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LA75 Companion Printer

Programmer Reference Manual

Prepared by Educational Services
of Digital Equipment Corporation

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- Reorient the receiving antenna.
- Relocate the receiver with respect to the printer.
- Move the printer away from the receiver.
- Plug the printer into a different outlet so that the printer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the booklet *How to Identify and Resolve Radio-TV Interference Problems*, prepared by the Federal Communications Commission, helpful. This booklet is available from the U.S. Government Printing Office, Washington, D C 20402, Stock No. 004-000-00345-4.

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INTRODUCTION

WHO SHOULD READ THIS MANUAL

This manual contains reference information for users with programming experience. Programmers can use this information to design or modify application software to take advantage of the features available in the printer.

Your application software determines the ability to select the printer functions you desire and the extent to which you can use them. For example, word processing applications should have menus that let you select bold, underline, margins, tabs, and related features for those applications.

This manual does not explain how to use these application-specific menus, send the control sequences from a particular host computer, or run a given operating system or application package.

This manual contains interface, communication, character processing, and escape and control sequence information.

Appendix C contains several examples of how to use the control functions in this manual. The sample programs are written in a generic version of BASIC. They may require modification for operating systems or applications that use other versions of BASIC.

OTHER LA75 MANUALS

Your printer comes with one other manual, *Installing and Using the LA75 Companion Printer*, which describes how to install, operate, and maintain the printer.

MANUAL ORGANIZATION

This manual has eight chapters and four appendices that cover the following topics.

PART 1 GENERAL INFORMATION

Chapter 1 gives an overview of the printer and its features.

Chapter 2 describes how the LA75 communicates with a computer. This chapter describes the printer's serial interface, communication signals, configuration (set-up) menu, and required data format. It also contains a description of operator controls and indicators.

PART 2 LA75 IN DEC-COMPATIBLE MODE

Chapter 3 describes how the LA75 processes received text mode characters.

Chapter 4 describes text mode escape and control sequences to select printing functions.

Chapter 5 describes the status and reset features of the printer.

Chapter 6 describes the processing of graphic mode control and printable characters.

PART 3 LA75 IN IBM PROPRINTER EMULATION MODE

Chapter 7 gives an overview of the Proprinter Emulation mode. It describes the set-up menu features, text mode characterprocessing, and IBM characters sets.

Chapter 8 describes text and graphic mode escape and control sequences used to select IBM-compatible functions.

Appendix A shows the character sets used with the LA75 in DEC-compatible environment.

Appendix B shows examples of vertical grid size and image scale size; and the relationship between image scale size and aspect ratio.

Appendix C contains several BASIC programming examples that use the commands defined in Chapter 4.

Appendix D contains alternative programming methods that help to improve print quality.

WARNINGS, CAUTIONS, AND NOTES

The warnings, cautions, and notes in this manual have specific purposes.

WARNINGS	Contain important information relating to personal safety.
CAUTIONS	Contain information to prevent damage to the equipment.
NOTES	Contain general information.

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PART 1
GENERAL INFORMATION

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PART 1
GENERAL INFORMATION

FEATURES 1

1.1 GENERAL

The LA75 Companion is a compact dot matrix printer. It is designed for use in personal computer systems, office workstations, and small-sized business computer systems.

The LA75 receives characters and commands through an asynchronous serial interface. The interface operates at any of several selectable baud rates up to 9600 baud. The printer has a 2 Kbyte input buffer.

The printhead mounts on a carriage that scans horizontally across the paper. The printer is capable of bidirectional printing to optimize printer throughput. The ribbon is in a disposable cartridge.

The LA75 printer has a protocol selection feature that allows the printer to operate in either DEC or IBM Proprinter Emulation mode.

In the DEC mode (Part 2), the printer can perform as a LA50 or LA210 printer. This means that the LA75 is immediately compatible with most operating systems and applications written to support these printers.

In the IBM Proprinter mode (Part 3), the LA75 emulates the IBM Proprinter, allowing you to run "off the shelf" industry-standard software applications written to support the IBM Proprinter.

You can select DEC or IBM Proprinter modes using the protocol switch on the front panel, a set-up menu, or by sending the appropriate control sequence to the printer.

The printer has two fundamental printing modes — text mode and graphic mode. It also provides downline-loading of a character set.

1.1.1 Text Mode

In the text mode, the printer uses a 9-element impact dot matrix printhead to print Courier style characters at speeds from 32 to 250 characters per second. Line length on 8-inch paper can be from 40 to 137 characters per line.

The LA75 has four print densities that can be selected through software control. You can also select the Near Letter Quality (NLQ) and Letter Quality (LQ) printing using the print quality switch on the front panel or through the set-up menu. (See Sections 2.7 and 2.8.) Faster Draft and Memo printing are selectable through the set-up menu.

You can print from many different character sets (including 20 built-in DEC character sets and 3 built-in IBM sets) to select different languages and line-drawing or scientific characters.

1.1.2 Graphic Mode

In the graphic mode, the LA75 lets the user print graphic images by sending data that controls the dot printing elements individually.

In DEC graphic mode, the LA75 is capable of printing bitmap data in accordance with the sixel graphic protocol. You can choose different combinations of graphic (dot) densities, aspect ratios, and image scale sizes. Each printable character is printed out of 64 possible 1 × 6 dot combinations. The LA75 provides several graphic print densities with up to 180 dots/inch horizontally and 144 dots/inch vertically.

IBM graphic mode is described in Part 3 of this manual. IBM graphic mode provides the bit-image (dot) resolution up to 240 dots/inch horizontally and 72 dots/inch vertically. Bit-image graphics print using eight of nine printhead wires (bottom wire is not used).

1.1.3 Downline-Loadable Memory

The printer has memory space allocated to store up to 96 user-defined, downline-loaded draft characters that can be used as an active character set.

1.1.4 Options

The LA75 printer supports two options — LA75X-SF sheet feeder and LA75 font cartridges. For more information on the sheet feeder, see Paragraph 4.4.8 and "Installing and Using the LA75-SF Single-Tray Feeder" (EK-LA75X-UG). For more information on the font cartridges, see an appropriate user manual for each cartridge.

1.1.5 LA75 Features

Some of the main features of the LA75 printer are as follows.

- Compact size suitable for desk-top location
- Digital and IBM compatibility
- ASCII and national character sets
- VT100 special graphic character set
- Digital and ISO Multinational and Supplemental character sets
- Digital Technical character set
- Katakana character set for Japan
- Downline-loadable characters
- Graphic printing
- Four print densities — draft, memo, NLQ, and LQ
- Bold, italics, superscript, and subscript
- High reliability

1.2 SPECIFICATIONS

The following are the specifications for the LA75 printer.

Print method	Incremental with bidirectional lookahead
Print speed	250 characters/second — draft 125 characters/second — memo 42 characters/second — near letter quality 32 characters/second — letter quality
Character format (dots)	9 × 9 standard, 11 × 12 full in draft 18 × 9 std., 22 × 12 full in memo 17 × 17 std., 21 × 23 full in NLQ 27 × 18 std., 35 × 24 full in LQ

Graphic mode	DEC mode — up to 180 dots/inch horizontally and 144 dots/inch vertically 1 to 1, 2 to 1 or 2-1/2 to 1 aspect ratios
	IBM mode — up to 240 dots/inch horizontally and 72 dots/inch vertically
Characters	DEC mode — 94 ASCII 96 Multinational 63 JIS Katakana 27 VT100 special graphic 85 Technical (scientific) graphic 1 error indicator
	IBM mode — Sets A, B, and All Characters
Character pitch	Pica pitch — 10 characters/inch, 80 characters/line
	Double width — 5 characters/inch, 40 characters/line
	Elite pitch — 12 characters/inch, 96 characters/line
	Double width — 6 characters/inch, 48 characters/line
	Compressed font — 17.1 characters/inch, 137 characters/line
	Double width — 8.55 characters/inch, 68 characters/line
	DEC-only compressed font — 16.5 chararacter/inch, 132 char/line
	DEC-only double width — 8.25 character/inch, 66 char/line

Character highlighting	Underlining Double underlining (DEC only) Bolding Italics Superscript and subscript Overscoring
Line spacing	12,8,6,4,3, or 2 lines/inch Partial line up and down, 1/12 inch
Line feed speed	600 ms/inch
Form dimensions	Single sheets: 3 to 9 inches wide
Form thickness	Up to 0.011 inches, up to 3-part form
Paper feed method	Friction feed and tractor feed from rear and tractor feed from bottom Optional automatic sheet feeder
Form loading	Single sheets from rear-top
	Continuous forms from bottom; use bottom feed when printing envelopes, labels, and multi-part forms.
	Continuous forms from rear; use rear feed when printing on single-ply paper.
Ribbon cartridge	Operator installable
Power requirements	LA75-A5 100 Vac, 50/60 Hz LA75-A2 120 Vac, 50/60 Hz
	LA75-A3 240 Vac, 50/60 Hz LA75-A4 220 Vac, 50/60 Hz
Power consumption	Less than 180 W
Weight	9.5 Kg (20 lb)
Dimensions	427 mm (W) × 345 mm (D) × 121 mm (H) (16.8 in × 13.6 in × 4.75 in)
Data interface	Serial RS423 and RS232-C (with an adaptor) EIA Standard 2 Kbyte input buffer

Character highlighting	Underlining Double underlining (DEC only) Bolding Italics Superscript and subscript Overscoring
Line spacing	12 5.0, 4.3, or 3 lines/inch Partial line up and down 1/12 inch
Line feed speed	300 msec/line
Form dimensions	Single sheets 3 to 9 inches wide
Form thickness	Up to 0.011 inches, up to 8-part form
Paper feed method	Friction feed and tractor feed from rear and tractor feed from bottom Optional automatic sheet feeder
Form loading	Single sheets from operator
	Continuous forms from bottom, use bottom feed when printing envelopes, labels, and multipart forms
	Continuous forms from rear, use rear feed when printing on single ply paper
Ribbon cartridge	Operator installable
Power requirements	115 V, 50/60 Hz 230 V, 50/60 Hz
Power consumption	Less than 150 W
Weight	9.5 kg (20 lb)
Dimensions	427 mm (W) x 343 mm (D) x 121 mm (H) (16.8 in x 13.5 in x 4.75 in)
Data interface	Serial RS423 and RS232-C (with an adapter) EIA Standard 2 Kbyte input buffer

PRINTER COMMUNICATION, CONTROLS, AND SELF-TESTS 2

This chapter describes the LA75 interface to a host computer, required data format, operating controls and set-up menu, and self-tests.

2.1 SERIAL DATA INTERFACE

The LA75 works as part of your computer system, providing hardcopy output of text or graphic. Before you can use the printer, you must establish a communication link between the printer and the computer. The communication link you must provide is a serial data interface. For hardware interface requirements, see *Installing and Using the LA75 Companion Printer.*

The following sections describe these communication characteristics.

EIA serial interface connector and interface signals
Baud rates
Data character format
Data buffering requirements

2.2 EIA INTERFACE CONNECTOR

LA75 interface signals meet EIA (Electronic Industry Association) standards RS423, RS449, and RS232-C. The EIA interface connector is the MMJ 6-pin female connector that mounts on the back of the printer. Figure 2-1 shows the EIA connector and pin numbers.

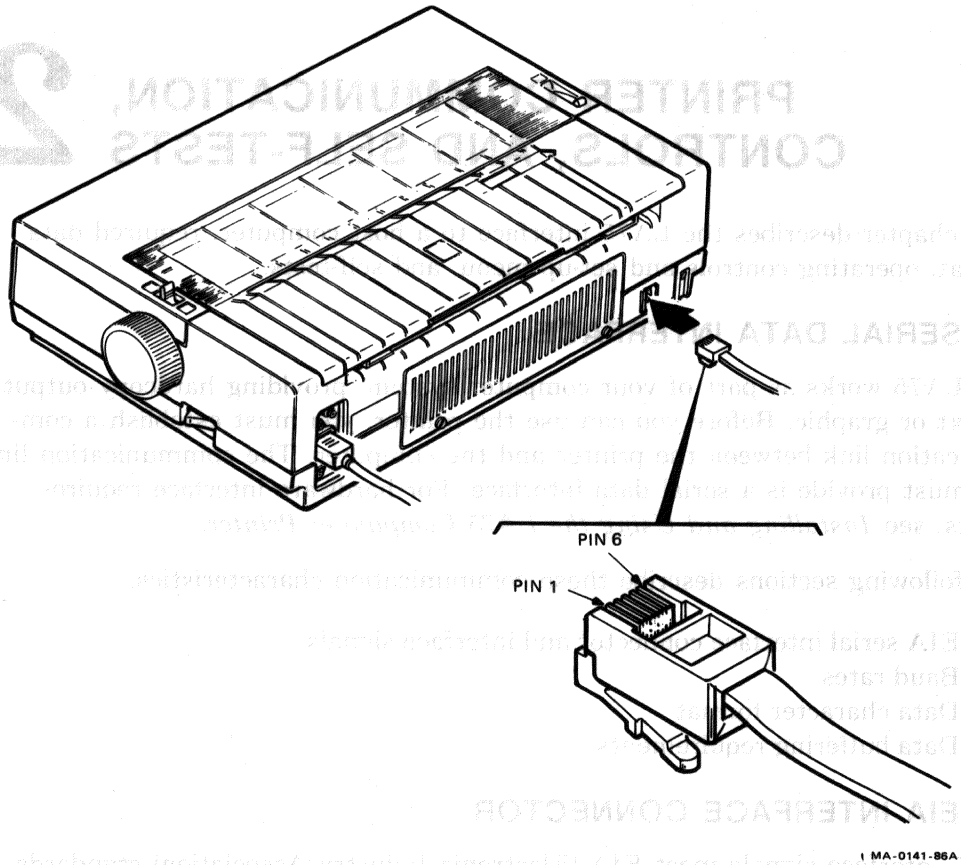

Figure 2-1 EIA MMJ Serial Interface Connector

2.3 INTERFACE SIGNALS

Table 2-1 shows pin assignments in the MMJ connector for the interface signals.

Table 2-1 Interface Signals

Pin	Direction	RS449 Name	Function	RS232-C Name
1	From printer	TR	Terminal Ready	CD
2	From printer	SD	Send Data	BA
3	From printer		Send Common	
4	To printer		Receive Common	
5	To printer	RD	Receive Data	BB
6	To printer	DM	Data Set Ready	CC

The following paragraphs describe individual signals.

2.3.1 Send Common

This line is the common ground reference potential for the Send Data and Terminal Ready interface circuits.

2.3.2 Receive Common

This line is the common ground reference potential for the Receive Data and Data Set Ready interface circuits.

2.3.3 Receive Data

The printer receives serial encoded characters from the computer on this line.

2.3.4 Send Data

The printer sends serial encoded characters to the computer on this line.

The bit rate within a character can be up to 9600 bits per second. However, the character transmission rate from the printer to the computer over any 2 characters does not exceed 100 characters per second. These limits ensure that two stop bits are always sent to the computer at baud rates above 1200 baud.

2.3.5 Terminal Ready

The printer uses this line to tell the computer when the printer is ready to send and receive data.

The ON condition indicates the printer is ready to send and receive data. The OFF condition indicates that the printer is not ready.

After the power-up initialization, the printer is ready to send and receive data. The printer remains ready to communicate indefinitely.

2.3.6 Data Set Ready

The LA75 does not use this line.

2.4 DATA FORMAT

The LA75 requires data transmission in a bit serial, asynchronous character format. This format consists of a start bit (space), 7 or 8 data bits (1 = mark, 0 = space), a selectable parity bit, and at least 1 stop bit (mark). You select the number of data bits and parity through the set-up menu (Section 2.8). The LA75 must use the same data bits and parity as your computer.

Figures 2-2 and 2-3 show the printer-to-computer and computer-to-printer character formats.

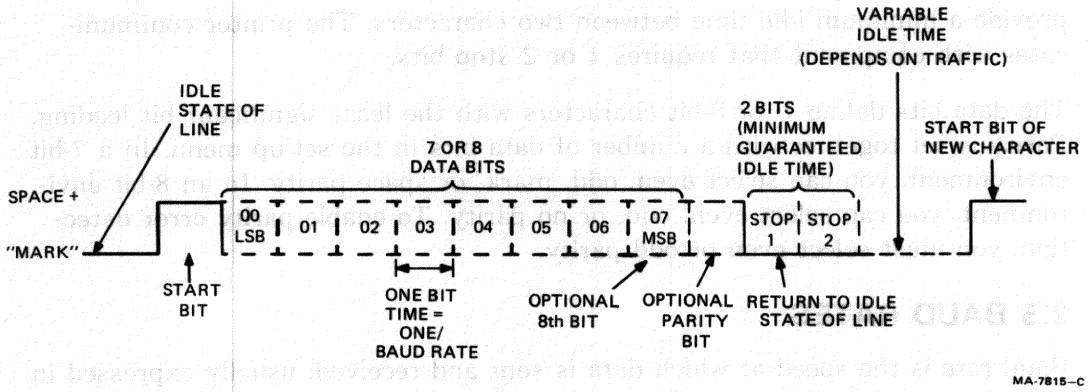

Figure 2-2 Serial Character Format (Printer-to-Computer)

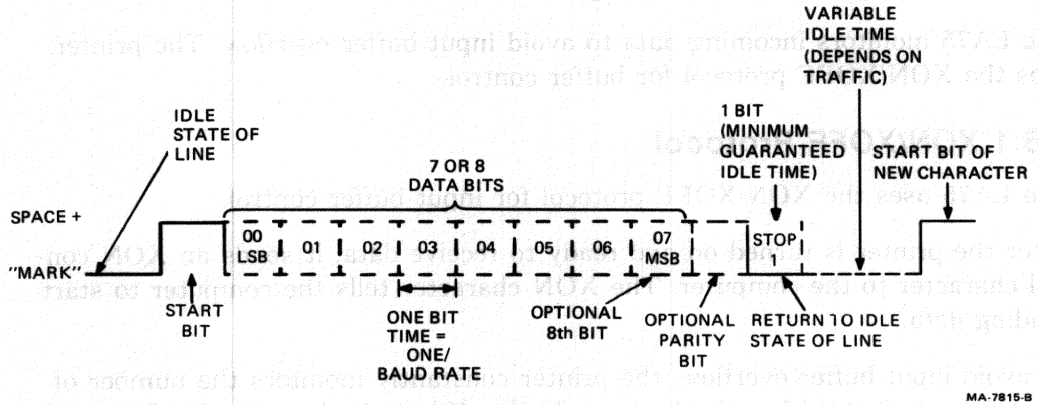

Figure 2-3 Serial Character Format (Computer-to-Printer)

The printer sends 2 stop bits between characters to the computer. Stop bits provide a minimum idle time between two characters. The printer communicates with equipment that requires 1 or 2 stop bits.

The data bits define 7- or 8-bit characters with the least significant bit leading. Parity is set together with a number of data bits in the set-up menu. In a 7-bit environment, you can select even, odd, mark, or space parity. In an 8-bit environment, you can select even, odd, or no parity. To enable parity error detection, you must select even or odd parity.

2.5 BAUD RATES

Baud rate is the speed at which data is sent and received, usually expressed in bits per second. The LA75 must use the same baud rate as your computer. You can select a printer baud rate of 110, 200, 300, 600, 1200, 2400, 4800, or 9600 bits per second. You select the baud rate through the set-up menu (Section 2.8).

2.6 INPUT BUFFER CONTROL

The LA75 monitors incoming data to avoid input buffer overflow. The printer uses the XON/XOFF protocol for buffer control.

2.6.1 XON/XOFF Protocol

The LA75 uses the XON/XOFF protocol for input buffer control.

After the printer is turned on and ready to receive data, it sends an XON control character to the computer. The XON character tells the computer to start sending data.

To avoid input buffer overflow, the printer constantly monitors the number of empty character positions in the input buffer. When the input buffer fills to 1920 (of 2048 maximum) characters, the printer sends an XOFF control character. This first XOFF character tells the computer to stop sending data.

If the computer misses the first XOFF character, the printer sends a second XOFF control character when the input buffer fills to 1984 characters. Meanwhile, the printer continues to print or process characters from the input buffer. When the input buffer drops to 1792 characters, the printer sends an XON character, telling the computer to resume sending data.

If you open the printer's access cover or run out of paper during printing, the printer continues to buffer data the usual way. (An XOFF is sent when the input buffer fills to 1920 characters.) When you close the cover or reload paper, the printer sends an XON character only when the input buffer falls below 1792 characters.

2.6.2 Input Buffer Processing

The printer temporarily stores all received characters in its input buffer before processing. The input buffer can hold 2048 (2 Kbyte) characters without losing data.

As the printer is processing data from the input buffer, it moves characters into the print buffer. The LA75 does not start printing until one of the following conditions are met:

1. A line terminator character (LF, FF, VT, CR) is received (Section 3.5).
2. In Text mode, the Autowrap feature is set and printing occurs beyond the right margin.
3. In Text mode, the printer has not received data for 500 milliseconds.
4. In Graphic mode, the printer has not received data for the last 3 seconds.

If the printer receives characters faster than it can process or print them, the input buffer may overflow. The LA75 uses the XON/XOFF protocol to avoid the input buffer overflow. If, however, the host computer ignores the XON/XOFF protocol, data may be lost. The printer replaces each lost character with a substitute (SUB) control character. The printer inserts the SUB character in the input buffer at the point of loss. SUB prints as an error character (reverse question mark).

The printer uses the same method to replace characters received with a parity or framing error.

Unlike all other DEC-made control codes and sequences, the Device Status Request (DSR) control sequence is processed out of sequence and as soon as it is received (Sections 5.3 and 5.4). The printer immediately responds to the DSR without placing it into the buffer, even when the buffer is full and an XOFF has been sent to the host computer.

2.7 FRONT PANEL CONTROLS AND OPERATING MODES

At power up the LA75 can be placed in one of two operating modes — Print or Set-up. Each switch on the LA75 control panel has two functions, one for each of these operating modes.

In Print mode, the control panel switches perform the functions that appear in white letters above the switch. In Set-up mode, the control switches perform the functions that appear in dark grey letters below the switches. The two indicators for Power and Fault operate in all modes.

Figure 2-4 shows the front control panel of the printer.

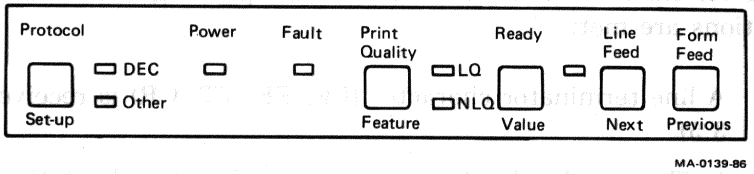

Figure 2-4 LA75 Companion Control Panel

2.7.1 Print Mode Controls and Operation

In Print mode, the printer receives input data from the host computer and prints the data. This mode operation depends on the set-up features stored in the printer's memory.

2.7.1.1 Print Mode Controls and Indicators - These controls are as follows.

1. The POWER is a green indicator that lights when the printer is powered up.
2. The FAULT is a red indicator. The FAULT indicator lights and stays on when the paper supply is out or a printhead position error is detected.

   The FAULT indicator blinks continuously when a hardware error is detected during the self-test (Section 5.9).
3. The PROTOCOL switch allows you to connect the LA75 to a different host computer. To change between DEC and OTHER protocols, press the switch once and the corresponding indicator will light.

NOTE: Use "OTHER" when you want the LA75 to emulate the IBM Proprinter.

4. The PRINT QUALITY switch allows you to force one of two print densities (LQ or NLQ) regardless of software selection. LQ stands for Letter Quality (32 cps); and NLQ stands for Near Letter Quality (42 cps). There are two indicators (LQ and NLQ) that light up at the print quality that you have selected. If both indicators are out, the software is in control of print quality selections.

NOTE: At power up, both indicators are off, and the print quality is controlled by the printer's set-up memory and software.

The LA75 has two other print qualities: memo quality (125 cps) and draft quality (250 cps) that can be selected through the set-up menu and software.

5. The READY indicator shows if the printer is "on line" or "off line" with the host computer. When the READY indicator is lit, the printer is on-line and will print incoming data from the host computer. When the indicator is off, the printer is off-line and will not print data.

   If you press the READY switch while the printer is printing (putting it "off line"), the printer completes only the line it is currently printing and then stops.

   If the printer runs out of paper, the FAULT indicator lights. You can press the READY switch to print one line at a time at the bottom of the page.

   If the access cover is open, the printer is off-line (READY indicator is off). After you close the cover, press the READY switch to put the printer on-line.

6. The LINE FEED switch advances the paper in the printer one line at a time. Holding the switch down will advance the paper a number of lines.

7. FORM FEED advances the paper in the printer by one form length at a time.

NOTE: The READY switch remains active while the printer is printing. The LINE FEED, FORM FEED, and PRINT QUALITY switches are active only when there is no error condition and the printer is idle; that is, the printer is off-line or there is no data in the input buffer. The PROTOCOL switch is only active when there is no data in the input buffer.

2.7.1.2 Using Print Mode - To run the LA75 in the Print mode, proceed as follows.

1. Set the power switch to 1 (on).

2. Load the paper now or anytime during operation.

3. The green POWER indicator will light. The READY indicator is lit to indicate that the printer is on-line with paper loaded and the cover closed.

4. Choose the protocol, if necessary. The indicator next to your choice will light.

NOTE: The PROTOCOL switch does not work if the printer is off-line and there is data in the input buffer.

5. Choose the print quality. Use the PRINT QUALITY switch if you want to change from the software-set print quality or if you want to change between the letter quality (LQ) and near letter quality (NLQ) printing. The indicator next to your choice will light.

   You are now ready to print.

NOTE: If you press this switch, you force print quality selection and software selection is disabled.

2.7.2 Set-up Mode Controls and Operation

You can enter the Set-up mode to change the operating features of the printer. The controls are shown on the front panel in dark grey.

You enter the Set-up mode at power up while pressing the SET-UP switch. The printer then automatically prints out the current printer settings and sets itself to the Feature Select state.

NOTE: On the set-up menu, "DEC" indicates DEC protocol features, and "Emulation" indicates IBM Proprinter features.

The FEATURE switch allows you to move between two select states (Paragraph 2.7.2.1), selecting set-up features.

The VALUE switch allows you to get into value select state and to select or change the feature's value.

The NEXT switch lists and steps through the next feature or value when you are setting your printer's configuration. Each time you press NEXT, the printer advances one feature or value, depending on which select state the printer is in.

The PREVIOUS switch goes back one feature or value when you are setting your printer's configuration. Each time you press PREVIOUS, the printer steps back one feature or value, depending on which select state the printer is in.

2.7.2.1 Select States - There are two select states in the Set-up mode: Feature Select and Value Select.

In the Feature Select state you can step through the list of printer features, and see what value is presently stored in the printer's memory. Feature Select is accessed through the FEATURE switch.

In the Value Select state you can step through the list of values for each feature until you find the one you want to store in the printer's memory. Value Select is accessed through the VALUE switch.

2.7.2.2 Entering Set-up Mode - To enter this mode, proceed as follows.

NOTE: Make sure the power switch is set to the off position and that paper is loaded in the printer.

1. Press and hold the SET-UP switch while you set the power switch to 1 (on).
2. The green Power indicator lights. The indicator next to OTHER on the PROTOCOL switch starts flashing and continues to flash throughout the set-up procedure to indicate that the printer is in the set-up mode. The lower (NLQ) indicator on the FEATURE switch will also begin flashing to indicate that the printer is in the Feature Select state.
3. The printer will automatically (Figure 2-5):
   - print a firmware version number,
   - print a list of the features and values stored in the printer,
   - print out the first feature in the list (Baud Rate), and its value, and
   - advance the paper five times.

LA75-S Code Version 1.0

Feature		Value	
1	Baud Rate	7	4800
2	Data Bits and Parity	7	8-None
3	Protocol	1	DEC
4	Form Length	2	11 inches
5	Character Set (DEC)	1	U.S. ASCII
6	Supplemental Character Set (DEC)	1	DEC Supplemental
7	Print Density (DEC)	1	Draft
8	Printer ID (DEC)	1	LA50 ID
9	Text Mode Right Margin (DEC)	1	Truncate
10	Auto LF on CR (DEC)	2	NO Auto LF
11	Auto CR on LF (DEC)	2	NO Auto CR
12	CAN Control Code (DEC)	1	Cancel Control Functions
13	80 or 132 Columns (DEC)	1	80 Columns
14	Paper Out Bell (Emulation)	2	On
15	Slashed Zero (Emulation)	2	Zero without slash
16	Auto LF on CR (Emulation)	2	No auto LF
17	Active Character Set (Emulation)	1	Graphics set A
18	Auto CR on LF (Emulation)	2	No auto CR
19	Power-up Density (Emulation)	1	Draft
20	LQ or NLQ (Emulation)	1	Select NLQ
1	Baud Rate	7	4800

MA-0170-86

Figure 2-5 LA75 Set-up Menu

2.7.2.3 Changing Set-up Parameters - Once the printer is in the Feature Select state, there are two choices. If you want to keep the value for the first feature listed, and review the next feature, press NEXT. The printer prints the next feature and its value, and advances another 5 lines.

If you want to change the value for the first, or any other feature listed, you must enter the Value Select state, and proceed as follows.

1. Press the VALUE switch.

NOTE: The indicator on the VALUE switch will begin to flash; the indicator on the FEATURE switch will stop flashing.

2. Press NEXT or PREVIOUS to step through the value options for a feature. After you step through the last value, the list begins again with the first value.

NOTE: Each time you press NEXT or PREVIOUS, a new value is selected and printed, and the paper then advances 5 lines. If you press NEXT or PREVIOUS continuously, the LA75 prints values one line at a time. When you stop pressing the switch, the paper is advanced 5 lines.

3. Stop at the value you want to select. It will be saved and made active when you leave the Set-up mode later.

   Now you can return to the Feature Select state by pressing the FEATURE switch to list the next feature and its value.

2.7.2.4 Re-entering the Feature Select State - After changing the value setting(s), you can return the printer to the Feature Select state as follows.

1. Press the FEATURE switch to re-enter the Feature Select state.

NOTE: The indicator on the VALUE switch stops flashing; the indicator on the FEATURE switch begins flashing.

2. Press NEXT to list the next feature and its current value. Press PREVIOUS to list the previous feature and its current value.

NOTE: Each time you press NEXT or PREVIOUS, a new feature and its value is printed, and the paper advances 5 lines. If you press NEXT or PREVIOUS continuously, the printer prints the list of features and their values one line at a time. When you stop pressing the switch, the paper advances 5 lines.

3. Stop at the feature whose value you want to change. Enter the Value Select state by pressing the VALUE switch.

NOTE: If you return to the same feature several times without exiting the Set-up mode, the printer will show the value that was previously stored in the set-up memory.

2.7.2.5 Saving New Values and Exiting Set-up Mode - To do this, press the SET-UP switch once. The feature/value changes are now stored in the printer's set-up memory.

The printer then automatically returns to the Print mode and moves to the next page.

NOTE: If you turn off the printer's power before you press the SET-UP switch, the new values will not be saved in the printer's set-up memory.

2.8 SET-UP MENU

The Set-up menu gives you access to the LA75 printer memory. The memory stores the list of all of the printer's features and values as well as the values that you (or the factory at the time of shipping) have selected to run the printer. You can access the set-up menu through the procedure described in Paragraph 2.7.3.

Table 2-2 shows the LA75 Set-up menu and the factory setting value for each feature. Figure 2-5 is the printout of the actual LA75 Set-up menu.

Table 2-2 LA75 Features, Values and Factory Settings

Feature Number	Feature	Value Number	Value	
1	Baud Rate	1	110	
		2	200	
		3	300	
		4	600	
		5	1200	
		6	2400	
		7	4800	Factory Setting
		8	9600	
2	Data Bits and Parity	1	7-Even	
		2	7-Odd	
		3	7-Space	
		4	7-Mark	
		5	8-Even	
		6	8-Odd	
		7	8-None	Factory Setting
3	Protocol	1	DEC	Factory Setting
		2	Other	
4	Form Length	1	12 inches	
		2	11 inches	Factory Setting
5	Character Set (DEC)	1	U.S. ASCII	Factory Setting
		2	Great Britian	
		3	DEC Finland	
		4	France	
		5	DEC French Canada	
		6	Germany	
		7	Italy	
		8	JIS Roman	
		9	DEC Norway/Denmark	
		10	Spain	
		11	DEC Sweden	
		12	Norway/Denmark	
		13	DEC Dutch	
		14	DEC Swiss	
		15	Portugal	
		16	Reserved*	

*Value 16 shows "Reserved" (available for future use).

