LQ-500 L-1000

TECHNICAL MANUAL

EPSON

FCC COMPLIANCE STATEMENT FOR AMERICAN USERS

This equipment uses and generates radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with limits for a Class B computing device in accordance with Sub-part J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- reorient the receiving antenna
- relocate the computer with respect to the receiver
- move the computer away from the receiver
- plug the computer into a different outlet so that the computer 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 following booklet, prepared by the Federal Communications Commission, helpful: " How to Identify and Resolve Radio-TV Interference Problems." 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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REVISION SHEET

REVISION	DATE ISSUED	UPDATES
A	July 15, 1988	1st issue

PRECAUTIONS

Precautionary notations throughout the text are categorized relative to 1) personal injury, and 2) damage to equipment:

DANGER Signals a precaution which, if ignored, could result in serious or fatal personal injury. Great caution should be exercised in performing procedures preceded by a DANGER heading.

WARNING Signals a precaution which, if ignored, could result in damage to equipment.

The precautionary measures itemized below always should be observed when performing repair/maintenance procedures.

DANGER

1. *ALWAYS DISCONNECT THE PRODUCT FROM BOTH THE POWER SOURCE* AND *PERIPHERAL DEVICES BEFORE PERFORMING ANY MAINTENANCE OR REPAIR PROCEDURE.*

2. *NO WORKSHOULD BE PERFORMED ON THE UNIT BY PERSONS UNFAMILIAR WITH BASIC SAFETY MEASURES AS DICTATED FOR ALL ELECTRONICS TECHNICIANS IN THEIR LINE OF WORK.*

3. *WHEN PERFORMING TESTING AS DICTATED WITHIN THIS MANUAL, DO NOT CONNECT THE UNIT TO A POWER SOURCE UNTIL INSTRUCTED TO DO SO. WHEN THE POWER SUPPLY CABLE MUST BE CONNECTED, USE EXTREME CAUTION IN WORKING ON POWER SUPPLY AND OTHER ELECTRONIC COMPONENTS.*

WARNING

1. *Repairs* on *Epson products should be performed only by an Epson-certified repair technician.*

2 *Make certain that the source voltage is the same as the rated voltage, listed on the serial number/rating plate. If the Epson product has a primary AC rating different from the available power source, do not connect it to the power source.*

3. *Always verify that the Epson* product *has been disconnected from* the *power source before removing or replacing printed circuit boards and/or individual chips.*

4. *In order to protect sensitive microprocessors and circuitry, use static discharge equipment, such as anti-static wrist straps, when accessing internal components.*

5. *Replace malfunctioning components only with those components recommended by the manufacturer,. introduction of second-source ICs or other nonapproved components may damage the product and void any applicable Epson warranty.*

PREFACE

This manual describes functions, theory of electrical and mechanical operations, maintenance, and repair of the LQ-500 and the L-1000. Thoughout this manual both printers are discussed. When an item is unique to one printer, special notation is made. Common items are treated in a general format.

The instructions and procedures included here are intended for the experienced repair technician, who should pay attention to the precautions on the preceding page. The chapters are organized as follows:

Chapter 1 - Provides a general product overview, lists specifications, and illustrates the main components of the printer.

Chapter 2 - Describes the theory of printer operation

Chapter 3 - Discusses the options.

Chapter 4 - Includes a step-by-step guide for product disassembly, assembly, and adjustment.

Chapter 5 - Provides Epson-approved techniques for troubleshooting.

Chapter 6 - Describes preventive maintenance techniques and lists lubricants and adhesives required to service the equipment.

* The contents of this manual are subject to change without notice.

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1 .1 FEATURES

The LQ-500/L-1000 are small, light-weight, low-cost printers compatible with the LQ-800. The two printers differ in the housing design. All other features are the same. The main features are as follows:

1. Expanded ESC/P-code printing, implemented as a standard feature
2. Printing speeds: 180 CPS (alphanumeric Draft 12 CPI)
   150 CPS (alphanumeric Draft 10 CPI)
   60 CPS (alphanumeric LQ 12 CPI)
   50 CPS (alphanumeric LQ 10 CPI)
3. Optional 8100 series interface
4. Clear, easy-to-read printing with a standard EPSON font
5. Two built-in LQ fonts (Roman and Sans Serif)
6. Optional Font Module to provide a wide variety of fonts
7. Front panel switch selection of Draft, Roman, Sans Serif, or slot (Optional Font Module) font
8. Automatic paper-loading function
9. Easy handling of cut sheets with the optional cut-sheet feeder (CSF)

The LQ-500/L-1000 is equipped with the standard EPSON 8-bit parallel interface. Various interface options enable users to print data from a wide variety of computers. Table l-l lists the interface options, Table l-2 lists the optional units available for the LQ-500/L-1000, and Figure l-l shows an exterior view of the LQ-500 / L-1000.

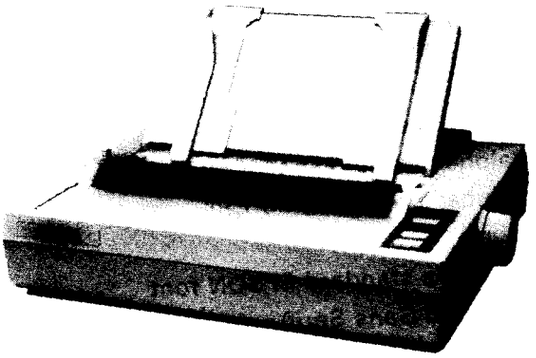
Table l-l. Interface Options

Model	Description
8143	New serial interface board
8145	RS-232C/Current loop interface type II
8148	Intelligent serial interface board
8149	Intelligent serial interface board type II
8149M	Intelligent serial interface board type III
8161	IEEE-488 interface board
8165	Intelligent IEEE-488 interface board
8172	32K buffer parallel interface board
8172M	128K buffer parallel interface board

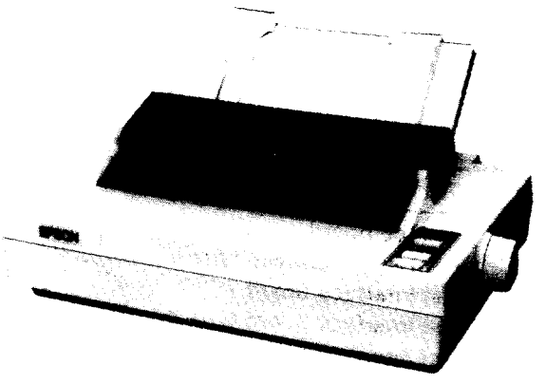
NOTE: Refer to the “Optional Interface Technical Manual” for details.

