1 1 1 1 15	SI 17 15 F	37 31 1F	/ 57 47 2F	? 77 63 3F	O 117 79 4F	_ 137 95 5F	o 157 111 6F	DEL 177 127 7F	SS3 217 143 8F	APC 237 159 9F	257 175 AF	¿ 277 191 BF	Ï 317 207 CF	ß 337 223 DF	ï 357 239 EF	377 255 FF

ASCII CONTROL SET | ASCII GRAPHIC CHARACTER SET | ADD'L CONTROL SET | DEC SUPPLIMENTAL GRAPHIC SET

KEY ← DEC MULTINATIONAL CHARACTER SET →

ASCII CHARACTER: ESC / 33 OCTAL / 27 DECIMAL / 1B HEX

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Figure 3-1 Standard Character Chart

Receiving Characters

1. Whenever 7 data bits is selected (communication switch set to 7-bit data), any code received is considered as an 8-bit code with the MSB set to "Ø".

2. Whenever the 8 data bits is selected, (communication switch set to 8-bit data), and its use is allowed (C1 Receive Enable mode is selected), any code received is considered an 8-bit code.

3. Whenever the 8 data bits is selected, (communication switch set to 8-bit data), and its use is restricted (C1 Receive Disable mode is selected), GR data is not changed, C1 control data is truncated (MSB set to "Ø").

Environment Conversion
The method for converting between 7-bit and 8-bit environments is described in ANSI X3.41 and ISO 2Ø22.

7-bit to 8-bit Conversion
Converting from 7 to 8 bit coding is not required. It only improves the data transmission rate.

Converting to C1 Control Codes
The C1 control functions, coded as two-character sequences of the form ESC Fe [where Fe is from the character charts, columns 4 and 5 (see Figure 3-1)], can be converted to one-byte C1 control characters by:

(1) removing the ESC character,
(2) setting the eighth bit, and
(3) clearing the seventh bit of the final character.

Converting to GR Graphic Codes
Rather than using SHIFT functions to bring a G set (GØ, G1, G2, G3) into GL, the set can be locked into GR, then accessed by setting the eigth bit to "1".

8-bit to 7-bit Conversion
When operating in a 7-bit environment, it is required to translate 8-bit codes into their 7-bit equivalent.

Converting C1 Control Codes
C1 functions coded as single characters from ANSI chart columns 8 and 9 can be converted to ESC Fe (where Fe represents a final character from the character chart columns 4 and 5) by inserting an ESC character followed by a final character obtained by setting the 8th bit of the C1 code to "Ø" and the 7th bit to "1".

Ccnverting GR Graphic Codes
Using the designation sequences, designate the desired set as G2. Then, for any GR code, first send a SS2 function, then the code with the eigth bit set to "Ø".

Equivalent C1 Control codes and Escape Sequences
All 8-bit single character control codes perform the same action as two-character escape sequences. Your Letterprinter 100 terminal supports the following combinations:

8-Bit Character		7-Bit Sequence	Function
IND	=	ESC D	Index
NEL	=	ESC E	Vertical line
HTS	=	ESC H	Horizontal tabulation set
VTS	=	ESC Z	Vertical tabulation set
PLD	=	ESC K	Partial line down
PLU	=	ESC L	Partial line up
RI	=	ESC M	Reverse index
SS2	=	ESC N	Single shift 2
SS3	=	ESC O	Single shift 3
DCS	=	ESC P	Device control string
CSI	=	ESC [	Control sequence introducer
ST	=	ESC \	String terminator
OSC	=	ESC]	Operating system command
PM	=	ESC ^	Private message
APC	=	ESC _	Application program command

The following sequences are used to enable or disable C1 Transmit

Name	Mnemonic	Sequence			Function
C1 Transmit		ESC	SP	G	Enables C1 Transmit
		033	040	107	
C1 Transmit		ESC	SP	F	Disables C1 Transmit
		033	040	106	

The following sequences are used to enable or disable C1 Receive

Name	Mnemonic	Sequence			Function
C1 Receive		ESC	SP	7	Enables C1 Receive
		033	040	067	
C1 Receive		ESC	SP	6	Disables C1 Receive
		033	040	066	

Line Feed New Line Mode -- defines your terminal's response to the line feed control character. When this mode is off and your terminal receives a line feed control character, it increments the active line and advances the paper one line. When this mode is on, a received line feed control character causes your terminal to return the active column to the left margin in addition to its usual functions.

NOTE: This feature does not affect any of the other functions modifying active line.

Use the following sequences to enable or disable line feed new line mode.

Name	Mnemonic	Sequence				Function
Line feed new line mode.	LNM	CSI 233	2 Ø62	Ø Ø6Ø	h 15Ø	Set line feed new line mode on.
		CSI 233	2 Ø62	Ø Ø6Ø	l 154	Set line feed new line mode off.

Auto Wraparound Mode -- determines where the next character is printed when received while the active position is greater than the right margin. When this mode is off, any characters received while the active position is at the right margin are not printed. When this mode is on, any characters received while the active position is greater than the right margin are printed starting at the left margin on the next line. Use the following sequences to enable or disable auto wraparound mode.

Name	Mnemonic	Sequence				Function
Auto wrap around mode	DECAWM	CSI 233	? Ø77	7 Ø67	h 15Ø	Set auto wraparound mode on.
		CSI 233	? Ø77	7 Ø67	l 154	Set auto wraparound mode off.

Active Column and Active Line -- The active column is the column where the next character will be printed. The active line is the line where the next character is printed. Column and line numbers begin with one, not zero. Printable characters usually increment the active column. Line feeds, vertical tabs, and form feeds increment the active line.

The active column and active line collectively are known as the active position. The active position is only loosely linked to the physical position of the carriage and paper mechanism.

Bell characters do not have an active position attribute in that they are not made to sound a bell tone at any particular position.

In addition to the control characters (backspace, horizontal tab, carriage return, line feed, vertical tab, and form feed) the following control functions modify active column and active line.

Name	Mnemonic	Sequence	Function
Index	IND	IND 2Ø4	Increment active line and advance paper. Line feed new line mode has no effect on this feature.

NOTE: The *** character is used to indicate variable numeric parameters within the octal representation of the control or escape sequence.

Vertical position absolute	VPA	CSI 233	Pn ***	d 144	Set active line to Pn if Pn is less than or equal to active line. If Pn is greater than bottom margin, active line is set to top margin on next page.
Next line	NEL		NEL 2Ø5		Set active column to left margin and increment active line.
Horizontal position absolute	HPA	CSI 233	Pn ***	14Ø	Set active column to column Pn. If Pn is greater than right margin, with wrap enabled, active column is set to left margin on next line. With wrap disabled, active column is set to right margin. If Pn is less than or equal to left margin, active column is set to left margin.
Horizontal position relative	HPR	CSI 233	Pn ***	a 141	Advance current active column by Pn columns. If active column exceeds right margin, with wrap enabled, active column is set to left margin on next line regardless of actual value of Pn. With wrap disabled, active column is set to right magin. If Pn = Ø, then no motion occurs.

Cursor up	CUU	CSI 233	Pn ***	A 101	Decrement current active line by Pn lines by Pn lines without going past top margin. If Pn is greater than or equal to current active line, sequence is ignored.
Vertical position relative	VPR	CSI 233	Pn ***	e 145	Advance active line by Pn lines. If Pn = Ø, 256 lines are assumed. If parameter exceeds bottom margin, active line is set to top margin on next page regardless of actual value of Pn.

NOTE: The PLD sequence does not modify the active line. To avoid losing the top of form reference send an equal number of PLU sequences to the terminal.

Partial line down	PLD	PLD 213	Index paper up .212 cm (1/12 inch). Line feed new line mode has no effect on this sequence.

NOTE: The PLU sequence does not modify the active line. To avoid losing the top of form reference, send an equal number of PLD sequences to the terminal.

Partial line up	PLU	PLU 214	Index paper down .212 cm (1/12 inch). Line feed new line mode has no effect on this sequence.
Reverse index	RI	RI 215	Decrement active line and move paper down one line. Line feed new line mode has no effect on this sequence.

Horizontal Forms Handling -- describes the interrelationships among print area, horizontal margins, horizontal pitch, pitch select mode and horizontal tabs.

Print Area -- the user-defined limits for printing, no printing will ever occur outside of these limits. These limits remain unchanged unless explicitly modified. The print area is modified by the following explicit commands:

1. Set print area
2. Recall from user permanent memory
3. Reset to factory default

The print area is an absolute reference in inches (see Figure 3-2). It is the base reference for all horizontal positioning. The print area provides the user with absolute limits to center the text on the platen.

NOTE: If no use is made of the print area, the horizontal functions will operate identically to the horizontal functions of DIGITAL's earlier model terminals.