Table 2-2 LA75 Features, Values and Factory Settings (Cont)

Feature Number	Feature	Value Number	Value	
6	Supplemental Character Set (DEC)	1	DEC Supplemental	Factory Setting
		2	ISO Supplemental	
		3	DEC Technical	
		4	Katakana	
7	Print Density (DEC)	1	Draft	Factory Setting
		2	Memo	
		3	NLQ	
		4	LQ	
8	Printer ID (DEC)	1	LA50 ID	Factory Setting
		2	LA210 ID	
		3	Conformance Level 2	
9	Text Mode Right Margin (DEC)	1	Truncate	Factory Setting
		2	Wrap	
10	Auto LF on CR (DEC)	1	Auto LF on CR	
		2	No Auto LF	Factory Setting
11	Auto CR on LF (DEC)	1	Auto CR on LF	
		2	No Auto CR	Factory Setting
12	CAN Control Code (DEC)	1	Cancel Control Functions	Factory Setting
		2	Kill Buffer	
13	80 or 132 Columns (DEC)	1	80 columns	Factory Setting
		2	132 columns	
14	Paper Out Bell (Emulation)	1	Off	
		2	On	Factory Setting
15	Slashed Zero (Emulation)	1	Zero with slash	
		2	Zero without slash	Factory Setting
16	Auto LF on CR (Emulation)	1	Auto LF on CR	
		2	No auto line feed	Factory Setting

Table 2-2 LA75 Features, Values and Factory Settings (Cont)

Feature Number	Feature	Value Number	Value	
17	Active Character Set (Emulation)	1	Graphics Set A	Factory Setting
		2	Graphics Set B	
18	Auto CR on LF (Emulation)	1	Auto CR on LF	
		2	No auto CR	Factory Setting
19	Power-Up Print Quality (Emulation)	1	Draft	Factory Setting
		2	LQ or NLQ	
20	LQ/NLQ Select (Emulation)	1	Select NLQ	Factory Setting
		2	Select LQ	

2.8.1 Features 1 — 4

These features set the values for baud rate, data bits and parity, form length, and protocol. They should be set to correspond to the information provided in your host computer's user guide (or equivalent manual). These settings are active all the time.

1. Baud Rate
   The baud rate is the speed (bits per second) at which the computer communicates with the printer.

2. Data Bits and Parity
   Data bits and parity determine the format that the printer will use to communicate with the host computer.

3. Protocol
   Protocol determines what software the LA75 is compatible with. Value 1 (DEC) sets the printer to be compatible with Digital computers. Value 2 (Other) sets the printer to be compatible with software written for IBM Proprinter.

4. Form Length
   Form Length effects the form feed function. It allows you to manually define the form length at either 11 or 12 inches depending on the paper you are using.

2.8.2 Features 5 — 13 DEC Protocol

These features are active if you have selected "DEC" for the Protocol feature.

5. Character Set (1 through 16)
   Character Set defines the active character sets on power up. Choose the character set that matches the language you had used to develop your files. Refer to Appendix A in this manual for all available character sets.

6. Supplemental Character Set
   This feature allows you to choose one of four supplemental character sets.

7. Print Density
   Print density determines the quality of printing your printer will provide when it is turned on. The print densities are draft (250 cps), Memo (125 cps), Near Letter Quality (42 cps), and Letter Quality (32 cps).

8. Printer ID
   Printer ID defines the power-up device name used by the printer when responding to requests from your host computer. LA50 ID allows the printer to function as an LA50. LA210 ID allows it to function and respond as an LA210. Conformance Level 2 allows it to respond as a Level 2 device (functionally equivalent to LA210 printer).

9. Text Mode Right Margin
   This feature controls processing of characters that go beyond the right margin. "Truncate" will ignore the characters in a line that exceed the right margin. "Wrap" will print the characters that exceed the right margin on the next line beginning at the left margin.

10. Auto Line Feed on CR
    This feature determines if the printer performs an automatic line feed (LF) on receiving the Carriage Return control code.

11. Auto Carriage Return on LF
This feature determines if the printer performs an automatic carriage return (CR) on receiving the Line Feed control code.

12. CAN Control Code
This feature allows you to define the CAN function. When you select "1," CAN cancels any escape or control function currently processed. When you select "2," CAN erases the input buffer.

13. 80 or 132 Columns
This feature allows you to select print line width on power-up — 80 (10 char/inch) or 132 columns (16.5 char/inch).

2.8.3 Features 14 — 20 "Other" Protocol (IBM Emulation)

When you select "Other" for the Protocol feature, you may want to set Features 14 — 20.

14. Paper-Out Bell
Paper-Out Bell determines defines whether the printer will sound a bell when paper-out signal is detected.

15. Slashed Zero
Slashed Zero gives you the choice of defining how the zero will be printed — with or without a slash through it.

16. Auto Line Feed on CR
This feature determines whether the printer performs an automatic Line Feed (LF) on receiving the Carriage Return (CR) control code.

17. Active Character Set
Active Character Set defines which graphic set the printer will use on power up — set A or B (Chapter 7).

18. Auto Carriage Return on LF
This feature determines whether the printer will automatically perform a carriage return on receiving the Line Feed (LF) control code.

19. Power-Up Print Density
This feature determines the print quality your printer will provide when it is turned on. It can be draft printing or letter quality selection (through Feature #20).

20. LQ or NLQ
This feature defines the print quality (LQ or NLQ) your printer will provide when you select LQ/NLQ printing through the software or Feature #19.

2.9 FACTORY-SET POWER-ON STATUS

Table 2-3 lists initial power-on conditions for printer operating parameters. Several parameters are switch-selectable through the set-up menu (Section 2.8) and may have one of several settings.

Table 2-3 Power-On Status

Program Selectable Parameters	Control Function	Power-on Status
Printing status		On-Line (Ready)
Horizontal pitch	DECSHORP	Set-up feature #13 (10 or 16.5 cpi)
Vertical pitch	DECVERP	6 lines/inch
Forms length	DECSLPP	Set-up feature #4 (11 or 12 inches)
Active position		column 1, line 1
Compatibility mode	DECIPEM	Set by menu
Underlining	SGR	Disabled
Double underlining	SGR	Disabled
Bolding	SGR	Disabled
Italics	SGR	Disabled
Superscript	SGR	Disabled
Subscript	SGR	Disabled
Unsolicited status	DSR	Disabled
Printing density	DECDEN	Set by menu
GL character set		Same as G0
GR character set		Same as G2
G0 to G2		Set by menu
G3		U.S. ASCII
Autowrap mode		Set by menu
Horizontal tabs	HTS, DECSHTS, DECHTS	Set at every eighth column

Table 2-3 Power-On Status (Cont)

Program Selectable Parameters	Control Function	Power-on Status
Vertical tabs	VTS, DECSVTS, DECVTS	Set at every line
Carriage return/ Newline mode	DECCCRNLM	Set by menu
Linefeed/Newline mode	LNM	Set by menu
Conformance level	DECSCL	Set by menu

2.10 SELF-TESTS

The LA75 has self-tests that check internal logic and printhead/carriage operation. If the selected test fails, the FAULT indicator on the front panel starts blinking. Refer to the manual *Installing and Using the LA75 Companion Printer* or call Digital Field Service.

2.10.1 Power-Up Self-Test

This self-test automatically checks out the internal logic at power-up.

2.10.2 Printing Self-Test

You can start this test by pressing the FORM FEED switch while turning power on. The printer should print 94 ASCII characters continuously in a 80-character wide swirl pattern (Figure 2-6).

To stop the test, turn the printer off.

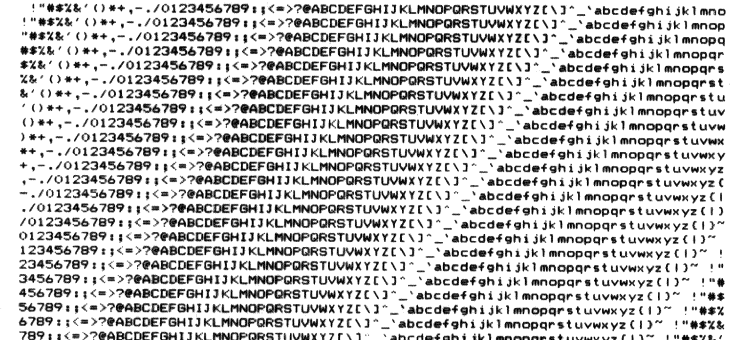

Figure 2-6 Printing Self-Test

PART 2
LA75 IN DEC-COMPATIBLE MODE

CHAPTER 3 CHARACTER PROCESSING 37

CHAPTER 4 ESCAPE AND CONTROL SEQUENCES FOR TEXT MODE 51

CHAPTER 5 STATUS, REPORT AND RESET SEQUENCES 105

CHAPTER 6 GRAPHIC MODE 115

CHARACTER PROCESSING 3

This chapter describes how the LA75 processes printable and control characters when operating in DEC-compatible text mode.

3.1 DEC CONFORMANCE LEVEL INTRODUCTION

The printer's ability to perform certain printing and control functions depends on the Conformance Level setting. The LA75 can be set to two Conformance Levels — Level 1 or Level 2.

Level 1 provides basic functionality and emulates the Digital LA50 printer, while Level 2 supports expanded functionality and emulates the Digital LA210 printer.

You can select the Power-up Conformance Level through the set-up menu using the PRINTER ID feature (Section 2.8). The LA50 ID provides Level 1 performance. The LA210 and Level 2 IDs provide Level 2 performance.

Level 1 functions are always active in the LA75. Level 2 functions become active only if the printer is set as a Level 2 device.

For more information on Level 1 and 2 functions, refer to Section 4.4.

3.2 CODING STANDARDS

The LA75 processes characters according to the American National Standards Institute (ANSI) standard X3.4-1977. The ANSI standard is based on the character's category, either printable or control. Categories are defined by the American Standard Code for Information Interchange (ASCII).

Control characters do not print. They affect how the printer processes, sends, and prints characters.

3.3 7-BIT AND 8-BIT ENVIRONMENTS

The LA75 is set to send and receive 7- or 8-bit data through the Set-up menu (Section 2.8). In a 7-bit environment, 128 control and printable character codes are available (Figure 3-1). In an 8-bit environment, 256 control and printable character codes are available (Figure 3-2).

Figure 3-1 is the standard U.S. ASCII character set table. Figure 3-2 is the 8-bit DEC multinational character set. Figure 3-3 is the ISO multinational (ISO Latin-1) character set.

A character set table shows all the characters in a character set. The table also shows the codes for each character. You can represent a character by its position (column/row) in a table. For example, you can represent the character H in Figure 3-1 as 4/8 (column 4/row 8). This manual uses this notation.

The 8-bit character set has twice as many characters as the 7-bit set. The left half of the 8-bit set is identical to the 7-bit set.

You can tell whether a character is a printable character or a control character by looking at its position in the character set table.

There are two sets of control characters, C0 and C1. C0 characters are 7-bit (that is, the eighth bit is set to 0) control characters. The characters from 0/0 to 1/15 in both tables are C0 control characters. C1 characters are 8-bit (the eighth bit is 1) control characters and are located in the positions from 8/0 to 9/15 in the 8-bit table. You can use C1 characters only in an 8-bit environment.

You can use two sets of printable characters at one time. The printer stores the two active sets in areas called GL (graphic left) and GR (graphic right). GL characters are 7-bit printable characters. The characters from 2/1 to 7/14 in both tables are GL characters. GR characters are 8-bit printable characters. The characters from 10/1 to 15/14 in the 8-bit table are GR characters. You can use GR codes only in an 8-bit environment.

BITS B7 B6 B5 / B4 B3 B2 B1	ROW	COLUMN 0 (0 0 0)		1 (0 0 1)		2 (0 1 0)		3 (0 1 1)		4 (1 0 0)		5 (1 0 1)		6 (1 1 0)		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		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

MA-7247T

Figure 3-1 7-Bit U.S. ASCII Character Set

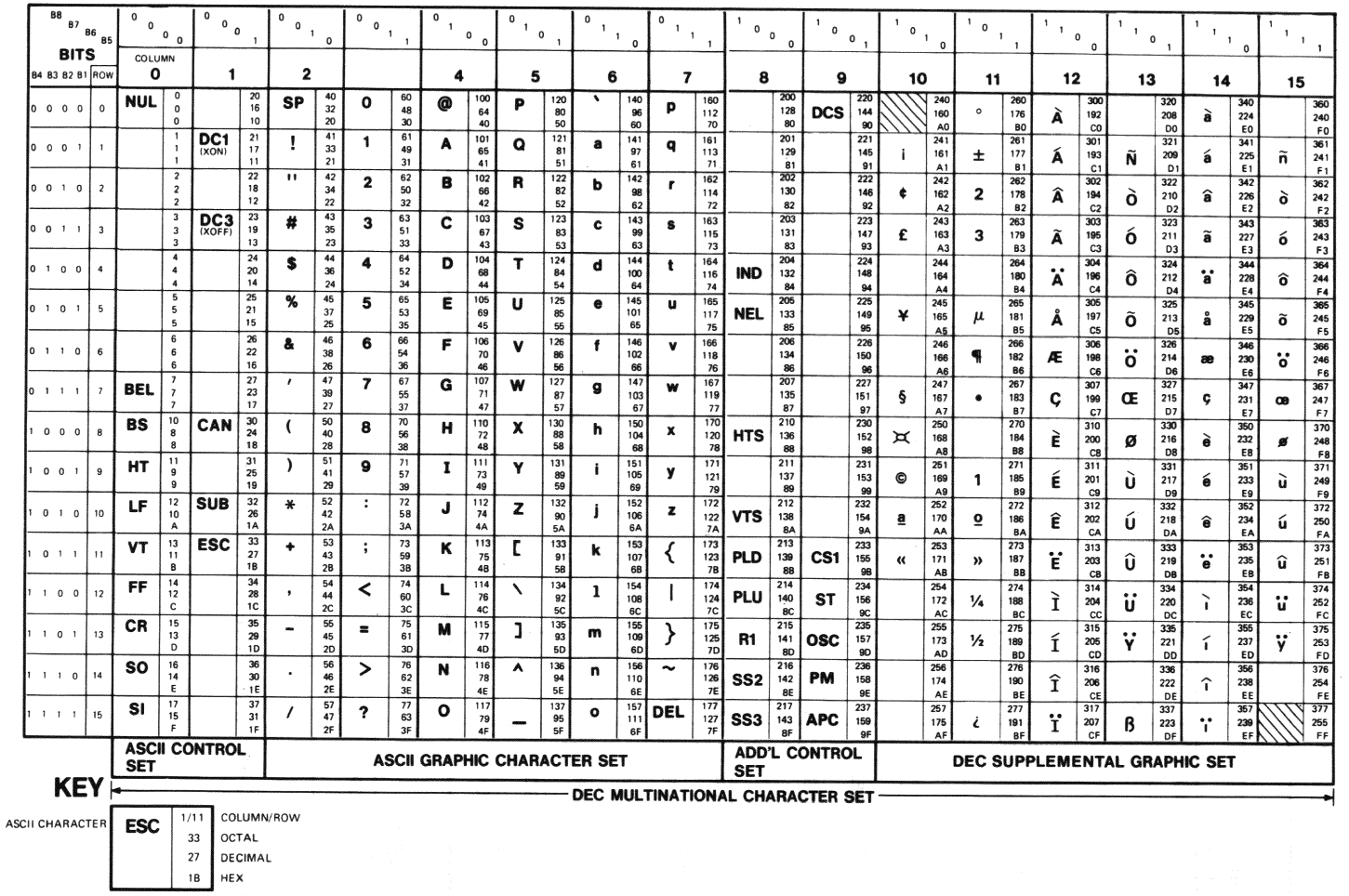

Figure 3-2 8-Bit DEC Multinational Character Set

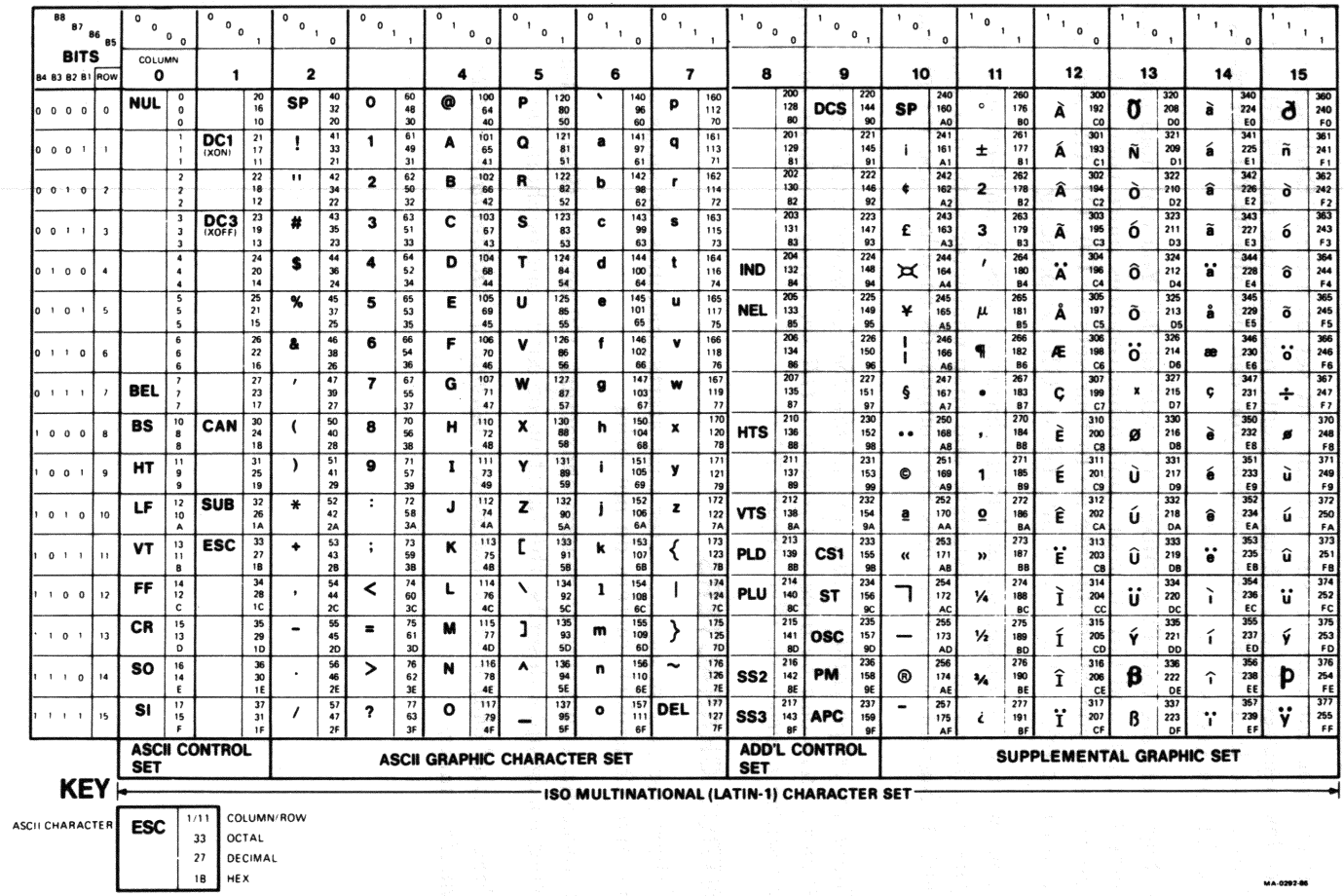

Figure 3-3 8-Bit ISO Multinational Character Set

3.4 CHARACTER SET MAPPING

The printer lets you use one GL set and one GR set at a time. Each set has 94 character codes reserved. In a 7-bit environment, you can use the 94 GL set codes (2/1 to 7/14). In an 8-bit environment, you can use the 94 GL set codes plus the 94 GR set codes (10/1 to 15/14).

Printable characters are usually grouped into sets of 94. You can map any two available sets into GL and GR. If your application requires more then 188 printable characters, you can designate up to four sets as G0, G1, G2, and G3. Then, you can map one of those sets into GL or GR for printing.

Figure 3-4 shows how to designate and map character sets in an 8-bit environment. Figure 3-5 shows hows to designate and map character sets in a 7-bit environment. Paragraph 4.5.5 describes the commands to select specific character sets.

NOTE: There are 96 printable characters in the ISO supplemental character set. All 96 characters can be accessed from the GR set using locations 10/0 and 15/15 as printable characters. (See Figure 3-3.)

3.5 CONTROL CHARACTERS

A control character is a single character that starts, modifies, or stops a printer function. Control characters do not print.

The LA75 recognizes two sets of control characters, C0 and C1 (Figure 3-2). The following paragraphs describe the function of each control character.

NOTE: Each control character is assigned a mnemonic (abbreviation of the control function name).

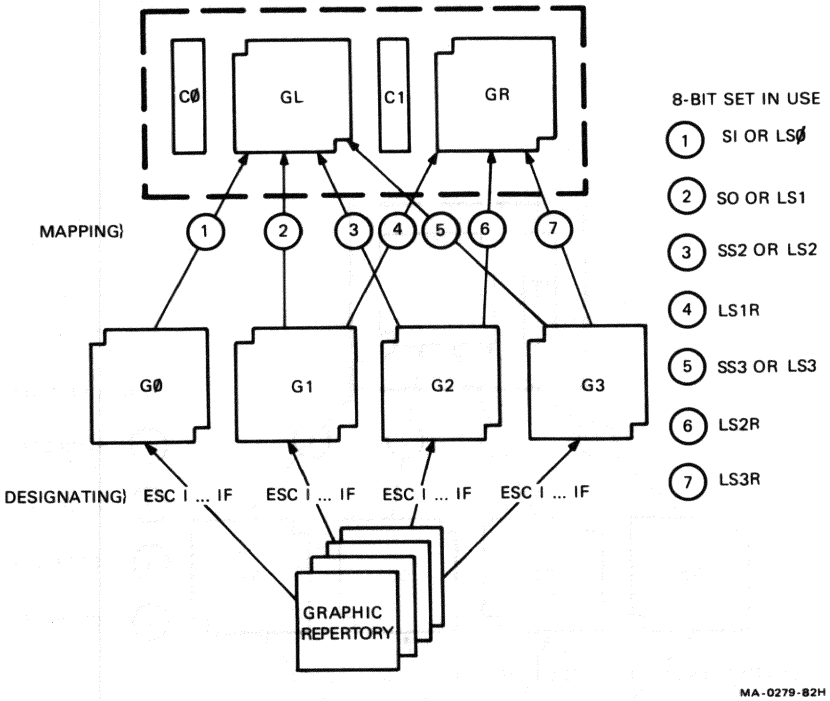

Figure 3-4 Designating and Mapping Character Sets (8-Bit Environment)

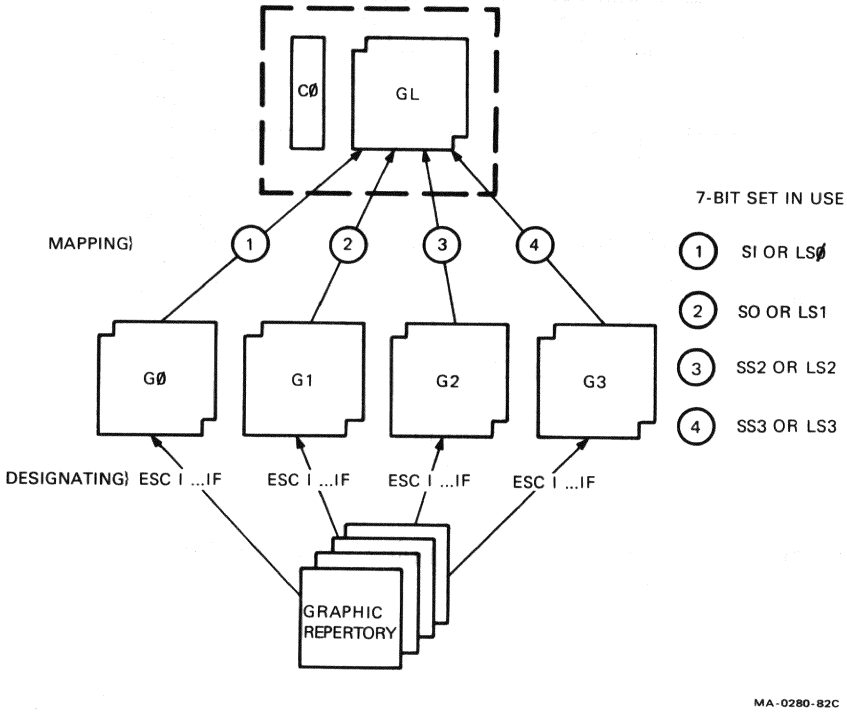

Figure 3-5 Designating and Mapping Character Sets (7-Bit Environment)

3.5.1 C0 (7-Bit) Control Characters

Table 3-1 lists the C0 control characters that the LA75 printer recognizes.

Table 3-1 C0 (7-Bit) Text Mode Control Characters

Column/Row	Mnemonic	Function
Printer Control Functions		
0/7	BEL	Bell
0/8	BS	Backspace
0/9	HT	Horizontal tab
0/10	LF	Line feed
0/11	VT	Vertical tab
0/12	FF	Form feed
0/13	CR	Carriage return
Character Set Control Functions		
0/14	SO	Shift out
0/15	SI	Shift in
Communication Control Functions		
0/0	NUL	Null
1/1	DC1	XON
1/3	DC3	XOFF
1/8	CAN	Cancel
1/10	SUB	Substitute
1/11	ESC	Escape

NOTE: The printer ignores all other ASCII C0 control characters.

3.5.1.1 Bell (BEL) - This character causes the bell to sound for 300 milliseconds (0.3 seconds).

3.5.1.2 Backspace (BS) - This character decreases the active column by one column space at the current horizontal pitch (Paragraph 4.5.2). If the active column is at the left margin, the BS character is ignored.

If the active column is one column beyond the right margin, you can use a BS character to print or overprint at the right margin.

3.5.1.3 Horizontal Tab (HT) - A horizontal tab is a preselected print position on a line. When the printer receives an HT character, the printhead advances to the next tab position on the line. Starting at column 9, the printer has default horizontal tab stops every 8 columns. Each time you change the horizontal pitch (Paragraph 4.4.1), the horizontal tab positions change appropriately.

NOTE: Horizontal tab stops can be changed only if you activate Level 2 (Level 2/LA210) functions.

When there are no more tab stops to the right of the active column, the right margin feature selection in the set-up menu controls the effect of an HT character (Section 2.8).

- If the right margin switch is set to wrap and HT is received, a printable character (including a space) causes the printer to perform a carriage return and line feed.
- If the right margin switch is set to truncate and HT is received, the printer ignores printable characters (including spaces) until the active column returns to the printable area.

3.5.1.4 Line Feed (LF) - This character increases the active line by one line at the current vertical pitch (Paragraph 4.4.2). If less than one line remains unprinted on the current page, the LF character sets the active line to the top-of-form position on the next page.

3.5.1.5 Vertical Tab (VT) - A vertical tab is a preselected line setting on a page. When the printer receives a VT character, the active line moves to the next tab position on the page. The printer has default vertical tab stops at every line. (This effectively causes the VT character to be processed as a LF character.)

Each time you change the vertical pitch (Paragraph 4.4.2), vertical tab positions change appropriately.

NOTE: You can set and reset the vertical tab stops only if the printer is set to Level 2 conformance (Paragraph 4.6.5).

3.5.1.6 Form Feed (FF) - This character advances the active line to the next top-of-form position (Paragraph 4.5.4).

3.5.1.7 Carriage Return (CR) - This character sets the active column to the left margin.

3.5.1.8 Shift Out (SO) - This character selects the G1 character set as the GL active character set.

3.5.1.9 Shift In (SI) - This character selects the G0 character set as the GL active character set.

3.5.1.10 Null (NUL) - This character does not affect the printer's operation.

3.5.1.11 XON (DC1) - This character performs no action. It is sent by the printer for input buffer control.

3.5.1.12 XOFF (DC3) - This character performs no action. It is sent by the printer for input buffer control.

3.5.1.13 Cancel (CAN) - Depending on selection of the CAN Control Code feature in the set-up menu (Section 2.8), this character can perform one of two functions:

1. If the CAN feature is set to "Cancel Control Functions," the CAN control character immediately cancels (without executing) any escape sequence, control sequence, or control string currently being processed.
2. If the CAN feature is set to "Kill Buffer," the CAN character, upon entering the input buffer, immediately clears the entire input buffer. The Kill Buffer command acts even if the printer has sent the XOFF to the host computer.

NOTE: The Kill Buffer command does not reset the printer to its initial state. All data including unprocessed control functions in the buffer are lost. Therefore, it is strongly recommended that you follow the Kill Buffer command with the DECSTR reset sequence (Section 5.6) to put the printer in a known state.

The Kill Buffer command is intended to be used for immediate control purposes and should be used with caution.

3.5.1.14 Substitute (SUB) - This character immediately stops the processing of any escape or control sequence. The SUB character prints as the error character (reverse question mark).

3.5.1.15 Escape (ESC) - This character introduces an escape sequence (Chapter 4).

3.5.2 C1 (8-Bit) Text Control Characters

Table 3-2 lists the C1 control characters the LA75 printer recognizes.

Table 3-2 C1 (8-Bit) Text Mode Control Characters

Column/Row	Mnemonic	Function
Printer Control Functions		
8/11	PLD	Partial line down
9/12	PLU	Partial line up
8/4	IND	Forward index (Level 2)
8/5	NEL	Next line (Level 2)
8/8	HTS	Horizontal tab set (Level 2)
8/10	VTS	Vertical tab set (Level 2)
Character Set Control Functions		
8/14	SS2	Single shift 2
8/15	SS3	Single shift 3
Communication Control Functions		
9/0	DCS	Device control string
9/11	CSI	Control sequence introducer
9/12	ST	String terminator
9/13	OSC	Operating System command
9/14	PM	Privacy Message
9/15	APC	Application Program Command

NOTE: The printer ignores all other C1 control characters.

3.5.2.1 Partial Line Down (PLD) - This character advances the paper 1/12 inch (Paragraph 4.5.1).

3.5.2.2 Partial Line Up (PLU) - This character reverses the paper 1/12 inch (Paragraph 4.5.1).

3.5.2.3 IND, NEL, HTS, and VTS - These control characters are Level 2 functions (Section 4.5.6).

3.5.2.4 Single Shift 2 (SS2) - This character selects the next printable character from the G2 character set (Paragraph 4.5.5).

3.5.2.5 Single Shift 3 (SS3) - This character selects the next printable character from the G3 character set (Paragraph 4.5.5).

3.5.2.6 Device Control String (DCS) Introducer - This character introduces a device control string. See Paragraph 4.1.3 for a description of DCS format and functions.

3.5.2.7 Control Sequence Introducer (CSI) - This character introduces a control sequence. See Paragraph 4.1.2 for a description of the control sequence format.

3.5.2.8 String Terminator (ST) - ST terminates a control string. See Paragraph 4.1.3 for a description and a list of control strings.

3.5.2.9 OSC, PM, and APC - These control characters introduce unused control strings. See Paragraph 4.1.3 for more information on unused control strings.

3.6 PRINTABLE, SPACE AND SPECIAL CHARACTERS

The LA75 usually interprets characters in the column/row range of 2/0 to 7/14 (GL) and 10/1 to 15/14 (GR) as printable characters. The space (SP) character is 2/0.

The LA75 prints a character at the active position on a page, defined by the active column and active line. Each printable or space character then increases the active column by one active column, advancing the printhead one column at the current horizontal pitch (Paragraph 4.5.2).

If the active column is at the right margin, the right margin feature selection in the set-up menu (Section 2.8) controls the effect of the next printable character as described in Paragraph 3.5.1.3.

The DEL character (7/15) is normally ignored.

The characters at 10/0 and 15/15 have a special effect on printer operation. In text mode, the printer normally processes the 10/0 character as an error character (reverse question mark). However, if a 96-character set resides in the GR, this character is processed as a normal printable character.

The printer normally ignores the 15/15 character. However, if the 96-character set resides in the GR, this character is processed as a normal printable character.

3.7 CHARACTER CELL

The LA75 prints characters using up to 12 dots (Draft mode) or up to 24 dots (LQ mode) vertically. However, the printhead has only 9 actual elements at 1/72″ spacing. Characters larger that 9 must be printed on a second pass of the printhead. Table 3-3 shows which dots are addressed for various printing modes and characters.

Table 3-3 Character Generation

Character Group/Attribute	Printhead Elements Used	
	Draft	LQ (2 Pass Printing)
Capitals	1 — 7	1 — 14
Lower Case	3 — 9	5 — 18
Ascenders	1 and 2	1 — 4
Descenders	8 and 9	15 — 18
ASCII Underline Character	9	17
VT100 Line Drawing Characters	1 — 12 (2 pass)	1 — 24 (4 pass)
Digital Technical Composite Characters	1 — 12 (2 pass)	1 — 24 (4 pass)
(SGR) Underline	9	17
(SGR) Double Underline	10 and 12 (2 pass)	19 and 23 (3 pass)

ESCAPE AND CONTROL SEQUENCES FOR TEXT MODE 4

This chapter describes the text mode control functions and their use in controlling the LA75 text printing in DEC mode. These control functions are grouped into two categories — Conformance Level 1 and Conformance Level 2 functions.

