LA210

Technical Manual

CONTENTS

CHAPTER 7   TROUBLESHOOTING

CHAPTER 8   MECHANICAL SERVICING

APPENDIX A   BASE MODELS

APPENDIX B   INTERFACES

APPENDIX C   OPTIONS AND ACCESSORIES

APPENDIX D   SPECIFICATIONS

INDEX

FIGURES

TABLES

INTRODUCTION

This technical manual provides operating, programming, installation, and maintenance information about the LA210 Letterprinter.

This manual is for Field Service and Customer Service engineers and other technical personnel involved in maintaining the LA210 Letterprinter. For information on programming and operation, refer to the programmer reference manual and the user guide. (A list of available documents for the printer is in Chapter 1, Table 1-1.)

The manual is divided into the following chapters.

Chapter 1, "Overview," describes the printers physical and functional characteristics. A list of documentation for the printer is included.

Chapter 2, "Installation," describes the environmental conditions to consider before installing the printer. It has procedures for unpacking the printer, installing it, turning it on, and verifying its operation.

Chapter 3, "Operator Information," is a description of the printer's controls, indicators, and self-tests.

Chapter 4, "Programming," covers the basic programming features and data that support the printer application software. For detailed information, see the programmer reference manual.

Chapter 5, "Theory of Operation," discusses the printer's internal operating principles. The chapter covers the primary functional areas of the printer: microprocessor/control system, input/output (I/O) communication system, printing process, paper advance process, and power supply. Each area is explained in terms of hardware and firmware.

Chapter 6, "Options," provides a functional description of the major printer options, along with installation, testing, and reference information.

Chapter 7, "Troubleshooting," is a fault isolation guide. It has tables that list possible failures and procedures for determining the faulty area. Basic (operator-oriented) and functional tests provide check-out procedures and in-depth troubleshooting.

Chapter 8, "Mechanical Servicing," has procedures for removing, replacing, and adjusting field replaceable units (FRUs).

Appendix A, "Base Models," lists the basic printer configurations.

Appendix B, "Interfaces," describes the printer's interface lines and their specifications.

Appendix C, "Options and Accessories," lists the printer options accessories, supplies, and spares.

Appendix D, "Specifications," lists the specifications for the printer.

CHAPTER 1
OVERVIEW

1.1   GENERAL

The LA210 Letterprinter is a dot matrix, receive-only (RO) printer
that fits on a desktop. You can use this compact
microprocessor-controlled printer with personal computer systems,
office workstations, and small business computer systems.

This chapter provides physical and functional descriptions of the
printer.

1.2   PHYSICAL DESCRIPTION

The printer has two main mechanical assemblies and two main
electronic assemblies. The mechanical assemblies are the printer
mechanism and the printhead. The electronic assemblies are the
control/logic module and power supply.

1.3   FUNCTIONAL DESCRIPTION

Figure 1-1 shows two ways of connecting the printer to a computer.
The printer processes data characters according to standards from
the American National Standards Institute (ANSI). Depending on
system variations, the printer operates in 7-bit and 8-bit modes.
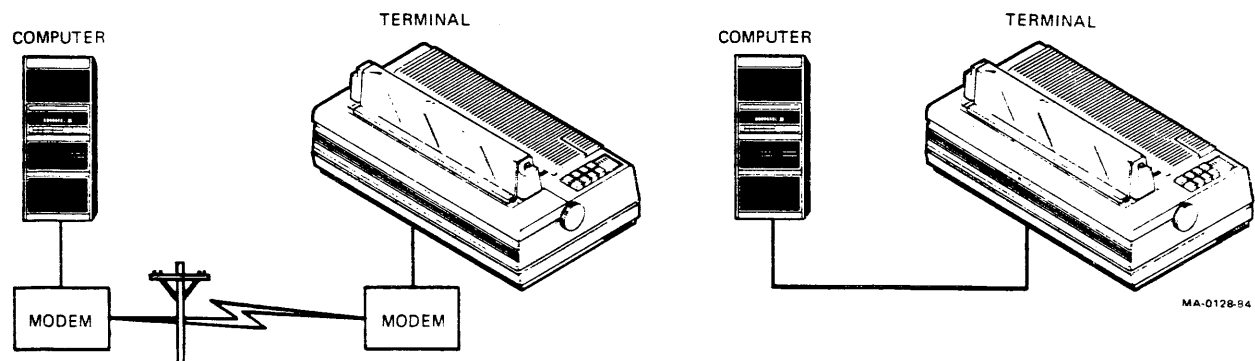
Figure 1-1   Connecting Printer to Computer

1-1

1.3.1   Control System

The printer's internal control system supervises data input/output (I/O), character generation and printing, and form control. This control system is built around an 8085A microprocessor supported by 24 Kbytes (8 Kbytes plus 16 Kbytes) of control read only memory (ROM) and 2 Kbytes of random access memory (RAM). Up to five plug-in font ROMs (8 Kbytes each) store the dot pattern sets (DPSs) used for selecting style (fonts) and/or function (character sets). The printer has three internal font slots and two external slots in a font assembly. You can use escape sequences to select fonts from the host computer or you can select fonts manually by using the operator control panel.

The 8085A uses an internal microprocessor control bus to monitor and control the communication module, or USART (Universal Synchronous-Asynchronous Receiver/Transmitter), the DC305 printer controller, and the control panel. Figure 1-2 is a simplified block diagram of the printer.
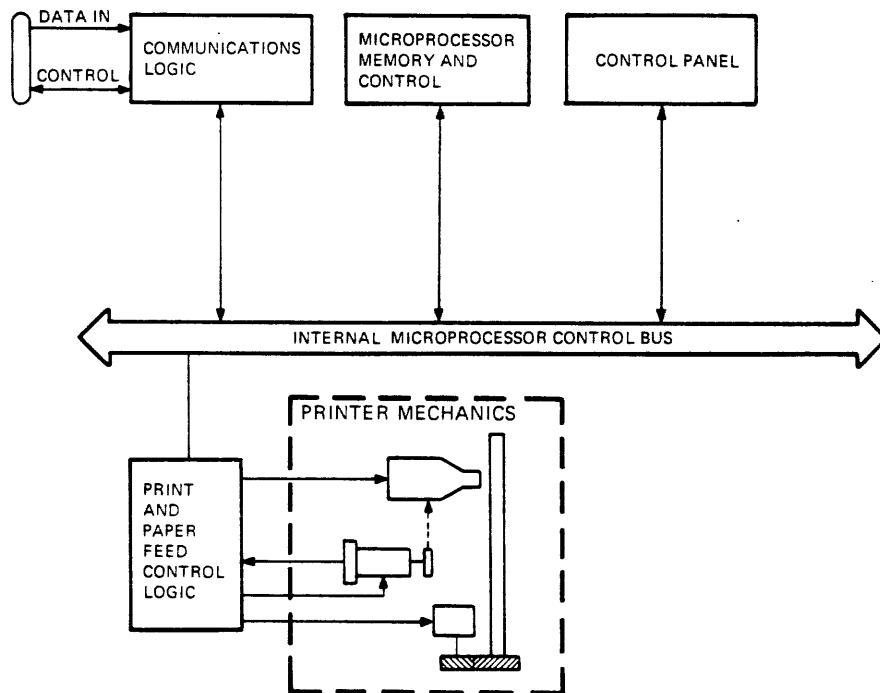
Figure 1-2   Simplified Block Diagram

The LA210 Letterprinter operates at medium speed in asynchronous, full-duplex mode. The printers interface conforms to the electrical requirements of EIA standards RS232-C and CCITT V.24. The printer supports baud rates of 50 to 9600. You can use different rates for sending and receiving.

The printer has electrically alterable read only memory (EAROM) that allows parameters and answerback messages to be stored permanently even after the power is off. You can overwrite this memory area to store new parameters.

1.3.2   Printing Process

The printer's standard character set is the USASCII (American Standard Code for Information Interchange) character set, which has 96 upper- and lowercase characters (Figure 1-3). In addition to English, the printer can print in several European languages and in graphic mode.

Characters are printed by a 9-wire, solenoid-operated printhead. The printhead moves horizontally along the print line and fires groups of discrete wires at each printing position, forming 7×9 (W $\times$ H) dot matrix characters. You can select multiple font draft and letter quality printing. Draft mode uses the basic 7×9 matrix. Letter mode uses either the standard 33×18 or optional 33×9, depending on the DPS (font) installed. Graphic mode prints a single vertical column of six dots (six printhead wires) for each character received.

The ribbon comes in a disposable cartridge that mounts on the carriage assembly and surrounds the printhead. The ribbon is easy to remove and replace.

The printhead mounts on the carriage assembly. A timing belt connects the carriage assembly to a servo drive motor. The reversible dc servo motor drives the carriage with the printhead and the ribbon cartridge. The ribbon advances when the carriage moves. The control logic module tracks the printhead position by means of feedback pulses sent from an encoder on the servo motor.

The paper feed mechanism moves the paper up or down. When the tractor feed is used, the printer only advances paper, except to use the superscript/subscript function. The printer reverses paper 1/12 inch when superscripting. A dc stepper motor directly drives the paper feed mechanism.

Standard Character Set

B8 B7 B6 B5 / BITS B4 B3 B2 B1 ROW	COLUMN 0	1	2	3	4	5	6	7
0 0 0 0 — 0	NUL (0/0/0)	(20/16/10)	SP (40/32/20)	0 (60/48/30)	@ (100/64/40)	P (120/80/50)	` (140/96/60)	p (160/112/70)
0 0 0 1 — 1		DC1 (XON) (21/17/11)	! (41/33/21)	1 (61/49/31)	A (101/65/41)	Q (121/81/51)	a (141/97/61)	q (161/113/71)
0 0 1 0 — 2		(22/18/12)	" (42/34/22)	2 (62/50/32)	B (102/66/42)	R (122/82/52)	b (142/98/62)	r (162/114/72)
0 0 1 1 — 3		DC3 (XOFF) (23/19/13)	# (43/35/23)	3 (63/51/33)	C (103/67/43)	S (123/83/53)	c (143/99/63)	s (163/115/73)
0 1 0 0 — 4	EOT (4/4/4)	(24/20/14)	$ (44/36/24)	4 (64/52/34)	D (104/68/44)	T (124/84/54)	d (144/100/64)	t (164/116/74)
0 1 0 1 — 5	ENQ (5/5/5)	(25/21/15)	% (45/37/25)	5 (65/53/35)	E (105/69/45)	U (125/85/55)	e (145/101/65)	u (165/117/75)
0 1 1 0 — 6	(6/6/6)	(26/22/16)	& (46/38/26)	6 (66/54/36)	F (106/70/46)	V (126/86/56)	f (146/102/66)	v (166/118/76)
0 1 1 1 — 7	BEL (7/7/7)	(27/23/17)	' (47/39/27)	7 (67/55/37)	G (107/71/47)	W (127/87/57)	g (147/103/67)	w (167/119/77)
1 0 0 0 — 8	BS (10/8/8)	CAN (30/24/18)	((50/40/28)	8 (70/56/38)	H (110/72/48)	X (130/88/58)	h (150/104/68)	x (170/120/78)
1 0 0 1 — 9	HT (11/9/9)	(31/25/19)	) (51/41/29)	9 (71/57/39)	I (111/73/49)	Y (131/89/59)	i (151/105/69)	y (171/121/79)
1 0 1 0 — 10	LF (12/10/A)	SUB (32/26/1A)	* (52/42/2A)	: (72/58/3A)	J (112/74/4A)	Z (132/90/5A)	j (152/106/6A)	z (172/122/7A)
1 0 1 1 — 11	VT (13/11/B)	ESC (33/27/1B)	+ (53/43/2B)	; (73/59/3B)	K (113/75/4B)	[(133/91/5B)	k (153/107/6B)	{ (173/123/7B)
1 1 0 0 — 12	FF (14/12/C)	(34/28/1C)	, (54/44/2C)	< (74/60/3C)	L (114/76/4C)	\ (134/92/5C)	l (154/108/6C)	| (174/124/7C)
1 1 0 1 — 13	CR (15/13/D)	(35/29/1D)	- (55/45/2D)	= (75/61/3D)	M (115/77/4D)	] (135/93/5D)	m (155/109/6D)	} (175/125/7D)
1 1 1 0 — 14	SO (16/14/E)	(36/30/1E)	. (56/46/2E)	> (76/62/3E)	N (116/78/4E)	^ (136/94/5E)	n (156/110/6E)	~ (176/126/7E)
1 1 1 1 — 15	SI (17/15/F)	(37/31/1F)	/ (57/47/2F)	? (77/63/3F)	O (117/79/4F)	_ (137/95/5F)	o (157/111/6F)	DEL (177/127/7F)

Column 0 and 1 = **ASCII CONTROL SET**

Columns 2–7 = **ASCII GRAPHIC CHARACTER SET**

KEY

ASCII CHARACTER	ESC	1/11	COLUMN/ROW
		33	OCTAL
		27	DECIMAL
		1B	HEX

MA-10087J

Figure 1-3 Standard Character Set (Sheet 1 of 2)

8 (1000)	9 (1001)	10 (1010)	11 (1011)	12 (1100)	13 (1101)	14 (1110)	15 (1111)
200 128 80	DCS 220 144 90	240 160 A0	° 260 176 B0	À 300 192 C0	320 208 D0	à 340 224 E0	360 240 F0
201 129 81	221 145 91	¡ 241 161 A1	± 261 177 B1	Á 301 193 C1	Ñ 321 209 D1	á 341 225 E1	ñ 361 241 F1
202 130 82	222 146 92	¢ 242 162 A2	2 262 178 B2	Â 302 194 C2	Ò 322 210 D2	â 342 226 E2	ò 362 242 F2
203 131 83	223 147 93	£ 243 163 A3	3 263 179 B3	Ã 303 195 C3	Ó 323 211 D3	ã 343 227 E3	ó 363 243 F3
IND 204 132 84	224 148 94	244 164 A4	264 180 B4	Ä 304 196 C4	Ô 324 212 D4	ä 344 228 E4	ô 364 244 F4
NEL 205 133 85	225 149 95	¥ 245 165 A5	µ 265 181 B5	Å 305 197 C5	Õ 325 213 D5	å 345 229 E5	õ 365 245 F5
206 134 86	226 150 96	246 166 A6	¶ 266 182 B6	Æ 306 198 C6	Ö 326 214 D6	æ 346 230 E6	ö 366 246 F6
207 135 87	227 151 97	§ 247 167 A7	• 267 183 B7	Ç 307 199 C7	Œ 327 215 D7	ç 347 231 E7	œ 367 247 F7
HTS 210 136 88	230 152 98	¤ 250 168 A8	270 184 B8	È 310 200 C8	Ø 330 216 D8	è 350 232 E8	ø 370 248 F8
211 137 89	231 153 99	© 251 169 A9	1 271 185 B9	É 311 201 C9	Ù 331 217 D9	é 351 233 E9	ù 371 249 F9
VTS 212 138 8A	232 154 9A	ª 252 170 AA	º 272 186 BA	Ê 312 202 CA	Ú 332 218 DA	ê 352 234 EA	ú 372 250 FA
PLD 213 139 8B	CSI 233 155 9B	« 253 171 AB	» 273 187 BB	Ë 313 203 CB	Û 333 219 DB	ë 353 235 EB	û 373 251 FB
PLU 214 140 8C	ST 234 156 9C	254 172 AC	¼ 274 188 BC	Ì 314 204 CC	Ü 334 220 DC	ì 354 236 EC	ü 374 252 FC
RI 215 141 8D	OSC 235 157 9D	255 173 AD	½ 275 189 BD	Í 315 205 CD	Ÿ 335 221 DD	í 355 237 ED	ÿ 375 253 FD
SS2 216 142 8E	PM 236 158 9E	256 174 AE	276 190 BE	Î 316 206 CE	336 222 DE	î 356 238 EE	376 254 FE
SS3 217 143 8F	APC 237 159 9F	257 175 AF	¿ 277 191 BF	Ï 317 207 CF	ß 337 223 DF	ï 357 239 EF	377 255 FF
ADDITIONAL CONTROL SET		DEC SUPPLEMENTAL GRAPHIC SET					

MA-10087H

Figure 1-3 Standard Character Set (Sheet 2 of 2)

1.4 RELATED DOCUMENTS

Table 1-1 lists the documents that support the LA210 Letterprinter.

Table 1-1 Related Documents

Title	Document Number	Description
LA210 Letterprinter User Documentation Package	EK-LA210-UP	User documentation package. Includes user guide, installation manual, programmer reference manual, and operator/programmer reference card and guide.
Installing the LA210 Letterprinter	EK-LA210-IN	Installation, checkout, and set-up information.
LA210 Letterprinter User Guide	EK-LA210-UG	Operating, user maintenance, and checkout information for the printer.
LA210 Letterprinter Programmer Reference Manual	EK-LA210-RM	Information on programming features of the printer (communication, character processing, escape and control sequences, ANSI control strings) for writing printer application software.
LA210 Letterprinter Operator and Programmer Reference Guide	EK-LA210-RC	A foldout card summarizing operator and programming information.
LA210 Letterprinter Emulation Mode Reference Guide	EK-LA210-RG	A foldout card summarizing programming information for using mode emulation.
LA210 Pocket Service Guide	EK-LA210-PS	Troubleshooting, general maintenance, and mechanical servicing information.

Table 1-1   Related Documents (Cont)

Title	Document Number	Description
LA210 Technical Manual	EK-LA210-TM	Summary of installation, operating, and programming with details on troubleshooting and mechanical servicing; includes specifications and other reference data.
LA210 Illustrated Parts Breakdown	EK-LA210-IP	Exploded views and parts lists.
LA210 Field Maintenance Print Set	MP-02007-01	Engineering drawings and parts lists.
LA10X-EP Parallel Interface Option User Guide	EK-L10EP-UG	Installation, functional, checkout, and set-up information for LA10X-EP option.
LA21X-BT Bidirectional Tractor Option Installation Guide		Installation, checkout, and set-up information for bidirectional tractor.
LA21X-SF/SH Cut Sheet Feeder User Guide		Installation, operating, checkout, and maintenance information for sheet feeder option.

NOTE

Installation guides are provided for plug-in ROM options. The ROM options are listed in Appendix C, Paragraph C.1. Refer to the option part number to determine the number of its installation guide.

2.1   GENERAL

This chapter has information on inspecting, installing, and powering up the printer. Before you connect the printer to the system, do the procedures in Chapter 3 (Paragraph 3.5) to make sure it is not damaged and is operating correctly.

2.2   SITE CONSIDERATIONS

Install the printer in an area free from excessive dust, dirt, corrosive fumes, and vapors. The following is a list of environmental and power requirements for the printer.

Weight   11.3 kg (25 lb)

Electrical requirements

    Input voltage   90 to 128 Vac
                       47 to 63 Hz
                          or
                     180 to 256 Vac
                     47 to 63 Hz

    Power receptacle   Nonswitched, 3-prong, grounded receptacle

Operating requirements

    Temperature 10° to 40°C (50° to 104°F)

    Relative humidity   10% to 90%

Appendix D has a complete list of specifications. Also see Figure 2-1, which shows the dimensions of the printer.
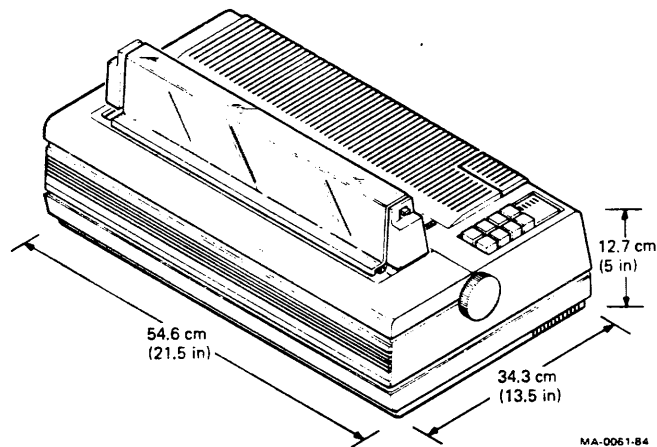
Figure 2-1   Printer Dimensions

2.3   UNPACKING AND INSPECTING THE PRINTER

Unpack and inspect the printer as follows. You will need a sharp tool.