The first parameter (Pl) in the set print area sequence defines the new absolute left reference in 1/12 of an inch (measured from the left edge of the platen). The second parameter (P2) in the set print area sequence defines the new absolute width of the print area in 1/12 of an inch.

If Pl is greater than 157 (13.Ø8 inches), it is truncated to 157. The width of the print area is the smallest of:

specified width (P2) or
13.2 inches - Left Reference (Pl)

The left margin is set to 1. The right margin is set to width / pitch. The horizontal tabs slide with the left reference. Active column remains unchanged. The print head slides with the left reference. If active column is greater than the new right margin, the next printable character will activate the auto wraparound (autowraparound/truncate) feature.

The following sequence is used to set the left reference and width of the print area.

Name	Mnemonic	Sequence	Function
Set Page Width Alignment	DECHPWA	CSI Pl ; P2 " s 233 *** Ø73 *** Ø42 163	Set left reference and width of the print area

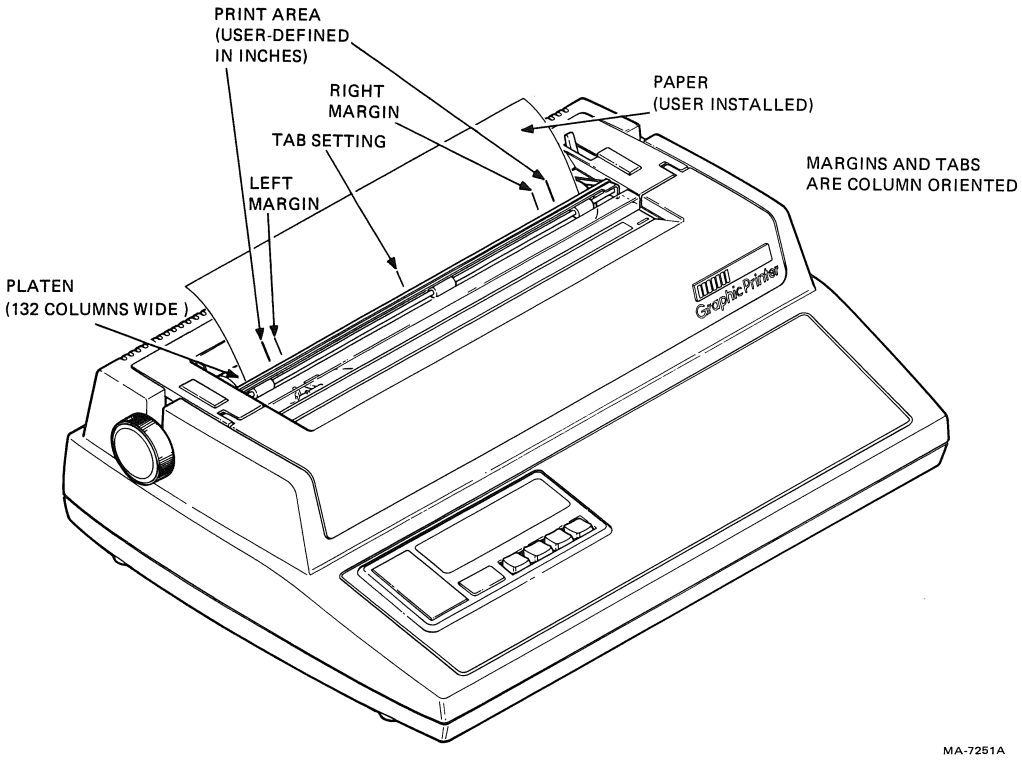


Figure 3-2 Print Area and Horizontal Settings

Horizontal Margins -- the user-defined limits for the carriage return and end-of-line functions (see Figure 3-2). They are column oriented and are modified by the following explicit commands:

1. Set margins
2. Recall from user permanent memory
3. Reset to factory default

and by the following implicit commands:

1. Set horizontal pitch (cleared)
2. Set horizontal pitch select mode
3. Select print quality
4. Select graphic rendition
5. Set print area

If both parameters of the DECSLRM sequence are not zero, and the first is the smaller of the two, set the left margin to the first parameter and the right margin to the second parameter. If active column is less than the new left margin, active column is set to the new left margin. If active column is greater than the new right margin, the next printable character will activate the auto wraparound (autowraparound/truncate) feature.

The sequence is ignored if the first parameter is greater than or equal to the second parameter. The sequence is also ignored if one of the parameters sets the right margin past the assigned print area.

If you omit the first parameter in a sequence, the remaining parameter sets the right margin to the column specified. If you attempt to set the right margin to the left of the left margin, the sequence will be ignored. If you omit the second parameter in a sequence, the first parameter sets the left margin to the column specified. If you attempt to set the left margin to the right of the right margin, the sequence will be ignored. If active column is less than the new left margin, active column is set to the new left margin. If active column is greater than the new right margin, the next printable character will activate the auto wraparound (autowraparound/truncate) feature.

If you set both parameters to zero, or omit them, the margins are unchanged.

The following sequence is used to set the left and right margins.

Name	**Mnemonic**	**Sequence**	**Function**
Set left and right margins	DECSLRM	CSI Pl ; Pl s 233 *** Ø73 *** 163	Set left and right margins to the values given

NOTE: The *** character is used to indicate variable numeric parameters within the octal representation of the control or escape sequence.

Horizontal Pitch -- determines the width of printed characters as well as their spacing. Your terminal has eight horizontal pitch selections (see Figure 3-3). Any combinations of pitch may be used on a single print line.

NOTE: The actual horizontal pitch used by the terminal depends on the density select mode, pitch select mode, and horizontal pitch features. Refer to all three features when attempting to select horizontal pitch.

Horizontal pitch is modified by the following explicit commands:

1. Set horizontal pitch
2. Recall from user permanent memory
3. Reset to factory default

and by the following implicit commands:

1. Set pitch select mode
2. Select print quality
3. Select graphic rendition

Changing the horizontal pitch modifies the active column. The modified new active column is the first column boundary at or to the right of the physical position of the previous active column in the old pitch. The new active column is calculated as follows:

$$\text{New column} = 1 + \frac{(\text{Old column} - 1) \times \text{New pitch}}{\text{Old pitch}}$$

where
- New column = the new active column
- New pitch = the new pitch in inches per character
- Old column = the old active column
- Old pitch = the old pitch in inches per character

The division performed above is an integer division. Any remainder or fractional part of the quotient is discarded.

Changing horizontal pitch also clears horizontal margins. The left margin is set to column one and, depending on the print area, the right margin is set to the maximum column for the selected pitch (see Table 3-1). Pitch settings have no effect on the print area. The following sequences are used to set horizontal pitch.

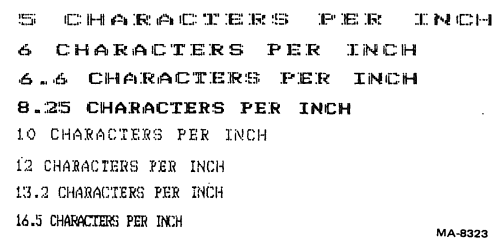


Figure 3-3 Horizontal Pitch Examples

Table 3-1 Maximum Right Margins (with print area set to 13.2 in.)

Horizontal Pitch	Maximum Right Margin
10	132
12	158
13.2	168
16.5	217
5	66
6	79
6.6	84
8.25	108

Name	Mnemonic	Sequence			Function
Set horizontal pitch	DECSHORP	CSI 233	Ø Ø6Ø	w 167	Set horizontal pitch to default (1Ø cpi)
		CSI 233	1 Ø61	w 167	Set horizontal pitch to 1Ø char/in
		CSI 233	2 Ø62	w 167	Set horizontal pitch to 12 char/in
		CSI 233	3 Ø63	w 167	Set horizontal pitch to 13.2 char/in
		CSI 233	4 Ø64	w 167	Set horizontal pitch to 16.5 char/in
		CSI 233	5 Ø65	w 167	Set horizontal pitch to 5 char/in
		CSI 233	6 Ø66	w 167	Set horizontal pitch to 6 char/in
		CSI 233	7 Ø67	w 167	Set horizontal pitch to 6.6 char/in
		CSI 233	8 Ø7Ø	w 167	Set horizontal pitch to 8.25 char/in

Horizontal Pitch Select Mode -- selects font pitches or all pitches. When your terminal is set to all pitches the terminal can print any of the eight horizontal pitch selections available. This feature is useful when your terminal is used as a lineprinter. When font pitches is selected, your terminal will print at the single width pitch of the current font (1Ø or 12 characters per inch) or its double width (5 or 6 characters per inch) only. This feature is useful when printing draft copies of future letter quality documents because the draft quality copy will look like the letter quality copy.

Horizontal pitch select mode is modified by the following explicit commands:

1. Set horizontal pitch select mode
2. Recall from user permanent memory
3. Reset to factory default

There are no implicit commands that modify horizontal pitch select mode. Use the following sequences to select font pitches or all pitches.