Table 1-2. Optional Units

Model	Description
7341	Cut-sheet feeder (CSF)
7400	Font module Courier
7401	Font module Prestige
7402	Font module Script
7403	Font module OCR-B



(Printer Cover A)



(Printer Cover B)

Figure 1-l. Exterior View of the LQ-500/L-l000

1.2 SPECIFICATIONS

This section describes the specifications for the LQ-500/L-1000 printer.

1.2.1 Hardware Specifications

Printing Method	Serial, impact, dot matrix
Pin Configuration	24 wires (12 x 2 staggered, diameter 0.2 mm)

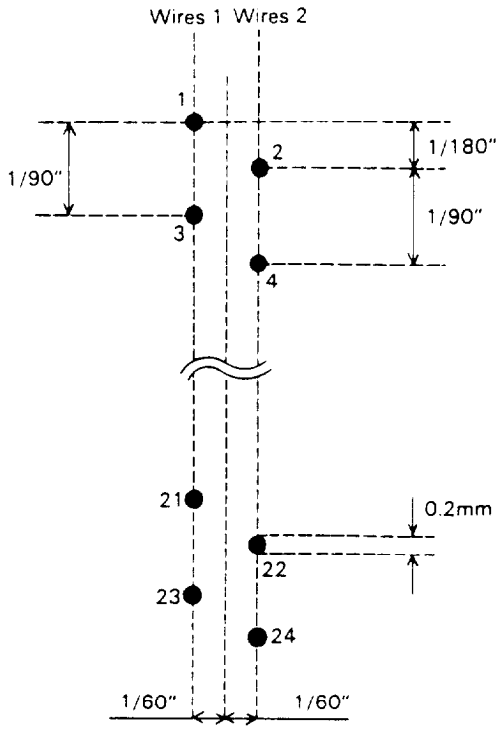


Figure 1-2. Pin Configuration

Feeding Method	Friction feed, tractor feed (pull tractor)
Line Spacing	1/6 inch, or programmable in units of 1/l80 inch
Paper Insertion	From rear
Paper-Feed Speed	100 ms/line (at 1/6-inch feed) 2.2 inches per second (continuous feed)
Paper Specifications	See Tables 1-3 and 1-4

Table 1-3. Cut-Sheet Specifications

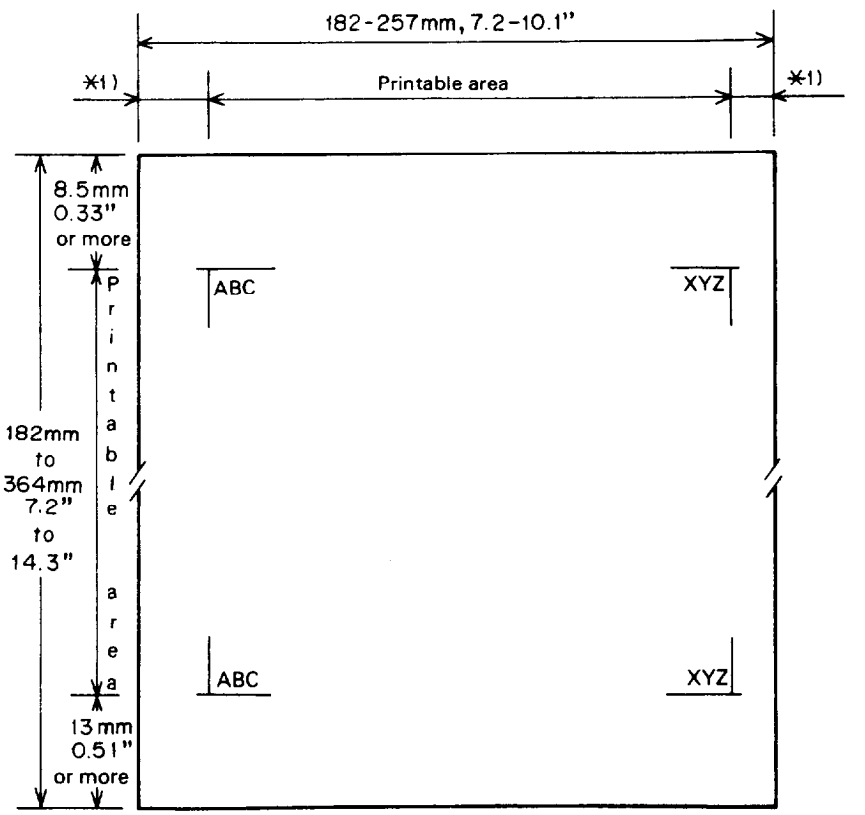
Width	182 mm to 257 mm (7.2 in. to 10.1 in.)
Length	182 mm to 364 mm (7.2 in. to 14.3 in.)
Thickness	0.065 mm to 0.1 mm (0.0025 in. to 0.004 in.)
Weight	52 g/m^2 to 82 g/m^2
Quality	Copier paper or bond
Copies	Not available

Table 1-4. Continuous (Sprocket) Paper Specifications

Width	101 mm to 254 mm (4.0 in. to 10.0 in.)
Copies	3 sheets, maximum (1 original and 2 copies)
Quality	Computer paper or other continuous-form paper
Total Thickness	0.065 mm to 0.25 mm (0.0025 in. to 0.01 in.)
Weight	1 sheet - 52 g/m² to 82 g/m²
	2 sheets - 40 g/m² to 58 g/m² X 2
	3 sheets - 40 g/m² to 58 g/m² X 3

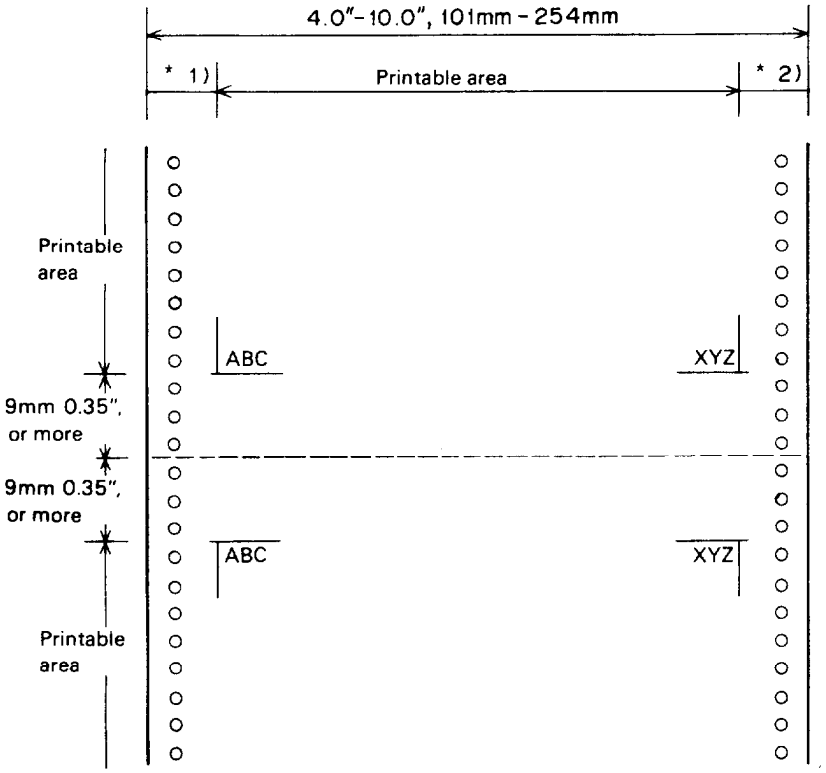
Printable Area

The figure below illustrates the printable area for cut sheets.



