EPSON

EPSON TERMINAL PRINTER

LQ-870/1170

SERVICE MANUAL

4000694
REV.-A

NOTICE

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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 headings.

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

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

DANGER

1. ALWAYS DISCONNECT THE PRODUCT FROM BOTH THE POWER SOURCE AND THE HOST COMPUTER BEFORE PERFORMING ANY MAINTENANCE OR REPAIR PROCEDURE.
2. NO WORK SHOULD 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 PRODUCT 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 μP CHIPS 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-870/1170.
The instructions and procedures included herein are intended for the experienced repair technician, and attention should be given 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 - Includes a step-by-step guide for product disassembly and assembly.

Chapter 4 - Includes a step-by-step guide for 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.

REVISION SHEET

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A	July 23, 1991	1st issue

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CHAPTER 1
GENERAL DESCRIPTION

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1.1 FEATURES

The LQ-870/1 170 is a small, light-weight, low-cost printer that provides advanced paper handling and is compatible with The LQ-5 10/550. The printer's main features are:

- Use of ESC/P 2 control codes
  The printer can print fonts in various point sizes and receive and print raster graphic images.
- Compatibility with LQ and SQ series printers
- Printing speeds:
  300 characters per second (cps) in high-speed draft mode at 10 characters per inch (cpi)
  330 cps (draft, 12 cpi)
  275 cps (draft, 10 cpi)
  110 cps (LQ, 12 cpi)
  92 cps (LQ, 10 cpi)
- Multiple fonts resident in the printer: nine letter quality (LQ) fonts (Roman, Saris Serif, Courier, Prestige, Script, OCR-B, Script-C, Orator, and Orator-S) and one draft font
- Clear, easy-to-read printing using standard EPSON fonts
- Selection of fonts, condensed printing, and the cut-sheet feeder (C SF) bin using control panel buttons
- Advanced paper handling
  Continuous paper:
  Three ways to insert continuous paper, using the front, bottom, or rear paper entrance
  Auto backout and auto loading when using the front or rear paper entrance
  Ability to use continuous paper without removing the cut-sheet feeder
  Ability to use the standard tractor in three positions (two push tractor positions and one pull tractor position)
  Single-sheet paper:
  Two ways to insert single-sheet paper, using the front or top paper entrance
  Auto loading
- Easy handling of single-sheet paper with the optional cut-sheet feeder
- Optional tractor that can be used to create a push-pull tractor feeding
- Optional interface cards

The LQ-870/1 170 is equipped with the standard EPSON 8-bit parallel interface. The optional interface cards ensure compatibility with a wide variety of computers. Table 1-1 Lists the optional interface cards, Table 1-2 lists the optional units available for the LQ-8 70/1 170, and Figure 1-1 shows an exterior view of the LQ-870/ 1170.

Table 1-1 Optional Interface Cards

Model No.	Description
C82305*	Serial interface card (inch screw) *1
C82306"	Serial interface card (mini screw) *1
C82307*	32KB serial interface card (inch screw)
C82308*	32KB serial interface card (mini screw)

● The last digit in each part numbers above, represented by an asterisk (*), varies depending on the country.

* I. You cannot use the printer with the following baud rates: 1800, 200, 134.5, 110, or 75 bps.

NOTE: Refer to the "Optional Interface Technical Manual" for more information on the optional interface cards.

Table 1-2. Optional Units for LQ-870

Model No.	Description
C80637*	Single-bin cut-sheet feeder
C80638*	High-capacity cut-sheet feeder
C80020	Tractor
7753	Fabric ribbon cartridge
7768	Film ribbon cartridge

Table 1-2-1. Optional Units for LQ-1 170

Model No.	Description
C80639*	Single-bin cut-sheet feeder
C80640*	High-capacity cut-sheet feeder
C80021*	Tractor
7754	Fabric ribbon cartridge
7770	Film ribbon cartridge

● When the last digit in the part number above is represented by an asterisk (“), the number varies depending on the country.

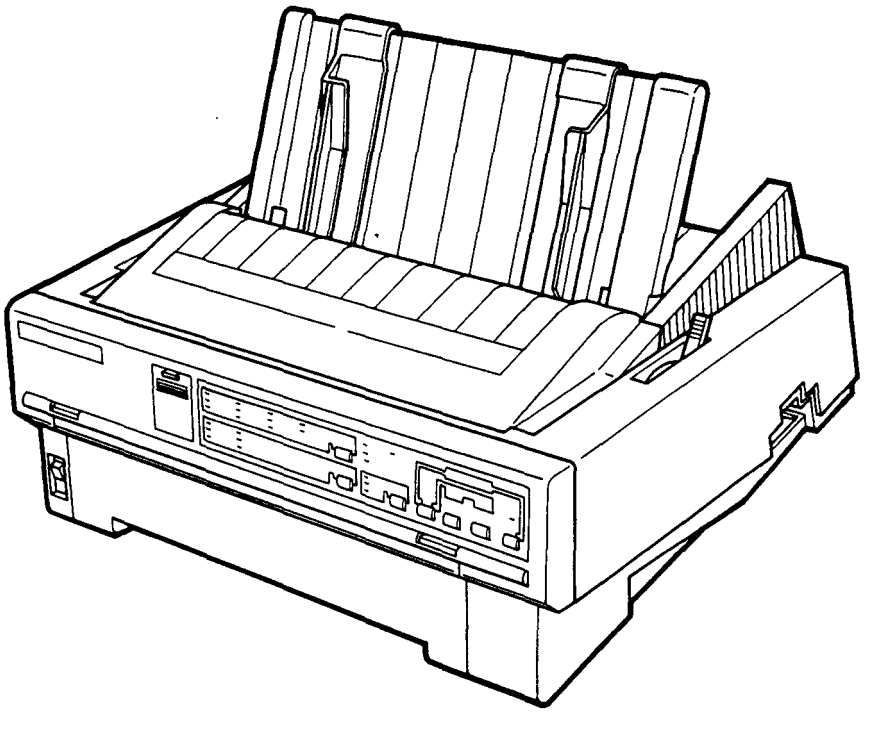


Figure 1-1. Exterior View of the LQ-870

1.2 SPECIFICATIONS

This section provides the specifications for the LQ-870/1 170.

1.2.1 *Hardware Specifications*

Printing method	Serial, impact, dot matrix
Pin configuration	24 wires; 12 x 2 staggered, diameter 0.2 mm (.008 in.)

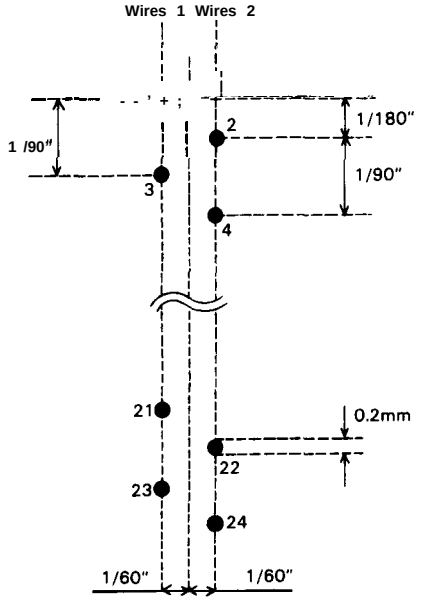


Figure 1-2. Pin Configuration

Feeding methods	Friction feeding (front and top paper entrances)
	Push tractor feeding (front and rear paper entrances)
	Pull tractor feeding (front and bottom paper entrances)
	Push-pull tractor feeding (front and rear paper entrances)
Line spacing	1/6 inch, 1/8 inch, or programmable in units of 1/360 inch
Paper insertion	Friction feeding: front or top paper entrance
	Tractor feeding: front, bottom, or rear paper entrance
Paper feed speed	Friction feeding without cut-sheet feeder:
	59.0 msec for a l/6-inch line feed
	3.6 inches per second (ips) during continuous feeding
	Friction feeding with cut-sheet feeder:
	62.7 msec for a l/6-inch line feed
	3.3 ips during continuous feeding
	Tractor feeding:
	64.1 msec for a l/6-inch line feed
	3.0 ips during continuous feeding

NOTE: Paper handling precautions are listed below.

Friction feeding precautions

- Move the release lever to the FRICTION position.
- Load paper into the front or top paper entrance.
- Do not use continuous paper.
- Do not perform any reverse feeds within the top 8.5 mm (.34 in.) or bottom 22 mm (.87 in.) of the paper.

. Do not perform reverse feeds greater than 1/6 inch after a paper end is detected.

- Use the paper tension unit.

. Load single-sheet multi-part forms only into the front paper entrance.

. Use only carbonless multi-part forms.

Push tractor feeding precautions

- Move the release lever to the REAR PUSH/FRONT PUSH position.
- Load paper into the rear paper entrance.

. Release the friction-feed mechanism.

- Multi-part forms must be spot pasted beyond the perforation between the sprocket holes.
- Use only carbonless multi-part forms.
- Use the paper tension unit.
- Do not perform reverse feeds greater than 1/6 inch.

. Because paper feeding accuracy cannot be assured after a paper end is detected, do not perform reverse feeds after a paper, end is detected.

Push-pull tractor feeding precautions

- Move the release lever to the REAR PUSH/FRONT PUSH position.
- Load paper into the front, rear, or bottom paper entrance.
- Release the friction-feed mechanism.
- Remove the paper tension unit and attach the pull tractor.
- Make sure there is no slack in the paper between the platen and the pull tractor.
- Carefully align the pull tractor and push tractor sprockets.

. Paper for multiple copies must be spot pasted beyond the perforation between the sprocket holes.

- Use only carbonless multi-part forms.
- Do not perform reverse feeds greater than 1/6 inch.
- Do not perform reverse feeds after a paper end is detected.

Pull tractor feeding precautions

- Move the release lever to the PULL position.
- Load paper into the front or bottom paper entrance.

. Release the friction feed mechanism.

. Remove the paper tension unit and attach the pull tractor.

- Paper for multiple copies must be spot pasted beyond the perforation between the sprocket holes.
- Use only carbonless multi-part forms. ‘

. Do not perform reverse feeds.

Paper specifications See Tables 1-3, 1-4, 1-5, 1-6, and 1-7.

Table 1-3. Specifications for Single-Sheet Paper (80/1 36 column)

Width	148 to 257/420 mm (5.8 to 10. 1/1 6.5 in.) (top insertion) 182 to 257/364 mm (7.2 to 10. 1/1 4.3 in.) (front insertion)
Length	364 mm (1 4.3 in.), maximum
Thickness	0.065 to 0.14 mm (0.0025 to 0.0055 in.)
Weight	14 to 24 lb (52.3 to 90 g/m²)
Quality	Standard paper (such as photocopier paper)

Table 1-4. Specifications for Single-Sheet Multi-Part Forms (Carbonless) (80/1 36 column)

Width	182 to 2 16/364 mm (7.2 to 8.5/1 4.3 in.)
Length	257 to 297 mm (10.7 to 11.7 in.)
Thickness	0.065 to 0.14 mm (0.0025 to 0.0055 in.) — per sheet
	0.12 to 0.64 mm (0.0047 to 0.0256 in.) total
Weight	17 to 24 lb (52.3 to 90 g/m²) single sheets
	12 to 15 lb (40 to 58 g/m²) each
Quality	Carbonless duplicating paper
Copies	Four sheets (one original and three copies)

Table 1-5. Specifications for Continuous Paper (80/1 36 column)

Width	101 to 254/406 mm (4.0 to 10.0/16 in.)
Thickness	0.065 to 0.10 mm (0.0025 to 0.0039 in.) single sheet
	0.065 to 0.32 mm (0.0025 to 0.012 in.) total
Weight	14 to 22 lb (52.3 to 82 g/m2) single sheet
	12 to 15 lb (40 to 58 g/m2) each
Quality	Standard paper or carbonless duplicating paper
Copies	4 sheets (1 original and 3 copies)

Table 1-6. Specifications for Envelopes

Size	No. 6 = 166 mm x 92 mm (6.53 in. x 3.62 in.)
	No. 10 = 240 mm x 104 mm (9.45 in. x 4.09 in.)
Thickness	0.16 to 0.52 mm (0.0063 to 0.0197 in.)
	Differences in thickness within the printing area must be less than 0.25 mm (0.0098 in.).
Weight	12 to 24 lb (45 to 91 g/m²)
Quality	Bond paper, standard paper, air mail
Copies	Not available

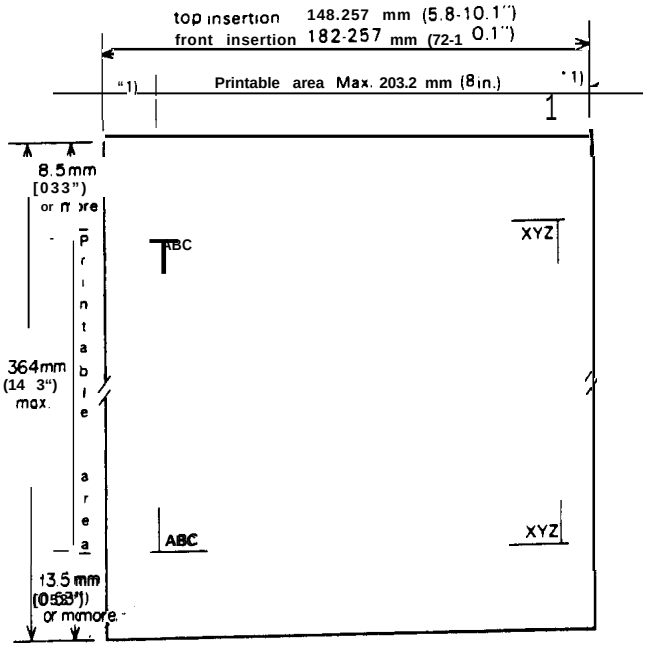
NOTES:
- Printing on envelopes is available only at normal temperatures.
- Load envelopes only into the top paper entrance.
- Keep the longer side of the envelope horizontal when you insert it.
- Place the left edge of a no. 6 envelope at the sheet guide mark.

Table 1-7. Specifications for Labels

Label size	2 1/2 in x 15/16 in.
	4 in. x 15/16 in.
	4 in. x 7/16 in.
Thickness	0.07 to 0.09 mm (0.0028 to 0.0031 in.) —for the backing paper
	0.16 to 0.19 mm (0.0063 to 0.0075 in.) — total
Copies	Not available

NOTES:
- Printing on labels is available only at normal temperatures.
- Only use labels on continuous backing paper with sprocket holes for tractor feeding.
- Labels with pressure-sensitive paper must be spot pasted beyond the perforation between the sprocketholes and the total thickness must be less than or equal to 0.3 mm (0.01 18 in.). You can print labels only when the temperature is between 5 and 35 degrees C (4 1 and 95 degrees F) and humidity is between 10% and 80% RH.
- Examples of labels: Avery continuous form labels and Avery mini-line labels

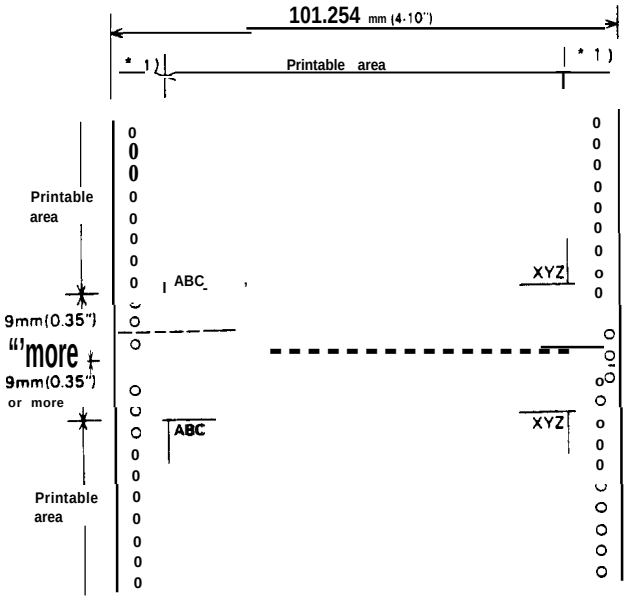
Printable area **See Figures 1-3, 1-4, and 1-5.**



'1) 3.0 mm (O. 12 in.) or more when paper width is less than 229 mm (9 in.).
25 mm (0.9 in.) or more for top insertion or 26 mm (1.0 in.) or more for front insertion when paper width is 257 mm (1 0.1 in.).

- **For top insertion, paper feeding accuracy cannot be assured within 26 mm (1 .02 in.) from the bottom edge of the paper.**
  For front insertion, paper feeding accuracy cannot be assured within 47.0 mm (1 .85 in.) from the bottom edge of the paper.

Figure 1-3 Printable Area for Single-Sheet Paper



- **1) 13 mm (0.51 in.) or more with paper 101 to 241 mm (4 to 9.5 in.) wide. 25 mm (0.9 in.) or more for rear insertion or 26 mm (1,0 in.) or more for front insertion with paper 254 mm (1 O in.) wide.**

Figure 1-4 Printable Area for Continuous Paper

Ink ribbon	**80-column:**	
	Black ribbon cartridge #7753	
	Film ribbon cartridge #7768	
	136-column:	
	Black ribbon cartridge #7754	
	Film ribbon cartridge #7770	
	Color Black	
	Life	**2 million characters at 48 dots/character (black ribbon)**
		0.2 million characters at 48 dots/character (film ribbon), 80-column
		0.3 million characters at 48 dots/character (film ribbon), 136-column
	Dimensions of ribbon cartridge:	
	80-column:	
	293 mm (width) x 34 mm (height) x 72 mm (depth)	
	11.7 in. (width) x 1.4 in. (height) x 2.9 in. (depth)	
	136-column:	
	468.5 mm (width) x 34 mm (height) x 72 mm (depth)	
	18.4 in. (width) x 1.4 in. (height) x 2.9 in. (depth)	
Reliability	**Mean cycles between failures (MCBF): 5 million lines (excluding printhead)**	
	Mean time between failures (MTBF): 4000 power-on hours (POH) at 25% duty, 80-column	
	Mean time between failures (M CBF): 6000 power-on hours (POH) at 25% duty, 136-column	
Printhead life	**200 million strokes (black ribbon)**	
	100 million strokes (film ribbon)	
Safety approvals	**Safety standards UL1 950 with D3 (U.S. version)**	
		CSA22.2#220
		EN 60950 (TUV) (European version)
	Radio frequency interference (RFI)	**FCC class B (U.S. version)**
		VDE0871 (self-certification) (European version)
Electrical specifications	**120 V version**	**Rated voltage** 120 VAC
		Input voltage range 103.5 to 132 VAC
		Rated frequency range 50 to 60 Hz
		Input frequency range 49.5 to 60.5 Hz
		Rated current 2.0 A
		Power consumption Approx.58 W (during self-test in draft)
		Insulation resistance 10 Megohms minimun (at 500 VDC between AC line and chassis)

		Dielectric strength	1000 VACrms for one minute or 1200 VACrms for one second (between AC line and chassis)
	220 to 240 V version	Rated voltage	220 to 240 VAC
		Input voltage range	198 to 264 VAC
		Rated frequency range	50 to 60 Hz
		Input frequency range	49.5 to 60.5 Hz
		Rated current	1.0 A
		Power consumption	Approx. 58 W (during self-test in draft mode at 10 cpi)
		Insulation resistance	10 Megohms minimum (at 500 VDC between AC line and chassis)
		Dielectric strength	1250 VACrms for one minute or 1500 VACrms for one second (between AC line and chassis)
Environmental conditions		Temperature	5 to 35 degrees C (41 to 95 degrees F), operating –30 to 65 degrees C (–22 to 149 degrees F), in shipping 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, maximum, operating 0.50 G, 55 Hz, maximum, storage
Physical specifications		Weight	80-column: Approx. 8.8 kg (4.0 lb) 136-column: Approx. 11.5 kg (5.2 lb)
		Dimensions	80-column: 449 mm (width) x 365 mm (depth) x 171 mm (height) 17.7 in. (width) x 14.7 in. (depth) x 6 in. (height) 136-column: 624 mm (width) x 365 mm (depth) x 171 mm (height) 24.6 in. (width) x 14.7 in. (depth) x 6 in. (height)

1.2.2 Firmware Specifications

Control codes	ESC/PTM level ESC/P 2 (EPSON standard code for printers)	
Printing direction	Bidirectional with logic seeking	
Input data buffer	8KB, 32KB, 64KB; to change RAM (4A 5A) This printer is able to input buffer capacity 8, 32, or 64KB	
Character code	8 bits	
Character tables	italic character table, PC 437, PC 850, PC 860, PC 863, PC 865 (PC indicates character tables for personal computers.)	
Fonts and pitches		
Bit map fonts	EPSON Roman	10, 12, 15, proportional
	EPSON Saris Serif	10, 12, 15, proportional
	EPSON Courier	10, 12, 15
	EPSON Prestige	10, 12
	EPSON Script	10, 12
	EPSON Script C	proportional
	OCR-B	10
	EPSON Orator	10
	EPSON Orator-S	10
	EPSON Draft	10, 12, 15
Scalable fonts	EPSON Roman	8 to 32 pt
	EPSON Saris Serif	8 to 32 pt

Printing modes

It is possible to select and mix the following printing modes, except 15 cpi condensed, which is not available.

. Print quality (draft or LQ)
● Character pitch (1 O, 12, 15, or proportional)
● Condensed
. Double-width
. Double-height
● Emphasized
. Double-strike
. Italic
. Underlined
● Double-underlined
● Overscore
● Strike-through
. Outline
● Shadow

NOTES: High-speed draft is valid when the printer's status is as follows:

- High-speed draft mode is selected by DIP switch(SW1-6).
- Emphasized mode is not selected.
- Condensed mode is not selected.
- Draft mode is selected.
- No D/L (download) characters are sent to the printer.
- The horizontal dot space of characters is not set.
- No bit image is sent to the printer.
- Super/subscriPt is not selected.

(The printer switches back to normal mode to print emphasized; condensed, or download characters and bit images.)

printing speed	See Tables 1-8 and 1-9.
printing columns	See Table 1-8.
Character matrix	See Table 1-10.
Character size	See Table 1-10.

Table 1-8. Printing (Text Mode) 80/1 36-Column

print Pitch	Peinting	Printable Columns	Character Pitch (cpi)	Printing Speed (cps)		
				Draft	LQ	HSD
10	0	80/1 36	10	275	92	300
	1	137/233	17.1	236	157	—
12	0	96/1 64	12	330	110	—
	1	160/274	20	275	183	—
15	0	120/204	15	413	138	—
	1	Invalid.				

cpi: characters per inch
Cps: characters per second
LQ: letter quality
HSD: high-speed draft

Table 1-9. Printing (Bit Image Mode) 80/1 36-Column

Pins	Bit Image Printing Mode	Density (dpi)	Printable Dots	Printing Speed (ips)
8	Single-density	60	480/8 16	27.5
8	Dual-density	120	960/1 632	13.8
8	Double-speed, dual-density	120	960/1 632	27.5
8	Quadruple-density	240	1920/3264	13.8
8	CRT graphics	80	640/1 088	13.8
8	CRT graphics II	90	720/1 224	18.3
24	Single-density	60	480/8 16	27.5
24	Dual-density	120	960/1 632	13.8
24	CRT graphics II	90	720/1 224	18.3
24	Triple-density	180	1440/2448	9.2
24	Hex-density	360	2880/4896	9.2

dpi: dots per inch
ips: inches per second

Table 1-10. Character Matrix and Character Size

printing Mode	Face Matrix	HDD	Character Size	Unit ESC SP
High-speed draft, 10 pitch	7 x 22	90	2.0 x 3.1	—
Draft, 10 pitch	9 x 22	120	1.9 x 3.1	120
Draft, 12 pitch	9 x 22	120	1.9 x 3.1	120
Draft, 15 pitch	7 X 16	120	1.0 X 2.3	120
Draft, 10 pitch, condensed	—	240	—	120
Draft, 12 pitch, condensed	—	240	—120	
LQ, 10 pitch	31 x 22	360	2.2 x 3.1	180
LQ, 12 pitch	27 X 22	360	1.9 x 3.1	180
LQ, 15 pitch	22 X 16	360	1.6 X 2.3	180
LQ, 10 pitch, condensed	—	360	—	180
LQ, 12 pitch, condensed	—	360	—	180
LQ, proportional	Max. 37 × 22 Min. 18 × 22	360 360	2.6 X 3.1 1.0 x 3.1	180
LQ, proportional, condensed	— —	360 360	— —	180
LQ, proportional, super/subscript	Max. 28 X 16 Min. 12 ×16	360 360	1.8 X 2.3 0.7 X 2.3	180
LQ, proportional, super/subscript, condensed	—	360 360	— —	180

NOTES:
- HDD is the horizontal dot density in dots per inch.
- Face matrix and character size indicate the size of the maximum character. This value depends on the paper, the ribbon, and other variables.
- Unit ESC sp (which also can be sent as unit followed by the character string CHR$(&h20)) indicates the minimum length to be added to the right of the character specified with the ESC SP control code.
- "—" indicates that printer firmware reshapes the character matrix. Character width becomes half of the noncondensed character width.

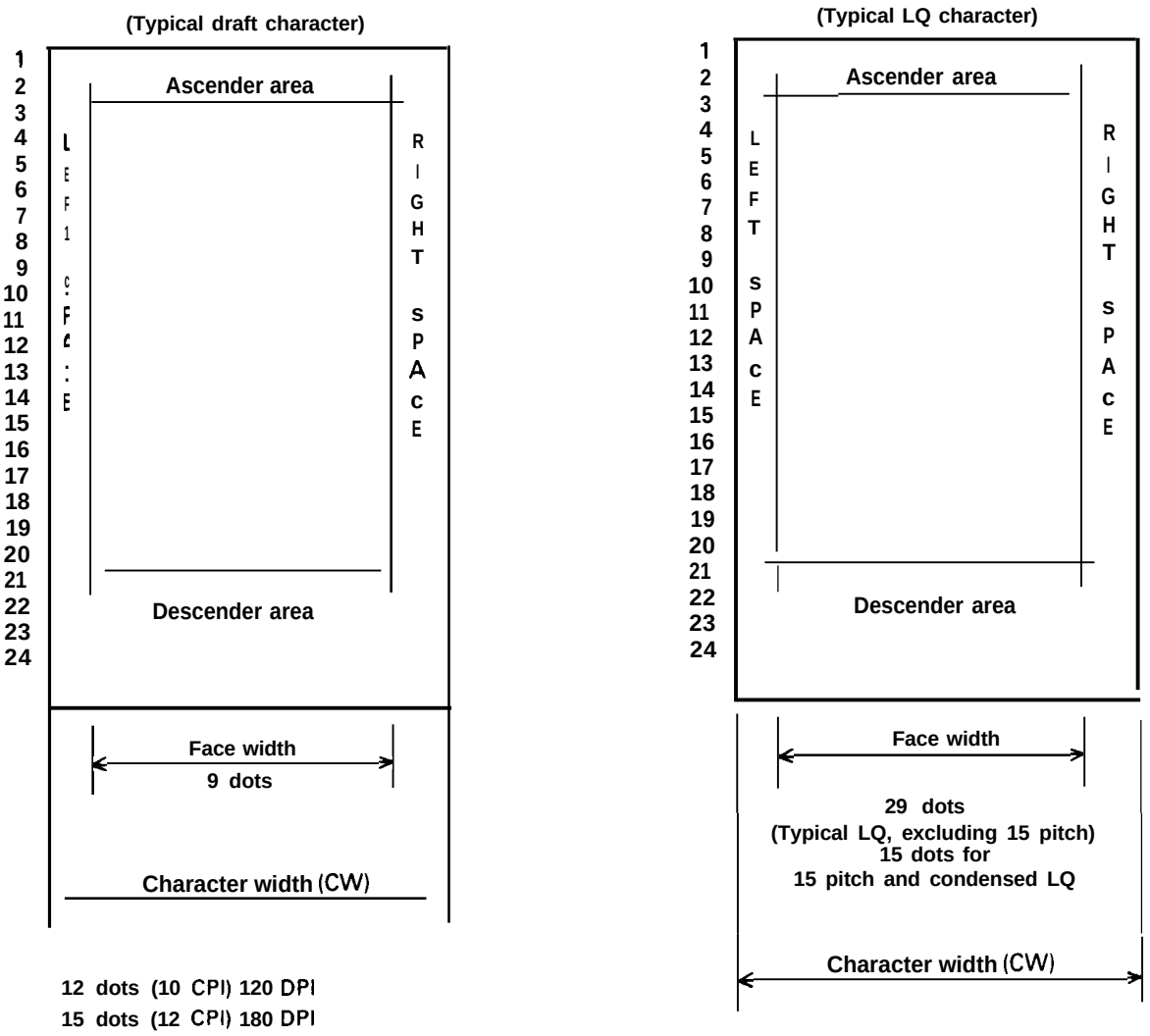


Figure 1-5. Character Matrix

1.3 PARALLEL INTERFACE

The specifications for the printer's 8-bit parallel interface are as follows:

Data format	8-bit parallel
Synchronization	/STROBE signal
Handshaking	BUSY and /ACKNLG signal
Signal level	TTL-compatible
Adaptable connector	57-30360 (Amphenol) or equivalent
Data transmission timing	See Figure 1-6.

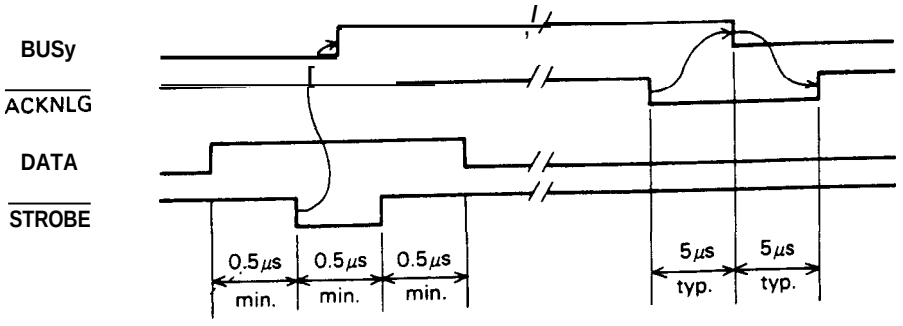


Figure 1-6. Data Transmission Timing

Table 1-11 provides the connector pin assignments and describes the signal functions of the 8-bit parallel interface.

Table 1-11. Connector Pin Assignments and Signal Functions

Pin No.	Signal Name	Return Pin No.	Dir.	Function
1	STROBE	19	IN	STROBE pulse to read the input data. Pulse width must be more than 0.5 μs. Input data is latched at the falling edge of this signal.
2	DATA 1	20	IN	Parallel input data to the printer. HIGH level means data 1. LOW level means data O.
3	DATA 2	21	IN	
4	DATA 3	22	IN	
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	ACKNLG	28	OUT	This pulse indicates data has been received and the printer is ready to accept more data. Pulse width is approximately 11 μs.
11	BUSY	29	OUT	HIGH indicates the printer cannot accept more data.
12	PE	30	OUT	HIGH indicates paper out. This signal is effective only when the ERROR signal is LOW.
13	SLCT	—	OUT	Always HIGH output. (Pulled up to +5V through a S. SK-ohm resistor.)

Table 1-11. Connector Pin Assignments and Signal Functions (Cont.)

Pin No.	Signal Name	Return Pin No.	Dir.	Functional Description
14	$\overline{\text{AUTO FEED-XT}}$	—	IN	If LOW when the printer is initialized, the printer automatically performs a line feed upon input of the 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	INIT	16	IN	Pulse input for printer initialization (width: 50 μs, minimum, active LOW).
32	$\overline{\text{ERROR}}$		OUT	LOW indicates an 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 3.3 K-ohm resistor.)
36	$\overline{\text{SLCT-IN}}$	—	IN	If LOW when the printer is initialized, DC 1/DC3 control is disabled.

NOTES: 1. "Dir." indicates the direction of the signal flow as viewed from the printer.

2. "Return Pin No." 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 /AUTOFEED-XT signal can be set to LOW using DIP switch 2-4.
6. The /SELECT-IN signal can be set to LOW using jumper 3.
7. You can perform printing tests, including interface circuit tests, without using external equipment by setting the DATA 1 through DATA 8 pins to the /STROBE signal.

1.4 CONTROL PANEL

There are seven non-lock buttons and 19 indicators on the control panel.

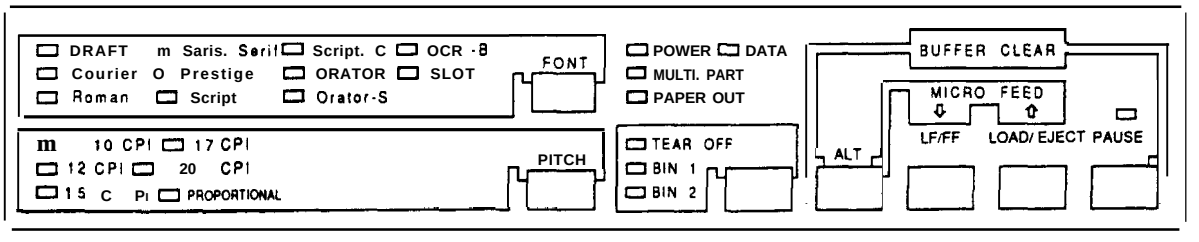


Figure 1-7. Control Panel

1.4.1 Buttons

(1) Operate switch
Use this switch to turn on the power supply to the printer.

(2) PAUSE button Press this button to toggle the printer between the PAUSE condition (in which there is no printing or paper feeding and the printer does not accept data) and the RUNNING condition. Press the PAUSE and ALT buttons at the same time to clear the input buffer and perform a software initialization. Pressing the PAUSE and ALT buttons has the same effect as the ESC @ command.

(3) **LINE FEED/FORM FEED button Press this button to perform a line feed. Hold it down to perform a form feed, whether the printer is in the PAUSE or the RUNNING condition. Press this button and the ALT button at the same time to use the micro reverse feed function.**

(4) LOAD/EJECT button Press this button to load or eject paper. See Section 1.6.8, Paper Loading and Ejection. Press this button and the ALT button at the same time to use the micro forward feed function.

(5) TEAR OFF/BIN l/BIN 2 button When the printer is in tractor feed mode, press this button to advance continuous paper to the tear-off position. The TEAR OFF indicator light comes on. When the printer is in friction feed mode, press this button to select bin 1 or bin 2 of the cut-sheet feeder. The indicator light of the selected bin comes on.

(6) ALT button Use this button with other buttons to perform a variety of functions.

(7) FONT button Press this button to select a font. Press it again to select the next font. The FONT indicator light shows the currently selected font.

(8) CONDENSED button Press this button to select normal or condensed printing.

NOTE: FONT and CONDENSED button selections are stored as defaults and take effect when the printer is initialized.

1.4.2 Indicator Lights

(1) OPERATING (green)
Lit when the printer's operate switch is on and AC power is supplied.

(2) **PAUSE (orange)**
Lit when the printer is in PAUSE mode. In PAUSE mode, there is no printing or paper feeding and the printer does not accept data.

(3) **TEAR OFF (orange)**
Lit when the page is advanced to the tear-off position.

(4) DATA (orange)
Lit when the printer has received data from the host machine.

(5) PAPER OUT (red)
Lit when the paper-out detector detects that there is no paper. See Section 1.6.3, Paper-out Detection and Form Override Function.

(6) MULTI-PART (green)
Lit when the paper-thickness lever is positioned at the fourth step or higher.

(7) BIN 1 (green)
Lit when bin 1 is selected.

(8) BIN 2 (green)
Lit when bin 2 is selected.

(9) FONT (green) -Draft, Courier, Roman, Saris Serif, Prestige, Script, Script C, Orator, Orator-S, OCR-B
These indicator lights show the currently selected font.

(10) CONDENSED (green)
Lit when condensed mode is selected.

1.5 DIP SWITCHES AND JUMPERS

This section describes the DIP switches and jumpers of the LQ-870/1 170.

1.5.1 *DIP Switches*

The printer has two banks of DIP switches located on the control panel. Tables 1-12 through 1-15 describe the functions of the DIP switches. The status of the DIP switches is read only at power-on or upon receipt of the /I NIT signal.

Table 1-12. DIP Switch Set 1 **(SW1)**

No.	Description	ON	OFF	Factory Setting
1 2 3	International and PC character set selection	See Table 1-14.		ON ON ON
4	Character table selection	Graphic	Italic	OFF
5	Graphics direction"	Unidir.	Bidir.	OFF
6	High-speed draft mode	Invalid	Valid	OFF
7	Input buffer	Invalid	Valid	OFF
8	One-inch skip continuous paper	ON	OFF	OFF

Table 1-13. DIP Switch Set 2 **(SW2)**

No.	Description	ON	OFF	Factory Setting
1 2	Page length of continuous paper	See Table 1-15.		OFF OFF
3	Auto tear-off	ON	OFF	OFF
4	Auto line feed	ON	OFF	OFF

Table 1-14. International and PC Character Set Selection

1-1	1-2	1-3	Country	Pc
ON	ON	ON	Us.	437
ON	ON	OFF	France	850
ON	OFF	ON	Germany	860
ON	OFF	OFF	U.K.	863
OFF	ON	ON	Denmark 1	865
OFF	ON	OFF	Sweden	(437)
OFF	OFF	ON	Italy	(437)
OFF	OFF	OFF	Spain 1	(437)

When you turn on DIP switch 1-4 and use ESC + O to select the italic character table, the country setting becomes U.S.

When you turn off DIP switch 1-4 and use ESC t 1 to select the graphics character table, the PC setting becomes 437.

Table 1-15. Page Length

2-1	2-2	Page Length
OFF	OFF	11 inches
ON	OFF	12 inches
OFF	ON	8.5 inches
ON	ON	70/6 inches

1.5.2 Jumpers

If jumper 3 is connected to GND, the /S LCT-IN signal is set to LOW and the printer ignores DC 1/DC3 control.

1.6 OPERATING INSTRUCTIONS

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

1.6.1 *Self-Test*

To run the self-test in draft mode, turn on the printer while pressing the LOAD/EJECT button. To run the self-test in LQ mode, turn on the printer while pressing the LINE FEED/FORM FEED **button. You can press the PAUSE button to stop or start the self test.**
When you are satisfied with the self test, press the PAUSE button to stop it and then turn off the printer.

The firmware revision number is printed on the first line of the self-test, followed by the current DIP switch settings.

```
Xxxxxx
Country/PC      SW1-1 1-2 1-3 1-4    High speed draft SW1-6
  U.S.o.         .'on on on  off       Valid             off
  France          on on off  off       Invalid           on
  Germany         on off on  off     Receive buffer    SW1-7
  U.h.            on off off off       Valid             off
  Denmark         off on on  off       Invalid           on
  Sweden          off on off off     1 inch skip       SW1-8
  Italy           off off on off       Invalid           off
  Spain           off off off off      Valid             on
  PC 437          on on on                             SW2-1 2-2
                                                         off off
```

Figure 1-8. Self-Test

1.6.2 *Hexadecimal Dump Function*

To enter hexadecimal dump mode, turn on the printer while pressing both the LOAD/EJECT and the LINE FEED/FORM FEED buttons. In hexadecimal dump mode, the printer prints the hexadecimal representation of the input data along with the corresponding ASCII characters. This function is useful for checking the data the printer receives from the host. If input data is a control code instead of a character code, a period (.) is printed in the ASCII column,

```
1B 40 1B 52 00 1B 74 01 1B 36 12 1B 50 1B 70 00   .@. R. .t. .6. .P. P.
20 20 54 68 69 73 20 69 73 20 61 6E 20 65 78 b1     This is an exa
6D 70 6C 65 20 6F 66 20 61 20 64 b1 74 61 20 64   mple of a data d
75 60 70 20 70 72 69 6E 74 6F 75 74 2E 20 54 68   ump printout. Th
69 73 20 66 65 61 74 75 72 65 20 6D 61 68 65 73   is featu re makes
0A 20 20 20 20 20 69 74 20 65 61 73 79 20 66 6F   .      i t easy fo
```

Figure 1-9. Hexadecimal Dump

1.6.3 Paper-Out Detection and Form Override Function

The paper-out detector is attached to the printer mechanism. When the paper-out detector senses a paper end, the printer first performs a form override. If paper loading fails, the BUSY signal goes HIGH, the PAPER OUT indicator light comes on, the interface PE signal becomes HIGH, the \ERROR signal becomes LOW, and the printer enters the PAUSE condition.

The form override function ignores the paper out and allows the printer to print additional lines after a paper out is detected. After you load paper and press the PAUSE button, the printer returns to the RUNNING condition and printing begins again.

The printer enters the paper-out state only when a paper out is detected after the printer performs a paper loading operation,

1.6.4 Error Conditions

If any of the following error conditions are detected, the printer automatically enters the PAUSE condition.

- **The home position is not detected at printer mechanism initialization.**
- **The home position is detected during printing.**
- **The PAUSE button is pressed and the printer enters the PAUSE condition.**
- **A paper out is detected after the printer performs a paper loading operation.**

If the parallel interface is selected, the following interface signals are output to indicate the error and to stop data transmission:

- **The BUSY signal becomes HIGH.**
- **The /ERROR signal becomes LOW.**
- **No /ACKNLG pulse is sent.**

1.6.5 Buzzer Operation

The buzzer sounds under the following conditions:

- **A paper-out error is detected. (The buzzer beeps three times for 0.1 seconds, with 0.1 second interval s.)**
- **Abnormal carriage movement is detected. (The buzzer beeps five times for 0.5 seconds, with 0.5 second intervals.)**
- **A control panel setting is accepted. (The buzzer produces one O. l-second beep.)**

1.6.6 Printer Initialization

There are three types of initialization: hardware, software, and control panel.

(1) Hardware initialization

This type of initialization takes place when you turn on the printer (and the AC power cord is plugged in) or when the /INIT signal is received.

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

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

(2) **Software initialization**

The ESC @ command initializes the printer but does not perform functions (a), (b), and (c) above. The last SelecType settings still take effect.

(3) **Control panel initialization**

Pressing the PAUSE and ALT buttons at the same time initializes the printer but does not perform functions (a) and (c) above. The last SelecType settings still take effect.