1.   Use a sharp tool to open the top of the shipping carton.

2.   Lift the printer up and out of the carton. Place the printer on a flat, clean surface.

3.   Remove the shock absorbing material and packing from around the printer.

4.   Remove the tractor assembly, documentation package, power cord, paper, ribbon, and loopback connector.

5.   Carefully inspect the printer for damage. Check for lost or missing items. Report any damage or missing items to the local carrier and your local Digital sales representative.

6.   Remove the access cover, cardboard retainer, and the tie wrap which holds the printhead (Figure 2-2). Replace the access cover.

7.   Use a clean, soft, lint-free cloth to clean the outer surfaces if they are dirty.

NOTE
Save the cardboard retainer and shock absorbing material to repack the printer.

2-2

ACCESS COVER

CARDBOARD RETAINER

TIE WRAP
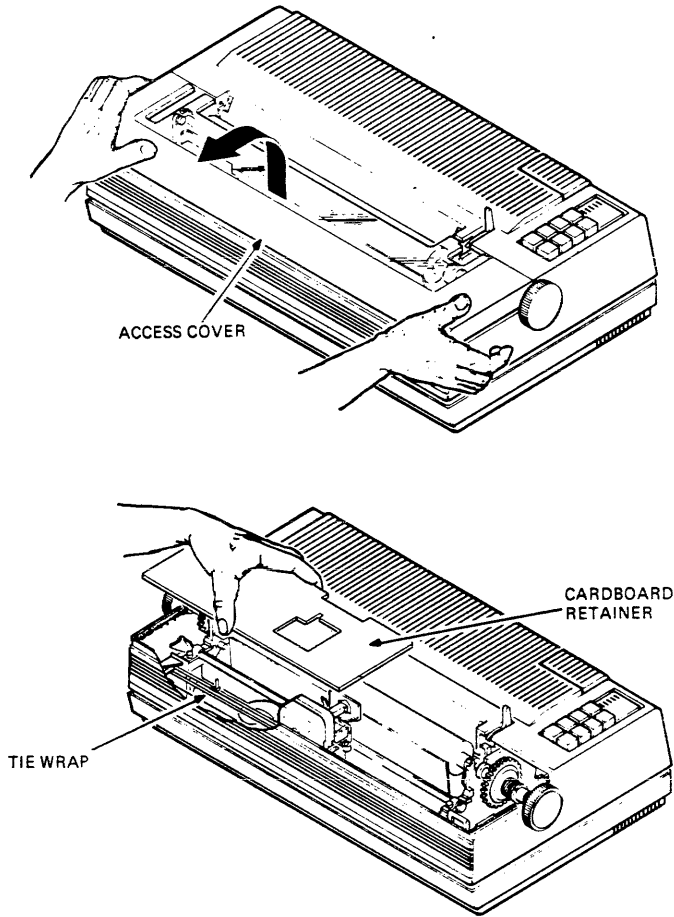
MA-0113-85

Figure 2-2   Removing the Packing Material

2.4   REPACKING THE PRINTER

Repack the printer for shipment as follows.

1.   Remove the ribbon cartridge, paper, and all cables.

2.   Remove the access cover and secure the printhead with a tie strap and cardboard retainer to prevent movement while in transit. Replace the access cover.

3.   Repack the printer with the shock absorbing material.

4.   Seal the shipping carton with reinforced tape.

2.5   INSTALLING THE PRINTER

Perform the procedures to install the printer as follows.

2.5.1   Cabling

Connect the cables as follows.

1.   Remove the printer top cover to access the voltage
      selector switch (Paragraph 8.3). The switch is on the top
      of the power supply (Figure 2-3). Make sure that the
      voltage switch setting matches the input voltage (115 V
      for U.S.).

                            CAUTION
             Never   use   a   pencil   to   change   the
             voltage. Lead particles can disturb
             printer operation. Always use a small,
             slotted screwdriver or a ballpoint pen.

2.   Attach either end of the communication cable to the rear
      of the printer. The cable may be either an EIA BC22D or a
      BCC04 PC cable. If the parallel interface adapter is
      installed, you must attach a DEC communication cable
      (part number 70-21511) for DEC parallel applications. For
      IBM/Epson   parallel   applications,   attach   an
      IBM/TI/Centronics cable (vendor part number R0097). For
      more information on the parallel interface adapter, see
      the LA10X-EP External Parallel Interface Adapter User
      Guide (EK-L10EP-UG).

2.5.2   Power-Up

Perform the following procedure to power-up the printer.

1.   Turn off the power switch on the rear of the printer.

2.   Plug the ac power cord into the printer and into the wall
      socket.

3.   Turn on the power switch.

230 V
MOVE
SWITCH
LEFT

115 V
MOVE
SWITCH
RIGHT

VOLTAGE SELECTOR
SWITCH
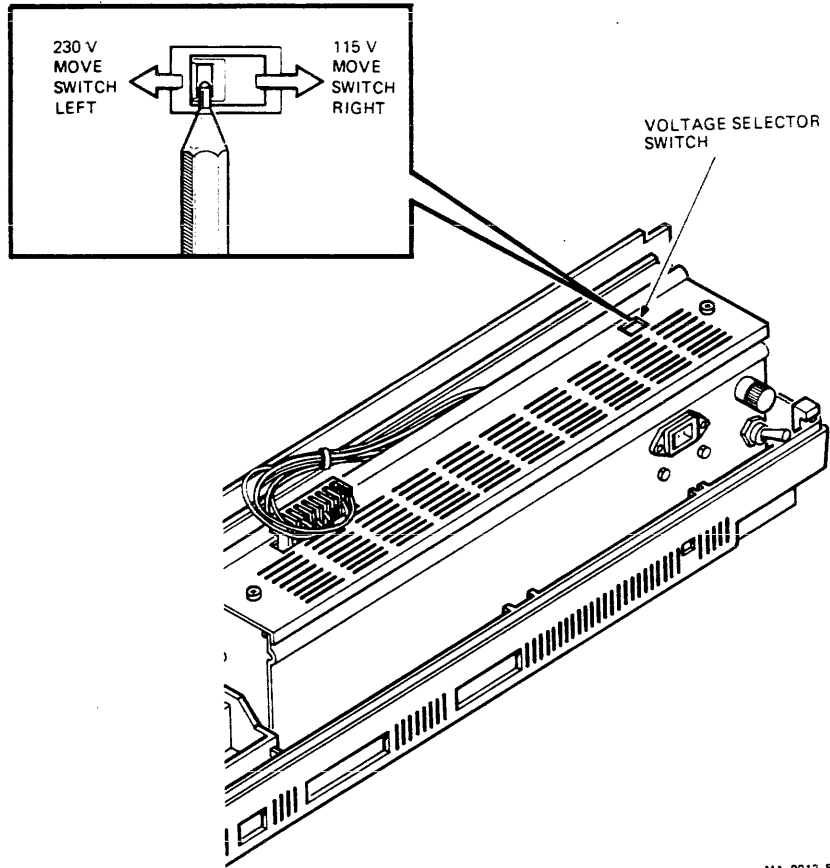
MA-0012-85

Figure 2-3   Voltage Selector Switch

2.5.3   Ribbon Cartridge

Install the ribbon cartridge as follows. You do not have to turn the power off.

CAUTION
Digital recommends the LA1ØR ribbon cartridge for replacement. Using other ribbon cartridges may damage the printhead and void the warranty.

1.   Remove the access cover. Remove and discard the old ribbon cartridge.

2.   Move the printhead adjustment lever to the right (Figure 2-4).

3.   Turn the ribbon adjust knob on the new ribbon cartridge clockwise to tighten the ribbon (Figure 2-5).

4.   Line up the snap buttons on the new ribbon cartridge with the mounting holes in the carriage assembly (Figure 2-6).
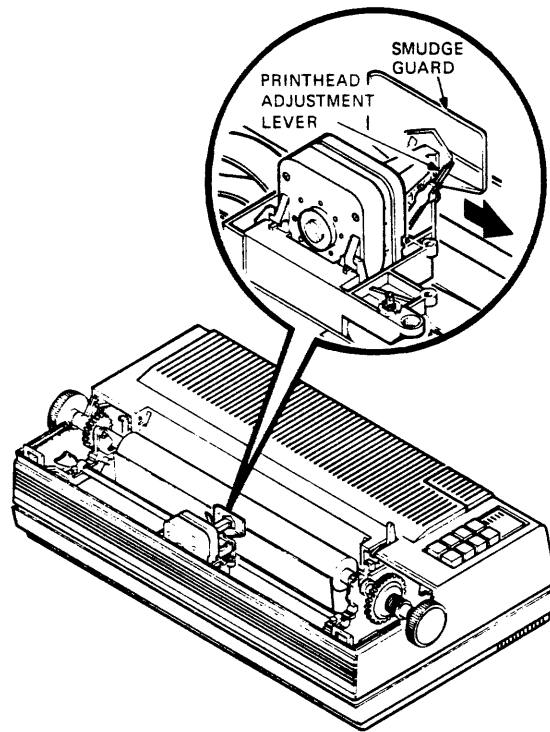
MA-0194-84A

Figure 2-4   Printhead Adjustment Lever

5. Slowly press the new ribbon cartridge onto the carriage
    assembly while turning the ribbon adjust knob. Make sure
    the slot in the ribbon cartridge engages the ribbon
    advancing mechanism and that the ribbon fits between the
    printhead and smudge guard.
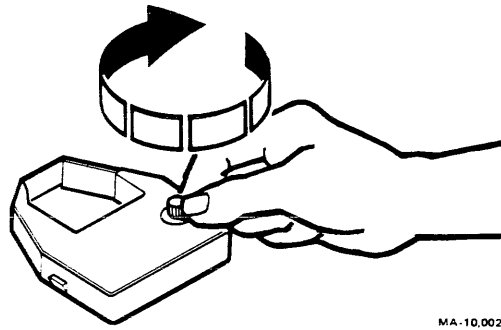
Figure 2-5   Ribbon Cartridge
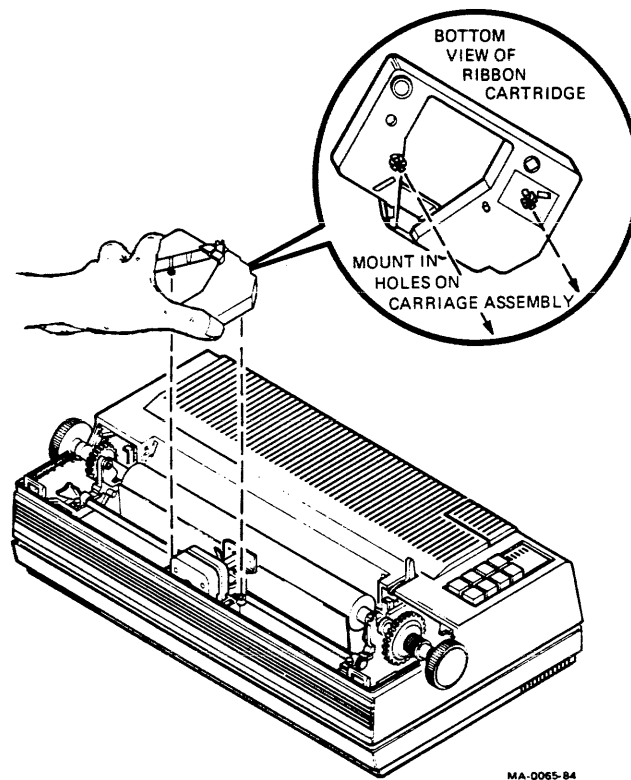
Figure 2-6   Ribbon Cartridge Installation

6. Move the printhead side to side two or three times while
    watching the ribbon adjust knob. If the ribbon adjust
    knob turns clockwise when the printhead moves, then the
    ribbon is advancing correctly.

7. Adjust the printhead (Paragraph 2.6).

8. Replace the access cover.

2.5.4   Installing Tractor Assembly

1. Pull the paper release lever toward you (Figure 2-7).

2. Hold the tractor assembly with both hands and press down
    on the tractor release levers (Figure 2-7).

3. Align the tractor assembly with the slots in the top of
    the printer. Then lower the assembly into place.

4. Release the tractor release levers.
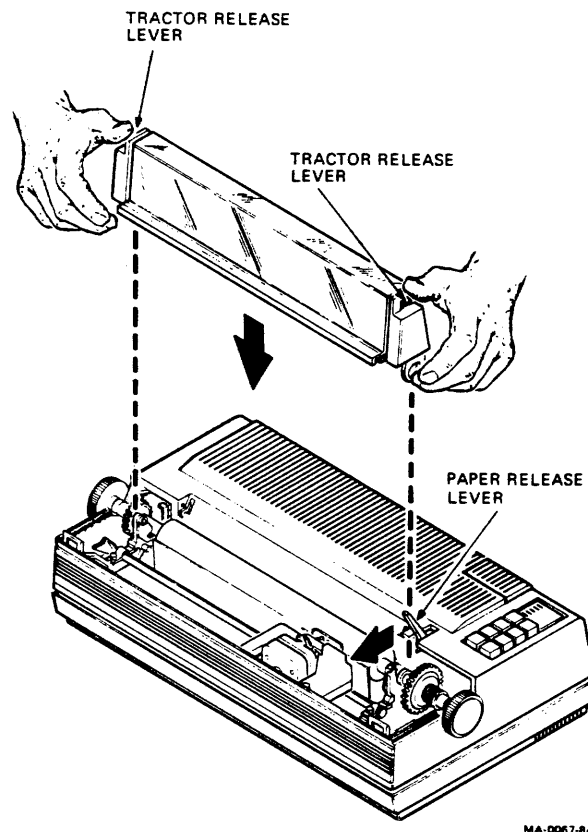
Figure 2-7   Tractor Assembly

2.5.5   Loading Paper

The printer accepts tractor feed paper from 3 to 14 7/8 inches in width. Digital recommends using the printer stand option for the most effective paper feed operation.

Observe the following suggestions when using tractor feed paper.

Do not use stapled forms.

Use multipart forms with no more than four parts and one card. The card must be on the back.

Dot or line glue margins are acceptable (one margin only).

Do not use first-surface impact paper.

Do not use split forms (different number of sheets on each side of form).

Follow these steps to load the paper.

1. Remove the access cover by pulling up and out.

2. Set the paper-out switch to the disabled (forward) position (Figure 2-8).

CAUTION
Make sure the paper-out switch is disabled before you feed or remove paper through the bottom slot in the printer. Otherwise, the switch may be damaged.
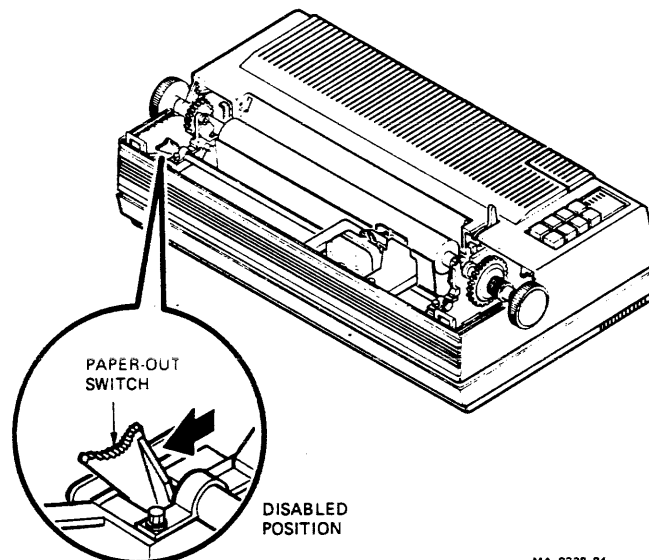
MA-0328-84

Figure 2-8   Paper-Out Switch in Disabled Position

2-9

3. Open the window (Figure 2-9).

4. Open the paper clamps (Figure 2-10).

5. You may have to adjust the right tractor to the paper width. To loosen the right tractor adjustment lever, pull it toward the front of the printer (Figure 2-11).

6. Move the tractor to the position that corresponds to paper width. Do not tighten the tractor adjustment lever yet.
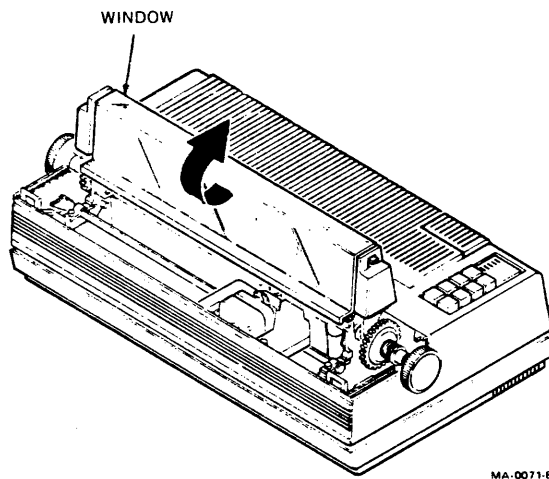
Figure 2-9   Tractor Assembly
Window

Figure 2-10   Paper Clamp

TRACTOR
ADJUSTMENT
LEVER

TRACTOR
RELEASE
LEVER (2)

3 cm (1 1/8 in)

PAPER SUPPORTS

LEFT TRACTOR
ADJUST LEVER

TRACTOR
COVERS

RIGHT TRACTOR
ADJUST LEVER
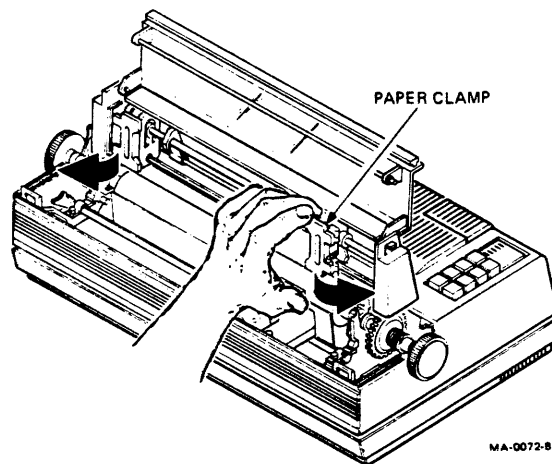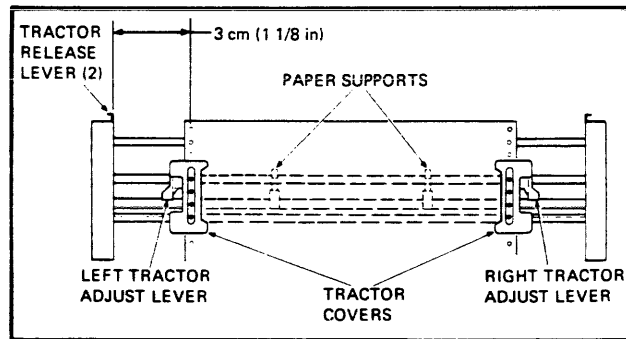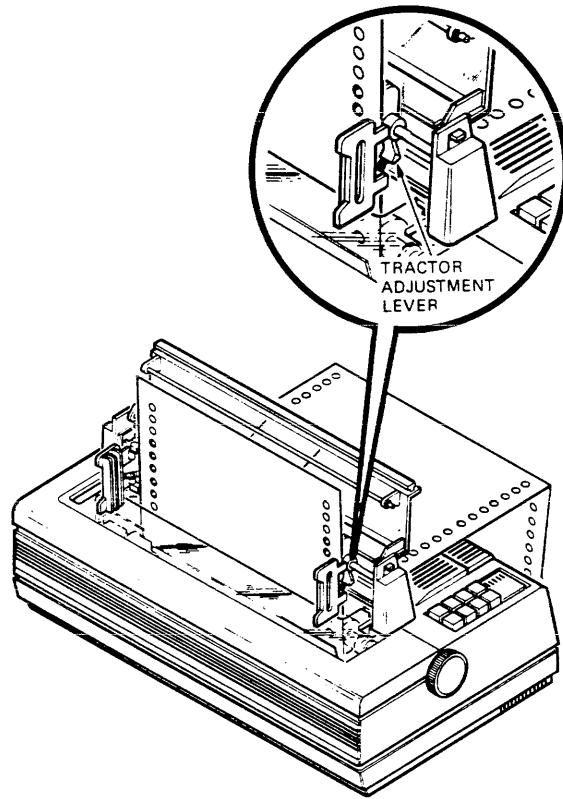
MA-0015-85

Figure 2-11   Tractor Adjustments
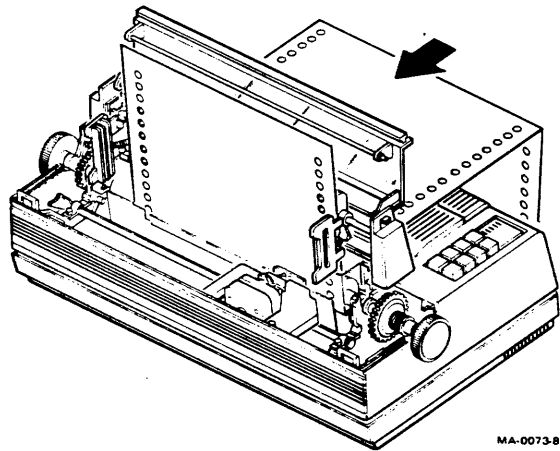
Figure 2-12   Loading Paper
(Printer on Table)

7. There are two ways to feed paper, depending on whether or
    not the printer is on a stand. Digital recommends using a
    stand. However, if a stand is not available, you may feed
    paper from the back of the printer (under the back of the
    tractor assembly, around the platen and up onto the
    tractors). (See Figure 2-12.)