*1) 3 mm or more using 182 mm to 229 mm (7.2 in. to 9 in.) width paper.
27 mm or more using 257 mm (10.1 in.) width paper.

Figure 1-3. Cut-Sheet Printable Area



*1) 13 mm or more using 101 mm to 242 mm (4 in. to 9.5 in.) width paper.
26 mm or more using 254 mm (10 in.) width paper.

● 2) 13 mm or more using 101 mm to 242 mm (4 in. to 9.5 in.) width paper.
24 mm or more using 254 mm (10 in.) width paper.

Figure 1-4. Printable Area for Continuous (Sprocket) -Feed Paper

Ink Ribbon	
Type	Exclusive ribbon cartridge
Color	Black
Reliability	2 million characters at 48 dots/character
Dimensions of Ribbon Cartridge	293 mm (width) x 34 mm (height) x 72 mm (depth)
Reliability	
Mean Cycles Between Failures (MCBF)	3 million lines (excluding printhead)
Mean Time Between Failures (MTBF)	4000 POH (25% duty)
Life of Printhead	200 million strokes
Safety Approvals	
Safety Standards	UL478 (U.S. version) CSA22.2#154 VDE0806 (TUV) (European version)
Radio Frequency Interference (RFI)	FCC class B (U.S. version) VDE0871 (Self-certification) (European version)
Electrical Specifications	
Power Conditions	120 VAC ± 10% (120 V version) 220 VAC ± 10% (220 V version) 240 VAC ± 10% (240 V version)
Frequency Range	49.5 to 50.5 Hz (50 Hz version) 59.5 to 60.5 Hz (60 Hz version)
Rating Current	1.8A (120 V version) 0.9A (220 V version) 0.9A (240 V version)
Insulation Resistance	10 Megohms min. (Between AC Line and Chassis)
Dielectric Strength (Between AC Line and Chassis)	1250 VAC (rms), 1 minute (120 V version) 3750 VAC (rms), 1 minute (220/240 V version)
Environmental Conditions	
Temperature	5 to 35 degrees C -operating -30 to 60 degrees C -in shipment container
Humidity	10 to 80 % RH -operating 5 to 85 % RH -storage
Resistance to Shock	1 G, within 1 ms -operating 2 G, within 1 ms -storage
Resistance to Vibration	0.25 G, 55 Hz max. -operating 0.50 G, 55 Hz max. -storage
Physical Specifications	
Weight	7 Kg
Dimensions	390 mm (width) x 320 (depth) x 139 mm (height), excluding knobs and paper guides

1.2.2 Firmware Specifications (ESC/P)

Control Code	ESC/P™ level ESC/P-83 (EPSON Standard Code for Printers)
Printing Direction	Bidirectional (text) Bidirectional (bit-image) (when SW 2-6 is ON) Unidirectional (bit-image) (when SW 2-6 is OFF)
Input Data Buffer	8K bytes (when SW 2-5 is ON)* 1K byte (when SW 2-5 is OFF) *When DIP SW 2-5 is set on ON, downloading will be ignored.
Character Code	8 bits
Character Set	96 ASCII and 13 international character sets
Family	EPSON Roman (Family number: 0) EPSON Sans Serif (Family number: 1)
Fonts	EPSON Roman 10, EPSON Roman 12, EPSON Roman 15, EPSON Roman Proportional; EPSON Sans Serif 10, EPSON Sans Serif 12, EPSON Sans Serif 15, EPSON Sans Serif Proportional; EPSON Draft 10, EPSON Draft 12, EPSON Draft 15.
Printing Mode	Selection and mixture of the following modes are allowed, except 15 CPI Condensed Mode ● Printing quality (draft/letter quality) ● Character pitch (10, 12, 15, or proportional) ● Condensed ● Double-width ● Double-height ● Emphasized ● Double-strike ● Italic ● Underlined ● Outline ● Shadow
Printing Speed	See Table 1-5.
Printing Columns	See Table 1-5.
Character Matrix	See Table 1-6.
Character Size	See Table 1-6.

Table 1-5. Printing Mode

Print pitch	Condensed	Emphasized	Double width		Printable columns	Character pitch (cpi)	Printing speed (cps)	
							Draft	LQ
10	0	0	0		80	10	150	50
	0	0	1		40	5	75	25
	0	1	0		80	10	75	50
	0	1	1		40	5	37.5	25
	1	x	0		137	17.1	128.6	85.7
	1	x	1		58	8.5	64.3	42.9
12	0	0	0		96	12	180	60
	0	0	1		48	6	90	30
	0	1	0		96	12	90	60
	0	1	1		48	6	45	30
	1	x	0		160	20	150	100
	1	x	1		80	10	75	50
15	0	0	0		120	15	225	75
	0	0	1		120	15	112.5	37.5
	0	1	0		60	7.5	112.5	37.5
	0	1	1		60	7.5	112.5	75
	1	x	x		Cannot be condensed			
Proportional	0	x	0	max.	68	8.6	—	42.9
				min.	160	20	—	100
	0	x	1	max.	34	4.3	—	21.4
				min.	80	10	—	50
	1	x	0	max.	137	17.1	—	85.7
				min.	320	40	—	200
	1	x	1	max.	68	8.6	—	42.9
				min.	160	20	—	100
Proportional Super/ Subscript	0	x	0	max.	102	12.8	—	64.3
				min.	240	30	—	150
	0	x	1	max.	51	6.4	—	32.1
				min.	120	15	—	75
	1	x	0	max.	204	25.7	—	128.6
				min.	480	60	—	300
	1	x	1	max.	102	12.8	—	64.3
				min.	240	30	—	150

NOTES:

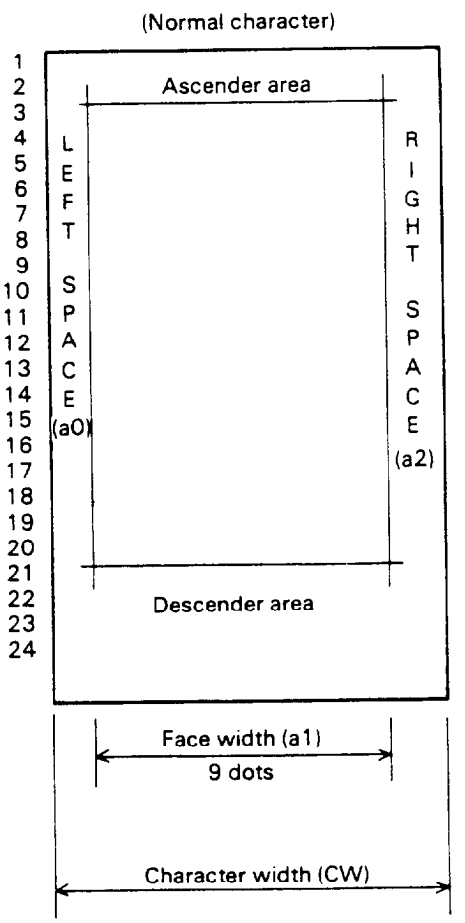
1. “Max.” means the value when characters of the maximum width were printed.
2. “Min.” means the value when characters of the minimum width were printed.
3. “-" means that “LQ” character set is automatically selected when proportional pitch is specified.

Table 1-6. Character Matrix and Character Size

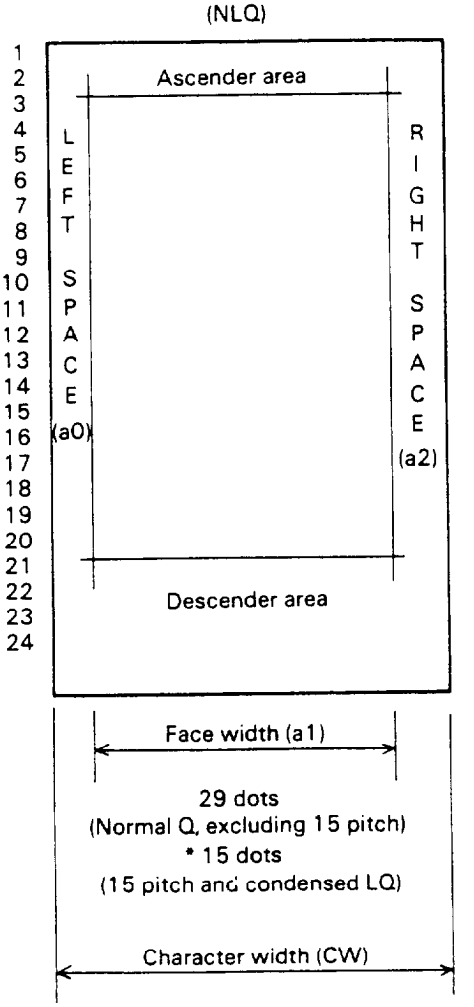
Printing mode	Face matrix	HDD	Character size H. × V. (mm)	Unit ESC sp
DARFT, 10 pitch	9 × 23	120	1.9 × 3.2	120
DRAFT, 12 pitch	9 × 23	120	1.9 × 3.2	120
DARFT, 15 pitch	9 × 16	120	1.0 × 2.3	120
DRAFT, 10 pitch, condensed	———	240	———	120
DRAFT, 12 pitch, condensed	———	240	———	120
LQ, 10 pitch	29 × 23	360	2.0 × 3.2	180
LQ, 12 pitch	29 × 23	360	2.0 × 3.2	180
LQ, 15 pitch	15 × 16	360	1.0 × 2.3	180
LQ, 10 pitch, condensed	———	360	———	180
LQ, 12 pitch, condensed	———	360	———	180
LQ, proportional	max. 39 × 23 min. 18 × 23	360 360	2.6 × 3.2 1.0 × 3.2	180
LQ, proportional, condensed	——— ———	360 360	——— ———	180
LQ, proportional, super/subscript	max. 28 × 16 min. 12 × 16	360 360	1.8 × 2.3 0.7 × 2.3	180
LQ, proportional, super/subscript, condensed	——— ———	360 360	——— ———	180

NOTES:

1. HDD is horizontal dot density in dots per inch.
2. Face matrix and character size indicate the size of the maximum character, and this value will be changed by differences in paper, ribbon, etc.
3. Unit ESC sp (which also can be sent as the unit followed by the character string CHR$ (&h20)) indicates the minimum length to be added to the right of the character that can be specified with the ESC sp control code.
4. " " indicates that character matrix is reshaped by printer firmware. Character width becomes half of noncondensed character width.

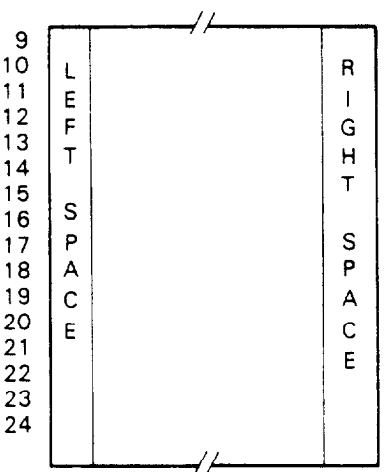


12 dots (10 pitch) 120 DPI
15 dots (12 pitch) 180 DPI
16 dots (15 pitch) 240 DPI
14 dots (condensed 10 pitch) 240 DPI
12 dots (condensed 12 pitch) 240 DPI



36 dots (10 pitch) 360 DPI
30 dots (12 pitch) 360 DPI
24 dots (15 pitch) 360 DPI
21 dots (condensed 10 pitch) 360 DPI
18 dots (condensed 12 pitch) 360 DPI

* 15 dots are made from 29 dots by printer firmware.