1.6.7 Default Values

When the printer is initialized, the following default values take effect:

Page position	**The current paper position becomes the top-of-form position.**
Left and right margins	**Released**
Line spacing	**1/6 inch**
Vertical tabs	**Cleared**
Horizontal tabs	**Every eight characters (relative)**
Family number of typestyle	**Last font selected from the control panel**
Download characters	**Kept during software initialization Cleared during hardware initialization**
Character spacing	**Last setting selected from the control panel**
Printing effects	**Cleared except condensed printing**
Condensed printing	**Last setting selected from the control panel**
Printer condition	**RUNNING (not PAUSE)**

1.6.8 Paper Loading and Ejection

The release lever can disengage the pull tractor drive mechanism. This provides the printer with the following paper handling features:

Automatic single-sheet loading without the cut-sheet feeder

Move the release lever to the friction feed position and place the sheet along the top or front paper guide. A few seconds later, the printer automatically advances the sheet to the top-of-form position and enters the RUNNING condition.

Automatic single-sheet loading and ejection with the cut-sheet feeder

Move the release lever to the friction feed position and load single-sheet paper into the hopper of the cut-sheet feeder. Press the LOAD\ EJECT button to load a sheet to the top-of-form position. If a paper out is detected before printing starts, the printer automatically loads another sheet to the top-of-form position.

Continuous paper loading and ejection (backout)

Move the release lever to the REAR PUSH / FRONT PUSH position and load the paper onto the tractor unit. Press the LOAD/EJECT button to load paper to the top-of-form position. If a paper out is detected before printing starts, the printer automatically advances the paper to the top-of-form position.

If you press the LOAD/EJECT button after you load continuous paper, the printer moves the paper backward to the push tractor. To back out several pages, press the LOAD/EJECT button several times. Each time you press the LOAD/EJECT button, the printer reverse feeds one page.

When the paper is at the current setting for the top-of-form position, the top-of-form adjustment function is valid for the setting a new top-of-form position. At this time, pressing the LOAD/EJECT button moves the paper forward and pressing the LINE FEED/FORM FEED and ALT buttons at the same time moves the paper backward. The adjusted top-of-form position for continuous paper is saved in EEPROM, but the setting for single-sheet paper is not saved.

1.6.9 Tear-off Function

Auto tear off

You enable the auto tear-off function by setting a DIP switch. When this function is enabled and the release lever is in the tractor position, the paper automatically advances to the tear-off position if the input data buffer is empty and the printer is in the RUNNING condition. The TEAR OFF indicator light comes on to indicate that you can use the LOAD/EJECT and LINE FEED/FORM FEED buttons with the ALT button for backward and forward micro feed adjustment. Using micro feed, adjust the paper to meet the tear-off edge. Once the tear-off position is set, this setting remains valid even after the printer is turned off or initialized. If subsequent data is sent to the printer, the paper automatically returns to the original position and printing starts. If you press the PAUSE button while the printer is advancing the paper to the tear-off position, the paper returns to the original position and the printer enters the PAUSE condition.

Short tear off

To use the short tear-off function, press the TEAR OFF button. The release lever must be in the tractor position. The paper advances to the tear-off position, whether the printer is in the PAUSE or the RUNNING condition. The TEAR OFF indicator light comes on to indicate that you can use the LOAD/EJECT and LINE FEED/FORM FEED buttons with the ALT button for backward and forward micro feed adjustment. Using micro feed, adjust the paper to meet the tear-off edge. Once the tear-off position is set, this setting remains valid even after the printer is turned off or initialized. If subsequent data is sent to the printer and the printer is in the RUNNING condition, the paper automatically returns to its original position and printing starts. If you press the TEAR OFF button again while the printer is advancing the paper to the tear-off position, the paper returns to its original position whether the printer is in the PAUSE or the RUNNING condition.

1.6.10 Paper-Thickness Lever Operation

You must set the paper-thickness lever (the adjust lever) to the proper position for the thickness of your paper. If this lever is set at the fourth step or higher, printing speed is reduced and printhead energy is increased.

Table 1,-16. Paper-Thickness Lever Positions

Lever	*Position Paper Thickness*
O (2nd step)	**0.06 to 0.12 mm (.0024 to .0047 in.)**
1 (3rd step)	**0.13 to 0.17 mm (.0051 to .0067 in.)**
2 (4th step)	**0.18 to 0.25 mm (,0071 to .010 in.)**
3 (5th step)	**0.26 to 0.32 mm (.01 O to .013 in.)**

NOTE: If the printing density **becomes lighter, move the adjust lever position one step higher.**

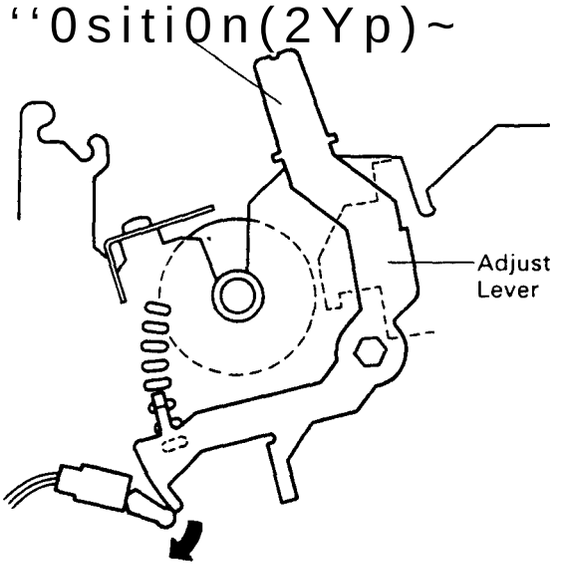


Figure 1-10. Paper-Thickness Lever Positions

1.6.11 Protection during Heavy Duty Printing

This printer has a protection function to prevent the printhead from overheating and to stop printing when the head driver voltage drops. If the temperature of the printhead exceeds the maximum allowed value, printing stops automatically. When the printhead temperature drops to a certain value, printing resumes. At first, printing resumes at a lower print speed. However, as the printhead temperature decreases, print speed increases
to the normal speed. If the printhead temperature continues to increase at the lower speed, the printer stops printing. The printer stops or resumes printing as the printhead temperature increases or decreases.

If the voltage supplied to the head drive circuit drops below its minimum limit as a result of heavy duty printing, printing is interrupted immediately. When the power supply voltage increases to a certain value, the remaining print line is printed at half speed. this protective action occurs when half or more of the wires are activated continuously.

1.7 MAIN COMPONENTS

The main components of the LQ-870/1 170 are designed for easy removal and replacement during maintenance and repair. The main components are:

1) C060 MAIN board: the main control board; the CPU on this board controls all the printer's main functions.
2) C060 PNL board: the control panel board.
3) C060PSB/PSE board: the power supply board.
4) C060 DRV board: the drive board.
5) M-5D 10/5D60: the printer mechanism.

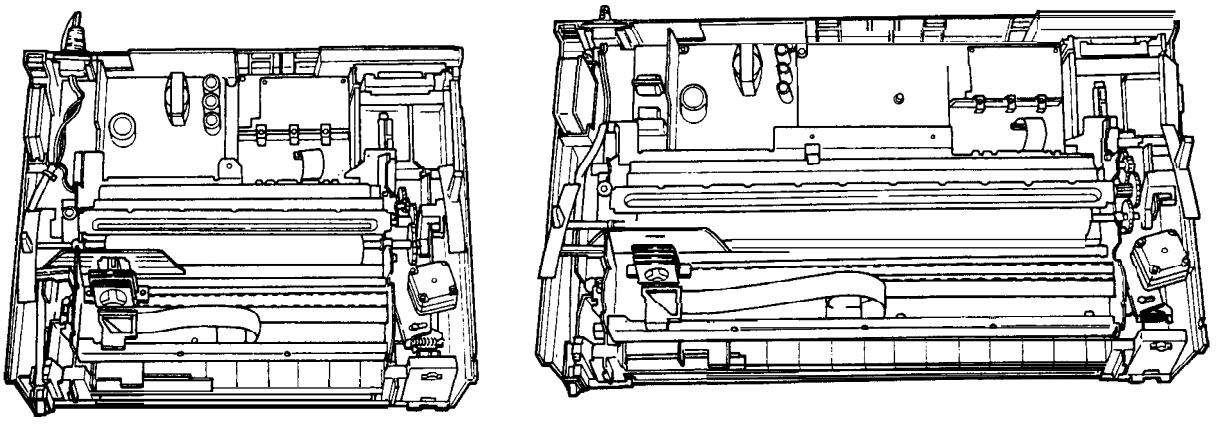


Figure 1-11. **LQ-870/1** *170 Component Layout*

1.7.1 **C060** *MAIN Board (Main Control Circuit Board)*

The C060 MAIN board consists of a TMP90C041 N 8-bit CPU, an E05A494B gate array, a PROM (5 12K), a PSRAM (256 K), a mask ROM (character generator, 2M), and an EEPROM.

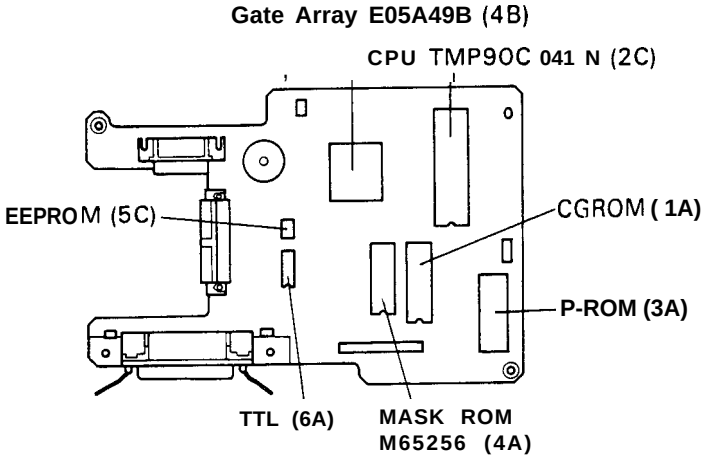


Figure 1-12. **C060** *MAIN Board*

1.7.2 **C060 PNL** *Board (Control Panel Circuit Board)*

The C060PNL board is the LQ-870/1 170 control panel, which includes the buttons, indicator LEDs, and DIP switches.

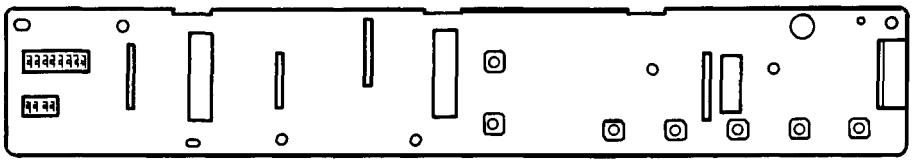


Figure 1-13. **C060 PNL** *Board*

1.7.3 **C060 PSB/PSE** *Board (Power Supply Circuit Board)*

The power supply unit consists of a switching regulator circuit that converts the AC line voltage to the DC voltages (for example, +35 V and +5 V) used by the printer. The C060PSB board is the 120 V input type and the C060PSE board is 220/240 V input type.

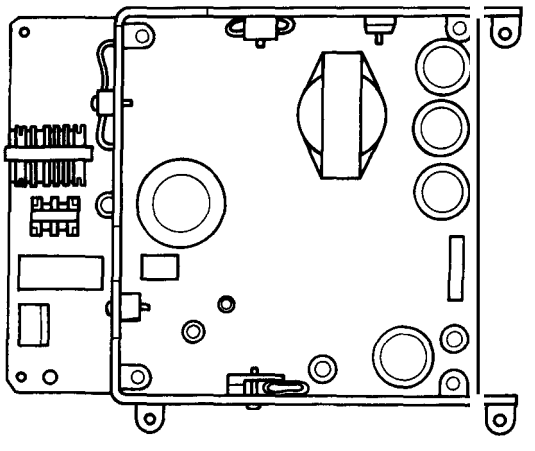


Figure 1-14. **C060 PSB/PSE** *Board*

1.7.4 **C060DRV** *Board (Head Control Circuit Board)*

The C060DRV board consists of a SLA7024M hybrid IC, a PU 1501, and a PU4 135 transistor array.

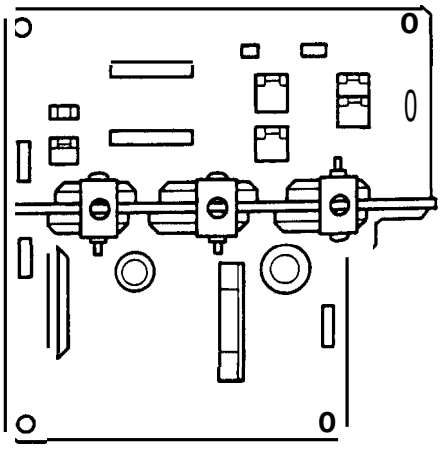


Figure 1-15. **C060DRV** *Board*

1.7.5 **M-5D10/5D60** *Printer Mechanism*

The M-5D 10/5D60 printer mechanism was developed specifically for use with LQ-870/1 170. Its components include the carriage motor, carriage mechanism, paper-feed motor, paper-feed mechanism, ribbon-feed mechanism, printhead, and sensors. The printer mechanism provides four ways to insert paper.

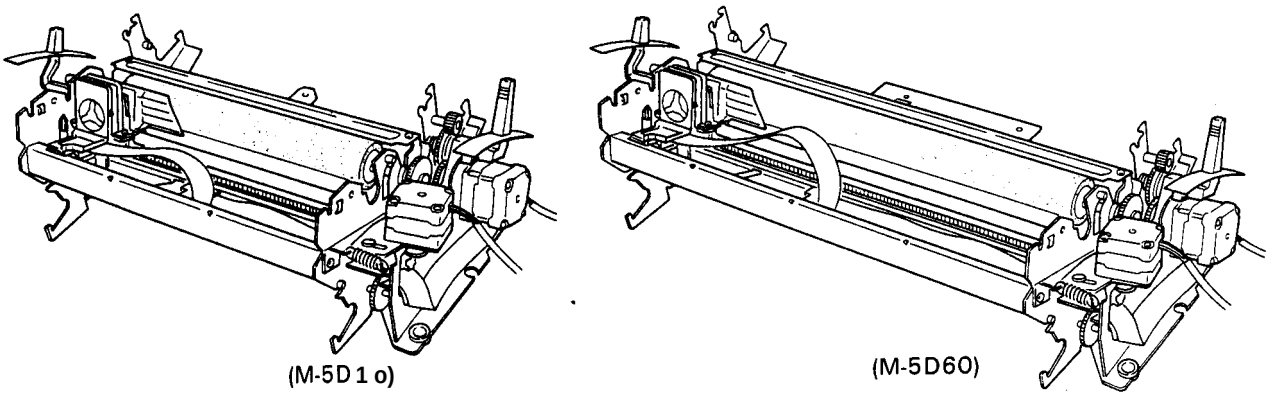


Figure 1-16. M-5 **D10/5D60** *Printer Mechanism*

1.7.5 Housing

The LQ-870/1170 housing consists of the upper, lower, and front cases. The front case houses the control panel board. The lower case contains the printer mechanism, main control circuit board, and power supply circuit board.

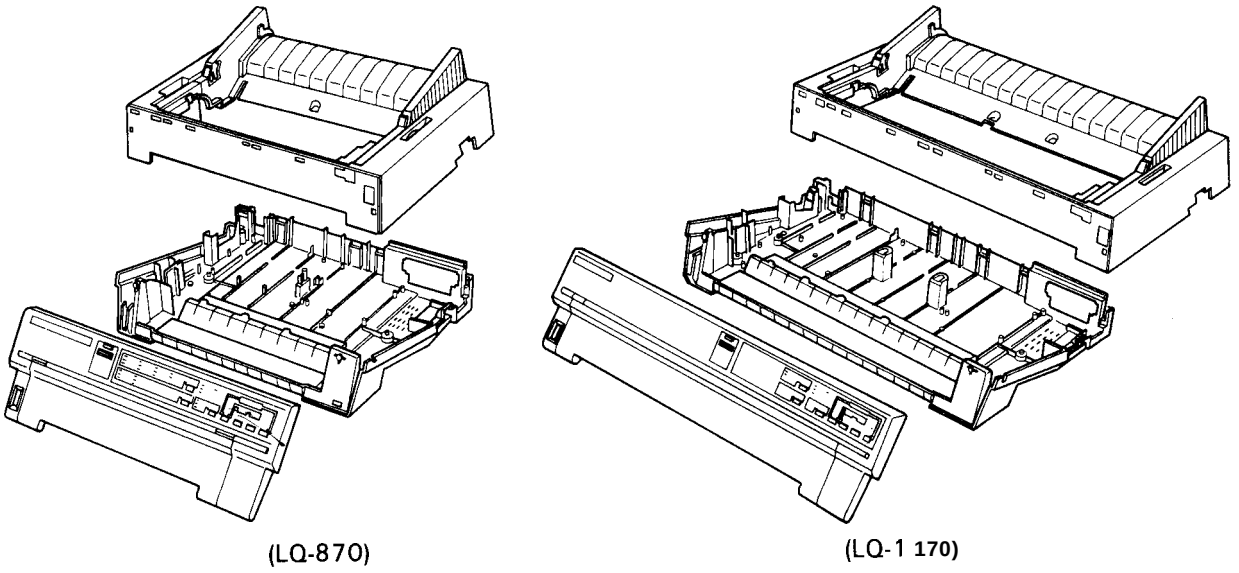


Figure 1-17. Housing

CHAPTER 2
OPERATION PRINCIPLES

LIST OF FIGURES

LIST OF TABLES

2.1 PRINTER MECHANISM OPERATION

This section describes the Model 5D 10/5D60 printer mechanism and explains how it works. The Model 5D 10\5D60 printer mechanism features a 24-pin impact dot printhead for serial printing. The printer mechanism has four main parts: the printhead mechanism, the carriage movement mechanism, the paper advance mechanism, and the ribbon advance mechanism. The following sections describe these parts.

2.1.1 Printhead Mechanism

The printhead mechanism consists of the printhead itself, the ink ribbon, and the platen. The printhead contains 24 wires in a zigzag arrangement in two rows of 12. A drive coil is provided for each of these wires to make the wires move in and out of the printhead and print dots independently of each other. The four steps below describe the basic way that the wires are driven.

1. The control circuit outputs the drive signal to the printhead drive circuit. This changes the printhead drive voltage and current flows through the corresponding printhead coil. The coil acts as a solenoid and generates a magnetic force.
2. This induced force causes the plate to approach the coil rod and the associated dot wire is rapidly ejected to impact on the platen.
3. The dot wire presses the ink ribbon up against the paper as it hits the platen and, in this way, prints a dot on the paper.
4 As soon as the current through the coil is switched off, the force induced in the coil rod stops. The plate then returns to its original position (its position before the coil was energized) through the action of the plate spring. After the dot wire hits the platen, the rebounding force of hitting the platen works with the wire return spring to pull the wire back to its original position in relation to the plate.

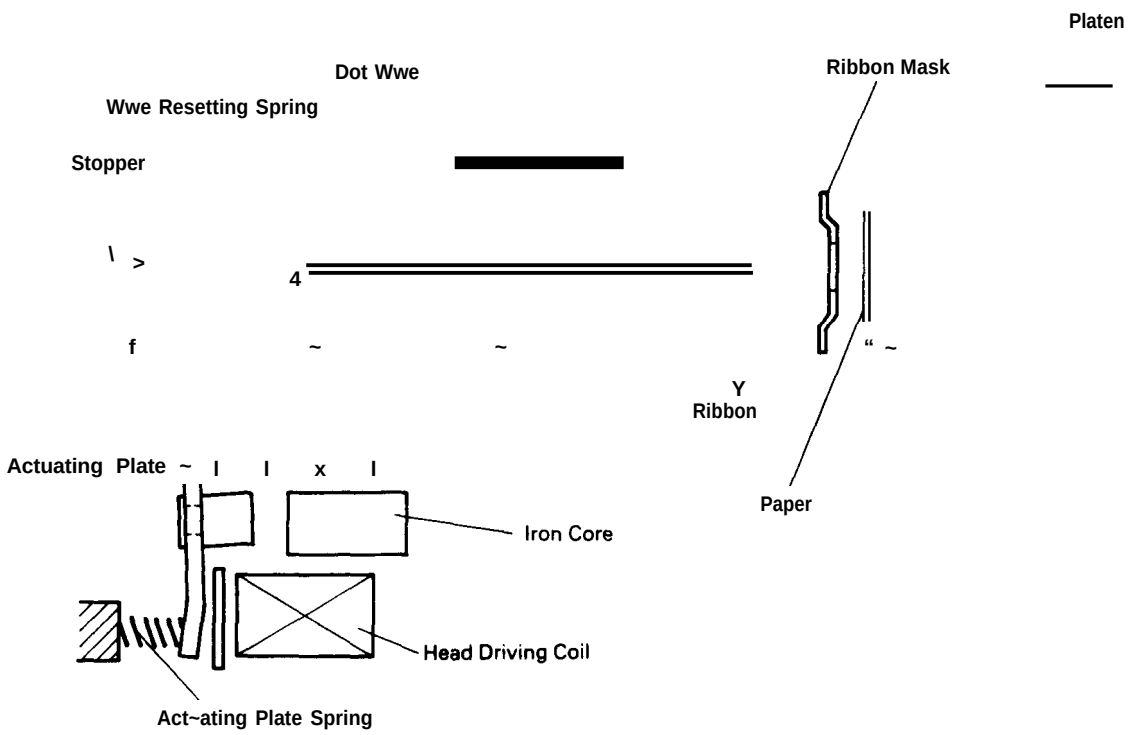


Figure 2-1. How the Printhead Works

Figure 2-1 shows how the printer mechanism prints a single dot.

The printhead tends to heat up after a period of continuous printing. To minimize the possibility of the dot wire drive coils in the printhead overheating and causing a loss of performance, the printhead is equipped with a thermistor that detects the temperature of the printhead. When this thermistor detects changes in the printhead temperature, the voltage signal changes. The control circuit reads this signal change for feedback control.

2.1.2 Carriage Movement Mechanism

A timing belt is connected to the carriage on its lower side. With the printhead installed, this carriage moves in either direction along the carriage guide shaft. The carriage is driven by the carriage motor, a stepping motor that drives the timing belt via the belt drive pulley. The home-position sensor detects when the carriage is in the home position.

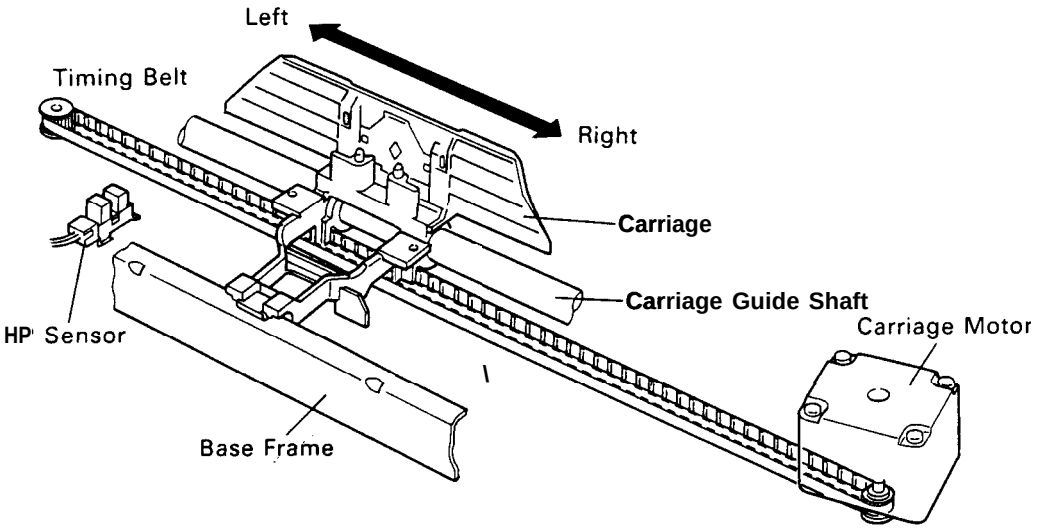


Figure 2-2. Carriage Movement

The paper-thickness adjustment lever allows the printer to use paper of different weights (or thicknesses). The user can change the platen gap on the carriage guide shaft by moving this lever. Changing the position of the lever turns the carriage guide shaft and moves the carriage either toward or away from the platen. Moving the paper-thickness adjustment lever to the fourth position or higher slows the printing speed to protect the printhead. The PG sensor reads the current position of the paper-thickness adjustment lever.

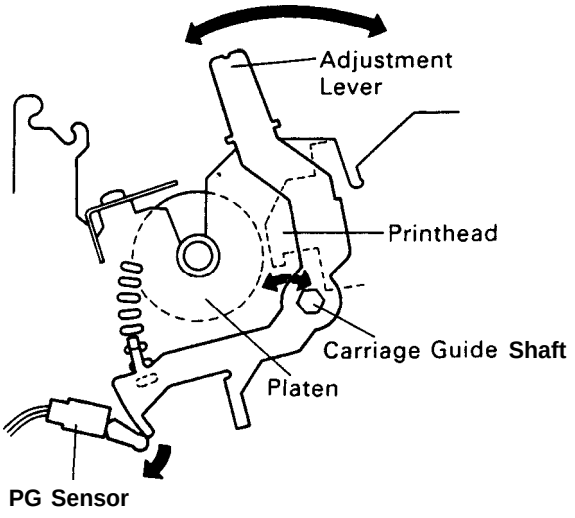


Figure 2-3. Moving the Paper-Thickness Adjustment Lever

2.1.3 Paper Advance Mechanism

The printer uses friction feeding to advance single-sheet paper and tractor feeding to advance continuous paper. There are three ways to advance paper using a tractor feed mechanism: using the push tractor, using the pull tractor, or using the push and pull tractors together. During normal operation, the printer has one tractor that functions as either a push or a pull tractor, depending on where it is attached to the printer. To use the push-pull tractor feed method, the standard tractor and the optional tractor must be installed.

There are four ways to insert paper into the printer. The printer uses different paper insertion entrances and paper paths for different types of paper. Table 2-1 lists which paper insertion entrances you can use with each paper advance method.

Table 2-1. Paper Advance Methods and Paper Entrances

	Paper Insertion (Paper Paths)			
Paper Advance Method	Rear	Front	Bottom	Top
Friction	No	OK	No	OK
Push Tractor	OK	OK	No	No
Pull Tractor	OK	OK	OK	No
Push-pull Tractor	OK	OK	No	No

2.1.3.1 Paper Feeding Mechanisms

This section describes how the friction and tractor feed mechanisms advance paper in the printer.

Friction Feed Method

The paper is held between the platen and the paper advance roller, and between the paper eject roller and the paper eject unit cover. The paper-feed pinion gear, turning in the direction of the black arrow, drives the paper-feed reduction gear. The paper-feed reduction gear turns the platen gear, paper-feed rollers, and top paper tension roller. The paper then advances in the direction of the white arrow. The paper advance roller spring holds the paper against the platen.
Setting the release lever to the tractor feed position releases this pressure and frees the paper. Figure 2-4 illustrates friction feeding when you insert paper into the top paper entrance.

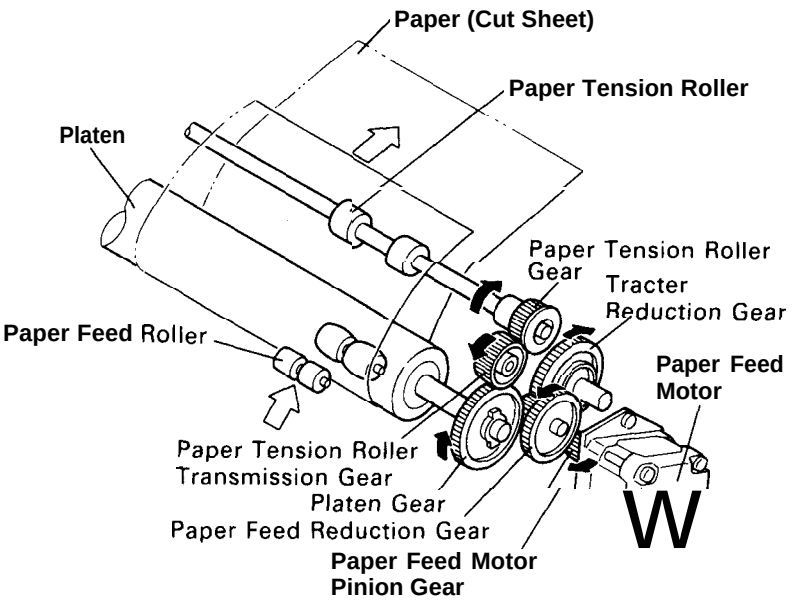


Figure 2-4. Friction Feeding Using the Top Entrance

Push Tractor Method

When the push tractor is selected, the tractor reduction gear engages the tractor gear on the tractor assembly. The tractor reduction gear is driven by the paper-feed gear, which in turn is driven by the paper-feed motor pinion gear. The paper-feed pinion gear, when turning in the direction of the black arrow, results in pushing the paper through the mechanism.

During tractor feeding, the release lever is set to the tractor position to disengage the friction drive. This releases the pressure between the paper advance roller and the platen. Figure 2-5 illustrates push tractor operation.

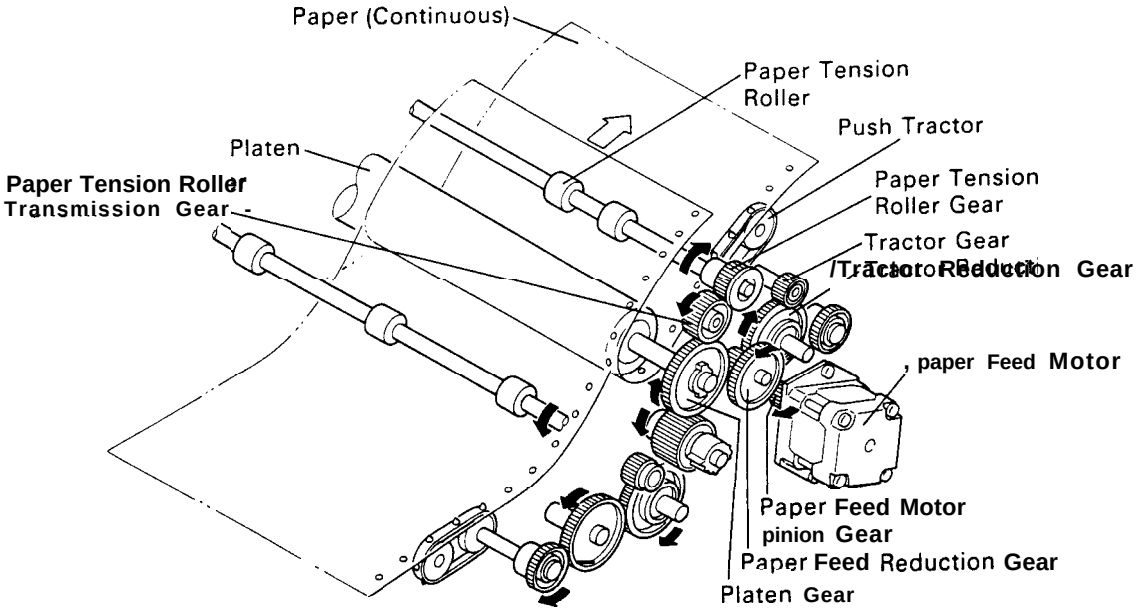


Figure 2-5. Push Tractor Operation

Pull Tractor Method

Pull tractor feeding is basically the same as push tractor feeding. In push tractor feeding, the tractor (the paper advance mechanism) is before the paper entrance. It pushes the paper through the printer mechanism. In pull tractor feeding, however, the tractor is after the paper entrance. Because it pulls the paper through the printer mechanism, it requires no paper tension unit. Figure 2-6 illustrates pull tractor operation when you insert paper into the bottom paper entrance.

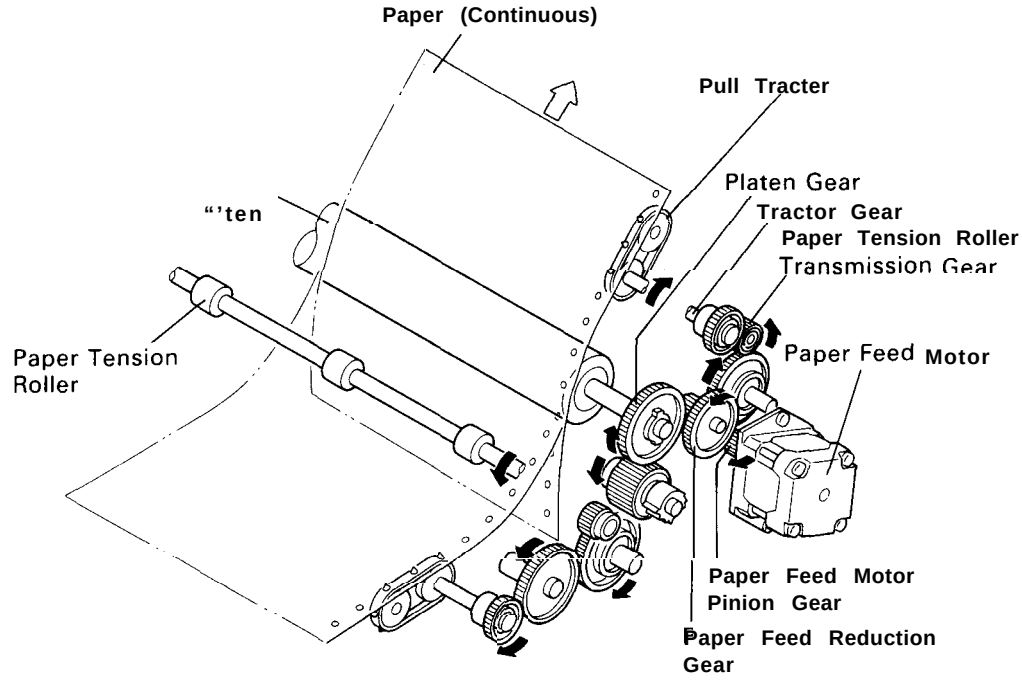


Figure 2-6. Pull Tractor Operation

Push-Pull Tractor Method

The push-pull tractor method is a combination of the push tractor and pull tractor methods. In push-pull tractor feeding, the printer uses two tractors, one in front of and one behind the paper entrance, to advance the paper. They simultaneously push and pull the paper through the printer mechanism. Figure 2-7 illustrates push-pull tractor operation.

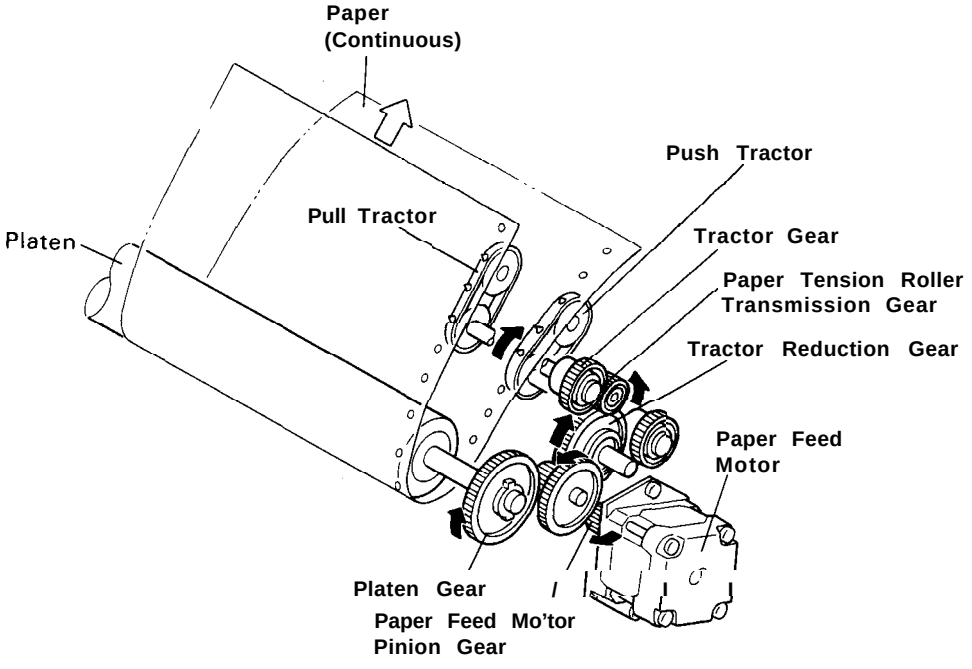


Figure 2-7. Push-Pull Tractor Operation

You use the release lever to switch between friction and tractor feeding. Setting the release lever to the friction feed position presses the paper advance roller against the platen. Setting the release lever to the tractor feed position separates the paper advance roller from the platen and releases this pressure. The release detector senses the current position of the release lever.

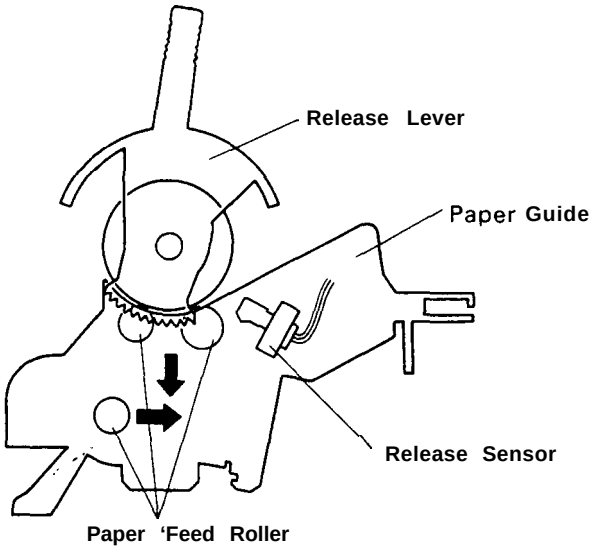


Figure 2-8. Moving the Release Lever

2.1.3.2 Paper Insertion Entrances

This section describes how the printer feeds paper when you use each of the paper insertion entrances.

Top paper insertion entrance

When you insert paper into the top entrance, the printer uses friction feeding to advance the paper. The printer has two paper-out detectors: the front paper-out detector, which is in front of the printer mechanism, and the rear paper-out detector, which is behind the printer mechanism. When you insert paper into the top entrance, the rear detector senses when the paper runs out.

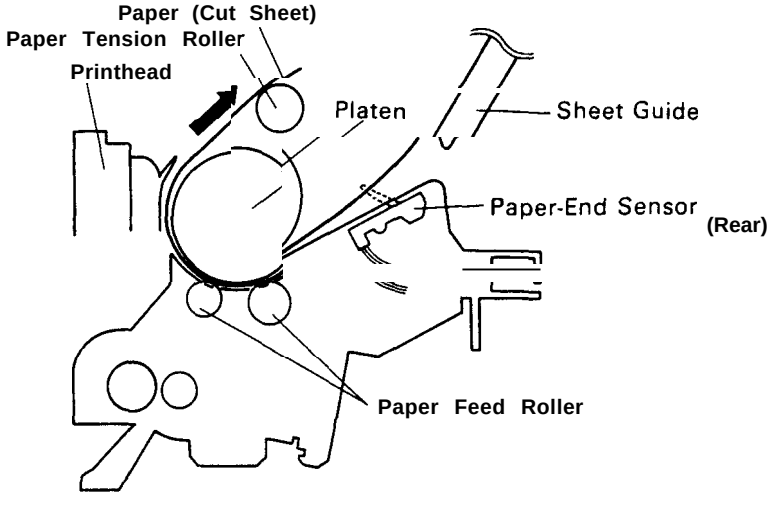


Figure 2-9. Friction Feeding Using the Top Entrance

Rear paper insertion entrance

When you insert paper into the rear entrance, the printer can use the push tractor, the pull tractor, or the push-pull tractor method to advance the paper. The rear paper-out detector senses when the paper runs out.

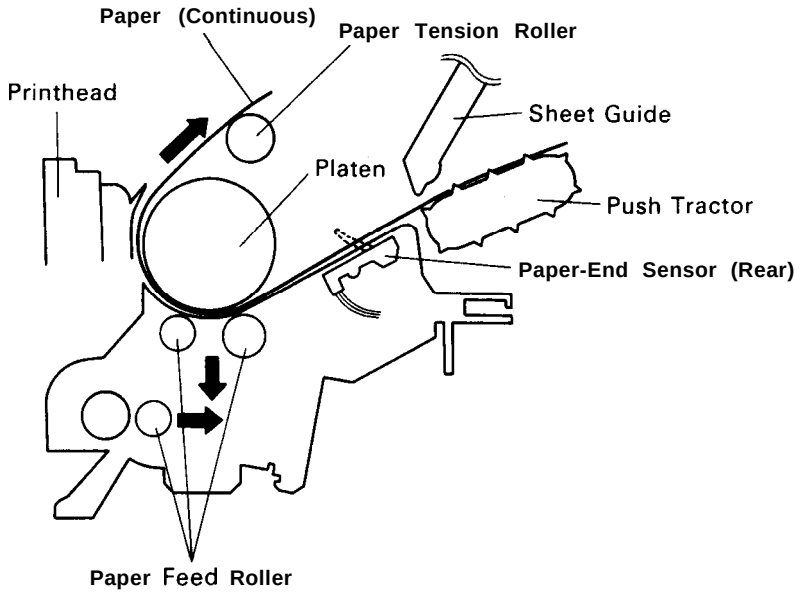


Figure 2-10. Push Tractor Feeding Using the Rear Entrance

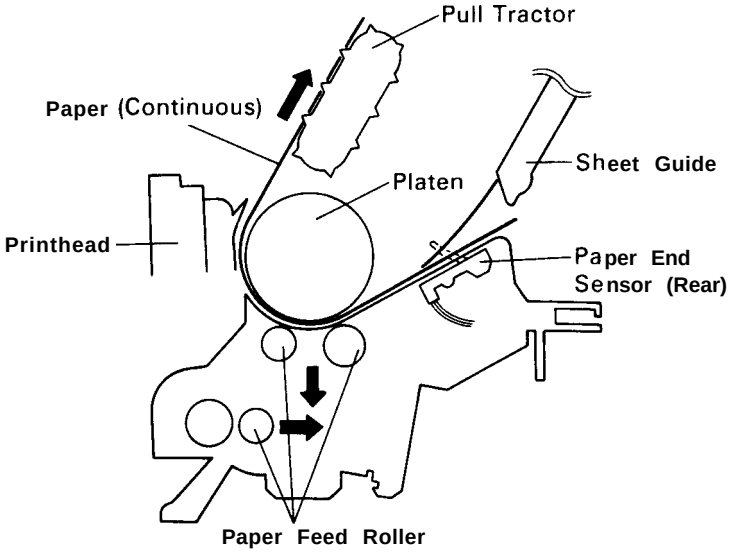


Figure 2-11. Pull Tractor Feeding Using the Rear Entrance

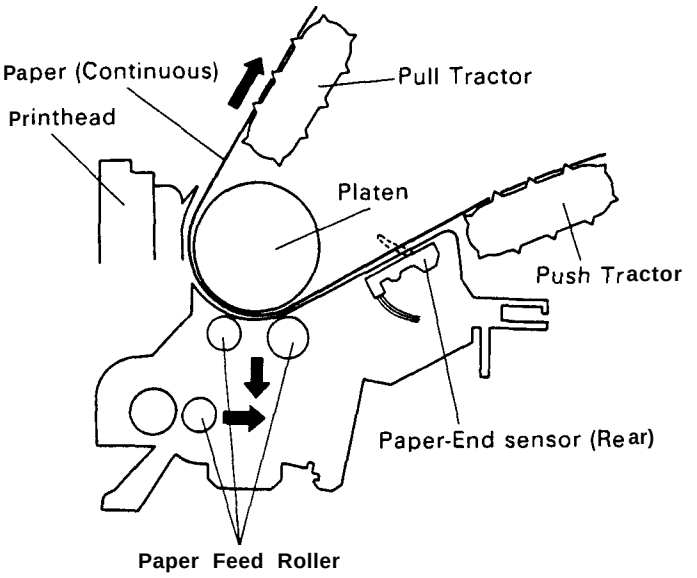


Figure 2-11-1. Push-Pull Tractor Feeding Using the Rear Entrance

Bottom paper insertion entrance

When you insert paper into the bottom entrance, the pull tractor advances the paper. The front paper-out detector senses when the paper runs out.