                        NOTE
        Feed only single-part paper through the
        back of the printer.

        Make sure the paper-out switch (Figure
        2-8) is disabled before you feed paper
        from the back. If not, the power/fault
        indicator turns on and the printer will
        not feed paper.

    If the printer is on a stand, then you may feed either
    single-part or multipart paper through the slot in the
    bottom of the printer and onto the tractors (Figure
    2-13).

                        NOTE
        You can enable the paper-out function
        when paper is feeding from the bottom.
        First load the paper. Then return the
        paper-out   switch   to   the   enabled
        position.

2-12

PAPER ──────▶

TRACTOR

STAND

PAPER
SLOTS

CROSS
MEMBER
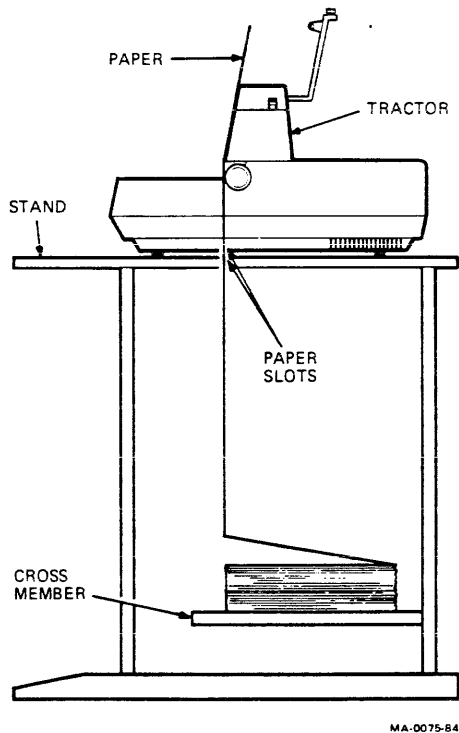
MA-0075-84

Figure 2-13   Loading Paper
               (Printer on Stand)

8. Place the paper's left margin holes over the left
    tractor's feed pins. Close the tractor clamp.

                    NOTE
    Do not move the left tractor unless
    necessary. If you move the left tractor,
    reset the margins to the default settings
    with the page width alignment sequence. See
    LA210 Letterprinter Programmer Reference
    Manual (EK-LP210-RM).

9. Place the right margin holes over the right tractor's
    feed pins. Close the tractor clamp.

10. Tighten the right tractor adjustment lever to secure the
    tractor.

                   CAUTION
    Do not stretch the paper too tight. If
    the paper pulls against the tractor pins
    or is loose in the center, readjust the
    right tractor.

11. Position each paper support at one third of the distance between the tractors (Figure 2-11).

12. Make sure the paper stack is centered directly under the tractors.

13. Close the window.

14. If you are feeding paper from the bottom, you can enable the paper-out switch now.

15. Replace the access cover by sliding it in and down.

2.6   PRINTHEAD ADJUSTMENT

Adjust the printhead as follows.

1. Make sure the power switch is off.

2. Remove the access cover and open the window.

3. Move the printhead adjustment lever all the way to the right (Figure 2-4).

4. Remove the gap setting guide from the ribbon adjust knob.

5. Slide the narrow end of the gap setting guide between the printhead and the paper.

6. Move the printhead adjustment lever to the left until the gap setting guide can slide (with slight resistance) between the printhead and the paper (Figure 2-14). Your printhead is now adjusted correctly.

7. Reinstall the access cover and close the window.

8. If necessary, repeat steps 3 through 6 until the printed characters are clear and sharp.

NOTE
If the form ripples or is pulled by the printhead, the printhead is not adjusted correctly. Repeat steps 2 through 5.
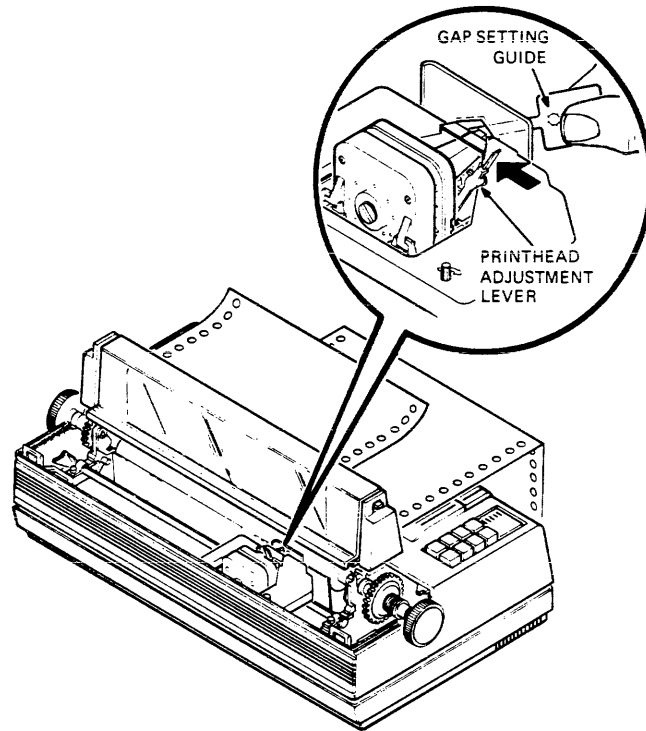
Figure 2-14   Printhead Adjustment

CHAPTER 3
OPERATOR INFORMATION

3.1   GENERAL

This chapter is a summary of the controls, indicators, operator
selectable and jumper selectable features, self-tests, and basic
troubleshooting information for the printer. Details on selecting
and using these features and operator procedures are in the user
documentation.

3.2   CONTROLS AND INDICATORS

The controls and indicators are used to set up, monitor, and
control printer operation. This section covers the following
topics.

    Printer controls
    LA210 operator control panel
    Indicators

3.2.1   Printer Controls

The following table describes the function of the printer
controls.

Table 3-1   Printer Controls

Control	Figure	Function
Voltage selector switch	3-1	Selects terminal input power (115 or 220 Vac).
Power switch	3-1	Turns power on or off.
Paper adjust knobs	3-2	Advance paper 1/48 inch at a time. Turning the knobs lets paper roll freely in either direction for precise vertical positioning.
Paper release lever	3-2	Controls paper holding tension. In the back position, the paper is held tightly against the platen. In the forward position, the paper is free for positioning or removal.
Printhead release lever	3-2	Used to remove or install printhead. Moving it toward the rear of the terminal releases the printhead. Moving it toward the front of the terminal locks the printhead in place.
Printhead adjustment lever	3-2	Adjusts space between the printhead and platen for correct print impression.
Ribbon adjust knob	3-3	Removes slack from the ribbon.
Paper out manual override lever	3-4	Disables paper out detection.
Tractor release levers	3-5	Used to install or remove tractor.
Tractor adjustment levers	3-5	Used to adjust tractor for different margins and paper sizes.

VOLTAGE
SELECTOR SWITCH

FUSE
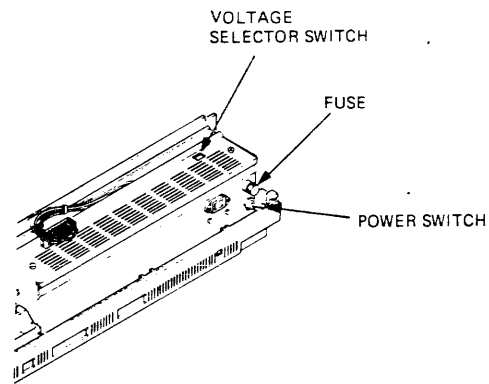
POWER SWITCH

MA-0108-85

Figure 3-1   Power Supply

PRINTHEAD
RELEASE
LEVER

PRINTHEAD
ADJUSTMENT
LEVER

PRINTHEAD

PAPER RELEASE
LEVER

PAPER-OUT
SWITCH
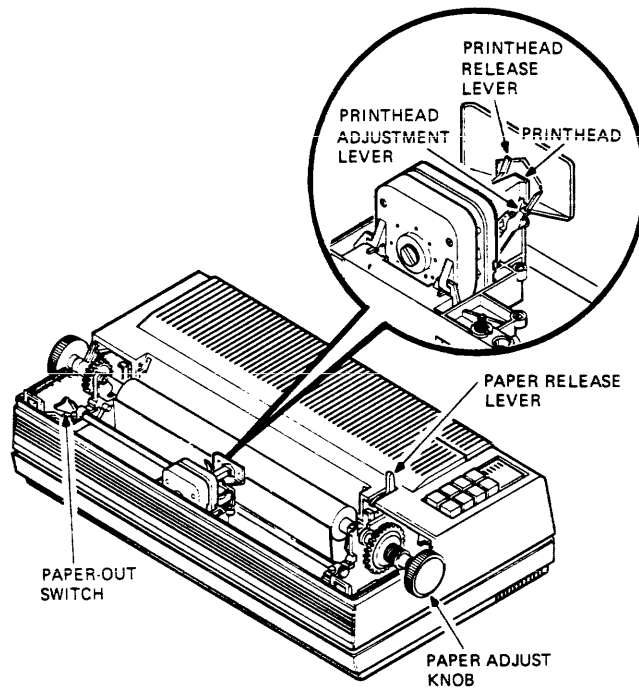
PAPER ADJUST
KNOB

MA-0102-84

Figure 3-2   Printer Controls
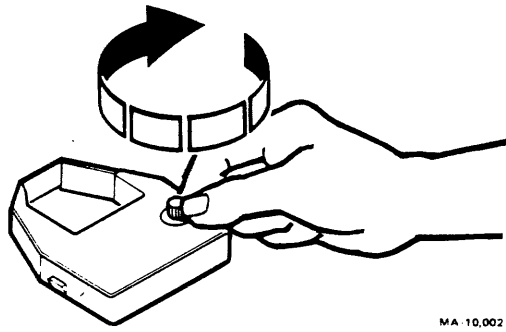
Figure 3-3   Ribbon Adjust Knob
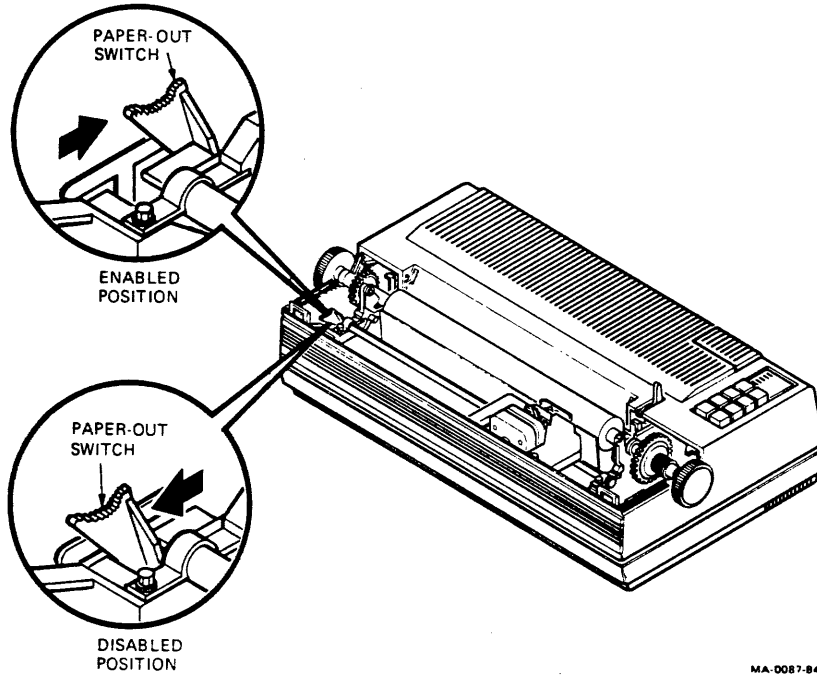
Figure 3-4   Paper-Out Switch
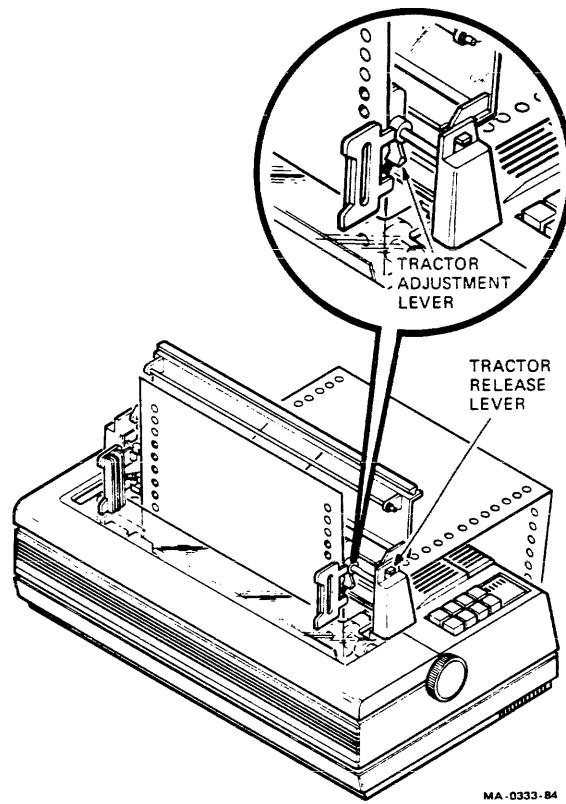
Figure 3-5   Tractor Release and
              Adjustment Levers

3.2.2   Control Panel

The control panel has the switches that control routine printer operation. Figure 3-6 shows the operator control panel. The following table lists the switches on the control panel and their functions.
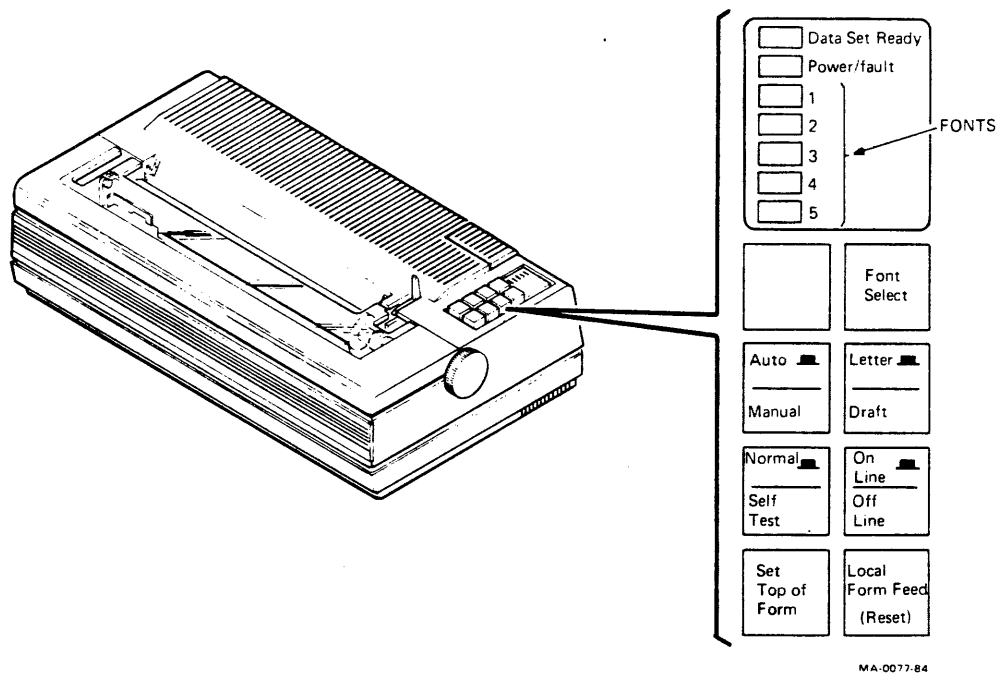
Figure 3-6   Control Panel

Table 3-2   Control Panel Switches

Switch	Function
Auto/Manual	
Auto (up position)	Disables the **Letter/Draft** switch. Printing mode is selected with control escape sequences from the computer.
Manual (down position)	Enables the **Letter/Draft** switch. Control escape sequences from the computer are processed but not executed.
Letter/Draft	
Letter (up position)	Prints characters in letter quality mode (medium or high density, depending on character ROM).
Draft (down position)	Prints characters in draft mode (low density).

Table 3-2   Control Panel Switches (Cont)

Switch	Function
On Line/Off Line	
On Line (up position)	Lets the printer receive and process data. The local form feed, set top of form, and self test functions are not active.
Off Line (down position)	If enabled, signals the computer to temporarily stop sending data. The local form feed, set top of form and self test functions are active.
Normal/Self Test	When the printer is off-line, this switch selects self-test and prints the status message. It disconnects the communication line, exits graphic mode, and clears the input buffer.
Set Top of Form	When the printer is off-line, defines the current line as line 1 (top of form). During self-test, starts the loopback test.
Local Form Feed (Reset)	
Local Form Feed	When the printer is off-line, advances the paper to top margin on the next page. During self-test, selects printer self-tests.
(Reset)	Resumes printing after a fault condition such as access cover open, paper fault, or printhead jam is corrected.

3.2.3   Indicators

This section describes the printer's visual and audible indicators.