Name	Mnemonic	Sequence					Function
Pitch select mode		CSI 233	? Ø77	2 Ø62	9 Ø71	h 15Ø	Set pitch select mode to font pitches.
Pitch select		CSI 233	? Ø77	2 Ø62	9 Ø71	1 154	Set pitch select mode to all pitches.

Horizontal Tabs -- are column oriented predefined positions on paper (see Figure 3-2). The Letterprinter 1ØØ has 217 possible horizontal tab stops, one for each column. Tab stops are associated with column numbers relative to the print area, not physical positions on the paper. Therefore, if you change the horizontal pitch you also change the physical position of the tab stops. Tabs are modified by the following explicit commands:

1. Set horizontal tab
2. Clear horizontal tab
3. Recall from user permanent memory
4. Reset to factory default

and by the following implicit commands:

1. Set horizontal pitch
2. Set horizontal pitch select mode
3. Set print density
4. Select graphic rendition
5. Set print area

You may set or clear each tab stop independently or in groups. You may set stops or clear them regardless of margins or horizontal pitch. However, setting a stop already set has no effect; the same is true for clearing a stop already cleared. The default settings for horizontal tabs are one in every eight columns.

The following sequences are used to set or clear horizontal tab stops.

Name	Mnemonic	Sequence	Function
Horizontal tabulation set	HTS	HTS 210	Set horizontal tab stop at active column
Horizontal tabulation set	DECHTS	ESC 1 033 061	Set horizontal tab stop at active column
Tabulation clear	TBC	CSI Ø g 233 060 147	Clear horizontal tab at active column
Tabulation clear	TBC	CSI 2 g 233 062 147	Clear all horizontal tab stops
Tabulation clear	TBC	CSI 3 g 233 063 147	Clear all horizontal tab stops
Clear all horizontal tabs	DECCAHT	ESC 2 033 062	Clear all horizontal tab stops

NOTE: The *** character is used to indicate variable numeric parameters within the octal representation of the control or escape sequence.

Set horizontal tabs	DECSHTS	CSI 233	Pn ***	; 073	... ...	Pn ***	u 165	Set horizontal tab stops at the given values

Vertical Forms Handling -- describes the interrelationships among vertical pitch, form length, vertical margins and vertical tabs.

*Vertical Pitch -- Vertical pitch determines the spacing between lines, not the height of the printed characters (see Figure 3-4). The Letterprinter 100 has six vertical pitch selections. If you change the vertical pitch you change:

- the active line. Changing the vertical pitch causes the active line to move down on the next vertical motion command so that the distance between the top margin and the active line is an integer multiple of the pitch you selected.
- the action of the form length command.
- the action of set top and bottom margin commands.
- the position of the last printed line on the form. The last printed line will always be above the bottom margin.
- the position of the vertical tabs.

If you change the vertical pitch you do not affect:

- the top of form reference.
- the form length.
- the top margin. The first line will always be printed at the same position.
- the bottom margin. The last line will never be printed below the bottom margin.

---

* Note that the vertical pitch feature is different from that of DIGITAL's previous terminals.

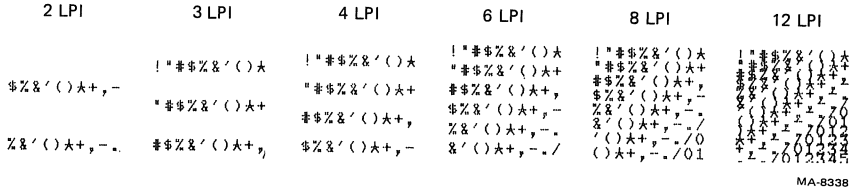


Figure 3-4 Vertical Pitch Examples

The vertical pitch default selection is six lines per inch. The following sequences are used to set vertical pitch.

Name	Mnemonic	Sequence			Function
Set vertical pitch	DECVERP	CSI 233	Ø ØSØ	z 172	Set vertical pitch to six lines per inch
		CSI 233	1 Ø61	z 172	Set vertical pitch to six lines per inch
		CSI 233	2 Ø62	z 172	Set vertical pitch to eight lines per inch
		CSI 233	3 Ø63	z 172	Set vertical pitch to twelve lines per inch
		CSI 233	4 Ø64	z 172	Set vertical pitch to two lines per inch
		CSI 233	5 Ø65	z 172	Set vertical pitch to three lines per inch
		CSI 233	6 Ø66	z 172	Set vertical pitch to four lines per inch

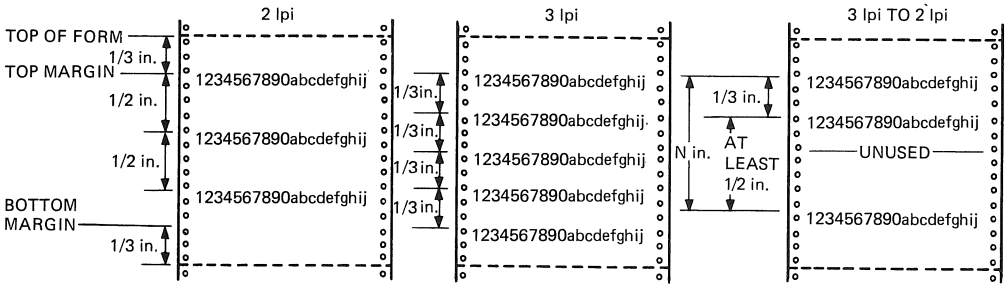
*Form Length -- The Letterprinter 1ØØ can operate in one of two modes: form mode or no form mode (roll paper). In the no form mode, there are no vertical margins or form length; printing occurs continuously, the line spacing being dictated by the current pitch.

When in form mode, the terminal will not print above the top margin or below the bottom margin, and the lines will be spaced so that the distance between the active line and the top margin is always a multiple of the current pitch. (see Figure 3-5).

When a form length of zero is defined for the terminal, the Letterprinter 1ØØ assumes that roll paper is being used and enters the no form mode. When a non-zero form length is defined, the terminal assumes that form paper is being used, and enters the form mode.

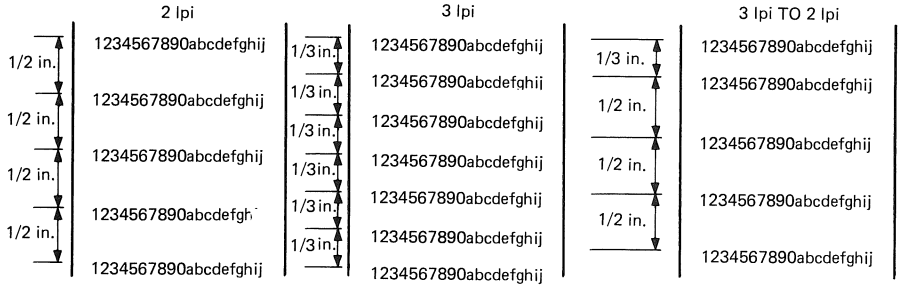
*Note that the form length feature is different from that of DIGITAL's previous terminals.

FORM



NOTE:
ALWAYS START PRINTING AT TOP MARGIN OR AT SOME DISTANCE FROM TOP MARGIN THAT IS A MULTIPLE OF THE CURRENT VERTICAL PITCH. NEVER PRINT BELOW BOTTOM MARGIN.

NO FORM



NOTE:
ALWAYS PRINT LINES EVENLY ACCORDING TO VERTICAL PITCH.

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Figure 3-5 Form/No Form Mode

The form length is measured in horizontal lines 1/24 of an inch wide. The form length can be no longer than 21 inches. To set form length, first make sure that the terminal is at the top of the form.

NOTE: Remember that the form feed puts the active line at the top margin, not the top of the form. To advance to the top of the form the top margin must be cleared.

Measure the form length in inches. Make sure that you know what the current vertical pitch of the terminal is and that the new form length is a multiple of that pitch. If the current pitch is unknown or the form length is not a multiple of the vertical pitch, set a new vertical pitch.

NOTE: Most form lengths are a multiple of 1/12, and all allowed form lengths are either a multiple of 1/12 or 1/8.

In any case, send the form length command with the parameter equal to the form length multiplied by the current vertical pitch.

The default form length selection is 11 inches. The following sequence sets form length.

Name	Mnemonic	Sequence			Function
Set lines per physical page	DECSLPP	CSI 233	Pn ***	t 164	Set form length to n X pitch in inches. Set top margin to Ø inches, active line to line one. Set top of form to current position, and set bottom margin to form length.

NOTE: The *** character is used to indicate variable numeric parameters within the octal representation of the control or escape sequence.

Vertical Margins -- The top vertical margin specifies the first printable line; the bottom vertical margin specifies the limit for the last printable line (see Figures 3-5 and 3-6). Printing is allowed only on the lines between the top and bottom margins (including the top margin). The bottom margin may not be included depending on the vertical pitch.