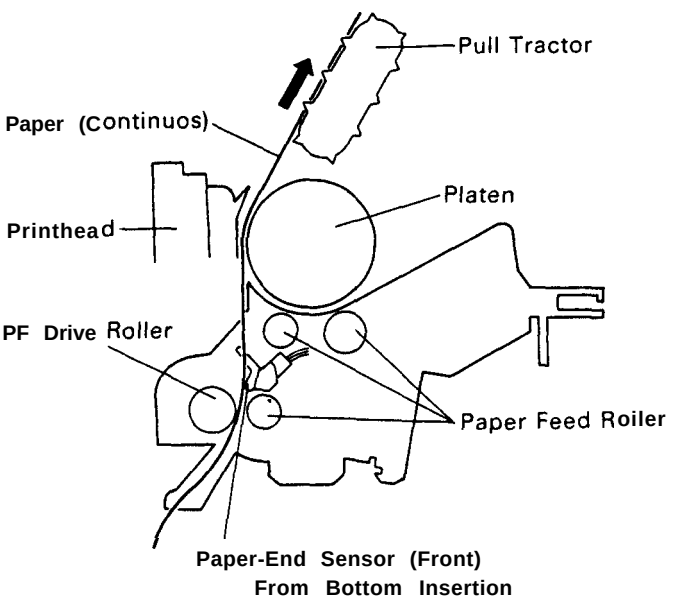


Figure 2-12. Pull Tractor Feeding Using the Bottom Entrance

Front paper insertion entrance

When you insert paper into the front entrance, the printer can use friction feeding, the push tractor, the pull tractor, or the push and pull tractors to advance the paper. The front paper-out detector senses when the paper runs out.

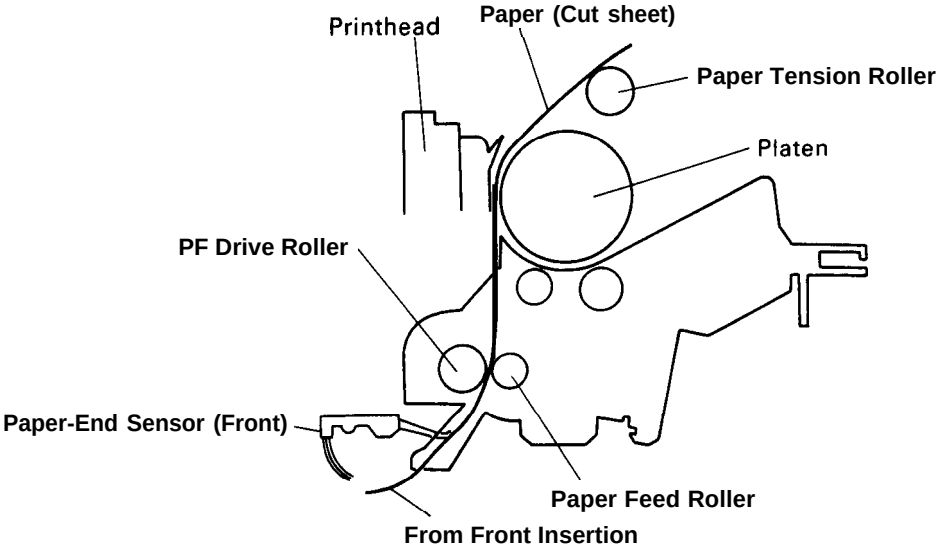


Figure 2-13. Friction Feeding Using the Front Entrance

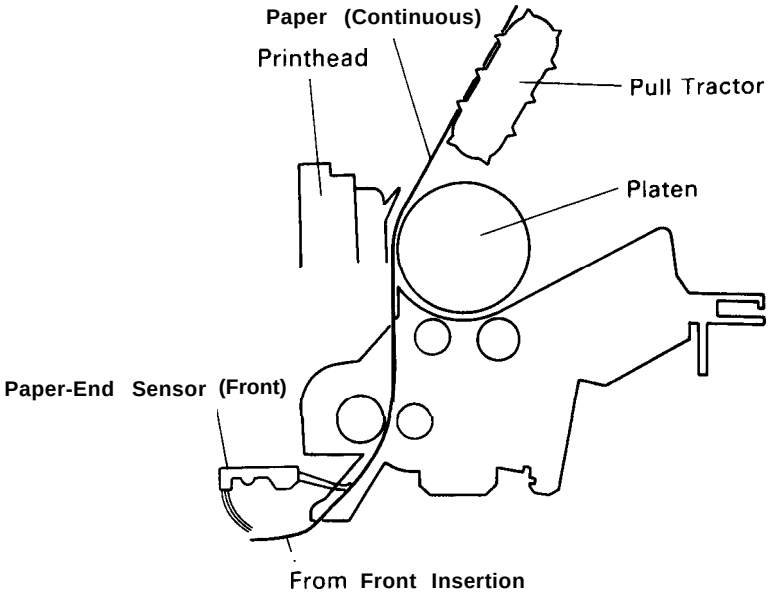


Figure 2-14. Pull Tractor Feeding Using the Front Entrence

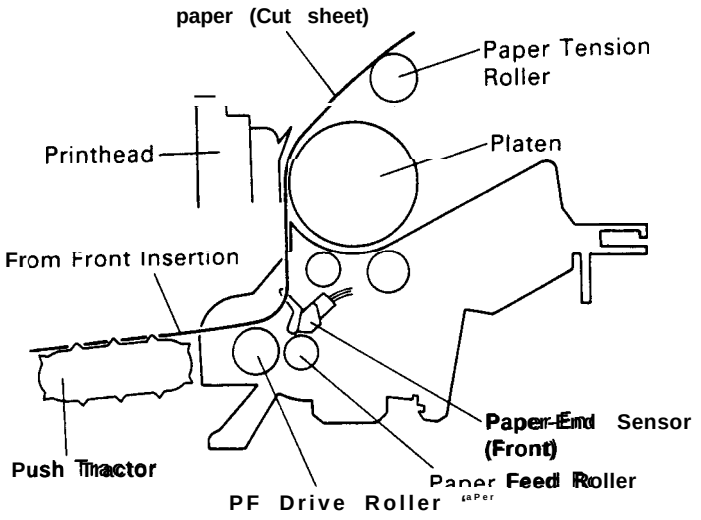


Figure 2-14-1 .Push Tractor Feeding Using the Front Entrance

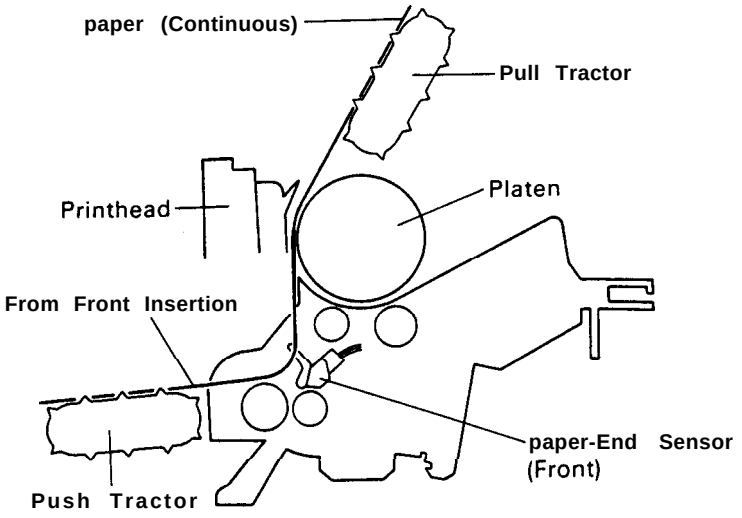


Figure 2-14-2. Push Pull Tractor Feeding Using the Front Entrance

2.1.4 Ribbon Advance Mechanism

The ribbon drive gear advances the ribbon through a gear linkage. This arrangement of gears always turns the ribbon drive gear counterclockwise, regardless of the direction in which the carriage is moving.

Table 2-2. Ribbon Advance Gear Linkage

Direction of Carriage Movement	Gear Linkage
Left to right (arrow ➡)	Belt-driven pulley ➡ Ribbon transmission gear ● Planet gear (1) ● Planet gear (3) ➡ Planet gear (4) ● Ribbon-driving gear
Right to left (arrow ⇨)	Belt-driven pulley ⇨ Ribbon transmission gear ⇨ Planet gear (1) ⇨ Planet gear (2) ⇨ Ribbon-driving gear

The ink ribbon within the cartridge case is an endless ribbon. The pressure of the ribbon grip roller holds the ribbon against the ribbon advance roller. The ribbon advance roller is linked to the ribbon drive gear and winds the ink ribbon. The ribbon brake spring is attached to the exit slot of the cartridge case. It prevents slack in the ribbon and maintains the correct ribbon tension. The ribbon mask keeps the paper clean by preventing the ribbon from brushing against the paper.

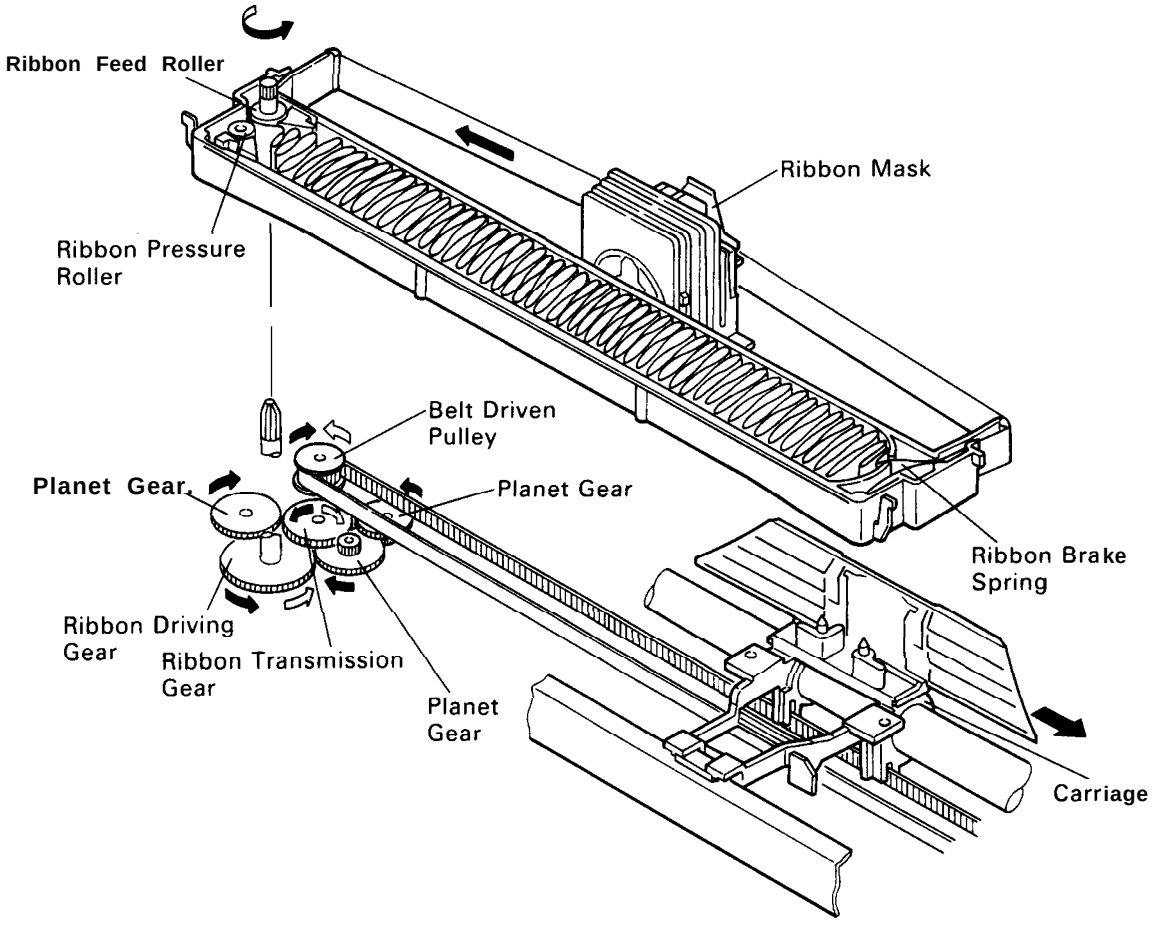


Figure 2-15. Ribbon Advance Mechanism

2.2 POWER SUPPLY OPERATION

The printer can be powered by either of two power supply boards: the 120V C060PSB board or the 220/240 V C060PSE board. The only difference between these boards is in the primary circuitry. The ways in which they supply power to the printer are identical. These power supply boards output the DC current necessary to drive the printer control circuits and the printer drive mechanism. Table 2-3 shows the input voltages and fuse ratings for these boards.

Table 2-3. Power Supply Boards

Board	Input Voltage (VAC)	Fuse F1 Rating
C060 PSB	103.5 to 132	2.5A / 125 V
C060 PSE	198 to 264	1.25A / 250 V

2.2.1 Power Supply Overview

The power supply board has two power output lines that supply power to the various control circuits and drive mechanisms. Table 2-4, lists the parts of the printer that run off these two DC output supply voltages.

Table 2-4. Power Supply Output Voltages and Applications

Output Supply Voltage (DC)	Applications
+35 v	Carriage motor drive Paper advance motor drive Printhead drive
+5 v	C060 MAIN board logic circuitry Various sensors Control panel LEDs Paper advance motor hold

2.2.2 supply Circuit Operation

Figure 2-16 shows the power supply circuitry in block diagram form. AC power feeds into the printer from the external power source. A filter circuit removes the noise. The AC voltage then undergoes full wave rectification and is smoothed to produce the direct current supply voltage. This voltage is fed through a switching circuit and secondary smoothing circuit to produce the stepped down +35 VDC supply. A +35 V line voltage detector circuit is connected to the switching circuit. This feedback control arrangement ensures that the +35 VDC supply remains stable.

The + 5 VDC supply is achieved by feeding the +35 VDC line through the + 5 VDC power supply circuit. This circuit further steps down the +35 VDC voltage and outputs a stabilized + 5 VDC supply.

There are four circuits to protect the supply circuitry and avoid danger. The + 5 VDC line contains a current overload protection circuit and a voltage overload protection circuit. The current overload protection circuit is part of the +5 VDC supply circuit. It cuts the + 5 VDC line if the current is too great. The + 5 V voltage overload protection circuit cuts the supply if the voltage reaches or exceeds +7 VDC. It stops switching circuit operation, which stops the output of the +35VDC line.

The +35 VDC line has a voltage overload protection circuit and a voltage drop protection circuit. The +35 V voltage overload protection circuit cuts the supply if the voltage reaches or exceeds +36 VDC. It stops switching circuit operation, which stops the output of the +35 VDC line. The voltage drop protection circuit protects the printer from damage that might occur if the secondary circuitry of the +35 VDC line short circuits. If a voltage drop is detected, it stops switching circuit operation, which stops the output of the +35 VDC line.

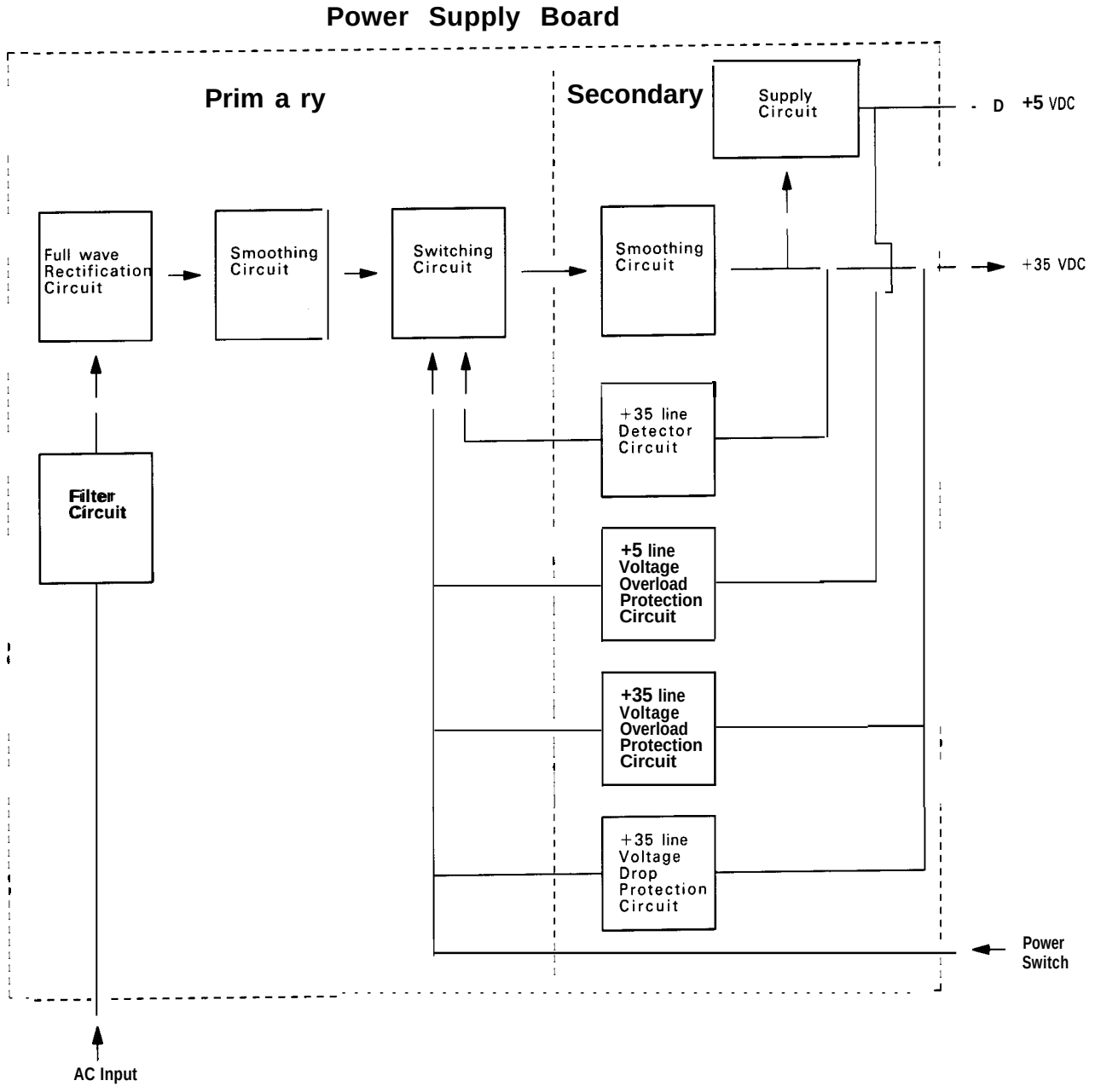


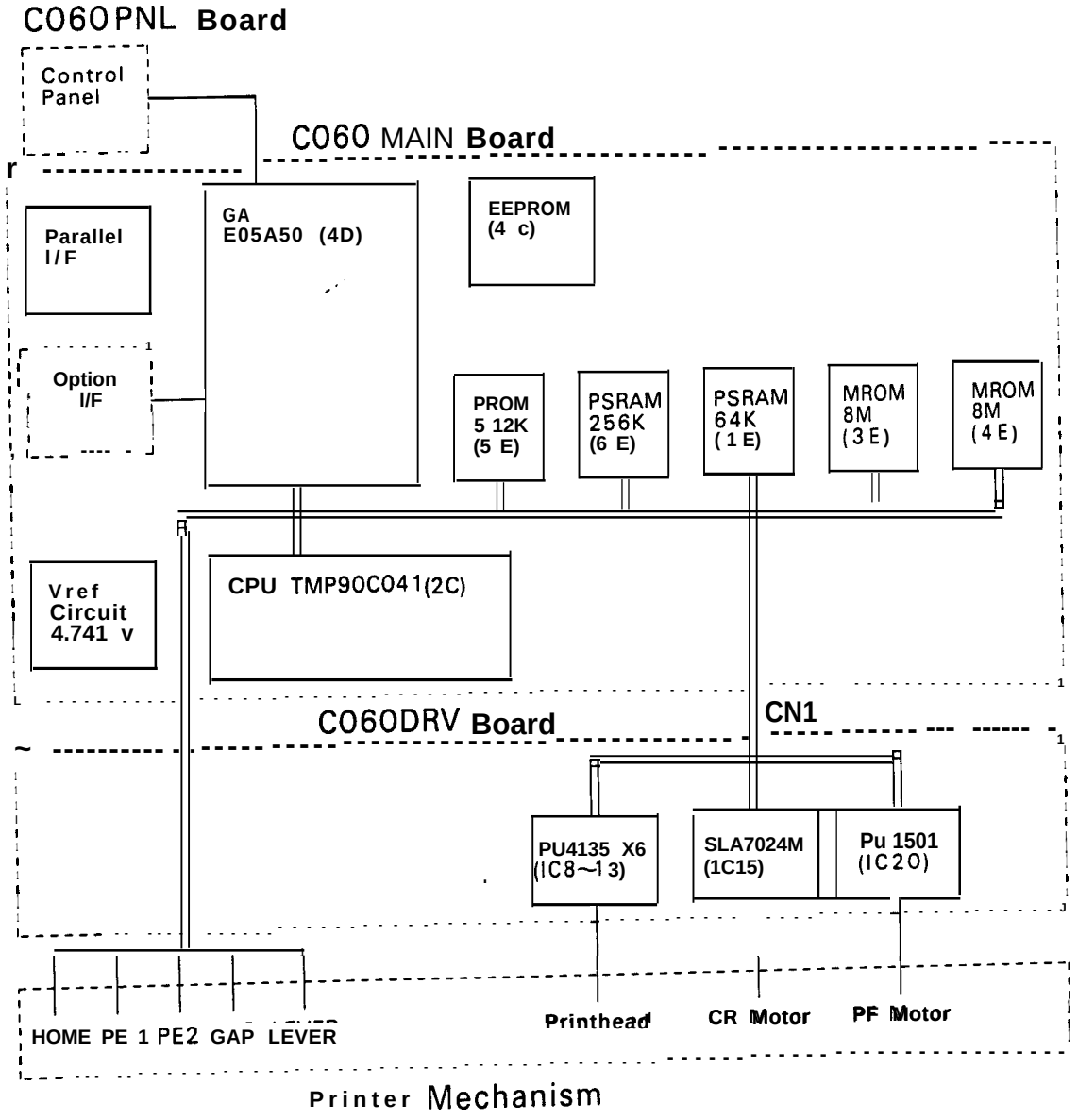
Figure 2-16. Power Supply Circuit Block Diagram

2.3 CONTROL CIRCUIT OPERATION

The control circuit consists of three boards: the C060 MAIN board (the main control board), the C060 DRV board (the drive board), and the C060PNL board (the control panel board). This section describes how these boards work.

2.3.1 Control Circuit Operation Overview

The printer's CPU is an 8-bit CPU TMP90C041 that runs at 10 MHz. It controls all the components of the printer. The E05A49 gate array contains various memory management functions that assign memory and I/O areas. The PU 4135 rationalizes and simplifies the circuitry and holds all the driver circuits for driving the printer mechanism on five chips. Figure 2-17 shows the control circuits in block diagram form.



GA	Gate array
GAP	Platen-gap sensor
SPE1	Front paper-out detector (positioned in front of the printer mechanism)
LEVER	Release sensor
PE2	Rear paper-out detector (positioned behind the printer mechanism)
HOME	Home-position sensor
CR motor	Carriage motor
PF smotor	Paper advance motor

Figure 2-17. Control Circuit Block Diagram

Table 2-5 lists the functions of the printer's main components and circuits. The CPU converts the print data sent from the host computer to image data (the print image). Then the printer loads the image data to RAM. The printer processes each line of data sequentially. The CPU transfers the print data to the printhead drive circuit and sends the printhead drive pulse to the printhead drive circuit, The length of the pulse corresponds to the printhead drive voltage. Then the printhead drive circuit outputs the printhead drive signal.

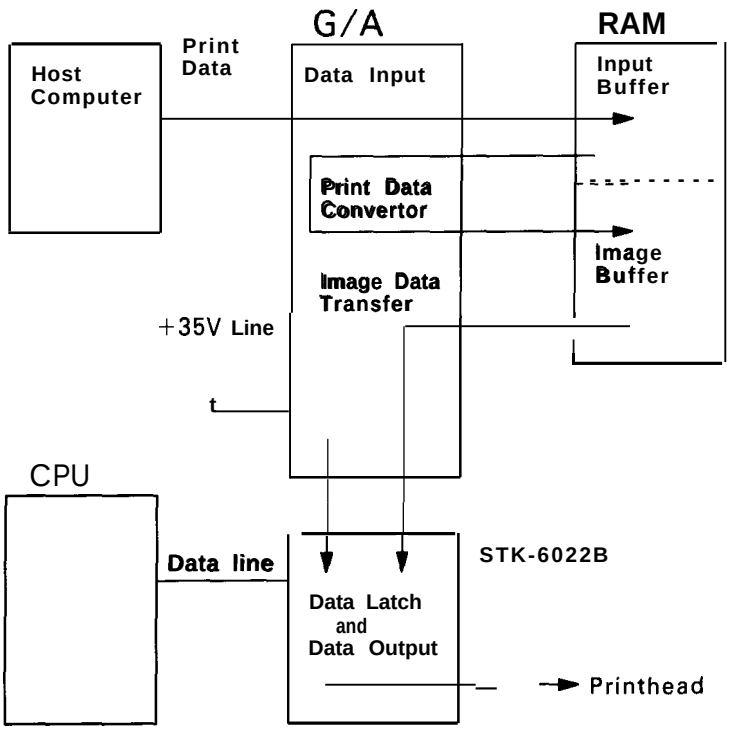


Figure 2-18. Data Flow

Table 2-5. Functions of the Main IC and Circuits

IC or Circuit	Location	Functions
TMP90C041	2C	Receives data from the host computer and loads the data to the input buffer in RAM (under interrupt processing control). Expands the input data held in the buffer to create image data. Loads this image data to the image buffer in RAM. Transfers the image data to the printhead drive circuit. Also controls various parts of the printer mechanism, such as the motors.
E05A49	4B	This gate array consists of seventeen components configured on a single chip: Memory Management Unit Wait Control Unit Refresh Control Unit Program ROM Select Unit Centronics I/F Control Unit Option Control Unit Panel Control Unit EEPROM Control Unit General Output Unit HPW Differential Unit HPW Pulse Limit Unit Bit manipulation unit Head Control Unit Internal Clock Generate Unit Internal I/O and MMIO Decode Unit Output Data Multiplex and Input Data Latch Unit
PU41 35	IC8-IC 13	This is a drive circuit for the printhead. h consists of six chips.
PROM	3A	The PROM contains the program that runs the CPU.
RAM	4A 5A	The RAM contains the CPU working area and the various buffers. (5A is not used and not installed in the 80-column printer.)
MROM (Mask ROM)	1A 2A	The mask ROM contains the character design (also called the character generator).
EEPROM	5C	The EEPROM is an electronically writable and erasable ROM that contains information such as the top-of-form position.
Vref Circuit TL431	1C	This circuit generates the reference voltage used in the A/D converter in the CPU.

2.3.2 Reset Circuit

Figure 2-19 shows the reset circuit in block diagram form. The reset circuit issues the /RESET signal. The control circuits are initialized when they receive the /RESET signal. The conditions under which the /RESET signal is output are described below.

When you turn on the power

Immediately after you turn on the power, PST-520 (6C) outputs the /VCCON pulse. E05A49 (46) receives this pulse and outputs the /DISC pulse. Then the electrical charge through the resistor (R49) in the condenser (C28,C29) is discharged. After this, E05A49 outputs the THLD signal and E05A49 outputs the /RESET signal. After a certain time has elapsed, the charge in the condenser builds up again. The THLD signal is canceled and then the /RESET signal is canceled.

When the CPU performs a reset (CPU self-reset)

The CPU outputs the /RESET signal if there is a /RESET request for E05A49 and if E05A49 has output the /DISC pulse.

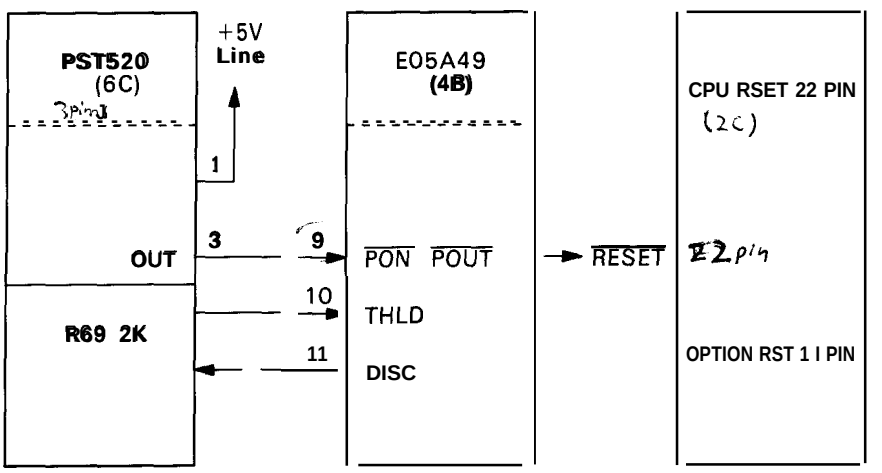


Figure 2-19. Reset Circuit Block Diagram

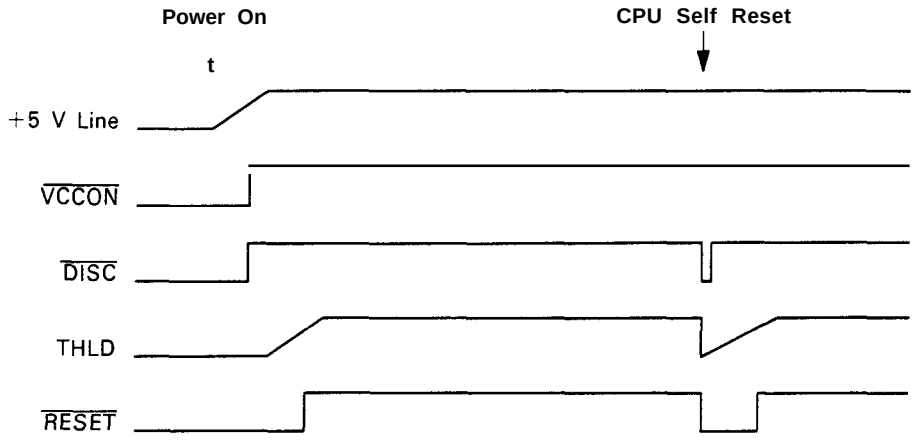


Figure 2-20. /RESET Signal Timing

2.3.3 Sensor Circuits

Figure 2-21 shows the sensor circuits in block diagram form. When the printhead temperature exceeds the maximum allowed value, the TEMP2 signal and other signals, such as the CRHOME signal, are sent directly to the CPU. The +35 V line signal passes through the reset circuit before it reaches the CPU. Terminals P50 to P55 in the CPU are used for the A/D converter. The Vref circuit generates the A/D converter reference voltage Vref.

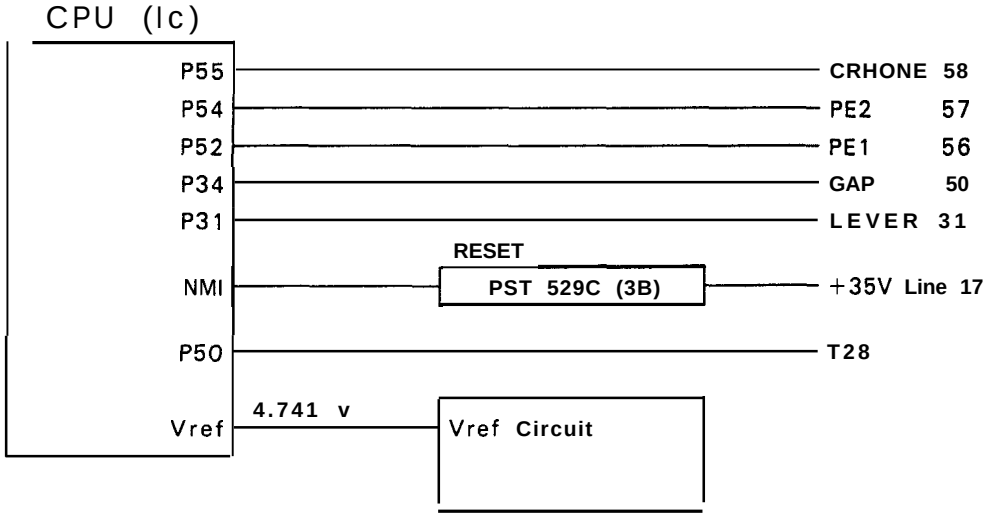


Figure 2-21. Sensor Circuit Block Diagram

2.3.4 Carriage Motor Drive Circuit

Figure 2-22 shows the carriage motor drive circuit. An open-loop, constant-current drive arrangement runs the carriage motor. 2-2 and 1-2 phase excitation drive the motor. 2-2 phase excitation corresponds to two 1-2 phase excitation steps. For each single-step phase change of a 2-2 phase excitation motor, the carriage moves 1/1 20 inch. For each single-step phase change of a 1-2 phase excitation motor, the carriage moves 1/240 inch.

The carriage motor drive circuit of the SLA7024M detects and regulates the amount of current flowing in the carriage motor coil. The current flowing through the coil varies depending on the speed of the carriage motor. The CPU sets the amount of current via the E05A49I/O port. Signals are sent to HOLD to -M on the SLA7024M. The SLA7024M sets the coil current to correspond to the carriage motor speed.

The printer uses ports P60 to P63 in the CPU exclusively as control ports for the stepping motor.

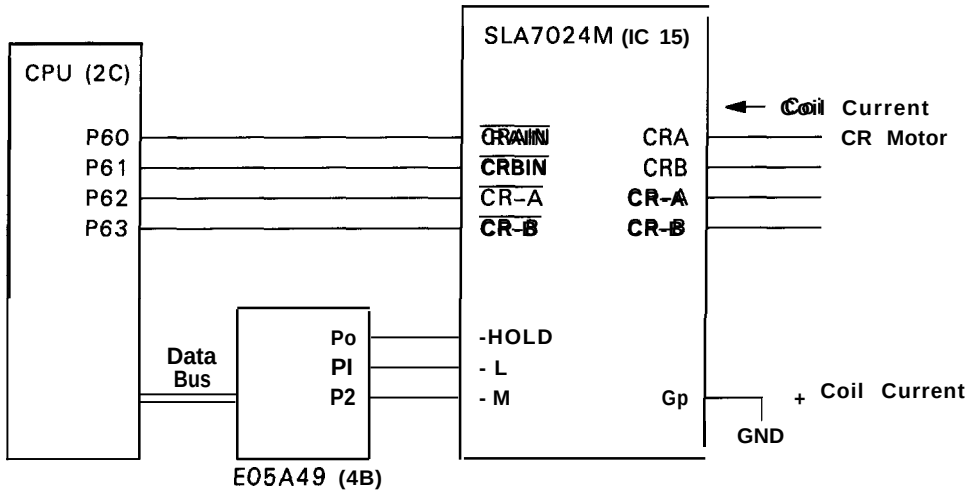


Figure 2-22. Carriage Motor Drive Circuit

Table 2-6. Carriage Motor Drive Modes

Drive Mode	Excitation	Driva Fraquency	Standard Characters Printed
10/3 X speed	2-2 phase	3593 pps	High Speed Draft
3 X speed	2-2 phase	3300 pps	Draft
8/3 X speed	2-2 phase	2932 pps	Draft
2 X speed	2-2 phase	2202 pps	High Speed Japanese Kanji
1.5 X speed	1-2 phase	1651 pps	
4/3 X speed	1-2 phase	1463 pps	
1 X speed	1-2 phase	1101 pps	LQ, Japanese Kanji
3/4 X speed	1-2 phase	825 pps	
2/3 X speed	1-2 phase	733 pps	
0.5 X speed	1-2 phase	550 pps	

2.3.5 Paper Advance Motor Drive Circuit

The printer uses a stepping motor to advance the paper. The minimum amount the printer can advance paper is 1/360 inch. The motor is a 2-2 or 1-2 phase, constant-voltage drive motor. P70 to P73 in the CPU are the control ports for the stepping motor. Paper advance motor phase data is output through these ports. PFB to PFD are turned on and off in the PU 1501 according to the phase data the CPU sends.

When the paper advance motor is running, the voltage supplying the coil of the paper advance motor is +35 V. When the paper advance motor is not running and is in hold status, the suPply voltage to the coil is + 5 V. Switching between these two supply voltages occurs at the PFCOM terminal of the PU 1501 when /PFENB is turned on or off.

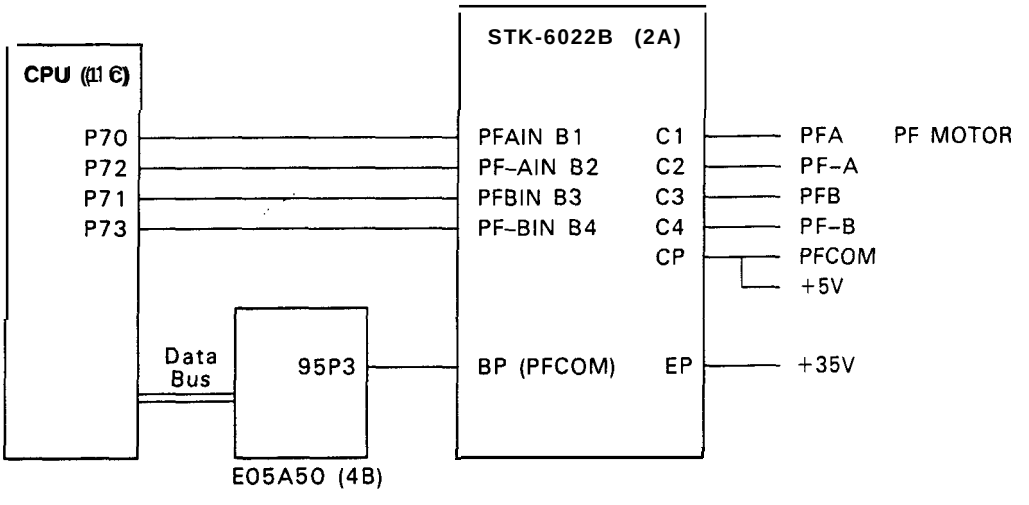


Figure 2-23. Paper Advance Motor Drive Circuit

2.3.6 Printhead Drive Circuit

Figure 2-24 shows the printhead drive circuit in block diagram form. The print data already has been expanded to create the image data. The CPU splits up this data three times and transfers this information to the latch circuit in the E05A49. The CPU samples the voltage of the +35 V line via the A/D converter. (See section 2.3.3.) The CPU outputs a pulse via the CPU time output port PPO. The length of this pulse corresponds to the +35 V line voltage. This pulse becomes the head drive signal. In this way, PU4 135 (8 A-1 3A) outputs head drive signals (signals HD 1 to HD24) that relate to voltage levels through the length of the pulses. These signals are output to the head for each of the sections of print data that were created by dividing the data three times before sending it.

By sampling the +35 V line voltage and determining the length of the head drive signal, it is possible to keep the energy supplied to the head constant. If the voltage of the +35 V line is HIGH, the CPU shortens the output pulse. If the voltage of the +35 V line is LOW, the CPU lengthens the output pulse.

Figure 2-25 shows the timing of the head drive signal output.