3.2.3.1 Visual Indicators -- The following table describes the function of the visual indicators.

Table 3-3   Visual Indicators

Indicator	Figure	Function
Power/fault	3-6	Lights when power is turned on. Used with data set ready indicator in power-up self-test. Flashes when terminal is not ready to print for any of the following reasons: paper out or low, access cover open, printhead jammed (also indicated by multiple bell tones).
Data set ready	3-6	Lights when terminal detects data set ready (DSR) signal. Used with Power/fault indicator in power-up self-test.
Font indicators	3-7	Show currently selected DPS. One light on indicates that the DPS shown is forced. One light off indicates that no DPS is forced. The indicator that is off also shows the current computer-selected DPS.
ROM cartridge (ROM cartridge options)	3-7	Lights when ROM cartridge is seated correctly in ROM cartridge socket.
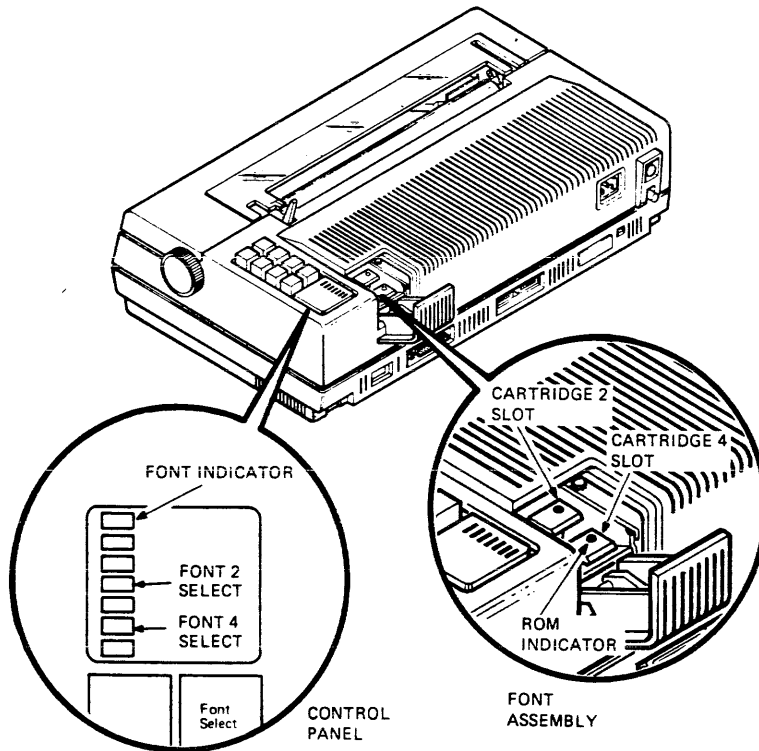
Figure 3-7   Font Indicators and Font Assembly

3.2.3.2 Audible Indicators -- The following table describes the
conditions that cause a bell tone.

Table 3-4   Audible Indicators

Condition	Description
Input buffer overflow	If the terminal cannot process characters from the input buffer before the buffer fills, an input buffer overflow can occur. During overflow, a bell tone sounds and each character is discarded.
Bell code	Each bell code the terminal receives sounds the bell tone.
Printhead jam	The Power/fault indicator flashes and there are multiple bell tones.

3.3   OPERATOR SELECTABLE FEATURES

The LA210 Letterprinter operates in three emulation modes in
addition to standard Digital (DEC) mode. In the emulation modes,
the printer operates as an IBM/Epson MX80 printer, an IBM/Epson
MX80 printer with Graftrax, or an IBM Graphics printer. In back of
the printer, there are switches for setting the different modes.
The factory setting of the switches is for DEC mode (Mode 0). Mode
1 is IBM/Epson MX80 emulation. Mode 2 is IBM/Epson MX80 plus
Graftrax emulation. Mode 3 is IBM Graphics emulation. For parallel
communication applications, the parallel interface adapter option
(PN LA10X-EP) must be installed (Figure 3-8). The status message
shows which mode the printer is using.

CAUTION
Always use a small slotted screwdriver,
scribe, or the equivalent to set the
configuration switches. Never use a lead
pencil. Broken lead can cause a short on
the printed circuit board.

NOTE
In emulation mode, most configuration
switches are only activated at power-up.
Always power down the printer before
changing the switch settings.

In standard DEC mode, the switches are
monitored all the time. You do not have
to power down the printer first.
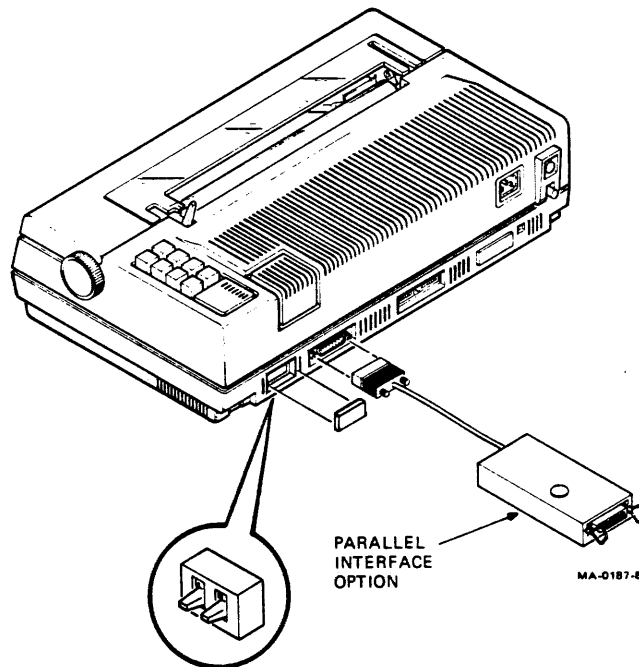
Figure 3-8   Parallel Interface Adapter

After you change the logic board, make sure to set the switches on
the new board to match the settings on the old logic board. Print
the status message to check that the desired features are
selected.

3.3.1   Mode 0 -- Standard DEC

Figure 3-9 shows the location of the configuration switches and
their factory settings. Table 3-5 lists the features that can be
selected with these switches.
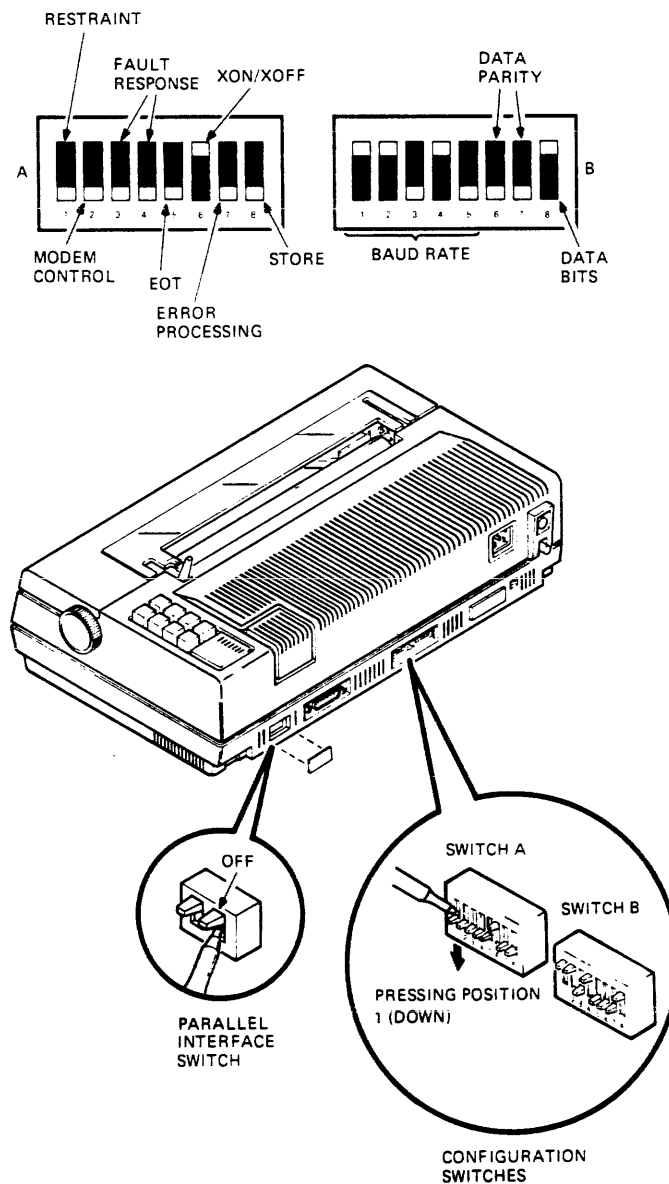
Figure 3-9   Configuration Switches

Table 3-5   Communication Features

Switch A Features	Switch Setting	
Speed Control/Restraint	A-1	
Restraint mode	Down (factory setting)	
Speed control mode	Up	
Modem Control	A-2	
No modem control	Down (factory setting)	
Modem control	Up	
Fault Response	A-3	A-4
No action (XOFF is sent if enabled).	Down	Down
Send break signal.	Up	Down
Disconnect (drop DTR).	Down	Up
Do not connect.	Up	Up
End Of Transmission	A-5	
Disables coded disconnect. (Ignore EOT.)	Down (factory setting)	
Enables coded disconnect (Disconnect upon receiving EOT.)	Up	
XON/XOFF Protocol	A-6	
Enable auto XON/XOFF.	Up (factory setting)	
Disable auto XON/XOFF.	Down	
Error Processing	A-7	
Sets receiver processing to print substitute character.	Down (factory setting)	
Sets receiver error processing to print characters as received.	Up	
Store Features	A-8	
Store features from operating memory to user permanent memory.	Move switch from down to up.	

Table 3-5   Communication Features (Cont)

Switch B Features	Switch Setting

Data Parity Switches

7 bit	8 bit		B-6	B-7
Space	no parity		Down	Down (factory setting)
Mark	no parity		Up	Down
Even	Even		Down	Up
Odd	Odd		Up	Up

Data Format	B-8
8 bits	Up (factory setting)
7 bits	Down

Parallel Interface

Parallel interface clock and power off.	Both up (factory setting)
Parallel interface clock and power on.	Both down

Baud Rate   Switch Setting

Baud Rate	B-1	B-2	B-3	B-4	B-5	
50	Down	Down	Down	Down	Down	
75	Up	Down	Down	Down	Down	
110	Down	Up	Down	Down	Down	
134.5	Up	Up	Down	Down	Down	
150	Down	Down	Up	Down	Down	
200	Up	Down	Up	Down	Down	
300	Down	Up	Up	Down	Down	
600	Up	Up	Up	Down	Down	
1200	Down	Down	Down	Up	Down	
1800	Up	Down	Down	Up	Down	
2400	Down	Up	Down	Up	Down	
4800	Up	Up	Down	Up	Down	(factory setting)
7200	Down	Down	Up	Up	Down	
9600	Up	Down	Up	Up	Down	

Table 3-5   Communication Features (Cont)

Switch B Features	Switch Setting				
Split Rate **Transmit/Receive**	B-1	B-2	B-3	B-4	B-5
75/600	Down	Down	Down	Down	Up
75/1200	Up	Down	Down	Down	Up
150/600	Down	Up	Down	Down	Up
150/1200	Up	Up	Down	Down	Up
300/2400	Down	Down	Up	Down	Up
300/4800	Up	Down	Up	Down	Up
600/2400	Down	Up	Up	Down	Up
600/4800	Up	Up	Up	Down	Up

3.3.2   Mode 1 -- IBM/Epson MX80

This mode emulates a basic dot matrix lineprinter. It provides single and double-width characters, four horizontal pitches, 1/6-inch high characters with two-pass printing, and bar charting. To operate in this mode, install font cartridge LA10X-LB (Mosaic, ID 137) in either slot 2 or 4 of the font option assembly (Figure 3-7). The remaining slot can hold any other font cartridge. Figure 3-10 shows the standard switch settings. Table 3-6 lists the settings to change the operating features.

> **NOTE**
> Some applications set a time limit for the printer to empty its input buffer. If the printer exceeds this limit, the applications abort.
>
> In emulation mode, the LA210 Letterprinter gives you a choice of two input buffers -- a 2 Kbyte buffer and a 0.13 Kbyte buffer. If your application displays a timeout message, use the 0.13 Kbyte buffer. Otherwise, use the 2 Kbyte buffer to reduce the number of data requests from the printer to the host.

MA-0226-84
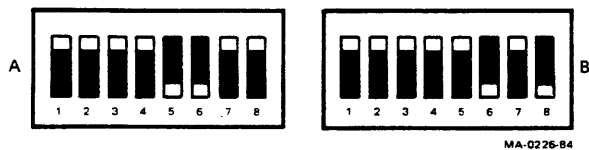
Figure 3-10   Mode 1 Standard Switch Settings

Table 3-6   Mode 1 Switch Settings -- IBM/Epson MX80 Emulation

Switch A	Setting	Function
A1, A2	Either	Not used.
A3	Up	When the line buffer is full, printer prints line and advances to next line.
	Down	When line buffer is full, printer drops characters.
A4	Up	Cancel (CAN) character clears line buffer.
	Down	CAN character is ignored.
A5	Up	Delete (DEL) character clears line buffer.
	Down	DELete character is ignored.
A6	Up	Printer performs an automatic line feed when it receives a carriage return (CR) character.
	Down	Printer only performs a carriage return.
A7	Up	When printer receives BELL character, error bell sounds.
	Down	BELL character is ignored.
A8	Up	Selects standard 8-inch paper width at power-up.
	Down	Selects 13-inch paper width.
Switch B	**Setting**	**Function**
B1 to B4	All up	Enables emulation mode.
B5	Up	Selects Epson/IBM MX80 emulation mode.
B6	Down	Selects Epson/IBM MX80 emulation mode.
B7	Up or down	Not used.
B8	UP	Enables 2K buffer.
	Down	Enables 0.13K buffer.

3.3.3   Mode 2 -- IBM/Epson MX80 Plus Graftrax

Mode 2 expands mode 1 to include graphics and character processing capabilities. This mode emulates the basic printer and adds italics, graphics, 1/16-inch high script characters, and bolding. To operate in mode 2, install the primary font cartridge LA10X-AP (Italics 10, ID 011) in slot 2 and font cartridge LA10X-LC (Graftrax, ID 143) in slot 4 of the font option assembly (Figure 3-7). For print styles other than the standard Courier or Italic 10, install the alternate primary font cartridge in slot 2.

Figure 3-11 shows the standard switch settings. Table 3-7 lists the settings to change the operating features.
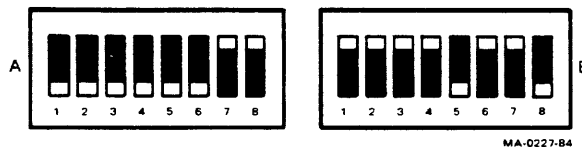
Figure 3-11   Mode 2 Standard Switch Settings

Table 3-7   Mode 2 Switch Settings -- IBM/Epson MX80 Plus
             Graftrax Emulation

Switch A	Setting	Function
A1	Down	Printer is set to standard horizontal pitch at power-up.
	Up	Printer operates at compressed horizontal pitch.
A2	Up	Sets bottom margin to 1 inch at power-up.
A3	Up	Enables bold printing at power-up.
	Down	Disables bold printing at power-up.
A4	Up	Enables italic printing at power-up.
	Down	Disables italic printing at power-up.
A5	Up	Enables slashed zero (0) printing at power-up.
	Down	Disables slashed zero (0) printing at power-up.

3-16

Table 3-7   Mode 2 Switch Settings -- IBM/Epson MX80 Plus
             Graftrax Emulation (Cont)

Switch A	Setting	Function
A6	Up	Printer performs an automatic line feed when it receives a carriage return (CR) character.
	Down	Printer only performs a carriage return.
A7	Up	When printer receives BELL character, error bell sounds.
	Down	BELL character is ignored.
A8	Up	Selects standard 8-inch paper width at power-up.
	Down	Selects 13-inch paper width.
Switch B	**Setting**	**Function**
B1 to B4	All up	Enables emulation mode.
B5	Down	Selects Epson/IBM MX80 plus Graftrax mode.
B6	Up	Selects Epson/IBM MX80 plus Graftrax mode.
B7	Up or down	Not used.
B8	UP	Enables 2K buffer.
	Down	Enables 0.13K buffer.

3.3.4   Mode 3 -- IBM Graphics Printer

This mode increases the capabilities of the basic MX lineprinter to include an extended character set, 1/16-inch high characters, bolding, underlining, subscripting and superscripting, four graphics modes, and bottom margin control.

To operate in this mode, install font cartridge LA10X-LA (Line Drawing, ID 139) and LA10X-LD (Foreign Style, ID 141) in slots 2 and 4 of the font option assembly (Figure 3-7). They may be installed in either slot.

Figure 3-12 shows the standard switch settings. Table 3-8 lists the settings to change the operating features.
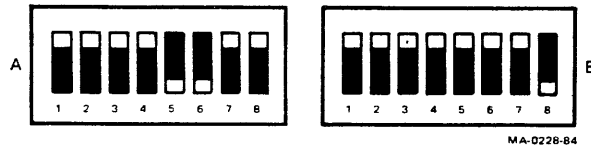
Figure 3-12   Mode 3 Standard Switch Settings

Table 3-8   Mode 3 Switch Settings -- IBM Graphics Printer
            Emulation

Switch A	Setting	Function
A1, A2	Up or down	Not used.
A3	Up	When line buffer is full, printer prints line and advances to next line.
	Down	When line buffer is full, printer drops characters.
A4	Up	Cancel (CAN) character clears line buffer.
	Down	CAN character is ignored.
A5	Up	Delete (DEL) character clears line buffer.
	Down	DEL character is ignored.
A6	Up	Printer performs an automatic line feed when it receives a carriage return (CR) character.
	Down	Printer only performs a carriage return.
A7	Up	When printer receives BELL character, bell sounds.
	Down	BELL character is ignored.
A8	Up	Selects 8-inch paper width at power-up.
	Down	Selects 13-inch paper width.

Table 3-8   Mode 3 Switch Settings -- IBM Graphics Printer
            Emulation (Cont)

Switch B	Setting	Function
B1 to B4	All up	Enables emulation mode.
B5, B6	Up	Selects IBM Graphics printer emulation mode.
B7	Up or down	Not used.
B8	Up	Enables 2K buffer.
	Down	Enables 0.13K buffer.

3.4   JUMPER SELECTABLE FEATURES

The printer has jumpers on the logic board for selecting or
changing some features, including BUSY, AUTO ANSWERBACK, and
ANSWERBACK PROTECT. For details on using these jumpers, refer to
Paragraph 5.5.10.

3.5   OPERATOR TESTS

The LA210 performs a power-up self-test and several printing
self-tests.

3.5.1   Power-Up Self-Test

The printer performs a power-up self-test when power is turned on.
A successful power-up self-test is indicated when the printhead
moves to the left margin and the Power/fault indicator is on. If
the printer fails to power up correctly, refer to Table 1-1.

To perform the power-up self-test, turn on the power switch
(Figure 3-1). If power is already on, turn the switch off, then
turn it on again.

3.5.2   Printer Self-Tests

The printer self-tests provide a visual indication of how the printer is working. The following printer self-tests help determine whether a problem exists.

    Status message
    Character pattern
    Horizontal registration
    Nonprinting
    Loopback

There are three types of printer self-tests: printing, nonprinting, and loopback. The following paragraphs describe these tests.

3.5.2.1   Printing Self-Tests -- The three printing self-tests are the status message, character registration and horizontal registration self-tests. Figure 3-13 shows examples of these three tests.

When you troubleshoot the printer, print the status message and perform the character pattern test to ensure correct printing. The status message shows whether the printer can print and gives a list of selectable features.

The status message shows the current microcode version, dot pattern sets (DPSs) installed, and which features are set in operating memory. Every LA210 has a ROM in slot 1, so the status message always has a 3-digit code for DPS 1. If there is a cartridge in another slot, the message has a 3-digit code for that slot. If there is no cartridge, or if it is incorrectly installed, the status message shows three periods for that slot (Figure 3-14).

The character pattern test lets you check print quality and observe other printer functions. The character pattern test continuously prints 94 characters within the currently selected margins.

The horizontal registration self-test prints four characters in multiple passes on the same line to check overstrike alignment. In draft mode, the printer makes four passes. In letter quality mode, the printer makes eight passes and prints in seven of the eight passes.