When you set the top and bottom margins, first be sure that the distance between the top of form and the desired margin is a multiple of the vertical pitch you have selected. Otherwise, change the pitch and then send the set margin command with a parameter equal to the desired margin in inches multiplied by the current vertical pitch in lines per inch.

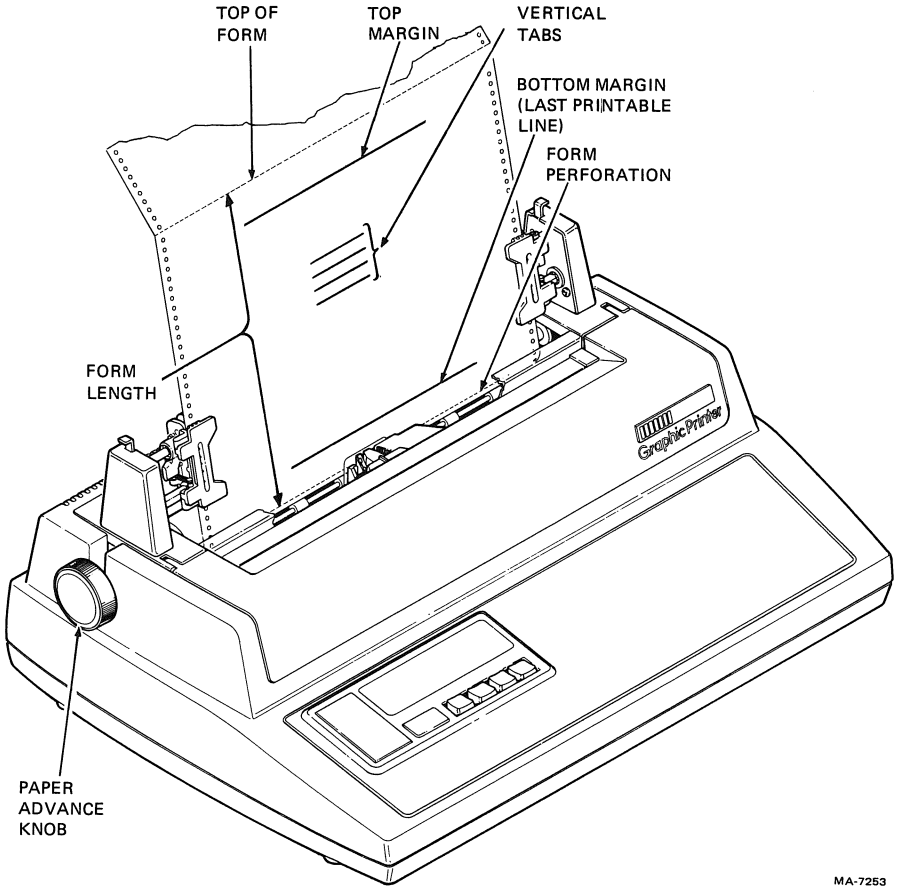


Figure 3-6 Vertical Margins and Tabs

If you attempt to print above the top margin or below the bottom margin, the active line will advance automatically to the top margin of the next page. For example, a line feed (LF) received at the bottom margin causes the terminal to perform a form feed.

The set vertical margins sequence, accompanied by two parameters, sets the top and bottom margins. If both parameters are not zero and the first is the smaller of the two, the top margin is set to the first parameter and the bottom is set to the second. Then the paper may be repositioned to the new top margin depending on the current line position and terminal activity.

The sequence is ignored if the first parameter is greater than or equal to the second parameter. The sequence is also ignored if one of the specified parameters would set the bottom margin past the assigned form length.

If you omit the first parameter in the sequence, the remaining parameter sets the bottom margin to the specified line. If you attempt to set the bottom margin above the top margin, the sequence is ignored.

If you omit the second parameter in the sequence, the first parameter sets the top margin to the specified line. If you attempt to set the top margin below the bottom margin, the sequence is ignored. If you make the active line less than the new top margin, the active line is set to the new top margin and the paper is repositioned.

If you omit both parameters or set them to zero, the margins are unchanged. The default top margin selection is top of form. The default selection for the bottom margin is 11 inches.

The following sequences set the top and bottom margins.

Name	Mnemonic	Sequence	Function
Set top, bottom margins	DECSTBM	CSI Pn ; Pn r 233 *** Ø73 *** 162	Set top margin to line Pn and bottom margin to line Pn.

NOTE: The *** character is used to indicate variable numeric parameters within the octal representation of the control or escape sequence.

Vertical Tabs -- A vertical tab is a preselected line to which the printhead advances when a vertical tab control character is received (see Figure 3-6). The terminal has 168 vertical tab positions. You may set and clear vertical tabs the way you do horizontal tabs. Vertical tab stops are associated with specific line numbers, not physical positions on the paper. Therefore, changing vertical pitch changes the printing position of vertical tabs on the paper. The default settings for vertical tabs are one in every line. The following sequences set or clear vertical tab stops.

NOTE: 21 inches at 12 lines per inch = 252 lines. Only the first 168 lines can have vertical tab stops.

Name	Mnemonic	Sequence	Function
Vertical tab set	VTS	VTS 212	Set vertical tab stop at active line.
Vertical tab set	DECVTS	ESC 3 Ø33 Ø63	Same.

NOTE: The *** character is used to indicate variable numeric parameters within the octal representation of the control or escape sequence.

Name	Mnemonic	Sequence	Function
Set vertical tab stops	DECVTS	CSI PN ; ... Pn v 233 *** Ø73 ... *** 166	Set vertical tab stops at lines given.
Tabulation clear	TBC	CSI 1 g 233 Ø61 147	Clear vertical tab stop at active line.
Tabulation clear	TBC	CSI 4 g 233 Ø64 147	Clear all vertical tab stops.
Clear all vertical tabs	DECCAVT	ESC 4 Ø33 Ø64	Same.

Character Style -- describes the interrelationships among quality select mode, select graphic rendition, character set designation and invocation. Unlike previous DIGITAL terminals, the repertory of characters for the Letterprinter 100 is not limited. Every Letterpinter 100 can be configured in infinite number of ways to match the customer's application. There are 3 main variables governing what character is available for use at any given time:

- Which character ROM options are installed in the terminal.
- What mode of operation the printer is set to (line printer/ Letterprinter).
- What selection parameters are specified (character set, horizontal pitch, typestyle)

Character Set Selection Rules

Line printer mode (draft mode selected, all pitch mode enabled) -- When the Letterprinter 100 is used as a lineprinter, a character is available for use provided the selected character set exists in the selected typestyle in any of the possible (5) character ROMs at printing time.

NOTE: This differs from version 1 of the Letterprinter 100 microcode. Version 1 microcode only searches a maximum of two character ROMs. This allows you to have only one copy of the special character set like APL, Symbols, VT100 Line Drawing which do not have a typestyle, and still be able to access them without changing the selected DPS.

For every character received, the Letterprinter 100 will take the typestyle of the currently selected DPS and search the character ROMs for the proper character set. The Letterprinter 100 will print the character in the selected character set if the selected character set exists in one of the character ROMs, and the typestyle is compatible, i.e.:

- identical,
- the selected DPS has no typestyle,
- or the character set has no typestyle

If no such character set exists, the default character set for the currently selected DPS is used.

Letterprinter mode (draft mode and font pitch mode selected, or letter mode selected) -- When the Letterprinter 100 is used as a letterprinter, a character is available for use provided the selected character set exists in the selected typestyle and pitch in any of the possible (5) character ROMs at printing time.

For every character received, the Letterprinter 100 will take the typestyle of the currently selected DPS and search the character ROMs for the proper character set. The Letterprinter 100 will print the character in the selected character set if the selected character set exists in one of the character ROMs at the proper pitch, and the typestyle is compatible, i.e.:

- identical,
- the selected DPS has no typestyle,
- or the character set has no typestyle

If no such character set exists, the default character set for the currently selected DPS is used.

Quality Select Mode -- determines if received characters are printed in letter mode (medium or high density, depending on character ROM) or draft mode (see Figure 3-7 for examples).

The standard Dot pattern Sets (DPSs) are designed to print in draft mode (7 X 9 character) or letter mode/high density (33 X 18 character). Some of the optional DPSs are designed to print in draft mode (7 X 9 character) or letter mode/medium density (33 X 9 character). Selecting letter mode selects either 33 X 18 or 33 X 9 characters, depending on the DPS selected.

NOTE: Both medium and high density DPSs can be resident in your terminal.

Your terminal will only respond to these sequences when the AUTO/MAN key is in the automatic (up) position. When the AUTO/MAN key is in the down position and the LTR/DRAFT key is used to select the print quality, any quality select sequence sent to your terminal will be processed and stored. The sequences are performed when the AUTO/MAN key is set to the automatic (up) position.