4.1 ESCAPE SEQUENCE, CONTROL SEQUENCE, AND CONTROL STRING FORMATS

The LA75 uses escape and control sequences standardized by the American National Standards Institute (ANSI) to control many of its functions. Other LA75 functions have escape sequences defined within the parameters of the ANSI standard. ANSI standards X3.4-1977 and X3.32-1973 define the escape and control sequences used in this chapter.

4.1.1 Escape Sequence Format

The LA75 format for an escape sequence is as follows.

ESC	I	F
1/11	2/0 to 2/15	3/0 to 7/14
Escape Sequence Introducer	Intermediate Characters (0 or more characters)	Final Character (1 character)

The *escape sequence introducer* is the ESC control character (1/11). When the printer receives the ESC character, the printer processes the following characters as part of the escape sequence, rather than printing them. The characters must be in the correct escape sequence format to be processed correctly.

A character received after ESC in the 2/0 to 2/15 range is an *intermediate character.* (The numbers 2/0 and 2/15 indicate a position in a character set table, such as Figure 3-1.) The printer may process zero, one, or more intermediate characters in a valid LA75 escape sequence.

A character received after ESC in the 3/0 to 7/14 range is a *final character.* The final character indicates the end of the escape sequence. The intermediate and final characters together define the function of the sequence. The printer performs the action specified by the sequence, then continues to process received characters as specified.

The printer ignores sequences it does not recognize.

Example

Action:

Assign the U.S. ASCII character set as the G0 set.

Sequence:

ESC	**(**	**B**
1/11	2/8	4/2
|	|	|
|	|	|
|	|	Final Character
|	Intermediate Character	
Escape Sequence Introducer		

4.1.2 Control Sequence Format

The LA75 format for a control sequence is as follows.

CSI	**P...P**	**I**	**F**
9/11	3/0 — 3/15	2/0 — 2/15	4/0 — 7/14
Control Sequence Introducer	Parameter Characters (0 or more characters)	Intermediate Characters (0 or more characters)	Final Character (1 character)

The *control sequence introducer* (CSI) is the 8-bit C1 control character (9/11). You can also use the equivalent 7-bit sequence ESC [(1/11, 5/11). See Section 4.2 for C1 control characters and their equivalent 7-bit sequences. After receiving the CSI, the printer stores (but does not print) the next received characters as part of the sequence. The characters must be in the correct format, as follows.

Parameter characters are characters received after the CSI, in the 3/0 to 3/15 range. A parameter character (usually an ASCII digit) modifies the action or interpretation of the sequence. All parameters are interpreted as unsigned decimal integers, with the most significant digit sent first. Leading zeros are allowed but are not necessary. Plus and minus signs are not allowed in parameter characters. You must separate parameters with a semicolon ; (3/11).

The printer processes two types of parameters, numeric and selective. A numeric parameter (Pn) indicates an actual numeric value, such as a tab or margin location. A selective parameter (Ps) indicates a numeric value associated with a specific action. For example, in the LA75's device status report sequence (Section 5.4), the Ps value of 21 indicates a hardware failure.

NOTE: This manual uses Pn, Ps, or P plus another letter to represent parameter characters (except when their actual value is shown). Since parameter values vary, their column/row positions appear as asterisks ***.

If you do not specify a decimal value for a parameter character in a sequence, the printer assumes a value of 0. There is a limit of 16 numeric parameters per string. The printer will store the first 16 parameters received and ignore those that follow.

If the printer receives an out-of-range parameter in a string of parameters, the printer ignores the out-of-range parameter and processes the other parameters.

When all parameters in a sequence are out of range or the sequence is invalid, the printer performs no action.

If the printer receives the ? character (3/15) at the beginning of a string of parameters, the printer notes the event for later reference. When the final character of the string is received, the presence or absence of this event determines the validity and meaning of the sequence.

If the printer receives the ":" (3/10), "<" (3/12), "=" (3/13), or ">" (3/14) characters while processing a parameter string, or if the ? (3/15) character is received after the first character of a parameter string, the printer processes the sequence but performs no action.

Characters received after the CSI in the 2/0 to 2/15 range are *intermediate characters*. The printer may process zero, one, or more intermediate characters in a valid LA75 control sequence.

A character received after the CSI in the 4/0 to 7/14 range is a *final character*. The final character indicates the end of a control sequence and defines the function of the sequence. After receiving the final character, the printer performs the action specified by the sequence. The printer ignores sequences it does not recognize.

Example

Action:

Set horizontal pitch to 17.1 characters per inch.

Sequence:

CSI	4	**w**
9/11	3/4	7/7
|	|	|
|	|	Final Character
|	Parameter Character	
Control Sequence Introducer		

4.1.3 Control String Format

A device control string is a delimited string of characters that is used in a data stream as a logical entity for control purposes.

Control string format is as follows:

String Introducer	Protocol Selector	Data String	String Terminator
DCS	P...P I...I F	D...D	ST
OSC		D...D	ST
PM		D...D	ST
APC		D...D	ST

where: P...P are parameters
I...I are intermediate characters
F is a final character
D...D is data
ST is a string terminator.

LA75 string introducers are the C1 control characters Device Control String (DCS), Operating System Command (OSC), Privacy Message (PM), and Application Program Command (APC). The OSC, PM, and APC characters introduce unused control strings and perform no action.

In the LA75, the DCS character introduces three control strings (described later in this manual).

- Sixel Graphic mode
- Assignment of User-Preference Supplemental Character Set (DECAUPSS)
- Level 2 character downline-loading (DECDLD)

DCS (9/0) is an 8-bit control character. You can also express it as ESC P when coding in a 7-bit system. ST (9/12) can also be expressed in a 7-bit environment as ESC \ (Paragraph 4.2.2).

Table 4-1 describes LA75 processing of the DCS and unused control string data.

Table 4-1 Control Strings

Name	8-bit Mnemonics	7-bit Sequence	Processing After String Introducer is Received
Device Control String	DCS 9/0	ESC P 1/11 5/0	Processing begins. If a C0 character is received, the printer processes it if applicable. If ESC, CAN, SUB, ST, or a C1 character is received, the printer enters Text mode and processes the control command. If the final character is "q", the printer exits the protocol selector and enters the sixel graphic mode (Chapter 6). If the final character is "u", the printer enters the DECAUPSS data command string. If the final character is "{" (in Level 2), the printer enters the DECDLD data command string. If the final character is other than "q", "u", or "{", the DCS data string is ignored until ESC, CAN, ST, SUB, or a C1 character is received.

Table 4-1 Control Strings (Cont)

Name	8-bit Mnemonics	7-bit Sequence		Processing After String Introducer is Received
Operating System Command	OSC 9/13	ESC 1/11	] 5/13	If ESC, CAN, SUB, ST, or a C1 character is received, the printer enters Text mode and processes the control command. Otherwise, the data string is ignored.
Privacy Message	PM 9/14	ESC 1/11	^ 5/14	Same as above.
Application Program Command	APC 9/15	ESC 1/11	_ 5/15	Same as above.

4.1.4 Error Handling

This section describes what happens when the printer receives invalid parameters, invalid sequences, or sequences with embedded control characters. The printer generally recovers from such errors by performing as much of the sequence as possible.

- Sequences not recognized by the printer are ignored.
- If a sequence has an invalid selective parameter, the printer ignores the sequence.
- If a numeric parameter exceeds its numeric limit, the printer uses the maximum allowable value for that parameter (unless otherwise specified in this manual).
- If a sequence includes C0 control character, except for cancel (CAN), substitute (SUB), or escape (ESC), the printer processes those characters as if they were received before the sequence. The printer then continues to process the sequence.

  A CAN (1/8) or SUB (1/10) character in a sequence cancels that sequence and returns the printer to Text mode character processing. The CAN or SUB is then processed.

  An ESC (1/11) character in a sequence cancels that sequence. The printer then starts processing another escape sequence.

- If the printer receives a C1 control character within an escape sequence, the sequence is aborted and the C1 character is processed if it is applicable to the printer. If the 10/0 character is received, it is treated as a SPACE (2/0) character, within the sequence. The 15/15 character is processed as a DELETE (7/15) character, and is ignored.

NOTE: 15/15 character is treated as DELETE and is ignored if it is found inside the escape sequence.

- If the printer receives a GR character during an escape or control sequence, this character will be stripped of the eighth bit and processed as a GL character.
- C0 and C1 control characters do not change the status or processing of a single shift (SS2 or SS3) control character (Paragraph 4.4.5.2). The printer processes control characters in sequence.

4.2 7-BIT AND 8-BIT CONVERSIONS

You do not need to convert from 7-bit to 8-bit coding. However, such conversion could improve the data transmission rate. If you need to operate in a 7-bit environment, you must convert 8-bit codes into 7-bit equivalents.

4.2.1 Converting 7-Bit Control Sequence to Equivalent 8-Bit C1 Control Character

The 8-bit C1 control functions are coded as 2-character sequences of the form ESC Fe. Fe is a final character from columns four and five on the standard 8-bit character chart (Figure 3-2). The following steps convert the C1 equivalent ESC Fe control functions to 1-byte C1 control characters.

1. Remove the ESC character.
2. Set the eighth bit of the final character.
3. Clear the seventh bit of the final character.

4.2.2 Converting 8-Bit C1 Control Character to Equivalent 7-Bit Control Sequence

The 8-bit C1 control characters are coded as single characters from columns eight and nine on the standard 8-bit character chart (Figure 3-2).

You can convert C1 control characters to equivalent 2-character ESC Fe sequences as follows.

1. Insert an ESC character.
2. Clear the eighth bit of the C1 code.
3. Set the seventh bit of the C1 code.

Table 4-2 summarizes valid LA75 C1 control characters and their 7-bit escape sequence equivalents. (You can also refer to Paragraph 3.5.2.)

Table 4-2 Control Function Equivalents

8-Bit Control Character	7-Bit Escape Sequence
PLD (8/11)	ESC K (1/11 4/11)
PLU (8/12)	ESC L (1/11 4/12)
SS2 (8/14)	ESC N (1/11 4/14)
SS3 (8/15)	ESC O (1/11 4/15)
DCS (9/0)	ESC P (1/11 5/0)
CSI (9/11)	ESC [(1/11 5/11)
ST (9/12)	ESC \ (1/11 5/12)
OSC (9/13)	ESC] (1/11 5/13)
PM (9/14)	ESC^(1/11 5/14)
APC (9/15)	ESC _ (1/11 5/15)
Level 2 Only	
IND (8/4)	ESC D (1/11 4/4)
NEL (8/5)	ESC E (1/11 4/5)
HTS (8/8)	ESC H (1/11 4/8)
VTS (8/10)	ESC J (1/11 4/10)

4.2.3 Converting 8-Bit GR Selection To 7-Bit Equivalent

Use the character set designation sequences in this chapter (Paragraph 4.4.5) to designate the desired set as G2. Then, for any GR code, first send an SS2 function followed by the code with the eighth bit set to 0.

4.2.4 C1 Control Character Transmit and Receive

You can specify processing of C1 control codes (C1 Transmit or Receive — S8C1T, S7C1T, S8C1R, S7C1R) only if Conformance Level 2 is selected. If you select Level 1, the printer transmits and receives C1 codes according to the noted power-up defaults (S7C1T and S8C1R).

C1 Transmit

ESC	SP	G	(S8C1T)
1/11	2/0	4/7	

Transmit C1 control codes as 8-bit C1 codes.

If you select a 7-bit environment (in the set-up menu), the printer ignores this sequence.

ESC	SP	F	(S7C1T) — power-up default
1/11	2/0	4/6	

Transmit C1 control codes as equivalent 7-bit ESC Fe sequences.

C1 Receive

ESC	SP	7	(S8C1R) — power-up default
1/11	2/0	3/7	

Enables processing of 8-bit C1 control characters. Equivalent 7-bit ESC Fe sequences are also processed.

ESC	SP	6	(S7C1R)
1/11	2/0	3/6	

Disables processing of 8-bit C1 control characters in 8-bit environment. The eighth bit of a received C1 character is stripped. The printer processes it as a C0 character. ESC Fe sequences are also processed.

4.3 DEC CONFORMANCE LEVELS

The LA75 can be set for one of two conformance levels that provide basic or enhanced operating and printing capabilities, interface features, and compatibility with appropriate software.

A Conformance level is a fixed group of functions common to a class of devices that satisfies certain hardware/software compatibility requirements. New functions require the creation of new conformance levels that are supersets of the levels below it. Each level consists of a number of functions which must be included in all products that implement that level of conformance.

The LA75 can operate as a Level 1 or a Level 2 device.

Level 1 provides basic printing and interface functions that are always active in the LA75, are LA50-compatible, and can be activated by selecting the LA50 Printer ID in the set-up menu (Section 2.8).

Level 2 adds the expanded printing functions that can be activated by selecting the Level 2 or LA210 Printer ID in the set-up menu. The Level 2 device always has the Level 1 functions active plus a subset of additional functions.

You can select the conformance level with the Printer ID feature in the set-up menu (Section 2.8) and/or by using the DECSCL control sequence (Section 5.1).

4.3.1 Level 1 and Level 2 Function Summary

Table 4-3 lists Level 1 and 2 functions and lets you differentiate between the two devices. The functions are described in detail in Chapters 4, 5, and 6.

The LA75 is shipped as a LA50-compatible (Level 1 functionality) device.

Table 4-3 Level 1 and 2 Functions

Level 1	Level 2
	Horizontal Form Handling
Horizontal pitch (DECSHORP)	Set Page Width Alignment (DECHPWA) Set Left and Right Margins (DECSLRM) Horizontal Tab Set Control Code (HTS) Set Horizontal Tab Stops (DECSHTS) Horizontal Tab Set (DECHTS) Tabulation Clear (TBC) Clear All Horizontal Tabs (DECCAHT)
	Vertical Form Handling
Vertical Pitch (DECVERP) Page Length (DECSLPP)	Set Top and Bottom Margins (DECSTBM) Vertical Tab Set Control Code (VTS) Vertical Tab Set (DECVTS) Set Vertical Tab Stops (DECSVTS) Tabulation Clear (TBC) Clear All Vertical Tabs (DECCAVT)
	Active Position Control
Partial Line Down (PLD) Partial Line Up (PLU)	Forward Index Control Code (IND) Next Line Control Code (NEL) Autowrap Mode (DECAWM) Carriage Return New Line Mode (DECCRNLM) Linefeed New Line Mode (LNM) Horizontal Position Absolute (HPA) Horizontal Position Relative (HPR) Vertical Position Absolute (VPA) Vertical Position Relative (VPR)
	Character Set Selection
Single and Locking Shifts (SS2, SS3, SI, SO, LS2, LS3, LS1R, LS2R, LS3R) Select Character Set Sequence (SCS)	Character Set Downline-loading (DECDLD)

Table 4-3 Level 1 and 2 Functions (Cont)

Level 1	Level 2
	Character Set Selection
Assign User-Preference Supplemental Character Set (DECAUPSS)	
ANSI Announcer Sequence	
	Print Speed, Printing Quality and Highlighting Selection
Print Density Selection (DECDEN)	Select Unidirectional/Bidirectional Printing (DECUPM)
Selection of Graphic Rendition (SGR)	
DEC Private Select Graphic Rendition (DECSGR)	
	Optional Form Handling
Automatic Sheet Feeder Control (DECASFC)	
	Status, Report, and Reset Requests (Chapter 5)
Set Conformance Level (DECSCL)	
IBM Proprinter Emulation Mode (DECIPEM)	
Product Identification (DA)	
Printer Status Request (DSR)	
Printer Status Report (DSR)	
Reset To Initial State (RIS)	
Soft Terminal Reset (DECSTR)	
Load Factory NVR Settings (DECFNVR)	
	Graphics
Sixel Graphic (Chapter 6)	

4.4 LEVEL 1 FUNCTIONS

The following sections describe the LA75's Level 1 escape and control sequences for text processing.

4.4.1 Horizontal Pitch (DECSHORP)

Horizontal pitch determines the width and spacing of printed characters. It is specified in characters per inch. The LA75 has 8 horizontal pitch selections: 5, 6, 8.25, 8.55, 10, 12, 16.5 and 17.1 characters per inch (Figure 4-1). You can use any combination of pitch selections on a single print line.

When the horizontal pitch changes (Figure 4-2), the printer converts the active column to the grid of the new horizontal pitch. If the conversion yields a fraction, it is rounded to the next highest integer. This rounding allows printing on the correct column grid for the new pitch.

You can use the following formula to determine the precise location of the active column when the horizontal pitch changes.

$$\text{Newcol} = 1 + \frac{\text{Newpitch} \times (\text{Oldcol}-1)}{\text{Oldpitch}}$$

where:

Newcol	=	the new active column,
Newpitch	=	the new pitch in characters per inch,
Oldcol	=	the old active column, and
Oldpitch	=	the old pitch in characters per inch.

NOTE: The division performed above is integer division. Any nonzero remainder is rounded to the next higher integer.

```
DECSHORP: set horizontal pitch test -


This line is printed at 12 cpi.
This line is printed at 12 cpi.

This line is printed at 10 cpi.
This line is printed at 10 cpi.

This line is printed at 16.5 cpi.
This line is printed at 16.5 cpi.

This line is printed at 16.5 cpi.
This line is printed at 16.5 cpi.

This line is printed at 10 cpi.
This line is printed at 10 cpi.

This line is printed at 17.1 cpi.
This line is printed at 17.1 cpi.

This line is printed at 10 cpi.
This line is printed at 10 cpi.

This line is printed at 5 cpi.
This line is printed at 5 cpi.

This line is printed at 6 cpi.
This line is printed at 6 cpi.

This line is printed at 8.25 cpi.
This line is printed at 8.25 cpi.

This line is printed at 8.55 cpi.
This line is printed at 8.55 cpi.
```

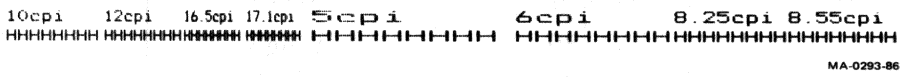

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Figure 4-1 Horizontal Pitch Selections

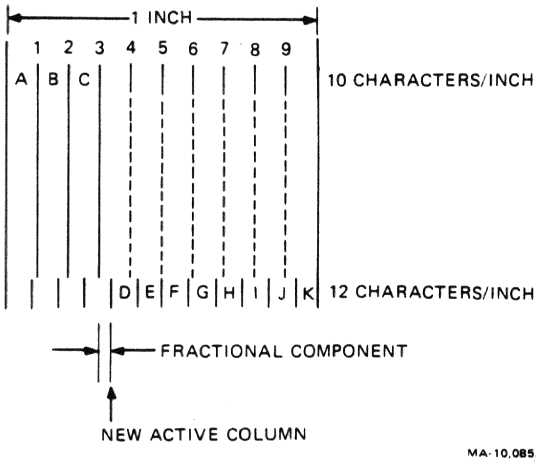


Figure 4-2 Changing Horizontal Pitch

Changing horizontal pitch sets the left and right margin to column 1 and the maximum column at the new horizontal pitch, respectively.

Horizontal pitch also determines if single- or double-width character printing occurs.

Horizontal Pitch Characters/Inch	Maxium Characters Per Line	Character Width
10	80	Single
12	96	Single
16.5	132	Single
17.1	137	Single
5	40	Double
6	48	Double
8.25	66	Double
8.55	68	Double

The printer considers double-width characters to be one column wide (not two columns wide). Therefore, tab stops are reset to the appropriate double-width column grid when horizontal pitch is changed (as with all pitches).

The following control sequences set single-width horizontal pitches.

Name	Mnemonic	Sequence				Function
Set horizontal pitch	DECSHORP	**CSI**		**w**		Sets pitch to default of 10 char/inch.
		9/11		7/7		
		CSI	**0**	**w**		Sets pitch to default of 10 char/inch.
		9/11	3/0	7/7		
		CSI	**1**	**w**		Sets pitch to 10 char/inch.
		9/11	3/1	7/7		
		CSI	**2**	**w**		Sets pitch to 12 char/inch.
		9/11	3/2	7/7		
		CSI	**4**	**w**		Sets pitch to 16.5 char/inch.
		9/11	3/4	7/7		
		CSI	**1**	**1**	**w**	Sets pitch to 17.1 char/inch.
		9/11	3/1	3/1	7/7	

The following control sequences set double-width horizontal pitches.

Name	Mnemonic	Sequence				Function
Set horizontal pitch	DECSHORP	**CSI**	**5**	**w**		Sets pitch to 5 char/inch.
		9/11	3/5	7/7		
		CSI	**6**	**w**		Sets pitch to 6 char/inch.
		9/11	3/6	7/7		
		CSI	**8**	**w**		Sets pitch to 8.25 char/inch.
		9/11	3/8	7/7		
		CSI	**1**	**2**	**w**	Sets pitch to 8.55 char/inch
		9/11	3/1	3/2	7/7	

NOTE: If you use any other parameter values, the printer ignores them.

4.4.2 Vertical Pitch (DECVERP)

Vertical pitch determines the spacing between lines of text. Vertical pitch is specified in lines per inch. Changing vertical pitch does not change the height of the printed character or top-of-form position. The printer has six vertical pitch selections: 2, 3, 4, 6, 8, and 12 lines per inch (Figure 4-3).

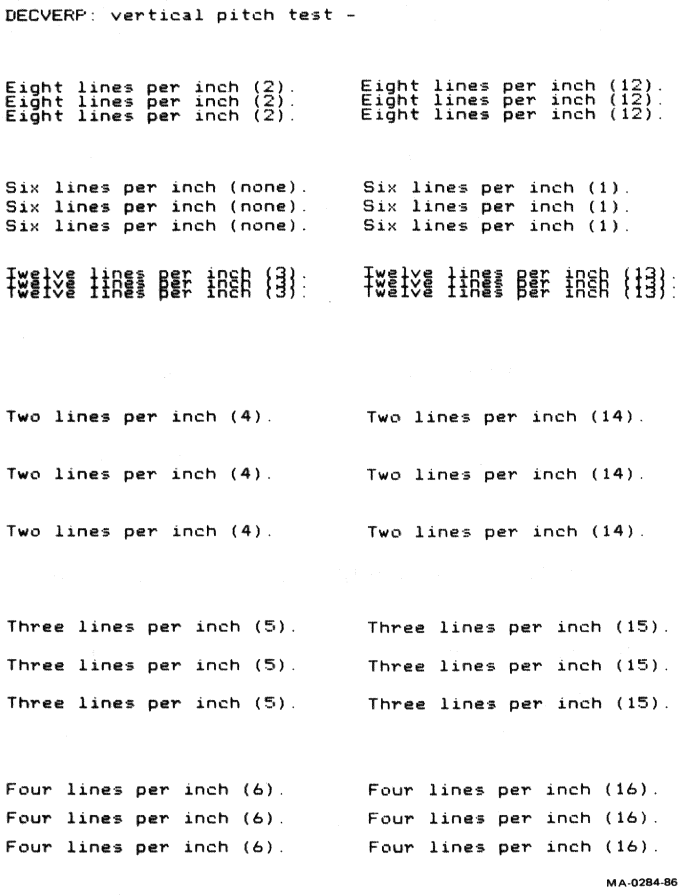


Figure 4-3 Vertical Pitch Selections

When you change vertical pitch, the printer converts the active line to the grid of the new vertical pitch. If the conversion yields a fraction, the active line is rounded to the next integer. Then, after receiving a paper motion command, the printer advances the paper to the next line on the new vertical grid.

The following control sequences set vertical pitch.

Name	Mnemonic	Sequence			Function
Set vertical pitch	DECVERP	**CSI** 9/11	**z** 7/10		Sets pitch to default of 6 lines/inch.
		CSI 9/11	**0** 3/0	**z** 7/10	Same as above
		CSI 9/11	**1** 3/1	**z** 7/10	Sets pitch to 6 lines/inch.
		CSI 9/11	**2** 3/2	**z** 7/10	Sets pitch to 8 lines/inch.
		CSI 9/11	**3** 3/3	**z** 7/10	Sets pitch to 12 lines/inch.
		CSI 9/11	**4** 3/4	**z** 7/10	Sets pitch to 2 lines/inch.
		CSI 9/11	**5** 3/5	**z** 7/10	Sets pitch to 3 lines/inch.
		CSI 9/11	**6** 3/6	**z** 7/10	Sets pitch to 4 lines/inch.

4.4.3 Page Length (DECSLPP)

You can select the default page length by the Form Length feature in the set-up menu (Section 2.8). The factory setting is 11 inches. An 11-inch page gives you 66 lines at the default vertical pitch of 6 lines per inch.

The page length control sequence lets you set the page length by selecting the number of lines (0 to 252) per page at the current vertical pitch. If the distance specified exceeds 21 inches, the printer sets the page length to the maximum of 21 inches.

You can select any page length from 1/12 inch to 21 inches with the number of lines at the current vertical pitch. If the page length is set to 0, the printer ignores paging and treats all form feed characters as line feed characters.

Table 4-4 shows the lines per page and page length as a function of vertical pitch.

Table 4-4 Page Length and Vertical Pitch

Page Length (Inches)	Vertical Pitch Selected (Lines per Inch)					
	2	3	4	6	8	12
	Lines per Page					
3.67	n/a	11	n/a	22	n/a	44
4.25	n/a	n/a	17	n/a	34	51
8.5	17	n/a	34	51	68	102
11	22	33	44	66	88	132
14	28	42	56	84	112	168
21	42	63	84	126	168	252

NOTE: Where n/a is indicated, the particular page length is not available for that vertical pitch selection.

If vertical pitch changes after page length has been set, the page may contain a nonintegral number of lines. In this case, the fractional line portion is added to the last full line on that page. For example, suppose you select 22 lines per page at 6 lines per inch, then change the vertical pitch to 8 lines per inch. The form length is 29 lines per page now, with 28 lines at 8 lines per inch and 1 line at 6 lines per inch preserving the selected physical form length of 3.67 inches.

The following control sequence sets the page length.

Name	Mnemonic	Sequence	Function
Set page length	DECSLPP	**CSI Pn t** 9/11 *** 7/4	Sets the active line to the top-of-form position and sets the page length to Pn units of the current vertical pitch.

4.4.4 Partial-line Paper Motion (PLD and PLU)

The following escape sequences let you advance or reverse paper in 1/12 inch increments. These sequences modify the printer's active line counter.

Name	Mnemonic (8-bit)	Sequence (7-bit)	Function
Partial Line Down	PLD	**ESC K** 1/11 4/11	Advances paper 1/12 inch.
Partial Line Up	PLU	**ESC L** 1/11 4/12	Reverses paper 1/12 inch.

4.4.5 Character Set Selection

This section describes how to select character sets in both the 7- and 8-bit environments. You can assign and select any of the available character sets in the printer.

4.4.5.1 Select Character Set Sequences (SCS) - The Select Character Set (SCS) escape sequences are used to assign any of the LA75 character sets to the G0, G1, G2, and G3 character set designators. These designators define the contents of the GL and GR printable sets and may be controlled with the single and locking shift command (Paragraph 4.4.5.2).

Table 4-5 lists the character sets and SCS sequences.

Table 4-5 Assigning Character Sets

G0	G1	G2	G3	Character Set
ESC (B	ESC) B	ESC * B	ESC + B	U.S. ASCII
ESC (A	ESC) A	ESC * A	ESC + A	ISO Great Britain
ESC (5	ESC) 5	ESC * 5	ESC + 5	DEC Finland
ESC (R	ESC) R	ESC * R	ESC + R	ISO France
ESC (9	ESC) 9	ESC * 9	ESC + 9	DEC French Canada
ESC (K	ESC) K	ESC * K	ESC + K	ISO Germany
ESC (Y	ESC) Y	ESC * Y	ESC + Y	ISO Italy
ESC (J	ESC) J	ESC * J	ESC + J	JIS Roman
ESC (I	ESC) I	ESC * I	ESC + I	JIS Katakana
ESC (6	ESC) 6	ESC * 6	ESC + 6	DEC Norway/Denmark
ESC (Z	ESC) Z	ESC * Z	ESC + Z	ISO Spain
ESC (7	ESC) 7	ESC * 7	ESC + 7	DEC Sweden
ESC (<	ESC) <	ESC * <	ESC + <	User-Preference Supplemental
ESC (0	ESC) 0	ESC * 0	ESC + 0	DEC VT100 Special Graphic
ESC (>	ESC) >	ESC * >	ESC + >	DEC Technical
ESC (‘	ESC) '	ESC * ‘	ESC + ‘	ISO Norway/Denmark
ESC (4	ESC) 4	ESC * 4	ESC + 4	DEC Holland
ESC (=	ESC) =	ESC * =	ESC + =	DEC Switzerland
ESC (% 6	ESC) % 6	ESC * % 6	ESC + % 6	DEC Portugal
N/A	ESC - A	ESC . A	ESC / A	ISO Supplemental
ESC (% 5	ESC) % 5	ESC * % 5	ESC + % 5	DEC Supplemental

NOTE: The SCS escape sequences (Table 4-6) select a DEC character set as an error fallback. Digital reserves the right to redefine these sequences in the future to agree with new ISO standards. Digital recommends that you use the sequences above in new application software, rather than the following sequences.

Table 4-6 Fallback Escape Sequences

G0	G1	G2	G3	Character Set
ESC (C	ESC) C	ESC * C	ESC + C	DEC Finland
ESC (Q	ESC) Q	ESC * Q	ESC + Q	DEC French Canada
ESC (E	ESC) E	ESC * E	ESC + E	DEC Norway/Denmark
ESC (H	ESC) H	ESC * H	ESC + H	DEC Sweden

4.4.5.2 Single and Locking Shifts - In a 7-bit environment, only the GL active character set is available. Sequences that refer to the GR active character set have no effect in a 7-bit character environment.

In an 8-bit environment, the printer uses the GL active character set if a character's eighth bit is 0, and the GR active character set if the character's eighth bit is 1.

Table 4-7 lists the escape sequences and control characters that assign the available character sets to the active character set (GL or GR).

Table 4-7 Selecting an Active Character Set

Name	Mnemonic	Sequence		Function
Single shift 2	SS2*	**ESC** 1/11	**N** 4/14	The character following SS2 is selected from the G2 character set.
Single shift 3	SS3*	**ESC** 1/11	**O** 4/15	The character following SS3 is selected from the G3 character set.
Shift In	SI†	n/a		The G0 character set becomes the GL active character set.
Shift Out	SO†	n/a		The G1 character set becomes the GL active character set.
Locking shift 2	LS2†	**ESC** 1/11	**n** 6/14	The G2 character set becomes the GL active character set.
Locking shift 3	LS3†	**ESC** 1/11	**o** 6/15	The G3 character set becomes the GL active character set.
Locking shift 1 right	LS1R†	**ESC** 1/11	~ 7/14	The G1 character set becomes the GR active character set.
Locking shift 2 right	LS2R†	**ESC** 1/11	} 7/13	The G2 character set becomes the GR active character set.
Locking shift 3 right	LS3R†	**ESC** 1/11	| 7/12	The G3 character set becomes the GR active character set.

* SS2 and SS3 only affect the first printable character following the single-shift sequence. The printer executes nonprintable characters (such as the space character, control characters, escape sequences, and control sequences) as usual.

In an 8-bit environment, the eighth bit of the printable character following the single shift (SS2 or SS3) is ignored thus providing a character code in the range of 2/1 to 7/14. The 10/0 character clears the single shift code and is processed as an error character (¿).

† A locking shift (SI, SO, LS2, LS3, LS1R, LS2R, OR LS3R) remains in effect until the printer receives another locking shift.

4.4.5.3 Assign User-Preference Supplemental Character Set (DECAUPSS) - When the printer receives the DECAUPSS control string, it assigns the character set defined by the parameter and data in the string as the User-Preference Supplemental (UPS) Character set. By using the appropriate SCS sequence (Table 4-5), you can designate this character set into G0, G1, G2, or G3. On power up, the UPS character set is defined by the UPS feature in the set-up menu (Section 2.8).

The DECAUPSS sequence is as follows:

DCS	Ps	!	u	D....D	ST
9/0	***	2/1	7/5	**..**	9/12

Ps = 0 or none — 94-character set
= 1 — 96-character set

D....D are the data that include the intermediate and final characters of the SCS sequence used to explicitly select the supplemental character set. Possible data values are:

% 5 2/5 3/5	DEC Supplemental	(Ps must be 0)
A 3/0	ISO Supplemental	(Ps must be 1)
I 4/9	JIS Katakana	(Ps must be 0)
> 3/14	DEC Technical	(Ps must be 0)

4.4.5.4 ANSI Announcer Sequence - The following escape sequences conform to the draft ANSI standard dpANS X3.134.1-19XX, 8-Bit Structures and Rules, and can be used to load ASCII and ISO character sets.

ESC SP L 1/11 2/0 4/12	Load ASCII set into G0 and invoke it into GL. Load ISO Supplemental set into G1 and invoke it into GR.
ESC SP M 1/11 2/0 4/13	Same as above.
ESC SP N 1/11 2/0 4/14	Load ASCII set into G0 and invoke it into GL only.

4.4.6 Printing Quality Selection (DECDEN)

The following control sequences select draft, memo, near letter quality, or letter quality printing (Figure 4-4).