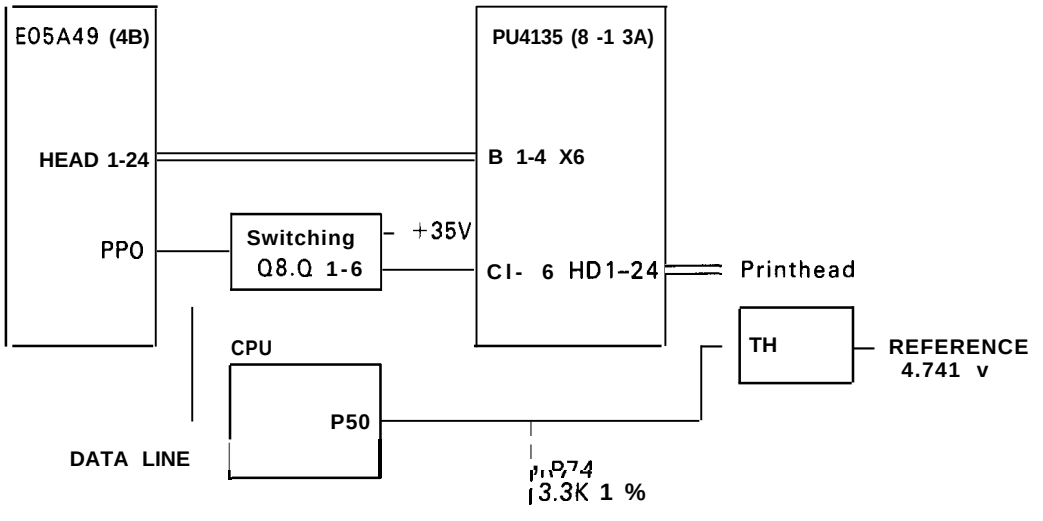


Figure 2-24. Printhead Drive Circuit

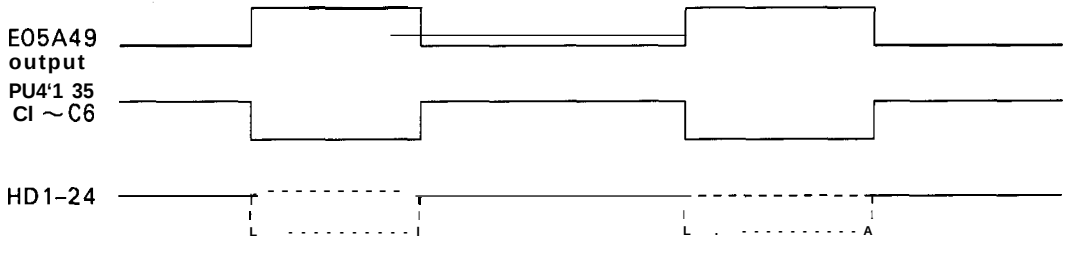


Figure 2-25. Head Drive Signal Output Timing

2.3.7 Parallel Interface Circuit

Figure 2-26 shows the parallel interface circuit in block diagram form. The /STROBE signal latches the data sent from the host computer in E05A49.E05A49 automatically outputs the BUSY signal to stop the host computer from sending more data. Then it outputs the /IBF signal for the CPU. The CPU receives the \IBF signal via the interrupt signal input port P82, recognizes that the printer has received the data from the host computer, and reads the data latched in the E05A49. Then the CPU resets the BUSY signal so that the printer is ready to receive more data from the host computer.

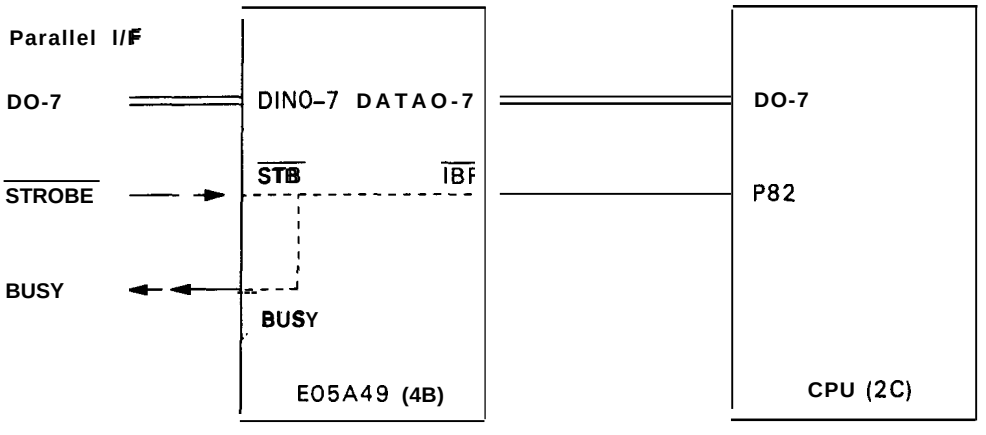


Figure 2-26. Parallel Interface Circuit

2.3.8 EEPROM Control Circuit

Figure 2-27 shows the EEPROM control circuit in block diagram form. The EEPROM contains information such as the top-of-form position. EEPROM is non-volatile memory so information it contains is not lost when you turn off the printer. Because the EEPROM is a serial I/O device, E05A49 converts the 8-bit parallel data that the printer receives from the CPU to serial data.

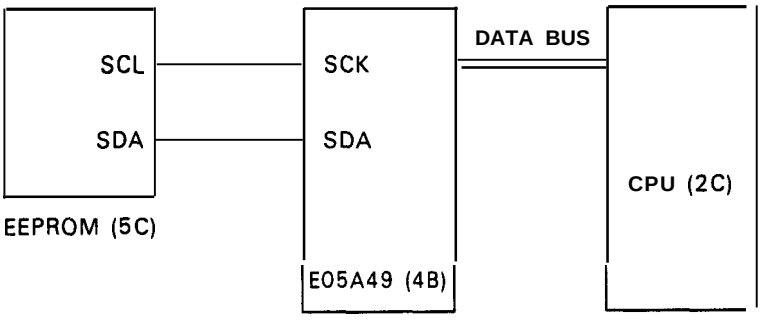


Figure 2-27. EEPROM Control Circuit

CHAPTER 3
DISASSEMBLY AND ASSEMBLY

LIST OF FIGURES

LIST OF TABLES

3.1 OVERVIEW

This section describes disassembly precautions, tools, service checks after repair, and screw specifications.

3.1.1 Disassembly Precautions

Follow the precautions below when disassembling the printer.

WARNING

Before disassembling, assembling, or adjusting the printer, disconnect the power cord from the external AC power socket. Failure to do so risks personal injury. The printer's power switch is wired into the primary circuitry. As a result, the printer still remains live with current flowing even when this switch is off.

CAUTION

For efficient printer operation, use only the recommended tools for maintenance work.
Use only the lubricants and adhesives recommended in Chapter 6.
Adjust the printer only as described in this manual.

3.1.2 Tools

Tables 3-1 and 3-2 list the tools you need when disassembling, assembling, or adjusting the printer. Use only tools that meet these specifications.

Table 3-1. Recommended Tools

Tool	Part No.
Round-nose pliers	B740400100
Nippers	B7405OO1OO
Tweezers	B74 1000100
Soldering iron	B740200 100
E-ring holder # 2.5 (Note 2)	B740800400
E-ring holder # 5	B740800700
E-ring holder # 6	B740800800
Phillips screwdriver No. 2	B743800200
Normal screwdriver	B743000 100
Box driver (7 mm across)	B74 1700200
Thickness gauge (0.36 mm)	—
Thickness gauge (0.40 mm)	—

NOTE

All tools are commercially aveilable.

Table 3-2. Equipment Required for Maintenance

Description	Specification
Multimeter	
Oscilloscope	20 MHz

3.1.3 Service Checks After Repair

When repaired printer is to be sent back to the customer, use the checklist shown in Table 3-3 to note the current state of the components. This checklist provides a record to make servicing and shipping more efficient.

Table 3-3. Inspection Checklist for Repaired Printer

Category	Component	Item(s) to Check	Is Check Required?
Printer features	Printhead	Are any wires broken?	Checked, • Not necessary
		Are any wires worn out?	❑ Checked, ❑ Not necessary
	Carriage mechanism	Does the carriage move smoothly? ❑ Movement noisy, ❑ Mechanism dirty, ❑ Mechanism oily	❑ Checked, ☐ Not necessary
		Is the carriage motor running at the correct temperature and not overheating?	❑ Checked, ❑ Not necessary
	Paper advance mechanism	Is the paper advancing smoothly? ❑ Movement noisy, ❑ Mechanism dirty, Mechanism oily	❑ Checked, ❑ Not necessary
		Is the paper advance motor running at the correct temperature and not overheating?	❑ Checked, ❑ Not necessary
	Paper path	Is the paper in the printer feeding smoothly?	❑ Checked, ☐ Not necessary
	•	Is the tractor feeding the paper correctly?	Checked, ❑ Not necessary
	•	Is the paper path clear of all obstructions?	Checked, ❑ Not necessary
		Is the platen free of damage?	☐ Checked, ❑ Not necessary
	Ribbon mask	Is the ribbon mask free of distortion?	Checked, ❑ Not necessary
	Self-test	Was the self test successful?	Checked, ☐ Not necessary
	On-line test	Was the on-line test successful?	Checked, ☐ Not necessary
Adjustment	Printhead	Is the platen gap adjusted correctly?	❑ Checked, ☐ Not necessary
	Printing	Is the bidirectional print position adjusted correctly?	❑ Checked, Not necessary
	DIP switch settings	Are DIP switches" the reset to their factory shipment settings?	☐ Checked, ❑ Not necessary
System upgrade	ROM version	The ROM version is —.	Checked, ❑ Not necessary
Shipment		Is the ribbon removed?	Checked, ❑ Not necessary
		Are all necessary parts been included in the shipment?	❑ Checked, ❑ Not necessary

3.1.4 Screw Specifications

In the following sections, abbreviations are used for small parts, such as screws and washers. Tables 3-4 and 3-5 list these abbreviations.

Table 3-4. Abbreviations Used for Screws

Abbreviation	Part Name
s(c)	Cross-recessed Bind head Cone point S tight screw
CBB(C)	Cross-recessed Bind head Cone point B tight screw
CB	Cross-recessed Bind head screw
CBS(0)	Cross-recessed Bind head S tight with screw with Outside toothed lock washer

Table 3-5. Types of Screws and Abbreviations

Head		Body	Washer (assembled)
Top	Side		
cross-recessed head	1. Bind	1. Normal	1. Plain washer
	(with Notch)	2. S-tight	2. Outside toothed lock washer
1. Slotted head	2. Pan	3. B-tight	
	3. Cup	4. Tapping	3. Spring washer
	4, Truss		

3.2 DISASSEMBLY AND ASSEMBLY

This section describes how to disassemble and assemble the main components of the printer. When the procedure for installing a component in the printer is simply the reverse of the procedure for removing the component from the printer, no description of how to install the component is given.

Assembly and adjustment notes follow the disassembly procedure description, when necessary. Please follow the instructions in these notes when you assemble or adjust printer components.

CAUTION

Before disassembling any part of the printer, read the warnings in Section 3.1.
Before disassembling any part of the printer, remove the paper and the ribbon cartridge.

Disassembly consists of the following procedures:

- Removing the printhead
- Removing the case
- Removing the electrical circuits
- Removing the printer mechanism
- Disassembling the printer mechanism

Diagrams in the appendix show how the components fit together. Refer to them as necessary.

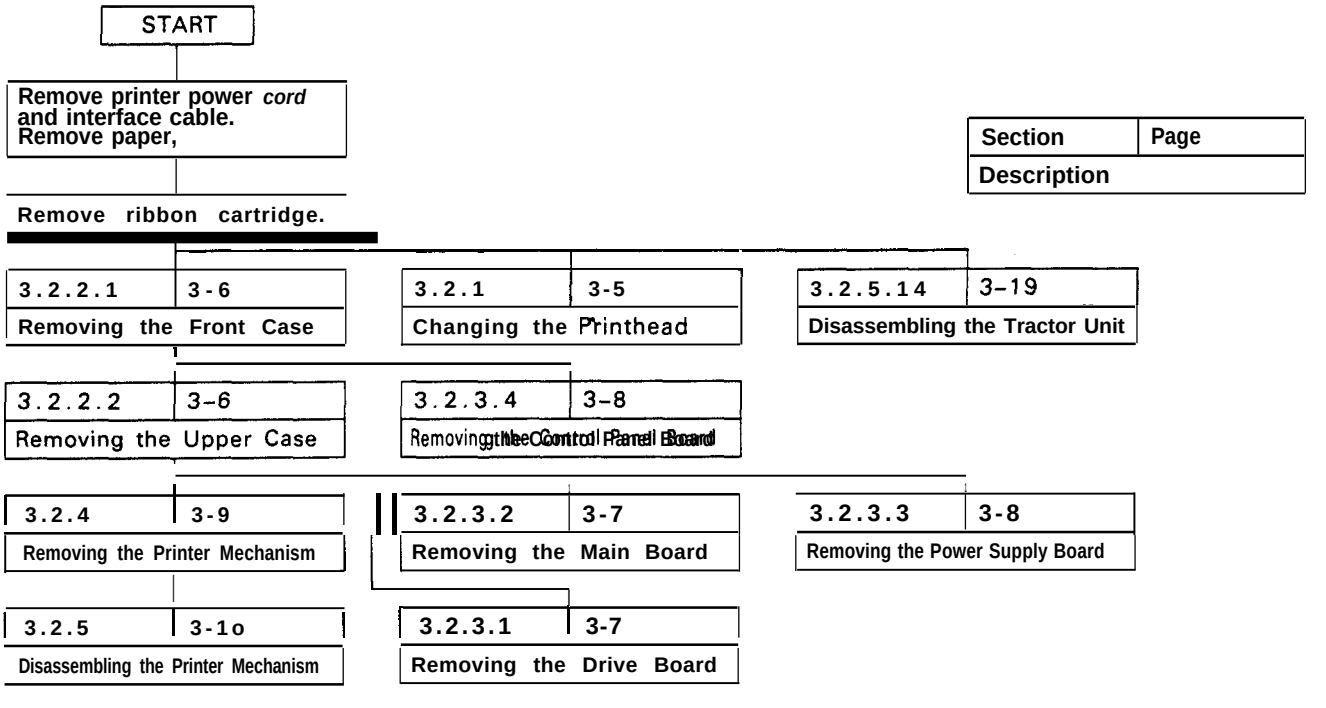


Figure 3-1. Flowchart for Disassembling the Printer

3.2.1 Removing the **Printhead**

1. **Remove the printer cover.**
2. **Remove the paper eject cover.**

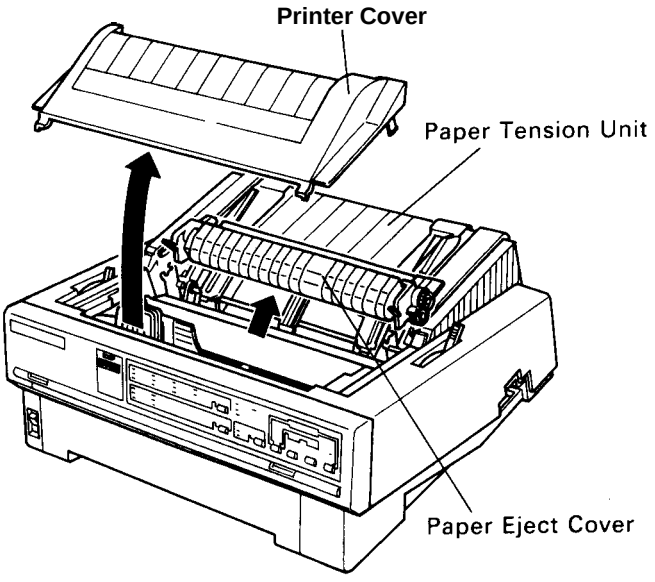


Figure 3-2. Removing the Printer and Paper Eject Covers

3. **Remove the two screws that secure the** printhead **to the carriage. Lift out the** printhead.
4. **Remove the two FFCS from the** printhead.

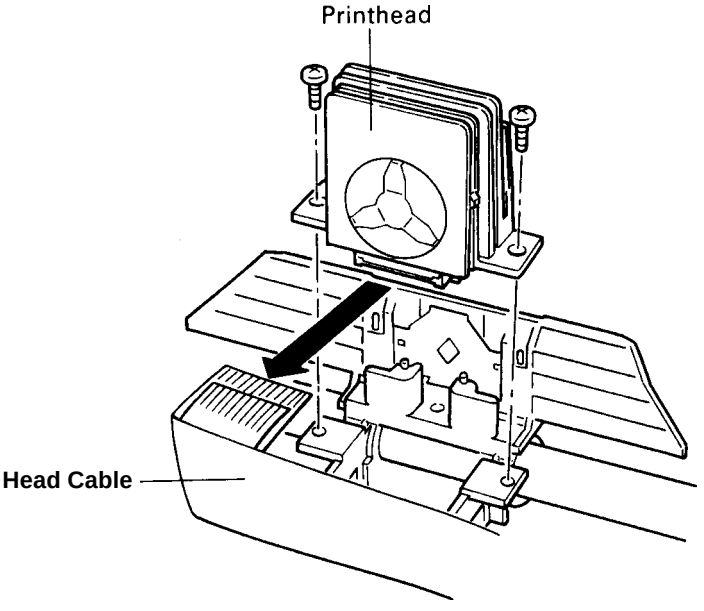


Figure 3-3. Removing the Printhead

3.2.2 Removing the Printer Case

This section describes how to remove the front case and upper case.

3.2.2.1 Removing the Front Case

1. **Remove the printer cover.**
2. **Use a screwdriver to release a clip and a screw that secure the front case to the upper case. Open the front case. Disconnect connector CN 1 on the control panel board (C060 PNL).**
3. **Remove the front case.**

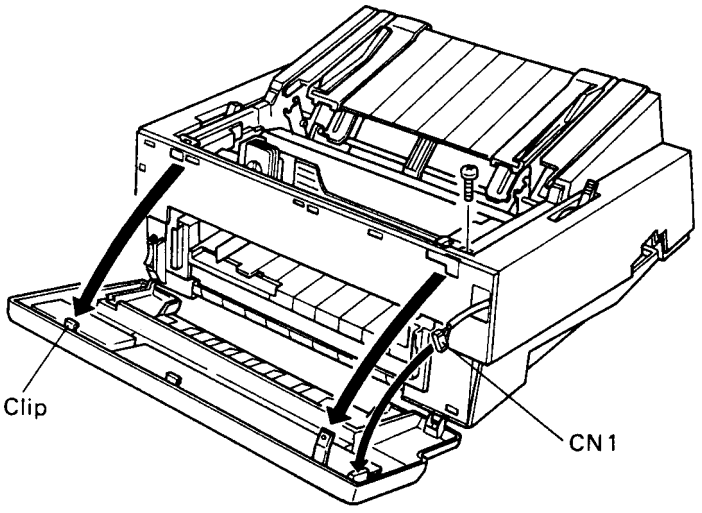


Figure 3-4. Removing the Front Case

3.2.2.2 Removing the Upper Case

1. **Remove the printer cover, the paper tension unit, the tractor, and the paper advance knob.**
2. **Remove the two CBS(C) (M3 X 12) screws that attach the optional interface card cover. Remove the cover.**

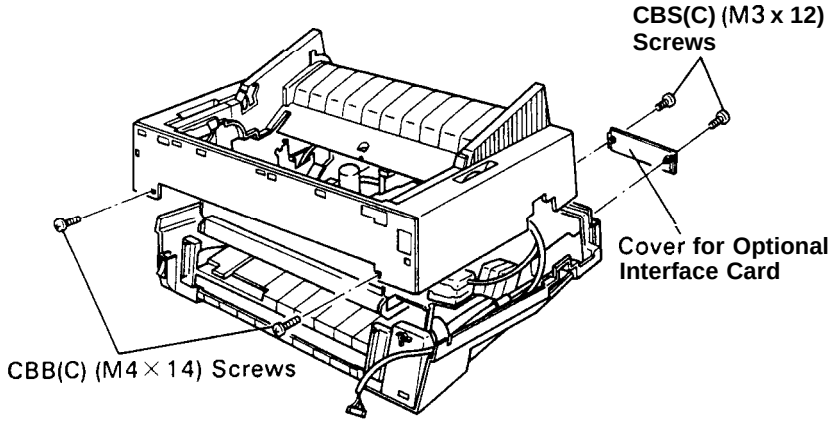


Figure 3-5. Removing the Optional Cover for Optional Interface Card

3. **Remove the front case, as described in Section 3.2.2.1.**
4. **Remove the two CBB(C) (M4 X 14) screws that secure the upper case to the lower case.**
5. **Depress the two clips that hold the upper case to the front sheet guide. Remove the upper case.**

3.2.3 Removing the Circuit Boards

This section describes how to remove the main board (C060 MAIN board), the drive board (C060DRV board), the power supply board (C060PSB/PSE board), and the control panel board (C060 PNL board).

3.2.3.1 Removing the Drive Board (C060DRV Board)

1. Remove the upper case, as described in Section 3.2.2.2.
2. Remove the mechanism unit, as described in Section 3.2.4.
3. Disconnect the cable from connector CN2.3.4.5.6.7.8.9. 10.11.12 on the drive board.
4. Disconnect the cable from connector CN 1 on the power switch.
5. Remove the four stoppers attach the main board. Remove the drive board.

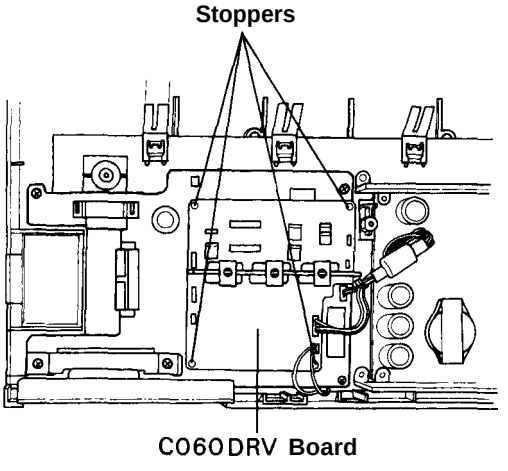


Figure 3-6. Removing the Drive Board

3.2.3.2 Removing the Main Board (C060 MAIN Board)

1. Remove the upper case, as described in Section 3.2.2.2.
2. Remove the mechanism unit, as described in Section 3.2.4.
3. Remove the drive board, as described in Section 3.2.3.1.
4. Disconnect the cable from connector CN.4.on the PSB Board.
5. Remove the CB (M3 X 12) screws that secures the the lower case.
6. Remove the the main board.

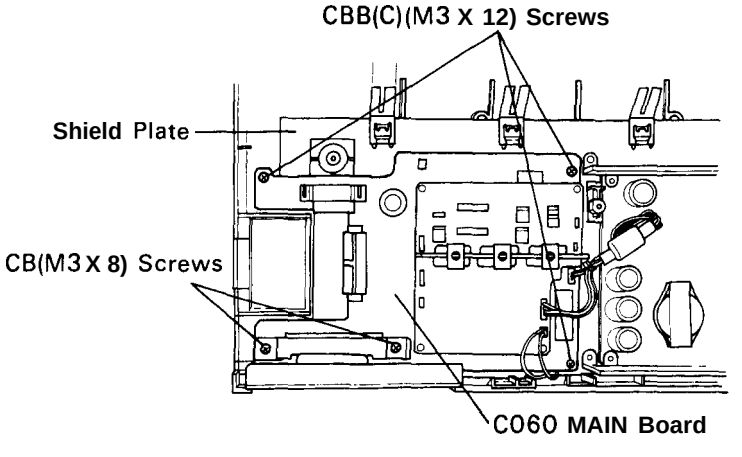


Figure 3-7. Removing the Main Board

Assembly and Adjustment Note

After replacing the main board, you must adjust the bidirectional print position again to ensure that bidirectional printing is correctly aligned. (See Section 4.2.)

3.2.3.3 Removing the Power Supply Board (C060PSB/PSE Board)

1. Remove the upper case, as described in Section 3.2.2.2.
2. Remove the mechanism unit, as described in Section 3.2.4.
3. Disconnect the cable from connector CN2 on the main board.
4. Disconnect the cable from connector CN 1 on the power switch.
5. Remove the two CBB(C)(M3 X 12) screws and the CBS(C)(M3 X 8) screws that attach the power supply board to the lower case. Remove the power supply board.

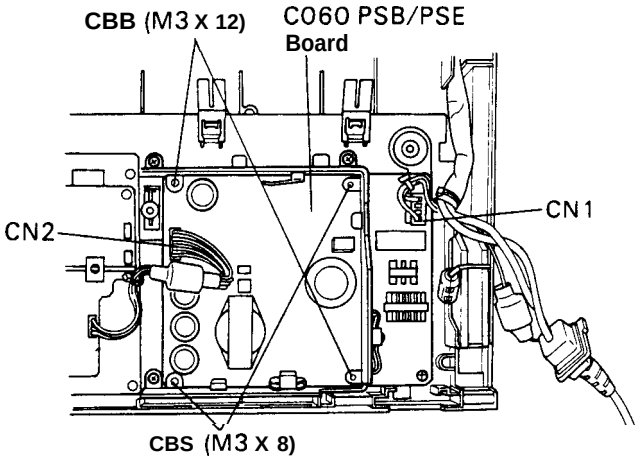


Figure 3-8. Removing the Power Supply Board

3.2.3.4 Removing the Control Panel Board (C060PNL Board)

1. Remove the front case, as described in Section 3.2.2.1.
2. Remove the 4 CBB(C)(M3 X 12) screws that secure the control panel board to the front case. Remove the control panel board.

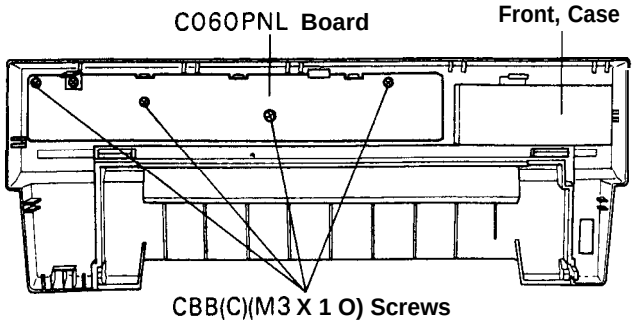


Figure 3-9. Removing the Control Panel Board

3.2.4 Removing the Printer Mechanism

1. **Remove the upper case, as described in Section 3.2.2.2.**
2. **Remove the CB (M3 X 6) screws that attach the FFC holding plate to the shield plate. Remove the FFC holding plate.**
3. **Disconnect the 2 FFCS from connectors CN3 and CN4 on the drive board. Disconnect the cables for thefollowing C060 DRV board connectors: CN5 (white, 2-pin); CN6 (white, 5-pin); CN7 (black, 5-pin); CN8 (white, 2-pin); CN9 (black, 2-pin); CN 10 (black, 3-pin); CN 11 (blue, 2-pin); and CN 12 (white, 3-pin).**
4. **Remove the CBB(C) (M3 X 6) screws that secure the printer mechanism to the shield plate. Remove the right shield plate.**
5. **Remove the three CBB(C) (M4 X 14) screws that secure the printer mechanism to the lower case. Remove the printer mechanism.**

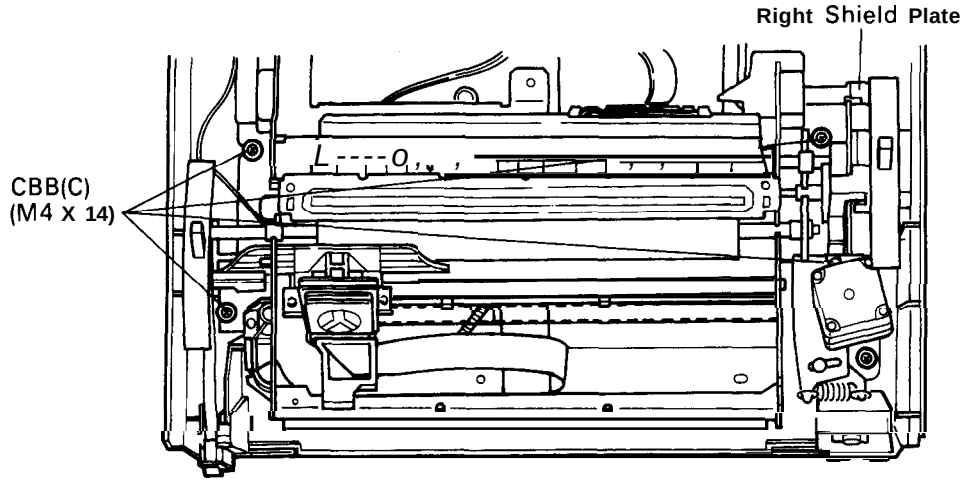


Figure 3-10. Removing the Printer Mechanism

Assembly and Adjustment Note

After replacing the printer mechanism, you must adjust the bidirectional print position to ensure that bidirectional printing is correctly aligned. (See Section 4.2.)

3.2.5 Disassembling the Printer Mechanism

This section describes how to disassemble the main components of the printer mechanism.

3.2.5.1 Removing the Carriage Motor

1. **Remove the printer mechanism from the lower case, as described in Section 3.2.4.**
2. **Remove the printer spring (1 056 gm) from the base frame and the carriage motor frame.**
3. **Remove the timing belt from the belt pulley.**
4. **Remove the carriage motor frame from the right frame.**
5. **Remove the two CBS(0) (M3 X 6) screws that hold the carriage motor to the carriage motor frame. Remove the carriage motor.**

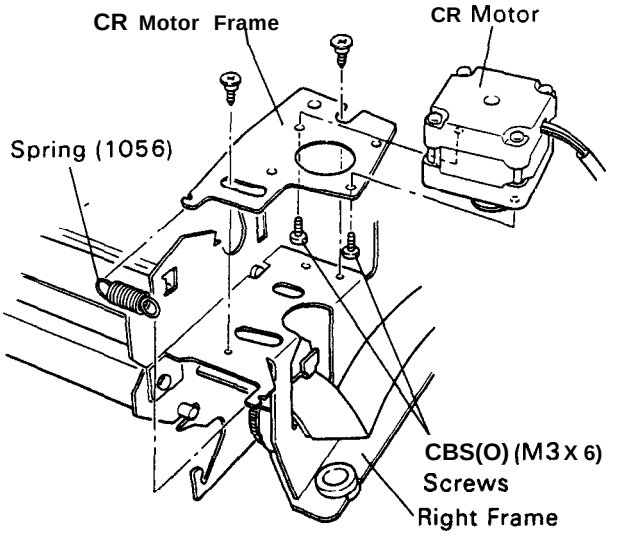


Figure 3-11. Removing the Carriage Motor

Assembly and Adjustment Notes

See Section 3.2.5.15 for details on arranging and positioning the motor cable.

After removing the carriage motor from the carriage motor frame, you must adjust the carriage motor backlash (see Section 4.1. 1). You also must. adjust the bidirectional print position to ensure that bidirectional printing is correctly aligned. (See Section 4.2.)

3.2.5.2 Removing the Paper Advance Motor

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Remove the retaining spring that holds the platen shaft.
3. Release the two clips holding the paper advance motor to the right frame.
4. Remove the paper advance motor from the right frame.

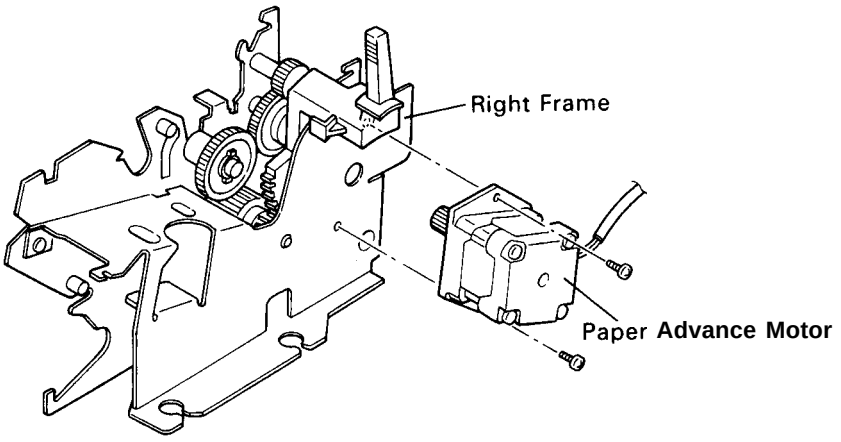


Figure 3-12. Removing the Paper Advance Motor

Assembly Note

See Section 3.2.5.15 for details on arranging and positioning the motor cable.

3.2.5.3 Removing the FFC

1. Remove the printhead, as described in Section 3.2.1.
2. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
3. Remove the FFC from the clips that hold it along the rear side of the printer mechanism. Make sure that the FFC is free.
4. Remove the FFC from clip on the head cable holder at the rear of the printer mechanism.
5. Remove the clips that hold the head cableholder to the base frame. Remove the FFC and the head cable holder.

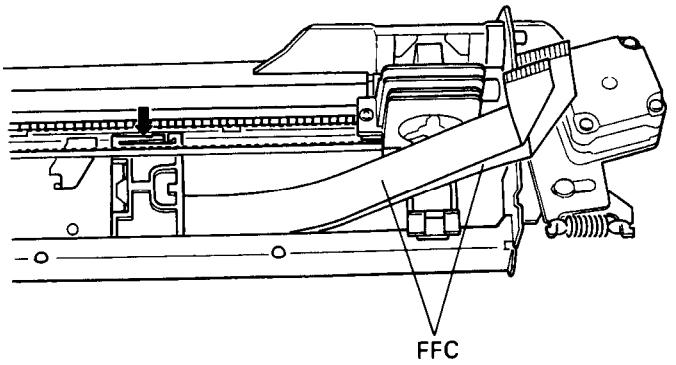


Figure 3-13. Removing the FFC Cable

Assembly Note

See Section 3.2.5.15 for details on arranging and positioning the FFC.

3.2.5.4 Removing the Carriage

1. **Remove the FFC, as described in Section 3.2.5.3.**
2. **Remove the timing belt from the carriage as described in Section 3.2.5.1.**
3. **Use the box driver to rotate and free the adjusting bushing. This bushing holds the carriage guide shaft to the right frame. Remove the bushing.**
4. **Remove the carriage unit and the carriage guide shaft by pulling the carriage guide shaft a little to the right.**

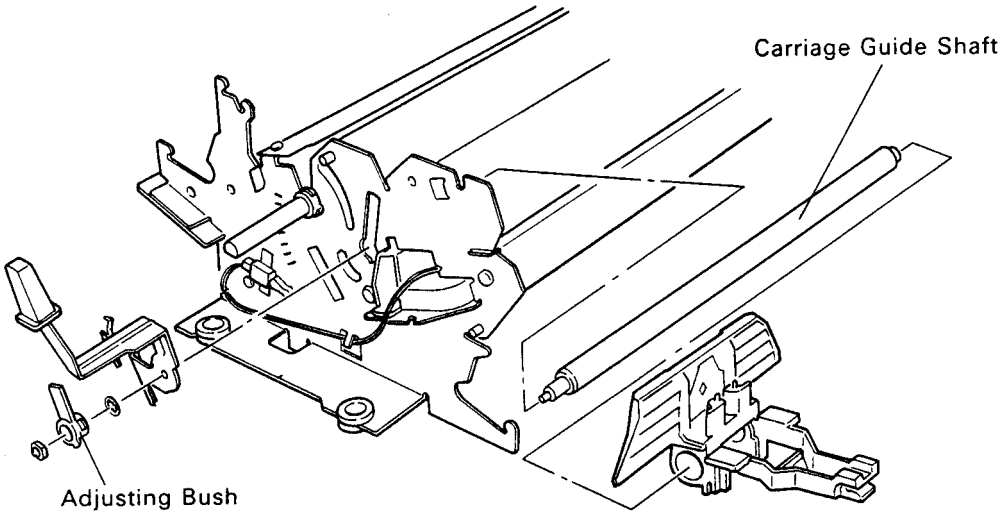


Figure 3-14. Removing the Carriage Unit

Assembly and Adjustment Note

After removing or rotating the adjusting bushing, you must adjust the platen gap (see Section 4. 1.2).

3.2.5.5 Removing the Platen

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Remove the two CBP(C)(M3 X 10) screws that secure the platen cover to the left and right frames. Remove the platen cover.
3. Remove the retaining spring that holds the platen shaft. (See Section 3.2.5.2, step 2.)
4. Set the head adjust lever to the most forward position.
5. Remove the two clips that secure the release lever to the platen shaft. Remove the release lever from the platen shaft.
6. Rotate the bushing that holds the platen to the left frame. Remove this bushing.
7. Rotate the bushing that holds the platen to the right frame. Remove the platen by lifting it up and toward the right.

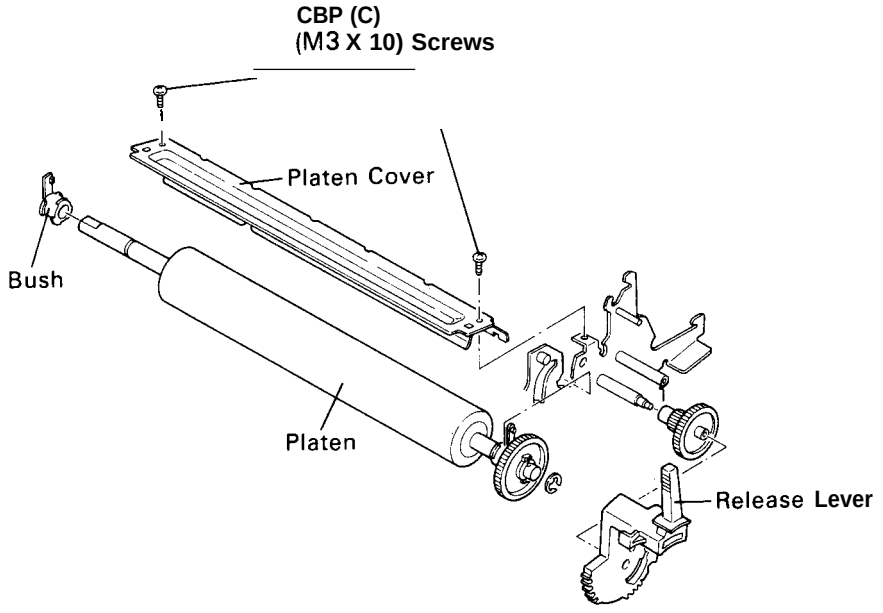


Figure 3-15. Removing the Platen

Assembly Note

When you insert the release lever onto the platen shaft, mesh the release lever with the mechanism correctly by positioning the lever at the mark on the auxiliary release shaft.

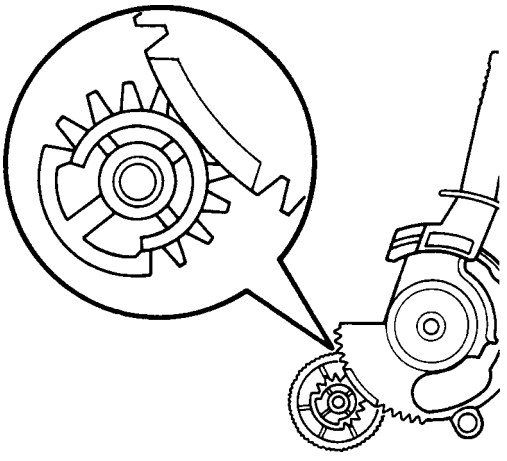


Figure 3-16. Positioning the Release Lever for Insertion

3.2.5.6 Removing and Disassembling the Right Frame

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Remove the platen from the printer mechanism, as described in Section 3.2.5.5.
3. Remove the carriage motor from the base frame, as described in Section 3.2.5.1.
4. Remove the three CBS(C)(P) (M3 X 10) screws that secure the right frame to the base frame. Remove the right frame from the base frame.
5. Remove the following items from the right frame in the this order: paper advance motor, tractor clutch cam, cog(8.5 mm, 30 mm), cog (34 mm), plain washer, spring (200 gin), and cog (15 mm).

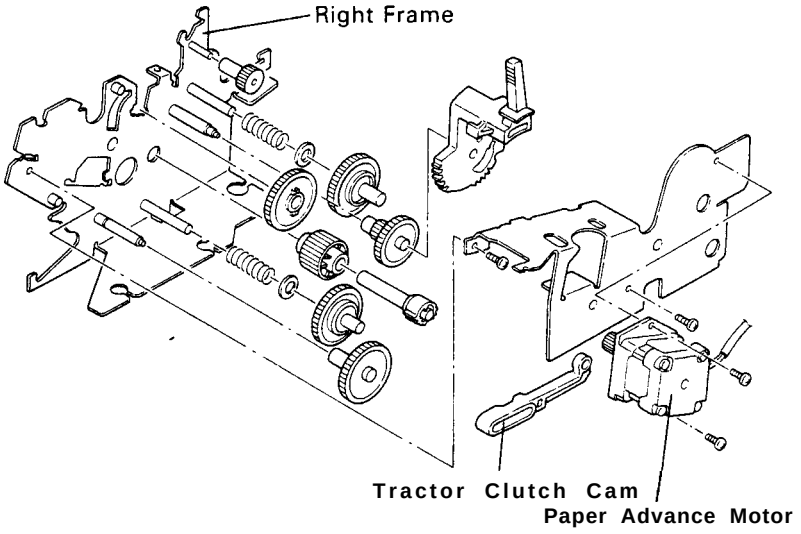


Figure 3-17. Disassembling the Right Frame

3.2.5.7 Removing and Disassembling the Left Frame

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Remove the platen from the printer mechanism, as described in Section 3.2.5.5.
3. Remove the carriage motor from the base frame, as described in Section 3.2.5.1.
4. Remove the three CBS(C)(P) (M3 X 8) screws that secure the left frame to the base frame. Remove the left frame from the base frame.

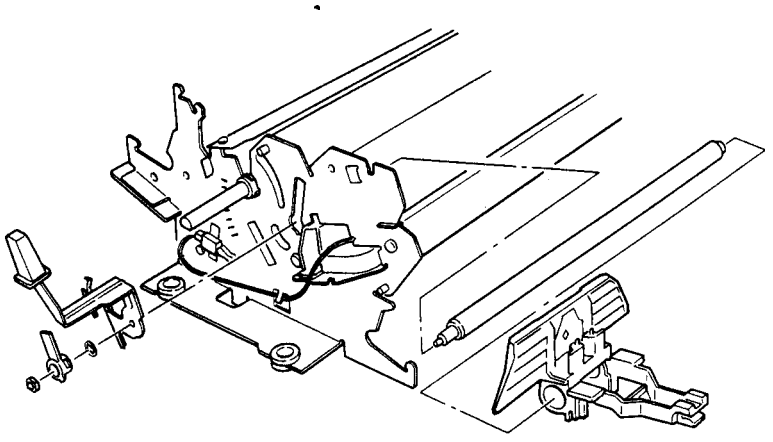


Figure 3-18. Disassembling the Left Frame

3.2.5.8 Removing and Disassembling the Paper Guide Support Assembly

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Remove the platen from the printer mechanism, as described in Section 3.2.5.5.
3. Removing and Disassembling the Right Frame as described in Section 3.2.5.6.
4. Removing and Disassembling the Left Frame as described in Section 3.2.5.7.
5. Remove the Paper Guide Support Assembly.