STATUS MESSAGE

```
LA210  V2.1    RO
Emulation mode 0
2K Buffer
DPSs: 006...131......
```

*Printer Settings

```
Form Length (1/24):264
G0 Character set:United States
G1 Character set:Line drawing
G2 Character set:DEC Multinational
G3 Character set:United States
GL Set mapping:G0
GR Set mapping:G2
Pitch Mode:All Pitches
Horiz pitch (cpi):10
Vert pitch (lpi):6
End of line control:wrap mode
New Line request char.:none
```

*Communication Settings

```
Auto-answerback:Disabled
Disconnect on EOT:Disabled
Paper fault processing:XOFF (if enabled)
Parity:8/N
Receiver error:Print error block
Speed(bps):4800
Auto XON/XOFF:Enabled
Modem Control:No Modem Control-Restraint Mode
C1 receive:Disabled
C1 transmit:Disabled
```

CHARACTER PATTERN

```
 ''#$%& ()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~''#$%&'()*+,-./0123456789:;<=>?@ABCDEF
'#$%& ()*+,-./0123456789:;<= ?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~''#$%&'()*+,-./0123456789:;<= ?@ABCDEFG
#$%&'()*+,-./0123456789:;= >?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~''#$%&'()*+,-./0123456789:;=>?@ABCDEFGH
$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~''#$%&'()*+,-./0123456789:;=>?@ABCDEFGHI
%&'()*+,-./0123456789:;<= >@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~''#$%&'()*+,-./0123456789:;=>?@ABCDEFGHIJ
&'()*+,-./0123456789:;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}~''#$%&'()*+,-./0123456789:;<=>?@ABCDEFGHIJK
```

HORIZONTAL REGISTRATION

```
###############################################################################################################################
###############################################################################################################################
###############################################################################################################################
###############################################################################################################################
###############################################################################################################################
###############################################################################################################################
```

MA-0010-85

Figure 3-13   Printing Self-Tests

```
LA210  V2.1   RO
Emulation mode 0
2K Buffer
DPSs: 006...131......
```
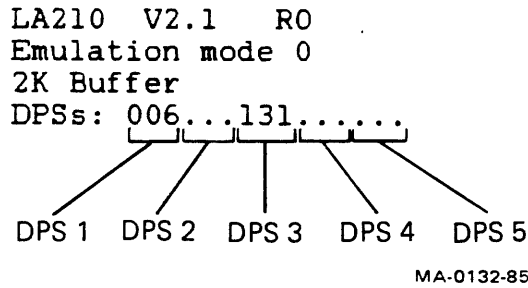
Figure 3-14   3-Digit Codes
              in Status Message

3.5.2.2 Nonprinting Self-Test -- This test checks carriage
operation, paper motion, and for ribbon smudging. The carriage
moves from the left margin to the right margin, back to the left
margin, and then advances one line. The test runs continuously
until the operator sets the **Normal/Self Test** switch on the control
panel to **Normal** (Figure 3-6).

3.5.2.3 Loopback Self-Tests -- These tests check the printer I/O
lines at the EIA/RS232-C serial interface. Refer to Paragraph 7.2
for descriptions of the tests and how to run them. For more
information on the loopback self-tests, see Chapter 7.

3.5.3   Performing the Printer Tests

Run the printer tests as follows.

1.   Turn power on.

2.   Set the On Line/Off Line switch to the Off Line (down)
     position.

3.   Set the **Normal/Self Test** switch to the Self Test (down)
     position. Then the printer prints the status message.

                         NOTE
          If   the   Normal/Self Test switch is
          already in the down position, put it in
          the up position and then reset it to the
          down position.

4.   Press and release the **Local Form Feed** switch. The printer
     prints the character pattern test.

5.   Press and release the **Local Form Feed** switch again. The
     printer prints the horizontal registration test.

3-22

6.   Press and release the Local Form Feed switch again. The
     nonprinting test starts.

NOTE

The printer repeats the tests in the
same order each time you press the Local
Form Feed switch.

To stop any test, set the Normal/Self
Test switch to Normal.

3.6   OPERATOR TROUBLESHOOTING

If the power does not turn on or the printer does not work
properly, refer to Table 3-9. This table describes the checks you
should make before turning to Chapter 7, "Troubleshooting."

Table 3-9   Troubleshooting Checklist

Indication	Possible Cause	Action
Printer does not turn on when power switch is set to 1 (on).	AC power cord is not plugged into wall receptacle or printer.	Plug in cord.
	No power from wall receptacle.	Check receptacle with a known working electrical device (lamp).
	Blown ac line fuse.	Turn printer off and replace fuse (Figure 3-1).
Characters do not print. Power/fault indicator flashes.	Printer is out of paper.	Install paper and press Reset key.
	Access cover is open.	Replace access cover and press Reset.
Characters do not print. Carriage moves.	Printhead is too far from paper.	Readjust printhead.

Table 3-9   Troubleshooting Checklist (Cont)

Indication	Possible Cause	Action
Characters do not print or are garbled.	Data set (modem) is unplugged.	Plug in data set.
	Communication set-up is incorrect.	Make sure data communication features are set to match the host.
Characters are light.	Printhead is too far from paper.	Readjust printhead.
	No ink on ribbon.	Replace ribbon cartridge.
Ink smudges during printing.	Paper is not firmly wrapped around platen.	Smooth paper over surface of platen.
	Printhead is too close to paper.	Readjust printhead.
Paper does not advance.	Paper is not loaded correctly.	Reload paper.
	Feed holes are torn.	Reload paper.
Multipart paper tears.	Printhead is too close to paper.	Readjust printhead.
	Paper is not straight in printer.	Realign paper stack within 1 cm (1/2 in) of tractors.
	Tractors are incorrectly adjusted.	Readjust right tractor.
	Paper or printhead is jammed.	Remove access cover and clear jam. Replace cover and press Reset key.
Characters are garbled or double.	Communication switches are set up incorrectly.	Make sure data communication switches are set to match host computer.

CHAPTER 4
PROGRAMMING

4.1   GENERAL

The printer operates in standard DEC mode (mode 0), and also emulates the IBM/Epson MX80 printer (mode 1), the IBM/Epson MX80 printer with Graftrax (mode 2), and the IBM Graphics printer (mode 3). This chapter provides a summary of the programming information for printer operation in these modes. For more complete interface and character processing information, see the LA210 Letterprinter Programmer Reference Manual (EK-LA210-RM).

4.2   PROGRAMMING INFORMATION FOR DEC MODE

This section lists programmer selectable features: standard character sets, graphic control characters, and escape and control sequences. Figure 4-1 shows the 7-bit character set. Figure 4-2 shows the 8-bit character set.

4.2.1   STANDARD CONTROL CHARACTERS

Table 4-1 lists the standard C0 control characters. Table 4-2 lists the standard C1 control characters.

Table 4-1   Standard C0 Control Characters

Name	Mnemonic	Octal Code	Function
Null	NUL	000	Used for fill characters. See Paragraph 2.3.3 in programmer reference manual.
End of transmission	EOT	004	Used for disconnect character if enabled.
Enquiry	ENQ	005	Requests answerback message.
Bell	BEL	007	Sounds bell tone.
Backspace	BS	010	Moves active column left one column (except in graphics mode).
Horizontal tab	HT	011	Advances to next horizontal tab stop (except in graphics mode).
Line feed	LF	012	Advances to next line. Performs carriage return if enabled (except in graphics mode).
Vertical tab	VT	013	Advances to next vertical tab stop (except in graphics mode).
Form feed	FF	014	Advances to next top margin (except in graphics mode).
Carriage return	CR	015	Returns to left margin. Performs line feed if enabled (except in graphics mode).
Shift out	SO	016	Maps G1 to GL printer character set.
Shift in	SI	017	Maps G0 to GL printer character set.
Cancel	CAN	030	Immediately ends any control or escape sequence.

Table 4-1   Standard C0 Control Characters (Cont)

Name	Mnemonic	Octal Code	Function
Substitute	SUB	032	Immediately ends any control or escape sequence. Replaces characters received with errors by SUB if enabled.
			SUB prints as _____ or _____. In graphics mode, SUB prints as a one-column space.
Escape	ESC	033	Introduces escape sequence.
Delete	DEL	177	No operation (not stored in input buffer and not used as filler).

Table 4-2   Standard C1 Control Characters

Name	Mnemonic	Octal Code	Function
Index	IND	204	Increments active line and advances paper. Line feed/ new line mode does not affect this feature.
Next line	NEL	205	Sets active column to left margin and increments active line.
Horizontal tabulation set	HTS	210	Sets horizontal tab stop at active column.
Vertical tabulation set	VTS	212	Sets vertical tab stop at active line.
Partial line down	PLD*	213	Indexes paper up 1/12 inch. Line feed/new line mode does not affect this sequence.
Partial line up	PLU*	214	Indexes paper down 1/12 inch. Line feed/new line mode does not affect this sequence.

* PLD and PLU do not modify active line or the position counter. To maintain correct vertical forms handling, send the same number of PLDs and PLUs.

Table 4-2   Standard C1 Control Characters (Cont)

Name	Mnemonic	Octal Code	Function
Reverse index	RI	215	Decrements active line and moves paper down one line. Line feed/new line feed does not affect this sequence.
Single shift 2	SS2	216	Activates G2 character set for 1 character.
Single shift 3	SS3	217	Activates G3 character set for 1 character.
Device control string	DCS	220	Device control string introducer. (See Chapter 5 in the programmer reference manual.)
Control sequencer introducer	CSI	233	Used to select more functions through control sequencing.
String terminator	ST	234	Ends any pending ANSI string and reverts to text processing mode.
Operating system command	OSC	235	Starts OSC string. (See Chapter 5 in the programmer reference manual.)
Privacy message	PM	236	Starts privacy message. (See Chapter 5 in the programmer reference manual.)
Application program command	APC	237	Starts application program command. (See Chapter 5 in the programmer reference manual.)

BITS

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

KEY

ASCII CHARACTER	ESC	1 11 COLUMN ROW
		33 OCTAL
		27 DECIMAL
		1B HEX

MA 7247

Figure 4-1   7-Bit Character Set

BITS

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

ASCII CONTROL SET	ASCII GRAPHIC CHARACTER SET

KEY

ASCII CHARACTER

ESC	1 11	COLUMN ROW
	33	OCTAL
	27	DECIMAL
	1B	HEX

MA-10087J

Figure 4-2   8-Bit Character Set (Sheet 1 of 2)

Figure 4-2 8-Bit Character Set (DEC Supplemental Graphic Set). Column headers show binary bit patterns; each cell lists the character with its octal (top), decimal (middle), and hexadecimal (bottom) codes.

8 (1000)	9 (1001)	10 (1010)	11 (1011)	12 (1100)	13 (1101)	14 (1110)	15 (1111)
200 / 128 / 80	DCS 220 / 144 / 90	▨ 240 / 160 / A0	° 260 / 176 / B0	À 300 / 192 / C0	320 / 208 / D0	à 340 / 224 / E0	360 / 240 / F0
201 / 129 / 81	´ 221 / 145 / 91	¡ 241 / 161 / A1	± 261 / 177 / B1	Á 301 / 193 / C1	Ñ 321 / 209 / D1	á 341 / 225 / E1	ñ 361 / 241 / F1
202 / 130 / 82	222 / 146 / 92	¢ 242 / 162 / A2	2 262 / 178 / B2	Â 302 / 194 / C2	Ò 322 / 210 / D2	â 342 / 226 / E2	ò 362 / 242 / F2
203 / 131 / 83	223 / 147 / 93	£ 243 / 163 / A3	3 263 / 179 / B3	Ã 303 / 195 / C3	Ó 323 / 211 / D3	ã 343 / 227 / E3	ó 363 / 243 / F3
IND 204 / 132 / 84	224 / 148 / 94	244 / 164 / A4	264 / 180 / B4	Ä 304 / 196 / C4	Ô 324 / 212 / D4	ä 344 / 228 / E4	ô 364 / 244 / F4
NEL 205 / 133 / 85	225 / 149 / 95	¥ 245 / 165 / A5	µ 265 / 181 / B5	Å 305 / 197 / C5	Õ 325 / 213 / D5	å 345 / 229 / E5	õ 365 / 245 / F5
206 / 134 / 86	226 / 150 / 96	246 / 166 / A6	¶ 266 / 182 / B6	Æ 306 / 198 / C6	Ö 326 / 214 / D6	æ 346 / 230 / E6	ö 366 / 246 / F6
207 / 135 / 87	227 / 151 / 97	§ 247 / 167 / A7	• 267 / 183 / B7	Ç 307 / 199 / C7	Œ 327 / 215 / D7	ç 347 / 231 / E7	œ 367 / 247 / F7
HTS 210 / 136 / 88	230 / 152 / 98	¤ 250 / 168 / A8	270 / 184 / B8	È 310 / 200 / C8	Ø 330 / 216 / D8	è 350 / 232 / E8	ø 370 / 248 / F8
211 / 137 / 89	231 / 153 / 99	© 251 / 169 / A9	1 271 / 185 / B9	É 311 / 201 / C9	Ù 331 / 217 / D9	é 351 / 233 / E9	ù 371 / 249 / F9
VTS 212 / 138 / 8A	232 / 154 / 9A	ª 252 / 170 / AA	º 272 / 186 / BA	Ê 312 / 202 / CA	Ú 332 / 218 / DA	ê 352 / 234 / EA	ú 372 / 250 / FA
PLD 213 / 139 / 8B	CSI 233 / 155 / 9B	« 253 / 171 / AB	» 273 / 187 / BB	Ë 313 / 203 / CB	Û 333 / 219 / DB	ë 353 / 235 / EB	û 373 / 251 / FB
PLU 214 / 140 / 8C	ST 234 / 156 / 9C	254 / 172 / AC	¼ 274 / 188 / BC	Ì 314 / 204 / CC	Ü 334 / 220 / DC	ì 354 / 236 / EC	ü 374 / 252 / FC
RI 215 / 141 / 8D	OSC 235 / 157 / 9D	255 / 173 / AD	½ 275 / 189 / BD	Í 315 / 205 / CD	Ÿ 335 / 221 / DD	í 355 / 237 / ED	ÿ 375 / 253 / FD
SS2 216 / 142 / 8E	PM 236 / 158 / 9E	256 / 174 / AE	276 / 190 / BE	Î 316 / 206 / CE	336 / 222 / DE	î 356 / 238 / EE	376 / 254 / FE
SS3 217 / 143 / 8F	APC 237 / 159 / 9F	257 / 175 / AF	¿ 277 / 191 / BF	Ï 317 / 207 / CF	ß 337 / 223 / DF	ï 357 / 239 / EF	▨ 377 / 255 / FF

ADDITIONAL CONTROL SET (columns 8–9) — DEC SUPPLEMENTAL GRAPHIC SET (columns 10–15)

MA 10087

Figure 4-2   8-Bit Character Set (Sheet 2 of 2)

4.2.2 Graphics Mode Control Characters

Table 4-3 lists the graphics ANSI control characters. Table 4-4 lists the graphics private control characters.

4.2.3 Escape and Control Sequences

Table 4-5 lists the 8-bit character equivalents for 7-bit escape sequences. Table 4-6 lists the escape and control sequences, and the features that these sequences select.

Table 4-3   Graphics ANSI Control Characters

Name	Mnemonic	Octal Code	Function
Cancel	CAN	030	Immediately exits graphics mode.
Substitute	SUB	032	Replaces any character received with errors. When received in graphics mode, SUB is processed as 77 octal (column space).
Escape	ESC	033	Printer exits graphics mode and processes sequence.
All C1 control codes	(See C1 control codes table.)	200 through 237	Printer exits graphics mode and processes C1 codes.

NOTE
The printer processes NUL, EOT, ENQ, BEL, DEL, SI, and SO as it does in text mode. See C0 control codes table.

The printer ignores BS, LF, CR, FF, HT, and VT in graphics mode.

Table 4-4   Graphics Private Control Characters

Name	Mnemonic	Octal Code	ASCII Character	Function
Graphics repeat introducer	DECGRI	041	!	Begins repeat sequence.
Graphics carriage return	DECGCR	044	$	Returns to graphics left margin.
Graphics new line	DECGNL	055	--	Returns to graphics left margin and advances to next graphics line.

Table 4-5   8-Bit Character Equivalents of 7-Bit Escape Sequences

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

Table 4-6 DEC Mode Escape and Control Sequence Summary

C1 Control Character Processing

Sequence			Function
ESC	SP	Ps	Ps enables or
033	040	***	disables C1 transmission and reception.

Ps	Octal	Function
G	107	Enables C1 transmission.
F	106	Disables C1 transmission.
7	067	Enables C1 reception.
6	066	Disables C1 reception.

Printing Mode (Draft Mode Only)

Sequence					Function
CSI	?	4	1	h	Prints from left to
233	077	064	061	150	right.
CSI	?	4	1	l*	Prints bidirectionally.
233	077	064	061	154	

Active Column and Active Line

Sequence			Mnemonic	Function
IND			IND	Increments active
204				line and advances paper.
CSI	Pn	d	VPA	Sets active line to Pn.
233	***	144		
NEL			NEL	Sets active column to
205				left margin. Increments active line.
CSI	Pn		HPA	Sets active column
233	***	140		to column Pn.
CSI	Pn	a	HPR	Advances current
233	***	141		active column by Pn columns.
CSI	Pn	A	CUU	Decrements current
233	***	101		active line by Pn lines without going past top margin.

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Active Column and Active Line

Sequence			Mnemonic	Function
CSI 233	Pn ***	e 145	VPR	Advances active line by Pn lines and stops at beginning of next page.
PLD 213			PLD	Moves paper up 1/12 inch (for subscripts or return from superscripts).
PLU 214			PLU	Moves paper down 1/12 inch (for superscripts or return from subscripts).
RI 215			RI	Decrements active line and moves paper down one line. (Prints on previous line.)

Line Feed/New Line Mode (LNM)

Sequence				Function
CSI 233	2 062	0 060	h 150	Sets line feed/new line mode on.
CSI 233	2 062	0 060	1* 154	Sets line feed/new line mode off.

Carriage Return/New Line Mode

Sequence					Function
CSI 233	? 077	4 064	0 060	h 150	Sets carriage return/new line mode on.
CSI 233	? 077	4 064	0 060	1* 154	Sets carriage return/new line mode off.

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Autowraparound Mode (DECAWM)

Sequence				Function
CSI	?	7	h	Sets autowraparound
233	077	067	150	mode on.
CSI	?	7	l*	Sets autowraparound
233	077	067	154	mode off.

Page Width Alignment (DECPWA)

Sequence						Function
CSI	Pn1	;	Pn2	"	s	Pn1 specifies the left
233	***	073	***	042	163	edge of print area relative to the left edge of physical page. Pn2 specifies width of print area. Pn1 and Pn2 are measured in units of 1/12 inch.

Horizontal Margins (DECSLRM)

Sequence					Function
CSI	Pn1	;	Pn2	s	Sets left and right
233	***	073	***	163	margins to the given values.

Horizontal Pitch (DECSHORP)

CSI	Ps	w
233	***	167

Ps	Octal	Characters per Inch
0	060	Default (10)
1	061	10
2	062	12
3	063	13.2
4	064	16.5
5	065	5
6	066	6
7	067	6.6
8	070	8.25

* The last character of the sequence is lowercase L (154 octal).

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Pitch Select Mode (DECPSM)

Sequence					Function
CSI 233	? 077	2 062	9 071	h 150	Sets pitch select mode to font pitches.
CSI 233	? 077	2 062	9 071	l* 154	Sets pitch select mode to all pitches.

Horizontal Tabs

Sequence							Mnemonic	Function
HTS 210							HTS	Sets horizontal tab stop at active column.
ESC 033	1 061						DECHTS	Sets horizontal tab stop at active column. Not recommended; use HTS instead.
CSI 233	0 060	g 147					TBC	Clears horizontal tab stop at the active column.
CSI 233	2 062	g 147					TBC	Clears all horizontal tab stops.
CSI 233	3 063	g 147					TBC	Clears all horizontal tab stops.
ESC 033	2 062						DECAHT	Clears all horizontal tab stops. Not recommended; use TBC instead.
CSI 233	Pn ***	; 073	... ...	Pn ***	u 165		DECSHTS	Sets horizontal tab stops at the given values for Pn. (You can specify 16 stops in one sequence, to a total of 217.)

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Set Vertical Pitch (DECVERP)

```
CSI   Ps     z
233   ***    172
```

Ps	Octal	Lines per Inch
0	060	Default (6)
1	061	6
2	062	8
3	063	12
4	064	2
5	065	3
6	066	4

Form Length (DECSLPP)

Sequence   Function

```
CSI   Pn     t
233   ***    164
```

Sets form length to
Pn lines.
Pn = F $\times$ VP*.
Sets top margin to 0
inches and active line
to line 1. Sets top
of form to current
position. Sets bottom
margin to form length.

Vertical Margins (DECSTBM)

Sequence   Function

```
CSI   Pn1    ;    Pn2    r
233   ***    073  ***    162
```

Sets top margin to
line Pn1.
Sets bottom margin
to line Pn2.