The LA75 can print in one of four printing densities:

1. Draft — which is font-generated.
2. Memo — which is created by bolding the draft font text.
3. Near Letter Quality — which is created by dot fill-in of the draft font text.
4. Letter Quality — which is font-generated.

Name	Mnemonic	Sequence				Function
Select density	DECDEN	**CSI** 9/11	" 2/2	**z** 7/10		Defaults to draft printing (250 cps).
		CSI 9/11	**0** 3/0	" 2/2	**z** 7/10	Defaults to draft printing.
		CSI 9/11	1 3/1	" 2/2	**z** 7/10	Selects draft printing (250 cps).
		CSI 9/11	**2** 3/2	" 2/2	**z** 7/10	Selects letter quality (LQ) printing (32 cps).
		CSI 9/11	**3** 3/3	" 2/2	**z** 7/10	Selects memo printing (125 cps).
		CSI 9/11	**4** 3/4	" 2/2	**z** 7/10	Selects near letter quality (NLQ) printing (42 cps).

NOTE: If you use any other parameter values, the printer will ignore the sequence.

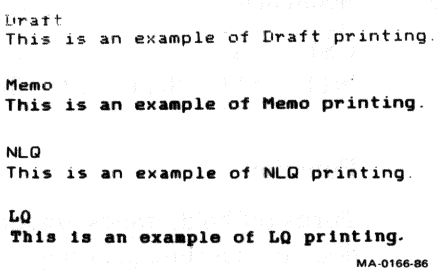


Figure 4-4 Print Quality Examples

4.4.7 Highlighting Your Printing (SGR)

There are two Select Graphic Rendition (SGR) sequences that you can use to highlight the printing text. ANSI-standard SGR sequence lets you highlight using bolding, underlining, double underlining, and italics. DEC Private SGR controls superscript, subscript, and overline printing.

4.4.7.1 Select Graphic Rendition (SGR) Sequence - One or more SGR highlight attributes may be specified in one sequence. All printable characters following the SGR sequence are printed using the selected highlighting features, until the next SGR sequence. The printer evaluates Ps parameters sequentially from left to right.

Name	Mnemonic	Sequence						
Select graphic rendition	SGR	CSI 9/11	Ps ***	; 3/11	... ...	; 3/11	Ps ***	m 6/13

Ps	Function
0 or none (3/0)	Turns off bold, italics, underline, and double underline printing.
1 (3/1)	Turns on bold printing.
3 (3/3)	Turns on italics printing.
4 (3/4)	Turns on underline printing. Turns off double underline printing if selected (Paragraph 4.12.1).
21 (3/2 3/1)	Turns on double underline printing. Turns off underline printing if selected.
22 (3/2 3/2)	Turns off bold printing.
23 (3/2 3/3)	Turns off italics printing.
24 (3/2 3/4)	Turns off underline and double underline printing.

If you selected to bold the text while using memo-quality printing (SGR=1) the printer performs bolding by overprinting the text.

When you enter graphic mode, the printer stores the current parameter values for the SGR sequence. When you return to text mode, the printer uses these parameters.

The printer ignores all other parameter values received in this control sequence, but still executes the valid parameter values. The printer executes the parameters in the order received.

4.4.7.2 DEC Private SGR Sequence - You can use the DEC Private SGR sequence to print superscript and subscript characters or to highlight with an overline.

CSI	?	Ps	;	...	Ps	m
9/11	3/15	***	3/11		***	6/13

Ps = 0 or none	Turns off superscripting, subscripting, and overline printing.
Ps = 4 3/4	Turns on superscripting and turns off subscripting if it was selected.
= 5 3/5	Turns on subscripting and turns off superscripting if it was selected.
= 6 3/6	Turns on overline.
= 2 4 3/2 3/4	Turns off superscripting and subscripting.
= 2 6 3/2 3/6	Turns off overline.

All DEC Private SGR parameters are retained while in the Graphic mode. When you enter this mode, the printer stores the current parameter values for the SGR sequence. When you return to the text mode, the printer uses these parameters.

Superscripted and subscripted text characters are printed at half-height on the active line. The printer does not change horizontal and vertical pitch in this case.

4.4.8 Automatic Sheet Feeder

If the printer is equipped with the automatic sheet feeder (ASF), you can use the DECASFC control sequence to insert and eject cut sheet paper.

Name	Mnemonic	Sequence			
ASF Control	DECASFC	**CSI**	**Ps**	**!**	**v**
		9/11	***	2/1	7/6

If Ps = 0 or none, eject current page;
= 1, insert next sheet;
> 1, same as Ps = 1.

When the LA75 receives the insert command, it first ejects the current sheet (if already inserted). When the LA75 receives the eject command, it ejects the current sheet into the output bin and stops.

NOTE: When the ASF is not installed, the printer interprets the DECASFC command as a Form Feed control.

4.4.8.1 Other ASF Control Functions - In addition to the DECASFC command, the following conditions and commands also control automatic operation of the sheet feeder.

Feature	Paper Sheet Installed	No Paper
FF control code received.	Ejects current sheet and inserts new sheet.	Inserts new sheet only.
Active position advances beyond bottom margin.	Waits for printable character, then ejects current sheet and inserts next sheet.	Waits for printable character, then inserts new sheet.
FF switch (on the front panel) pressed.	Ejects current sheet	Inserts new sheet.
LF switch (on the front panel) pressed.	Performs line feed.	No action
On power up	Ejects paper only, waits for printable character, then inserts new sheet.	Waits for printable character, then inserts new sheet.

4.4.8.2 ASF Error Conditions - If an ASF error is detected and DSR unsolicited reporting is enabled (Section 5.5), the LA75 sends the error code 32 to the host computer. The error may be caused by one of the following conditions.

1. No paper is detected during the insertion.
2. The sheet feeder is unable to eject paper.

If the printer cannot detect paper during the insertion or is unable to eject paper, it becomes de-selected and the READY indicator goes off. If you then press the READY switch, the printer turns on the READY indicator and again attempts to insert paper and continue operation.

4.5 LEVEL 2 FUNCTIONS

The following sections describe LA75's Level 2 functions, escape and control sequences for text processing. When set as a Level 2 device (LA210-compatible), the LA75 provides all Level 1 and Level 2 functions.

4.5.1 Set Page Width Alignment (DECHPWA)

The user may define the limits of the print area. This limit will not change, unless modified by another DECHPWA command.

The print area (Figure 4-5) shows absolute limits to center text on the platen. This area is the base reference for horizontal positioning and is expressed in inches.

The following DECHPWA sequence sets the left reference and print area width.

CSI	Pn1	;	Pn2	"	s
9/11	***	3/11	***	2/2	7/3

The first parameter (Pn1) defines the absolute left reference in 1/12 inch increments (measured from the leftmost position of the printhead). The second parameter (Pn2) defines the absolute width of the print area in 1/12-inch increments.

Limits on Pn1 and Pn2 are as follows:

Pn1 = 0 to 95

If Pn1 is greater than 95, value of 95 is used.

Pn1 changes the physical location of column 1 and tabs.

Pn2 = 1 to 96

(Pn1 + Pn2) must not be greater than 96 (8 inches).
If Pn1 + Pn2 is greater than 96, the Pn2 value is equal to 96 minus Pn1 value.

Pn2 must be at least 1 in order to define a printable area.
Pn2 defines the new rightmost printable position.

The column value of the horizontal tabs remains unchanged by DECHPWA. The physical locations of the horizontal tabs shift by the same amount as the left reference shift.

If the active position is less than the new column 1, the printer sets the active position to the new column 1. If the active postion is greater than the new rightmost printable position, the action of the next printable character is determined by the right margin (Autowrap/Truncate) setting.

NOTE: This sequence clears the previously set left and right margins. The left margin is set to the new column 1, while the right margin is set to the rightmost position defined by Pn1 and Pn2 (left reference and width).

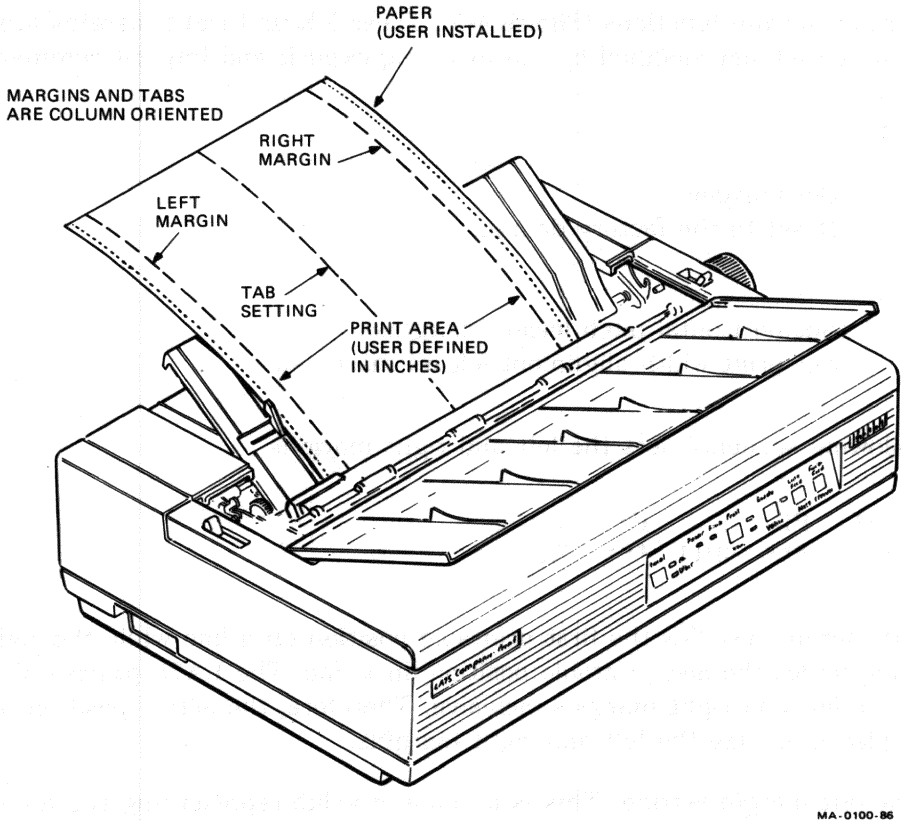


Figure 4-5 Print Area and Horizontal Settings

4.5.2 Set Left and Right Margins (DECSLRM)

The left and right margins define the limits for the carriage return and end-of-line (wrap/truncate) functions (Figure 4-5). These left and right margins are column-oriented and modified by the following explicit and implicit commands.

Explicit

1. Set margins.
2. Reset to the factory default.

Implicit

1. Set horizontal pitch (clears margins).
2. Set print width alignment (clears margins).

The following sequence sets the left and right margins.

CSI	Pl	;	Pr	s
9/11	***	3/11	***	7/3

The left margin specifies the first printable position on a line while the right margin specifies the last printable position on a line. The LA75 prints only within the left and right margins inclusive. Therefore, the active position may not be placed outside the left and right margins.

Pl is the left margin setting. This is a numeric value representing the number of columns from the leftmost position at which to set the left margin. At power on, the printer sets Pl to the leftmost position (column 1).

Pr is the right margin setting. This is a numeric value representing the number of columns from the leftmost position at which to set the right margin. On power on, the printer sets Pr to the rightmost position (column 80 at 10 characters/inch).

If Pl = 0 or none, no change is made to the left margin.
If Pr = 0 or none, no change is made to the right margin.
If Pr > the rightmost printable position, the printer sets the right margin at the right-most printable position.
If Pl > Pr, the printer ignores the command.

If the active position is less than the left margin specified by this command, then the printer sets the active position to the new left margin.

If the active position is greater than the right margin specified by this command, then the action of the next printable character is determined by the right margin (Autowrap/Truncate) setting.

If you change the horizontal pitch, this will reset the left and right margin to their printable limits (column 1 and rightmost position, respectively). If you redefine the print area, this resets the margins.

4.5.3 Horizontal Tabs

Horizontal tabs are column-oriented, predefined positions on the print line (Figure 4-5). The printer has a maximum of 137 possible horizontal tab stops, one for each column at 17.1 characters/inch. Tab stops are associated with column numbers that relate to the print area, not physical positions on the paper. So, when you change the horizontal pitch, the physical positions of the tab stops also change.

You can set or clear tab stops independently or in groups. You can 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. At power up, there is one horizontal tab setting at every eighth column.

The following sequences set or clear horizontal tab stops.

4.5.3.1 Horizontal Tabulation Set Control Code (HTS) -

ESC	**H**	HTS C1 control code is 8/8.
1/11	4/8	

Sets a horizontal tab stop at the active column.

4.5.3.2 Set Horizontal Tabulation Stops (DECSHTS)

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

This sequence sets a horizontal tab stop at the specified Pn columns. You can specify up to 16 tab stops in any order within one sequence. The maximum number of tab stops is 137 per line.

If Pn is greater than 137, the printer ignores this parameter.

4.5.3.3 Horizontal Tabulation Set (DECHTS)

ESC	1
1/11	3/1

Sets a horizontal tab stop at the active column.

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

4.5.3.4 Tabulation Clear (TBC)

CSI	0	g
9/11	3/0	6/7

Clears a horizontal tab at the active column.

CSI	2	g
9/11	3/2	6/7

Clears all horizontal tab stops.

CSI	3	g
9/11	3/3	6/7

Clears all horizontal tab stops.

4.5.3.5 Clear All Horizontal Tabs (DECCAHT)

ESC	**2**
1/11	3/2

Clears all horizontal tab stops.

NOTE: This sequence is included for backward compatibility only and should be used in new products.

4.5.4 Set Top and Bottom Margins (DECSTBM)

The top vertical margin specifies the first printable line. The bottom vertical margin specifies the limit for the last printable line (Figures 4-6 and 4-7). The LA75 prints only on the lines between the top and bottom margins, inclusive. Depending on vertical pitch, the printing may or may not be allowed exactly at the bottom margin.

If you try to set the active line above the top margin or below the bottom margin, the active line advances automatically to the top margin of the next page. For example, a line feed (LF) received at the bottom margin causes the printer to perform a form feed.

When you set the top and bottom margins, first make sure the distance between the top of form and the desired margin is a multiple of the vertical pitch selected. If not, change the vertical pitch. When you use the following DECSTBM sequence, set Pn1 and Pn2 equal to the desired margins in inches, multiplied by the current vertical pitch in lines per inch.

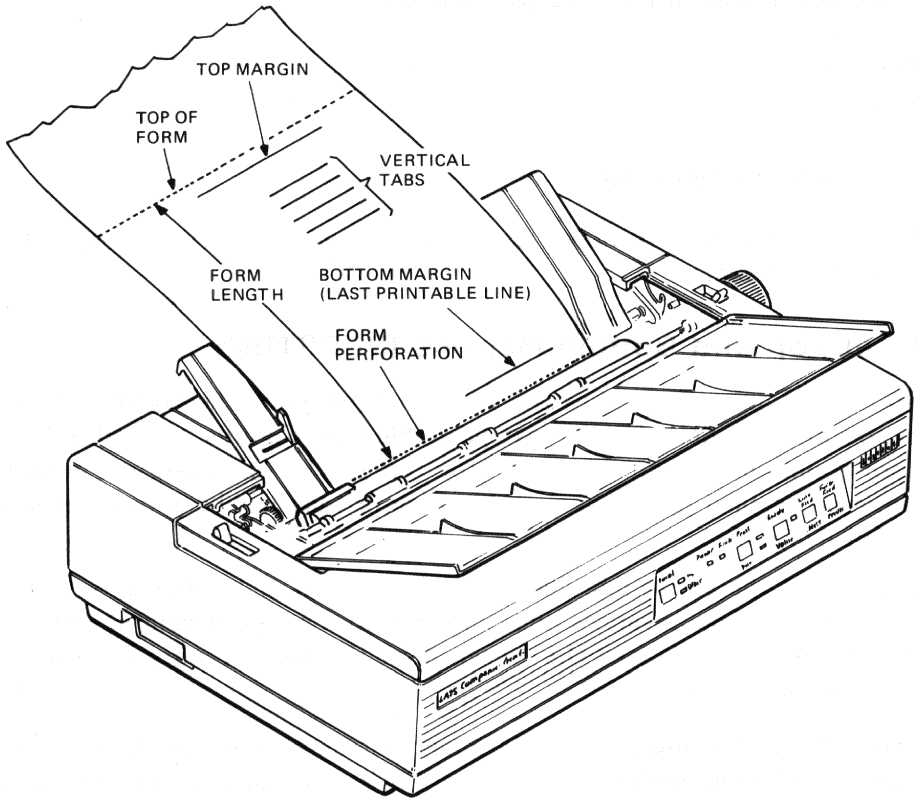


Figure 4-6 Form Length and Vertical Settings

The following sequence sets the top and bottom margins.

CSI	Pt	;	Pb	r
9/11	**	3/11	**	7/2

Pt is the top margin setting. This is a numeric value representing the number of lines from the top of form at which to set the top margin. At power up, Pt is equal to top of form (line 1).

Pb is the bottom margin setting. This is a numeric value representing the number of lines from the topmost position on a page at which to set the bottom margin. At power up, Pb is equal to the bottommost position (line 66 at 6 lpi).

If Pt equals 0 or none, no change is made to the top margin.
If Pb equals 0 or none, no change is made to the bottom margin.
If Pb is greater than the current form length, the LA75 sets the bottom margin to the last print line of the form.
If Pt is greater than Pb, the printer ignores this command.

If the active position is less than Pt, the printer sets the active position to the new top margin specified by the Pt value. If the active position is greater than the new bottom margin, the active line immediately moves to the top margin on the next page.

If the VPA and VPR commands (Paragraphs 4.5.6.8 and 4.5.6.9) cause the active position to move off the current page, the next printable character moves the active line to the top margin of the next page.

If the LA75 receives a LF while at the bottom margin, or when less than 1 line remains on the page, the printer sets the active line to the top margin of the next page.

When you change the page length, the top margin is reset to line 1 and the bottom margin is set to the bottom-most position of the new page length.

You can print one superscript character with the PLU command if the active line is at the top margin. If the printer receives more PLU commands, they are ignored.

You can print one subscript character with the PLD command if the active line is at the bottom margin. If the printer receives more PLD commands, they are ignored.

When you change the vertical pitch, the physical position of the top and bottom margins do not change relative to the new vertical pitch. Line spacing beginning with the top margin corresponds to the new vertical pitch.

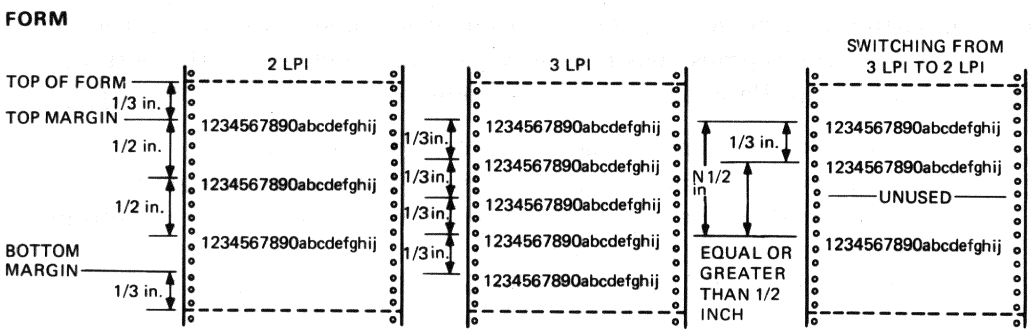


Figure 4-7 Top/Bottom Margins and Pitches

4.5.5 Vertical Tabs

The printhead advances to a preselected line when the printer receives a vertical tab control character (Figure 4-6). The printer has 252 maximum possible vertical tab positions. You can set and clear vertical tabs the same way as horizontal tabs.

Vertical tab stops are associated with specific line numbers, not physical positions on the paper. So, changing vertical pitch changes the printing position of vertical tabs on the paper. At power up, vertical tabs are set at every line. The following sequences set or clear vertical tab stops.

4.5.5.1 Vertical Tab Set Control Code (VTS)

ESC	J	VTS C1 control code is 8/10.
1/11	4/10	

Sets a vertical tab stop at the active line.

NOTE: If active line is not at an integer line number due to a PLU or PLD command, the printer sets the tab stop at the next integer line.

4.5.5.2 Vertical Tab Set (DECVTS)

ESC	3
1/11	3/3

Sets a vertical tab stop at the active line. (See the Note in the paragraph above.)

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

4.5.5.3 Set Vertical Tab Stops (DECSVTS)

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

Sets vertical tab stop at the specified Pn.

You can specify up to 16 vertical tab stops in one sequence: the maximum number of vertical tab stops is 252. If Pn is greater than 252. the printer ignores this parameter.

4.5.5.4 Tabulation Clear (TBC)

CSI	1	g
9/11	3/1	6/7

Clears one vertical tab at the active line (see Note in Paragraph 4.5.5.1).

CSI	4	g
9/11	3/4	6/7

Clears all vertical tab stops.

4.5.5.5 Clears All Vertical Tabs (DECCAVT)

ESC	4
1/11	3/4

Clears all vertical tab stops.

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

4.5.6 Active Column And Active Line Commands

In addition to the Level 1 control characters listed in Chapter 3, the following Level 2 control functions affect active column and active line.

4.5.6.1 Forward Index Control Code (IND)

ESC	D	IND C1 control code is 8/4
1/11	4/4	

Performs a Line Feed (LF) function.

This sequence is not affected by the Line Feed New Line Mode (LNM) or Automatic Carriage Return settings in the set-up menu (Section 2.8).

4.5.6.2 Next Line Control Code (NEL)

ESC	E	NEL C1 control code is 8/5
1/11	4/5	

Sets the active column to the left margin and increments the active line.

4.5.6.3 Autowrap Mode (DECAWM)

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

Sets Autowrap mode.

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

Resets to Truncate mode.

The power-up status of this function is selected with the right margin feature in the set-up menu (Section 2.8).

If the Autowrap mode is set and the active position is beyond the right margin, all of the printable characters that follow this command are printed on the next line starting at the left margin. If the Autowrap mode is reset (off), all printable characters received beyond the right margin are ignored (truncated).

4.5.6.4 Carriage Return New Line Mode (DECCRNLM)

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

Sets CR New Line mode.

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

Resets CR New Line mode.

The power-up status of this function is set through the Automatic Line Feed feature in the set-up menu (Section 2.8).

The Carriage Return New Line Mode defines the function of Carriage Return (CR). If this function is set and a CR is received, the printer sets the active position at the left margin of the next line. If the function is reset and a CR is received, the printer returns the active position to column 1 of the current line.

4.5.6.5 Linefeed New Line Mode (LNM)

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

Sets LF New Line mode.

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

Resets LF New Line mode.

The power-up status of this function is set through the Automatic Carriage Return feature in the set-up menu (Section 2.8).

The Linefeed New Line Mode defines the function of Line Feed (LF). If LNM is set and a LF character is received, the printer advances the active position to the left margin of the next line. If LNM is reset and a LF is received, the printer advances the active position to the same column on the next line.

4.5.6.6 Horizontal Position Absolute (HPA)

CSI	Pn	‘
9/11	***	6/0

Sets the active column to column Pn.

If Pn is greater than the right margin, the active position moves beyond the right margin. If Pn is less than or equal to the left margin, the active column moves to the left margin.

4.5.6.7 Horizontal Position Relative (HPR)

CSI	Pn	a
9/11	***	6/1

Advances the active column by Pn columns.

If the active column plus Pn is greater than the right margin, the active position moves beyond the right margin.

4.5.6.8 Vertical Position Absolute (VPA)

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

Sets the active line to line Pn.

If the Pn position is below the bottom margin, the next printable character causes the active line to move to the top margin of the next page. If the Pn position is less than the active line, the next printable character advances the active line to the top margin of the next page.

4.5.6.9 Vertical Position Relative (VPR)

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

Advances the active line by Pn lines.

If the active line plus Pn is greater than the bottom margin, the next printable character causes the active line to move to the top margin of the next page.

4.5.7 Unidirectional/Bidirectional Printing (DECUPM)

In Text mode, printing occurs in either a unidirectional (left-to-right) or bidirectional pattern. In Graphic mode, printing is done unidirectionally ONLY. The following sequences control printing direction.

CSI	?	4	1	h
9/11	3/15	3/4	3/1	6/8

Sets to unidirectional (left to right) printing.

CSI	?	4	1	l
9/11	3/15	3/4	3/1	6/12

Sets to bidirectional printing.

4.5.8 Downline-Loadable Character Set

The LA75 allows you to create up to 96 unique characters that you can store for future use. These user-defined characters create a Dynamically Redefinable Character Set (DRCS). You can load this character set into the font memory of the printer and subsequently designate and invoke it as a regular resident character set. Once the font is loaded, the printer processes the user-defined characters in the same way as all other character sets.

The fonts may consist of 94- or 96-character sets that are loaded into the printer buffer using the downline-load (DECDLD) control string.

The 94-character set may include characters in positions from 2/1 through 7/14. The 96-character set may include characters in positions from 2/0 through 7/15.

On printer power down, the loaded DRCS character sets are lost.

4.5.8.1 Designing a Character Set - You can design characters for your character set by defining a pixel bit pattern for each character. The pixel is the smallest element of a picture (individual dot on the paper). Each pixel in a character font is represented by a bit with a binary value of 1 (on) or 0 (off). One (1) specifies foreground (printing) and zero (0) specifies background (no printing).

Pixel bit patterns are loaded in a font using sixels. Each sixel specifies one vertical column of six pixels.

For example, to design the character A using 7 × 10 character cell, you have to designate which pixels are to be printed. Figure 4-8 shows Character A pattern.

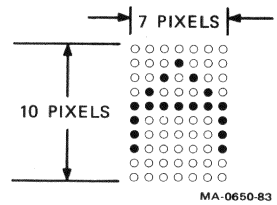


Figure 4-8 Pixel Pattern for Character A

After you establish what your character A is going to look like, you then break the pixels in this character cell into sixels as shown in Figure 4-9. The column numbers here designate the order in which the sixels will be sent to the printer.

In each column (sixel), the least significant bit corresponds to the top pixel and the most significant bit corresponds to the bottom pixel. Because the character height (10 pixels) is not a multiple of six, the columns on the bottom of the character cell consist of only four bits each. (The two highest order bits, b4 and b5, are ignored.)

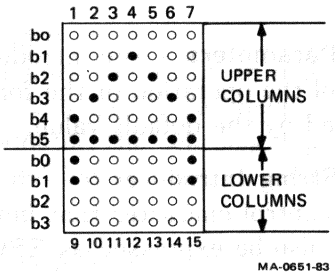


Figure 4-9 Character A in Sixel Pattern

After you have broken the designed character into sixels, you can convert the binary values of each sixel to its equivalent character. Because sixel column codes are restricted to characters with the range of ? (3/15) to ~ (7/14), you must add an offset of hexadecimal 3/15 (decimal 63) to each sixel column value. Thus, binary value 000000 is converted to hexadecimal 3/15, binary 110101 is coverted to hexadecimal 7/4 (3/5 + 3/15), and binary 111111 is converted to hexadecimal 7/14 (3/15 + 3/15).

After converting the binary sixel codes to hexadecimal values (using the offset), you then convert the resultant value for each sixel to its equivalent character using the ASCII table in Figure 3-1. Figure 4-10 shows the conversion procedure for the sample character A.

After you designed your DRCS character set using the conversion procedure described, you can then downline-load these characters using the DECDLD device control string.

4.5.8.2 DECDLD Control String - The downline-load control string consists of the Device Control String (DCS) introducer and protocol selector followed by the Select Character Set (Dscs) command string.

The introducer and protocol selector format is as follows:

DCS	Pfn	;	Pcn	;	Pe	;	Pcmw	;
9/10	***	3/11	***	3/11	***	3/11	***	3/11

Pss	;	Pu	;	Pcmh	;	Pcss	{
***	3/11	***	3/11	***	3/11	***	3/11

The Dscs string format is as follows:

Dscs Sxbp1 Sxbp2 ... Sxbpn ST

4.5.8.2.1 DCS Introducer Parameters - The introducer and protocol selective sequence parameters control the operation of the font load function. If a parameter is omitted, it is replaced by the default value.

DCS - Device Control String Introducer
9/0 DCS is an 8-bit control character that initiates the DECDLD control string. DCS can also be expressed as ESC P (1/11 5/0) in 7-bit coding.

Pfn - Font Number
This parameter specifies the DRCS buffer to be loaded. The LA75 has only one DRCS font buffer. You can use two values, 0 and 1 (default) to load this DRCS buffer. The printer ignores DECDLD sequences that attempt to load any other buffer.

Pcn - Starting Character Number
This parameter selects the location of the first character in the font buffer to be loaded. Parameter value 0 starts loading at character location 2/0, parameter value 1 at character location 2/1. Value 95 starts loading at character location 7/15. (Refer to ASCII table in Figure 3-1.)

If more than one character is to be loaded, the locations are filled consecutively, starting with Pcn, until the last legal location is reached.

NOTES:

1. *If the Character Set Size parameter (Pcss) is 0 (94-character set), the default value for Pcn is 1 (2/1).*
2. *If the Pcss parameter is 1 (96-character set), the default value for Pcn is 0 (2/0).*

Pe - Erase Control

This parameter determines which previously loaded characters are erased while new characters are loaded into the buffer. Valid Pe parameters are:

0 = erase all characters in the DRCS set (default).
1 = erase only the characters that are being loaded, and
2 = erase all characters in the DRCS set.

You can use Pe value 1 to change one or more characters in the specified set without affecting the remaining characters. Characters that are erased and are not redefined are printed as error characters (x).

Pcmw - Character Cell Width

This parameter defines the width (in pixels) of the character cell matrix. Some values also specify cell height. For example, if you use 2 as the width parameter, the cell height is set to 10, taking precedence over any specified Pcmh (Cell Height) parameter in the sequence.

Pcmw values are as follows:

0 = 9 (device default - LA75 Standard Text width)
1 = not used (DECDLD sequence is ignored)
2 = 5(W) × 10(H)
3 = 6 × 10
4 = 7 × 10
5 = 5
6 = 6
7 = 7
8 = 8
9 = 9 (LA75 Standard Text width)
10 = 10
11 = 11 (LA75 Full Cell width)

If the Pcmw value is greater than 11, the printer uses value 11 and truncates pixels beyond 11.

If you change the Pcmw parameter from a previous DECDLD sequence, the entire user-defined DRCS set currently loaded in the buffer is erased and a new load sequence is started. If you make an illegal selection for the Pcmw parameter, the printer will ignore the remainder of the load sequence.

Pss - Font Set Size
The LA75 ignores this parameter.

Pu - Font Usage
This parameter allows software to treat the font as a text font or a full-cell font. Full-cell fonts are 11 pixels wide by 12 pixels high (LA75 maximum cell size); text-cell fonts are 9 by 9 (standard cell size).

The Pu parameter effectively defines the absolute cell size limits of the DRCS font. Character cell size defined by Pcmw and Pcmh must fit within these limits. Loaded sixel data which exceeds the limits set by the Pu, Pcmw, and Pcmh parameters is truncated.

Pu values are:

0 = text (default)
1 = text
2 = full cell

If you change the Pu parameter from a previous DECDLD sequence, the entire user-defined DRSC set currently loaded in the buffer is erased and a new load sequence is started.

Pcmh - Character Cell Height
This parameter defines the height (in pixels) of the character cell matrix.

Pcmh values are as follows:

0 = 9 (default - LA75 Standard Text height, pixels)
1 = 1
2 = 2
3 = 3
4 = 4
5 = 5
6 = 6
7 = 7
8 = 8
9 = 9 (LA75 Standard Text height)
10 = 10
11 = 11
12 = 12 (LA75 Full Cell height)

If the Pcmh value is greater than 12, the LA75 uses value 12 and truncates pixels beyond it.

If you change this parameter from a previous DECDLD sequence, the entire current DRSC set is erased and a new load is started.

Pcss - Character Set Size
This parameter defines the size of the character set associated with the downline-loaded font according to:

Pcss values are as follows:

0 = 94-character set (default), and
1 = 96-character set.

This parameter must be consistent with the selection of the Pcn parameter. If you set Pcn to 0 in order to load a character at location 2/0, you must define a 96-character set by setting Pcss to 1. Likewise, if you want to load a character into location 7/15, you must set Pcss to 1 to designate a 96-character set.

{ - Final character
7/11 This character signals the end of the parameter list and specifies the Downline-load (DECDLD) function. The data following this final character up to the ST character must be in the 2/0 to 7/14 range and represents the actual font load command string.

4.5.8.2.2 DECDLD Dscs Command String - This string controls the actual loading of sixel data for the specified characters in the selected character set. The Dscs command string has the form:

Dscs	Sxbp1	Sxbp2	Sxbpn	ST
	***	***	***	9/12

Dscs - Select Character Set (SCS)
This SCS designation string defines the character set "name" for the loaded font, and is used in an SCS escape sequence (see Paragraph 4.4.5.1) to invoke the font after it is loaded.

The Dscs format is I I F.
The designation string is a set of up to three ANSI intermediate characters (2/0 through 2/15), followed by a final character (3/0 through 7/14).