Use the following sequences to change the quality select feature.

Name	Mnemonic	Sequence				Function
Quality Select		CSI 233	Ø 060	" 042	z 172	Set quality select mode to default (draft mode).
Quality Select		CSI 233	1 061	" 042	z 172	Set quality select mode to draft mode.
Quality Select		CSI 233	2 062	" 042	z 172	Set quality select mode to letter mode (medium density or high density, depending on DPS).

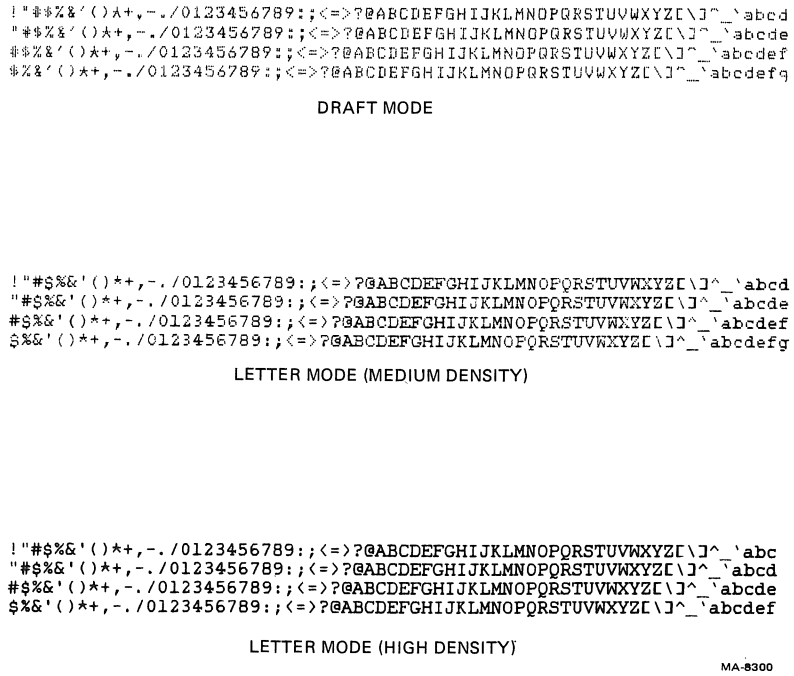


Figure 3-7 Character Density Examples

Select Graphic Rendition -- Select Graphic Rendition is used to define the attributes with which characters are printed. Your Letterprinter terminal recognizes only two attributes: style or font, and auto underline.

Font Selection: Your Letterprinter 100 can print characters in different fonts or styles. Changing a font simply changes the shape of the character not the character itself. DIGITAL currently provides users with the following fonts:

Courier
Gothic
Orator

Additional fonts will be made available in the future. Your Letterprinter 100 terminal can make up to five fonts accessible at a given time. If the multiple font option is installed, your terminal will only respond to these sequences when the option is set to computer select. If you force a font from the multiple font option, any font select sequences sent to your terminal will be processed and stored. These sequences will be executed when the option is set to computer select. Refer to Letterprinter 100 Operator Guide and multiple font option information for more detail.

NOTE: If the selected DPS is not installed, your terminal uses the default (DPS 1) until the selected DPS is installed.

Auto Underline: When Auto Underline is enabled, all characters received are underlined when printed. When Auto Underline is disabled, characters are printed without underlining.

Name	Mnemonic	Sequence & Octal Code				Function
Select Graphic Rendition	SGR	CSI 233	Ø 060	m 155		disable underline
Select Graphic Rendition	SGR	CSI 233	4 064	m 155		enable underline
Select Graphic Rendition	SGR	CSI 233	1 061	Ø 060	m 155	Use style of 1st DPS
Select Graphic Rendition	SGR	CSI 233	1 061	1 061	m 155	Use style of 2nd DPS (if installed)
Select Graphic Rendition	SGR	CSI 233	1 061	2 062	m 155	Use style of 3rd DPS (if installed)
Select Graphic Rendition	SGR	CSI 233	1 061	3 063	m 155	Use style of 4th DPS (if installed)
Select Graphic Rendition	SGR	CSI 233	1 061	4 064	m 155	Use style of 5th DPS (if installed)

Designating Character Sets -- is selecting one of the character sets from an infinite repertory to be one of four preselected character sets GØ-G3. As the Letterprinter 1ØØ does not know which character sets will be installed at the time of printing, it will accept any valid designation sequence and memorize it. Only at the time of printing will the terminal ensure that the set is available. If the set is not available, the terminal uses the default character set for the currently selected DPS.

You use the appropriate Select Character Set (SCS) escape sequences to designate from the available repertory any four sets as GØ, Gl, G2, G3 (See Figure 3-8). As the repertory is divided between primary and alternate character sets, there are eight sets of sequences from which to choose.

These escape sequences take the form of:

ESC	Il . . . In	F
Escape Sequence Introducer	Intermediate Characters (1 or more)	Final Character (1)

Il defines the target character set as GØ-G3, and whether the set is to be taken from the primary or the alternate section of the repertory as follows:.

Select from Primary for	GØ	Gl	G2	G3
Il =	(	)	*	+
	Ø5Ø	Ø51	Ø52	Ø53

Select from Alternate for	GØ	Gl	G2	G3
	,	-	.	/
	Ø54	Ø55	Ø55	Ø57

If Il is in the range Ø5Ø to Ø53, the designated set is a primary set. If Il is in the range Ø54 to Ø57, the designated set is an alternative set.

- If Il is Ø5Ø or Ø54, the designated set goes into GØ
- If Il is Ø51 or Ø55, the designated set goes into Gl
- If Il is Ø52 or Ø56, the designated set goes into G2
- If Il is Ø53 or Ø57, the designated set goes into G3.

Thus,

ESC * A designates the primary set "A" as the G2 set. ("A" in this instance is the United Kingdom character set)

and,

ESC / A designates the alternate set "A" as the G3 set. ("A," in this instance, is a special set yet to be defined.)

The number of intermediates that can be used is limitless. However, your Letterprinter 100 Terminal will only support character sets (whether primary or alternative) having designation sequences less than five characters long (including the ESC and final characters). It will ignore all other sequences.

NOTE: This is an extension of the Letterprinter 100 version 1 microcode. version 1 microcode only allowed for three character set designation sequences and did not allow selection from the alternate section of the repertory.

Table 3-2 lists the standard character sets and their valid final characters. The available character sets for the most part are language sets with some exceptions such as the VT100 line drawing set. There are standard DPSs for the following character sets:

-- ISO United kingdom
-- USASCII
-- DIGITAL Finnish
-- DIGITAL Norwegian/Danish
-- DIGITAL Swedish
-- ISO German
-- DIGITAL French Canadian
-- ISO French
-- ISO Italian
-- ISO Spanish
-- DIGITAL VT100 line drawing set
-- DIGITAL Supplemental Set (Multinational)

Table 3-2 Character Set Final Characters

Character Set	Final Character
ISO United Kingdom	A 101
USASCII	B 102
DIGITAL Finnish	5 065
DIGITAL Norwegian/Danish	6 066
DIGITAL Swedish	7 067
ISO German	K 113
DIGITAL French Canadian	9 071
ISO French	R 122
DIGITAL VT100 line drawing set	0 060
ISO Italian	Y 131
ISO Spanish	Z 132
DIGITAL Multinational	< 74

For additional character sets, refer to the character ROM option documentation. The Letterprinter 100 accepts the ISO (LA120) final characters for the Finnish, Norwegian/Danish, and Swedish character sets. However the sequence selects the DIGITAL character set. This error handling method may be different in future terminals.

Invoking Character Sets -- is to activate one of the four preselected character sets (GØ-G3). Character sets are invoked in one of three ways:

- locked into GL using LS (locking shift) functions (remain active until the next LS command)
- locked into GR using LSR (locking shift right) functions (remain active until the next LSR command)
- Called in for a single printable character using SS (single shift) functions (remain active for one printable character only)

Once you have designated a character set as GØ-G3, you use a single control function to map (or invoke) the G sets into GL/GR where they become active character sets. There are nine control functions used to invoke designated character sets (Table 3-3).

Error Handling -- describes how the Letterprinter 1ØØ reacts to error conditions. The way errors are handled may vary in future terminals. The single shift function should be followed by a GL printable character code. If the terminal receives a CØ or C1 control code, it will execute the control code and still apply the single shift function to the next printable character. If the terminal receives a GR printable character code, it will truncate the 8th bit, and apply the single shift function to the truncated value. If the terminal receives the space character, it will process the space and apply the single shift function to the next printable character. If the terminal receives the character code represented by octal 24Ø, it will display the error character, and ignore the single shift function.

Locking shift right functions have no meaning in 7-bit mode. The Letterprinter 1ØØ will accept and memorize them anyway. They will take action when 8-bit mode is enabled.