---

*   F = form length in inches
    VP = current vertical pitch

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Vertical Tabs

Sequence						Mnemonic	Function
VTS 212						VTS	Sets vertical tab stop at active line.
ESC 033	3 063					DECVTS	Sets vertical tab stop at active line. Not recommended; use VTS instead.
CSI 233	Pn ***	; 073	... ...	Pn ***	v 166	DECSVTS	Sets vertical tab stop at line Pn. (You can specify 16 lines in one sequence, to a total of 168.)
CSI 233	1 061	g 147				TBC	Clears vertical tab stop at active line.
CSI 233	4 064	g 147				TBC	Clears all vertical tab stops.
ESC 033	4 064					DECCAVT	Clears all vertical tab stops. Not recommended; use TBC instead.

Quality Select Mode (DECDEN)

CSI	Ps	"	z
233	***	042	172

	Ps	Octal	Function
	0	060	Sets density select mode to default (draft) density.
	1	061	Sets density select mode to draft density.
	2	062	Sets density select mode to letter density (medium or high density, depending on DPS).

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Select Graphic Rendition (SGR)

```
CSI   Ps1   ;     Ps2   ;     ...   ;     Psn   m
233   ***   073   ***   073   ...   073   ***   155
```

Ps	Octal		Function
0	060		Reset.
4	064		Selects underline.
10	061,	060	Selects DPS 1.
11	061,	061	Selects DPS 2.
12	061,	062	Selects DPS 3.
13	061,	063	Selects DPS 4.
14	061,	064	Selects DPS 5.
24	062,	064	Clears underline.

Select Character Set (SCS)

Sequence				Function

```
ESC   I1    I2    I3    Final
033   ***   ***   ***   ***
```
I1 designates a character set from the primary or alternate section of the repertory. The final character selects the character set.

```
       G0    G1    G2    G3
I1 =   (     )     *     +
       050   051   052   053
```
Designates a primary character set.

```
       G0    G1    G2    G3
I1 =   ,     _           /
       054   055   056   057
```
Designates an alternate character set.

Final	Character Set
0 060	Digital VT100 line drawing
5 065	Digital Finnish
6 066	Digital Norwegian/Danish
7 067	Digital Swedish
8 070	Digital APL

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Final		Character Set
9 071		Digital French Canadian
< 074		Digital multinational
A 101		ISO U.K.
B 102		ISO U.S.
K 113		ISO German
R 122		ISO French
Y 131		ISO Italian
Z 132		ISO Spanish
" 042	1 061	Digital symbol

Shift Functions

Name	Mnemonic	Escape Sequence	Function
Locking shift 0	LS0	Same as shift in.	Maps G0 into GL.
Locking shift 1	LS1	Same as shift out.	Maps G1 into GL.
Locking shift 2	LS2	ESC n 033 156	Maps G2 into GL.
Locking shift 3	LS3	ESC o 033 157	Maps G3 into GL.
Locking shift 1 right	LS1R	ESC ~ 033 175	Maps G1 into GR.
Locking shift 2 right	LS2R	ESC } 033 175	Maps G2 into GR.

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Shift Functions (Cont)

Name	Mnemonic	Escape Sequence		Function
Locking shift 3 right	LS3R	ESC Ø33	| 174	Maps G3 into GR.
Single shift 2	SS2	SS2 216		Invokes G2 for a single printable character.
Single shift 3	SS3	SS3 217		Invokes G3 for a single printable character.

NOTE

There is no locking shift Ø right. You
cannot map GØ into GR.

Request Font Configuration (DECRQSC)

Sequence					Function
CSI 233	? Ø77	1 Ø61	Ø Ø6Ø	c 143	Requests printer to send current font configuration.

Report Font Configuration Sequence

CSI	Ps1	;	Ps2	;	Ps3	;	Ps4	;	Ps5	SP	D
233	***	Ø73	***	Ø73	***	Ø73	***	Ø73	***	Ø4Ø	1Ø4

Ps1 represents the DPS location code. This code is the same as the
select graphic rendition sequence.

Ps1 (Location Code)	DPS
1Ø	1
11	2
12	3
13	4
14	5

NOTE

DPS location code 1Ø is always present
and is sent last to indicate the end of
the report.

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Ps2 represents the ROM identification code. There are four possible ROM identification categories.

Ps2	Function
1-64	Indicates draft and letter standard DPS.
65-128	Indicates draft and memo standard DPS.
129-192	Indicates draft and letter custom DPS.
192-200	Indicates draft and memo special DPS.

For more detail about a specific number, see the appropriate ROM option documentation.

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

        USASCII
        Digital Finnish
        Digital Norwegian/Danish
        Digital Swedish
        Digital French Canadian
        Digital multinational
        Digital VT100 line drawing set
        ISO United Kingdom
        ISO German
        ISO French
        IDO Italian
        ISO Spanish

Ps3 represents one of the following type style attributes.

Ps3	Function
0	No type style
1	Gothic
5	Courier
9	Orator

Ps4 represents one of the following pitch attributes.

Ps4	Function
8	10 characters per inch/5 characters per inch.
0	12 characters per inch/6 characters per inch.

Ps5 represents one of the following print quality attributes.

Ps5	Function
0	Letter (33 X 18 matrix)
1	Memo (33 X 9 matrix)

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Product Identification Request

Sequence			Mnemonic	Function
CSI	c		DA	Requests product
233	143			identification.
CSI	Ø	c	DA	Requests product
233	Ø6Ø	143		identification.
ESC	z		DECID	Requests product
Ø33	132			identification. Not recommended; use DA instead.

Product Identification Report

Report								Device
ESC	[	?	1	Ø	;	3	c	Base printer (V2,
Ø33	133	Ø77	Ø61	Ø6Ø	Ø73	Ø63	143	microcode-8-bit)

ANSI Strings

Name	8-Bit Character	7-Bit Sequence	
String terminator	ST 234	ESC Ø33	\ 134
Application program command	APC 237	ESC Ø33	1̄37
Operating system command	OSC 235	ESC Ø33	] 135
Privacy message	PM 236	ESC Ø33	^ 136
Device control string	DCS 22Ø	ESC Ø33	P 12Ø

Table 4-6   DEC Mode Escape and Control Sequence Summary (Cont)

Graphics String

```
DCS   Ps    q    Data  ...   Data  ST
220   ***   161  ***   ...   ***   234
```

Ps	Octal	Dot Spacing (mils)
0, 1, or 5	060, 061, or 065	7.57
2	062	3.03
3	063	4.54
4	064	6.06
6	066	9.09
7	067	10.60
8	078	12.12
9	071	13.63

Repeat Sequence

Sequence   Function

```
 !    Pn    dot column                     Lets printer print a
041   060   077                            specified dot column
      to    to                             consecutively for Pn
      071   176                            times.
```

Answerback Message

Sequence   Function

```
DCS   1    v    Data  ...   Data  ST       Enters an answerback
220   061  166  ***   ...   ***   234      message. Data consists
                                           of up to 30 characters
                                           in hexadecimal code.
```

4.3   PROGRAMMING INFORMATION FOR EMULATION MODE 1 -- IBM/EPSON
         MX80

This section lists the programmer selectable features in the
IBM/EPSON MX80 printer emulation mode. Figure 4-3 shows the
printable characters for mode 1.

Figure 4-3 Mode 1 Character Set

BITS B4 B3 B2 B1 / ROW	COLUMN 0 (0 0 0 0)	1 (0 0 0 1)	2 (0 0 1 0)	3 (0 0 1 1)	4 (0 1 0 0)	5 (0 1 0 1)	6 (0 1 1 0)	7 (0 1 1 1)
0 0 0 0 / 0	NUL (0/0/0)	(20/16/10)	SP (40/32/20)	0 (60/48/30)	@ (100/64/40)	P (120/80/50)	` (140/96/60)	p (160/112/70)
0 0 0 1 / 1	(1/1/1)	DC1 (21/17/11)	! (41/33/21)	1 (61/49/31)	A (101/65/41)	Q (121/81/51)	a (141/97/61)	q (161/113/71)
0 0 1 0 / 2	(2/2/2)	DC2 (22/18/12)	" (42/34/22)	2 (62/50/32)	B (102/66/42)	R (122/82/52)	b (142/98/62)	r (162/114/72)
0 0 1 1 / 3	(3/3/3)	DC3 (23/19/13)	# (43/35/23)	3 (63/51/33)	C (103/67/43)	S (123/83/53)	c (143/99/63)	s (163/115/73)
0 1 0 0 / 4	(4/4/4)	DC4 (24/20/14)	$ (44/36/24)	4 (64/52/34)	D (104/68/44)	T (124/84/54)	d (144/100/64)	t (164/116/74)
0 1 0 1 / 5	(5/5/5)	(25/21/15)	% (45/37/25)	5 (65/53/35)	E (105/69/45)	U (125/85/55)	e (145/101/65)	u (165/117/75)
0 1 1 0 / 6	(6/6/6)	(26/22/16)	& (46/38/26)	6 (66/54/36)	F (106/70/46)	V (126/86/56)	f (146/102/66)	v (166/118/76)
0 1 1 1 / 7	BEL (7/7/7)	(27/23/17)	' (47/39/27)	7 (67/55/37)	G (107/71/47)	W (127/87/57)	g (147/103/67)	w (167/119/77)
1 0 0 0 / 8	(10/8/8)	CAN (30/24/18)	((50/40/28)	8 (70/56/38)	H (110/72/48)	X (130/88/58)	h (150/104/68)	x (170/120/78)
1 0 0 1 / 9	HT (11/9/9)	(31/25/19)	) (51/41/29)	9 (71/57/39)	I (111/73/49)	Y (131/89/59)	i (151/105/69)	y (171/121/79)
1 0 1 0 / 10	LF (12/10/A)	(32/26/1A)	* (52/42/2A)	: (72/58/3A)	J (112/74/4A)	Z (132/90/5A)	j (152/106/6A)	z (172/122/7A)
1 0 1 1 / 11	VT (13/11/B)	ESC (33/27/1B)	+ (53/43/2B)	; (73/59/3B)	K (113/75/4B)	[(133/91/5B)	k (153/107/6B)	{ (173/123/7B)
1 1 0 0 / 12	FF (14/12/C)	(34/28/1C)	, (54/44/2C)	< (74/60/3C)	L (114/76/4C)	\ (134/92/5C)	l (154/108/6C)		(174/124/7C)
1 1 0 1 / 13	CR (15/13/D)	(35/29/1D)	- (55/45/2D)	= (75/61/3D)	M (115/77/4D)	] (135/93/5D)	m (155/109/6D)	} (175/125/7D)
1 1 1 0 / 14	SO (16/14/E)	(36/30/1E)	. (56/46/2E)	> (76/62/3E)	N (116/78/4E)	^ (136/94/5E)	n (156/110/6E)	~ (176/126/7E)
1 1 1 1 / 15	SI (17/15/F)	(37/31/1F)	/ (57/47/2F)	? (77/63/3F)	O (117/79/4F)	_ (137/95/5F)	o (157/111/6F)	DEL (177/127/7F)

ASCII CONTROL SET (columns 0–1)
ASCII GRAPHIC CHARACTER SET (columns 2–7)

KEY

ASCII CHARACTER	ESC	33	OCTAL
		27	DECIMAL
		1B	HEX

MR-12448
MA-0601-84

Figure 4-3   Mode 1 Character Set (Sheet 1 of 2)

	8	9	10	11	12	13	14	15
bits	1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
	NUL 200/128/80	220/144/90	240/160/A0	260/176/B0	300/192/C0	320/208/D0		
	201/129/81	DC1 221/145/91	241/161/A1	261/177/B1	301/193/C1	321/209/D1		
	202/130/82	DC2 222/146/92	242/162/A2	262/178/B2	302/194/C2	322/210/D2		
	203/131/83	DC3 223/147/93	243/163/A3	263/179/B3	303/195/C3	323/211/D3		
	204/132/84	DC4 224/148/94	244/164/A4	264/180/B4	304/196/C4	324/212/D4		
	205/133/85	225/149/95	245/165/A5	265/181/B5	305/197/C5	325/213/D5		
	206/134/86	226/150/96	246/166/A6	266/182/B6	306/198/C6	326/214/D6		
	BEL 207/135/87	227/151/97	247/167/A7	267/183/B7	307/199/C7	327/215/D7		
	210/136/88	CAN 230/152/98	250/168/A8	270/184/B8	310/200/C8	330/216/D8		
	HT 211/137/89	231/153/99	251/169/A9	271/185/B9	311/201/C9	331/217/D9		
	LF 212/138/8A	232/154/9A	252/170/AA	272/186/BA	312/202/CA	332/218/DA		
	VT 213/139/8B	ESC 233/155/9B	253/171/AB	273/187/BB	313/203/CB	333/219/DB		
	FF 214/140/8C	234/156/9C	254/172/AC	274/188/BC	314/204/CC	334/220/DC		
	CR 215/141/8D	235/157/9D	255/173/AD	275/189/BD	315/205/CD	335/221/DD		
	SO 216/142/8E	236/158/9E	256/174/AE	276/190/BE	316/206/CE	336/222/DE		
	SI 217/143/8F	237/159/9F	257/175/AF	277/191/BF	317/207/CF	337/223/DF		
	ADDITIONAL CONTROL SET		MODE 1 SUPPLEMENTAL CHARACTER SET					

MR-12448

MA-0602-84

Figure 4-3   Mode 1 Character Set (Sheet 2 of 2)

4-23

4.3.1   Mode 1 C0 and C1 Control Characters

The following table lists the mode 1 C0 and C1 control characters.

Table 4-7   Mode 1 C0 and C1 Control Characters

Name	Mnemonic	Octal Code C0	C1	Function
Null	NUL	00	200	Used in escape sequences.
Bell	BEL	07	207	Sounds bell if enabled by switch A7.
Horizontal tab	HT	11	211	Advances to next horizontal tab, if any. Otherwise, takes no action.
Line feed	LF	12	212	Prints buffer's contents, then advances paper by current line spacing.
Vertical tab	VT	13	213	Prints buffer's contents, then moves to next vertical tab, if any. Otherwise, performs line feed.
Form feed	FF	14	214	Advances to next top of form.
Carriage return	CR	15	215	Prints buffer's contents, then performs a carriage return. Also performs a line feed if line feed/new line is enabled by switch A6.

Table 4-7   Mode 1 C0 and C1 Control Characters (Cont)

Name	Mnemonic	Octal Code C0	Octal Code C1	Function
Shift out	SO	16	216	Sets double width for all following characters, until the next line terminator or DC4 is received.
Shift in	SI	17	217	Sets compressed pitch for current line and following lines, until DC2 is received.
Device control 1	DC1	21	221	Enables the printer and clears print buffer.
Device control 2	DC2	22	222	Sets standard pitch for current line and following lines, until SI is received.
Device control 3	DC3	23	223	Disables the printer until DC1 is received.
Device control 4	DC4	24	224	Sets single width for all following characters, until SO is received.
Cancel	CAN	30	230	Clears the print buffer if enabled by switch A4.
Escape	ESC	33	233	Starts escape sequences.

4.3.2   Mode 1 Escape and Control Sequences

The following table lists the escape and control sequences for mode 1 and the features that these sequences select.

Table 4-8   Mode 1 Escape and Control Sequence Summary

Vertical Form Handling

Name (Mnemonic)	Sequence					Function
Set vertical pitch (ER8LI)	ESC Ø33	Ø Ø6Ø				Sets vertical pitch to 8 lines per inch.
(ER1ØLI)	ESC Ø33	1 Ø61				Sets vertical pitch to 1Ø.3 lines per inch (72/7).
(ERNLI2)	ESC Ø33	2 Ø62				Sets vertical pitch to the setting specified in a previous ESC A sequence.
(ERNLI1)	ESC Ø33	A 1Ø1	Pn ***			Sets vertical pitch to 72/Pn lines per inch. Does not take effect until ESC2 is sent.
Set form length (ERSFL)	ESC Ø33	C 1Ø3	Pn ***			Sets the form length to the number of inches that equal Pn X current pitch.

Vertical Tabs

| Set vertical tabs (ERSVT) | ESC Ø33 | B 1Ø2 | Pn1 *** | Pn2 *** | Pn *** | NUL ØØØ | Clears vertical tabs, then sets tabs at Pn1, Pn2, and other desig- nated stops. Pn is a character representing the line numbers in ascending order. For example, the character DC2 sets a tab at line 18. You can specify up to 16 tabs in one sequence. |

Table 4-8   Mode 1 Escape and Control Sequence Summary (Cont)

Horizontal Tabs

Name (Mnemonic)	Sequence					Function
Set horizontal tabs (ERSHT)	ESC 033	D 104	Pn1 ***	Pn2 ***	Pn ***	NUL 000	Clears horizontal tabs, then tabs at Pn1, Pn2, and other designated stops. Pn is a character representing the column number of the desired tab. For example, the character DC2 sets a tab at column 18. You can specify up to 16 tabs.

Paper Fault Handling

			Function
Disable paper out (ERDPO)	ESC 033	8 056	Disables paper out handling.
Enable paper out (EREPO)	ESC 033	9 057	Enables paper out handling.

Printing Modes

			Function
Enable bold (EREBD)	ESC 033	E 105	Sets bold printing for all following characters.
Disable bold (ERDBD)	ESC 033	F 106	Turns off bold printing for all following characters.
Set high resolution (EREHR)	ESC 033	G 107	Enters high resolution mode.
Set low resolution (ERDHR)	ESC 033	H 108	Enters low resolution mode.

This section lists the programmer selectable features in the IBM MX80 plus Graftrax emulation mode. Figure 4-4 shows the printable characters for mode 2.

BITS — B8 B7 B6 B5 (columns), B4 B3 B2 B1 / ROW (rows). Each cell shows the ASCII character with octal / decimal / hex values.