The intermediate and final characters define the intermediate and final characters used in SCS escape sequences (Table 4-4).

For example:
If Dscs = B, a loaded 94-character font replaces the US ASCII set.
If Dscs = sp @, the loaded font is defined as an unused DRCS set. (This Dscs value is recommended for user-defined sets.)

You can load the Dscs-assigned fonts into G0, G1, G2, and G3 using the appropriate SCS sequences as follows.

ESC (	Dscs —> G0	94-character set
ESC)	Dscs —> G1	"
ESC *	Dscs —> G2	"
ESC +	Dscs —> G3	"
ESC -	Dscs —> G1	96-character set
ESC .	Dscs —> G2	"
ESC /	Dscs —> G3	"

Note that the correct SCS sequence depends on the set size of the loaded font (94 or 96 characters).

If you change the Dscs designation string from a previous DECDLD sequence, the entire current DRCS set is erased and a new load is started.

Sxbp - Sixel Bit Patterns

The sixel bit patterns define each downline-loaded character. The bit patterns that define individual characters are separated by the ";" character (3/8). Each sixel bit pattern has the form:

S...S/S...S

where first S...S represents the upper columns (sixels) of the DRCS character, the slash (2/5) advances the sixel pattern to the lower columns (sixels) of the DRCS character, and the second S...S represents the lower sixels of the DRCS character.

If no sixel data is specified for a particular character location (no data exists between the "; ;" delimiters) in the data string, that character is not loaded. If a character already exists at that location and its erasure has not been specified in the sequence, the character is retained in the loaded set.

If the loaded sixel data exceeds the specified character width or height, only those pixels beyond the limits are ignored. If the sixel data does not completely fill a character cell, the missing pixels are set to zero (no printing).

ST - String Terminator
9/12 This is an 8-bit control character that indicates the end of the device control string. This character is equivalent to the 7-bit ESC \ (1/11 5/12) sequence.

4.5.8.3 Example of DECDLD Control String - Suppose you want to load a character set with the example character A designed at the beginning of this section as the first character. To do this, you have to enter the following device control string (Figure 4-10).

DCS 1;1;1;4;;2;;0 { B ogcacgo/B?????B; (next character); ... ST

DCS — introduces the sequence.

1;1;1;4;;2;;0 — specifies loading of the DRCS font buffer number 1, selects the starting character as character 2/1, selects the erasure of only the characters that are to be loaded, selects character cell size (7 × 10), selects the full-cell font size, and selects the size of the character set (94 characters).

{ — indicates the end of the parameter characters and specifies that this is a DECDLD control string.

B — defines the loaded font as U.S. ASCII set.

ogcacgo — are the sixel character codes for the upper columns of the example character A.

/ — advances the sixel sequence to the lower columns of the character A.

B?????B — are the sixel character codes for the lower columns of the example character A.

; — separates DRCS characters in the set.

ST — indicates the end of the device control string.

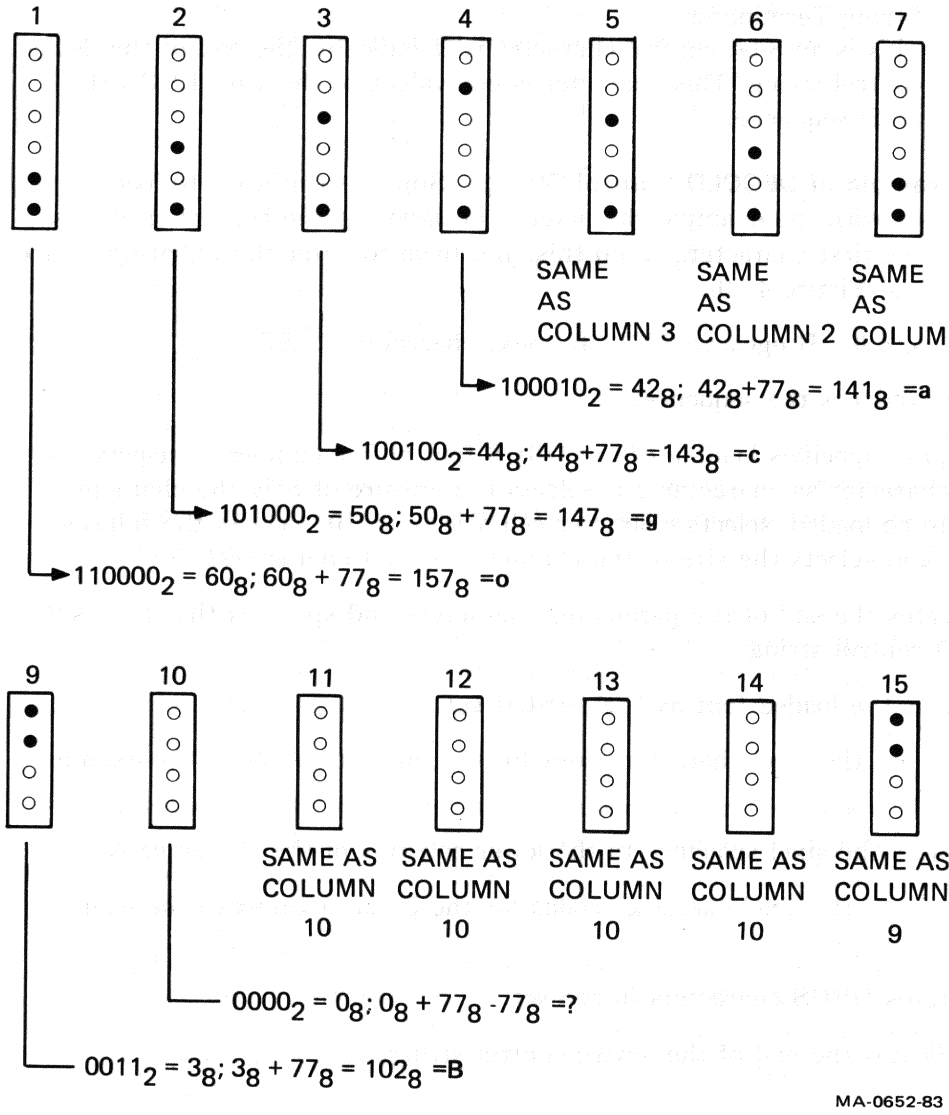


Figure 4-10 Column Codes for Example 80-Column Font "A" Character

STATUS, REPORT AND RESET SEQUENCES 5

This chapter describes the escape and control sequence you can use to select certain compatibilty modes, request status reports, and reset the printer.

5.1 IBM PROPRINTER EMULATION MODE (DECIPEM)

The LA75 powers on to operate in the DEC protocol mode. You can also set the LA75 to run in the IBM Proprinter emulation mode (see Part 3 for IBM Emulation Mode description). The DEC and OTHER protocol indicators on the front panel always show the current mode of operation where OTHER is the IBM Proprinter Emulation mode.

You can use the DECIPEM control sequence as follows:

Mnemonics	Sequence
DECIPEM	**ESC [? 5 8 h** 1/11 5/11 3/15 3/5 3/8 6/8 Enter IBM Proprinter Emulation mode from DEC mode.

The printer will not reset to its initial conditions in the IBM Emulation Mode but will maintain the same conditions that were present when IBM Emulation Mode was last exited.

DECIPEM	**ESC [? 5 8 l** 1/11 5/11 3/15 3/5 3/8 6/12 Exit IBM Proprinter Emulation mode and return to DEC mode.

NOTE: Do NOT use the CSI control character when the printer is in IBM Emulation mode.

After the printer exits the IBM emulation mode, it returns to DEC-compatible text mode maintaining the same conditions that were present before DEC-compatible mode was exited.

These settings include the following:

Horizontal and Vertical Pitch
(SGR) Attributes
Print Density
Form Length
Top and Bottom Margins
Print Area
Horizontal and Vertical Tabs
DSR Solicited/Unsolicited
Active Character Sets (GL, GR, G0 — G3)

When you enable the IBM emulation mode or return to the DEC mode, the paper advances to the next top-of-form.

NOTE: You can also use the front panel protocol switch or the set-up menu (Sections 2.7 and 2.8) to set IBM or DEC emulation modes.

5.2 SET CONFORMANCE LEVEL (DECSCL)

You can select the functional conformance level (Level 1 or Level 2) that provides interface compatibility with other Digital equipment. Section 4.4 gives a description of Levels 1 and 2 functions.

The DECSCL control sequence is as follows.

CSI	Ps	"	p
9/11	***	2/2	7/0

Ps = 7	1	Resets the printer to initial state and
3/7	3/1	enables the conformance Level 1 functions.
		Enables Level 2 device attribute (DA) response (Section 5.3).
= 7	2	Resets the printer to initial state and
3/7	3/2	enables Level 1 and Level 2 functions.
		Enables Level 2 device attribute (DA) response.

All other Ps values are ignored.

The Printer ID feature in the set-up menu determines the printer's conformance level and device attribute (DA) response at power up.

5.3 PRODUCT IDENTIFICATION: DEVICE ATTRIBUTES (DA) SEQUENCES

The printer sends a reply to a request from the computer for primary or secondary device attributes. The printer sends the reply after printing all data received before the DA request. You select the reply sequences through the set-up menu by setting the Printer ID feature (Section 2.8). There are three device IDs — LA50, LA210, and Conformance Level 2. The printer responds with one of the three appropriate DA reply sequences.

5.3.1 Primary Device Attributes

The device attribute response depends on the printer indentification (ID) selected through the set-up menu. The reply sequences provide printer ID and option identifications.

DA Request from Computer	DA reply from printer
CSI 0 c 9/11 3/0 6/3	
or	
CSI c 9/11 6/3	
Printer ID = LA50	**ESC [? 1 7 c** 1/11 5/11 3/15 3/1 3/7 6/3 The printer sends LA50 reply (1 7).
Printer ID = LA210	**ESC [? 1 0 ; 3 c** 1/11 5/11 3/15 3/1 3/0 3/11 3/3 6/3 The printer sends LA210 reply (1 0).
Printer ID = Level 2	**ESC [? 7 2 ; 5 ;** 1/11 5/11 3/15 3/7 3/2 3/11 3/5 3/11 **Ps3 ; 7 c** *** 3/11 3/7 6/3 First parameter (7 2) confirms Level 2. Second parameter (5) indicates that the Katakana character set is available.

The third parameter (Ps3) may be 6 (3/6), indicating that the sheet feeder is available. (This parameter is sent only if the sheet feeder is installed.)

The fourth parameter is always 7 (3/7), indicating that the downline-loading (DECDLD) is available.

5.3.2 Secondary Device Attributes

The secondary device attribute response provides the printer model ID and the firmware revision level.

For all printer IDs (LA50, LA210, and Level 2), the printer sends the same secondary DA reply.

DA request from computer

CSI	**>**	**0**	**c**
9/11	3/14	3/0	6/3

or

CSI	**>**	**c**
9/11	3/14	6/3

DA reply from printer

ESC	**[**	**>**	**1**	**6**	**;**	**Ps2**	**c**
1/11	5/11	3/14	3/1	3/6	3/11	***	6/3

First parameter (1 6) identifies the printer as the LA75.

Second parameter (Ps2) identifies the firmware revision level. Currently Ps2 = 1 (3/1).

5.4 DEVICE STATUS REQUEST (DSR)

The printer sends an answer to a device status request sequence from the computer. The following sequences control the printer status reports and enable or disable unsolicited reports.

Name	Mnemonic	Sequence				Function
Device status request	DSR	**CSI**	**n**			
		9/11	6/14			
		CSI	**0**	**n**		
		9/11	3/0	6/14		
		or				
		CSI	**5**	**n**		Send extended status report.
		9/11	3/5	6/14		
		CSI	**?**	**1**	**n**	Disable all unsolicited status reports.
		9/11	3/15	3/1	6/14	
		CSI	**?**	**2**	**n**	Enable unsolicited brief status report and send extended status report.
		9/11	3/15	3/2	6/14	
		CSI	**?**	**3**	**n**	Enable unsolicited extended status reports and send extended status report.
		9/11	3/15	3/3	6/14	

5.5 DEVICE STATUS REPORT (DSR)

The printer can send both brief and extended status reports. The reports may be solicited or unsolicited. Solicited reports are sent immediately upon request. The printer sends unsolicited reports (if enabled) when there is a change in any reportable status condition (such as a failure and subsequent printer's reset). Unsolicited status reports are initially disabled.

When solicited, DSR must be processed on its way into the input buffer. Therefore, the printer immediately responds to DSR, even when the buffer is full and an XOFF has been sent to the host computer. The printer may receive and answer an unlimited number of status requests.

The control sequences and contents of the brief and extended printer status reports are as follows.

Name	Mnemonic	Sequence	Function
Brief Report			
Device status report (brief)	DSR	**ESC [0 n** 1/11 5/11 3/0 6/14	No malfunction detected.
		ESC [3 n 1/11 5/11 3/3 6/14	Malfunction detected.
Extended Report			
Device status report (extended)	DSR	**ESC [0 n** 1/11 5/11 3/0 6/14	No malfunction detected.
		followed by:	
		ESC [? 2 0 n 1/11 5/11 3/15 3/2 3/0 6/14	
		ESC [3 n 1/11 5/11 3/3 6/14	Malfunction detected.
		followed by:	
		ESC [? Pn ; ... Pn n 1/11 5/11 3/15 *** 3/11 ... *** 6/14	

Where "Pn" is an error code that can be any valid combination of the following values.

Pn	Failure
21 (3/2 3/1)	Hardware failure.*
22 (3/2 3/2)	Communication failure.†
23 (3/2 3/3)	Input buffer overflow.‡
24 (3/2 3/4)	Printer deselected.
26 (3/2 3/6)	Access cover open.
27 (3/2 3/7)	Paper out.
30 (3/3 3/0)	Automatic sheet feeder is installed and operates correctly.
32 (3/3 3/2)	Automatic sheet feeder failure caused by paper feed error.

* The only reportable hardware failure is a printhead position failure. This occurs when the printhead loses track of position and attempts to move beyond the physical left stop.

† A communication failure can be a parity or framing error, or an erroneous character received by the printer.

‡ Failures designated as events (communication failure and buffer overflow) are automatically reset when an extended report is sent, and are only reported when they occur—not when they are reset.

5.6 RESET TO INITIAL STATE (RIS)

This sequence resets all DEC-compatible features to the initial state without running the power-up self-test. Data in the buffer is preserved (including the DECDLD buffer) and the paper advances to the next top-of-form.

Name	Mnemonic	Sequence	Function
Reset to initial state	RIS	**ESC c** 1/11 6/3	Reset printer to its DEC-compatible initial state.

NOTE: RIS does not reset IBM-compatible settings.

5.7 SOFT TERMINAL RESET (DECSTR)

This sequence resets all features to DEC-compatible initial state (as with RIS) without running the power-up self-test. Data in the buffer is preserved and the paper advances to the next top-of-form.

Name	Mnemonic	Sequence	Function
Soft terminal reset	DECSTR	**CSI ! p** 9/11 2/1 7/0	Reset printer to its DEC-compatible initial state.

NOTE: DECSTR does not reset IBM-compatible settings.

5.8 LOADING FACTORY NONVOLATILE MEMORY (NVR) SETTINGS (DECFNVR)

The DECFNVR sequence allows you to enter and store in the printer's memory the set-up menu parameters. You cannot load the power-up or currently active parameters. The DECFNRV-selected parameters will become active the next time the printer is powered up.

WARNING: Use of this sequence in the LA75 is limited to 10,000 writes. If you use this function in your application software, care must be taken NOT to use this sequence more than 10,000 times during the expected lifetime of the printer.

Name	Mnemonic	Sequence							
Loading Factory NVR Settings	DECFNVR	CSI 9/11	Ps1 ***	; 3/11	Ps2 ***	...	Psn ***	! 2/1	u 7/5

Ps1 = Set-up feature 1
Ps2 = Set-up feature 2
:
:
Psn = Set-up feature n

The DECFNVR parameters must match the select features and values defined in the set-up menu (Section 2.8).

Example:
The following sequence sets the Print Quality (DEC) feature to LQ printing and stores it for later use on the next power up.

CSI ; ; ; ; ; ; 2 ! u

GRAPHIC MODE 6

This chapter describes how to send graphic data to the LA75 printer set in the DEC-compatible mode.

6.1 OVERVIEW

To print graphics, you must use *sixel* data. A sixel is a column of six vertical pixels. Pixels are the smallest elements of a picture — the individual dots on a video terminal screen or a dot matrix printer.

A sixel represents bit map data. Each pixel of a sixel represents one bit of information. A bit value of 1 means to print a pixel, while a bit value of 0 means to leave a space. The printer decodes the sixel data into bits of information and maps them to the 9 printhead impact elements for printing (Figure 6-1).

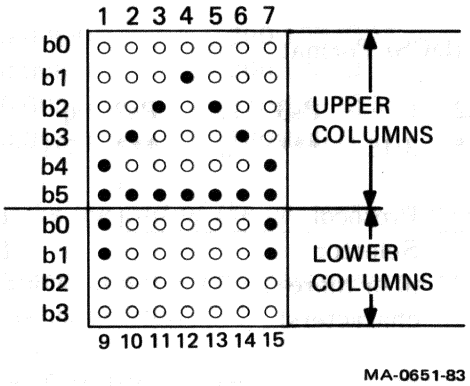


Figure 6-1 Sixel Pattern

Sixel data consists of characters each represented by a binary bit pattern. To encode picture data into valid sixel data, first convert each six-bit binary sixel to a hexadecimal value. In each sixel column, the least significant bit corresponds to the top pixel, and the most significant bit corresponds to the bottom pixel. Because sixel column codes are restricted to characters in the range from ? (3/15) through ~ (7/14), you must then add the hexadecimal offset 3/15 (decimal 63) to each sixel column value. For example, the binary value of 000000 is converted to hexadecimal 3/15, binary 110101 is converted to hexadecimal 7/4 (3/5 plus 3/15), and binary 111111 is converted to hexdecimal 7/14 (3/15 plus 3/15).

After this binary-to-hexdecimal conversion, you can convert the hexadecimal values for each sixel into the equivalent characters using the ASCII table (Figure 3-1).

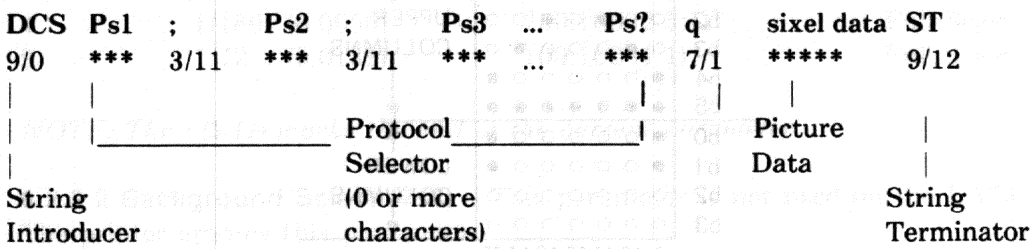
6.2 SELECTING GRAPHIC MODE: THE SIXEL PROTOCOL

You select Graphic mode by sending a special device control string (DCS). You include all your sixel graphic data and formatting information in the device control string.

The formatting section of the device control string is called the sixel protocol selector. The rest of this section describes the features you can select within the sixel protocol selector.

The device control string starts with the DCS control code, called a string introducer. Next comes the protocol selector, which contains your formatting information. The protocol selector is followed by the sixel graphic data. Finally, the string terminator (ST) control code ends the string. The ST code also ends Graphic mode.

Device Control String (DCS) Format



6.2.1 String Introducer

When you send the string introducer in Text mode, you identify the start of the device control string. In the LA75, sixel graphic mode is one of the three valid uses of the device control strings. You can use the 8-bit DCS (9/0) control code or the 7-bit ESC P (1/11 5/0) escape sequence for the string introducer.

6.2.2 Protocol Selector

The protocol selector can contain a string of 0, 1, or more selective parameters (Ps), each separated by a ; (3/11). A valid selective parameter can have 0, 1, or more digits in the column/row range of 3/0 to 3/9. When you send any selective parameter with the final character q (7/1), the printer enters the Graphic mode.

The protocol selector has the following format.

Psl	;	Ps2	;	Ps3	...	Ps	q
***	3/11	***	3/11	***	...	***	7/1

6.2.2.1 Macro Parameter (Ps1) - The Ps1 parameter selects the fixed horizontal grid size (pixel width) and aspect ratio. This parameter provides for backward compatibility with existing software.

NOTE: For new software, you should set Ps1 to 0, explicitly define the horizontal grid size (by using Ps3), and the aspect ratio numerator and denominator (by using Pn1 and Pn2 of the "Set Raster Attributes" control sequence (Paragraph 6.3.2.2).

Psl	Horizontal Grid Size (Inches)	Pixel Aspect Ratio (Vertical:Horizontal)	Image Scale Size
0 or none	1/144 (0.0069)	200:100 (2:1)	Full Scale
1	1/144 (0.0069)	200:100 (2:1)	Full Scale
4	1/180 (0.0056)	250:100 (2.5:1)	Full Scale
9	1/72 (0.0139)	100:100 (1:1)	Full Scale

NOTE: The ; (3/11) marks the end of the current parameter.

6.2.2.2 Background Select (Ps2) - This parameter is not used on the LA75. The printer ignores this parameter.

6.2.2.3 Horizontal Grid Size (Ps3) - The Ps3 parameter defines the horizontal grid size (pixel width) in decipoints. A decipoint is 1/720 inch. This parameter and the aspect ratio define the grid size and image scale size.

The printer has horizontal grid size defaults for some decipoint values. The following shows the horizontal grid size specified for each Ps3 value.

Ps3 Decipoints (1/720 Inch Units)	Horizontal Grid Size (Inches)
0 or none	No change to grid size (defined by Ps1)
1, 2, and 3*	1/180 (0.0056)
4	1/180 (0.0056)
5	1/144 (0.0069)
6*	1/144 (0.0069)
7*	1/144 (0.0069)
8	1/90 (0.0111)
9*	1/90 (0.0111)
10	1/72 (0.0139)
11 to 19*	1/72 (0.0139)
20	1/36 (0.0278)
21 and up*	1/36 (0.0278)

* Defaults to horizontal grid size listed.

If Ps3 is 0 or not present, the horizontal grid size is determined by the macro parameter (Ps1). Otherwise, Ps3 overrides the horizontal grid size portion of the Ps1, while attempting to preserve the aspect ratio (A/R) as follows.

- When Ps1 selects a 2.5:1 aspect ratio

Ps3 Selection	Resulting Aspect Ratio (A/R) And Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180 in.	2.5:1 A/R and HGS of 1/180 in.	Full Scale
1/144	2.5:1 A/R and HGS of 1/180	Full Scale
1/90	2.5:1 A/R and HGS of 1/90	2 × Full Scale
1/72	2.5:1 A/R and HGS of 1/90	2 × Full Scale
1/36	2.5:1 A/R and HGS of 1/90	2 × Full Scale

- When Ps1 selects a 2:1 aspect ratio

Ps3 Selection	Resulting Aspect Ratio (A/R) And Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180 in.	2.5:1 A/R and HGS of 1/180 in.	Full Scale
1/144	2:1 A/R and HGS of 1/144	Full Scale
1/90	2:1 A/R and HGS of 1/144	Full Scale
1/72	2:1 A/R and HGS of 1/72	2 × Full Scale
1/36	2:1 A/R and HGS of 1/72	2 × Full Scale

- When Ps1 selects a 1:1 aspect ratio

Ps3 Selection	Resulting Aspect Ratio (A/R) And Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180 in.	2.5:1 A/R and HGS of 1/180 in.	0.5 × Full Scale
1/144	1:1 A/R and HGS of 1/144	0.5 × Full Scale
1/90	1:1 A/R and HGS of 1/144	0.5 × Full Scale
1/72	1:1 A/R and HGS of 1/72	Full Scale
1/36	1:1 A/R and HGS of 1/36	2 × Full Scale

6.2.2.4 Additional Parameters (Ps?) - Additional parameters may be supported in future products. The LA75 ignores other parameters without affecting the current sixel protocol sequence.

6.2.2.5 Final Character (q) - The final character q (7/1) identifies this sequence as a sixel protocol selector and places the printer in Graphic mode.

6.2.3 Picture Data

Picture data includes sixel printable characters and sixel control characters. The printer processes picture data in Graphic mode as defined in Section 6.3. In Graphic mode, printing is performed only unidirectionally.

6.2.4 String Terminator (ST)

The string terminator (ST) control code causes the printer to leave Graphic mode and enter Text mode. You can use the 8-bit control code ST (9/12) or the 7-bit escape sequence ESC \ (1/11, 5/12) for the string terminator.

6.3 CHARACTER PROCESSING IN GRAPHIC MODE

In Graphic mode, printable character codes define specific columns of dots to print.

6.3.1 Sixel Printable Characters

In sixel graphic mode, the printer interprets GL (graphic left) characters in the column/row range of 3/15 to 7/14 as printable characters. Each of these 64 values represents a code of 6 vertical pixels (1 sixel) to print. The actual pixel size is defined by the horizontal grid size (HGS) parameter and the aspect ratio (Paragraph 6.2.2).

The printer subtracts a hexadecimal offset of 3/15 from each graphic printable character received, resulting in a binary value in the range of 0/0 to 3/15. The 6-bit binary value obtained represents a sixel column definition.

For each bit set to 1, the printer activates a printhead element or group of elements to print a dot. The least significant bit (bit 0) is the top pixel of a sixel.

The printer processes GR (graphic right) characters in the 11/15 to 15/14 range as GL characters, by setting the eighth bit to 0 and subtracting the 3/15 hexadecimal offset from the graphic printable character.

Column/ Row	ASCII Character	Binary Value	Pixels Activated	Action Performed
3/15	?	000000	None	Advance by a sixel space.
4/0	@	000001	Top	Print top pixel only.
5/15	_	100000	Bottom	Print bottom pixel only.
7/14	~	111111	All	Print one full column.

If you try to print past the right margin, the printer truncates all remaining sixel data until it receives the next graphic carriage return (\$) or graphic new line (-) character.

6.3.2 Sixel Control Codes

Sixel control codes are GL characters in the 2/0 to 3/14 range. Note that this range also includes the parameter separator ; (3/11) and parameter digits 0 to 9 (3/0 to 3/9).

The printer processes GR characters in the 10/0 to 11/14 range as GL characters, by setting the eighth bit to 0.

The printer recognizes the following sixel control characters.

Column/ Row	ASCII Character	Function
2/1	!	Repeat introducer
2/2	"	Set raster attributes
2/4	$	Graphic carriage return
2/13	—	Graphic new line
3/0 to 3/9	0 to 9	Numeric parameters
3/11	;	Parameter separator

A control sequence in Graphic mode begins with a sixel control character (not including the 0 to 9 and ; characters) and ends with either a printable character or another sixel control character.

The printer ignores unassigned sixel control characters (along with any parameters or parameter separators) until receiving the next valid sixel control character, printable character, or string terminator (ST).

6.3.2.1 Repeat Introducer (!) and Sequence - You can use the following sequence to print the same character a consecutive number of times.

!	Pn	printable character
2/1	***	

Pn specifies the number of times to print the character that follows.

The numeric parameter is a string of characters in the 3/0 to 3/9 range that the printer interprets as a decimal number, from 0 to 65,535. If you omit Pn or set Pn to 0, the printer uses 1. If you use a Pn value larger than 65535, the printer uses the maximum value of 65535.

NOTE: Sixel control characters received during a repeat sequence cancel the repeat sequence. The printer will then process these control characters,

The LA75 prints the printable character (in the 3/15 to 7/14 range) as many times as specified by Pn. The printable character terminates the repeat sequence.

Examples

Repeat Sequence				Function
!	**1**	**0**	**?**	Repeats 10 graphic spaces.
2/1	3/1	3/0	3/15	
!	**6**	**@**		Repeats 6 patterns of top dot.
2/1	3/6	4/0		

6.3.2.2 Set Raster Attributes Sequence - This sequence defines the pixel aspect ratio. This aspect ratio applies to all sixel data that follow. After entering Graphic mode, the printer must immediately receive this sequence before the first sixel printable character.

If the printer receives the sequence after any other valid sixel data, the printer recognizes this sequence but ignores its parameters. The printer continues to process all following sixel data.

If the sequence is received before any other valid sixel data, the printer processes the sequence.

The set raster attributes sequence format is as follows.

"	**Pn1**	**;**	**Pn2**	**;**	**Pn3**	**;**	**Pn4**
2/2	***	3/11	***	3/11	***	3/11	***

where

" = Set raster attributes control character.

Pn1 = Pixel aspect ratio numerator, and

Pn2 = Pixel aspect ratio denominator.

Pn1 and Pn2 are numeric parameters. A numeric parameter is a string of characters in the 3/0 to 3/9 range, which the printer evaluates as decimal numbers. If the parameter is a value larger than the maximum 65,535, the printer uses 65,535. If Pn1 and Pn2 are 0, the printer uses an aspect ratio of 2.5:1.

Pn3, Pn4 and all other parameters received in this sequence are ignored by the printer.

Pixel aspect ratio defines the shape of the pixel needed to reproduce the picture without distortion. This ratio is defined by two numbers, a numerator and a denominator. The pixel aspect ratio is the ratio of the pixel's vertical size to its horizontal size.

For example, an aspect ratio of 2:1 represents a pixel twice as high as it is wide. The pixel aspect ratio (A/R) multiplied by the horizontal grid size (HGS) yields the ideal vertical grid size (VGS).

This printer supports only the following three aspect ratios.

Aspect Ratio	Sixel Scale	HGS (inch)	Horizontal Dots/Pixel	VGS (inch)
1:1	0.5	1/144	1	1/144
	Full	1/72	1	1/72
	2×	1/36	2	1/36
2:1	Full	1/144	1	1/72
	2×	1/72	2	1/36
2.5:1	Full	1/180	1	1/72
	2×	1/90	2	1/36

Other aspect ratios specified by Pn1 and Pn2 are processed as follows.

- If the aspect ratio is less than 1.5:1, the printer uses 1:1.
- If the aspect ratio is greater than or equal to 1.5:1 and less than 2.25:1, the printer uses 2:1.
- If the aspect ratio is greater than 2.25:1, the printer uses 2.5:1.

The printer attempts to preserve the specified aspect ratios at each horizontal grid size as follows:

- When the selected aspect ratio is 2.5:1

Horizontal Grid Size	Resulting Aspect Ratio (A/R) And Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180 in.	2.5:1 A/R and HGS of 1/180 in.	Full Scale
1/144	2.5:1 A/R and HGS of 1/180	Full Scale
1/90	2.5:1 A/R and HGS of 1/90	2 × Full Scale
1/72	2.5:1 A/R and HGS of 1/90	2 × Full Scale
1/36	2.5:1 A/R and HGS of 1/90	2 × Full Scale

- When the selected aspect ratio is 2:1

Horizontal Grid Size	Resulting Aspect Ratio (A/R) And Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180 in.	2.5:1 A/R and HGS of 1/180 in.	Full Scale
1/144	2:1 A/R and HGS of 1/144	Full Scale
1/90	2:1 A/R and HGS of 1/144	Full Scale
1/72	2:1 A/R and HGS of 1/72	2 × Full Scale
1/36	2:1 A/R and HGS of 1/72	2 × Full Scale

- When the selected aspect ratio is 1:1

Horizontal Grid Size	Resulting Aspect Ratio (A/R) And Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180 in.	2.5:1 A/R and HGS of 1/180 in.	0.5 × Full Scale
1/144	1:1 A/R and HGS of 1/144	0.5 × Full Scale
1/90	1:1 A/R and HGS of 1/144	0.5 × Full Scale
1/72	1:1 A/R and HGS of 1/72	Full Scale
1/36	1:1 A/R and HGS of 1/36	2 × Full Scale

By following these rules, the only possible vertical grid sizes the printer can use are 1/144, 1/72 or 1/36 inch. This means the printer can only support three vertical pixel scales.

Each vertical pixel size corresponds to a vertical sixel size (six vertical pixels) and image scale size as described below and in Appendix B.

Vertical Grid Size	Vertical Sixel Size	Image Scale Size	Pixel Construction
1/144 inch	1/24 inch	0.5 Scale	1/2 vertical dot per pixel (two-pass printing, pixel overlap)
1/72 inch	1/12 inch	Full Scale	1 vertical dot per pixel
1/36 inch	1/6 inch	2 × Scale	2 vertical dots per pixel

6.3.2.3 Graphic Carriage Return ($) - The graphic carriage return (GCR) control code $ (2/4) returns the carriage to the graphic left margin. The graphic left margin is the active position where the printer enters the Graphic mode. This allows overprinting lines of sixel data.

6.3.2.4 Graphic New Line (-) - The graphic new line (GNL) control code (2/13) ends a printed graphic sixel line by

- returning the printhead to the graphic left margin, and
- advancing the paper to print the next sixel line. The active vertical position is advanced by one sixel line at the current vertical grid size.