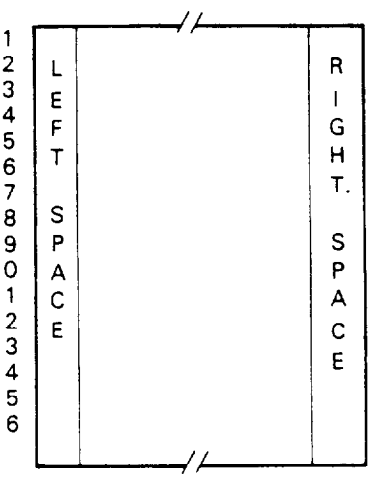


Figure 1-5. Character Matrix

1.3 INTERFACE OVERVIEW

The 8-bit parallel interface, provided standard with this printer, has the following specifications:

Data Format	8-bit parallel
Synchronization	By $\overline{\text{STROBE}}$ pulse
Handshaking	By BUSY and $\overline{\text{ACKNLG}}$ signal
Signal Level	TTL-compatible
Adaptable Connector	57-30360 (Amphenol) or equivalent
Data Transmission Timing	See Figure 1-6

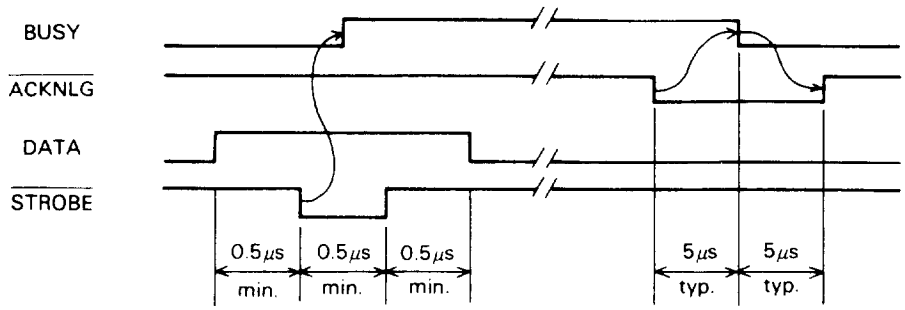


Figure 1-6. Data Transmission Timing

Table 1-7 shows the connector pin assignments and signal functions of the 8-bit parallel interface.

Table 1-7. Connector Pin Assignments and Signal Functions

Pin No.	Signal Name	Return Pin No.	Dir.	Functional Description
1	$\overline{\text{STROBE}}$	19	In	Strobe pulse to read the input data. Pulse width must be more than 0.5 μs. Input data is latched after falling edge of this signal.
2	DATA 1	20	In	Parallel input data to the printer.
3	DATA 2	21	In	HIGH level means 1.
4	DATA 3	22	In	LOW level means 0.
5	DATA 4	23	In	
6	DATA 5	24	In	
7	DATA 6	25	In	
8	DATA 7	26	In	
9	DATA 8	27	In	
10	$\overline{\text{ACKNLG}}$	28	Out	This pulse indicates data has been received and the printer is ready to accept more data. Pulse width is approximately 11μs.
11	BUSY	29	Out	HIGH indicates printer cannot accept more data.

Table 1-7. Connector Pin Assignments and Signal Functions (Cont.)

Pin No.	Signal Name	Return Pin No.	Dir.	Functional Description
12	PE	30	Out	HIGH indicates paper-out. This signal is effective only when $\overline{\text{ERROR}}$ signal is LOW.
13	SLCT	—	Out	Always HIGH output. (Pulled up to +5 V through 3.3 kΩ register.)
14	$\overline{\text{AUTOFEED-XT}}$	—	In	If the signal is LOW when the printer is initialized, a line feed is automatically performed upon receipt of CR code (Auto LF).
15	—	—	—	Not used.
16	GND	—	—	Ground for twisted-pair grounding.
17	Chassis GND	—	—	Chassis ground level of printer.
18	—	—	—	Not used.
19 to 30	GND	—	—	Ground for twisted-pair grounding.
31	$\overline{\text{INIT}}$	16	In	Pulse (Width: 50 μs min., active LOW) input for printer initialization.
32	$\overline{\text{ERROR}}$		Out	LOW indicates that some error has occurred in the printer.
33	GND	—	—	Ground for twisted-pair grounding.
34	—	—	—	Not used.
35	—	—	Out	Always HIGH. (Pulled up to +5 V through a 3.3 kΩ register.)
36	$\overline{\text{SLCT-IN}}$	—	In	If the signal is LOW when printer is initialized, the DC1/DC3 control is disabled.

NOTES:

1. "Dir." refers to the direction of the signal flow as viewed from the printer.
2. "Return" denotes a twisted-pair return line.
3. The cable used must be shielded to prevent noise.
4. All interface conditions are based on TTL levels. Both the rise and fall times of all signals must be less than 0.2 μs.
5. The $\overline{\text{AUTO FEED-XT}}$ signal can be set at LOW by DIP switch 2-4.
6. The $\overline{\text{SELECT-IN}}$ signal can be set at LOW by jumper 6.
7. Printing tests, including those of the interface circuits, can be performed without using external equipment by setting DATA 1-8 of the interface connector to certain codes and connecting the $\overline{\text{ACKNLG}}$ signal to the $\overline{\text{STROBE}}$ signal.

Table 1-8 shows the printer select/deselect (DC1 /DC3) control, including relations among ON-LINE, SELECT-IN input, DC1 /DC3, and interface signals.

Table 1-8. Printer Select/Deselect Control

ON-LINE SW	$\overline{\text{SLCT-IN}}$	DC1/DC3	$\overline{\text{ERROR}}$	BUSY	$\overline{\text{ACKNLG}}$	DATA ENTRY
OFF-LINE	HIGH/LOW	DC1/DC3	LOW	HIGH	No pulse	Disable
ON-LINE	HIGH	DC1	HIGH	LOW/HIGH (During data entry)	Pulse output after entry	Enable (Normal Process)
		DC3	HIGH	LOW/HIGH (During data entry)	Pulse output after entry	Enable (Waits DC1. See Note 2)
	LOW	DC1	HIGH	LOW/HIGH (During data entry)	Pulse output after entry	Enable (Normal Process)
		DC3	HIGH	LOW/HIGH (During data entry)	Pulse output after entry	

NOTES:

1. In Table 1-8, it is assumed that no $\overline{\text{ERROR}}$ status exists other than that attributable to OFF-LINE mode.
2. Once the printer is deselected by the DC3 code, the printer will not revert to the selected state unless the DC1 code is input again. (In the deselected state, the printer ignores input data until the DC1 code is received.)
3. The DC1 and DC3 codes are enabled only when the $\overline{\text{SLCT-IN}}$ signal (Input Connector 36 for the parallel interface unit) is HIGH and printer power is initialized.
4. If the SLCT-IN signal is LOW when the printer is initialized, $\overline{\text{DC1}}$ /DC3 printer select/deselect control is invalidated, and these control codes are ignored.
5. If the $\overline{\text{SLCT-IN}}$ signal is HIGH and is not set to LOW by jumper 6 when printer initialized, the printer starts from the selected (DCl) state.

1.4 DIP SWITCHES AND JUMPER SETTING

This section describes the DIP switch selections and the jumper setting for the LQ-500/L-1000 printer.

1.4.1 DIP Switch Settings

The two **DIP** switches for the printer are located inside the ROM cartridge slot cover and function **as** shown in Tables 1-9 through 1-13. (Note that the status of the DIP switches is read only at power on or upon receipt of the INIT signal.)