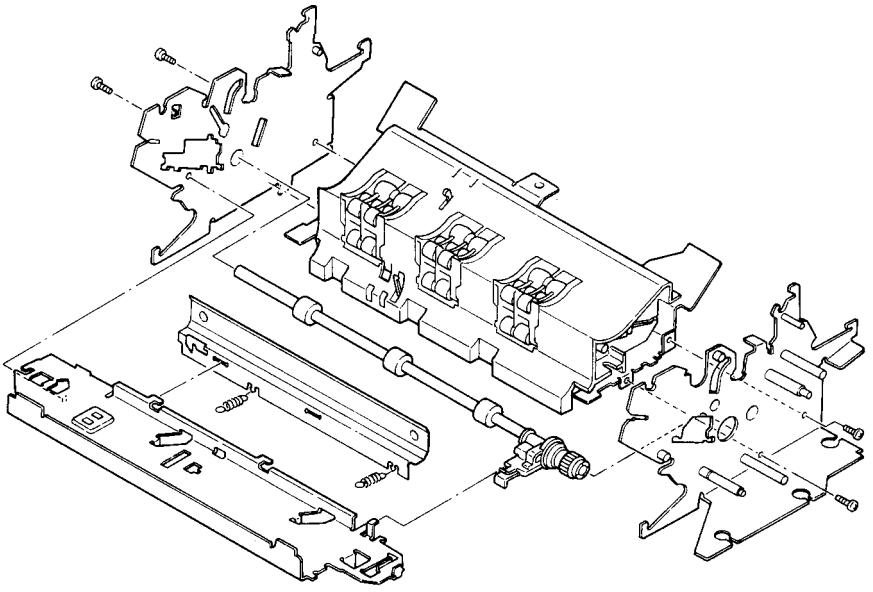


Figure 3-19. Disassembling the Paper Guide Support Assembly

3.2.5.9 Removing and Disassembling the Carriage Guide Assembly

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Remove the platen from the printer mechanism, as described in Section 3.2.5.5.
3. Removing and Disassembling the Right Frame as described in Section 3.2.5.6.
4. Removing and Disassembling the Left Frame as described in Section 3.2.5.7.
5. Remove the Carriage Assembly.

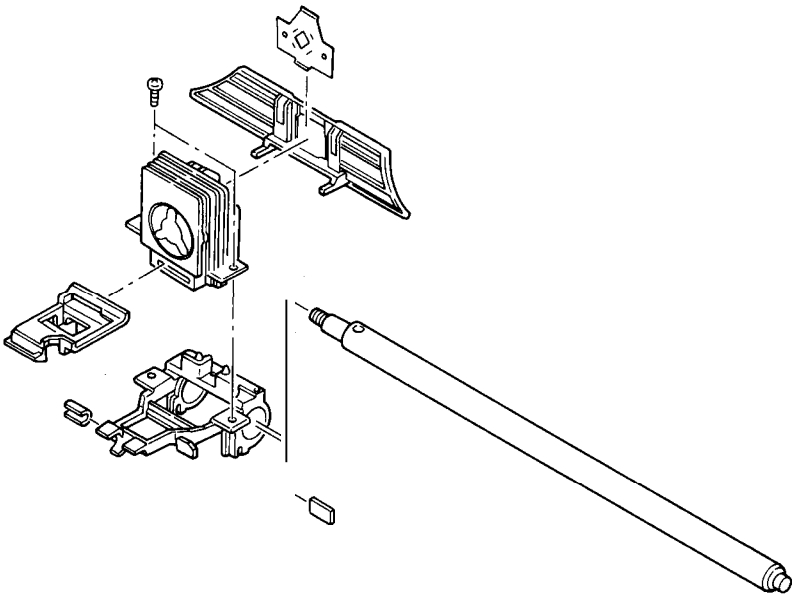


Figure 3-20. Disassembling the Carriage Guide Assembly

Assembly Note

When you install the plain washer, insert it from the front in the direction indicated by the mark.

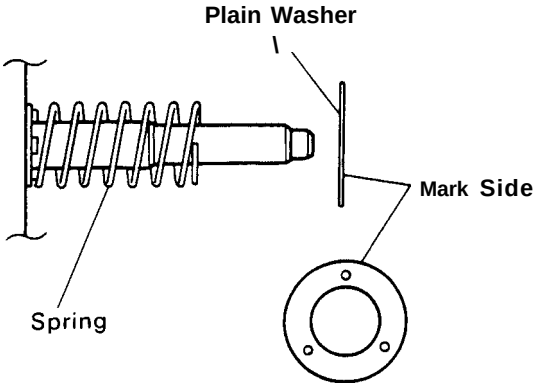


Figure 3-21. Plain Washer Insertion Direction

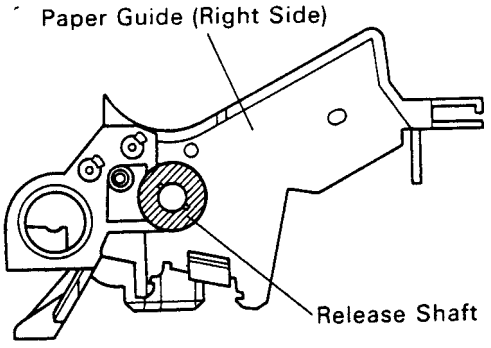


Figure 3-22. Inserting the Release Shaft

3.2.5.10 Removing the Home-Position Sensor

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Remove the clips that secure the home-position sensor from the rear side of the base frame. Remove the home-position sensor from the rear of the base frame.

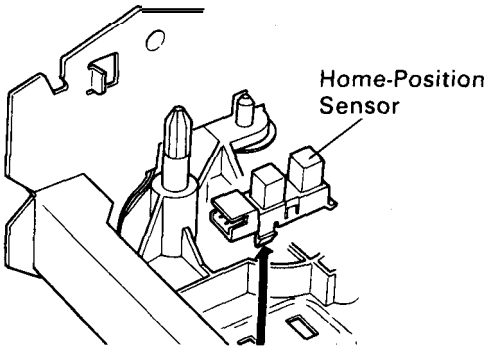


Figure 3-23. Removing the Home-Position Sensor

3.2.5.11 Removing the Rear Paper-Out Detector

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Remove the two CBP(C) (M3 X 10) screws that hold the platen cover to the frame. Remove the platen cover.
3. Remove the clips that hold the rear paper-out detector in the paper guide. Remove the rear paper-out detector.

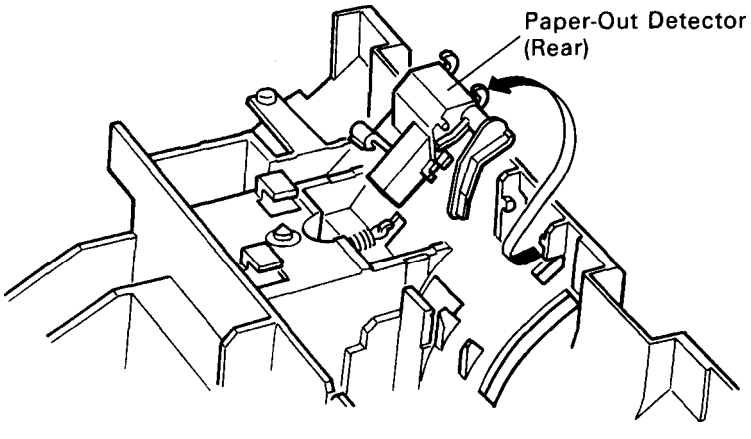


Figure 3-24. Removing the Rear Paper-Out Detector

3.2.5.12 Removing the Front Paper-Out Detector

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Open the clips that hold the front paper-out detector to the base frame. Remove the front paper-out detector.

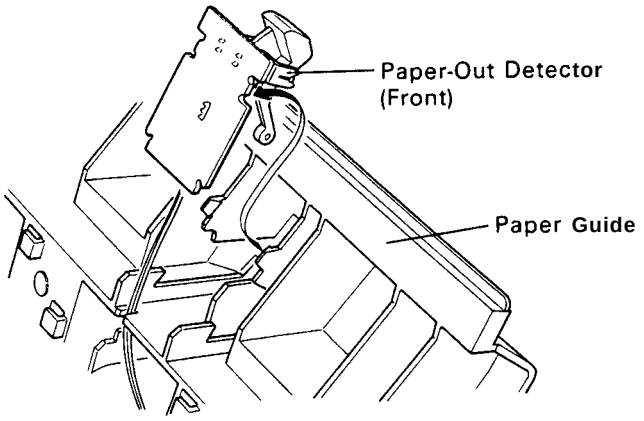


Figure 3-25. Removing the Front Paper-out Detector

3.2.5.13 Removing the Platen-Gap Sensor

1. Remove the printer mechanism from the lower case, as described in Section 3.2.4.
2. Remove the clips that hold platen-gap sensor to the left frame. Remove the platen-gap sensor.

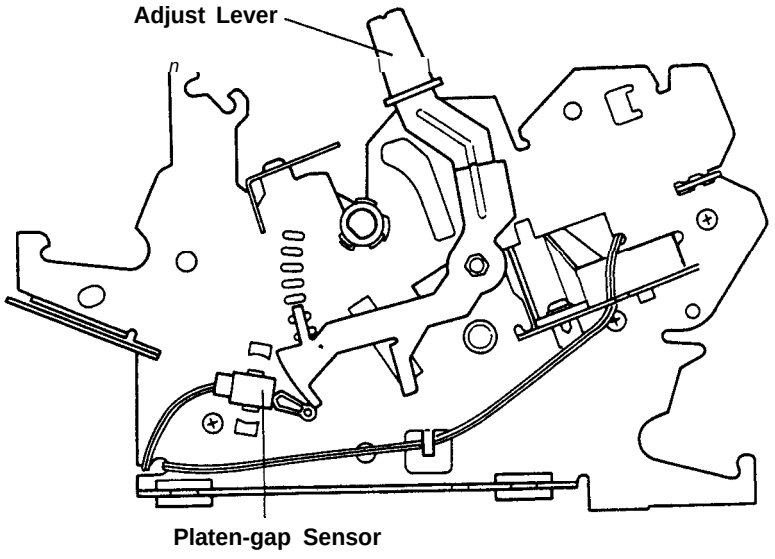


Figure 3-26. Removing the Platen-Gap Sensor

3.2.5.14 Disassembling the Tractor Unit

1. Remove the tractor unit from the printer.
2. Remove the cog (17 mm) from the tractor shaft.
3. Remove the right tractor frame from the tractor shaft and the tractor guide shaft.
4. Remove E-ring 6 from the tractor shaft.
5. Remove the right tractor, the paper support unit, and the left tractor from the tractor shaft and tractor guide shaft.

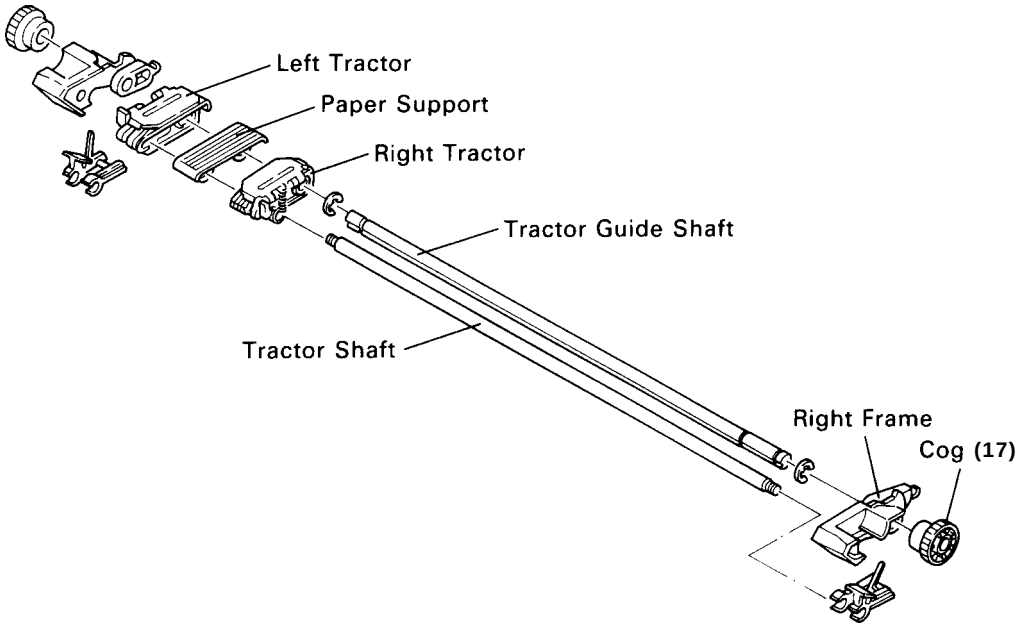


Figure 3-27. Disassembling the Tractor Unit

3.2.5.15 Arranging the Cables

When you assemble the printer, arrange the cables as shown in Figure 3-28.

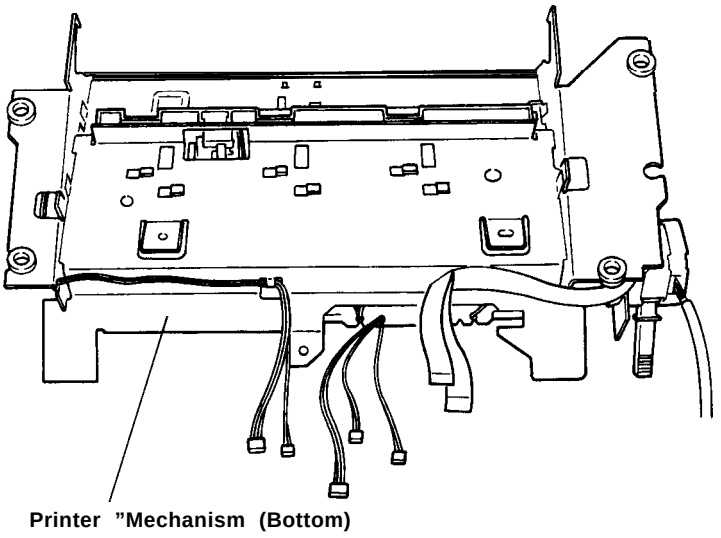


Figure 3-28. Arranging the Cables

CHAPTER 4
ADJUSTMENTS

LIST OF FIGURES

4.1 ADJUSTING THE PRINTER MECHANISM

This section describes the various adjustments you may need to make to the printer mechanism.

4.1.1 Paper feed Motor Backlash Adjustment

In the PF motor backlash adjustment, the pinion gear of the PF motor is meshed smoothly with the cog. If the pinion gear is poorly aligned, printer operation becomes noisy, and the accuracy of character lignment during printing suffers.

1. **Remove the PF motor, along with the Right frame, from the printer mechanism (see Section 3.2.5. 1).**
2. **Loosen the two CBS(0) (M3 X 6) screws that hold the PF motor to the Right frame.**
3. **Check the alignment of the PF motor pinion gear with the pulley cog. Move the Right until you judge that there is a gap of about 0.05-0.15 mm (0.002 -0.006 inch) between the two. Tighten the two CBS(0) (M3 X 6) screws.**

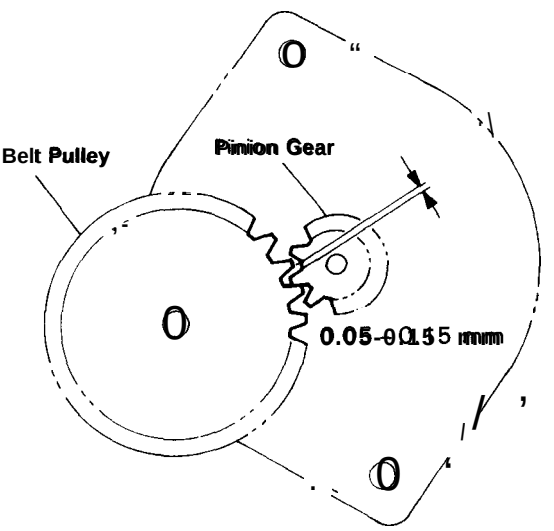


Figure 4-1. Paper Advance Motor Backlash Adjustment

4.1.2 Platen Gap Adjustment

If you have rotated or reassembled the carriage guide shaft or the adjusting bushing, or if printing is abnormal, you must adjust the gap between the platen and the printhead.

1. **Remove the printer mechanism from the lower case (see Section 3.2.4).**
2. **Remove the printhead from the carriage (see Section 3.2. 1).**
3. **Use tweezers to remove the ribbon mask from the carriage.**

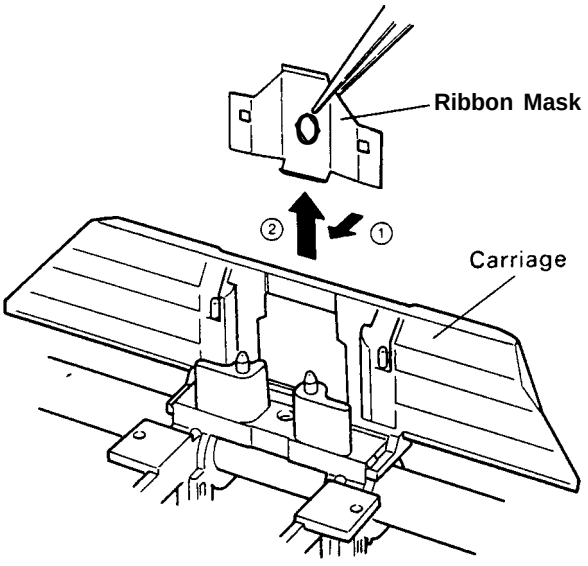


Figure 4-2. Removing the Ribbon Mask

4. **Remount the printhead on the carriage.**
5. **Set the paper adjustment lever to position O (the second step position) from rear.**
6. **Move the release lever backward to the friction setting.**
7. **Move the carriage until the edge of the printhead is at the fifth column print position.**
8. **Use the box driver (7 mm) to rotate the adjusting bushing on the left frame of the printer mechanism.**

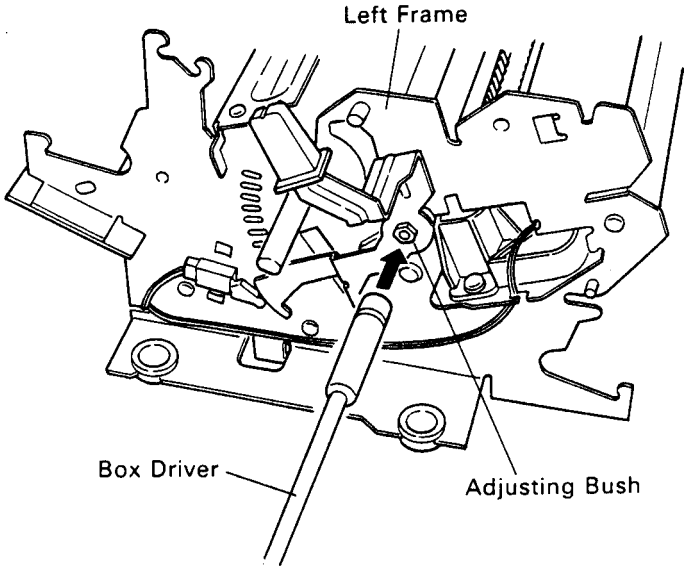


Figure 4-3. The Adjusting Bushing

9. Rotate the adjusting bushing until the platen gap is large enough for a 0.36 mm thickness gauge but too narrow for a 0.40 mm thickness gauge.

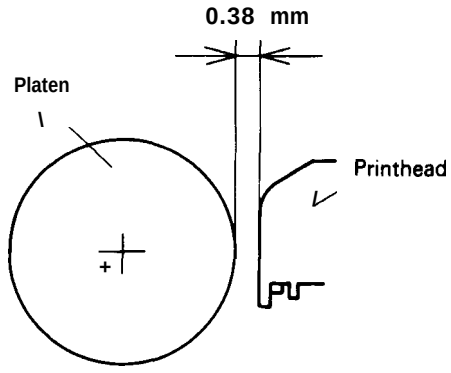


Figure 4-4. Platen Gap

10. Move the carriage until the edge of the printhead is at the 75th column print position for an 80-column printer or at the 130th column print position for a 136-column printer.
11. Use the box driver (7 mm) to rotate the adjusting bushing on the right frame of the printer mechanism.
12. Rotate the adjusting bushing until the platen gap is large enough for a 0.36 mm thickness gauge but too narrow for a 0.40 mm thickness gauge.
13. Move the printhead back again so that the edge of the printhead is at the 5th column print position. Check the platen gap again with the thickness gauge. It should still be large enough for a 0.36 mm thickness gauge but too narrow for a 0.40 mm thickness gauge. If this is not the case, go back to step 8.
14. Center the carriage. Check the platen gap again with the thickness gauge. It should still be large enough for a 0.36 mm thickness gauge but too narrow for a 0.40 mm thickness gauge. If this is not the case,go back to Step 8.
15. Remove the printhead, install the ribbon mask, and then replace the printhead.

4.2 BIDIRECTIONAL PRINT POSITION ADJUSTMENT

This section describes how to adjust the bidirectional print position to ensure correct printing alignment.

4.2.1 Overview of Bidirectional Print Position Adjustment

This printer prints characters when the carriage is moving in either direction (i.e., from left to right or from right to left). Adjustment is necessary to ensure that the printing of characters in one direction is properly aligned with the printing of characters in the opposite direction. For example, if the the print position is out of alignment, printing of a vertical line shows staggering because of the skew effect.

It is important to readjust the bidirectional print position if anything has been done to the gear arrangement that might affect this printing alignment. By making the timing lag slightly during printing while the carriage moves from right to the left, it is possible to line up printing done in this direction so that it will match printing done in the left-to-right direction. The procedure to alter the timing is called the bidirectional print position adjustment.

The degree of bidirectional printing skew differs, depending on the unique characteristics of each printer mechanism. For this reason, there is no standard skew correction value that can be applied to each printer. The unique skew correction value for each printer has to be written to EEPROM on the main board.

Whenever the printer mechanism, or the main board itself, is changed during servicing, the bidirectional print position must be readjusted and a new bidirectional skew correction value must be written to EEPROM.

4.2.2 Bidirectional Print Position Adjustment Procedure

Initial operation

Before performing the bidirectional alignment adjustment, complete the initial operation below:

- Position the adjustment lever at position O.
- Verify that the DIP switch setting for high-speed draft is off (DIP switch 1-6 is on).
- Verify that the DIP switch setting for country is U.S. (DIP switches 1-1, 1-2, and 1-3 are on, and 1-4 is off).
- Load paper.
- Feed at least 10 lines.
- Turn the printer off.

NOTE: The printer enters unidirectional printing mode automatically from the top of form to the line 10 position on the paper, because this improves paper-feed accuracy. Therefore, you must perform the bidirectional alignment adjustment after 10 lines or more have been fed.

Adjustment operation

The alignment procedure is as follows:

1. Turn the printer power on while pressing the ALT, LF/FF, and LOAD\ EJECT buttons.
2. The printer enters draft mode and prints the reference value and "|" characters for 4 lines.

Are the characters aligned vertically? NO → GO TO STEP 6.
YES → GO TO STEP 7.

3. Refer to the odd-numbered lines (Ist and 3rd), and adjust the even-numbered lines (2nd and 4th).

* If the even-numbered lines are shifted o the right:
→ Press the LOAD/EJECT button once while pressing the ALT button.
(The reference value increases + 1 and even lines shift to the left.
* If the even-numbered lines are shifted to the left:
→ Press the LF\FF button once while pressing the ALT button.
(The reference value decreases – 1 and even lines shift to the right.)

4. Press the ALT,LF/FF, and LOAD/EJECT buttons at the same time.
5. The printer enters LQ mode, and the printer prints the reference value and the "I" characters for 4 lines.

Are the characters aligned vertically? NO → GO TO STEP 6.
YES → GO TO STEP 7.

6. Refer to the odd-numbered lines (1st and 3rd), and adjust the even-numbered lines (2nd and 4th).

* If the even-numbered lines are shifted to the right:
→ Press the LOAD/EJECT button once while pressing the ALT button.
(The reference value increases + 1 and even lines shift to the left.)
* If the even-numbered lines are shifted to the left:
→ Press the LF/FF button once while pressing the ALT button.
(The reference value decreases – 1 and even lines shift to the right.)

7. Turn printer power off.

CHAPTER 5
TROUBLESHOOTING

LIST OF FIGURES

LIST OF TABLES

5.1 OVERVIEW

Problems in the printer may exhibit a variety of symptoms, which can complicate the task of troubleshooting, unless you follow the procedure shown in the flowchart below.

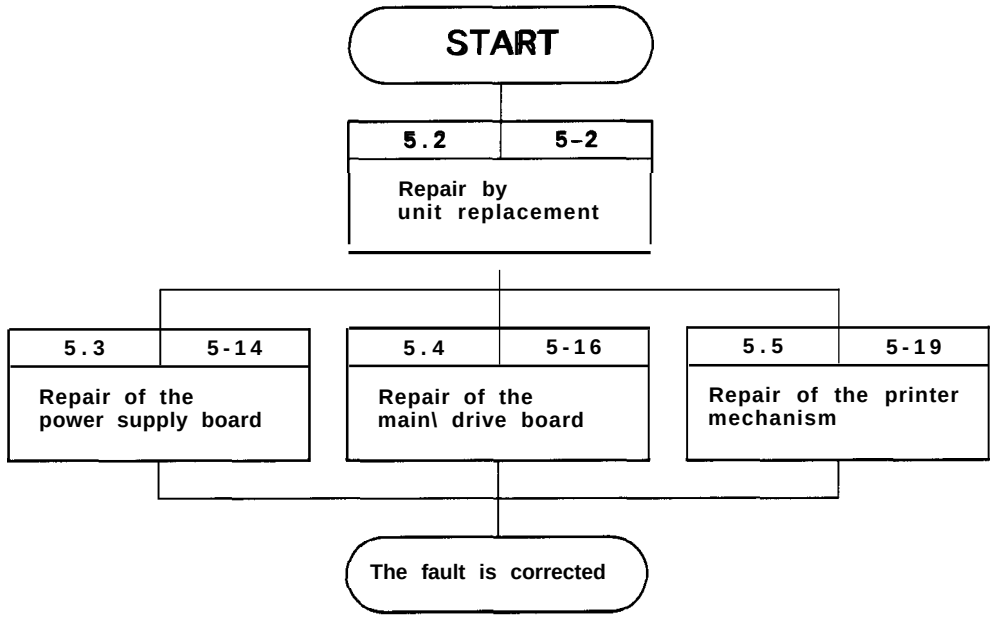


Figure 5-1. Troubleshooting Procedure

The following tables provide troubleshooting information.

Table 5-1. Motor and Printhead Coil Resistance

Part	Specifications
Carriage motor	Coil resistance 5.0 ohms +/- 7% at 25 degrees C(77 degrees F)
Paper-feed motor	Coil resistance 79.0 +/- 5 ohms at 25 degrees C (77 degrees F)
Printhead	Coil resistance 45.5 +/- 3.0 ohms at 25 degrees C (77 degrees F)

Table 5-2. Error Codes

Error Display	Error	Cause
Buzzer beeps 3 times for 0.1 second, with O. l-second intervals.	Paper-out error	. Printer is out of paper. . Paper-end sensor is abnormal.
Buzzer beeps 5 times for 0.5 second, with 0.5-second intervals.	Carriage error	. Carriage motor is abnormal. • Carriage mechanism is abnormal. •Carriage motor driver current is abnormal.

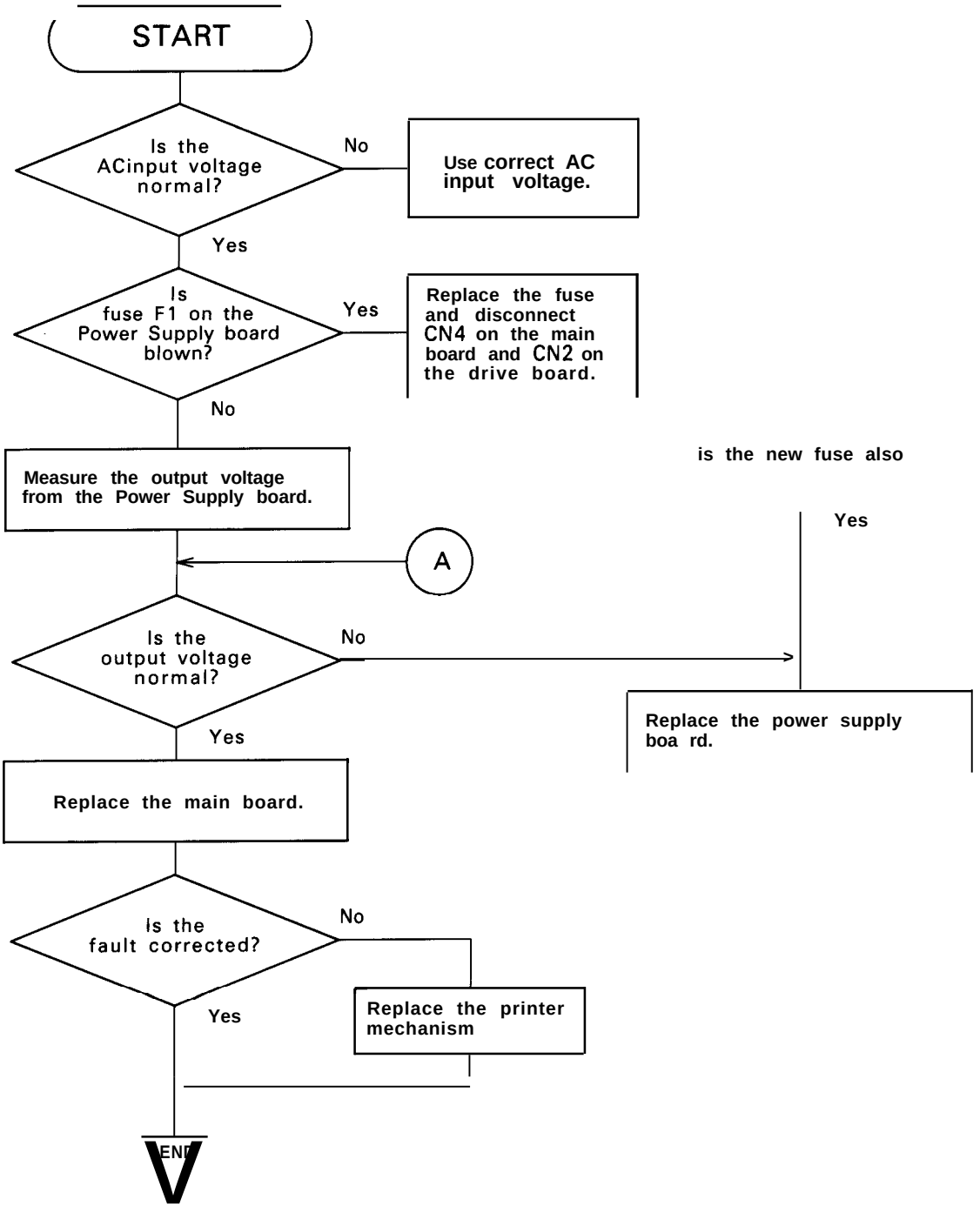
5.2 REPAIR BY UNIT REPLACEMENT

For most problems, it is sufficient for you to determine the difficulty to the unit level. Refer to Table 5-3, identify what the problem is, then perform the checks according to the corresponding flowchart.

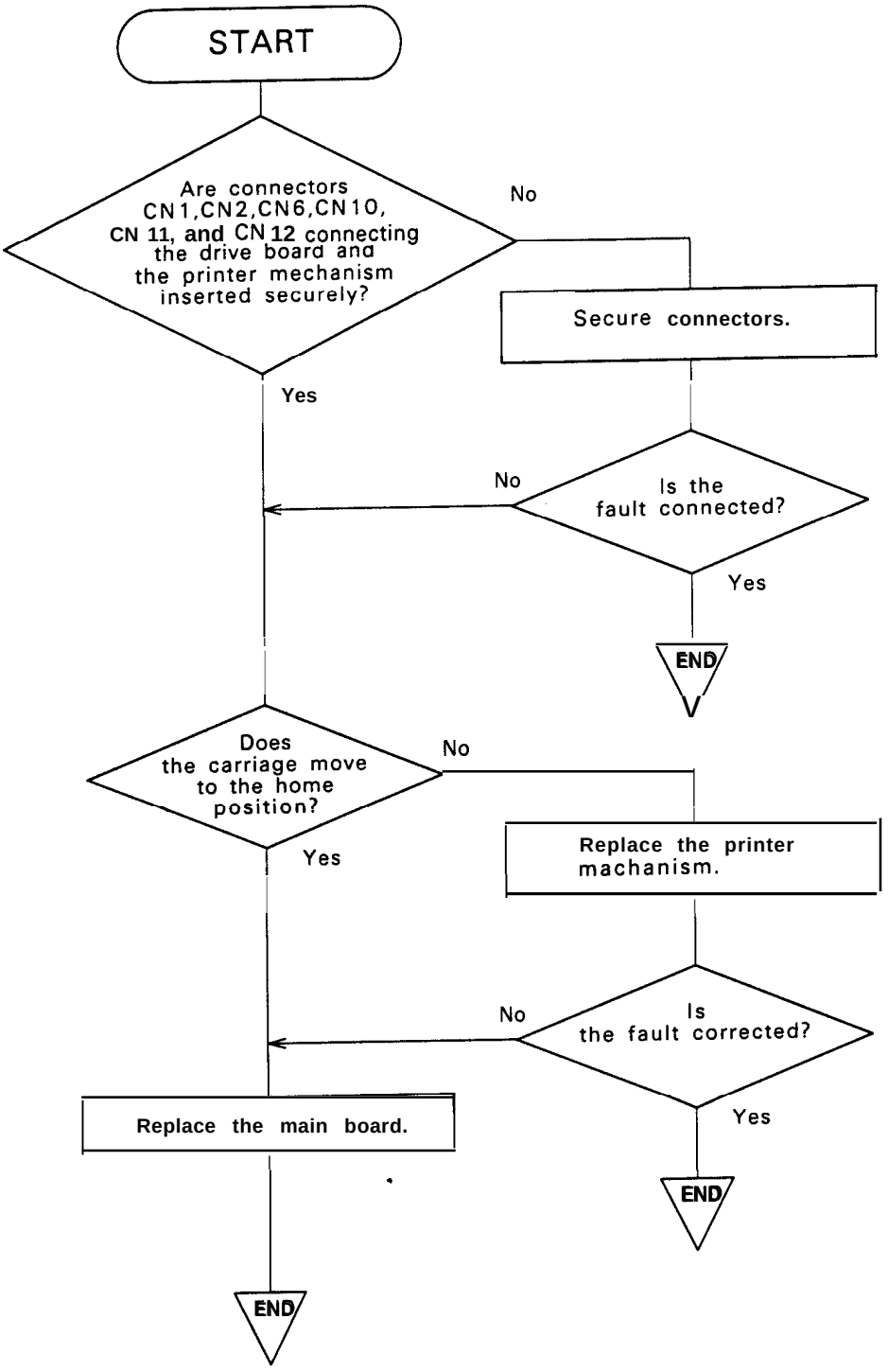
Table 5-3. Symptoms and Reference Pages

Symptom	Problem	See Page
Printer fails to operate when power is on.	• Carriage does not move. • Control panel indicator lamp does not light.	5-3
Carriage operation is abnor-real.	. Carriage moves away from home position at power on. • The carriage returns to the home position correctly, but the printer then fails to enter the READY mode.	5-4
Printing is faulty during self-test, but carriage operation is normal.	• No printing at all. • Fau lty printing - some of the dots are not printed.	5-5
Paper feeding is abnormal.	• No paper is fed. . Regular paper feed, but with variations in the separations between lines.	5-9
Control panel operation is abnormal.	■ When the LF switch is activated, no paper is fed.	5-12
Printing of data sent by the host computer is faulty.	. Carriage operates normally at power on, and self-test is executed correctly. • Print data from the computer, however, is not printed correctly.	5-13

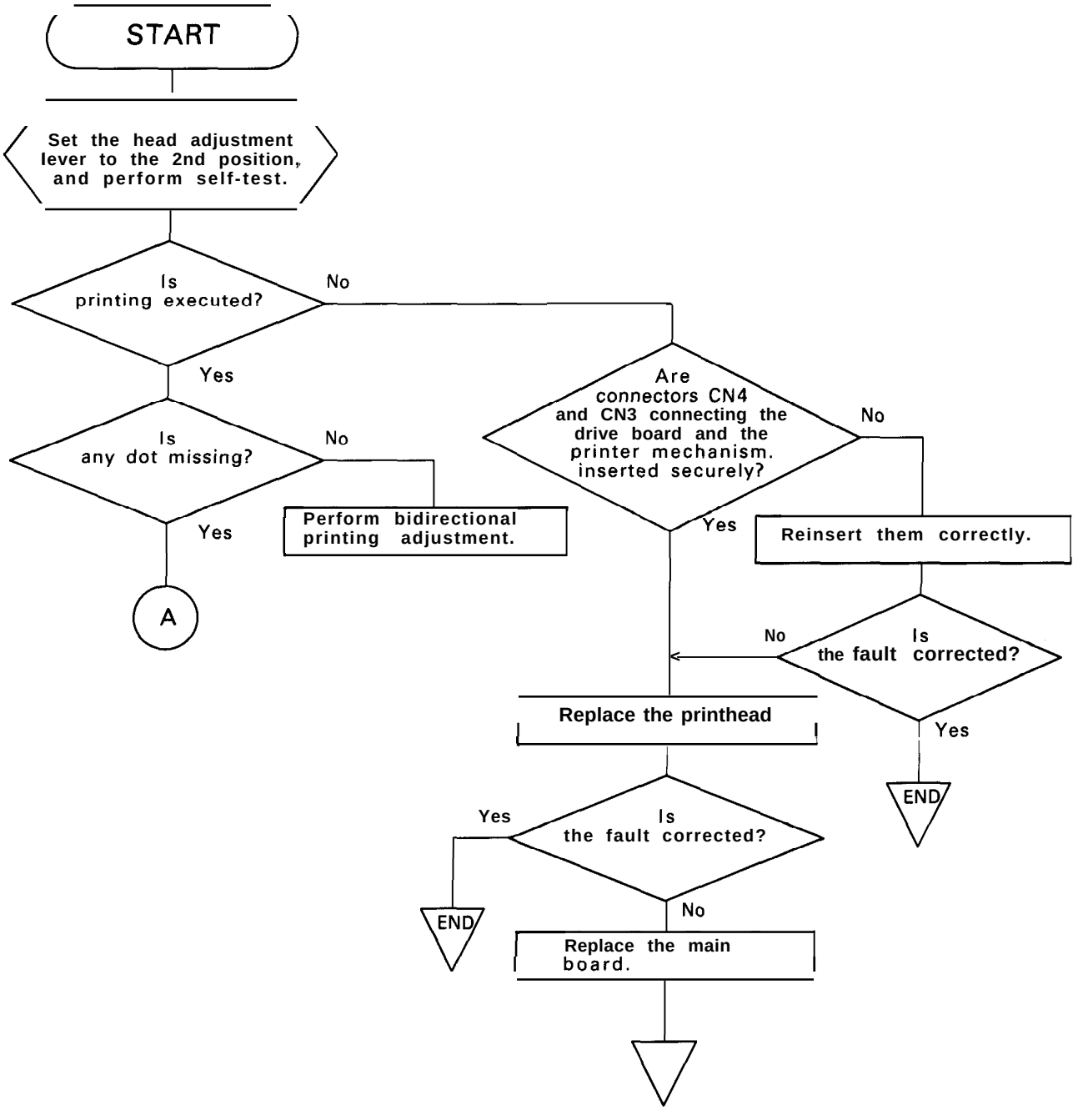
(1) Printer Fails to Operate when Power is On