6.3.2.5 Numeric Parameters (0—9) - Some graphic control codes must be followed by a numeric value. The numeric value is a decimal number, coded by using the ASCII digits 0 to 9 (3/0 to 3/9). A numeric value is ended by any nondigit, specifically another control code or a graphic printable character. The default value for any numeric parameter is 0.

6.3.2.6 Parameter Separator (;) - The parameter separator ; (3/11) separates a series of numeric parameters. If there is no number before the separator, then the preceding parameter value defaults to 0. If a number does not follow the separator, then the following parameter value defaults to 0.

6.3.3 Graphic C0 Control Characters

In Graphic mode, the printer ignores all C0 control characters except CAN, SUB, and ESC. When these control characters are received, the printer performs the following actions.

C0 Control Character	Printer Action
CAN	Leaves Graphic mode, enters Text mode, then processes CAN.
SUB	Processes SUB as a sixel space (3/15) to limit communication line errors (Paragraph 6.3.4).
ESC	Leaves Graphic mode, enters Text mode, then processes ESC.

NOTE: When the printer receives any C1 control code in Graphic mode, the printer leaves Graphic mode and enters Text mode. The printer then processes the C1 control codes, if recognized.

6.3.4 Graphic Substitute (SUB) Character

The printer interprets the substitute character SUB (1/10) as being in place of a character or characters received in error. In Graphic mode, the printer processes SUB as a sixel space character (3/15).

If the printer is processing a repeat sequence, the sequence is terminated. The printer then prints a number of sixel spaces equal to the repeat number specified in the repeat sequence. The printer remains in Graphic mode.

6.3.5 Leaving Graphic Mode

The following control characters cause the printer to leave Graphic mode and perform the following actions.

Control Character	Printer Action
CAN	Enters Text mode and processes the CAN character.
ESC	Enters Text mode and begins processing another escape sequence.
ST	Enters Text mode.

6.3.6 Printer State After Leaving Graphic Mode

After leaving Graphic mode, the printer enters the following state.

- Horizontal position returns to the last active position before entering Graphic mode.
- Horizontal pitch returns to the last value used before entering Graphic mode.
- Vertical position is modified by the vertical control characters received in Graphic mode.
- Vertical pitch returns to the last value used before entering Graphic mode.
- All SGR attributes return to the last state before entering Graphic mode.

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PART 3
GATE IN IBM PROPRINTER EMULATION MODE

7 IBM EMULATION FEATURES

This chapter describes the LA75 basic features, control characters and character sets used in the IBM Proprinter emulation mode.

7.1 GENERAL

You can manually set the LA75 to operate in the IBM emulation mode using the front panel PROTOCOL switch and/or the set-up menu (described in Section 2.8). The OTHER indicator on the front panel lights up if the printer is in the IBM emulation mode.

You can also enter and exit IBM operating mode under software control using the DECIPEM sequences (see Paragraph 8.2.5).

Feature settings for IBM emulation mode, as they are presented in the menu selection, are as follows (FS is factory setting).

FEATURE		VALUE		
14	Paper Out Bell	1	Off	
		2	On	FS
15	Slashed Zero	1	Zero with slash	
		2	Zero without slash	FS
16	Auto Line Feed on CR	1	On	
		2	Off	FS
17	Active Character Set	1	Set A	FS
		2	Set B	
18	Auto Carriage Return on LF	1	On	
		2	Off	FS

19	Power-up Print Density	1 2	Draft NLQ/LQ	FS
20	LQ or NLQ	1 2	NLQ LQ	FS

The LA75 is completely compatible with existing software packages written for the IBM Proprinter. While in the emulation mode, the LA75 uses the IBM-compatible escape and control sequences that allow the software developed for the IBM Proprinter to run without modifications.

In IBM emulation mode, the LA75 can run either as a text printer or a graphics printer. The following paragraphs describe these modes and character processing features.

7.1.1 Line-Oriented Buffer and Line Terminators

In DEC mode, the LA75 operates as a character printer; characters cannot be altered after they are sent to the printer. In IBM emulation mode, the printer operates as a buffered lineprinter; received characters are stored in a buffer until the printer receives a line terminator character. Then, the entire contents of the buffer are printed. You can erase an entire line while it is still in the buffer. The following characters and escape sequences are line terminators and cause the contents of the buffer to print.

BS	Backspace
CR	Carriage return
LF	Line feed
VT	Vertical tab
FF	Form feed
ESC J	Set variable line feed
ESC L	Enter graphic mode
ESC K	Enter graphic mode
ESC Y	Enter graphic mode
ESC Z	Enter graphic mode

If no line terminator is received, the buffer will empty 0.5 seconds after the receipt of the last character.

7.1.2 Graphic Mode Overview

The graphic escape sequences operate differently than the line buffer operation described above. Graphic escape sequences are self-terminating. Each sequence specifies the number of graphic data bytes to follow. When the printer receives the specified number of data bytes, the printer prints the graphic data, unless a timeout in data transmission has occurred. In this mode, the buffer will automatically empty 3 seconds after the receipt of last character.

7.1.3 Compatible Control Characters, Escape Sequences, and Character Sets

In emulation mode, all escape sequences and control characters are compatible with software written for the IBM Proprinter. The character sets used by the LA75 in the emulation mode are compatible with character sets used by the emulated IBM Proprinter. The LA75 also provides line drawing compatibility with IBM screen characters.

7.1.4 Character Size

In emulation mode, the LA75 usually prints 1/8-inch high characters, although some graphic characters are 1/6-inch high and are IBM-compatible. Most of the characters in IBM emulation mode are printed in a 9 × 9 dot matrix (draft font). When you select high resolution printing, the printer can use either Near-Letter Quality (17 × 17) or Letter Quality (27 × 18) dot matrix in the same size character cell.

7.1.5 Standard, Compressed, and Double-Width Printing

IBM emulation mode uses control characters to select standard or compressed printing. Compressed printing provides more characters per inch. Control characters and escape sequences are also used for selecting double-width or single-width printing. When the printer receives a control character or escape sequence that indicates double-width printing, the printer doubles the character size of the current standard or compressed printing. This allows six combinations of character size (Table 7-1).

Table 7-1 Character Sizes Vs. Print Density

Character Width Selection	Standard		Compressed
Single width	10 cpi	12 cpi	17.1 cpi
Double width	5 cpi	6 cpi	8.55 cpi

7.1.6 Escape Sequence Processing

Some escape sequences require parameters. These parameters are represented by Ps or Pn. The characters *** below Ps or Pn represent the encoding of the parameter. Both the processing of escape sequences and coding of parameters differ between DEC mode and IBM emulation mode. To send a decimal parameter "X" in the IBM emulation mode, send the character with the decimal value equal to X. For example, to send a parameter of 115 decimal, send the character "s" which is located in 7/3 and has the decimal code of 115.

7.2 CHARACTER SETS

This section describes the character sets the LA75 printer uses while emulating an IBM Proprinter. This mode causes the printer to respond to the same control characters and escape sequences used by the IBM Proprinter, and to print the same characters. As with the IBM Proprinter, three character sets are available — character sets A, B, and All Characters. These character sets are software selectable.

The character sets are selected using corresponding escape sequences described in Chapter 8.

7.2.1 Character Set Charts

Figures 7-1 through 7-3 show character sets A, B, and All Characters, respectively.

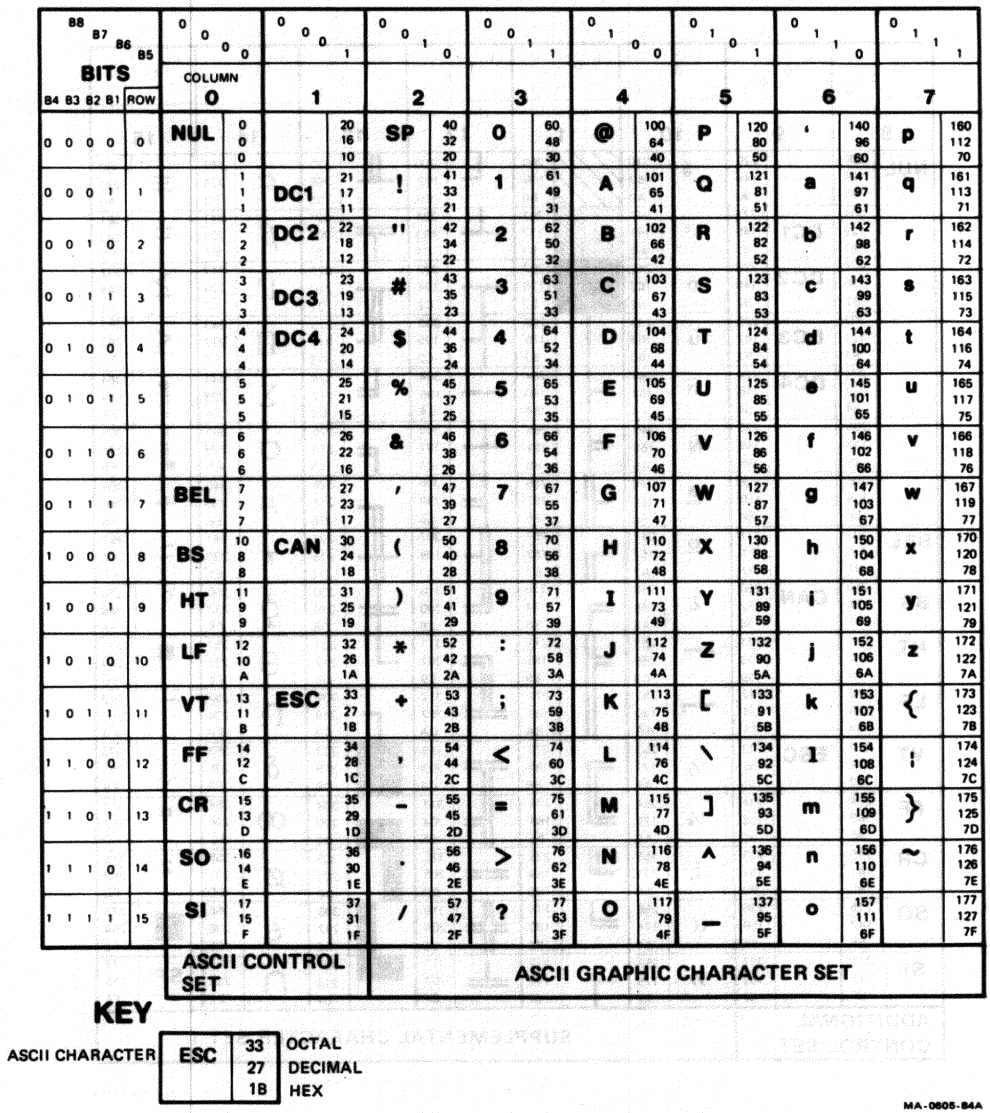

Figure 7-1 IBM Graphic Character Set A (GL) (Sheet 1 of 2)

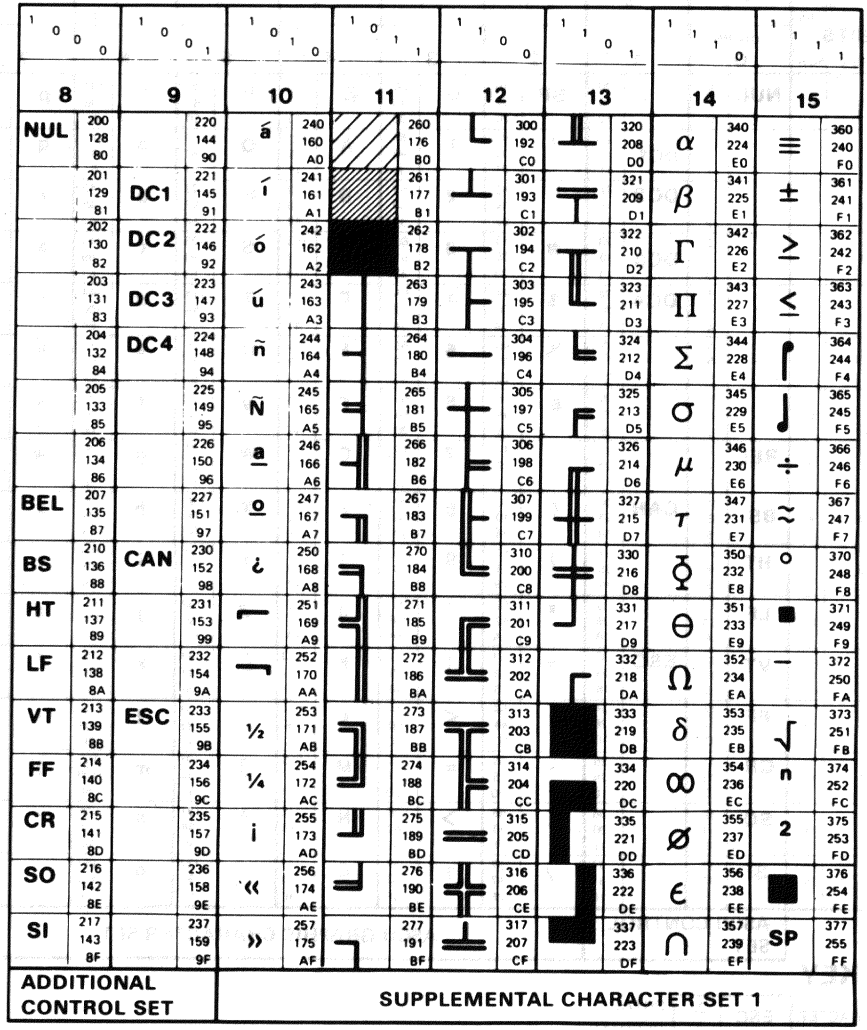

Figure 7-1 IBM Graphic Character Set A (GR) (Sheet 2 of 2)

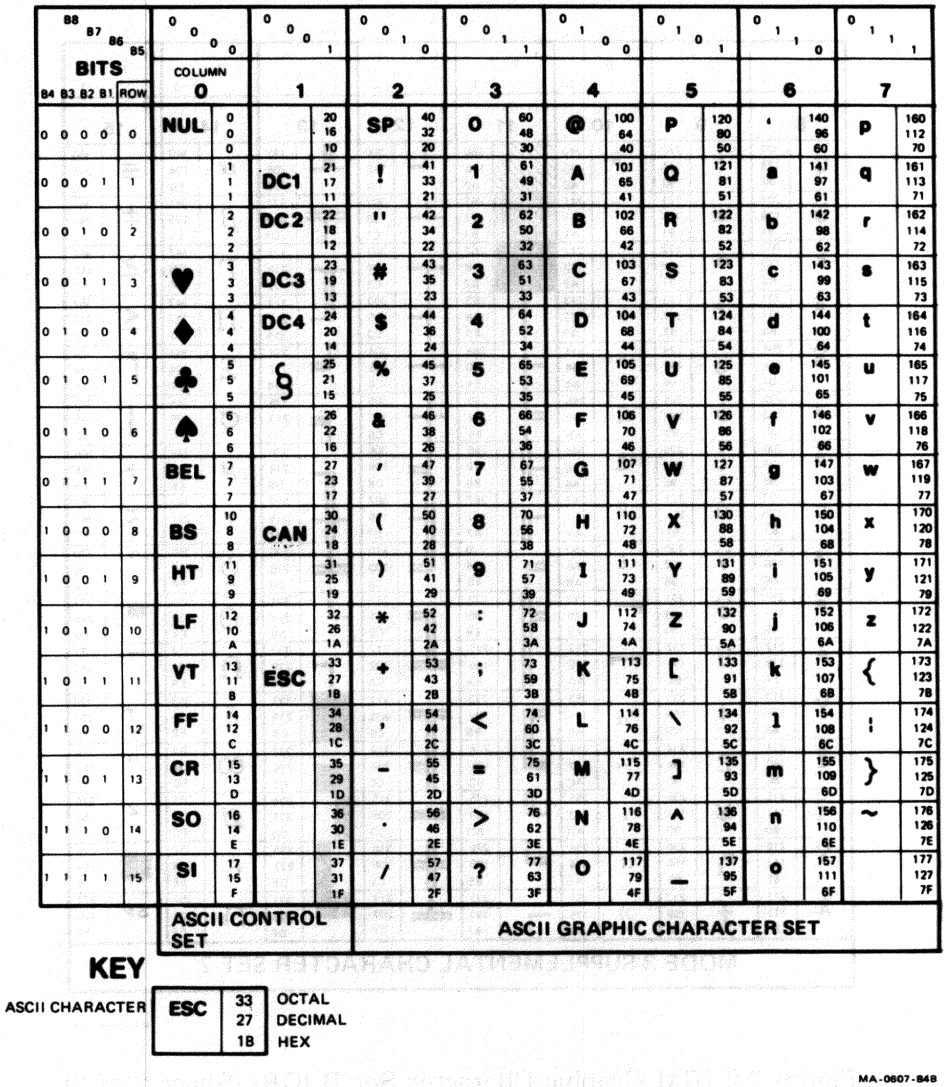

Figure 7-2 IBM Graphic Character Set B (GL) (Sheet 1 of 2)

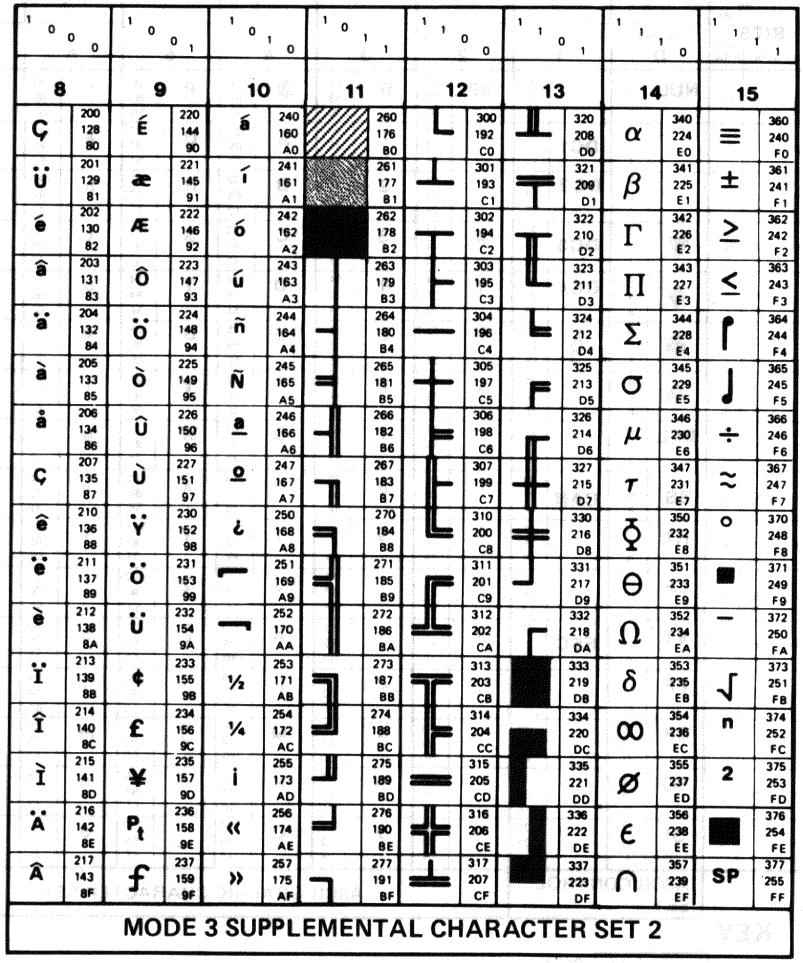

Figure 7-2 IBM Graphic Character Set B (GR) (Sheet 2 of 2)

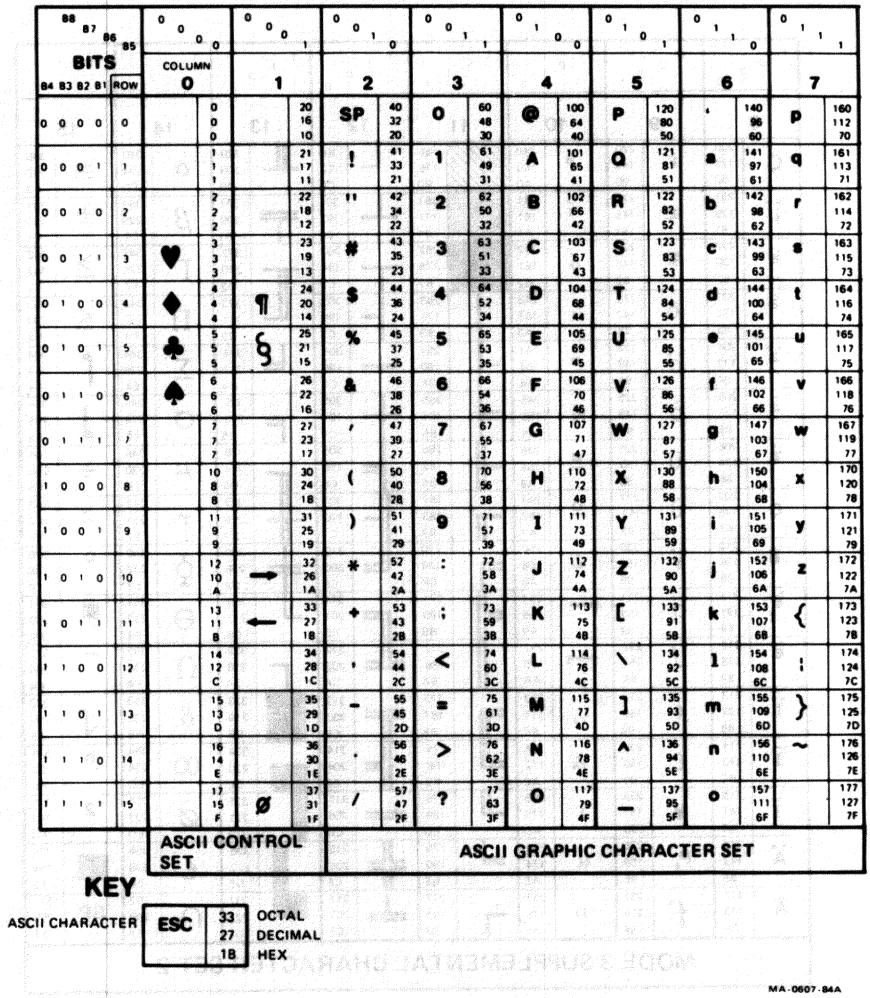

Figure 7-3 IBM All Character Set (GL) (Sheet 1 of 2)

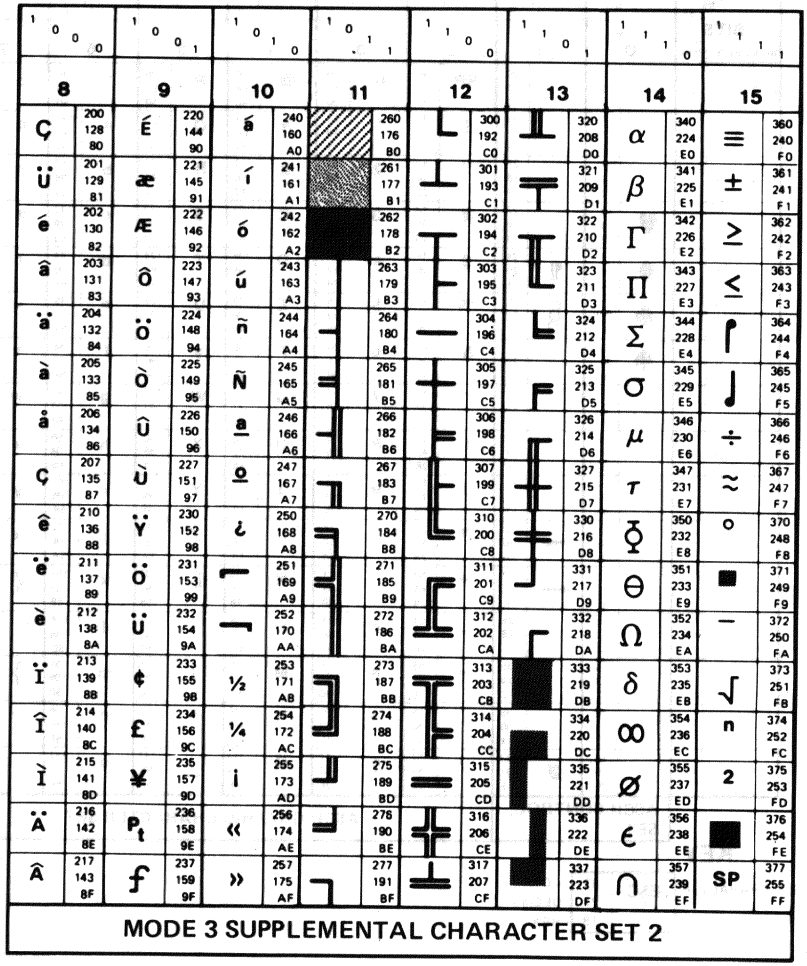

Figure 7-3 IBM All Character Set (GR) (Sheet 2 of 2)

7.2.2 Control Characters

Character sets A and B use control characters. The All Characters Set does not have control characters. Control characters are grouped into C0 and C1 sets that are used as follows:

Control Character Set	Character set A	B	All Character
C0 (0/0 to 1/15)	Used	Used	Not Used
C1 (8/0 to 9/15)	Used	Not Used	Not Used

Characters in the C0 and C1 control sets usually cause the LA75 to perform an action. Control characters do not print. When it receives a control character, the printer responds by performing the action associated with that control character.

Table 7-2 is a summary of all C0 and C1 control characters used by the printer in the IBM emulation mode.

Table 7-2 Summary of Control Characters

Name	Mnemonic	Location	Function in Text Mode
Null	NUL	0/0 (C0) 8/0 (C1)	Used with ESC B and ESC D as a list terminator and with other escape sequences to select options. This code is otherwise ignored.
Bell	BEL	0/7 (C0) 8/7 (C1)	Causes the bell to sound for one second.
Backspace	BS	0/8 (C0) 8/8 (C1)	Moves the printhead one character to the left at the current pitch.
Horizontal Tab	HT	0/9 (C0) 8/9 (C1)	Moves to next horizontal tab stop. At power up, tabs are set at every 8 columns, beginning at column 9 and ending at column 73. HT advances one column after the last tab is reached.

Table 7-2 Summary of Control Characters (Cont)

Name	Mnemonic	Location	Function in Text Mode
Line Feed	LF	0/10 (C0) 8/10 (C1)	Advances the paper one line. This control code cancels double-wideth printing if enabled by SO. A carriage return will occur if Auto CR is selected (#18) in the menu.
Vertical Tab	VT	6/11 (C0) 8/11 (C1)	Advances paper to the next vertical tab stop. If none are set, acts as a line feed. Additionally, if the next VT exceeds the form length minus the bottom margin, a line feed is executed. VT cancels double-width printing if enabled by SO. A carriage return will occur if selected (#18) in the menu.
Form Feed	FF	0/12 (C0) 8/12 (C1)	Performs a carriage return and advances to the next top of form. FF cancels double-width printing if enabled by SO. Form length is set through menu setting #4.
Carriage Return	CR	0/13 (C0) 8/13 (C1)	Terminates the line and returns active position to column 1. No line feed occurs unless auto line feed is enabled (menu selection #16) or by ESC 5. CR cancels double-width printing if enabled by SO.

Table 7-2 Summary of Control Characters (Cont)

Name	Mnemonic	Location	Function in Text Mode
Shift Out	SO	0/14 (C0) 8/14 (C1)	Selects the double-width print mode. A carriage return, line feed, form feed, vertical tab, cancel, ESC W 0, or DC4 cancels this print mode. If at 10 cpi, SO changes the horizontal pitch to 5 cpi. If at 12 cpi, SO changes the horizontal pitch to 6 cpi. If at 17.1 cpi, SO changes the horizontal pitch to 8.55 cpi.
Shift In	SI	0/15 (C0) 8/15 (C1)	Selects the compressed character mode. The DC2 code cancels the compressed printing mode. If at 10 cpi, SO changes the horizontal pitch to 17.1 cpi. If at 5 cpi, SO changes the horizontal pitch to 8.55 cpi.
Device Control 1	DC1	1/1 (C0) 9/1 (C1)	Selects printer to accept data.
Device Control 2	DC2	1/2 (C0) 9/2 (C1)	Terminates printing in compressed or 12 cpi modes and sets the printer to 10 cpi (5 cpi if double-width). DC2 changes the horizontal pitch as follows: from 17.1 cpi to 10 cpi. from 8.55 cpi to 5 cpi. from 12 cpi to 10 cpi, and from 6 cpi to 5 cpi.

Table 7-2 Summary of Control Characters (Cont)

Name	Mnemonic	Location	Function in Text Mode
Device Control 3	DC3	1/3 (C0) 9/3 (C1)	Ignored.
Device Control 4	DC4	1/4 (C0) 9/4 (C1)	Terminates printing in the double-width mode, if set by SO, and returns to the previously selected character spacing. DC4 changes the horizontal pitch as follows: from 5 cpi to 10 cpi, from 6 cpi to 12 cpi, and from 8.55 cpi to 17.1 cpi.
Cancel	CAN	1/8 (C0) 9/8 (C1)	Clears the last unterminated line buffer, retaining the current print position. Printing mode status: Double-width printing is cancelled if set with SO, and remains active if set with ESC W (Section 2.4.1.1); all other printing modes remain in effect.
Escape	ESC	1/11(C0) 9/11(C1)	Initiates all escape sequences. (See Chapter 8).

7.2.3 Special Characters

The following special characters are available in all character sets.

SP character (2/0)
Character represented by (15/15)

In Text mode, the space character (SP) increments the active column without printing.

The 15/15 character performs the same function as the SP character.

ESCAPE SEQUENCES FOR IBM EMULATION 8

This chapter lists and describes the escape sequences that you can use to control LA75 operation in IBM Proprinter emulation mode.

8.1 GENERAL

Escape sequences provide more control over the printer than control characters. These sequences are multiple-character strings that start with the escape character (ESC, 1/11). Escape sequences do not print, but instead control various aspects of how data prints. The following text describes IBM Proprinter Emulation mode escape sequences. These sequences are grouped by function as follows.

Terminal management
Vertical form handling
Horizontal form handling
Paper fault handling
Unidirectional/bidirectional printing control
Alternate character set mapping
Printing modes
Graphic mode

NOTE: Do not use the CSI control character in the IBM Emulation mode.

8.2 TERMINAL MANAGEMENT

You can control the reset (default) status and printer selection (from host computer) by using the following commands.

8.2.1 Reset To Initial State (RIS)

ESC	c
1/11	6/3

This sequence resets the printer to DEC mode with DEC power-up settings. The printer advances paper to the next top of form if printing has occurred on this page.

8.2.2 Soft Terminal Reset (STR)

ESC	[	!	p
1/11	5/11	2/1	7/0

This sequence resets the printer to DEC mode with DEC power-up settings. The printer advances paper to the next top of form if printing has occurred on this page.

8.2.3 IBM Terminal Reset

ESC	@
1/11	4/0

This sequence only resets the IBM emulation mode to its initial state without returning to DEC mode. The printer advances paper to the next top-of-form if printing has occurred on this page.

8.2.4 Deselect Printer

ESC	Q	3
1/11	5/1	0/3

This sequence prints the contents of the print buffer, then deselects the printer. Any data following this sequence are ignored until the DC1 control character is received.

8.2.5 IBM Proprinter Emulation Mode (DECIPEM)

ESC	[	?	5	8	l
1/11	5/11	3/15	3/5	3/8	6/12

This sequence resets to DEC mode without resetting previous DEC protocol selections.

8.3 VERTICAL FORM HANDLING

There are several ways to control the vertical form. You can control the size of the vertical pitch, the length of the form, the positions of the bottom margin, and vertical tabs. You can also set automatic line feed on receiving carriage return.

The length of the form is the distance from the top of one page to the top of the next page.

1. Form length is usually set to the size of the paper currently in the printer. In other applications, you may want to set a smaller or larger form. For example, when using the line drawing characters, you can draw multiple graphs on one page of paper, or have a graph extend over more than one page if you set to different form lengths.
2. Vertical pitch is the distance between lines and is measured in lines per inch. Vertical pitch is not the height of printed characters. When you set a new vertical pitch, all subsequent paper feed controls (like LF or VT) advance the paper at this new pitch.
3. The bottom margin is set in terms of the number of lines from the bottom of the form. You must know the current vertical pitch to do this. For example, to set a bottom margin 1 inch from the bottom of the form, using a vertical pitch of 6 lines per inch, you would set Pn equal to 6 in the set bottom margin sequence. To set the same bottom margin, using a vertical pitch of 8 lines per inch, you would set Pn equal to 8.
4. A form feed control character advances the paper to the top of the next form.

The following escape sequences control the vertical forms:

8.3.1 Set Vertical Pitch (ER8LI)

ESC 0
1/11 3/0

Sets vertical pitch to 8 lines per inch.

8.3.2 Set Vertical Pitch (ER10LI)

ESC	1
1/11	3/1

Sets vertical pitch to 10.3 lines per inch (72/7 inch).

8.3.3 Set Vertical Pitch (ERNLI2)

ESC	2
1/11	3/2

Sets vertical pitch to the setting specified in a previous ESC A sequence. If none was set, sets vertical pitch to 6 lines per inch.