B4 B3 B2 B1	ROW	COLUMN 0 (0000)	1 (0001)	2 (0010)	3 (0011)	4 (0100)	5 (0101)	6 (0110)	7 (0111)
0 0 0 0	0	NUL 0/0/0	20/16/10	SP 40/32/20	0 60/48/30	@ 100/64/40	P 120/80/50	` 140/96/60	p 160/112/70
0 0 0 1	1	1/1/1	21/17/11	! 41/33/21	1 61/49/31	A 101/65/41	Q 121/81/51	a 141/97/61	q 161/113/71
0 0 1 0	2	2/2/2	DC2 22/18/12	" 42/34/22	2 62/50/32	B 102/66/42	R 122/82/52	b 142/98/62	r 162/114/72
0 0 1 1	3	3/3/3	23/19/13	# 43/35/23	3 63/51/33	C 103/67/43	S 123/83/53	c 143/99/63	s 163/115/73
0 1 0 0	4	4/4/4	DC4 24/20/14	$ 44/36/24	4 64/52/34	D 104/68/44	T 124/84/54	d 144/100/64	t 164/116/74
0 1 0 1	5	5/5/5	25/21/15	% 45/37/25	5 65/53/35	E 105/69/45	U 125/85/55	e 145/101/65	u 165/117/75
0 1 1 0	6	6/6/6	26/22/16	& 46/38/26	6 66/54/36	F 106/70/46	V 126/86/56	f 146/102/66	v 166/118/76
0 1 1 1	7	BEL 7/7/7	27/23/17	' 47/39/27	7 67/55/37	G 107/71/47	W 127/87/57	g 147/103/67	w 167/119/77
1 0 0 0	8	BS 10/8/8	30/24/18	(50/40/28	8 70/56/38	H 110/72/48	X 130/88/58	h 150/104/68	x 170/120/78
1 0 0 1	9	HT 11/9/9	31/25/19	) 51/41/29	9 71/57/39	I 111/73/49	Y 131/89/59	i 151/105/69	y 171/121/79
1 0 1 0	10	LF 12/10/A	32/26/1A	* 52/42/2A	: 72/58/3A	J 112/74/4A	Z 132/90/5A	j 152/106/6A	z 172/122/7A
1 0 1 1	11	VT 13/11/B	ESC 33/27/1B	+ 53/43/2B	; 73/59/3B	K 113/75/4B	[133/91/5B	k 153/107/6B	{ 173/123/7B
1 1 0 0	12	FF 14/12/C	34/28/1C	, 54/44/2C	< 74/60/3C	L 114/76/4C	\ 134/92/5C	l 154/108/6C	¦ 174/124/7C
1 1 0 1	13	CR 15/13/D	35/29/1D	- 55/45/2D	= 75/61/3D	M 115/77/4D	] 135/93/5D	m 155/109/6D	} 175/125/7D
1 1 1 0	14	SO 16/14/E	36/30/1E	. 56/46/2E	> 76/62/3E	N 116/78/4E	^ 136/94/5E	n 156/110/6E	~ 176/126/7E
1 1 1 1	15	SI 17/15/F	37/31/1F	/ 57/47/2F	? 77/63/3F	O 117/79/4F	_ 137/95/5F	o 157/111/6F	DEL 177/127/7F

Column 0 and Column 1: **ASCII CONTROL SET**

Columns 2 through 7: **ASCII GRAPHIC CHARACTER SET**

KEY

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

MR-12449
MA-0603-84

Figure 4-4   Mode 2 Character Set (Sheet 1 of 2)

8	9	10	11	12	13	14	15
1 0 0 0	1 0 0 1	1 0 1 0	1 0 1 1	1 1 0 0	1 1 0 1	1 1 1 0	1 1 1 1
NUL 200 128 80	220 144 90	SP 240 160 A0	0 260 176 B0	@ 300 192 C0	P 320 208 D0	τ 340 224 E0	p 360 240 F0
£ 201 129 81	221 145 91	! 241 161 A1	1 261 177 B1	A 301 193 C1	Q 321 209 D1	a 341 225 E1	q 361 241 F1
•• 202 130 82	DC2 222 146 92	" 242 162 A2	2 262 178 B2	B 302 194 C2	R 322 210 D2	b 342 226 E2	r 362 242 F2
, 203 131 83	223 147 93	# 243 163 A3	3 263 179 B3	C 303 195 C3	S 323 211 D3	c 343 227 E3	s 363 243 F3
' 204 132 84	DC4 224 148 94	$ 244 164 A4	4 264 180 B4	D 304 196 C4	T 324 212 D4	d 344 228 E4	t 364 244 F4
§ 205 133 85	⌐ 225 149 95	% 245 165 A5	5 265 181 B5	E 305 197 C5	U 325 213 D5	e 345 229 E5	u 365 245 F5
⌐ 206 134 86	⊢ 226 150 96	& 246 166 A6	6 266 182 B6	F 306 198 C6	V 326 214 D6	f 346 230 E6	v 366 246 F6
BEL 207 135 87	⊣ 227 151 97	' 247 167 A7	7 267 183 B7	G 307 199 C7	W 327 215 D7	g 347 231 E7	w 367 247 F7
BS 210 136 88	⊤ 230 152 98	(250 168 A8	8 270 184 B8	H 310 200 C8	X 330 216 D8	h 350 232 E8	x 370 248 F8
HT 211 137 89	L 231 153 99	) 251 169 A9	9 271 185 B9	I 311 201 C9	Y 331 217 D9	i 351 233 E9	y 371 249 F9
LF 212 138 8A	⌐ 232 154 9A	* 252 170 AA	: 272 186 BA	J 312 202 CA	Z 332 218 DA	j 352 234 EA	z 372 250 FA
VT 213 139 8B	ESC 233 155 9B	+ 253 171 AB	; 273 187 BB	K 313 203 CB	[333 219 DB	k 353 235 EB	{ 373 251 FB
FF 214 140 8C	| 234 156 9C	, 254 172 AC	< 274 188 BC	L 314 204 CC	\ 334 220 DC	l 354 236 EC	/ 374 252 FC
CR 215 141 8D	— 235 157 9D	- 255 173 AD	= 275 189 BD	M 315 205 CD	] 335 221 DD	m 355 237 ED	} 375 253 FD
SO 216 142 8E	⊥ 236 158 9E	, 256 174 AE	> 276 190 BE	N 316 206 CE	∧ 336 222 DE	n 356 238 EE	~ 376 254 FE
SI 217 143 8F	+ 237 159 9F	/ 257 175 AF	? 277 191 BF	O 317 207 CF	— 337 223 DF	o 357 239 EF	DEL 377 255 FF
ADDITIONAL CONTROL SET	**MODE 2 SUPPLEMENTAL CHARACTER SET**						

MR-12449
MA-0604-84

Figure 4-4   Mode 2 Character Set (Sheet 2 of 2)

4.4.1   Mode 2 CØ and Cl Control Characters

The following tables lists the mode 2 CØ and Cl control
characters.

Table 4-9   Mode 2 CØ Control Characters

Name	Mnemonic	Octal Code	Function
Null	NUL	ØØ	Used in escape sequences.
Bell	BEL	Ø7	Sounds bell if enabled by switch A7.
Backspace	BS	1Ø	Prints buffer's contents, then moves back one character cell. (Moves back two cells if this is first time in double width.)
Horizontal tab	HT	11	Moves to next horizontal tab, if any. Otherwise, takes no action.
Line feed	LF	12	Prints buffer's contents, then advances paper by current line spacing.

Table 4-9   Mode 2 C0 Control Characters (Cont)

Name	Mnemonic	Octal Code	Function
Vertical tab	VT	13	Prints buffer's contents, then performs a line feed.
Form feed	FF	14	Advance to next top of form.
Carriage return	CR	15	Prints buffer's contents, then returns to left margin. Performs line feed if enabled by switch A6.
Shift out	SO	16	Sets double width for all following characters until the next line terminator or DC4 is received.
Shift in	SI	17	Sets compressed pitch for current line and following lines, until DC2 received.
Device control 2	DC2	22	Sets standard horizontal pitch for current line and following lines, until SI is received.
Device control 4	DC4	24	Sets single width for all following characters, until SO is received.
Escape	ESC	33	Starts escape sequences.

Table 4-10   Mode 2 C1 Control Characters

Name	Mnemonic	Octal Code	Function
Null	NUL	200	Used in escape sequences.
Pound sign	--	201	*
Umlaut	--	202	*
Opening single quote	--	203	*
Closing single quote	--	204	*
Paragraph	--	205	*
Top level corner	--	206	*
Bell	BEL	207	Sounds bell tone if enabled by switch A7.
Backspace	BS	210	Prints buffer's contents, then moves back one character cell.
Horizontal tab	HT	211	Advances to next horizontal tab stop, if any. Otherwise, takes no action.
Line feed	LF	212	Prints buffer's contents, then advances paper by current line spacing.
Vertical tab	VT	213	Prints buffer's contents, then performs a line feed.
Form feed	FF	214	Advances to next top of form.

Table 4-1Ø Mode 2 C1 Control Characters (Cont)

Name	Mnemonic	Octal Code	Function
Carriage return	CR	215	Prints buffer's contents, then returns to left margin. Performs line feed if enabled by switch **A6**.
Shift out	SO	216	Sets double width for all following characters, until next line terminator or DC4 is received.
Shift in	SI	217	Sets compressed horizontal pitch for current line and following lines, until DC2 is received.
Device control 2	DC2	222	Sets standard horizontal pitch for current line and following lines, until SI is received.
Device control 4	DC4	224	Sets single width for all following characters, until SO is received.
Top right corner		225	*
Right T		226	*
Left T		227	*
Top T		23Ø	*

* Indicates a printable character. See the Mode 2 Character Set for examples of these characters.

Table 4-10   Mode 2 C1 Control Characters (Cont)

Name	Mnemonic	Octal Code	Function
Bottom left corner		231	*
Bottom right corner		232	*
Escape	ESC	233	Starts escape sequences.
Vertical line		234	*
Horizontal line		235	*
Bottom T		236	*
Center cross		237	*

* Indicates a printable character. See the Mode 2 Character Set for examples of these characters.

4.4.2   Mode 2 Escape and Control Sequences

The following table lists the escape and control sequences for mode 2 and the features these sequences select.

NOTE

Pn is a variable numeric parameter in escape sequences. In emulation mode escape sequences, Pn is the ASCII character equivalent of a decimal value. Calculate this value according to the instructions with the escape sequence. Locate the value in the character chart. Use the ASCII character in the sequence.

The *** character below each Pn parameter represents the octal code of the Pn character.

Table 4-11   Mode 2 Escape and Control Sequence Summary

Vertical Form Handling

Name (Mnemonic)	Sequence			Function
Set vertical pitch (ER8LI)	ESC 033	Ø 060		Sets vertical pitch to 8 lines per inch.
(ER10LI)	ESC 033	1 061		Sets vertical pitch to 10.3 (72/7) lines per inch.
(ER6LI2)	ESC 033	2 062		Sets vertical pitch to 6 lines per inch.
(ERNLI3)	ESC 033	3 063	Pn ***	Sets vertical pitch to 216/Pn lines per inch.
(ERNLI5)	ESC 033	A 101	Pn ***	Sets vertical pitch to 72/Pn lines per inch.
(ERNLI4)	ESC 033	J 112	Pn ***	Prints buffer's contents, then sets vertical pitch to 216/Pn lines per inch for next line feed only.
Set form length (ERSFL)	ESC 033	C 103	Pn ***	Sets the form length to the number of inches that equal Pn X current pitch.
(ERSFLI)	ESC 033	C 103	NUL 000	Pn *	Sets the form length to Pn inches.
Set bottom margin (ERSBM)	ESC 033	N 116	Pn ***	Sets the bottom margin to Pn lines from the bottom of the page.
Clear bottom margin (ERCBM)	ESC 033	O 117		Clears the bottom margin. Overrides any margin set by switch A2.

4-35

Table 4-11   Mode 2 Escape and Control Sequence Summary (Cont)

Horizontal Form Handling

Name (Mnemonic)	Sequence			Function
Set right margin (ERSRM)	ESC 033	Q 121	Pn ***	Sets right margin to Pn (column number in octal).
Set double-width characters (EREDW)	ESC 033	W 127	>0 ***	Sets double width characters for current line and following lines. Any non zero character as the third character completes this sequence.
Set single-width characters (ERDDW)	ESC 033	W 127	NUL 000	Sets single width characters for current line and following lines.

Horizontal Tabs

Name (Mnemonic)	Sequence						Function
Set horizontal tabs (ERSHT)	ESC 033	D 104	Pn1 ***	Pn2 ***	Pn ***	NUL 000	Sets horizontal tab stops at Pn1, Pn2, and other designated stops. Pn is a character representing the column number of the desired stop. For example, the character DC2 sets a tab at column 18. You can specify up to 16 tabs.
	or						
	ESC 033	D 104	Pn1 ***	Pn2 ***	Pn ***	80H 200	

Paper Fault Handling

Name (Mnemonic)	Sequence		Function
Disable paper out (ERDPO)	ESC 033	8 056	Disables paper out handling.
Enable paper out (EREPO)	ESC 033	9 057	Enables paper out handling.

Table 4-11   Mode 2 Escape and Control Sequence Summary (Cont)

Unidirectional/Bidirectional Control

Name (Mnemonic)	Sequence			Function
Set one-line unidirectional printing (EREUDI)	ESC 033	< 074		Prints current line from left to right.
Set bidirectional printing (ERDUD)	ESC 033	U 074	NUL 000	Prints lines in bidirectional mode.
Set unidirectional printing (EREUD)	ESC 033	U 074	>0 ***	Prints lines from left to right only. Any nonzero character as the third character completes this sequence.

Character Set Mapping
When you install a primary cartridge other than the italic cartridge in slot 2, all references to the italic set in the following table apply to the character set of the installed primary cartridge.

Switch A4 Setting	Escape Sequence	C0	GL		C1	GR
Down (normal)	None	C0	ASCII		C1	Italic ASCII
Up (italic)	None	C0	Italic ASCII		C1	Italic ASCII
Down (normal)	ER8BS	C1	Italic ASCII		C1	Italic ASCII
Down (normal)	ER8BC	C0	ASCII		C0	ASCII
Up (italic)	ER8BS	C1	Italic ASCII		C1	Italic ASCII
Up(italic)	ER8BC	C0	Italic ASCII		C0	Italic ASCII

Name (Mnemonic)	Sequence		Function
Retain eighth bit (ER8BU)	ESC 033	# 043	Keeps 8th bit unchanged. Use current character set.
Clear eighth bit (ER8BC)	ESC 033	= 075	Clears 8th bit (sets to 0). Maps the default GL and C0 character set to the C1 and GR range.
Set eighth bit (ER8BS)	ESC 033	> 076	Sets 8th bit. Maps the default C1 and GR character set to the C0 and GL range.

Table 4-11   Mode 2 Escape and Control Sequence Summary (Cont)

Printing Modes

Name (Mnemonic)	Sequence			Function
Enable bold (EREBD)	ESC 033	E 105		Sets bold printing for all following characters.
Disable bold (ERDBD)	ESC 033	F 106		Turns off bold printing for all following characters.
Set high resolution (EREHR)	ESC 033	G 107		Enters high resolution mode.
Set low resolution (ERDHR)	ESC 033	H 108		Enters low resolution mode, and resets the script setting.
Set underline (EREUL)	ESC 033	– 045	>Ø ***	Underlines all following characters. Any nonzero character as the third character completes this sequence.
Reset underline (ERDUL)	ESC 033	– 045	NUL ØØØ	Turns off underlining for all following characters.
Select italic (EREIL)	ESC 033	4 064		Selects italic ASCII set as GL.
Select nonitalic (ERDIL)	ESC 033	5 065		Selects nonitalic ASCII set as GL.
Enable superscript (ERESCR)	ESC 033	S 123	NUL ØØØ	Prints all following characters in superscript mode.
Enable subscript (ERESCR)	ESC 033	S 123	>Ø ***	Prints all following characters in subscript mode. Any nonzero character as the third character completes this sequence.
Reset script and directional printing (ERDSCR)	ESC 033	T 124		Resets script setting to no script and resets printing mode to bidirectional.

Table 4-11   Mode 2 Escape and Control Sequence Summary (Cont)

Graphics Mode

Name (Mnemonic)	Sequence				Function
60 DPI graphics (ERGR6)	ESC 033	K 113	Pn1 ***	Pn2 ***	Enter 60 dots per inch for the next n bytes. Pn1 and Pn2 together specify the number of bytes according to the formula n= 256 X Pn2) + Pn1
					The total must be less than the remainder of bytes in the line buffer. If the buffer is empty, the total must be less than 480 (8 inch paper selected) or less than 780 (13 inch paper selected).
132 DPI graphics (ERGR12)	ESC 033	L 114	Pn1 ***	Pn2 ***	Enter 132 dots per inch for the next n bytes. Pn1 and Pn2 together specify the number of bytes according to the formula
					n=(256 X Pn2) + Pn1
					The total must be less than the remainder of bytes in the line buffer. If the buffer is empty, the total must be less than 960 (8 inch paper selected) or less than 1740 (13 inch paper selected).

4.4.3   Restoring Mode 2 Default Settings

The following sequence resets all features set by escape sequences to the default conditions.

Name (Mnemonic)	Sequence		Function
Reset (ERRIS)	ESC 033	@ 100	Resets all features (previously set by escape sequences) to their initial default settings.

4.5   PROGRAMMING INFORMATION FOR EMULATION MODE 3 -- IBM GRAPHICS PRINTER

This section lists the programmer selectable features in the IBM graphics printer emulation mode. The printer has two character sets for Mode 3. They are shown in Figures 4-5 and 4-6.

Table 4-12   Mode 2 Default Settings (Restored by Reset)

Feature	Setting
GL character set	Set to current setting of switch **A4** (GL is not italic if **A4** is set to down position.)
8-bit operations	Leave 8th bit unchanged.
Print direction	Set to bidirectional.
Script	Set to no superscript or subscript.
Character width	Set to single width.
Underline	Set to no underlining.
Paper fault	Enabled.
Vertical tab	Set to every line.
Horizontal tab	Set every eight columns (1, 9, 17, ...).
Form length	Set to 11 inches.
Bottom margin	Set to current setting of switch **A2** (either no bottom margin or 1 inch margin).
Vertical pitch	Set to 6 lines per inch.
Paper width	Set to current setting of switch **A8** (either 8 inches or 13 inches).
Right margin	Set to the current paper width selected by switch **A8**.
Resolution	Set to low resolution.
Bold	Set to current setting of switch **A3**.
Horizontal pitch	Set to current setting of switch **A1** (either standard or compressed).

ASCII Character Set Table (BITS: B8 B7 B6 B5 columns; B4 B3 B2 B1 rows). Each cell shows character with octal / decimal / hex values.

ROW (B4 B3 B2 B1)	COLUMN 0 (0 0 0 0)	1 (0 0 0 1)	2 (0 0 1 0)	3 (0 0 1 1)	4 (0 1 0 0)	5 (0 1 0 1)	6 (0 1 1 0)	7 (0 1 1 1)
0 (0 0 0 0)	NUL 0/0/0	20/16/10	SP 40/32/20	0 60/48/30	@ 100/64/40	P 120/80/50	` 140/96/60	p 160/112/70
1 (0 0 0 1)	1/1/1	21/17/11	! 41/33/21	1 61/49/31	A 101/65/41	Q 121/81/51	a 141/97/61	q 161/113/71
2 (0 0 1 0)	2/2/2	DC2 22/18/12	" 42/34/22	2 62/50/32	B 102/66/42	R 122/82/52	b 142/98/62	r 162/114/72
3 (0 0 1 1)	3/3/3	23/19/13	# 43/35/23	3 63/51/33	C 103/67/43	S 123/83/53	c 143/99/63	s 163/115/73
4 (0 1 0 0)	4/4/4	DC4 24/20/14	$ 44/36/24	4 64/52/34	D 104/68/44	T 124/84/54	d 144/100/64	t 164/116/74
5 (0 1 0 1)	5/5/5	25/21/15	% 45/37/25	5 65/53/35	E 105/69/45	U 125/85/55	e 145/101/65	u 165/117/75
6 (0 1 1 0)	6/6/6	26/22/16	& 46/38/26	6 66/54/36	F 106/70/46	V 126/86/56	f 146/102/66	v 166/118/76
7 (0 1 1 1)	BEL 7/7/7	27/23/17	' 47/39/27	7 67/55/37	G 107/71/47	W 127/87/57	g 147/103/67	w 167/119/77
8 (1 0 0 0)	10/8/8	CAN 30/24/18	(50/40/28	8 70/56/38	H 110/72/48	X 130/88/58	h 150/104/68	x 170/120/78
9 (1 0 0 1)	HT 11/9/9	31/25/19	) 51/41/29	9 71/57/39	I 111/73/49	Y 131/89/59	i 151/105/69	y 171/121/79
10 (1 0 1 0)	LF 12/10/A	32/26/1A	* 52/42/2A	: 72/58/3A	J 112/74/4A	Z 132/90/5A	j 152/106/6A	z 172/122/7A
11 (1 0 1 1)	VT 13/11/B	ESC 33/27/1B	+ 53/43/2B	; 73/59/3B	K 113/75/4B	[133/91/5B	k 153/107/6B	{ 173/123/7B
12 (1 1 0 0)	FF 14/12/C	34/28/1C	, 54/44/2C	< 74/60/3C	L 114/76/4C	\ 134/92/5C	l 154/108/6C	¦ 174/124/7C
13 (1 1 0 1)	CR 15/13/D	35/29/1D	- 55/45/2D	= 75/61/3D	M 115/77/4D	] 135/93/5D	m 155/109/6D	} 175/125/7D
14 (1 1 1 0)	SO 16/14/E	36/30/1E	. 56/46/2E	> 76/62/3E	N 116/78/4E	^ 136/94/5E	n 156/110/6E	~ 176/126/7E
15 (1 1 1 1)	SI 17/15/F	37/31/1F	/ 57/47/2F	? 77/63/3F	O 117/79/4F	_ 137/95/5F	o 157/111/6F	177/127/7F

Column 0 and 1 = ASCII CONTROL SET. Columns 2–7 = ASCII GRAPHIC CHARACTER SET.