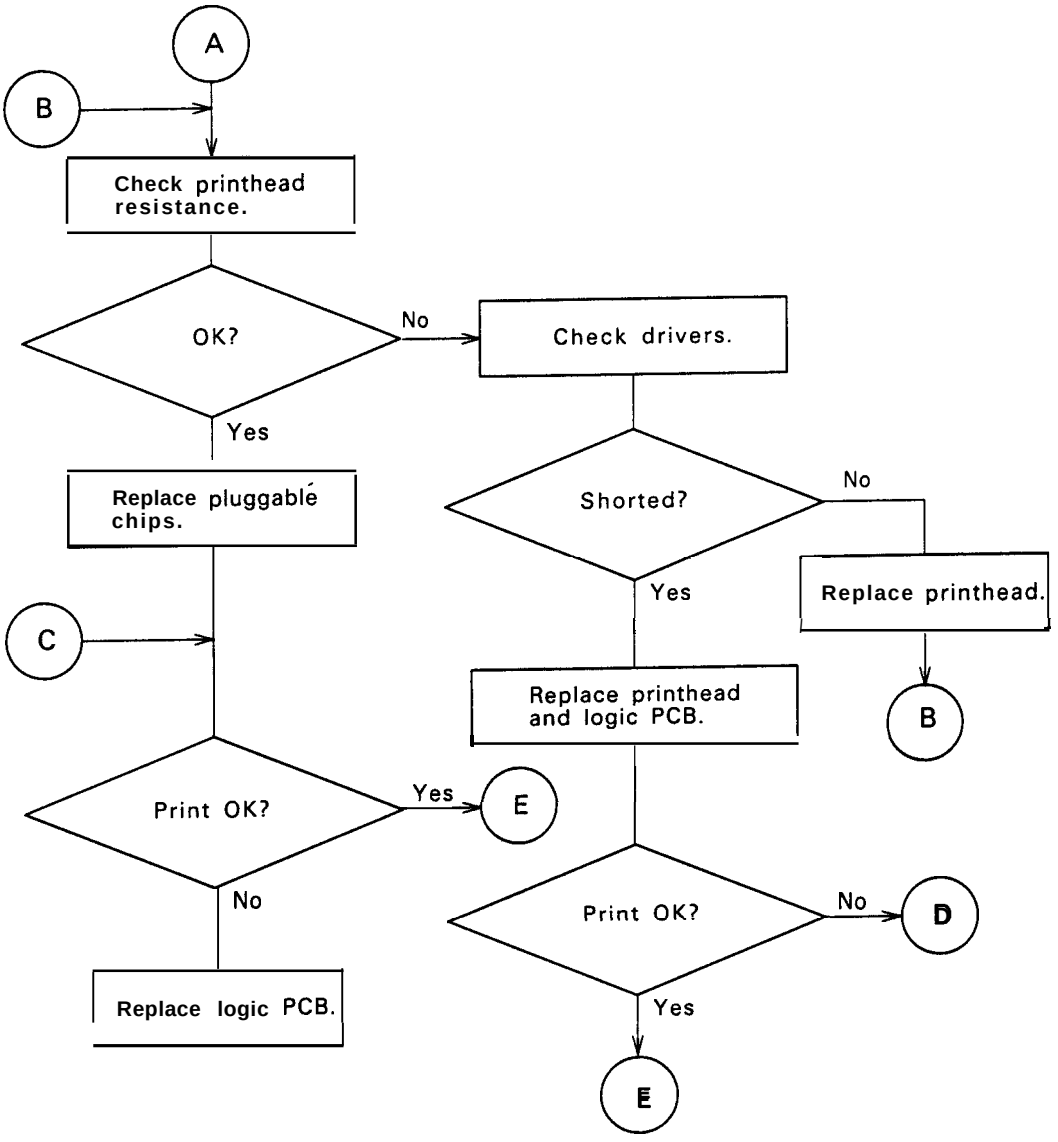


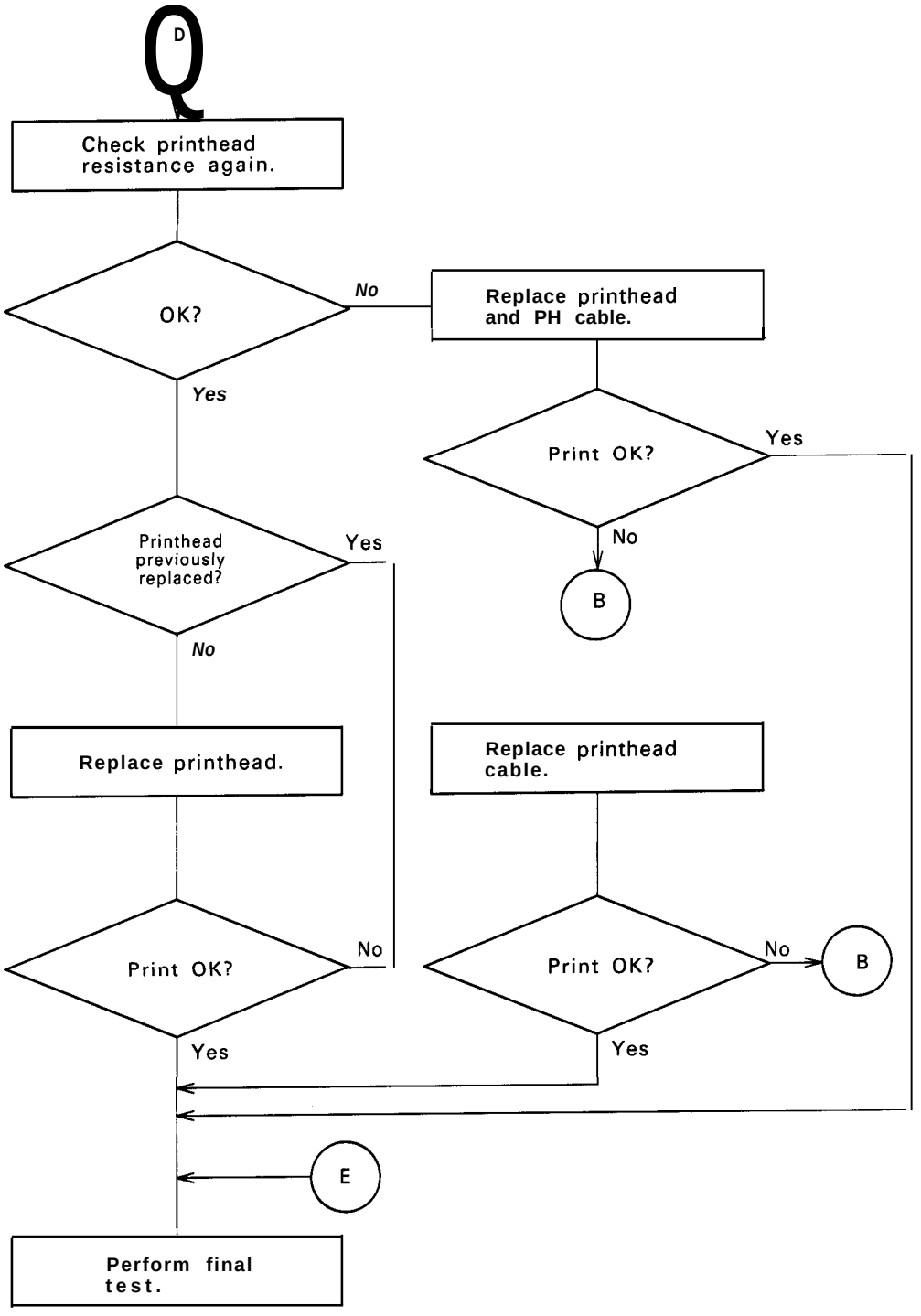
(2) Carriage Operation is Abnormal

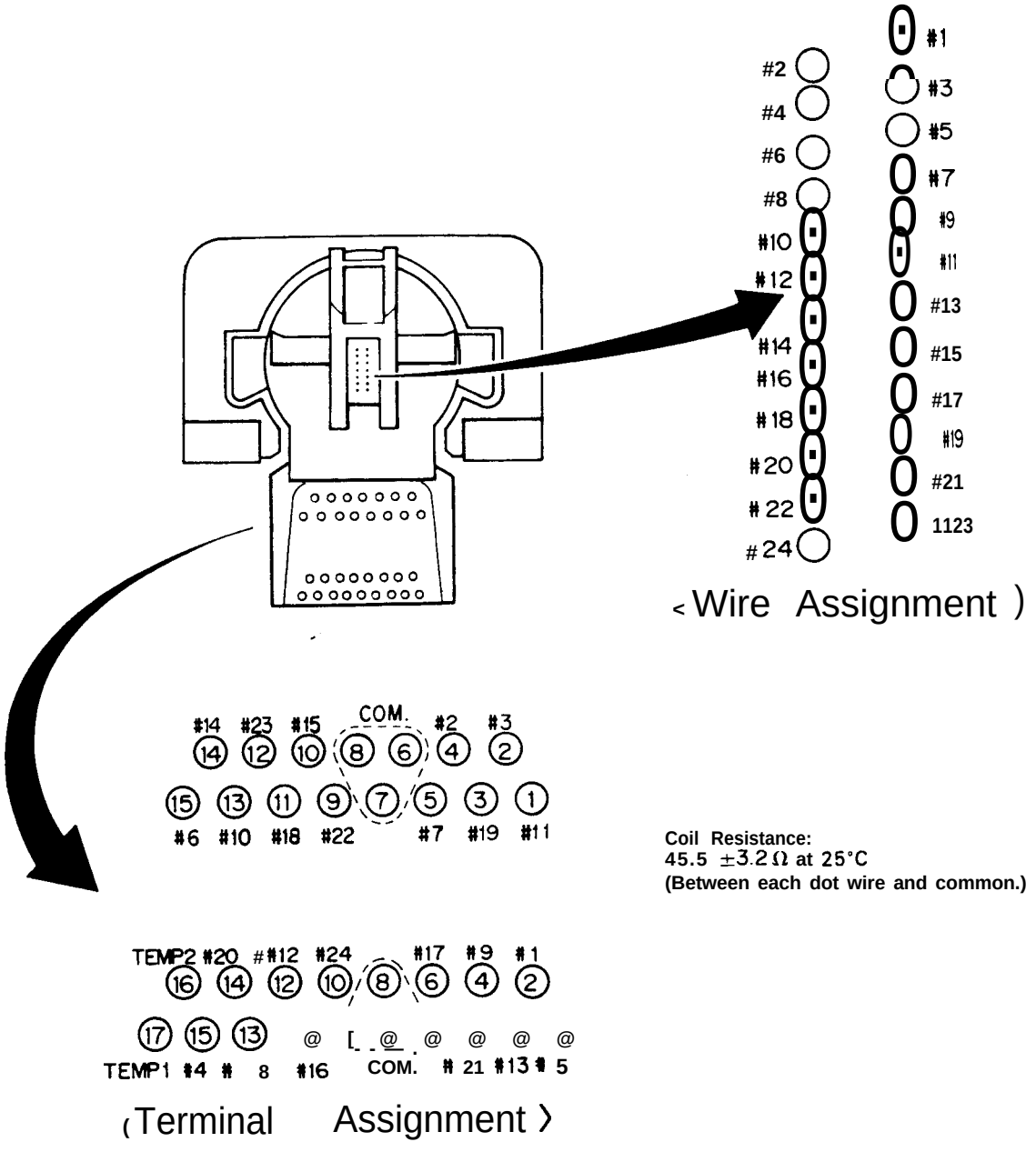


(3) **Printing is Faulty During Self-Test, but Carriage Operation is Normal**




A
B
Check printhead resistance.
OK?
No
Check drivers.
Yes
Shorted?
No
Yes
Replace printhead.
Replace pluggable chips.
C
Replace printhead and logic PCB.
B
Print OK?
Yes
E
No
Print OK?
No
D
Replace logic PCB.
Yes
E

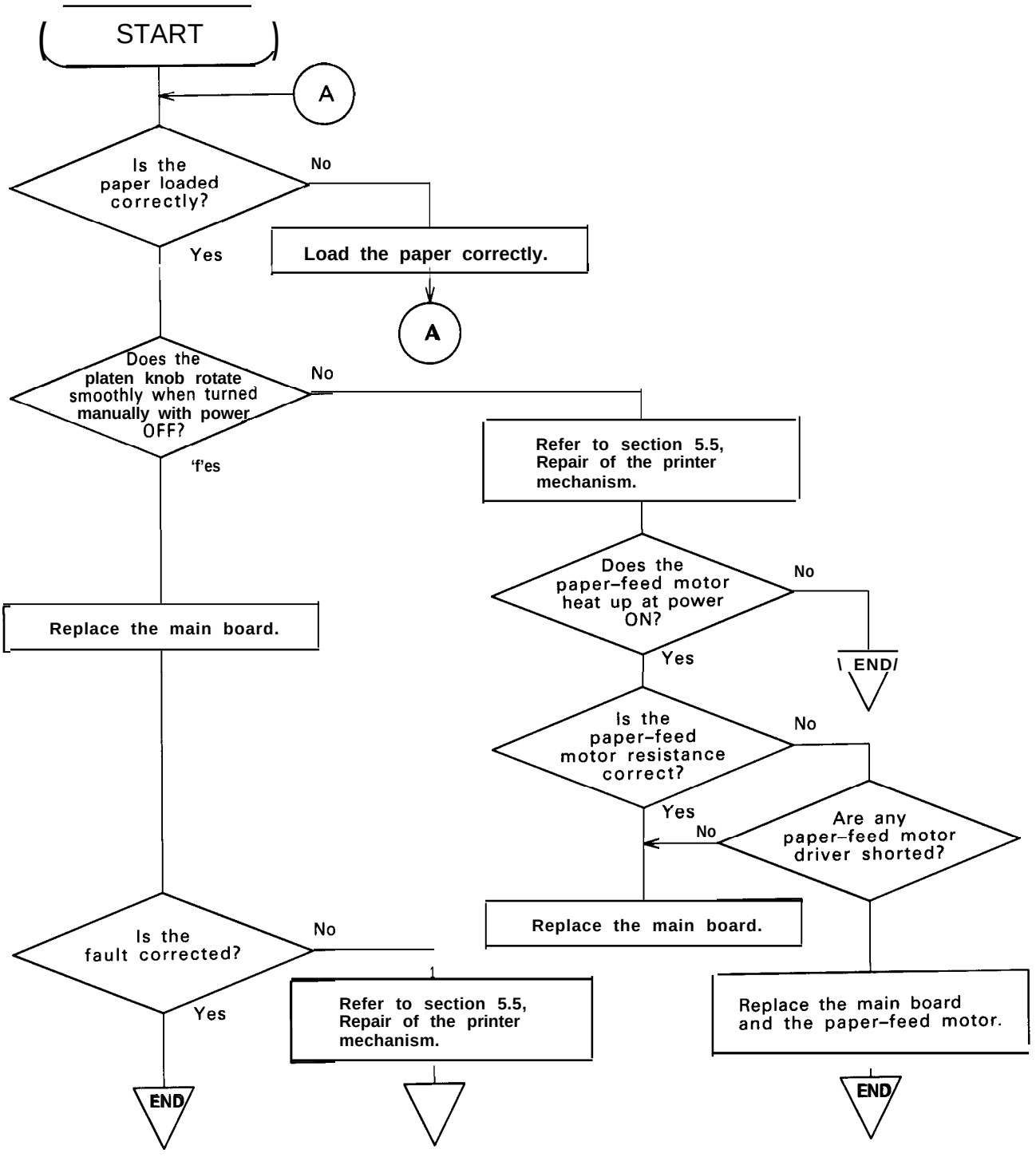

Q D
Check printhead resistance again.
OK?
No
Replace printhead and PH cable.
Yes
Print OK?
Yes
No
B
Printhead previously replaced?
Yes
No
Replace printhead.
Replace printhead cable.
Print OK?
No
Print OK?
No
B
Yes
Yes
E
Perform final test.

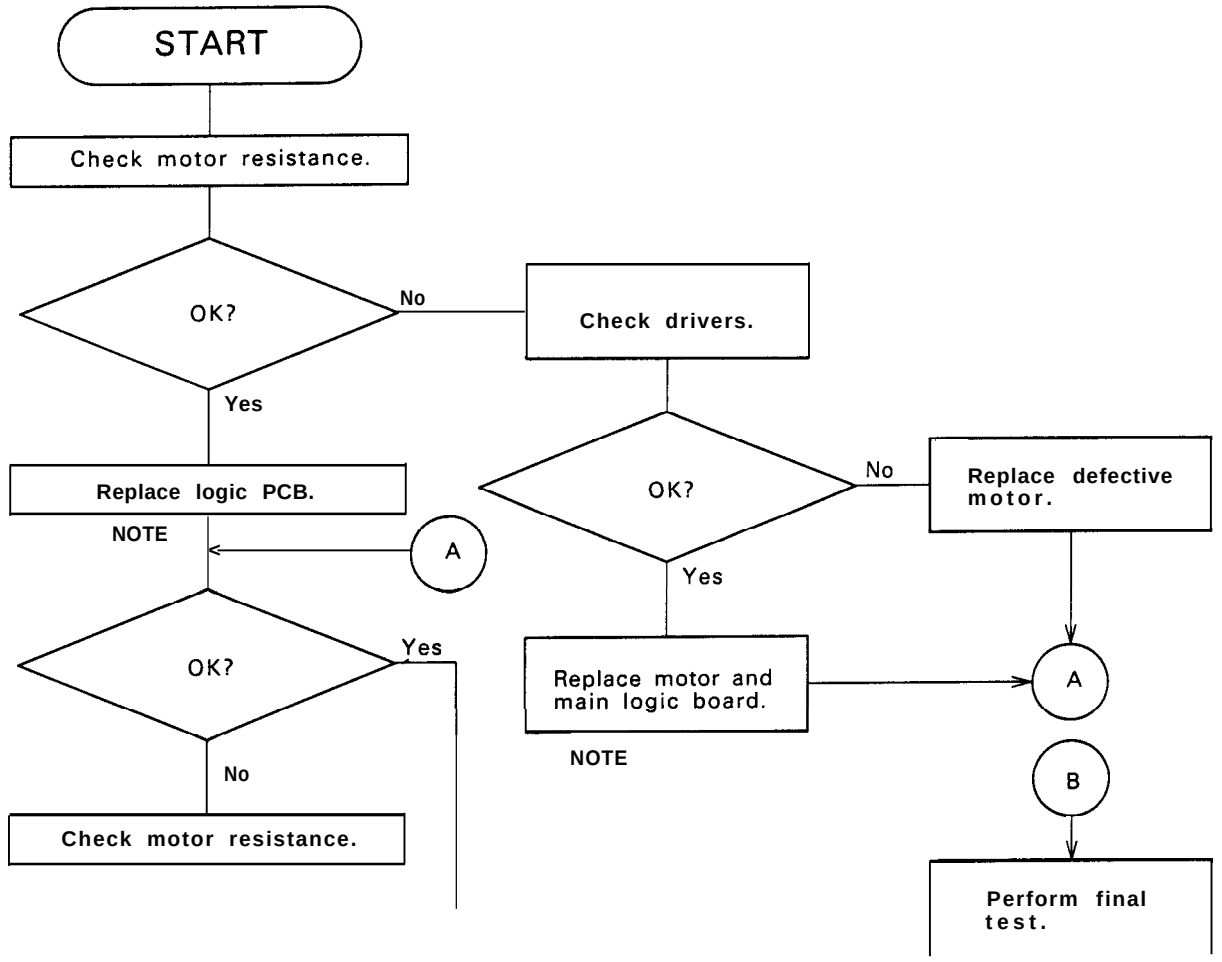


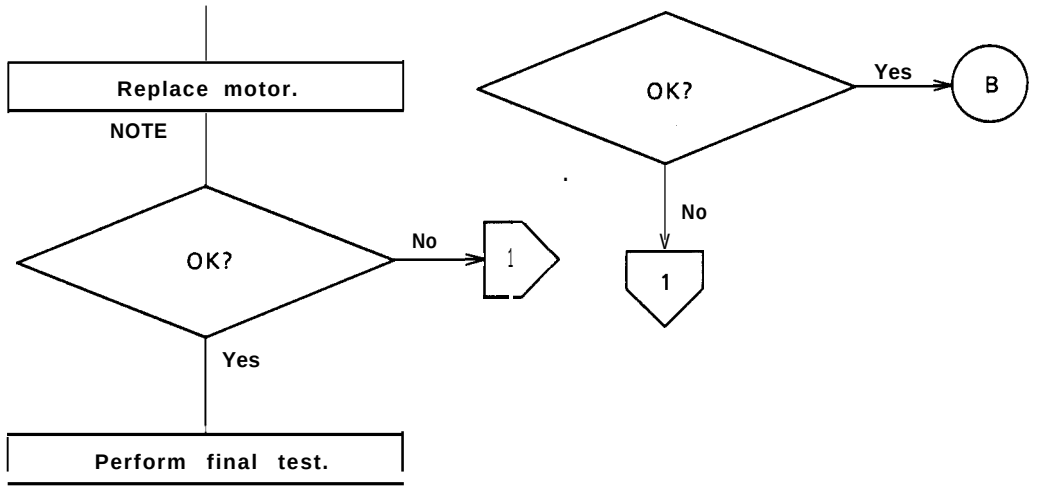
Coil Resistance:
45.5 ±3.2 Ω at 25°C
(Between each dot wire and common.)

Figure 5-2. Printhead Resistance

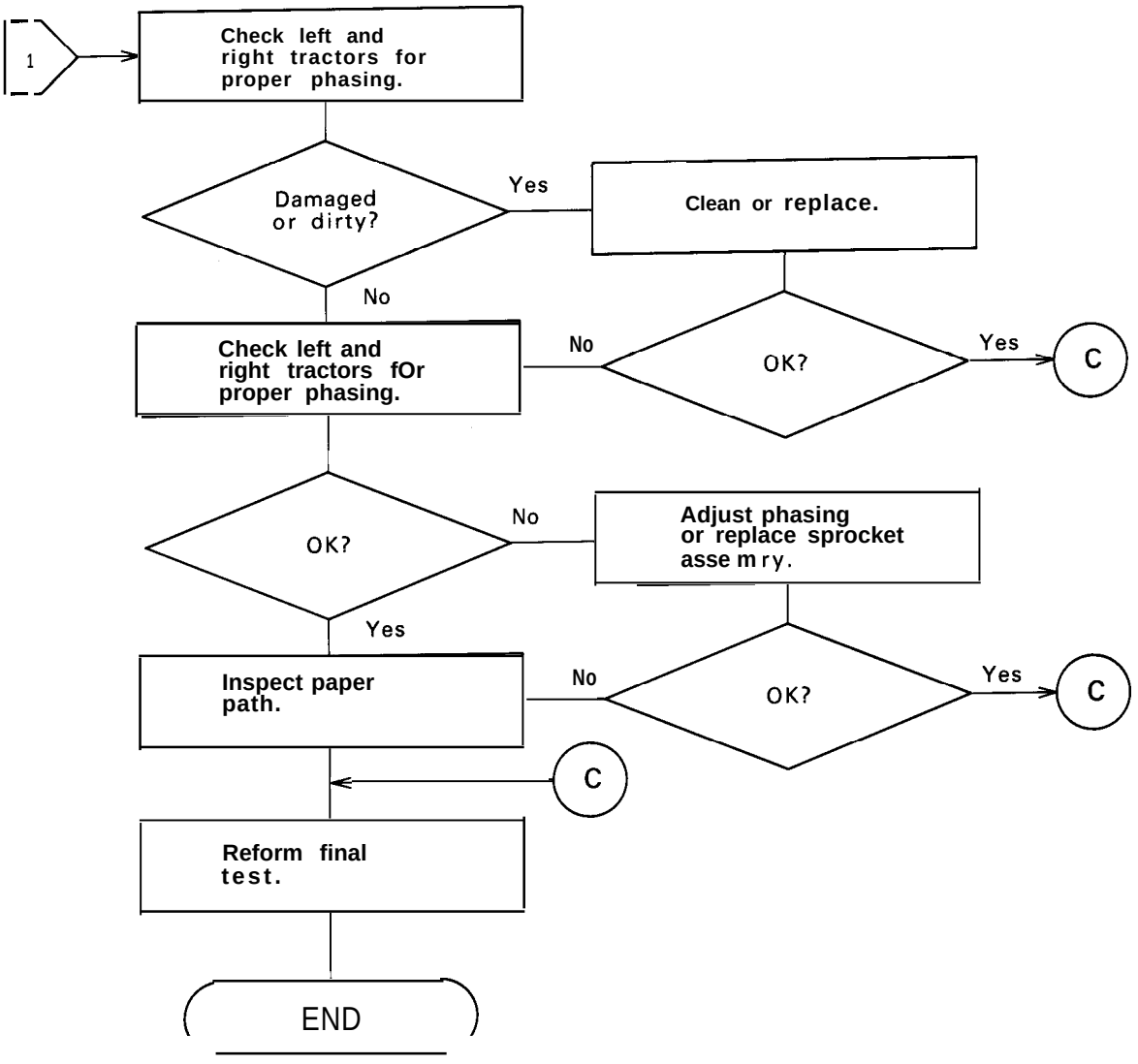
(4) Paper Feeding is Abnormal (but Printing is Normal)



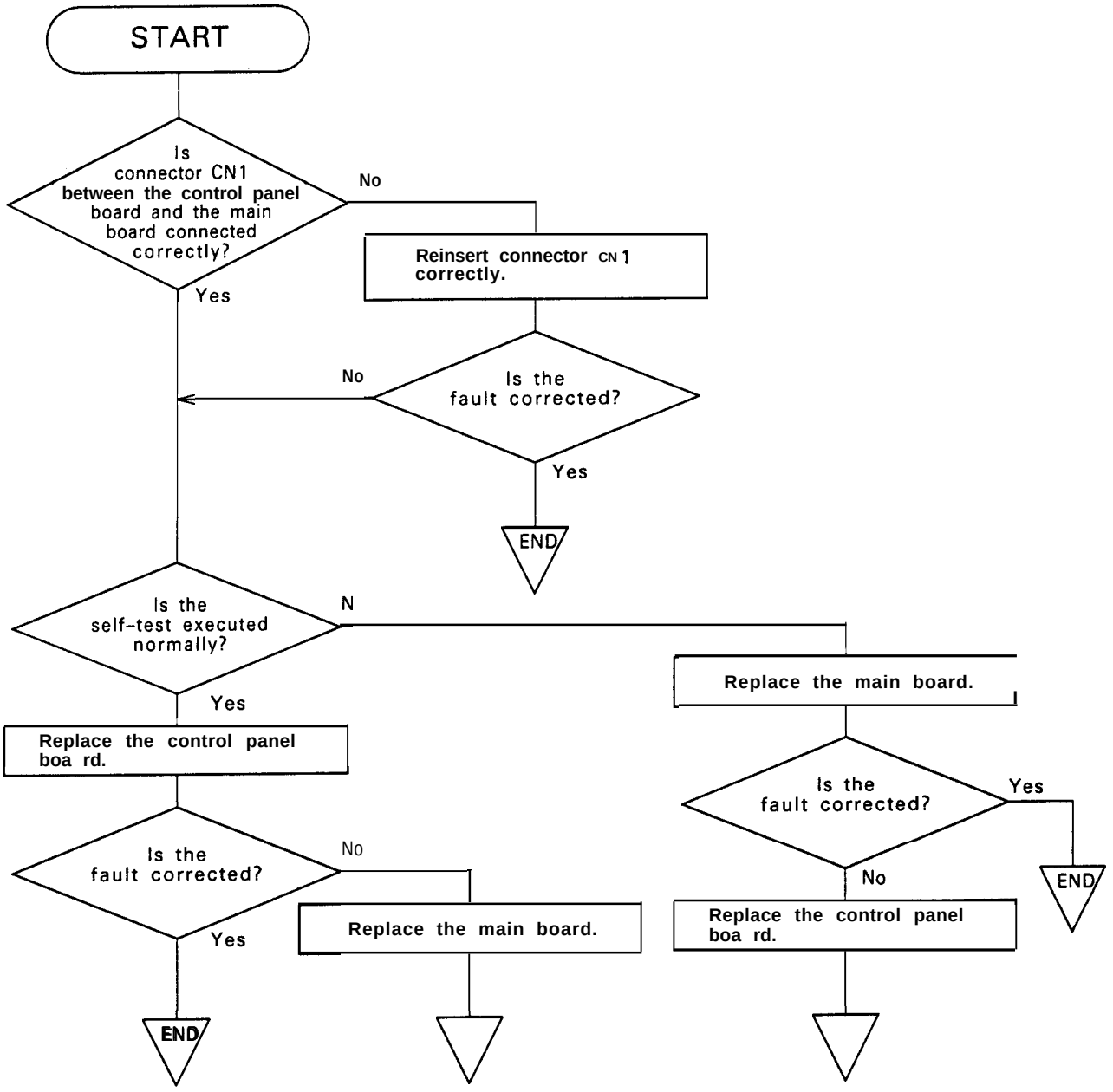




NOTE : Perform bidirectional print alignment adjustment.

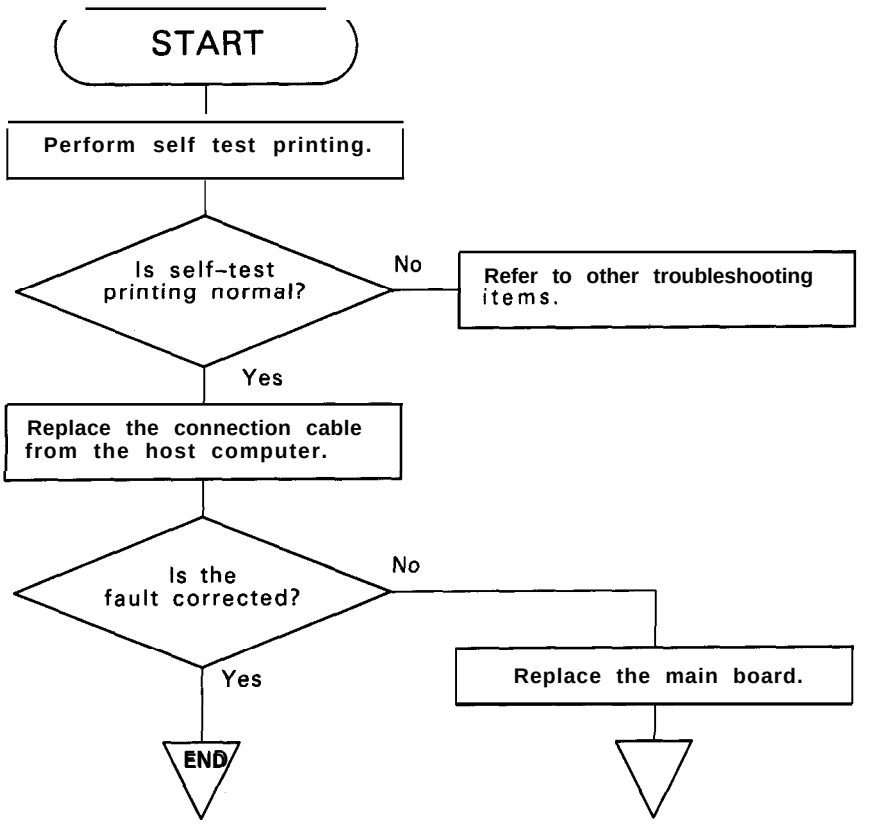

1
Check left and right tractors for proper phasing.
Damaged or dirty?
Yes
Clean or replace.
No
Check left and right tractors fOr proper phasing.
No
OK?
Yes
C
OK?
No
Adjust phasing or replace sprocket asse m ry.
Yes
Inspect paper path.
No
OK?
Yes
C
C
Reform final test.
END

(5) Control Panel Operation is Abnormal



(6) Printing of Data Sent by the Host Computer is Faulty

NOTE: It is assumed here that the host computer is operating normally.



5.3 REPAIR OF THE POWER SUPPLY BOARD

This section describes problems that indicate that the power supply board is defective, and it provides various symptoms, likely causes, and checkpoints. Checkpoints refer to power waveforms, resistance values, and other values to be checked to evaluate the operation of any component that might be bad. Check these values and take the appropriate action.

WARNING

The power switch for this printer controls the secondary (AC) power circuit. The primary (AC) circuit is continually active as long as the printer is connected to AC power.

Table 5-4. Repair of the Power Supply Board

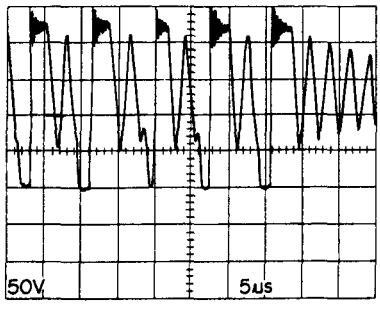
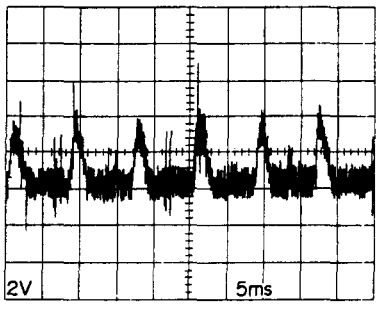
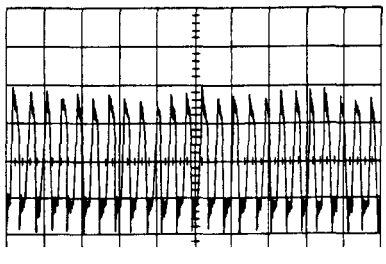
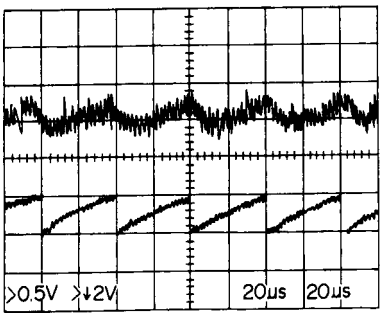
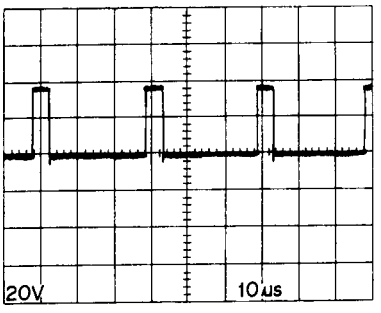
Condition	Cause	Checkpoint	Action
The +35V line is dead.	Diode bridge DB1 is dead.	Measure the DC voltage between pin 3 and pin 4 of DB1.	Replace DB1.
	Transformer coils are open.	Measure the resistance of T1 transformer coils. 3-2, 5-4, 10-11, 11-9	Replace T1.
	Q1 is dead.	Check the voltage waveforms at Q1. 	Replace Q1.
The voltage on the +35V line is below normal.	Q3, IC4, PC1, or ZD20 is dead.	Check the voltage waveforms at Q3. 	Replace Q3, IC4, PC1, or ZD20.
	Q2 is dead.	Check the voltage waveforms at Q2. 	Replace Q2.

Table 5-4. Repair of the Power Supply Board (Continued)

Condition	Cause	Checkpoint	Action
The voltage at + 5V line is dead.	The +35V line is dead.	Check the +35V line.	
	ICl is dead.	Check the oscillation waveform (IC21, pin 5) and the switching waveform (IC21, pin 3). 	Replace IC21.
	D24 is dead.	Check the output waveform. 	Replace D24.

5.4 REPAIR OF THE MAIN/DRIVE BOARD

This section provides instructions for repairing the main board when it is defective and describes various symptoms, likely causes, and checkpoints. Checkpoints refer to proper waveforms, resistance values, and other values to be checked to evaluate the operation of any component that might be bad. Check these values and take the appropriate action.

Table 5-5. Repair of in the Main/DRIVE Circuit Board

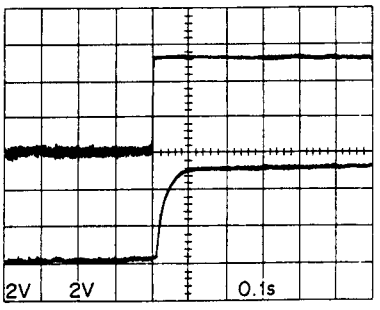
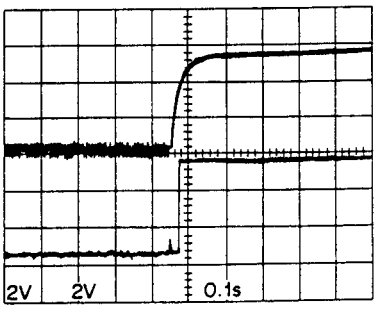
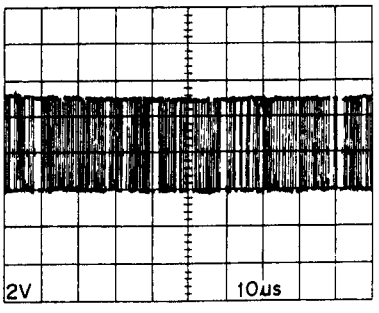
Problem	Symptom	Cause	Checkpoint	Solution
The printer does not operate at all.	The CPU does not operate.	The reset circuit is not operational.	Check the voltage waveforms for the +5V line (IC5C pin 7) and for the THLD signal (IC4B pin 10) when power is on. 	Replace IC4B, IC5C.
			Check the voltage waveforms for the THLD signal (IC4B pin10) and for the $\overline{\text{RESET}}$ signal (IC4B pin 12) when power is on. 	Replace IC4B.
			Check pin 21 of IC1C for the Vxvoltage ($\overline{\text{NMI}}$ signal HIGH).	Replace IC2C.
		Selection of control ROM is abnormal.	Check pin 71 of IC4B for a change in the signal HIGH/LOW. 	Replace IC4B.

Table 5-5. R air of in the Main/Drive Circuit Board (Continued)

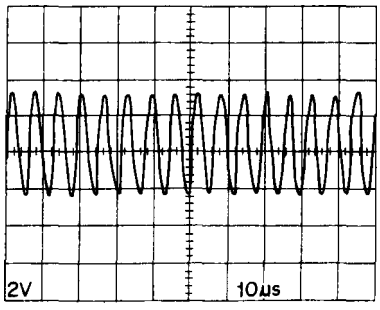
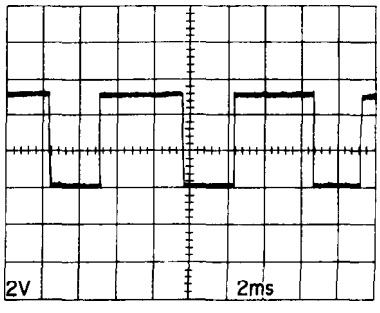
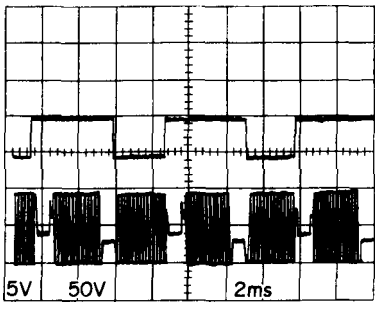
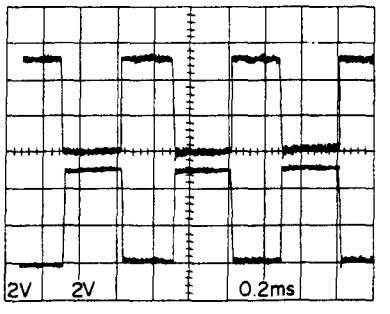
Problem	Symptom	Cause	Checkpoint	Solution
The printer does not operate at all.	The CPU does not operate.	Either ROM or RAM is defective.		Replace IC3A or IC4A.
		The CPU is defective.	Check the oscillator signal at either pin 33 or pin 34 of the CPU. 	If a signal is detected, replace IC2C. Otherwise, replace CR1.
The carriage operates abnormally.	The carriage does not operate at all.	IC2C is defective.	Check the CR motor phase signal at pins 9, 10, 11, and 12 of IC2C. 	Replace IC2C.
		ICl 5 is defective	At IC 15, check the input signal for pin 6 and the output waveform for pin 8. 	Replace IC 15.
	Carriage operation is unstable (lack of torque).	IC152A is defective.		Replace IC 15.

Table 5-5. Repair of in the Main/Drive Circuit Board (Continued)

Problem	Symptom	Cause	Checkpoint	Solution
Self-test printing is abnormal.	Self-test is not executed.	The CPU can't measure the voltage on the +35V line.	Measure the voltage at Vref (pin 1) of IC2C. The normal voltage is 4.741 V.	
		IC4B is defective.	At IC4B, check the input signal at pin 101 and the output signal at pin. 	Replace IC4D.
	A particular dot is not being printed.	IC2B is defective. IC8-IC13 are defective		Replace IC2A.Replace IC8-IC13
Paper is not fed normally.	The paper does not feed, or the feed pitch is abnormal.	IC20 is defective.		Replace IC20.
Printing of data from the host computer is faulty.	Data corruption occurs when the parallel interface is used.	IC46AD or IC4B is defective.		Replace IC6A or IC4B.

5.5 REPAIR OF THE PRINTER MECHANISM

For detailed procedures for replacing or adjusting parts, refer to Chapter 3, *Disassembly and Assembly,* and Chapter *4, Adjustment.* If a problem or symptom recurs following an attempted repair, refer to Table *5-5* to try to find other potential causes.

Table 5-6. Repair of the Printer Mechanism

Problem	Symptom	Cause	Checkpoint	Solution
The carriage motor fails to operate.	The carriage motor completely fails to activate at power on.	Foreign substances are lodged in the gears or elsewhere in the mechanism.	Manually move the timing belt to see if this causes the motor to rotate.	Remove any foreign substances.
		The carriage motor is defective.	Measure the coil resistance of the motor. The resistance should be about 5.0 ohms.	Replace the carriage motor.
The carriage does not operate normally at power on (after the carriage has been manually centered prior to power on).	The carriage motor rotates, but the carriage does not move.	The belt pulley is defective.	Check for broken or worn pulley.	Replace the belt pulley.
		The timing belt is defective.	Check that the timing belt is correctly inserted into the bottom of the carriage.	Reinsert the timing belt.
			Check for a broken timing belt.	Replace the timing belt.
	The carriage moves left slightly, then stops.	Carriage movement is not smooth.	Check whether the carriage moves smoothly when moved manually.	Clean and lubricate.
	The carriage moves to the left or right end, then stops.	The home position sensor is defective.	Use a multimeter to check the home-position sensor.	Replace the home-position sensor.
Self-test printing does not execute.	The carriage moves, but no printing is performed.	The printhead FFC common wires are disconnected.	Check the common wires for the printhead FFC.	Replace the FFC.

Table 5-6. Repair of the Printer Mechanism (Continued)

Problem	Symptom	Cause	Checkpoint	Solution
Self-test printing is abnormal.	A particular dot fails to print.	The printhead is defective.	Measure the coil resistance of the printhead. The normal value is approximately 45.5 ohms.	Replace the printhead.
			Check whether the dot wire is worn.	Replace the printhead.
	The printing is too light, or the print density is not uniform.	The printhead is defective.	Check whether the tip of the dot wire is worn.	Replace the printhead.
		The platen gap is not properly adjusted.	Set the gap adjust lever to the second position, and check the gap between the tip of the printhead and the platen. The appropriate value is 0.38 mm.	Adjust the gap. Refer to Section 4.1.2, *Platen Gap Adjustment.*
Paper feeding is abnormal.	Printing is performed, but the paper is not fed, or is not fed uniformly.	Foreign substances are lodged in the paper path.	Perform a visual check of the paper path.	Remove any foreign substance.
		The paper-feed motor is not driving the gear correctly.	Check that no foreign substance is lodged between the gears, and that the gears are not broken or worn.	. Remove any foreign substance. . Replace the paper-feed reduction gear. • Replace the platen gear.
		The paper-feed motor is defective.	Measure the coil resistance for the paper feed-motor. The approximate value should be 79 ohms.	Replace the paper-feed motor.