Table 3-3 Shift Functions

Name	Mnemonic	Escape Sequence and Octal Code	Function
Locking Shift Ø	LSØ	Same as SHIFT IN Ø17	Invokes GØ into GL
Locking Shift 1	LS1	Same as SHIFT OUT	Invokes G1 into GL
Locking Shift 2	LS2	ESC n Ø33 156	Invokes G2 into GL
Locking Shift 3	LS3	ESC o Ø33 157	Invokes G3 into GL
Locking Shift 1 Right	LS1R	ESC ~ Ø33 176	Invokes G1 into GR
Locking Shift 2 Right	LS2R	ESC } Ø33 175	Invokes G2 into GR
Locking Shift 3 Right	LS3R	ESC | Ø33 174	Invokes G3 into GR
Single Shift 2	SS2	SS2 216	Invokes G2 for a single printable character
Single Shift 3	SS3	SS3 217	Invokes G3 for a single printable character

NOTE: There is no LOCKING SHIFT Ø RIGHT; there is no way to invoke GØ into GR.

Reports -- describes the method of requesting and reporting font configuration and terminal identification information.

Request Font Configuration -- causes the terminal to send the font configuration report to the computer. Send the following sequence to your Letterprinter 100 to request the font configuration.

Name	Sequence					Function
Request Font Configuration	CSI 233	? 077	1 061	0 060	c 143	Causes Letterprinter 100 to send font configuration report. Refer to font configuration report for more detail.

Report Font Configuration -- your terminal responds to the font configuration request with the following sequence. One sequence is sent for each installed DPS.

Report Font Configuration Sequence

CSI	P0	;	P1	;	P2	;	P3	;	P4	SP	D		
233	***	073	***	073	***	073	***	073	***	040	1	0	4

NOTE: Letterprinter 100 version 1 microcode only reports P0 and P1.

P0 represents the DPS location code. This code is to be used for the select graphic rendition sequence. One code is available for each DPS location as follows.

DPS	LOCATION CODE
1	10
2	11
3	12
4	13
5	14

NOTE: DPS selection code 10 is always present and sent last; therefore, it indicates the end of the report.

P1 represents the ROM identification code. There are four possible ROM ID categories as shown below:

1--64 (Indicates draft and letter standard DPS)
65--128 (Indicates draft and memo standard DPS)
129--192 (Indicates draft and letter custom DPS)
192--200 (Indicates draft and memo custom DPS)

For more detail concernig a specific number, refer to ROM option information.

A standard DPS with an odd ID number contains USASCII and ISO United Kingdom character sets. A standard DPS with an even ID number, contains the following character sets:

ISO United Kingdom
USASCII
DIGITAL Finnish
DIGITAL Norwegian/Danish
DIGITAL Swedish
ISO German
DIGITAL French Canadian
ISO French
ISO Italian
ISO Spanish
DIGITAL Multinational

P2 represents the typestyle attribute. The typestyle attribute can be one of the following numbers:

Ø No typestyle
1 Gothic
5 Courier
9 Orator

More numbers will be added as new typestyles are made available for the Letterprinter 1ØØ. Refer to the ROM option documentation for more detail.

P3 represents the pitch attribute. The pitch attribute is one of following numbers:

8 = 1Ø CPI/5 CPI
Ø = 12 CPI/6 CPI

P4 represents the print quality attribute. The print quality attribute is one of the following numbers:

Ø = LETTER (33 X 18 matrix)
1 = MEMO (33 X 9 matrix)

Request Product Identification -- The Letterprinter 100 automatically transmits an answer to the ANSI standard request for device attributes. The following sequences cause the terminal to transmit its product identification sequence.

Name	Mnemonic	Sequence	Function
Device attributes	DA	CSI c 233 143	Requests transmission of the product identification
Device attributes	DA	CSI Ø c 233 Ø6Ø 143	Same.
*Identify terminal	DECID	ESC Z Ø33 132	Same.

Report Product Identification -- The Letterprinter 100 automatically transmits one of the following sequences in response to the request product identification sequence.

Name	Sequence							Function
Terminal ID	CSI 233	? Ø77	1 Ø61	Ø Ø6Ø	c 143			Base LA1ØØ (level 1 microcode - 7-bit only)
Terminal ID	CSI 233	? Ø77	1 Ø61	Ø Ø6Ø	; Ø73	2 Ø62	c 143	Enhanced LA1ØØ (level 2 microcode - 8-bit)

NOTE: Depending on the enviroment, these reports will be sent using either 7 or 8 data bit encoding. Make sure that your system can handle 8 bit data or disble 8 bit transmit before requesting these reports.

*This sequence is provided for compatibility with previous products. It may not be supported in future products and is therefore not recommended.

CHAPTER 4
ANSI STRING PROCESSING

GENERAL

This chapter describes the Letterprinter 100 method of processing ANSI control strings. This includes answerback message encoding and graphics procssing.

ANSI CONTROL STRINGS

When the Letterprinter 100 receives any of the escape sequences listed in Table 4-1, it leaves the standard text processing mode, and starts processing characters according to different rules. The Letterprinter 100 has three sets of rules to process strings;

Graphics mode
Answerback entry mode
Default string processing

Graphics mode and answerback entry mode are defined later in this chapter. When in default string processing mode, the terminal responds as usual to control characters received (octal 000 -- 037 and 177) and discards any printable characters received (octal 041 -- 176 and 241 -- 376). Your terminal will revert to the text processing mode when one of the following conditions occur.

- String terminator (ST or ESC \) is received (normal termination)

- One of the following characters is received:

  CANCEL (octal 030)
  SUBSTITUTE (octal 032)
  ESCAPE (octal 033)
  Any C1 control code (octal 200 -- 237)
  Any character received with a transmission error

NOTE: The Letterprinter 100 remains in DCS mode until it recognizes a valid protocol selector (graphics mode or answerback entry mode) or the terminal receives the terminator sequence ESC \. For more detail on DCS mode, refer to the Graphics Mode and Answerback Message entry sections in this manual.

Table 4-1 ANSI String Introducers/Terminator

Name	8-bit Character	7-bit Sequence
String terminator	ST 234	ESC \ Ø33 134
Application Program Command	APC 237	ESC _ Ø33 137
Operating System Command	OSC 235	ESC] Ø33 135
Privacy Message	PM 236	ESC ^ Ø33 136
Device Control String	DCS 22Ø	ESC P Ø33 12Ø

GRAPHICS MODE

While in the text mode, characters are printed as they are received. In the graphics mode, characters received define specific columns of dots to be printed. The graphics mode permits users to print dot combinations anywhere on a page. This mode can be used to draw pictures and plot graphs (Figure 4-1).

After entering the graphics mode, the vertical pitch, horizontal pitch, and horizontal margins change. These changes are described in "Graphics Mode Pitch" and "Graphics Mode Margins" sections.

DIGITAL does not recommend using single sheet or tractor feed paper when operating in the graphics mode.

Your Letterprinter 100 now has variable horizontal resolution from 72 columns per inch to 330 columns per inch and a vertical resolution of 72 dots per inch (see Figure 4-2). This feature allows greater resolution, or allows you to vary print density, but it mainly allows the Letterprinter 100 to be compatible with various host software.

Dots are the basic printable unit while in graphics mode. For the Letterprinter 100, dots are circles 13.5 mil in diameter.

Dot Spacing is the distance between the centers of two consecutive dots. The vertical dot spacing is 13.5 mil. The horizontal dot spacing is variable.

As the horizontal dot spacing can be smaller than the dot diameter, two consecutive dots may overlap. There is no overlap between two consecutive dots in the vertical direction, but there will be a 6 mil (forty percent of dot diameter) overlap between two consecutive lines.

Dot aspect ratio is the ratio between horizontal dot spacing and vertical dot spacing. It defines how many dots must be sent in each direction to get a perfect square.

Due to the variable horizontal dot spacing, and the fact that the Letterprinter 100 prints dots in horizontal groups of thirty, the number of dots per line varies. So do the exact maximum length of a graphic line.

Table 4-2 lists the possible values for horizontal dot spacing, horizontal dots per inch, horizontal overlap, aspect ratio, dots per line, inches per line, and how to select them.