Table 1-9. Settings for DIP Switch 1 (SW1)

No.	Description	ON	OFF
1 2 3	International character set selection	See Table 1-11 below.	
4 5	Font selection	See Table 1-12 below.	
6	Condensed printing	On	Off
7	Code table selection	Graphic	Italic
8	Cut-sheet feeder (CSF) mode	On	Off

Table 1-10. Settings for DIP Switch 2 (SW2)

No.	Description	ON	OFF
1	Page length	12 in.	11 in.
2	CSF page length	65 lines (A4)	61 lines (letter)
3	1-inch skip	On	Off
4	Auto LF	On	Off
5	Input data buffer	8 KB	1 KB
6	Print direction of graphics	Bidirect.*	Unidirect.
7 8	Character pitch selection	See Table 1-13 below.	

* Unidirectional printing is selected by default, however input of ESC U O can be used to set the print direction to Bidirectional.

Table 1-11. International Character Set Selection

1-1	1-2	1-3	Country	1-1	1-2	1-3	Country
On	On	On	U.S.	Off	On	On	Denmark 1
On	On	Off	France	Off	On	Off	Sweden
On	Off	On	Germany	Off	Off	On	Italy
On	Off	Off	U.K.	Off	Off	Off	Spain 1

Table 1-12. Font Selection

1-4	1-5	Font
Off	Off	Roman
On	Off	Sans Serif
Off	On	Slot
On	On	Draft

Table 1-13. Character Pitch Selection

2-7	2-8	Character Pitch
Off	Off	10 CPI
On	Off	12 CPI
Off	On	15 CPI
On	On	Proportional

1.4.2 Jumper Setting

Jumper 6, which is user-selectable, is located inside the ROM cartridge slot cover. If the jumper is connected, the SLCT-IN signal is fixed to LOW, and DC1 /DC3 printer select control is ignored.

1.5 SELECTYPE FUNCTION

Selectype allows the user to choose fonts easily while the printer is ON-LINE. This function provides for selection of Draft, Roman, Sans Serif, or the slot (ROM cartridge) font. SelecType is effective only when the printer is ON-LINE and is not printing. Font selection is performed by pressing the FORM-FEED switch with the printer ON-LINE and not printing. The printer's control panel indicates which font has been specified.

1.6 OPERATING INSTRUCTIONS

This section describes the self-test and hexadecimal dump functions and also includes the error states, printer initialization, and the buzzer operation.

1.6.1 Self-Test

To begin printing the self-test using Draft mode, turn the printer ON while pressing the LINE-FEED button. To begin printing the self-test using the Letter Quality (LQ) mode, turn the printer power ON while pressing FORM-FEED.

Self-test printing can be stopped or started by pressing ON-LINE (ON-LINE indicator is not lit). To finish the self-test, stop the printing by pressing the ON-LINE switch and turn OFF the printer power.

The firmware revision number is printed as the first line of the self-test, and subsequently, current DIP switch settings are printed.

```
xxxxxx

Country          SW1-1 1-2 1-3
  USA              on  on  on
  France           on  on  off
  Germany          on  off on
  U.K.             on  off off
  Denmark          off on  on
  Sweden           off on  off
  Italy            off off on
  Spain            off off off
Font             SW1-4 1-5
  Roman            off off
  Sans serif       on  off
  Slot             off on
  Draft            on  on
Condensed        SW1-6
  Invalid          off
  Valid            on
CG table         SW1-7
  Italic           off
  Graphic          on
CSF mode         SW1-8
  Invalid          off
  Valid            on

Page length      SW2-1
  11"              off
  12"              on
CSF page length  SW2-2
  61 Lines         off
  65 Lines         on
1"Skip           SW2-3
  Invalid          off
  Valid            on
Auto LF          SW2-4
  Invalid          off
  Valid            on
Receive buffer   SW2-5
  1kbytes          off
  8kbytes          on
Graphics print   SW2-6
  Uni-d            off
  Bi-d             on
Pitch            SW2-7 2-8
  10 pitch         off off
  12 pitch         on  off
  15 pitch         off on
  Proportional     on  on

Roman 10
 !"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'abc
!"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'abcd
"#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'abcde
#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'abcdef
$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'abcdefg
%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_'abcdefgh
```

Figure 1-7. Self-Test Printout

1.6.2 Hexadecimal Dump Function

The printer enters HEX-DUMP mode when it is powered on while the LINE-FEED and FORM-FEED buttons are pressed down. In HEX-DUMP mode, the hexadecimal representation of the input data is printed out, along with corresponding ASCII characters. This function is valuable for checking the data the printer has received from the host. If input data is a control code rather than a character code, a period (.) is printed in the ASCII column.