8.3.4 Set Vertical Pitch (ERNLI1)

ESC	A	Pn
1/11	4/1	***

Sets vertical pitch to 72/Pn lines per inch. It does not take effect until ESC 2 is sent. If Pn = 0, it retains previous ESC A setting. Maximum Pn = 255.

8.3.5 Set Vertical Pitch (ERNLI3)

ESC	3	Pn
1/11	3/3	***

Sets vertical pitch to 216/Pn lines per inch.
Maximum Pn = 255, while Pn = 0 is ignored.

8.3.6 Set Vertical Pitch (ERNLI4)

ESC	J	Pn
1/11	4/10	***

Performs one line feed at a vertical pitch of 216/Pn lines per inch. Performs a carriage return if menu selection #18 is set.
Maximum Pn = 255, while Pn = 0 is ignored.

ESC J does not affect the line feed caused by LF control character.

8.3.7 Set Form Length (ERSFL)

ESC	C	Pn
1/11	4/3	***

Sets form length (in inches) to Pn (required number of lines) times the current vertical pitch. Sets top of form, and clears bottom margin.

Maximum Pn = 255, while Pn = 0 is ignored. Maximum absolute form length is 151 inches.

NOTE: This sequence overrides menu selection #4 (Form Length).

8.3.8 Set Form Length (ERSFLI)

ESC	C	NUL	Pn
1/11	4/3	0/0	***

Sets form length to Pn inches as you requested, sets top of form, and clears bottom margin.

Maximum Pn = 151, while Pn = 0 is ignored.

NOTE: This sequence overrides menu selection #4 (Form Length).

8.3.9 Set Bottom Margin (ERSBM)

ESC	N	Pn
1/11	4/14	***

Sets bottom margin (in inches) to Pn lines from the current form length using the current vertical pitch.

Maximum Pn = 255, while Pn = 0 is ignored.

8.3.10 Clear Bottom Margin (ERCBM)

ESC	O
1/11	4/15

Clears bottom margin.

8.3.11 Set Vertical Tabs

ESC	B	Pn1	Pn2	Pn	NUL
1/11	4/2	***	***	***	0/0

Sets vertical tab stops at Pn1, Pn2, and other designated stops. Pn is a character representing the line number of the desired tab stop. For example, character 1/2 sets a tab at line 18.

You must specify tab positions in ascending order, any descending values are ignored.

This sequence cancels any previously set tabs.

8.3.12 Set Top Of Form

ESC	4
1/11	3/4

Set the current paper position as top of form.

8.3.13 Enable/Disable Automatic Line Feed

ESC	5	Ps
1/11	3/5	***

If Ps = 1 (0/1), this sequence causes a line feed to occur whenever the printer receives a carriage return (CR control code).

If Ps = 0 (NUL), this sequence disables an automatic line feed on receiving a carriage return (CR control code).

NOTE: This sequence overrides menu setting #16.

8.4 HORIZONTAL FORM HANDLING

This section describes how to select single- or double-width printing, how to use an escape sequence to perform a carriage return, how to set horizontal tabs, and how to select 12 cpi horizontal pitch.

8.4.1 Print Width and Carriage Return

Double-width printing doubles the width of the current character setting. For example, if the current character pitch setting is compressed, the double-width print command doubles the width of the compressed characters. You can send an escape sequence that sets double- or single-width characters. You can send these escape sequences while printing in compressed or standard pitches, so there are six different combinations of horizontal pitch.

8.4.1.1 Set Double-Width Characters (EREDW)

ESC	W	Ps
1/11	5/7	***

If Ps = 1 (0/1), this sequence sets double-width characters for current and following lines.

8.4.1.2 Set Single-Width Characters (ERDDW)

ESC	W	Ps
1/11	5/7	0/0

If Ps = 0 (NUL), this sequence sets single-width characters for current and following lines.

8.4.1.3 Carriage Return (PCR1)

ESC	<
1/11	3/12

This sequence provides a carriage return without performing a line feed, unless the auto line feed is enabled with the menu setting #16 or the ESC 5 sequence.

8.4.2 Horizontal Tabs

Horizontal tabs are column-oriented, predefined positions on the paper. There are 137 possible HT stops on the line. When the HT control character is sent, the printhead advances to the next horizontal tab, if any are set.

Horizontal tabs correspond to column locations, not physical positions. For example, if you set compressed print, the tab stops correspond to the compressed character columns. You can specify up to 28 tabs in one escape sequence. The following escape sequences modify horizontal tabs.

8.4.2.1 Set Horizontal Tabs (ERSHT)

ESC	D	Pn1	Pn2	Pn	NUL
1/11	4/4	***	***	***	0/0

Clears all horizontal tab stops and sets horizontal tab stops at Pn1, Pn2, and other designated stops. Pn is a character representing the column number of the desired tab stop. For example, character DC2 (1/2) sets a tab at column 18.

Tabs must be specified in ascending order, any descending character is ignored.

This sequence cancels all previously set tabs.

8.4.2.2 Set All Horizontal Tabs

ESC	R
1/11	5/2

Sets horizontal tab stop every eight columns beginning with column 9. Additionally, all previously set vertical tab stops are cleared.

8.4.3 Set Horizontal Spacing to 12 CPI

The following escape sequence allows you to select horizontal pitch.

ESC	:
1/11	3/10

Sets the printer to 12 cpi if single width, or set to 6 cpi if double width is selected.

8.5 PAPER FAULT HANDLING

The following escape sequences handle paper fault conditions.

When the paper-out detector on the printer is enabled, the printer stops if it is out of paper.

8.5.1 Disable Paper Out (ERDPO)

ESC	8
1/11	3/8

Disables paper-out handling.

8.5.2 Enable Paper Out (EREPO)

ESC	9
1/11	3/9

Enables paper-out handling.

8.6 UNIDIRECTIONAL/BIDIRECTIONAL PRINTING CONTROL

In bidirectional printing mode, which can be used for text printing only, the printhead prints lines of text in both directions (right and left). In unidirectional mode, the printhead prints in the left-to-right direction only. Bidirectional printing is faster, because there is less nonprinting printhead motion. Unidirectional printing reduces possible misregistration. Unidirectional printing is also useful when printing vertical lines, because there is less chance for individual dots in the vertical line to appear out of alignment.

The following sequences select printing direction.

8.6.1 Set Bidirectional Printing (ERDUD)

ESC	U	Ps
1/11	5/6	***

If Ps = 0 (0/0), bidirectional mode (text only) is enabled.

8.6.2 Set Unidirectional Printing (EREUD)

ESC	U	Ps
1/11	5/6	***

If Ps = 1 (0/1), unidirectional left-to-right mode is enabled.

NOTE: Bit-image graphic always uses unidirectional printing.

8.7 ALTERNATE CHARACTER SET MAPPING

The following escape sequences let you select the alternate character sets. You can find these character sets in Figures 7-1 through 7-3.

NOTE: The following sequences override menu setting #17.

8.7.1 Select Set A (ERC01)

ESC	7
1/11	3/7

Selects character set A.

8.7.2 Select Set B (ERC02)

ESC	6
1/11	3/6

Selects the character set B.

8.7.3 Select All Characters Set

ESC	\	Pn1	Pn2
1/11	5/12	***	***

This escape sequence selects the All Characters Set as the active character set. This set has no control characters but rather contains extra characters in some of the locations (addresses) where control characters appear in sets A and B. A space is printed for any undefined character address which is received.

Pn1 and Pn2 represent the number of characters that follow that are to be printed from the All Characters Set.

Pn1 represents values from 0 — 255
Pn2 represents values equal to (Pn2 × 256), where Pn2 can be 0 or greater integer.

Total characters = Pn1 + (Pn2 × 256)

8.7.4 Print Single Character From All Character Set

ESC ^
1/11 5/14

This sequence allows the next character to be accessed and printed from the All Characters Set.

8.8 PRINTING MODES

This section describes the various text printing modes and text enhancements that the LA75 printer (in IBM emulation) features. Menu feature selection #20 determines if the mode selected by the ESC G or ESC I 2 sequences is the Letter Quality (LQ) or Near Letter Quality (NLQ) printing.

NOTE: Any downline-loaded font selected by the ESC I 6 sequence will always be created in the NLQ mode, regardless of the menu selection.

8.8.1 Draft Printing

This low-resolution matrix is based on a 9 × 9 standard-sized character font table. Draft printing speed is 250 char/sec maximum.

8.8.2 LQ Printing

This high-resolution matrix is based on a 27 × 18 standard-sized character font table. This font is created with two one-third speed passes in the same direction. LQ printing speed is 32 characters/second maximum.

8.8.3 NLQ Printing

NLQ printing is created with an algorithm applied to the draft font data. This print mode is created with two half-speed passes in the same direction. Effectively, this mode will darken a draft character by filling in between the dots.

NLQ printing speed is 42 characters/second maximum.

8.8.4 Shadow Bold Printing Features

You can select shadow bold printing if the current font is draft, NLQ, or LQ.

8.8.4.1 Shadow Bolded Draft - It is created at half-speed with one pass. The printer performs horizontal shadowing at 125 characters/second.

NOTE: No vertical shadowing is performed.

8.8.4.2 Shadow Bolded NLQ - It is created at half-speed with two passes. The printer performs both horizontal and vertical shadowing.

8.8.4.3 Shadow Bolded LQ - It is created at half-speed with two passes. The printer performs horizontal shadowing.

8.8.5 Superscript and Subscript

The superscript and subscript functions both print half-size (1/16-inch) characters slightly offset from the current line. Superscript prints in the upper half of a character cell, to allow printing of exponential expressions and footnotes. Subscript prints in the lower half of a character cell, to allow printing of mathematical equations and scientific expressions.

Superscript and subscript are available in all modes and pitches. A single algorithm is used for draft, NLQ, and LQ printing. Shadow bolding of superscripts and subscripts is supported with the draft bolding algorithm.

8.8.6 Selecting Printing Modes

The following escape sequences control the printing functions.

8.8.6.1 Enable Shadow Bold (EREBD)

ESC E
1/11 4/5

Sets shadow bold printing for all following characters.

8.8.6.2 Disable Shadow Bold (ERDBD)

ESC F
1/11 4/6

Turns off shadow bold printing for all following characters.

8.8.6.3 Set Letter Quality/NLQ Printing (EREHR)

ESC G
1/11 4/7

Enters LQ or NLQ mode depending on menu feature setting #20.

8.8.6.4 Set Draft (ERDHR)

ESC	H
1/11	4/8

Enters draft mode.

8.8.6.5 Select Print Quality

ESC	I	Ps
1/11	4/9	***

You can use this sequence to select the print quality where "Ps" parameter determines the required print quality.

Ps =

0 0/0	Selects draft mode.
2 0/2	Selects LQ/NLQ mode.
4 0/4	Selects draft mode. Uses downline-loaded set (Section 8.11)
6 0/6	Selects NLQ mode. Uses downline-loaded set (Section 8.11)

8.8.6.6 Set/Reset Underline (EREUL)

ESC	—	Ps
1/11	2/13	***

If Ps = 1 (0/1), it underlines all characters that follow this sequence.

If Ps = 0 (0/0), it turns off underlining.

8.8.6.7 Set/Reset Overscore

ESC	—	Ps
1/11	5/15	***

If Ps = 1 (0/1), it overscores all characters that follow this sequence.

If Ps = 0 (0/0), it turns off overscore.

8.8.6.8 Enable Superscript/Subscript (ERESCR)

ESC	S	Ps
1/11	5/3	***

If Ps = 0 (0/0), all following characters are printed in superscript mode.

If Ps = 1 (0/1), all following characters are printed in subscript mode.

8.8.6.9 Reset Script (ERDSCR)

ESC	T
1/11	5/4

Cancels superscript and subscript printing.

8.9 PRINTING MODE RULES AND EXCEPTIONS

The following are exceptions or clarifications to printing mode combinations.

1. If both the 12 cpi and the compressed modes are active, the printer sets the pitch to 12 cpi only. Setting the printer to 12 cpi pitch cancels the compressed mode.
2. Compressed (17.1 or 8.55 cpi) printing cannot be shadow bolded. If both are active, the printer runs at the previous pitch (5 or 10 cpi) and the previous print density (draft, NLQ/LQ) with shadow bold set. Compressed printing will take effect when shadow bolding is removed.
3. NLQ and LQ printing can be compressed. Printing is darker than draft compressed.
4. Double-width printing is available for all pitches (10, 12, compressed), print densities (draft, NLQ, and LQ), and their superscripts and subscripts. Double-width printing can also be shadow bolded for all pitches and print densities except the compressed pitch.

8.10 GRAPHIC MODE

The host computer sends graphic data to the printer as a string of 8-bit characters. An escape sequence before these characters defines how many characters follow.

You can select the graphic mode with the escape sequences described below. After executing the escape sequence, the printer returns to text mode. The number of graphic bytes to print must equal the number specified. If the actual number of bytes differs from the number specified, the printer may (1) interpret text characters as graphic data, or (2) interpret graphic data as text.

8.10.1 Escape K (480 Bit-Image Graphic Mode)

This sequence changes printing from the text mode to the bit-image graphic mode at 60 dots per inch (dpi) resolution. At every horizontal position, each byte can print up to 8 vertical dots. Each bit in a graphic data byte addresses a single printhead pin. The most significant bit (MSB) addresses the top printhead pin, while the least significant bit (LSB) addresses the bottom printhead pin. Bit-image data may be mixed with text data on the same line.

ESC	K	Pn1	Pn2	v1	v2	...	vk
1/11	4/2	***	***	***	***		***

Pn1 and Pn2 are data bytes which specify the number of bit image data bytes to be transferred. v1 through vk are the the bytes of the bit-image data. The number of bit-image data bytes (k) is equal to Pn1 + (256 × Pn2) but cannot exceed 480 bytes.

Pn1 represents values from 0 — 255.
Pn2 represents values (0 or 1) × 256.

If the specified number of bytes exceeds the maximum number of printable bytes in a certain graphic mode, the excess graphic data is not printed. These characters, however, shall be counted in order to properly exit the graphic mode.

Example: If 500 bytes are specified in 480 bit image graphic mode, the first 480 bytes will be printed and the remaining 20 bytes will be ignored before exiting the graphic mode.

8.10.2 Escape L (960 Bit-Image Graphic Mode/Half-Speed)

ESC	L	Pn1	Pn2	v1	v2	...	vk
1/11	4/3	***	***	***	***		***

Pn1 represents values from 0 — 255.
Pn2 represents values (0,1,2,3) × 256.

This sequence changes printing from the text mode to the bit-image graphic mode at a 120 dpi resolution. Data input is the same as for ESC K command. The number of bytes of bit-image data (k) is equal to Pn1 + (256 × Pn2) but cannot exceed 960.

The 960 bit-image graphic mode operates at half the speed of the 480 bit-image graphic mode. All horizontal dots are addressable in this mode.

8.10.3 Escape Y (960 Bit-Image Graphic Mode — Normal Speed)

This sequence allows printing at the same speed as the 480 bit-image graphic mode.

ESC	Y	Pn1	Pn2	v1	v2	...	vk
1/11	5/9	***	***	***	***		***

Pn1 represents values from 0 — 255.
Pn2 represents values (0,1,2,3) × 256.

This sequence changes printing from the text mode to the bit-image graphic mode at a 120 dpi resolution. Data input is the same as for ESC K command. The number of bytes of bit-image data (k) is equal to Pn1 + (256 × Pn2) but cannot exceed 960.

Consecutive horizontal dots cannot be addressed at 120 dpi at this speed. Thus, only the first of two consecutive horizontal dots is printed.

8.10.4 Escape Z (1920 Bit-Image Graphic Mode)

This sequence changes printing from the text mode to bit-image graphic mode at 240 dpi resolution. Data input is the same as for ESC K command. The number of bytes of bit-image data (k) is equal to Pn1 + (256 × Pn2) but cannot exceed 1920.

ESC	Z	Pn1	Pn2	v1	v2	...	vk
1/11	5/10	***	***	***	***		***

Pn1 represents values from 0 — 255.
Pn2 represents values from (0—7) × 256.

The printing shall be at half the speed of the 480 bit image graphic mode. Consecutive horizontal dots cannot be addressed at 240 dpi at this speed. The first of two consecutive horizontal dots will only be printed.

8.11 DOWNLINE-LOAD CHARACTER IMAGE TO MEMORY

You can use this sequence to initiate character downline-loading. The sequence is self-terminating; it exits after a specified number of characters have been received. You can define a maximum of 94 downline-load characters.

Both draft and NLQ downline-load fonts are created from an 11-byte pattern. The character(s) need only be downline-loaded once. If the NLQ downline-load font is selected (<ESC> I 6), the enhanced algorithm will be applied to the downline-load font data. If the draft downline-load font is selected (<ESC> I 4), the downline-loaded font data will be translated directly.

The downline-load sequence format is as follows:

ESC	=	Pn1	Pn2	DC4	Pn3
1/11	3/13	***	***	1/4	***

To figure out how many bytes you will need to downline-load the font data, you have to find the numeric parameters for the downline-load sequence. The numeric parameters Pn1 and Pn2 specify the number of informational bytes that will follow, where Pn1 = 0 to 255 and Pn2 = (Pn2 × 256) and Pn2 can be equal to 0 or a greater integer.

In data string, each downline-loaded character contains 11 font data bytes preceded by two attribute bytes. Two additional bytes, DC4 and Pn3, precede all character data.

Therefore, you can calculate the total number of bytes as follows:

1. Number of character bytes = 2 + (number of characters × 13)
2. The total number of bytes is encoded with Pn1 and Pn2 as

   Total bytes = Pn1 + (Pn2 × 256).

If number of character bytes is 255 or less, Pn1 parameter is used and Pn2 = 0. If Pn1 is greater than 255, Pn2 is equal or greater than 1 and both Pn1 and Pn2 are used.

Example:

If you want to downline-load ten characters, you will need the following number of bytes:

Character bytes = 2 + (10 × 13) = 132 (bytes)

Total Number of bytes = 132 + (0 × 256) = 132 (bytes)

The Pn3 parameter specifies the character address of the first downline-loaded character. If more than one character is downline-loaded, incremental address locations are filled. Characters may only be downline-loaded into address positions 2/1 to 7/14 (ASCII 7-bit printables). If an illegal address is reached at some point during the sequence, the remaining bytes will be counted to terminate the sequence properly, but are not downline-loaded. Font data received before the illegal address was reached will be saved.

Character data following the sequence set-up is of the following form.

Attribute			Character		
Pn4	**NUL**	**v1**	**v2**	**...**	**v11**
***	0/0	***	***		***

Each character is preceded by the Pn4 parameter and NUL. Attribute is set by Pn4 as follows.

Pn4 = 0 (0/0) character is ascending (uses top 8 wires of printhead)

Pn4 = 128 (8/0) character is descending (uses bottom 8 wires)

Bytes v1 through v11 are bit-map font data. They address the printhead pins the same way as the four graphic modes. Each of the 11 bytes constitutes 1/12 of the horizontal character cell. When used in the draft mode, consecutive horizontal dots will not be printed. When used in the NLQ mode, all dots are printed AND the NLQ algorithm is used.

When the downline-load font is selected, only those printable characters which were downline-loaded are addressable. All control codes corresponding to the current character set remain active. (If the Character Set A is the active set, all C0 and C1 control codes remain in effect.) Any other undefined printable addresses, including ALL 8-bit printable addresses, perform a space <SP> function.

Additional downline-load sequences may overwrite current downline-load data. Any current downline-load data at addresses which are not redefined remain in the downline-load buffer.

The entire downline-load data buffer is cleared with the following sequence:

ESC	=	NUL	NUL
1/11	3/13	0/0	0/0

APPENDIX A

CHARACTER SETS

This appendix shows the character sets (Figures A-1 through A-20) supported by the LA75 Companion printer in DEC-compatible mode.

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NOTE: Additional character sets (fonts) are available if you use plug-in font cartridges.

B7 B6 B5 / BITS B4 B3 B2 B1	ROW	COLUMN 0 (000)		COLUMN 1 (001)		COLUMN 2 (010)		COLUMN 3 (011)		COLUMN 4 (100)		COLUMN 5 (101)		COLUMN 6 (110)		COLUMN 7 (111)	
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		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

MA-7247T

Figure A-1 U.S. ASCII Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		B7 0 B6 0 B5 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		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
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	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
12	1 1 0 0	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
13	1 1 0 1	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
14	1 1 1 0	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
15	1 1 1 1	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 | 1/11 COLUMN/ROW | 33 OCTAL | 27 DECIMAL | 1B HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA 7248C

Figure A-2 United Kingdom Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		B7 0 B6 0 B5 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
0	0 0 0 0	NUL	0 0 0		20 16 10	SP	40 32 20	0	60 48 30	¾	100 64 40	P	120 80 50	`	140 96 60	p	160 112 70
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	Ÿ	133 91 5B	k	153 107 6B	..	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	½	134 92 5C	l	154 108 6C	f	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	|	135 93 5D	m	155 109 6D	¼	175 125 7D
14	1 1 1 0	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
15	1 1 1 1	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	1/11	COLUMN/ROW
	33	OCTAL
	27	DECIMAL
	1B	HEX

MA-7247 M

Figure A-3 Dutch Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0 B7 0 B6 0 B5 0		1 0 0 1		2 0 1 0		3 0 1 1		4 1 0 0		5 1 0 1		6 1 1 0		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	ä	140 96 60	p	160 112 70
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	Ä	133 91 5B	k	153 107 6B	ä	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	Ö	134 92 5C	l	154 108 6C	ö	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	Å	135 93 5D	m	155 109 6D	å	175 125 7D
14	1 1 1 0	SO	16 14		36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	Ü	136 94 5E	n	156 110 6E	ü	176 126 7E
15	1 1 1 1	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 | 1/11 (COLUMN/ROW), 33 (OCTAL), 27 (DECIMAL), 1B (HEX)

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7420E

Figure A-4 Finnish Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0 B7 0 B6 0 B5 0		1 0 0 1		2 0 1 0		3 0 1 1		4 1 0 0		5 1 0 1		6 1 1 0		7 1 1 1	
0	0 0 0 0	NUL	0 0 0		20 16 10	SP	40 32 20	0	60 48 30	à	100 64 40	P	120 80 50	`	140 96 60	p	160 112 70
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	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	é	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	ç	134 92 5C	l	154 108 6C	ù	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	§	135 93 5D	m	155 109 6D	è	175 125 7D
14	1 1 1 0	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
15	1 1 1 1	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 | 1/11 COLUMN/ROW | 33 OCTAL | 27 DECIMAL | 1B HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

NOTE
QUOTATION MARKS (") ARE USED AS AN APPROXIMATION FOR THE DIAERESIS MARK (¨), COLUMN 7/ROW 14.

MA-74258

Figure A-5 French Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0 (B7 0, B6 0, B5 0)	1 (0 0 1)	2 (0 1 0)	3 (0 1 1)	4 (1 0 0)	5 (1 0 1)	6 (1 1 0)	7 (1 1 1)
0	0 0 0 0	NUL 0 0 0	20 16 10	SP 40 32 20	0 60 48 30	à 100 64 40	P 120 80 50	ê 140 96 60	p 160 112 70
1	0 0 0 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
2	0 0 1 0	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
3	0 0 1 1	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
4	0 1 0 0	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
5	0 1 0 1	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
6	0 1 1 0	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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	VT 13 11 B	ESC 33 27 1B	+ 53 43 2B	; 73 59 3B	K 113 75 4B	â 133 91 5B	k 153 107 6B	é 173 123 7B
12	1 1 0 0	FF 14 12 C	34 28 1C	, 54 44 2C	< 74 60 3C	L 114 76 4C	ç 134 92 5C	l 154 108 6C	ù 174 124 7C
13	1 1 0 1	CR 15 13 D	35 29 1D	- 55 45 2D	= 75 61 3D	M 115 77 4D	ê 135 93 5D	m 155 109 6D	è 175 125 7D
14	1 1 1 0	SO 16 14 E	36 30 1E	. 56 46 2E	> 76 62 3E	N 116 78 4E	î 136 94 5E	n 156 110 6E	û 176 126 7E
15	1 1 1 1	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 | 1/11 COLUMN/ROW | 33 OCTAL | 27 DECIMAL | 1B HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7247S

Figure A-6 French Canadian Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0 B7 0 B6 0 B5 0		1 0 0 1		2 0 1 0		3 0 1 1		4 1 0 0		5 1 0 1		6 1 1 0		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
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	Ä	133 91 5B	k	153 107 6B	ä	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	Ö	134 92 5C	l	154 108 6C	ö	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	Ü	135 93 5D	m	155 109 6D	ü	175 125 7D
14	1 1 1 0	SO	16 14 E		36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	ß	176 126 7E
15	1 1 1 1	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 | 1/11 COLUMN/ROW | 33 OCTAL | 27 DECIMAL | 1B HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7423B

Figure A-7 German Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		B7 0 B6 0 B5 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		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	ù	140 96 60	p	160 112 70
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	ç	133 91 5B	k	153 107 6B	ä	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	é	134 92 5C	l	154 108 6C	ö	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	ê	135 93 5D	m	155 109 6D	ü	175 125 7D
14	1 1 1 0	SO	16 14 E		36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	ì	176 126 7E
15	1 1 1 1	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	1/11	COLUMN/ROW
	33	OCTAL
	27	DECIMAL
	1B	HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7247Q

Figure A-8 Italian Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		B7 0 B6 0 B5 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		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
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	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
12	1 1 0 0	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
13	1 1 0 1	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
14	1 1 1 0	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
15	1 1 1 1	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 / 1/11 COLUMN/ROW, 33 OCTAL, 27 DECIMAL, 1B HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7247R

Figure A-9 Japanese (JIS Roman) Character Set

B8 B7 B6 B5	* 0 1 0			* 0 1 1			* 1 0 0			* 1 0 1			* 1 1 0			* 1 1 1		
BITS		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR
B4 B3 B2 B1	COLUMN	**2**	**10**		**3**	**11**		**4**	**12**		**5**	**13**		**6**	**14**		**7**	**15**
0 0 0 0	ROW **0**			ー	60 48 30	260 176 B0	タ	100 64 40	300 192 C0	ミ	120 80 50	320 208 D0		140 96 60	340 224 E0		160 112 70	360 240 F0
0 0 0 1	**1**	。	41 33 21 A1	ア	61 49 31 B1	261 177 B1	チ	101 65 41 C1	301 193 C1	ム	121 81 51 D1	321 209 D1		141 97 61 E1	341 225 E1		161 113 71 F1	361 241 F1
0 0 1 0	**2**	「	42 34 22 A2	イ	62 50 32 B2	262 178 B2	ツ	102 66 42 C2	302 194 C2	メ	122 82 52 D2	322 210 D2		142 98 62 E2	342 226 E2		162 114 72 F2	362 242 F2
0 0 1 1	**3**	」	43 35 23 A3	ウ	63 51 33 B3	263 179 B3	テ	103 67 43 C3	303 195 C3	モ	123 83 53 D3	323 211 D3		143 99 63 E3	343 227 E3		163 115 73 F3	363 243 F3
0 1 0 0	**4**	、	44 36 24 A4	エ	64 52 34 B4	264 180 B4	ト	104 68 44 C4	304 196 C4	ヤ	124 84 54 D4	324 212 D4		144 100 64 E4	344 228 E4		164 116 74 F4	364 244 F4
0 1 0 1	**5**	・	45 37 25 A5	オ	65 53 35 B5	265 181 B5	ナ	105 69 45 C5	305 197 C5	ユ	125 85 55 D5	325 213 D5		145 101 65 E5	345 229 E5		165 117 75 F5	365 245 F5
0 1 1 0	**6**	ヲ	46 38 26 A6	カ	66 54 36 B6	266 182 B6	ニ	106 70 46 C6	306 198 C6	ヨ	126 86 56 D6	326 214 D6		146 102 66 E6	346 230 E6		166 118 76 F6	366 246 F6
0 1 1 1	**7**	ァ	47 39 27 A7	キ	67 55 37 B7	267 183 B7	ヌ	107 71 47 C7	307 199 C7	ラ	127 87 57 D7	327 215 D7		147 103 67 E7	347 231 E7		167 119 77 F7	367 247 F7
1 0 0 0	**8**	ィ	50 40 28 A8	ク	70 56 38 B8	270 184 B8	ネ	110 72 48 C8	310 200 C8	リ	130 88 58 D8	330 216 D8		150 104 68 E8	350 232 E8		170 120 78 F8	370 248 F8
1 0 0 1	**9**	ゥ	51 41 29 A9	ケ	71 57 39 B9	271 185 B9	ノ	111 73 49 C9	311 201 C9	ル	131 89 59 D9	331 217 D9		151 105 69 E9	351 233 E9		171 121 79 F9	371 249 F9
1 0 1 0	**10**	ェ	52 42 2A AA	コ	72 58 3A BA	272 186 BA	ハ	112 74 4A CA	312 202 CA	レ	132 90 5A DA	332 218 DA		152 106 6A EA	352 234 EA		172 122 7A FA	372 250 FA
1 0 1 1	**11**	ォ	53 43 2B AB	サ	73 59 3B BB	273 187 BB	ヒ	113 75 4B CB	313 203 CB	ロ	133 91 5B DB	333 219 DB		153 107 6B EB	353 235 EB		173 123 7B FB	373 251 FB
1 1 0 0	**12**	ャ	54 44 2C AC	シ	74 60 3C BC	274 188 BC	フ	114 76 4C CC	314 204 CC	ワ	134 92 5C DC	334 220 DC		154 108 6C EC	354 236 EC		174 124 7C FC	374 252 FC
1 1 0 1	**13**	ュ	55 45 2D AD	ス	75 61 3D BD	275 189 BD	ヘ	115 77 4D CD	315 205 CD	ン	135 93 5D DD	335 221 DD		155 109 6D ED	355 237 ED		175 125 7D FD	375 253 FD
1 1 1 0	**14**	ョ	56 46 2E AE	セ	76 62 3E BE	276 190 BE	ホ	116 78 4E CE	316 206 CE	゛	136 94 5E DE	336 222 DE		156 110 6E EE	356 238 EE		176 126 7E FE	376 254 FE
1 1 1 1	**15**	ッ	57 47 2F AF	ソ	77 63 3F BF	277 191 BF	マ	117 79 4F CF	317 207 CF	゜	137 95 5F DF	337 223 DF		157 111 6F EF	357 239 EF			

LEGEND

CHARACTER — CODES

チ	101	301	OCTAL
	65	193	DECIMAL
	41	C1	HEX

* NOTE:
WHEN SET IS MAPPED INTO GR, BIT B8 IS 1 (V2 ONLY).

KATAKANA

MA-1121-85.