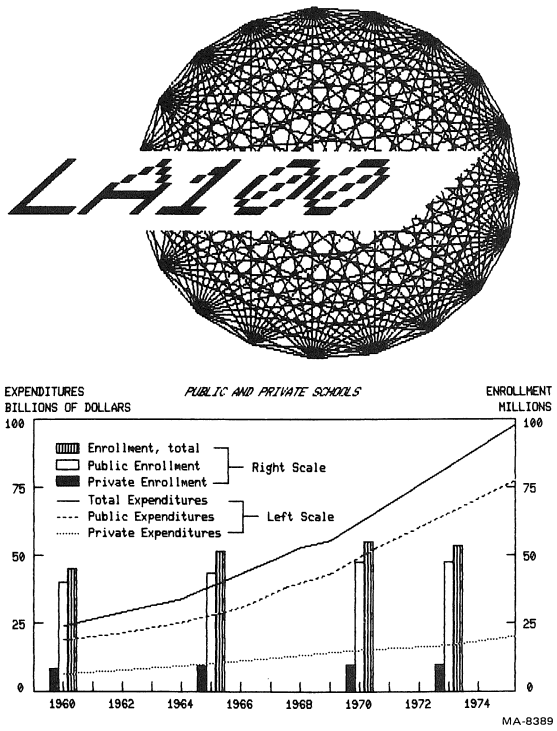


Figure 4-1 Graphics Capabilities

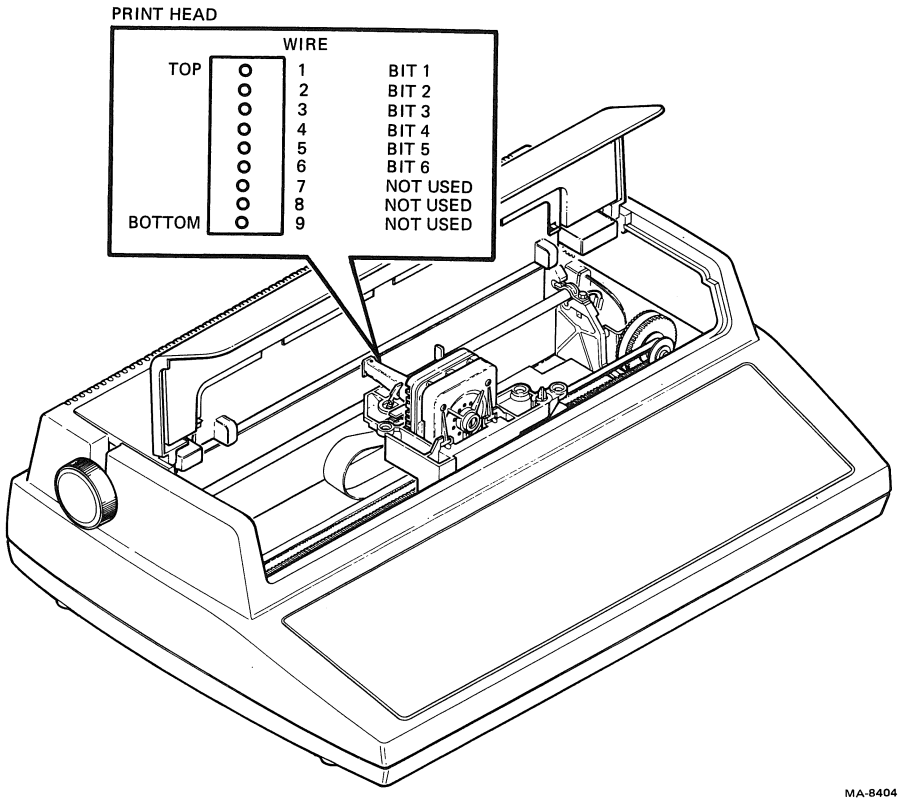


Figure 4-2 Graphics Printhead Use

Table 4-2 Dot Spacing as a Function of Pitch

Dot Spacing (in mils)	Dots/ Inch	Overlap	Aspect Ratio	Dots/ Line	Inches/ Line	P1 Selection Parameter
3.Ø	33Ø	77%	4.58	435Ø	13.18	2
4.5	22Ø	66%	3.Ø4	288Ø	13.Ø9	3
6.Ø	165	55%	2.29	216Ø	13.Ø9	4
7.5	132	5Ø%	1.83	176Ø	13.18	5 (Ø, 1)*
9.Ø	11Ø	32%	1.5Ø	144Ø	13.Ø9	6
1Ø.5	94	2Ø%	1.3Ø	125Ø	13.Ø5	7
12.Ø	83	9%	1.12	1Ø8Ø	13.Ø9	8
13.5	74	Ø%	1.Ø2	96Ø	13.Ø9	9

*Default values

Graphics String Format
The format for a string of graphics data is as follows:

DCS introducer	DCS or ESC P
Graphics Protocol selector	Pn q
Data	Control characters or column definitions
DCS terminator	ESC \

DCS Introducer
When your terminal receives the DCS introducer, it enters the DCS mode and waits for the correct protocol selector. The DCS introducer is the C1 control code DCS or the escape sequence ESC P (octal Ø33 12Ø).

When the protocol selector is received the terminal begins to process data as described in the data section.

Your terminal will remain in the DCS mode if the correct protocol selector is not received, or if your terminal receives a character that is out of range before the correct protocol selector is recognized.

Graphics Protocol Selector
After receiving the DCS introducer, the graphics protocol selector will cause your terminal to enter the graphics mode. The protocol selector consists of a numeric parameter and and the final character "q" (octal 161). The Letterprinter 1ØØ recognizes the following values for the numeric parameter in the graphics protocol selector:

- Ø selects default graphics protocol (same as 5 for the Letterprinter 1ØØ).
- 1 selects DECwriter IV/Letterprinter 1ØØ version 1 protocol (same as 5)
- Selectors 2 through 9 are given in Table 4-2.
- Selectors 1Ø -- 255 are reserved for future development.

DATA
The data contained within a graphics string can either be control characters or printable data. The control characters to which your terminal responds while in the graphics mode, and the format of the printable characters received are described in the following sections.

NOTE: Although GR codes are not allowed within the graphics data stream, the Letterprinter 1ØØ processes GR codes while in the graphic mode the same as it does GL codes; that is the 8th bit is stripped. This type of error handling may be different in future terminals.

Control Characters

In the graphics mode, your terminal will respond to the following control characters:

- **ANSI Control Characters**
  The ANSI control characters in the 000 to 037 octal range and in the 200 to 237 octal range, which are processed in graphics mode, are described in Table 4-3.

- **Private Control Characters**
  The private control characters in the 040 -- 076 octal range, which are processed in graphics mode, are described in Table 4-4.

Printable Data

After the correct protocol selector is received, your terminal will consider any character received in the 077 -- 176 octal range as printable. With the 8th bit set, any character in the 277 -- 376 range will also be considered printable. These characters define a column of six dots to be printed, which allows selective firing of the top six printhead wires (Figure 4-3). The seventh, eighth and ninth printhead wires are not used in the graphics mode.

Printable characters are processed by bit masking. The offset (octal 077) is subtracted from the binary value of the character received with the result that a printhead wire is fired and a dot printed when the resultant bit is set to one.

The least significant bit is associated with the top printhead wire (wire one). The sixth bit is associated with the sixth printhead wire, and is the last wire that can be fired in the graphics mode.

Refer to Table 4-5 for examples of printable characters.

Repeat Sequence

A repeat sequence allows your Letterprinter 100 terminal to print a dot column consecutively for a specified number of times. This repeat sequence is defined as follows.

Repeat introducer	! (octal 041)
Numeric parameter	Number of times to print the dot column (characters in the octal range of 060 -- 071)
Dot column	Character in the 077 -- 176 octal range

The repeat sequence introducer is the private control character ! (octal 041).

The numeric parameter specifies the number of times to print the column definition that follows. The numeric parameter is a string of characters in the 060 -- 071 octal range. If you do not specify a numeric parameter, a value of zero is assumed for the numeric parameter. If the value you specified is larger than the graphic printer limit for numeric parameters (64K), the limit is assumed. All decimal digits are processed as part of the count.

Table 4-3 Graphics ANSI Control Characters

Name	Mnemonic	Octal Code	Function
Cancel	CAN	Ø3Ø	Immediately causes an exit from the graphics mode.
Substitute	SUB	Ø32	Replaces any character received with errors. When received in the graphics mode, SUB is processed as a one column space.
Escape	ESC	Ø33	Causes the terminal to exit from the graphics mode and process the sequence.
All C1 Control Codes	(see Table 2-2)	2ØØ through 237	Cause the terminal to exit from the graphics mode and process the C1 codes.

NOTE: NUL, EOT, ENQ, BEL, DEL, SI, and SO are processed as in text mode (refer to Table 2-1).

BS, LF, CR, FF, HT, and VT are ignored in graphics mode.

Table 4-4 Graphics Private Control Characters

Name	Mnemonic	Octal Code	ASCII Character	Function
Graphics Repeat Introducer	DECGRI	Ø41	!	Begin repeat sequence.
Graphics Carriage Return	DECGCR	Ø44	$	Returns to graphics left margin.
Graphics New Line	DECGNL	Ø55	--	Returns to graphics left margin and advances to next graphics line.