Data Dump Mode

```
0D 43 41 50 54 45 52 20 31 0D 0A 47 45 4E 45 52   .CAPTER 1..GENER
41 4C 20 44 45 53 43 52 49 50 54 49 4F 4E 0D 0A   AL DESCRIPTION..
0D 0A 31 2E 31 20 46 45 41 54 55 52 45 0D 0A 31   ..1.1 FEATURE..1
2E 32 20 53 50 45 43 49 46 49 43 41 54 49 4F 4E   .2 SPECIFICATION
53 0D 0A 20 20 20 20 31 2E 32 2E 31 20 48 61 72   S..    1.2.1 Har
64 77 61 72 65 20 53 70 65 63 69 66 69 63 61 74   dware Specificat
69 6F 6E 73 0D 0A 20 20 20 20 31 2E 32 2E 32 20   ions..    1.2.2
46 69 72 6D 77 61 72 65 20 53 70 65 63 69 66 69   Firmware Specifi
63 61 74 69 6F 6E 73 20 28 45 53 43 2F 50 29 0D   cations (ESC/P).
0A 31 2E 33 20 49 4E 54 45 52 46 41 43 45 20 4F   .1.3 INTERFACE O
56 45 52 56 49 45 57 0D 0A 31 2E 34 20 44 49 50   VERVIEW..1.4 DIP
20 53 57 49 54 43 48 45 53 20 41 4E 44 20 4A 55    SWITCHES AND JU
4D 50 45 52 20 53 45 54 54 49 4E 47 0D 0A 20 20   MPER SETTING..
20 20 31 2E 34 2E 31 20 44 49 50 20 53 77 69 74     1.4.1 DIP Swit
63 68 20 53 65 74 74 69 6E 67 73 0D 0A 20 20 20   ch Settings
20 31 2E 34 2E 32 20 4A 75 6D 70 65 72 20 53 65    1.4.2 Jumper Se
74 74 69 6E 67 0D 0A 31 2E 35 20 53 45 4C 45 43   tting..1.5 SELEC
54 59 50 45 20 46 55 4E 43 54 49 4F 4E 0D 0A 31   TYPE FUNCTION..1
2E 36 20 4F 50 45 52 41 54 49 4E 47 20 49 4E 53   .6 OPERATING INS
54 52 55 43 54 49 4F 4E 53 0D 0A 20 20 20 20 31   TRUCTIONS..    1
2E 36 2E 31 20 53 65 6C 66 2D 54 65 73 74 20 0D   .6.1 Self-Test .
0A 20 20 20 20 31 2E 36 2E 32 20 48 65 78 61 64   .    1.6.2 Hexad
65 63 69 6D 61 6C 20 44 75 6D 70 20 46 75 6E 63   ecimal Dump Func
74 69 6F 6E 0D 0A 20 20 20 20 31 2E 36 2E 33 20   tion..    1.6.3
42 69 74 2D 49 6D 61 67 65 20 50 72 69 6E 74 69   Bit-Image Printi
6E 67 0D 0A 20 20 20 20 31 2E 36 2E 34 20 45 72   ng..    1.6.4 Er
72 6F 72 20 43 6F 6E 64 69 74 69 6F 6E 73 0D 0A   ror Conditions..
20 20 20 20 31 2E 36 2E 35 20 42 75 7A 7A 65 72       1.6.5 Buzzer
20 4F 70 65 72 61 74 69 6F 6E 0D 0A 20 20 20 20    Operation..
31 2E 36 2E 36 20 50 72 69 6E 74 65 72 20 49 6E   1.6.6 Printer In
69 74 69 61 6C 69 7A 61 74 69 6F 6E 0D 0A 20 20   itialization..
20 20 31 2E 36 2E 37 20 44 65 66 61 75 6C 74 20     1.6.7 Default
56 61 6C 75 65 73 0D 0A 20 20 20 20 31 2E 36 2E   Values..    1.6.
38 20 41 64 6A 75 73 74 20 4C 65 76 65 72 20 4F   8 Adjust Lever O
70 65 72 61 74 69 6F 6E 0D 0A 20 20 20 20 31 2E   peration..    1.
36 2E 39 20 50 72 69 6E 74 65 72 20 50 72 6F 74   6.9 Printer Prot
65 63 74 69 6F 6E 20 66 6F 72 20 48 65 61 76 79   ection for Heavy
2D 44 75 74 79 20 50 72 69 6E 74 69 6E 67 0D 0A   -Duty Printing..
31 2E 37 20 4D 41 49 4E 20 43 4F 4D 50 4F 4E 45   1.7 MAIN COMPONE
4E 54 53 0D 0A 20 20 20 20 31 2E 37 2E 31 20 50   NTS..    1.7.1 P
42 4D 41 20 42 6F 61 72 64 0D 0A 20 20 20 20 31   BMA Board..    1
2E 37 2E 32 20 50 45 42 50 4E 4C 20 42 6F 61 72   .7.2 PEBPNL Boar
64 0D 0A 20 20 20 20 31 2E 37 2E 33 20 50 45 42   d..    1.7.3 PEB
46 49 4C 20 42 6F 61 72 64 0D 0A 20 20 20 20 31   FIL Board..    1
2E 37 2E 34 20 54 72 61 6E 73 66 6F 72 6D 65 72   .7.4 Transformer
0D 0A 20 20 20 20 31 2E 37 2E 35 20 50 72 69 6E   ..    1.7.5 Prin
74 65 72 20 4D 65 63 68 61 6E 69 73 6D 20 28 4D   ter Mechanism (M
2D 35 34 31 30 29 0D 0A 20 20 20 20 31 2E 37 2E   -5410)..    1.7.
36 20 48 6F 75 73 69 6E 67 0D 0A 0D 0A 0D 0A 31   6 Housing......1
2E 31 20 46 45 41 54 55 52 45 53 0D 0A 0D 0A 54   .1 FEATURES....T
68 65 20 50 65 62 62 6C 65 73 20 20 69 73 20 61   he Pebbles  is a
20 73 6D 61 6C 6C 2C 20 6C 69 67 68 74 2D 77 65    small, light-we
```

Figure 1-8. Hexadecimal Dump Function

1.6.3 Bit-Image Printing

This printer has four standard print densities, listed below in dots per inch (dpi):

120 dpi (including half dots): Triple speed
180 dpi (including half dots): Double speed
240 dpi (including half dots): 1.5 speed
360 dpi (including half dots): Normal speed

The firmware, however, implements the print densities as shown in Table 1-14

Table 1-14. Print Density

Pins	m	Bit-image printing mode	Dot density (dpi)	Adjacent dot printing	256 × n2 + n1	Print speed (ips)
8	0	Single-density	60	yes	480	15
8	1	Dual-density	120	yes	960	7.5
8	2	Double-speed, dual-density	120	no	960	15
8	3	Quadruple-density	240	no	1920	7.5
8	4	CRT graphics	80	yes	640	7.5
8	6	CRT graphics II	90	yes	720	10
24	32	Single-density	60	yes	480	15
24	33	Dual-density	120	yes	960	7.5
24	38	CRT graphics II	90	yes	720	10
24	39	Triple-density	180	yes	1440	5
24	40	Hex-density	360	no	2880	5

NOTES: ESC* m n1 n2 [DATA] n2 x 256 + n1
dpi = dots per inch
ips = inches per second

The firmware handles the print densities as shown in Table 1-15.

Table 1-15. Bit-Image Printing

Dot Density	Printing Method
80 dpi	Prints at 240 dpi by expanding bit image by nine: 80 × 3 = 240

1.6.4 Error Conditions

If any of the following error conditions is detected, the printer automatically enters OFF-LINE mode.

- Home position is not detected at printer mechanism initialization.
- Home position is detected during printing.
- ON-LINE is pressed, and the printer enters OFF-LINE.
- A paper-out signal is detected and forms-override is finished.
- Paper out is detected after the printer performs a paper-loading operation with the cut-sheet feeder enabled.

The following interface signals are output to indicate the error and to halt data transmission:

BUSY signal becomes HIGH.
ERROR becomes LOW.
No ACKNLG pulse is sent.

1.6.5 Buzzer Operation

The buzzer sounds under the following circumstances:

- When the BEL code is sent to the printer (0.5-second ring).
- When a paper-out error is detected, the buzzer sounds 3 times (rings for 0.1 second with a 0.1-second interval).
- When abnormal carriage movement is detected, the buzzer sounds 5 times (rings for 0.5 second, with a 0.5-second interval).
- When a panel setting is accepted (0.1-second ring).

1.6.6 Printer Initialization

There are two initialization methods: hardware initialization and software initialization.