Table 5-6. Repair of Printer Mechanism (Continued)

Problem	Symptom	Ceuse	Checkpoint	Solution
The ribbon feed is abnormal.	The ribbon is not fed.	The ribbon cartridge is defective.	Dismount the ribbon cartridge, rotate its knob manually, and check whether the ribbon feeds normally.	Replace the ribbon cartridge.
		Foreign substances are caught in the gears.	Check whether the ribbon driving gear rotates when the carriage is moved manually.	• Remove any foreign substance. • Replace the ribbon-feed mechanism.
	The ribbon feeds properly only when the carriage moves in one direction (i.e., it fails to feed when the carriage moves in the other direction).	The planetary lever is defective.	Move the carriage manually, and check whether the planetary lever turns in reverse and engages the gear.	Replace the ribbon-feed mechanism.
Paper becomes stained.	Ink stains appear on areas where there is printing.	The ribbon mask is not correctly positioned.	Check whether the ribbon mask is in the correct position.	Reinstall the ribbon mask.
		The platen gap is not adjusted.	Set the gap adjust lever to the second position, and check the gap between the tip of the printhead and the platen. The appropriate value is 0.38 mm.	Adjust the gap. Refer to Section 4.1.2, *Platen Gap Adjustment.*
Printing continues after the paper ends or when no paper is loaded.	Printing continues past the paper end.	The paper-end sensor is defective.	Check the paper-end sensor switch.	Replace the paper-end sensor.

CHAPTER 6
MAINTENANCE

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6.1 PREVENTIVE MAINTENANCE

Preventive maintenance includes regular cleaning of the case exterior (using denatured alcohol), as well as occasional vacuuming of the mechanism's interior to remove dust and paper debris. After cleaning the unit, check that it is adequately lubricated (as described in Section 6.2, below.) Before returning the printer to the customer, inspect the springs, paper-feed rollers, and basic operation.

CAUTION

Disconnect the printer from the external AC power source before performing maintenance. Do not use thinner, trichloroethylene, or ketone-based solvents on the plastic components of the printer.

6.2 LUBRICATION AND ADHESIVE APPLICATION

EPSON recommends that the printer be lubricated at the points illustrated in Figure 6-2. Table 6-2 lists each point together with its recommended lubricant. The three recommended lubricants are EPSON O-2, G-20, and G-26, all of which have been tested extensively and found to comply with the needs of this printer. (Table 6-1 provides details about these lubricants.) Before applying a lubricant, be sure that the surface to be lubricated is clean. Do not apply too much lubricant, as this may damage related parts.

Adhesive application is necessary at the point described in Table 6-3. Figure 6-1 indicates the point at which adhesive must be applied following disassembly or replacement. EPSON recommends that Neji lock #2 (G) adhesive be applied to the point illustrated. Avoid overflow to adjacent parts.

Table 6-1. Lubricants and Adhesive

Type	Name	Quantity	Availability	Part No.
Oil	o-2	40 cc	E	B7 10200001
Grease	G-20	40 gm	E	B702000001
Grease	G-26	40 gm	E	B702600001
Adhesive	Neji lock #2 (G)	1000 gm	E	B730200200

E: EPSON-exclusive product

Table 6-2. Lubrication Points (Refer to Figure 6-2)

Ref. No.	Lubrication Points	Lubricant
1	1/4 of the perimeter of the top edge of the gear (8.5 mm, 30 mm)	G-26
2	1/3 of the perimeter of the top edge of the gear (40 mm)	G-26
3	1/3 of the perimeter of the top edge of the platen gear	G-26
4	Portion of carriage that contacts base frame	G-26
5	Oil pad	o-2
6	Gear (40 mm) shaft	G-26
7	Gear (40 mm) shaft	G-26
8	Portion of paper guide that contacts sub paper guide	G-26
9	Portion of paper tension roller shaft that contacts paper tension frame	G-26
10	Portion of tractor shaft that contacts tractor frame (left)	G-26
11	Ribbon planetary lever	G-26

NOTE: Lubrication must be applied during the reassembly process.

Table 6-3. Adhesive Application Point (Refer to Figure 6-l.)

Adhesive Application Point	No. of Points
Portion where timing belt engages the carriage	1

Figure 6-1. Correct Adhesive Application

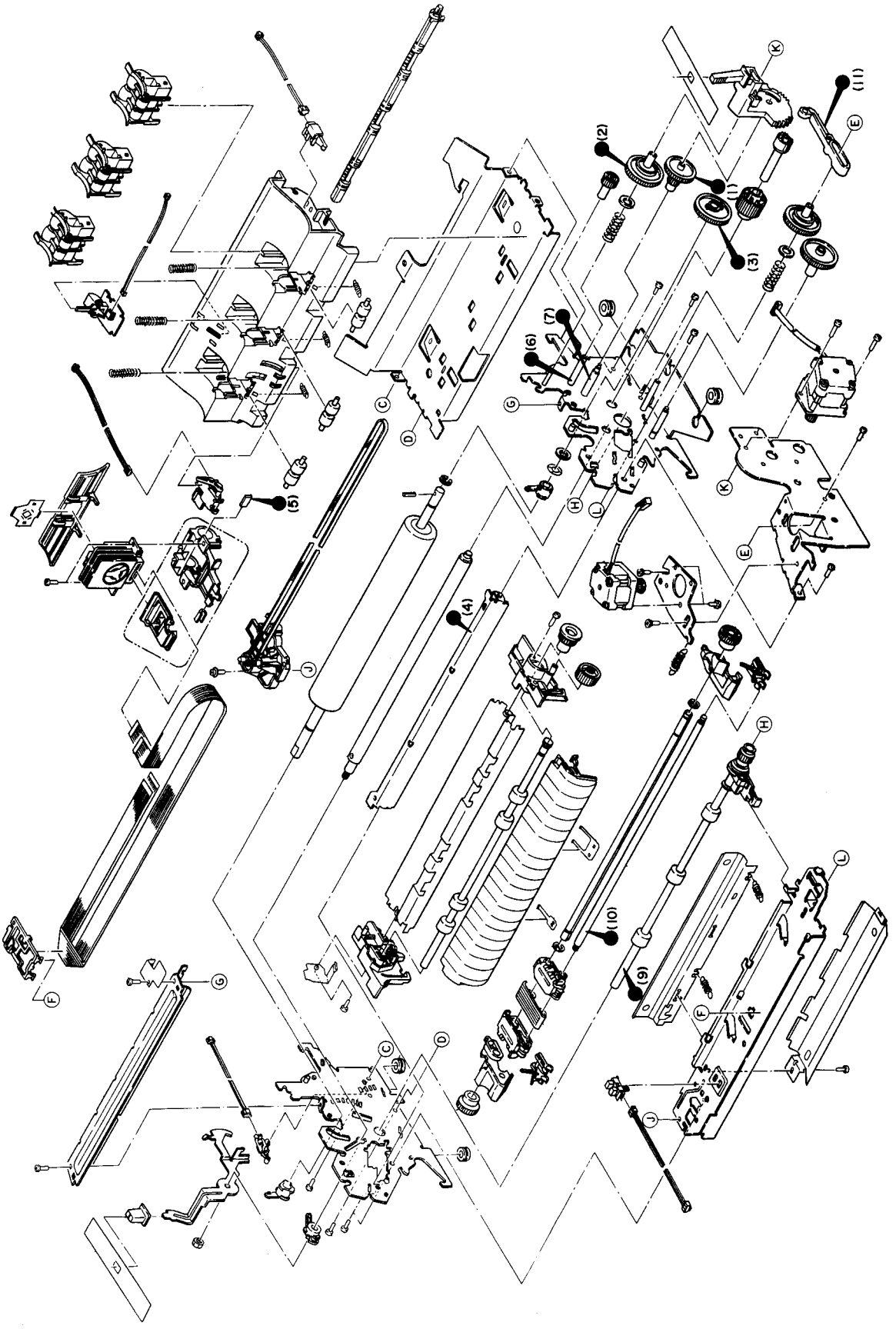

Figure 6-2. LQ-870 Lubrication Points

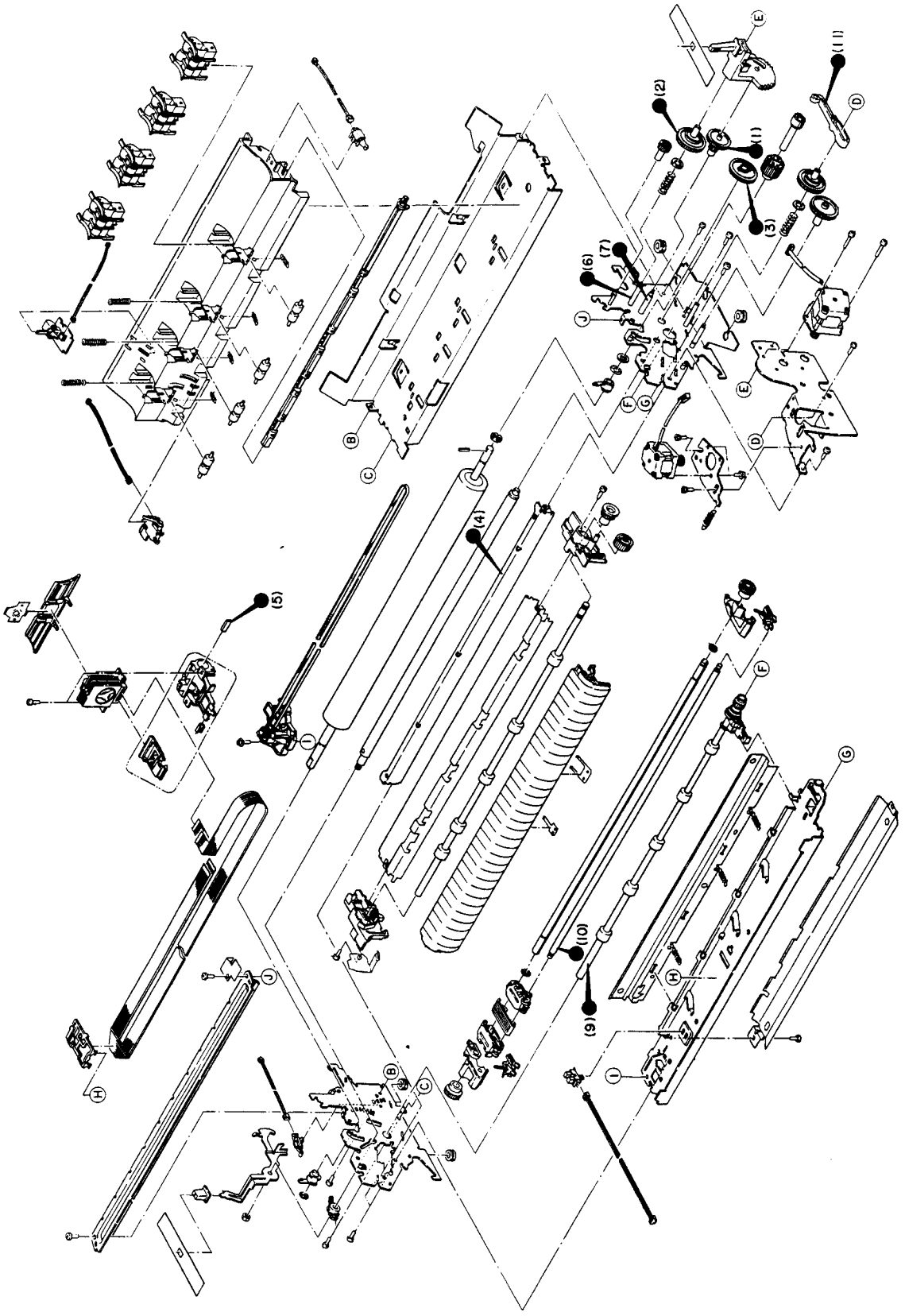

Figure 6-3. LQ-1 170 Lubrication Points

APPENDIX

LIST OF FIGURES

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A.1 CONNECTOR SUMMARY

Figure A-1 illustrates the interconnection of the primary components. Table A-1 summarizes the functions and sizes of the connectors.

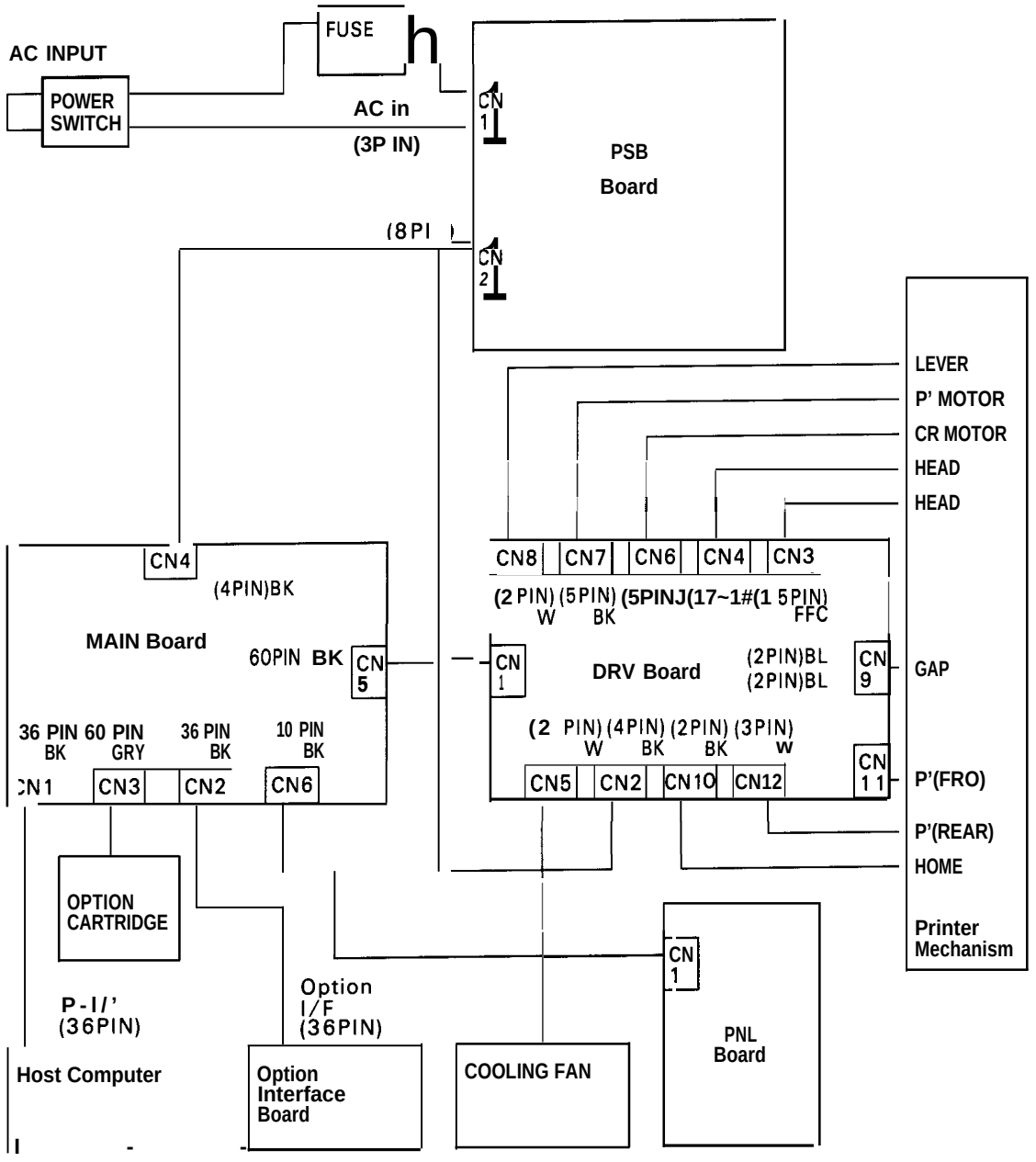

Figure A-1. Cable Connections

Table A-1. Board Connector Summary

Board	Connector	PINS	Function	Color
CO60 MAIN BOARD	CN1	36	Parallel interface	BLACK
	CN2	36	Optional interface card	BLACK
	CN3	60	Font cartridge card	GRAY
	CN4	4	Power supply board (+5VDC)	BLACK
	CN5	60	Driver board	BLACK
	CN6	10	Panel board	BLACK
CO60 DRV BOARD	CN1	60	Main board	BLACK
	CN2	4	Power supply board (+5VDC & +35VDC)	BLACK
	CN3	15	Printhead R side	WHITE
	CN4	17	Printhead L side	WHITE
	CN5	2	Fan motor	WHITE
	CN6	5	Carriage motor	WHITE
	CN7	5	Paper feed motor	BLACK
	CN8	2	Paper feed lever	WHITE
	CN9	2	Platen gap sensor	BLUE
	CN 10	2	Home position	BLACK
	CN1 1	2	PE1 (Front)	BLUE
	CN 12	3	PE2 (Rear)	WHITE
CO60 PSB BOARD	CN1	2	AC power supply	WHITE
	CN2	8	DRV board (+35 VDC), MAIN board (+5VDC)	WHITE

Table A-2. CN1(CO60 MAIN)

No.	1/0	Signal Name
1	I	STROBE
2	I	DATA1
3	I	DATA2
4	I	DATA3
5	I	DATA4
6	I	DATA5
7	I	DATA6
8	I	DATA7
9	I	DATA8
10	o	ACKNLG
11	0	BUSY
12	0	PE
13	0	SLCT
14	I	AUTO FEEDXT
15		
16	—	GND
17	—	FGND
18		
19	—	GND
20	—	GND
21	—	GND
22	—	GND
23	—	GND
24	—	GND
25	—	GND
26	—	GND
27	—	GND
28	—	GND
29	—	GND
30	—	GND
31	I	NIT
32	o	ERROR
33	—	GND
34		
35		
36	I	SLCT-IN

Table A-3. CN2 (CO60 MAIN)

No.	I/O	Signal Name
1	0	+ 5V
2	0	+5V
3	0	+5V
4	0	+ 5V
5	0	+ 5V
6	0	+ 5V
7	0	TXD
8	0	READY
9	I	RXD
10	—	
11	0	RST
12	0	INH
13	I	CMREQ
14	I	WRREQ
15	I	RDREQ
16	o	WR
17	0	RD
18	0	CS
19	—	GND
20	—	GND
21	—	GND
22	—	GND
23	—	GND
24	—	GND
25	0	A3
26	0	A2
27	0	A1
28	0	A0
29	I/O	D7
30	I/O	D6
31	I/O	D5
32	I/O	D4
33	I/O	D3
34	I/O	D2
35	I/O	D1
36	I/O	D0

Table A-4. CN3(CO60 MAIN)

No.	I/O	Signal Name
1	0	+5V
2	0	+5V
3	0	+5V
4	0	-PREQ
5	0	-CNT
6	0	-PROG
7	0	-RAM
8	0	-CG
9	0	-WR
10	0	CGA 18
11	0	-RD
12	0	CGA13
13	0	14
14	0	RAM 14
15	0	15
16	0	16
17	0	CGA16
18	0	RAM 16
19	0	CGA17
20	0	AO
21	0	AI
22	0	A2
23	0	A3
24	0	A4
25	0	A5
26	0	A6
27	0	A7
28	0	A8
29	0	+5V
30	0	+5V
31	—	GND
32	—	GND
33	—	GND
34	o	PROGA16
35	0	-MREQ
36	0	PROGA15
37	0	PROGA14
38	0	CGA22
39	0	21
40	0	20
41	0	19
42	0	PROGA13
43	0	RAMAI 3
44	0	A9
45	0	A1O
46	0	N.C
47	0	AI 1
48	0	N.C
49	0	AI 2
50	0	D7
51	I/O	D6
52	1/'0	5
53	I/O	4
54	I/O	3
55	I/O	2
56	I/O	1
57	I/O	0
58	—	GND
59	—	GND
60	—	GND

Table A-5. CN4 (CO60 MAIN)

No.	I/O	Signal Name
1	I	+5V
2	I	+5V
3	—	GND
4	—	GND

Table A-6. CN5 (CO60 MAIN)

No.	I/O	Signal Name
1	··	GND
2	-	GND
3	0	H16
4	0	H18
5	0	HI 1
6	0	H2
7	0	H19
8	0	H24
9	0	H14
10	0	H4
11	0	H1
12	0	H21
13	0	+5V
14	0	+5V
15	0	+5V
16	0	+ 5V
17	0	+35V
18	0	+35V
19	0	PPO
20	0	-M
21	0	PF COM
22	0	-HOLD
23	0	-B
24	0	+ 5V
25	0	PFB
26	0	-PFB
27	0	PE3 N.C
28	I	T
29	0	VU
30	0	VU
31	-	GND
32	--	GND
33	0	H23
34	0	H6
35	0	H10
36	O	H22
37	0	H7
38	0	H3
39	0	H9
40	0	H17
41	0	H12
42	0	H16
43	0	H8
44	0	H20
45	0	H13
46	0	H5
47	0	+ 5V
48	0	+ 5V
49	0	-L
50	-	GND
51	o	LEVER
52	0	B
53	0	-A
54	0	PFA
55	0	-PFA
56	I	PE1
57	I	PE2
58	I	CR HOME
59	··	GND
60	--	GND

Table A-7. CN6 (CO60 MAIN)

No.	I/O	Single
1	I	PAUSE
2	··	GND
3	0	TXS
4	0	LDLED
5	0	CKS
6	I	LDSW
7	I	RXS
8	0	+5 v
9	--	GND
10	--	GND

Table A-8. CN1 (CO60DRV Board)

No.	I/O	Signal Name
1	–	GND
2	-	GND
3	I	H16
4	I	H18
5	I	HI 1
6	I	H2
7	H19	
8	I	H24
9	I	H14
10	I	H4
11	I	HI
12	I	H21
13	I	+ 5V
14	I	+ 5V
15	I	+ 5V
16	I	+5V
17	I	+35V
18	I	+35V
19	I	PPO
20	I	-M
21	I	PF COM
22	I	-HOLD
23	I	-B
24	I	+5V
25	I	PFB
26	I	-PFB
27	I	PE3 N.C
28	0	T
29	I	vu
30	I	vu
31	-	GND
32	-	GND
33	I	H23
34	I	H6
35	I	H10
36	I	H22
37	I	H7
38	I	H3
39	I	H9
40	I	H17
41	I	H12
42	I	H16
43	I	H8
44	I	H20
45	I	H13
46	I	H5
47	I	+ 5V
48	I	+ 5V
49	I	-L
50	-	GND
51	I	LEVER
52	I	B
53	I	-A
54	I	PFA
55	I	-PFA
56	0	PE1
57	0	PE2
58	0	CR HOME
59	-	GND
60	-	GND

Table A-9.CN2 (CO60DRV Board)

No.	I/O	Signal Name
1	0	GND
2	0	GND
3	0	+35V
4	0	+35V

Table A-1 O. CN3(C060DRV Board)

No.	I/O	Signal Name
1	0	H3
2	0	HI 1
3	0	H2
4	0	H19
5	0	H7
6	0	C3
7	0	C6
8	0	C2
9	0	H22
10	0	H15
11	0	H18
12	0	H23
13	0	H10
14	0	H14
15	0	H6

Table A-1 1.CN4 (C060DRV Board)

No.	I/O	Signal Name
1	0	H5
2	0	HI
3	0	H13
4	0	H9
5	0	H21
6	0	H17
7	0	C5
8	0	C4
9	0	c I
10	0	H24
11	0	H20
12	0	H12
13	0	H8
14	0	H15
15	I	T
16	I	T
17	0	H4

Table A-12. CN5(C06DRV Board)

No.	I/O	Signal Name
1	0	+35V
2	0	Gp

Table A-1 3. CN6 (C060DRV Board)

No.	1/0	Signal Name
1	0	CRA
2	0	CR-A
3	0	CRB
4	0	CR-B
5	0	CRCOM
--		

Table A-14. CN7(C060DRV Board)

No.	I/O	Signal Name
1	0	PFA
2	0	PF-A
3	0	PFB
4	0	PF-B
5	0	PFCOM
	--	

Table A-1 5. CN8(C060DRV Board)

No.	I/O	Signal Name
1	--	GND
2	I	LSW

Table A-1 6. CN9(C060DRV Board)

No.	1/0	Signal Name
1	--	GND
2	I	GSW

Table A-1 7. CN1O(CO6O DRV Board)

No.	I/O	Signal Name
1	0	LED
2		GND
3	I	CR HOME
--	--	

Table A-1 8. CN11(C060 DRV Board)

No.	I/O	Signal Name
1	I	PE1(FRONT)
2		GND

Table A-1 9. CN12(C060 DRV Board)

No.	I/O	Signal Name
1	0	LED
2	I	PE2 (REAR)
3		GND

Table A-20. CN1(C060 PSB Board)

No.	I/O	Signal Name
1	0	L
2		N
3		N

Table A-21. CN2(C060 PSB Board)

No.	I/O	Signal Name
1	I	+ 5V
2	I	+5V
3		GND
4		GND
5		GND
6		GND
7		+35V
8		+35V

Table A-22. CN1(C060 PNL Board)