Figure A-10 Katakana Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0 B7 0 B6 0 B5 0		1 0 0 1		2 0 1 0		3 0 1 1		4 1 0 0		5 1 0 1		6 1 1 0		7 1 1 1	
0	0 0 0 0	NUL	0 0 0		20 16 10	SP	40 32 20	0	60 48 30	Æ	100 64 40	P	120 80 50	æ	140 96 60	p	160 112 70
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	Æ	133 91 5B	k	153 107 6B	æ	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	Ø	134 92 5C	l	154 108 6C	ø	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	Å	135 93 5D	m	155 109 6D	å	175 125 7D
14	1 1 1 0	SO	16 14 E		36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	Ü	136 94 5E	n	156 110 6E	ü	176 126 7E
15	1 1 1 1	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 | 1/11 | 33 | 27 | 1B

COLUMN/ROW
OCTAL
DECIMAL
HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7421C

Figure A-11 DEC Norwegian/Danish Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0 B7 0 B6 0 B5 0		1 (0 0 1)		2 (0 1 0)		3 (0 1 1)		4 (1 0 0)		5 (1 0 1)		6 (1 1 0)		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
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	Æ	133 91 5B	k	153 107 6B	æ	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	Ø	134 92 5C	l	154 108 6C	ø	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	Å	135 93 5D	m	155 109 6D	å	175 125 7D
14	1 1 1 0	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
15	1 1 1 1	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 | 1/11 COLUMN/ROW | 33 OCTAL | 27 DECIMAL | 1B HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7421D

Figure A-12 ISO Norwegian/Danish Character Set

BITS B4 B3 B2 B1	ROW	COLUMN 0		COLUMN 1		COLUMN 2		COLUMN 3		COLUMN 4		COLUMN 5		COLUMN 6		COLUMN 7	
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		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	Ã	133 91 5B	k	153 107 6B	ã	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	Ç	134 92 5C	l	154 108 6C	ç	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	Õ	135 93 5D	m	155 109 6D	õ	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

1/11	COLUMN/ROW
33	OCTAL
27	DECIMAL
1B	HEX

MA-7247P

Figure A-13 Portuguese Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0 (B7 B6 B5 = 0 0 0)		1 (0 0 1)		2 (0 1 0)		3 (0 1 1)		4 (1 0 0)		5 (1 0 1)		6 (1 1 0)		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
1	0 0 0 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
2	0 0 1 0		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
3	0 0 1 1		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
4	0 1 0 0		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
5	0 1 0 1		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
6	0 1 1 0		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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	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
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	Ñ	134 92 5C	l	154 108 6C	ñ	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	¿	135 93 5D	m	155 109 6D	ç	175 125 7D
14	1 1 1 0	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
15	1 1 1 1	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

1/11 COLUMN/ROW
33 OCTAL
27 DECIMAL
1B HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7247U

Figure A-14 Spanish Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		B7 0 B6 0 B5 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
0	0 0 0 0	NUL	0 0 0		20 16 10	SP	40 32 20	°	60 48 30	À	100 64 40	ς	120 80 50	à	140 96 60	ς	160 112 70
1	0 0 0 1		1 1 1	DC1 (XON)	21 17 11	¡	41 33 21	±	61 49 31	Á	101 65 41	Ñ	121 81 51	á	141 97 61	ñ	161 113 71
2	0 0 1 0		2 2 2		22 18 12	¢	42 34 22	2	62 50 32	Â	102 66 42	Ò	122 82 52	â	142 98 62	ò	162 114 72
3	0 0 1 1		3 3 3	DC3 (XOFF)	23 19 13	£	43 35 23	3	63 51 33	Ã	103 67 43	Ó	123 83 53	ã	143 99 63	ó	163 115 73
4	0 1 0 0		4 4 4		24 20 14	ς	44 36 24	ς	64 52 34	Ä	104 68 44	Ô	124 84 54	ä	144 100 64	ô	164 116 74
5	0 1 0 1		5 5 5		25 21 15	¥	45 37 25	µ	65 53 35	Å	105 69 45	Õ	125 85 55	å	145 101 65	õ	165 117 75
6	0 1 1 0		6 6 6		26 22 16	ς	46 38 26	¶	66 54 36	Æ	106 70 46	Ö	126 86 56	æ	146 102 66	ö	166 118 76
7	0 1 1 1	BEL	7 7 7		27 23 17	§	47 39 27	•	67 55 37	Ç	107 71 47	Œ	127 87 57	ç	147 103 67	œ	167 119 77
8	1 0 0 0	BS	10 8 8	CAN	30 24 18	¤	50 40 28	ς	70 56 38	È	110 72 48	ø	130 88 58	è	150 104 68	ø	170 120 78
9	1 0 0 1	HT	11 9 9		31 25 19	©	51 41 29	1	71 57 39	É	111 73 49	Ù	131 89 59	é	151 105 69	ù	171 121 79
10	1 0 1 0	LF	12 10 A	SUB	32 26 1A	ª	52 42 2A	º	72 58 3A	Ê	112 74 4A	Ú	132 90 5A	ê	152 106 6A	ú	172 122 7A
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	«	53 43 2B	»	73 59 3B	Ë	113 75 4B	Û	133 91 5B	ë	153 107 6B	û	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	ς	54 44 2C	¼	74 60 3C	Ì	114 76 4C	Ü	134 92 5C	ì	154 108 6C	ü	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	ς	55 45 2D	½	75 61 3D	Í	115 77 4D	Ý	135 93 5D	í	155 109 6D	ý	175 125 7D
14	1 1 1 0	SO	16 14 E		36 30 1E	ς	56 46 2E	ς	76 62 3E	Î	116 78 4E	ς	136 94 5E	î	156 110 6E	ς	176 126 7E
15	1 1 1 1	SI	17 15 F		37 31 1F	ς	57 47 2F	¿	77 63 3F	Ï	117 79 4F	ß	137 95 5F	ï	157 111 6F	DEL	177 127 7F

KEY

ASCII CHARACTER: ESC

1/11 COLUMN/ROW
33 OCTAL
27 DECIMAL
1B HEX

SUPPLEMENTAL GRAPHIC SET

MA-10,087L

Figure A-15 DEC Supplemental Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0 B7 0 B6 0 B5 0	1 0 0 1	2 0 1 0	3 0 1 1	4 1 0 0	5 1 0 1	6 1 1 0	7 1 1 1
0	0 0 0 0	NUL 0 0 0	20 16 10	SP 40 32 20	0 60 48 30	É 100 64 40	P 120 80 50	é 140 96 60	p 160 112 70
1	0 0 0 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
2	0 0 1 0	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
3	0 0 1 1	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
4	0 1 0 0	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
5	0 1 0 1	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
6	0 1 1 0	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
7	0 1 1 1	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
8	1 0 0 0	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
9	1 0 0 1	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
10	1 0 1 0	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
11	1 0 1 1	VT 13 11 B	ESC 33 27 1B	+ 53 43 2B	; 73 59 3B	K 113 75 4B	Ä 133 91 5B	k 153 107 6B	ä 173 123 7B
12	1 1 0 0	FF 14 12 C	34 28 1C	, 54 44 2C	< 74 60 3C	L 114 76 4C	Ö 134 92 5C	l 154 108 6C	ö 174 124 7C
13	1 1 0 1	CR 15 13 D	35 29 1D	- 55 45 2D	= 75 61 3D	M 115 77 4D	Å 135 93 5D	m 155 109 6D	å 175 125 7D
14	1 1 1 0	SO 16 14 E	36 30 1E	. 56 46 2E	> 76 62 3E	N 116 78 4E	Ü 136 94 5E	n 156 110 6E	ü 176 126 7E
15	1 1 1 1	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 | 1/11 COLUMN/ROW | 33 OCTAL | 27 DECIMAL | 1B HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7422B

Figure A-16 Swedish Character Set

B7 B6 B5 / BITS B4 B3 B2 B1 / ROW	COLUMN 0		1		2		3		4		5		6		7	
0 0 0 0 0	NUL	0 0 0		20 16 10	SP	40 32 20	0	60 48 30	à	100 64 40	P	120 80 50	ô	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	ù	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		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	é	133 91 5B	k	153 107 6B	ä	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	ç	134 92 5C	l	154 108 6C	ö	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	ê	135 93 5D	m	155 109 6D	ü	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	î	136 94 5E	n	156 110 6E	û	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	è	137 95 5F	o	157 111 6F	DEL	177 127 7F

KEY

ASCII CHARACTER — ESC — 1/11 COLUMN/ROW; 33 OCTAL; 27 DECIMAL; 1B HEX

MA-7247N

Figure A-17 Swiss Character Set

B8 B7 B6 B5		0 0			0 1			1 0			1 1			1 0			1 1		
BITS			GL	GR		GL	GR		GL	GR		GL	GR		GL	GR		GL	GR
B4 B3 B2 B1	COLUMN		2	10		3	11		4	12		5	13		6	14		7	15
0 0 0 0	0				⊦	60 48 30	260 176 B0	•⋰•	100 64 40	300 192 C0	Π	120 80 50	320 208 D0	⌐	140 96 60	340 224 E0	π	160 112 70	360 240 F0
0 0 0 1	1	⌟	41 33 21	241 161 A1	⊱	61 49 31	261 177 B1	∝	101 65 41	301 193 C1	Ψ	121 81 51	321 209 D1	α	141 97 61	341 225 E1	ψ	161 113 71	361 241 F1
0 0 1 0	2	⌜	42 34 22	242 162 A2	∠	62 50 32	262 178 B2	∞	102 66 42	302 194 C2	ς	122 82 52	322 210 D2	β	142 98 62	342 226 E2	ρ	162 114 72	362 242 F2
0 0 1 1	3	—	43 35 23	243 163 A3	\	63 51 33	263 179 B3	÷	103 67 43	303 195 C3	Σ	123 83 53	323 211 D3	χ	143 99 63	343 227 E3	σ	163 115 73	363 243 F3
0 1 0 0	4	⌠	44 36 24	244 164 A4	/	64 52 34	264 180 B4	Δ	104 68 44	304 196 C4		124 84 54	324 212 D4	δ	144 100 64	344 228 E4	τ	164 116 74	364 244 F4
0 1 0 1	5	⌡	45 37 25	245 165 A5	¬	65 53 35	265 181 B5	∇	105 69 45	305 197 C5		125 85 55	325 213 D5	ε	145 101 65	345 229 E5		165 117 75	365 245 F5
0 1 1 0	6	⎮	46 38 26	246 166 A6	⌟	66 54 36	266 182 B6	Φ	106 70 46	306 198 C6	√	126 86 56	326 214 D6	φ	146 102 66	346 230 E6	ƒ	166 118 76	366 246 F6
0 1 1 1	7	⌠	47 39 27	247 167 A7	〉	67 55 37	267 183 B7	Γ	107 71 47	307 199 C7	Ω	127 87 57	327 215 D7	γ	147 103 67	347 231 E7	ω	167 119 77	367 247 F7
1 0 0 0	8	⌊	50 40 28	250 168 A8		70 56 38	270 184 B8	~	110 72 48	310 200 C8	Ξ	130 88 58	330 216 D8	η	150 104 68	350 232 E8	ξ	170 120 78	370 248 F8
1 0 0 1	9	⌉	51 41 29	251 169 A9		71 57 39	271 185 B9	≃	111 73 49	311 201 C9	Υ	131 89 59	331 217 D9	ι	151 105 69	351 233 E9	υ	171 121 79	371 249 F9
1 0 1 0	10	⌋	52 42 2A	252 170 AA		72 58 3A	272 186 BA	Θ	112 74 4A	312 202 CA	⊂	132 90 5A	332 218 DA	θ	152 106 6A	352 234 EA	ζ	172 122 7A	372 250 FA
1 0 1 1	11	⎛	53 43 2B	253 171 AB		73 59 3B	273 187 BB	×	113 75 4B	313 203 CB	⊃	133 91 5B	333 219 DB	κ	153 107 6B	353 235 EB	←	173 123 7B	373 251 FB
1 1 0 0	12	⎝	54 44 2C	254 172 AC	≤	74 60 3C	274 188 BC	Λ	114 76 4C	314 204 CC	∩	134 92 5C	334 220 DC	λ	154 108 6C	354 236 EC	↑	174 124 7C	374 252 FC
1 1 0 1	13	⎞	55 45 2D	255 173 AD	≠	75 61 3D	275 189 BD	⇔	115 77 4D	315 205 CD	∪	135 93 5D	335 221 DD		155 109 6D	355 237 ED	→	175 125 7D	375 253 FD
1 1 1 0	14	⎠	56 46 2E	256 174 AE	≥	76 62 3E	276 190 BE	⇒	116 78 4E	316 206 CE	∧	136 94 5E	336 222 DE	ν	156 110 6E	356 238 EE	↓	176 126 7E	376 254 FE
1 1 1 1	15	⎟	57 47 2F	257 175 AF	∫	77 63 3F	277 191 BF	≡	117 79 4F	317 207 CF	∨	137 95 5F	337 223 DF	∂	157 111 6F	357 239 EF			

LEGEND

CHARACTER → α | 4/1 101 65 41 | 12/1 301 193 C1

COLUMN/ROW
OCTAL
DECIMAL
HEX

* NOTE:
WHEN SET IS MAPPED INTO GR, BIT B8 IS 1

Figure A-18 DEC Technical Character Set

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

KEY

ASCII CHARACTER: ESC | 1/11 COLUMN/ROW | 33 OCTAL | 27 DECIMAL | 1B HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

MA-7249C

Figure A-19 VT100 Line Drawing Character Set

B8 B7 B6 B5 BITS		0 1 0			0 1 1			1 0 0			1 0 1			1 1 0			1 1 1		
B4 B3 B2 B1	COLUMN		GL 2	GR 10		GL 3	GR 11		GL 4	GR 12		GL 5	GR 13		GL 6	GR 14		GL 7	GR 15
0 0 0 0	ROW 0	SP			°	60 48 30	260 176 B0	À	100 64 40	300 192 C0	ð	120 80 50	320 208 D0	à	140 96 60	340 224 E0	ð	160 112 70	360 240 F0
0 0 0 1	1	¡	41 33 21	241 161 A1	±	61 49 31	261 177 B1	Á	101 65 41	301 193 C1	Ñ	121 81 51	321 209 D1	á	141 97 61	341 225 E1	ñ	161 113 71	361 241 F1
0 0 1 0	2	¢	42 34 22	242 162 A2	2	62 50 32	262 178 B2	Â	102 66 42	302 194 C2	Ò	122 82 52	322 210 D2	â	142 98 62	342 226 E2	ò	162 114 72	362 242 F2
0 0 1 1	3	£	43 35 23	243 163 A3	3	63 51 33	263 179 B3	Ã	103 67 43	303 195 C3	Ó	123 83 53	323 211 D3	ã	143 99 63	343 227 E3	ó	163 115 73	363 243 F3
0 1 0 0	4	¤	44 36 24	244 164 A4	'	64 52 34	264 180 B4	Ä	104 68 44	304 196 C4	Ô	124 84 54	324 212 D4	ä	144 100 64	344 228 E4	ô	164 116 74	364 244 F4
0 1 0 1	5	¥	45 37 25	245 165 A5	µ	65 53 35	265 181 B5	Å	105 69 45	305 197 C5	Õ	125 85 55	325 213 D5	å	145 101 65	345 229 E5	õ	165 117 75	365 245 F5
0 1 1 0	6	¦	46 38 26	246 166 A6	¶	66 54 36	266 182 B6	Æ	106 70 46	306 198 C6	Ö	126 86 56	326 214 D6	æ	146 102 66	346 230 E6	ö	166 118 76	366 246 F6
0 1 1 1	7	§	47 39 27	247 167 A7	•	67 55 37	267 183 B7	Ç	107 71 47	307 199 C7	×	127 87 57	327 215 D7	ç	147 103 67	347 231 E7	÷	167 119 77	367 247 F7
1 0 0 0	8	¨	50 40 28	250 168 A8	¸	70 56 38	270 184 B8	È	110 72 48	310 200 C8	Ø	130 88 58	330 216 D8	è	150 104 68	350 232 E8	ø	170 120 78	370 248 F8
1 0 0 1	9	©	51 41 29	251 169 A9	1	71 57 39	271 185 B9	É	111 73 49	311 201 C9	Ù	131 89 59	331 217 D9	é	151 105 69	351 233 E9	ù	171 121 79	371 249 F9
1 0 1 0	10	ª	52 42 2A	252 170 AA	º	72 58 3A	272 186 BA	Ê	112 74 4A	312 202 CA	Ú	132 90 5A	332 218 DA	ê	152 106 6A	352 234 EA	ú	172 122 7A	372 250 FA
1 0 1 1	11	«	53 43 2B	253 171 AB	»	73 59 3B	273 187 BB	Ë	113 75 4B	313 203 CB	Û	133 91 5B	333 219 DB	ë	153 107 6B	353 235 EB	û	173 123 7B	373 251 FB
1 1 0 0	12	¬	54 44 2C	254 172 AC	¼	74 60 3C	274 188 BC	Ì	114 76 4C	314 204 CC	Ü	134 92 5C	334 220 DC	ì	154 108 6C	354 236 EC	ü	174 124 7C	374 252 FC
1 1 0 1	13	-	55 45 2D	255 173 AD	½	75 61 3D	275 189 BD	Í	115 77 4D	315 205 CD	Ý	135 93 5D	335 221 DD	í	155 109 6D	355 237 ED	ý	175 125 7D	375 253 FD
1 1 1 0	14	®	56 46 2E	256 174 AE	¾	76 62 3E	276 190 BE	Î	116 78 4E	316 206 CE	Þ	136 94 5E	336 222 DE	î	156 110 6E	356 238 EE	þ	176 126 7E	376 254 FE
1 1 1 1	15	¯	57 47 2F	257 175 AF	¿	77 63 3F	277 191 BF	Ï	117 79 4F	317 207 CF	ß	137 95 5F	337 223 DF	ï	157 111 6F	357 239 EF	ÿ	177 127 7F	377 255 FF

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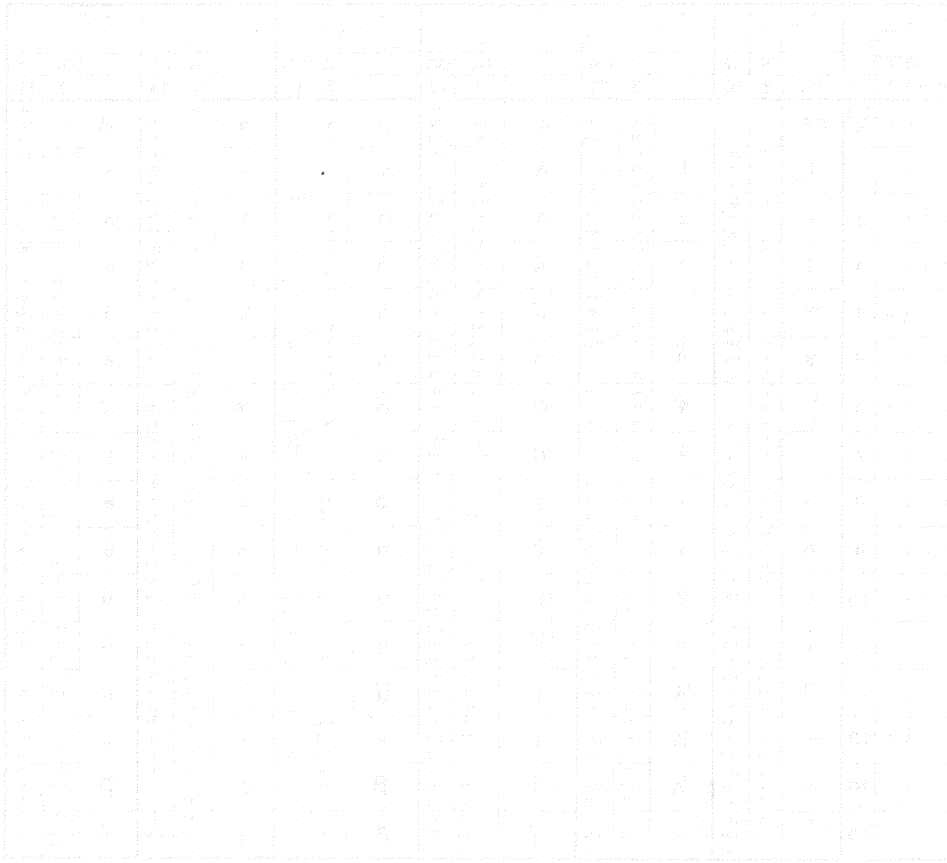
Figure A-20 ISO Supplemental Character Set



APPENDIX B

DEC GRAPHIC MODE — IMAGE EXAMPLES

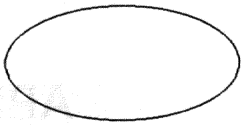
Table B-1 and examples below show different image scales and aspect ratios you can use with the LA75.

Table B-1 Selectable Image Scale Sizes and Aspect Ratios

Image Scale Size	Aspect Ratio	Horizontal Grid Size	Vertical Grid Size
0.5×	1:1	1/144-inch	1/144-inch
Full	2.5:1	1/180	1/72
	2:1	1/144	1/72
	1:1	1/72	1/72
2×	2.5:1	1/90	1/36
	2:1	1/72	1/36
	1:1	1/36	1/36

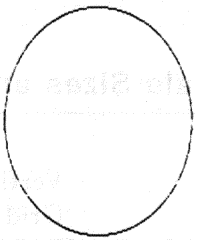
```
Horizontal Grid Size: 1/144 inch
Pixel Aspect Ratio:   1 to 1

Vertical Grid Size:   1/144 inch
Vertical Sixel Size:  1/24  inch
Image Scale Size:     0.5X  Scale
```



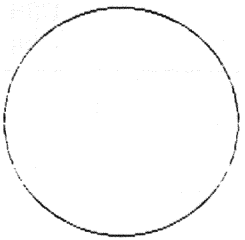
```
Horizontal Grid Size: 1/180 inch
Pixel Aspect Ratio:   2.5 to 1

Vertical Grid Size:   1/72 inch
Vertical Sixel Size:  1/12 inch
Image Scale Size:     Full Scale
```



```
Horizontal Grid Size: 1/144 inch
Pixel Aspect Ratio:   2 to 1

Vertical Grid Size:   1/72 inch
Vertical Sixel Size:  1/12 inch
Image Scale Size:     Full Scale
```



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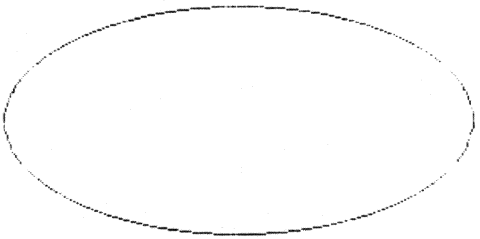
Example 1

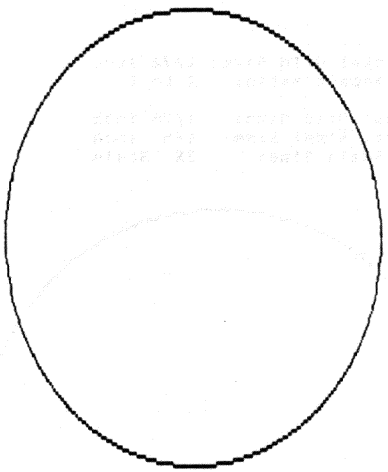
```
Horizontal Grid Size: 1/72 inch
Pixel Aspect Ratio:   1 to 1

Vertical Grid Size:   1/72 inch
Vertical Sixel Size:  1/12 inch
Image Scale Size:     Full Scale
```



```
Horizontal Grid Size: 1/90 inch
Pixel Aspect Ratio:   2.5 to 1

Vertical Grid Size:   1/36 inch
Vertical Sixel Size:  1/6  inch
Image Scale Size:     2X   Scale
```



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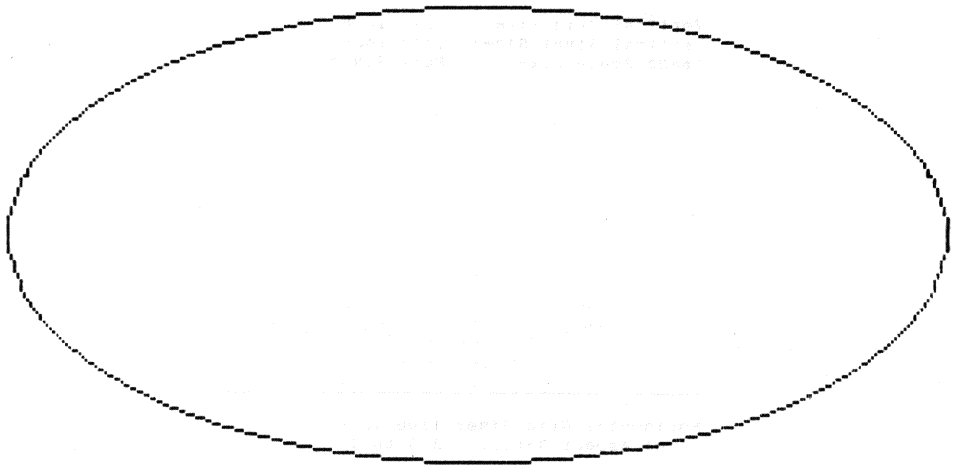
Example 2

```
Horizontal Grid Size: 1/36 inch
Pixel Aspect Ratio:   1 to 1

Vertical Grid Size:   1/36 inch
Vertical Sixel Size:  1/6  inch
Image Scale Size:     2X  Scale
```



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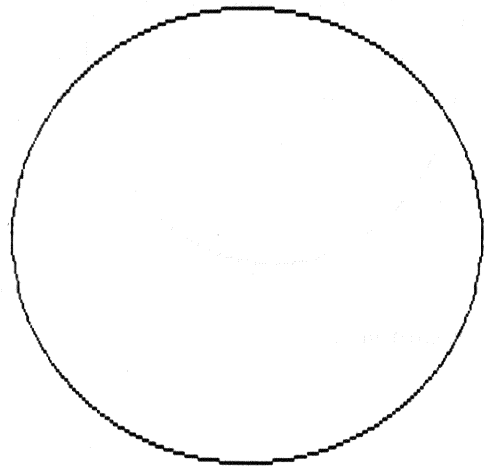
Example 3

```
Horizontal Grid Size: 1/72 inch
Pixel Aspect Ratio:   2 to 1

Vertical Grid Size:   1/36 inch
Vertical Sixel Size:  1/6  inch
Image Scale Size:     2X  Scale
```



MA-0289-86

Example 4

APPENDIX C

TEXT MODE PROGRAMMING EXAMPLES

Following are some generic examples of programming that can illustrate LA75 programming technique. Refer to the software/operating instructions of your computer to properly send the applicable escape sequences.

```
10  '--- Horizontal Pitch Changes ---
20  '
30 ESC$= CHR$(27)
40  '
50  '---Default (80) column width, 10 cpi ---
60  '
70  LPRINT ESC$; "[0w";
80  LPRINT "This line printed at default 10 cpi horizontal pitch. Maximum";
90  LPRINT " column width of 80"
100 LPRINT "characters."
110 LPRINT
120 LPRINT
130 '
140 '--- Expanded (132) column width, 16.5 cpi ---
150 '
160 LPRINT ESC$; "[4w";
170 LPRINT "This line printed at compressed pitch of 16.5 cpi. The expanded";
180 LPRINT " column width allows more data, up to 132 characters, to be";
190 LPRINT " displayed"
200 LPRINT "on a print line."
210 LPRINT
```

```
This line printed at default 10 cpi horizontal pitch. Maximum column width of 80
characters.
```

```
This line printed at compressed pitch of 16.5 cpi. The expanded column width allows more data, up to 132 characters, to be displayed
on a print line.
```

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Example 1 — Horizontal Pitch

```
10  '--- Draft, LQ, Memo, NLQ Modes ---
20  '
30 ESC$= CHR$(27)
40 DOUBQUOTE$= CHR$(34)
50  '
60  '--- Select draft density ---
70  '
80  LPRINT ESC$; "[1"; DOUBQUOTE$; "z";
90  LPRINT "This line printed in draft density."
100 LPRINT
110 '
120 '--- Select LQ density ---
130 '
140 LPRINT ESC$; "[2"; DOUBQUOTE$; "z";
150 LPRINT "This line printed in LQ density."
160 LPRINT
170 '
180 '--- Select Memo density ---
190 '
200 LPRINT ESC$; "[3"; DOUBQUOTE$; "z";
210 LPRINT "This line printed in Memo density."
220 LPRINT
230 '
240 '--- Select NLQ density ---
250 '
260 LPRINT ESC$; "[4"; DOUBQUOTE$; "z";
270 LPRINT "This line printed in NLQ density."
280 LPRINT
```

```
This line printed in draft density.

This line printed in LQ density.

This line printed in Memo density.

This line printed in NLQ density.
```

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Example 2 — Print Quality Selection

```
10  '--- DEC Technical Set Composites ---
20  '
30 ESC$= CHR$(27)
40  '
50  '--- Load Technical Set and construct mathematical signs ---
60  '
70  LPRINT "Construction of mathematical signs with DEC Technical Set"
80  LPRINT
90  LPRINT ESC$; "K";
100 LPRINT "    x=10";
110 LPRINT ESC$; "L"
120 LPRINT ESC$; "()";
130 LPRINT "    1##5"
140 LPRINT "     3";
150 LPRINT ESC$; "(B";
160 LPRINT "    x"; ESC$; "L"; "2"; ESC$; "K"; " + 1"
170 LPRINT ESC$; "()";
180 LPRINT "      7  ######"
190 LPRINT "     4";
200 LPRINT ESC$; "(B";
210 LPRINT "      2x"
220 LPRINT ESC$; "()";
230 LPRINT "    2##6"
240 LPRINT ESC$; "(B";
250 LPRINT "      1"
260 LPRINT
```

```
Construction of mathematical signs with DEC Technical Set
```

$$\sum_{1}^{x=10} \frac{x^2 + 1}{2x}$$

MA-0280-86

Example 3 — Using Digital Technical Character Set

```
10  '--- Form Length ---
20  '
30 ESC$= CHR$(27)
40 FF$= CHR$(12)
50  '
60  '--- Change form length to 10 lines (110/66 in. at default vert. pitch) ---
70  '
80  LPRINT ESC$; "[10t";
90  LPRINT "Form length set to 10 lines: TOP OF FORM - Line 1";
100 FOR X=1 TO 5
110     LPRINT
120 NEXT X
130 LPRINT "                                                Line 6"
140 LPRINT FF$;
150 LPRINT "                    next page: TOP OF FORM - Line 11";
160 LPRINT


Form length set to 10 lines: TOP OF FORM - Line 1




                                        Line 6



                  next page: TOP OF FORM - Line 11
```

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Example 4 — Form Length Selection

```
10  '--- Shadow Bold, Underline, and Double Underline SGR Parameters ---
20  '
30 ESC$= CHR$(27)
40  '
50  '--- Select shadow bolding
60  '
70  LPRINT ESC$; "[0m";
80  LPRINT "For highlighting text, ";
90  LPRINT ESC$; "[1m";
100 LPRINT "shadow bolding";
110 LPRINT ESC$; "[0m";
120 LPRINT " is available."
130 LPRINT
140  '
150  '--- Select underlining and double-underlining ---
160  '
170 LPRINT ESC$; "[4m";
180 LPRINT "Underlining";
190 LPRINT ESC$; "[0m";
200 LPRINT " and ";
210 LPRINT ESC$; "[21m";
220 LPRINT "double-underlining";
230 LPRINT ESC$; "[0m";
240 LPRINT " provide two means of underscoring."
250 LPRINT
```

For highlighting text, **shadow bolding** is available.

Underlining and double-underlining provide two means of underscoring.

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Example 5 — Text Highlighting

APPENDIX D

ALTERNATIVE PROGRAMMING METHODS

This appendix describes some operating limitations and alternative programming methods that can assure good printing accuracy.

D.1 LIMITATION OF THE PARTIAL LINE UP (PLU) COMMAND

The PLU command provides a 1/12 inch reverse line motion. The LA75 supports one PLU command per superscript. Since the LA75's reverse positioning accuracy cannot be guaranteed whenever two or more PLU commands are issued in succession, use only one PLU command to perform superscripting.

D.2 PAPER REVERSE LIMITATION WHEN BOTTOM FEEDING PAPER

Due to mechanical limitations when feeding paper from the bottom of the printer, the LA75 cannot accurately perform reverse paper motions. Therefore, when paper is bottom-fed, the LA75 does not support the Partial Line Up (PLU) command (Section 4.4.4) because it results in vertical misregistration.

Alternative:

> When using bottom paper feed, do not use the PLU and PLD vertical motion commands to achieve superscripting and subscripting. Instead, use the superscripting and subscripting functions described in Sections 4.4.7.2 and 8.8.5 of this manual.

D.3 AVOID "MULTI-PASS PRINTING" TO ASSURE GOOD PRINT ACCURACY

Multi-pass printing occurs when software attempts to send more than one line of data for the same print line. Under certain situations described below the LA75 will try to "reverse paper for line readjustment." This reverse motion is actually a small reverse and forward motion which adjusts the paper back to the original print line.

Avoid the following three situations:

- use of overstrike for bolding at high print densities
- use of the underline character at high print densities
- sending composite characters separate from text characters

Recommended alternative programming methods are identified for each situation.

NOTE: When using paper rear feed, you may use the following methods as the alternatives that assure good print accuracy. When using bottom feed, you MUST use these methods because the LA75 is not able to reverse paper.

D.3.1 Bolding by Overstriking

Do not use character overstrike (sending the same data to the printer twice) as a method of bolding in NLQ or LQ density. These high print densities require two-pass printing with a half-dot forward offset between passes. Therefore, overstriking in these densities will require "reversing paper for line re-adjustment" which may result in reduced print quality.

Alternative:

To avoid this, use the LA75 bolding function. (Refer to Sections 4.4.7 and 8.8.4 of this manual.) This function will provide good print accuracy while increasing print throughput as compared with the bolding by overstriking.

D.3.2 Underlining Text with Underline Character

Do not use the Underline character to underline the text in NLQ and LQ densities. These high print densities require two-pass printing with a half-dot forward offset between passes. When the text is underlined using the underline character, the printer must "reverse paper for line readjustment" which may result in reduced print quality.

Alternative:

To avoid this, use the LA75 underlining function. (Refer to Sections 4.4.7 and 8.8.6.6 of this manual.) This function will provide good print accuracy while increasing print throughput as compared with underlining the text with the underline character.

D.3.3 Printing "Full-Height" Composite Characters from VT100 Special Graphic Character Set, DEC Technical Character Set, and IBM Graphic Character Set

Full-height composite characters are characters such as the vertical bar | (7/8) of the VT100 Special Graphic Set which extend vertically to connect to adjacent composite characters.

In all print densities, when using the LA75's "full-height" composite characters, software may choose to send the composite characters and the normal text characters in separate lines of data intended for the same print line. If the composite characters are sent before the last line of data, the printer will need to "reverse paper for line readjustment" which may result in reduced print quality.

Alternative:

To avoid this, send the composite characters to the printer in a "single" line of data along with normal text or during the last line of data intended for the same print line.

In addition, to assure good horizontal, line-to-line registration when printing the LA75's composite characters, use the unidirectional printing. Refer to Sections 4.5.7 and 8.6.2 of this manual for the unidirectional printing setup in DEC and IBM Emulation modes.

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