Hardware Initialization

This type of initialization takes place when the printer power switch is turned ON (and the AC power cord is plugged in) or when the INIT signal is received over the parallel interface line.

When the printer is initialized, it performs the following actions:

(a) Initializes printer mechanism.
(b) Clears input data buffer.
(c) Clears downloaded character set.
(d) Clears the print buffer.
(e) Returns printer settings to their default values.

Software Initialization

This type of initialization takes place when the printer receives the software initialize code. Upon receipt of this code, the printer does not perform the functions listed above under (a), (b), and (c). The settings changed by the last SelecType operation are reset.

1.6.7 Default Values

When the printer is initialized, the following default values or functions are set:

Page Position	Current paper position becomes top-of-form position
Left and Right Margins	Released
Line Spacing	116 inch
Vertical Tabs	Cleared
Horizontal Tabs	Every 8 characters (relative)
VFH Channel	Channel 0
Category of Type Style	SelecType - Software initialization DIP switch - Hardware initialization
Downloaded Characters	Deselected - Software initialization Cleared - Hardware initialization
Justification	Left justification
Character Spacing	10 CPI
Bit-Image Mode Assignment	ESC K = ESC + 0, ESC L = ESC * 1 ESC Y = ESC * 2, ESC Z = ESC * 3
Printing Effects	Cleared

1.6.8 Adjust Lever Operation

The head adjust lever must be set to the proper position according to the paper thickness. See Table 1-16 and Figure 1-9.

Table 1-16. Lever Position Operation

Paper Type	Lever Position
Ordinary (single sheets or continuous)	2
Thin paper	2 or 1
Multi-part paper 2 sheets 3 sheets	 3 4

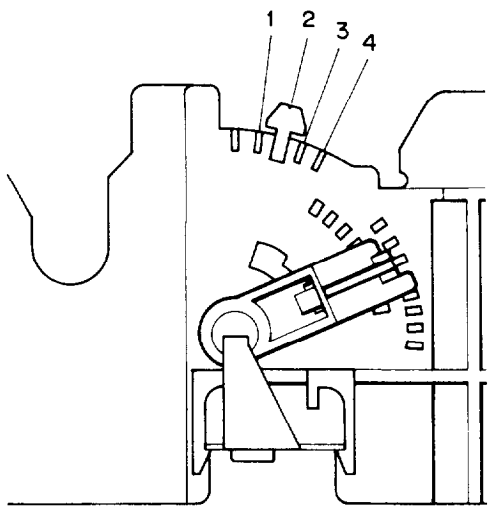


Figure 1-9. Lever Position

1.6.9 Printer Protection for Heavy-Duty Printing

This printer has “printhead protection” to safeguard the printhead from overheating or from voltage dropping to the head driver.

If head temperature exceeds upper limit value, then printing is automatically stopped until head temperature has dropped to a certain value to resume printing.

If heavy-duty printing causes the voltage supplied to the head drive circuit to drop to the lower limit, then printing is interrupted immediately, and thereafter, if power supply voltage is recovered to a certain value, then the remaining print line will be printed. This protection will occur when half or more of the wires are activated simultaneously and continuously.

1.7 MAIN COMPONENTS

The main components of the LQ-500/L-1000 printer are designed for easy removal and replacement to maintain/repair the printer. The main components are:

1) **PBMA** board: The main control board; the CPU on this board controls all main functions
2) PEBPNL board: The control panel board.
3) PEBFIL board: The filter circuit board.
4) Transformer
5) **M-5410:** The printer mechanism.

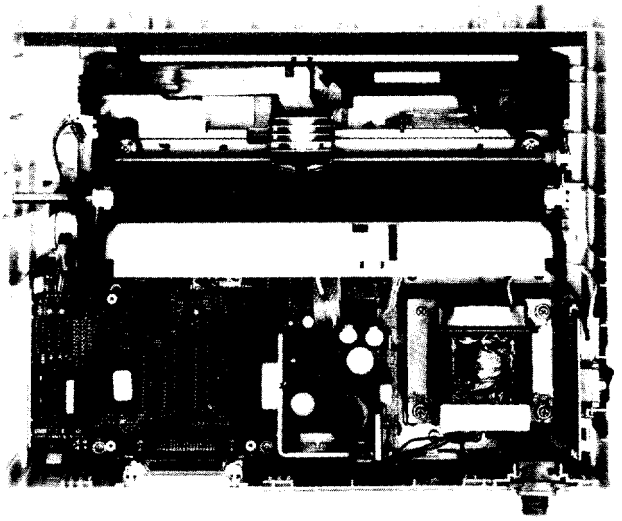


Figure 1-10. LQ-500/L-1000 Component Layout

1.7.1 PBMA Board

The use of the µPD7810HG CPU makes the main control board simple in its circuit design.

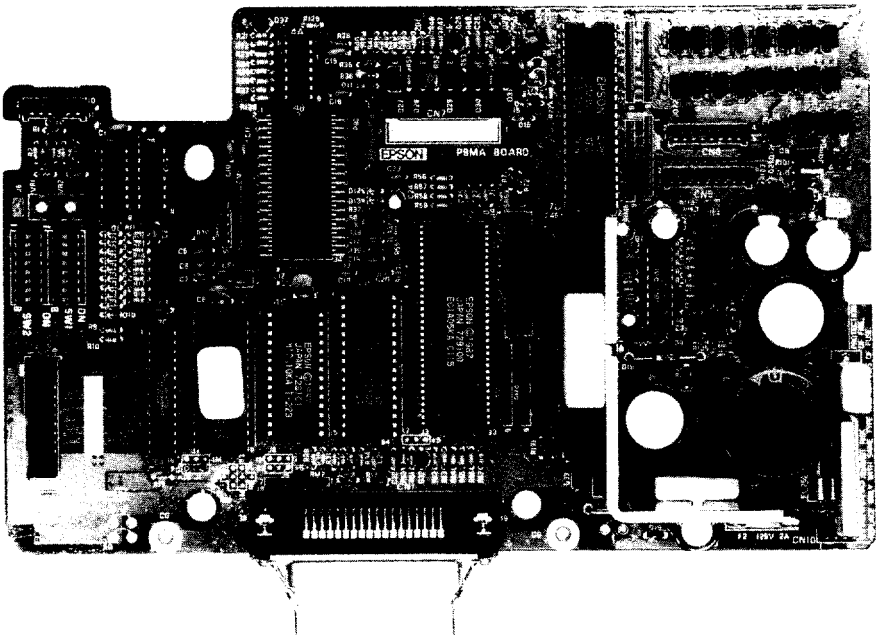


Figure 1-11. PBMA Main Control Board