No.	I/O	Signal Name
1	0	PAUSE
2		GND
3	I	TXS
4	I	LDLED
5	I	CKS
6	0	LDSW
7	0	RXS
8	I	+5V
9		GND
10		GND

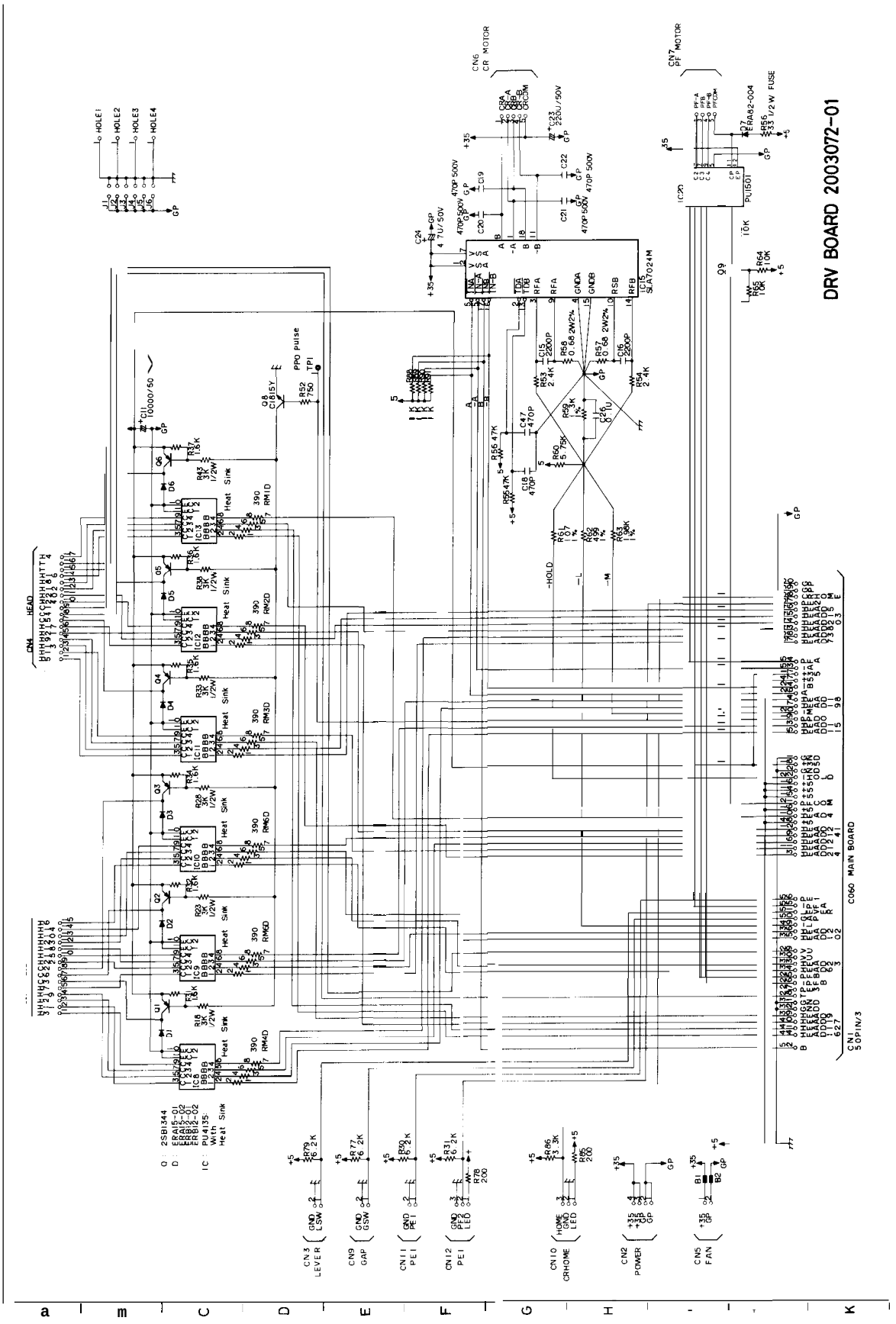

Figure A-3. C060 DRV Board Circuit Diagram

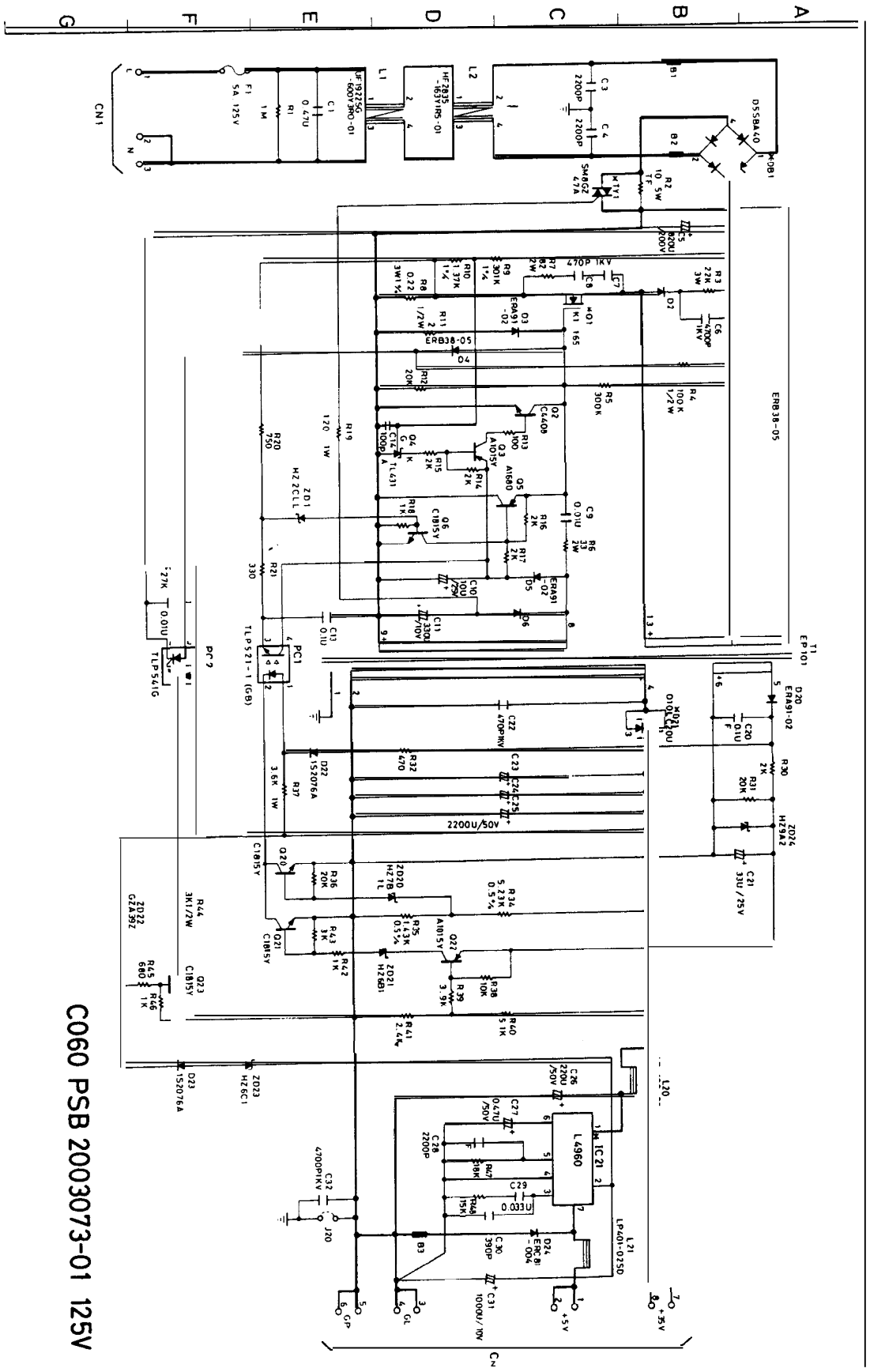

Figure A-4. C060 PSB Board Circuit Diagram

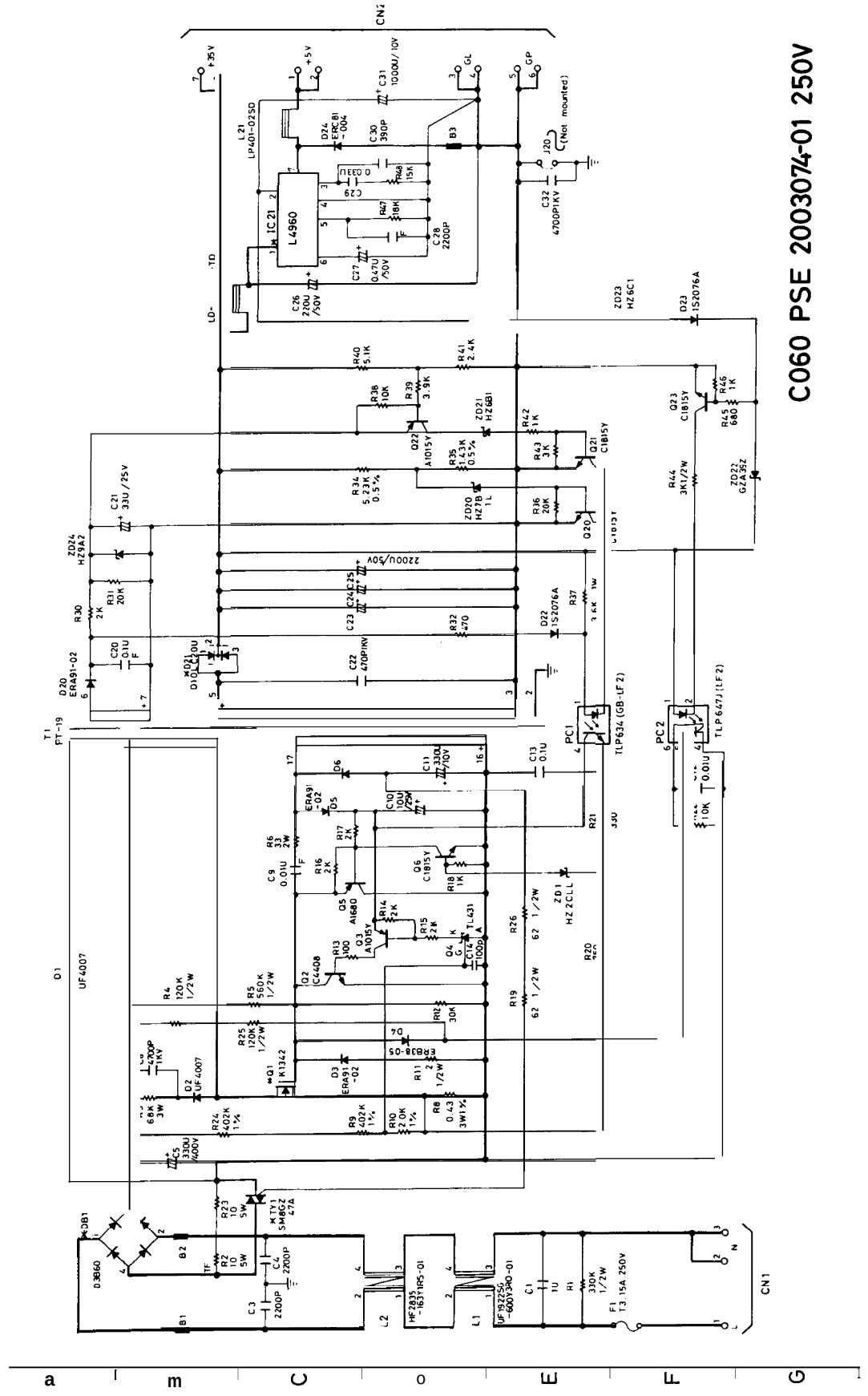

Figure A-5. C060 PSE Board Circuit Diagram

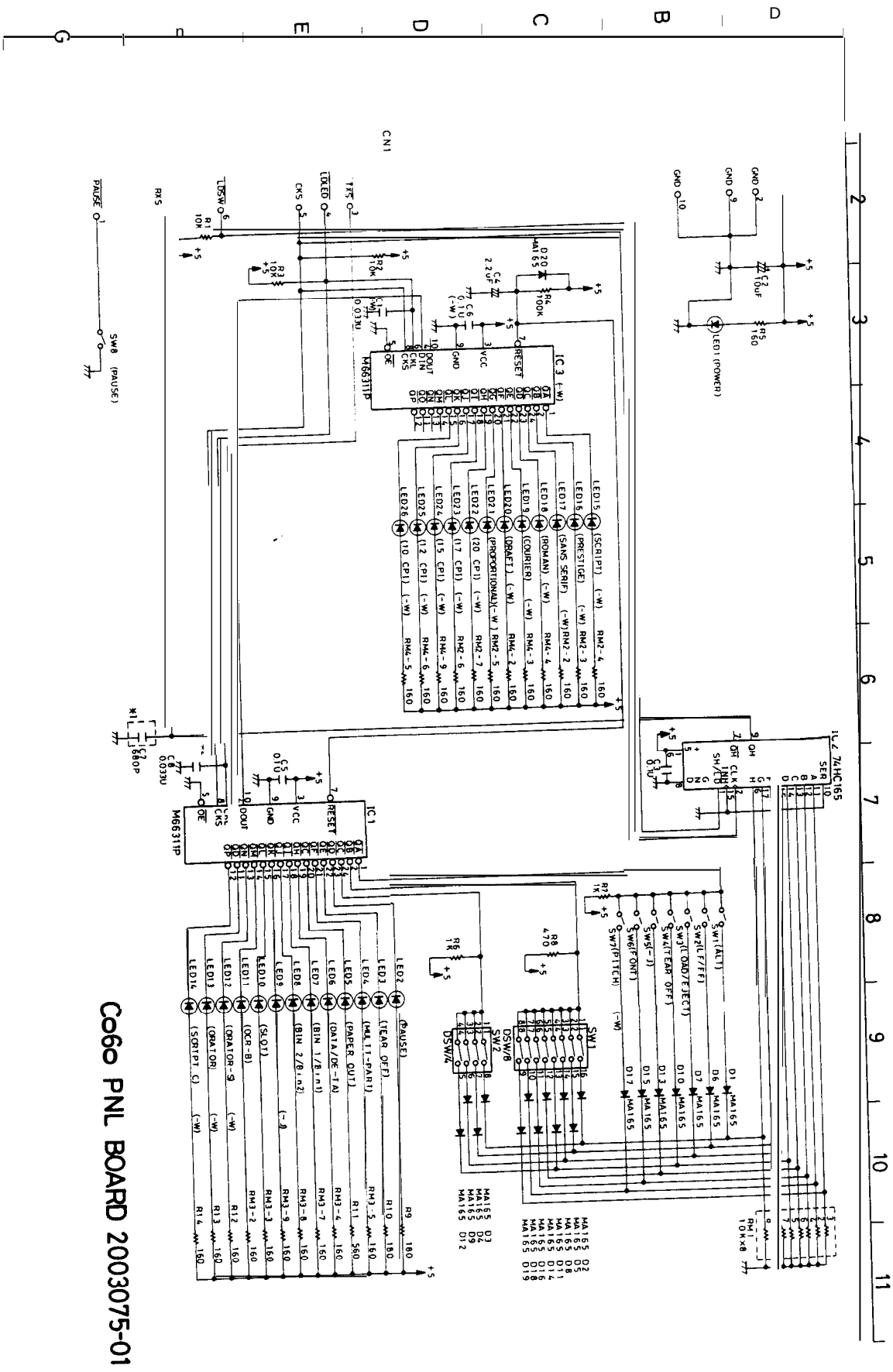

Figure A-6. C060 PNL Board Circuit Diagram

A-3. CIRCUIT BOARD COMPONENT LAYOUT

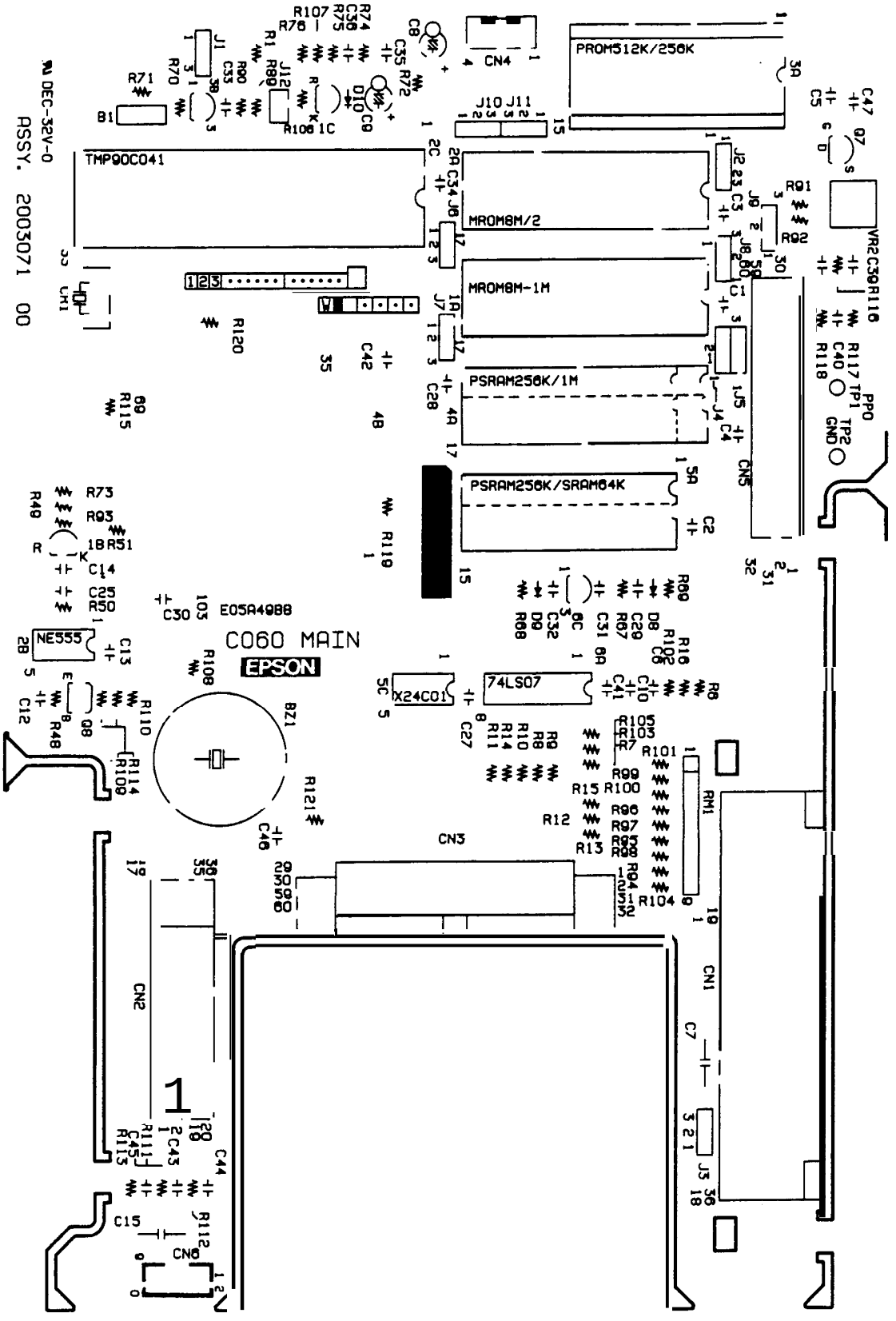

Figure A-7. **C060** MAIN Board Component Layout

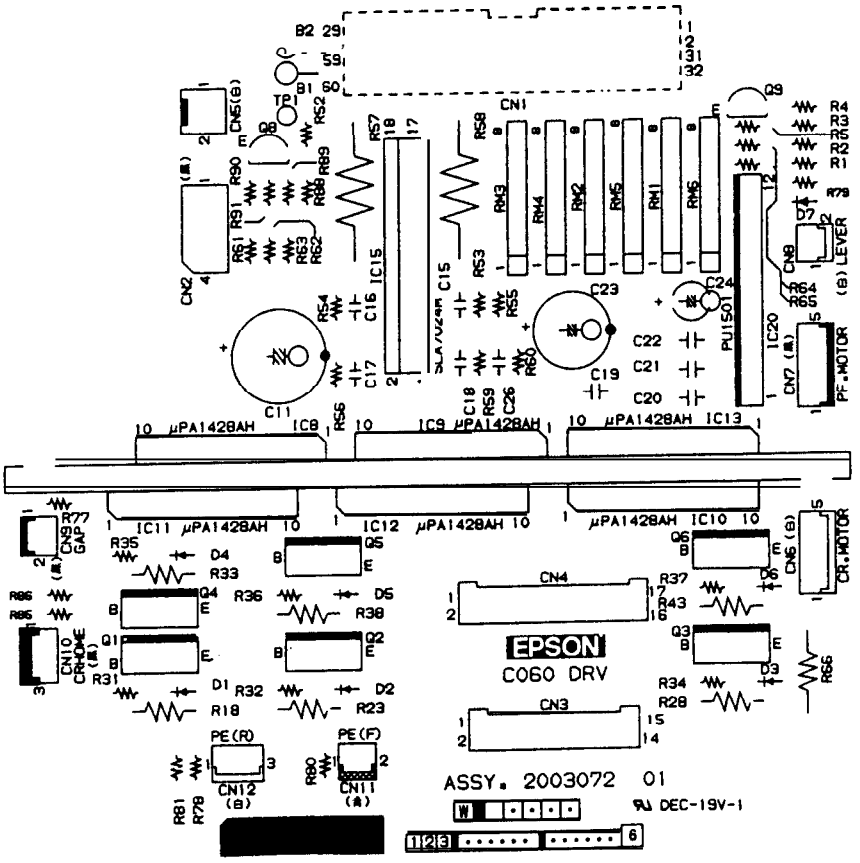

Figure A-8. C060DRV Board Component Layout

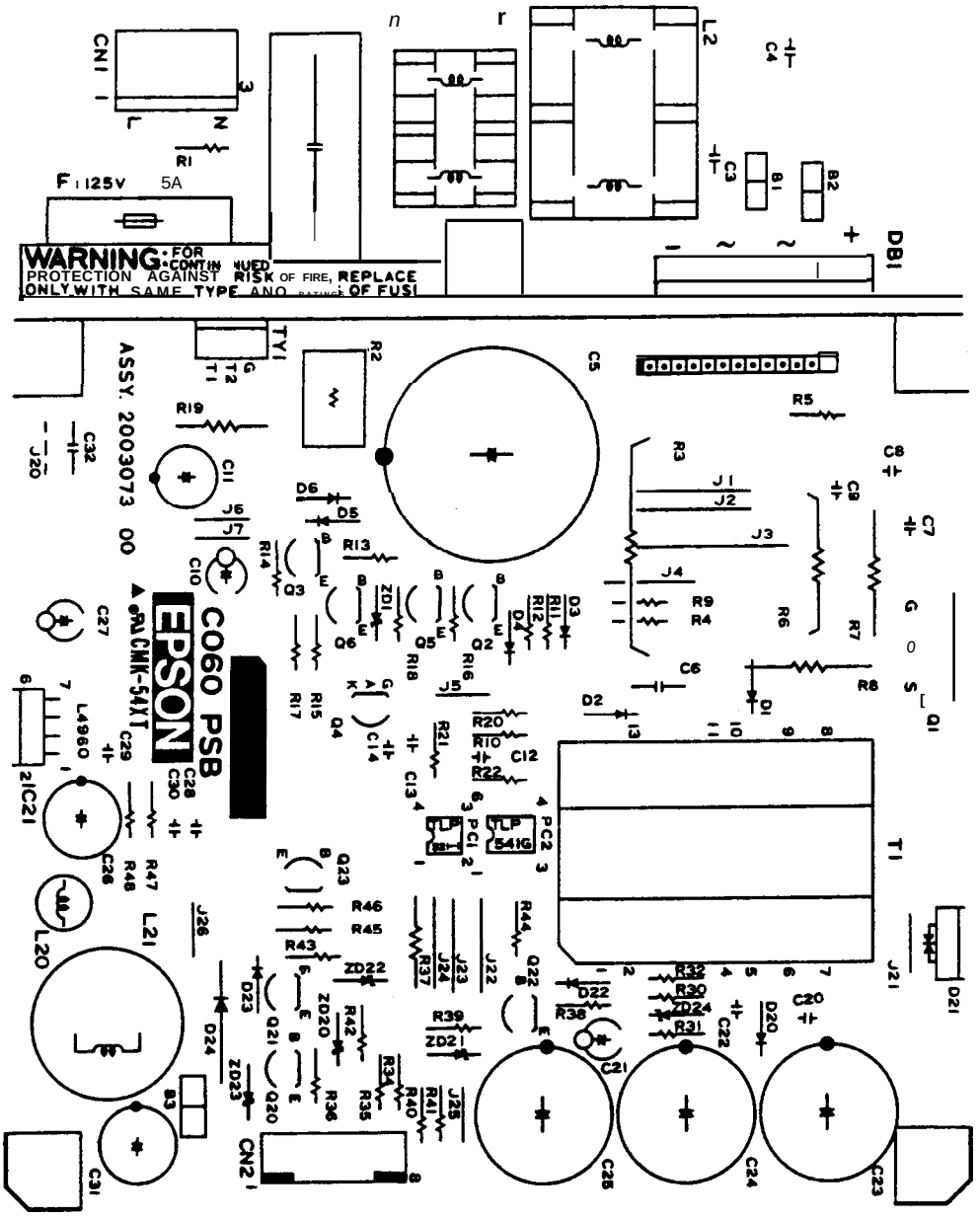

Figure A-9. C060 PSB Board Component Layout

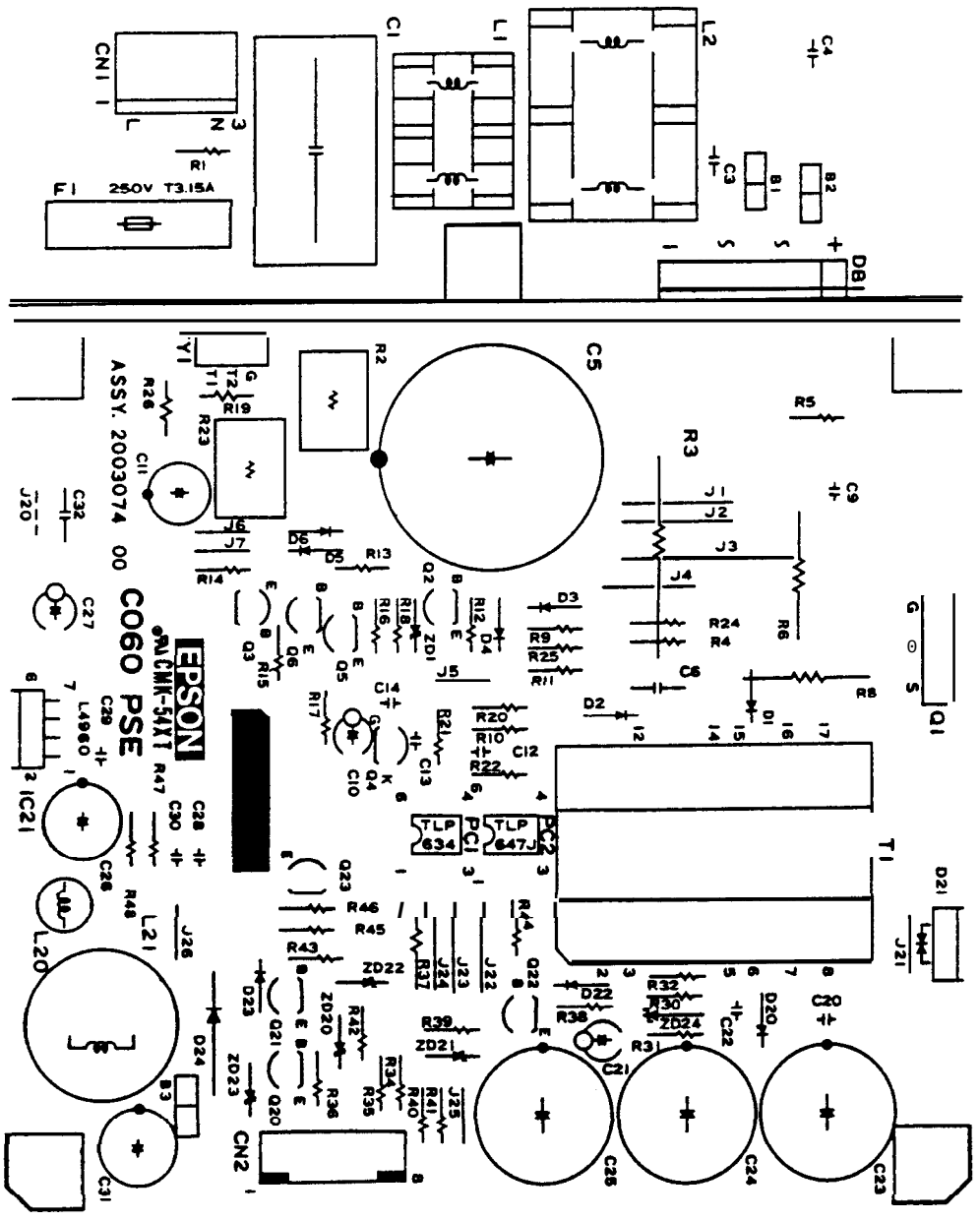

Figure A-1 O. C060 PSE Board Component Layout

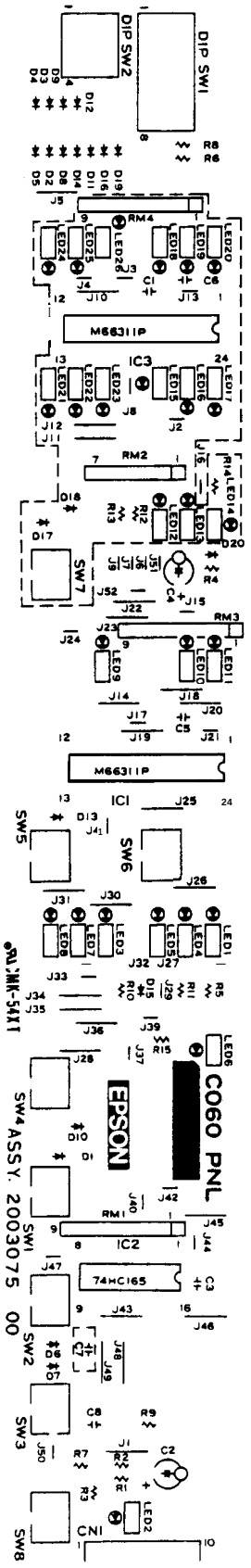

Figure A-1 1. C060 PNL Board Component Layout

A.4 EXPLODED DIAGRAM

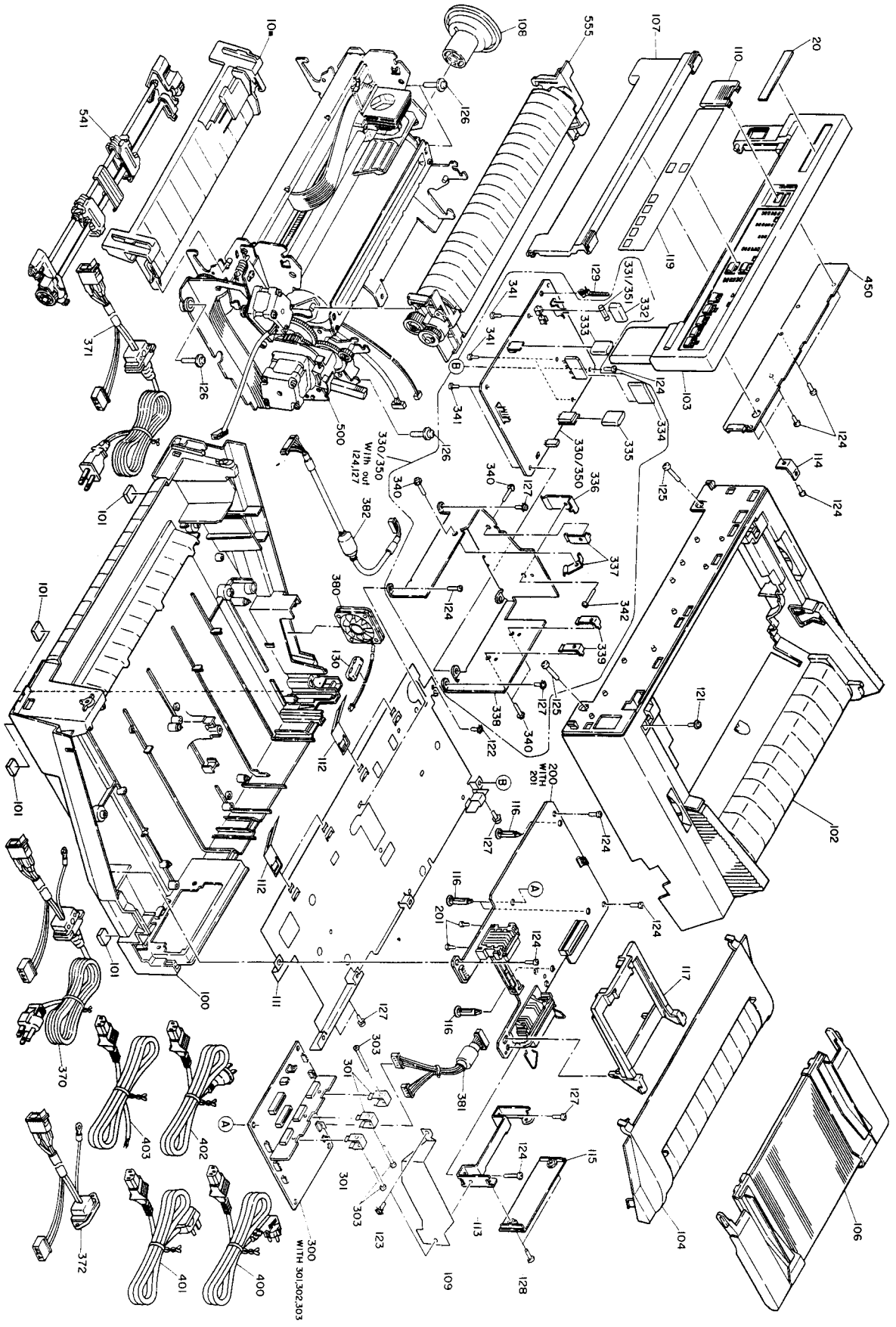

Figure A-1 2-1. Exploded Diagram for LQ-870

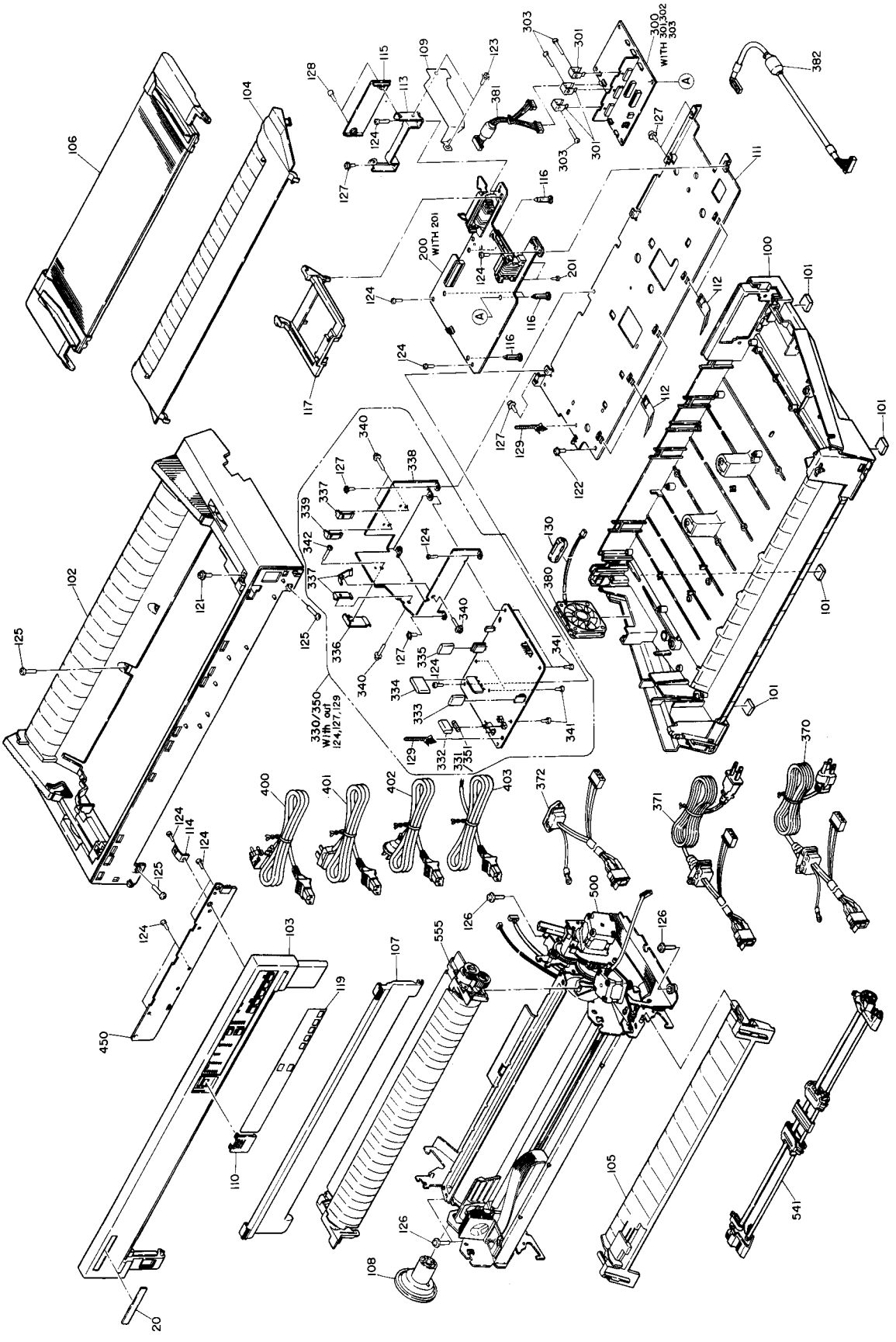

Figure A-1 2-2. Exploded Diagram for LQ-1 170

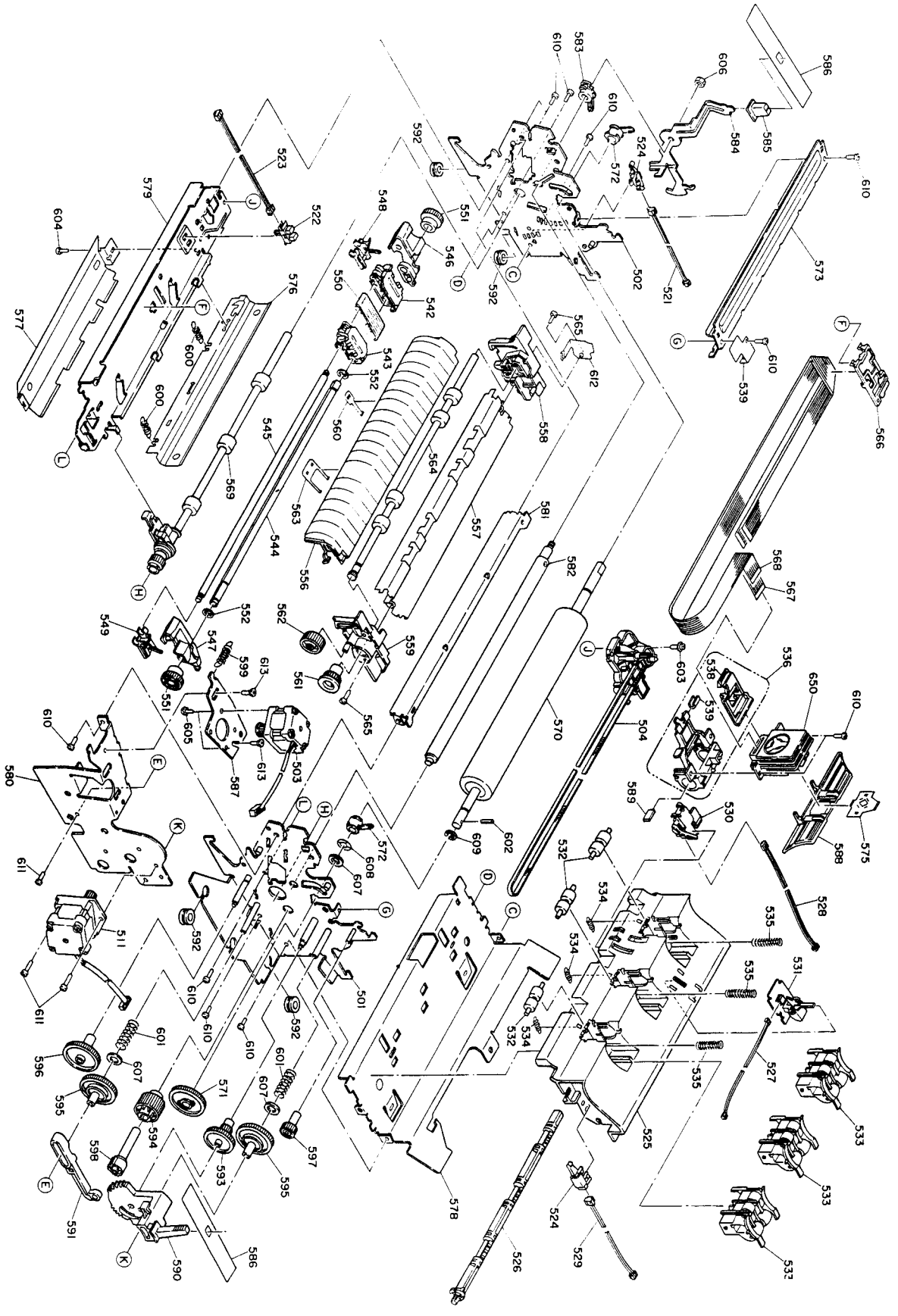

Figure A-1 3-1. Exploded Diagram for Model-5D10

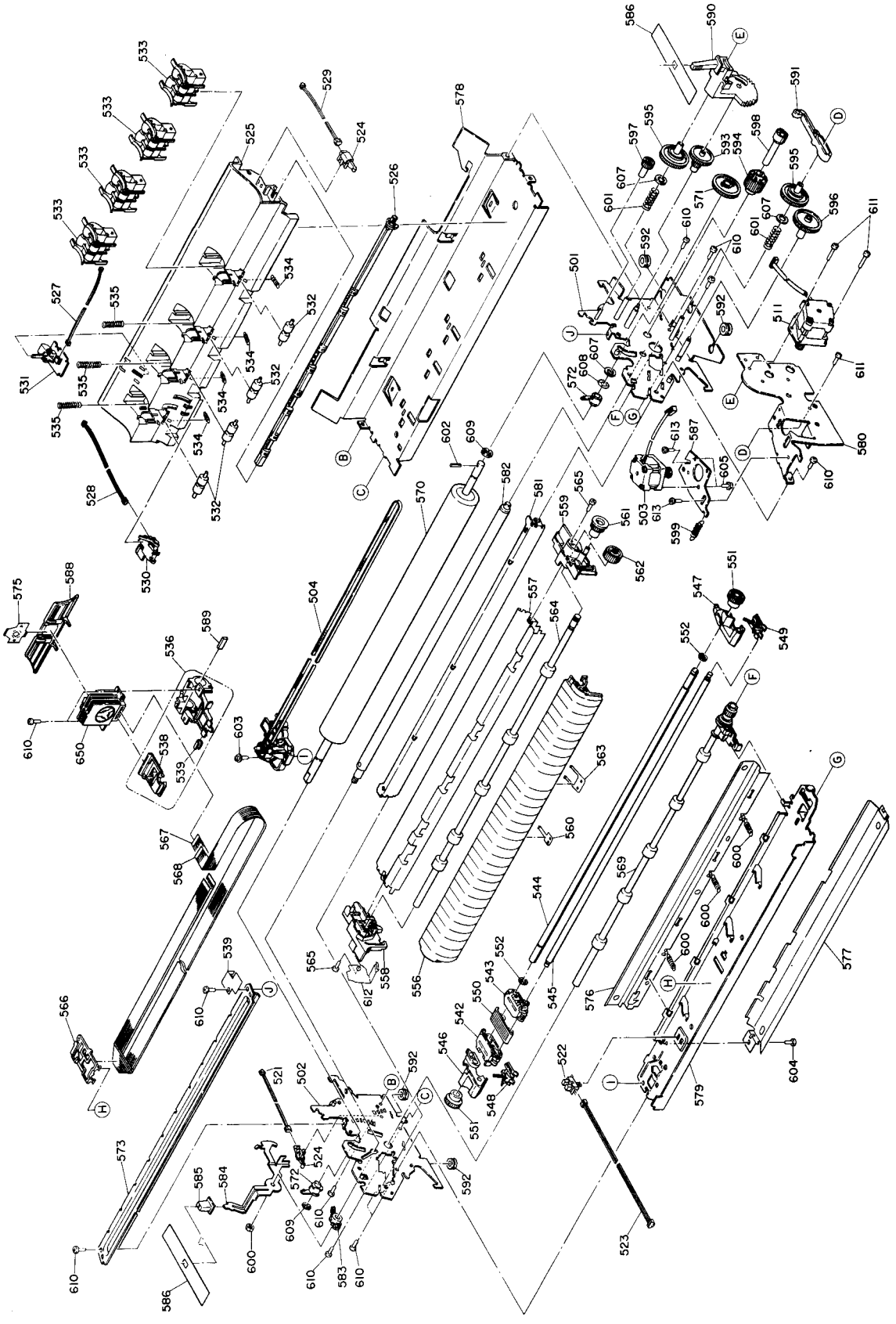

Figure A-1 3-2. Exploded Diagram for Model-5D60

Table A-23-1. Part No. Reference Table for LQ-870

Ref. No.	Description
100	HOUSING ASSY., LOWER
101	FOOT
102	HOUSING, FRONT
103	HOUSING, FRONT
104	COVER ASSY., PRINTER
105	EDGE GUIDE ASSY., REAR
106	EDGE GUIDE ASSY., REAR
107	COVER ASSY., FRONT
108	KNOB
109	SHIELD PLATE
110	COVER, DIP, SWITCH
111	SHIELD PLATE
112	GROUNDING PLATE
113	GROUNDING PLATE, I/F
114	GUIDE, I/F BOARD
115	XOVER, CONNECTOR, UPPER
116	CIRCUIT BOARD SPACER
117	GUKDE, I/F BOARD
119	SHEET, PANEL
120	LOGO PLATE
121	C. B. SCREW (m3 X 8)
122	C. B.(O) SCREW (M3 X 6)
123	C. B.S.(O) SCREW (M3 X 6)
124	C.B.B. SCREW (M3 X 12)
125	C.B.B. SCREW (M3 X 14)
126	PRINTER MECHANISM MOUNTING SCREW
127	C. B. B(O). SCREW (M3 X 8)
128	C. B. S.-TITESCREW (M3 X 12)
129	SNAP BAND
130	FERRITE CLAMP
200	BOARD ASSY., MAIN
200	BOARD ASSY., MAIN
201	C. P. B-TITE SCREW (M3 X 8)
330	BOARD ASSY., PSB
331	FUSE
332	'USE COVER
333	NSULATION SPACER
334	NSULATION SPACER
334	NSULATION SPACER
335	NSULATION SPACER
336	transistor
337	TRANSISTOR HOLDER
338	-I EAT SINK
339	HOLDER, TRANSISTOR
340	CUP SCREW (M3 X 14)
341	C.B.S. SCREW (M3 X 6)
342	C. B. S-TITESCREW (M3 X 12)

Table A-23-2. Part No. Reference Table for LQ-1 170

Ref. No.	Description
100	HOUSING ASSY., LOWER
101	FOOT
102	HOUSING ASSY., UPPER
103	HOUSING, FRONT
104	COVER ASSY., PRINTER
105	EDGE GUIDE ASSY., FRONT
106	EDGE GUIDE ASSY., REAR
107	COVER ASSY., FRONT
108	KNOB
109	SHIELD PLATE
110	COVER, DIP, SWITCHTOR
111	SHIELD PLATE
112	GROUNDIGN PLATE
113	GROUNDING PLATE, I/F
114	BRACKET
115	COKVER, CONNECTOR, UPPER
116	CIRCUIT BOARD SPACER
117	GUIDE, I/F BOARD
119	SHEET, PANEL
120	LOGO PATE
121	C. B. SCREW (M3 x 8)
122	C. B.(O) SCREW (M4x 8)
123	C. B.(M3 X 6)
124	C.B.B. SCREW (M3 X 12)
125	C.B. B. SCREW (M4 X 14)
126	PRINTER MECHANISM MOUNTING SCREW
127	C. B.S.(O) SCREW (M3 X 8)
200	BOARD ASSY., MAIN
201	C. P. B-TITE (M3 X 8)
330	BOARD ASSY., PSB
331	FUSE
332	FUSE
333	INSULATION SPACER
334	INSULATION SPACER
335	INSULATION SPACER
336	TRANSISTOR
337	TRANSISTOR HOLDER
338	HEAT SINK
339	HOLDER, TRANSISTOR
340	C.B.S. SCREW (M3 X 14)
341	C.B.S. SCREW (M3 X 6)
342	C. B. SPTITESCREW (M3 × 12)

A.5 CASE OUTLINE DRAWING

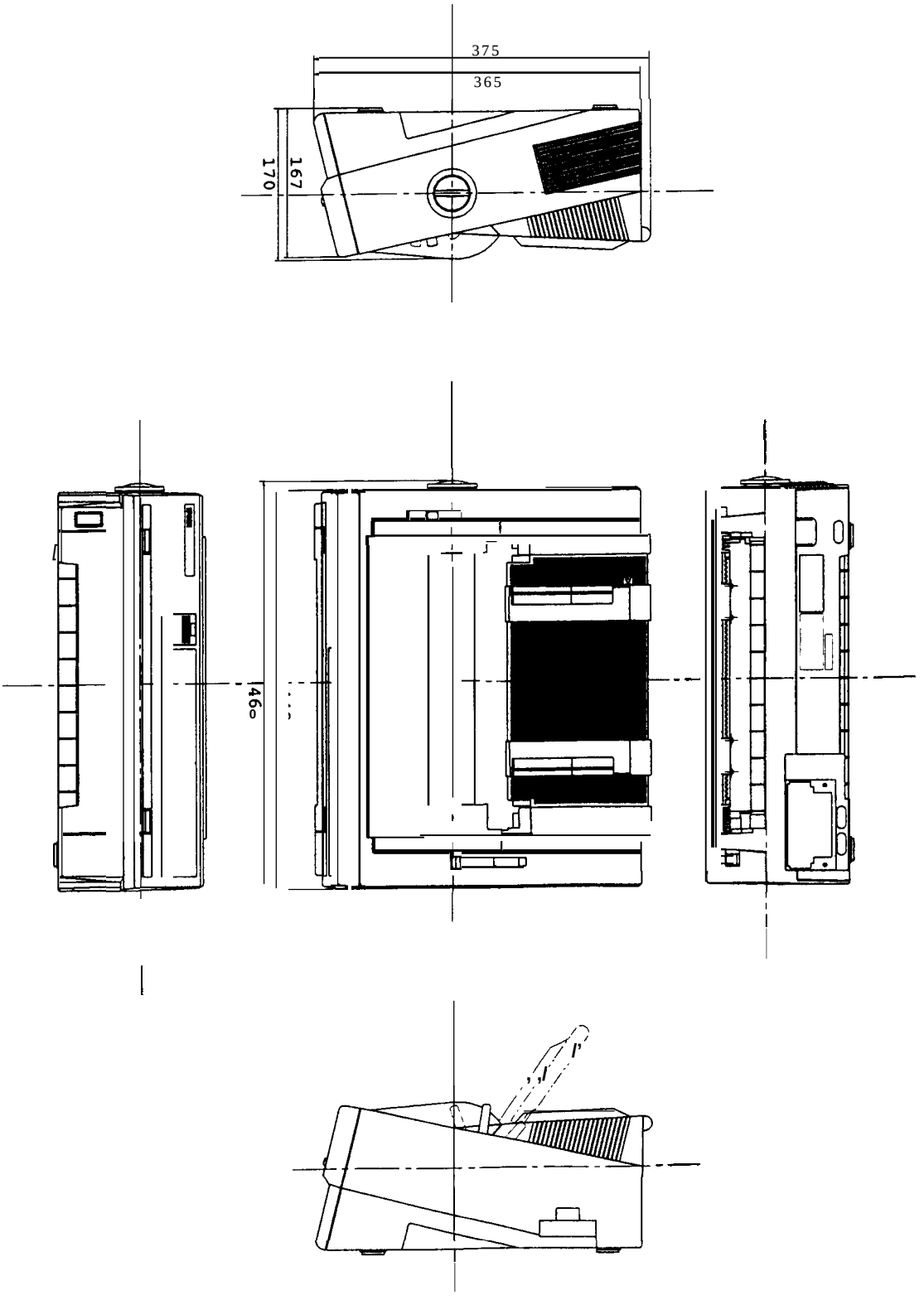

Figure A-1 4-1. Case Outline Drawing for LQ-870

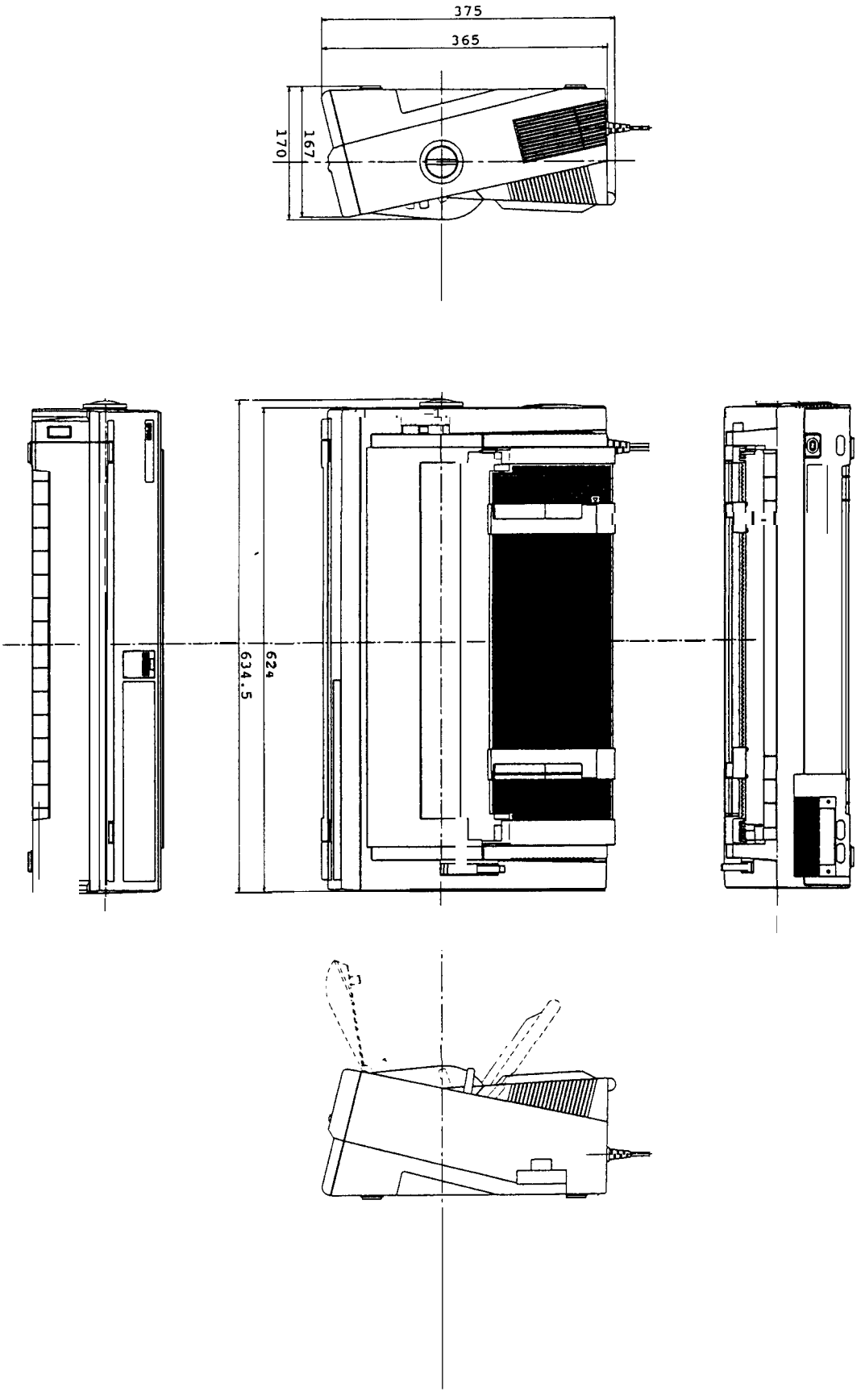

Figure A-14-2. Case Outline Drawing for LQ-1 170

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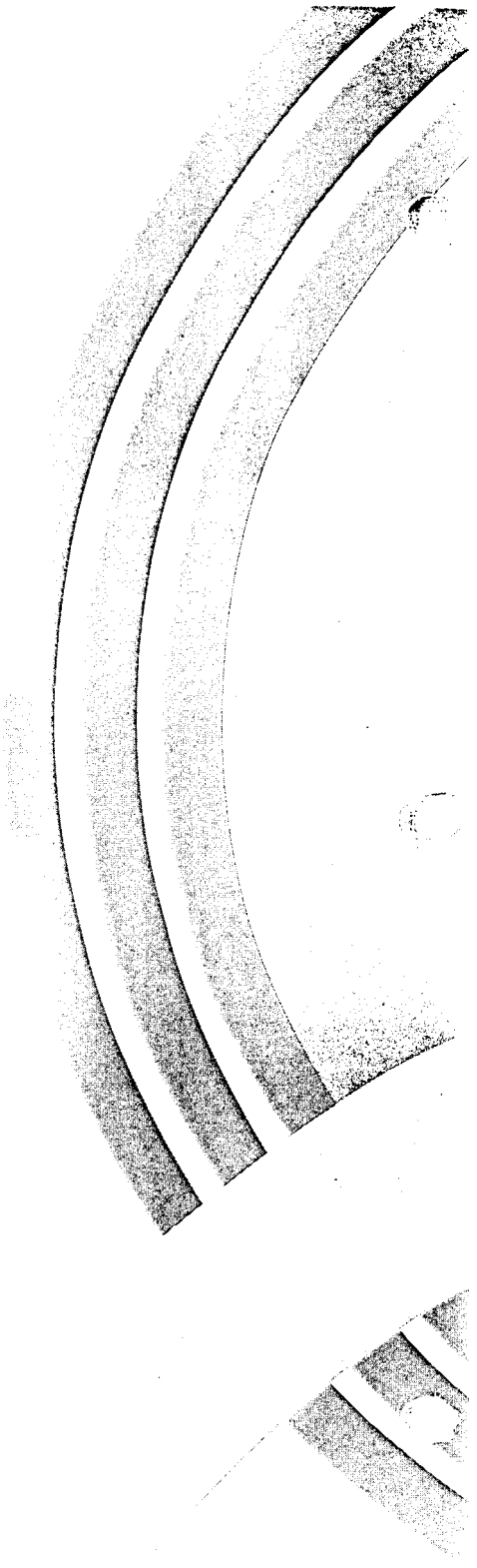

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