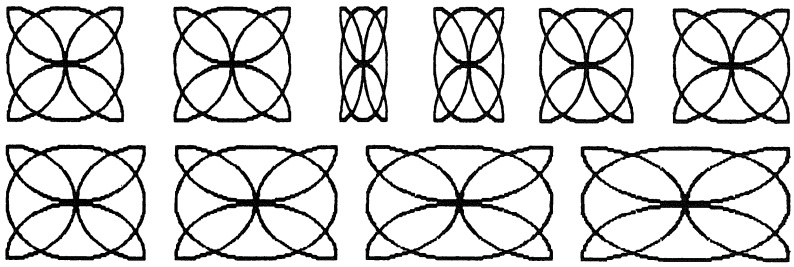


Figure 4-3 Variable Dot Spacing

Table 4-5 Printable Character Examples

Character	Octal Value	Binary Value (minus Offset)	Wires Fired
?	Ø77	ØØØØØØØØ	o
			o
			o
			o
			o
			o
@	1ØØ	ØØØØØØØ1	*
			o
			o
			o
			o
			o
~	176	ØØ111111	*
			*
			*
			*
			*
			*
-	137	ØØ1ØØØØØ	o
			o
			o
			o
			o
			*

The dot column (a character in the Ø77 -- 176 octal range) is printed as many times as specified by the numeric parameter count. All control characters received during a repeat sequence are processed as usual. For example, the control character ! resets the repeat sequence count.

All unspecified characters (octal Ø72 -- Ø76) are ignored.

DCS Terminator

The DCS terminator is the ST control function [7-bit encoding is ESC \ (octal Ø33 134) 8-bit encoding is ST (octal 234)]. It causes your terminal to exit the graphics mode and revert to text mode character processing. The CAN (cancel), ESC (escape) or any C1 control characters also cause your terminal to exit the graphics mode. In addition, both the ESC and C1 control character cause their usual actions.

After an exit from the graphics mode, your terminal will be set as follows:

- Text mode features (margins, pitch) will be restored.
- Vertical position will be modified according to the control characters received while in graphics mode.
- Horizontal position will be the same as before entering the graphics mode.
- The first text mode vertical motion command will cause your terminal to advance to the next text mode line before executing the command.

GRAPHICS MODE PITCH

In the graphics mode, the horizontal pitch is set according to the numeric parameter in the graphics protocol selector. The vertical pitch is set to 1/12 lines per inch.

GRAPHICS MODE MARGINS

Maximum Line Length

The graphics mode maximum line length depends on the print area, the horizontal pitch and the margins selected while in the text mode. In the graphics mode, the maximum line length is given in Table 4-2. To use the maximum line length, the following conditions must be met before you can enter the graphics mode.

- The print area must be 13.2 inches wide.
- The actual horizontal pitch must be 1Ø characters per inch (depends on pitch setting, pitch mode, and the density selection).
- Text mode left margin must be set to column one.
- Text mode right margin must be set to column 132.
- Active column must be column one.

Left Margin

After entering the graphics mode, the left margin is repositioned to the right of the last printed column in the text mode (maximum of 1 character width). The graphics mode left margin is calculated as follows:

$$\text{Left Margin} = \frac{(\text{Active Column} - 1) \times (\text{text character width})}{\text{Graphics Character Width}}$$

Character Width are in transitions. Refer to Table 4-6 for graphics character width and Table 4-7 text character width. If there is a remainder, round to the next whole number.

Right Margin

After entering the graphics mode, the right margin is repositioned to the left of the text mode right margin (maximum of 1 character width). The graphics mode right margin is calculated as follows:

$$\text{Right Margin} = \frac{\text{Old Right Margin} \times \text{text character width}}{\text{Graphics Character Width}}$$

Character Width are in transitions. Refer to Table 4-6 for graphics character width and Table 4-7 text character width. Discard any remainder.

If you attempt to print past the right margin, your terminal will respond according to the auto wraparound mode selection.

You can use superscripts or subscripts to label graphic data with text mode comments. Reverse line feed is not recommended because the graphics mode vertical pitch may not be the same as the text mode vertical pitch.

ANSWERBACK MESSAGE ENTRY

Answerback is a user defined message of up to thirty characters that can be used to identify your terminal for the computer. This message is transmitted upon request (ENQ control character) or automatically upon connection if enabled (refer to the auto answerback feature in the Operator Guide).

Both printable characters and control characters can be part of the answerback message. To allow downline entry of both printable and control characters, the message is hexadecimally encoded.

Table 4-6 Graphics Character Width, Horizontal Pitch and Horizontal Margin Adjustment

Selection Parameter	Graphics Character Width In Transitions	Graphics Character Width In Inches	Characters Per Inch
2	60	.091	11
3	90	.136	7.33
4	120	.182	5.5
5,0,1	150	.227	4.43
6	180	.272	3.66
7	210	.32	3.15
8	240	.36	2.75
9	270	.409	2.44

Table 4-7 Text Character Width, Horizontal Pitch and Horizontal Margin Adjustment

Selection Parameter	Text Character Width In Transitions	Text Character Width In Inches	Characters Per Inch
1,Ø	66	.1	1Ø
2	55	.Ø83	12
3	5Ø	.Ø75	13.2
4	4Ø	.7Ø	16.5
5	132	.2	5
6	11Ø	.16	6
7	1ØØ	.15	6.6
8	8Ø	.12	8.25

Answerback Message Format
The format for an answerback message is described as follows:

DCS introducer	DCS or ESC P
Answerback protocol selector	Pn V
Data	Encoded Answerback Message Text
DCS terminator	ST or ESC \

DCS Introducer
When the terminal receives the DCS introducer, it enters DCS mode and waits for the correct protocol selector. The DCS introducer is the C1 control code DCS or its 7 bit encoding equivalent ESC P (octal Ø33 12Ø).

The answerback protocol selector is followed by the text of the answerback message coded in hexadecimal format. Your terminal will remain in the DCS mode if the answerback protocol selector is not received, or if the terminal receives a character that is out of range before the answerback protocol selector is recognized.

Answerback Protocol Selector
After receiving the DCS introducer, the answerback protocol selector causes your terminal to enter the answerback message entry mode. The answerback protocol selector for the answerback message entry consists of a numeric parameter and a final character. The answerback protocol selector for the Letterprinter is 1 (octal Ø61) and v (octal 166).

NOTE: When the answerback protocol selector is recognized, the message stored in operating memory is erased. However, the message stored in user permanent memory remains the same until the next store is performed.

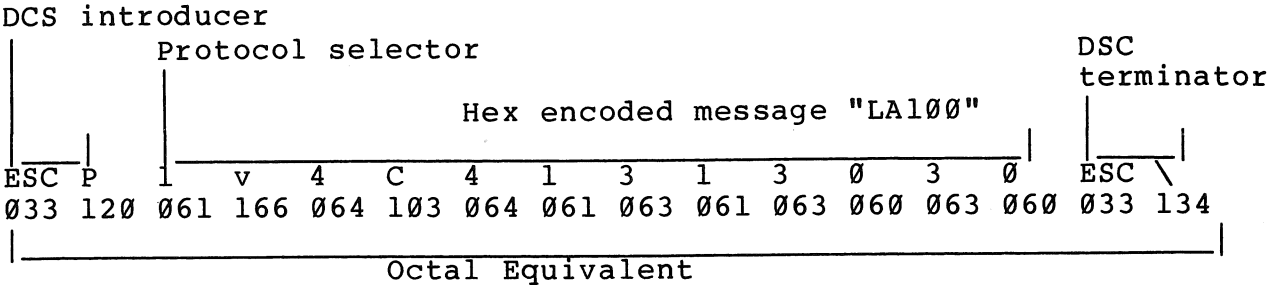
Data
After the answerback protocol selector has been received, control characters (Ø -- Ø37 and 177 octal range) are executed as usual.

Hexadecimal digits (characters in the Ø6Ø -- Ø71, 1Ø1 -- 1Ø6, 141 -- 146, octal range) are grouped in pairs to give the hexadecimal equivalent of the character to be entered in the answerback message. Any character from Ø -- 377 (octal) can be entered in the answerback message using the hex encoding system (see example).

When the answerback protocol selector is recognized, the message stored in operating memory is erased. Then, a character is added to the message every time a pair of hexadecimal digits has been received.

NOTE: The message is not made 3Ø characters long automatically. If padding NUL control characters are needed, they must be included in the message.

Example:
The following string will downline the message "LA1ØØ":



Error Processing

Any character received, which is not a control character or a hex digit, is discarded.

If an odd number of digits is received, the last digit is processed by itself.

Once 3Ø answerback message characters are received, additional characters are discarded.

NOTE: As mentioned in the 7/8 bit environment section, no conversion takes place when sending the answerback message. Any character sent on a 7-bit data path is truncated to 7-bits by dropping the MSB. When in the 8-bit mode with C1 transmission disabled, all C1 codes are truncated to 7 bits.