KEY

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

MR-12450
MA-0605-84

Figure 4-5   Mode 3 Character Set 1 (Sheet 1 of 2)

4-42

	8 (1 0 0 0)	9 (1 0 0 1)	10 (1 0 1 0)	11 (1 0 1 1)	12 (1 1 0 0)	13 (1 1 0 1)	14 (1 1 1 0)	15 (1 1 1 1)
0	NUL 200/128/80	220/144/90	á 240/160/A0	▨ 260/176/B0	└ 300/192/C0	⟂ 320/208/D0	α 340/224/E0	≡ 360/240/F0
1	201/129/81	, 221/145/91	í 241/161/A1	▨ 261/177/B1	┴ 301/193/C1	321/209/D1	β 341/225/E1	± 361/241/F1
2	202/130/82	DC2 222/146/92	ó 242/162/A2	▮ 262/178/B2	302/194/C2	322/210/D2	Γ 342/226/E2	≥ 362/242/F2
3	203/131/83	223/147/93	ú 243/163/A3	263/179/B3	├ 303/195/C3	323/211/D3	Π 343/227/E3	≤ 363/243/F3
4	204/132/84	DC4 224/148/94	ñ 244/164/A4	264/180/B4	─ 304/196/C4	324/212/D4	Σ 344/228/E4	⌠ 364/244/F4
5	205/133/85	225/149/95	Ñ 245/165/A5	265/181/B5	┼ 305/197/C5	325/213/D5	σ 345/229/E5	⌡ 365/245/F5
6	206/134/86	226/150/96	a̲ 246/166/A6	266/182/B6	306/198/C6	326/214/D6	μ 346/230/E6	÷ 366/246/F6
7	BEL 207/135/87	227/151/97	o̲ 247/167/A7	267/183/B7	307/199/C7	327/215/D7	τ 347/231/E7	~ 367/247/F7
8	210/136/88	CAN 230/152/98	¿ 250/168/A8	270/184/B8	310/200/C8	330/216/D8	♀ 350/232/E8	° 370/248/F8
9	HT 211/137/89	231/153/99	⌐ 251/169/A9	271/185/B9	311/201/C9	331/217/D9	θ 351/233/E9	■ 371/249/F9
10	LF 212/138/8A	232/154/9A	¬ 252/170/AA	272/186/BA	312/202/CA	332/218/DA	Ω 352/234/EA	— 372/250/FA
11	VT 213/139/8B	ESC 233/155/9B	½ 253/171/AB	273/187/BB	313/203/CB	333/219/DB	δ 353/235/EB	√ 373/251/FB
12	FF 214/140/8C	234/156/9C	¼ 254/172/AC	274/188/BC	314/204/CC	334/220/DC	∞ 354/236/EC	n 374/252/FC
13	CR 215/141/8D	235/157/9D	¡ 255/173/AD	275/189/BD	315/205/CD	335/221/DD	ø 355/237/ED	2 375/253/FD
14	SO 216/142/8E	236/158/9E	« 256/174/AE	276/190/BE	316/206/CE	336/222/DE	ε 356/238/EE	■ 376/254/FE
15	SI 217/143/8F	237/159/9F	» 257/175/AF	277/191/BF	317/207/CF	337/223/DF	∩ 357/239/EF	SP 377/255/FF

ADDITIONAL CONTROL SET | MODE 3 SUPPLEMENTAL CHARACTER SET 1

MR-12450
MA-0606-84

Figure 4-5   Mode 3 Character Set 1 (Sheet 2 of 2)

4-43

ASCII code chart (BITS B8 B7 B6 B5 for columns; B4 B3 B2 B1 / ROW for rows). Each cell shows: character, then octal / decimal / hex.

BITS B4 B3 B2 B1 / ROW	Column 0 (0000)	Column 1 (0001)	Column 2 (0010)	Column 3 (0011)	Column 4 (0100)	Column 5 (0101)	Column 6 (0110)	Column 7 (0111)
0 0 0 0 — 0	NUL 0/0/0	20/16/10	SP 40/32/20	0 60/48/30	@ 100/64/40	P 120/80/50	` 140/96/60	p 160/112/70
0 0 0 1 — 1	1/1/1	21/17/11	! 41/33/21	1 61/49/31	A 101/65/41	Q 121/81/51	a 141/97/61	q 161/113/71
0 0 1 0 — 2	2/2/2	DC2 22/18/12	" 42/34/22	2 62/50/32	B 102/66/42	R 122/82/52	b 142/98/62	r 162/114/72
0 0 1 1 — 3	♥ 3/3/3	23/19/13	# 43/35/23	3 63/51/33	C 103/67/43	S 123/83/53	c 143/99/63	s 163/115/73
0 1 0 0 — 4	♦ 4/4/4	DC4 24/20/14	$ 44/36/24	4 64/52/34	D 104/68/44	T 124/84/54	d 144/100/64	t 164/116/74
0 1 0 1 — 5	♣ 5/5/5	§ 25/21/15	% 45/37/25	5 65/53/35	E 105/69/45	U 125/85/55	e 145/101/65	u 165/117/75
0 1 1 0 — 6	♠ 6/6/6	26/22/16	& 46/38/26	6 66/54/36	F 106/70/46	V 126/86/56	f 146/102/66	v 166/118/76
0 1 1 1 — 7	BEL 7/7/7	27/23/17	' 47/39/27	7 67/55/37	G 107/71/47	W 127/87/57	g 147/103/67	w 167/119/77
1 0 0 0 — 8	10/8/8	CAN 30/24/18	(50/40/28	8 70/56/38	H 110/72/48	X 130/88/58	h 150/104/68	x 170/120/78
1 0 0 1 — 9	HT 11/9/9	31/25/19	) 51/41/29	9 71/57/39	I 111/73/49	Y 131/89/59	i 151/105/69	y 171/121/79
1 0 1 0 — 10	LF 12/10/A	32/26/1A	* 52/42/2A	: 72/58/3A	J 112/74/4A	Z 132/90/5A	j 152/106/6A	z 172/122/7A
1 0 1 1 — 11	VT 13/11/B	ESC 33/27/1B	+ 53/43/2B	; 73/59/3B	K 113/75/4B	[133/91/5B	k 153/107/6B	{ 173/123/7B
1 1 0 0 — 12	FF 14/12/C	34/28/1C	, 54/44/2C	< 74/60/3C	L 114/76/4C	\ 134/92/5C	l 154/108/6C	¦ 174/124/7C
1 1 0 1 — 13	CR 15/13/D	35/29/1D	- 55/45/2D	= 75/61/3D	M 115/77/4D	] 135/93/5D	m 155/109/6D	} 175/125/7D
1 1 1 0 — 14	SO 16/14/E	36/30/1E	. 56/46/2E	> 76/62/3E	N 116/78/4E	^ 136/94/5E	n 156/110/6E	~ 176/126/7E
1 1 1 1 — 15	SI 17/15/F	37/31/1F	/ 57/47/2F	? 77/63/3F	O 117/79/4F	— 137/95/5F	o 157/111/6F	177/127/7F

Column 0 and Column 1 = ASCII CONTROL SET. Columns 2–7 = ASCII GRAPHIC CHARACTER SET.

KEY

ASCII CHARACTER:

ESC	33 OCTAL
	27 DECIMAL
	1B HEX

MR-12451
MA-0607-84

Figure 4-6   Mode 3 Character Set 2 (Sheet 1 of 2)

8		9		10		11		12		13		14		15	
Ç	200 128 80	É	220 144 90	á	240 160 A0	▨	260 176 B0	└	300 192 C0	╨	320 208 D0	α	340 224 E0	≡	360 240 F0
Ü	201 129 81	æ	221 145 91	í	241 161 A1	▨	261 177 B1	┴	301 193 C1	╤	321 209 D1	β	341 225 E1	±	361 241 F1
é	202 130 82	Æ	222 146 92	ó	242 162 A2	█	262 178 B2	┬	302 194 C2	╥	322 210 D2	Γ	342 226 E2	≥	362 242 F2
â	203 131 83	Ô	223 147 93	ú	243 163 A3	│	263 179 B3	├	303 195 C3	╙	323 211 D3	Π	343 227 E3	≤	363 243 F3
ä	204 132 84	Ö	224 148 94	ñ	244 164 A4	┤	264 180 B4	─	304 196 C4	╘	324 212 D4	Σ	344 228 E4	⌠	364 244 F4
à	205 133 85	Ò	225 149 95	Ñ	245 165 A5	╡	265 181 B5	┼	305 197 C5	╒	325 213 D5	σ	345 229 E5	⌡	365 245 F5
å	206 134 86	Û	226 150 96	a	246 166 A6	╢	266 182 B6	╞	306 198 C6	╓	326 214 D6	μ	346 230 E6	÷	366 246 F6
ç	207 135 87	Ù	227 151 97	o	247 167 A7	╖	267 183 B7	╟	307 199 C7	╫	327 215 D7	τ	347 231 E7	≈	367 247 F7
ê	210 136 88	Ÿ	230 152 98	¿	250 168 A8	╕	270 184 B8	╚	310 200 C8	╪	330 216 D8	Φ	350 232 E8	°	370 248 F8
ë	211 137 89	Ö	231 153 99	⌐	251 169 A9	╣	271 185 B9	╔	311 201 C9	┘	331 217 D9	Θ	351 233 E9	∙	371 249 F9
è	212 138 8A	Ü	232 154 9A	¬	252 170 AA	║	272 186 BA	╩	312 202 CA	┌	332 218 DA	Ω	352 234 EA	·	372 250 FA
Ï	213 139 8B	¢	233 155 9B	½	253 171 AB	╗	273 187 BB	╦	313 203 CB	█	333 219 DB	δ	353 235 EB	√	373 251 FB
Î	214 140 8C	£	234 156 9C	¼	254 172 AC	╝	274 188 BC	╠	314 204 CC	█	334 220 DC	∞	354 236 EC	ⁿ	374 252 FC
Ì	215 141 8D	¥	235 157 9D	¡	255 173 AD	╜	275 189 BD	═	315 205 CD	▌	335 221 DD	∅	355 237 ED	²	375 253 FD
Ä	216 142 8E	Pt	236 158 9E	«	256 174 AE	╛	276 190 BE	╬	316 206 CE	▐	336 222 DE	∈	356 238 EE	■	376 254 FE
Â	217 143 8F	f	237 159 9F	»	257 175 AF	┐	277 191 BF	╧	317 207 CF	▄	337 223 DF	∩	357 239 EF	SP	377 255 FF

MODE 3 SUPPLEMENTAL CHARACTER SET 2

MR-12451
MA-0608-84

Figure 4-6   Mode 3 Character Set 2 (Sheet 2 of 2)

4.5.1   Mode 3 C0 and C1 Control Characters

The following tables list the mode 3 C0 and C1 control characters.

Table 4-13   Mode 3 C0 and C1 Control Characters (Set 1)

Name	Mnemonic	Octal Code C0	C1	Function
Null	NUL	00	200	Used in escape sequences.
Bell	BEL	07	207	Sounds bell tone if enabled by switch A7.
Horizontal tab	HT	11	211	Advances to next horizontal tab, if any. Otherwise, takes no action.
Line feed	LF	12	212	Prints buffer's contents, then advances paper by current line spacing.
Vertical tab	VT	13	213	Prints buffer's contents, then performs line feed.
Form feed	FF	14	214	Advances to next top of form.
Carriage return	CR	15	215	Prints buffer's contents, returns to left margin, and performs line feed if enabled by switch A6.
Shift out	SO	16	216	Sets double width for all following characters, until next line terminator or DC4 is received.
Shift in	SI	17	217	Sets compressed horizontal pitch for current line and following lines, until DC2 is received.

Table 4-13   Mode 3 CØ and C1 Control Characters (Set 1) (Cont)

Name	Mnemonic	Octal Code CØ	C1	Function
Device control 2	DC2	22	222	Sets standard horizontal pitch for current line and following lines, until SI is received.
Device control 4	DC4	24	224	Sets single width for all following characters, until SO is received.
Cancel	CAN	3Ø	23Ø	Clears print buffer if enabled by switch A4.
Escape	ESC	33	233	Starts escape sequences.

Table 4-14   Mode 3 CØ Control Characters (Set 2)

Name	Mnemonic	Octal Code	Function
Null	NUL	ØØ	Used in escape sequences.
Heart	-	Ø3	Prints a heart symbol.
Diamond	-	Ø4	Prints a diamond symbol.
Clubs	-	Ø5	Prints a club symbol.
Spade	-	Ø6	Prints a spade symbol.
Bell	BEL	Ø7	Sounds bell tone if enabled by switch A7.
Horizontal tab	HT	11	Advances to next horizontal tab, if any. Otherwise, takes no action.
Line feed	LF	12	Prints buffer's contents, then advances paper by current line spacing.

Table 4-14   Mode 3 CØ Control Characters (Set 2) (Cont)

Name	Mnemonic	Octal Code	Function
Vertical tab	VT	13	Prints buffer's contents, then performs line feed.
Form feed	FF	14	Advance to next top of form.
Carriage return	CR	15	Prints buffer's contents, then returns to left margin. Performs line feed if enabled by switch A6.
Shift out	SO	16	Sets double width for all following characters, until the next line terminator or DC4 is received.
Shift in	SI	17	Sets compressed horizontal pitch for current line and following lines, until DC2 is received.
Device control 2	DC2	22	Sets standard horizontal pitch for current line and following lines, until SI is received.
Device control 4	DC4	24	Sets single width for all following characters, until SO is received.
Paragraph	–	25	Prints paragraph symbol.
Cancel	CAN	30	Clears print buffer if enabled by switch A4.
Escape	ESC	33	Starts escape sequences.

4.5.2 Mode 3 Escape and Control Sequences

The following table lists the escape and control sequences for mode 3 and the features that these sequences select.

> **NOTE**
>
> Pn is a variable numeric parameter in escape sequences. In emulation mode escape sequences, Pn is the ASCII character equivalent of a decimal value. Calculate this value according to the instructions with the escape sequence. Locate the value in the character chart. Use the ASCII character in the sequence.
>
> The *** character below each Pn parameter represents the octal code of the Pn character.

Table 4-15   Mode 3 Escape and Control Sequence Summary

Vertical Form Handling

Name (Mnemonic)	Sequence			Function
Set vertical pitch (ER8LI)	ESC 033	Ø Ø6Ø		Sets vertical pitch to 8 lines per inch.
(ER1ØLI)	ESC 033	1 Ø61		Sets vertical pitch to 1Ø.3 lines per inch (72/7).
(ERNL12)	ESC 033	2 Ø62		Sets vertical pitch to the setting specified in a previously issued ESC A sequence. If none was set, sets pitch to 6 lines per inch.
(ERNLI1)	ESC 033	A 1Ø1	Pn ***	Sets vertical pitch to 72/Pn lines per inch. Does not take effect until ESC2 is sent.
(ERNLI3)	ESC 033	3 Ø63	Pn ***	Sets vertical pitch to 216/Pn lines per inch.

4-49

Table 4-15   Mode 3 Escape and Control Sequence Summary (Cont)

Vertical Form Handling (Cont)

Name (Mnemonic)	Sequence				Function
(ERNLI4)	ESC 033	J 112	Pn ***		Prints buffer's contents and sets vertical pitch to 216/Pn lines per inch for next line feed only.
Set form length (ERSFL)	ESC 033	C 103	Pn ***		Sets the form length to the number of inches that equal Pn X current pitch.
(ERSFLI)	ESC 033	C 103	NUL 000	Pn ***	Sets the form length to Pn inches.
Set bottom margin (ERSBM)	ESC 033	N 116	Pn ***		Sets the bottom margin to Pn lines from the bottom of the page.
Clear bottom margin (ERCBM)	ESC 033	O 117			Clears the bottom margin.

Horizontal Form Handling

Name (Mnemonic)	Sequence			Function
Set double-width characters (EREDW)	ESC 033	W 127	>0 ***	Sets double width characters for current line and following lines. Any nonzero character as the third character completes this sequence.
Set single-width characters (ERDDW)	ESC 033	W 127	NUL 000	Sets single width characters for current line and following lines.
Carriage return (PCR1)	ESC 033	< 074		Performs carriage return without performing line feed, regardless of current switch setting.

Table 4-15   Mode 3 Escape and Control Sequence Summary (Cont)

Horizontal Tabs

Name (Mnemonic)	Sequence	Function
Set horizontal tabs (ERSHT)	ESC D Pn1 Pn2 Pn NUL 033 104 *** *** *** 000	Sets horizontal tab stops at Pn1, Pn2, and other designated stops. Pn is a character representing the column number of the desired stop. For example, the character DC2 sets a tab at column 18. You can specify up to 16 tabs.

Paper Fault Handling

Name (Mnemonic)	Sequence	Function
Disable paper out (ERDPO)	ESC 8 033 056	Disables paper out handling.
Enable paper out (EREPO)	ESC 9 033 057	Enables paper out handling.

Unidirectional/Bidirectional Control

Name (Mnemonic)	Sequence	Function
Set bidirectional (ERDUD)	ESC U NUL 033 074 000	Prints lines in bidirectional mode.
Set unidirectional printing (EREUD)	ESC U >0 033 074 ***	Prints lines from left to right only. Any nonzero character as the third character completes this sequence.

Table 4-15   Mode 3 Escape and Control Sequence Summary (Cont)

Alternate Character Set Mapping

Name (Mnemonic)	Sequence			Function
Select set 2 (ERC02)	ESC 033	6 066		Selects the alternate character set (set 2).
Select set 1 (ERC01)	ESC 033	7 067		Selects character set 1. (This character set is the default set when you power on the printer.)

Printing Modes

Name (Mnemonic)	Sequence			Function
Enable bold (EREBD)	ESC 033	E 105		Sets bold printing for all following characters.
Disable bold (ERDBD)	ESC 033	F 106		Turns off bold printing for all following characters.
Set high resolution (EREHR)	ESC 033	G 107		Enters high resolution mode.
Set low resolution (ERDHR)	ESC 033	H 108		Enters low resolution mode.
Set underline (EREUL)	ESC 033	– 045	>0 ***	Underlines all following characters. Any nonzero character as the third character completes this sequence.
Reset underline (ERDUL)	ESC 033	– 045	NUL 000	Turns off underlining for all following characters.
Enable superscript (ERESCR)	ESC 033	S 123	NUL 000	Prints all following characters in superscript mode.

4-52

Table 4-15   Mode 3 Escape and Control Sequence Summary (Cont)

Name (Mnemonic)	Sequence			Function
Enable subscript (ERESCR)	ESC 033	S 123	>0 ***	Prints all following characters in subscript mode. Any nonzero character as the third character completes this sequence.
Reset script and directional printing (ERDSCR)	ESC 033	T 124		Resets script setting to no script and resets printing mode to bidirectional.

Graphics Mode

Name (Mnemonic)	Sequence				Function
60 DPI graphics (ERGR6)	ESC 033	K 113	Pn1 ***	Pn2 ***	Enter 60 dots per inch for the next n bytes. Pn1 and Pn2 together specify the number of bytes according to the formula

$$n = (256 \times Pn2) + Pn1$$

The total must be less than the remainder of bytes in the line buffer. If the buffer is empty, the total must be less than 480 (8 inch paper selected) or less than 780 (13 inch paper selected).

Table 4-15   Mode 3 Escape and Control Sequence Summary (Cont)

Graphics Modes (Cont)

Name (Mnemonic)	Sequence				Function
132 DPI graphics (ERGR12)	ESC 033	L 114	Pn1 ***	Pn2 ***	Enter 132 dots per inch for the next n bytes. Pn1 and Pn2 together specify the number of bytes according to the formula $n = (256 \times Pn2) + Pn1$ The total must be less than the remainder of bytes in the line buffer. If the buffer is empty, the total must be less than 960 (8 inch paper selected) or less than 1740 (13 inch paper selected).
132 DPI graphics (ERGS12)	ESC 033	Y 131	Pn1 ***	Pn2 ***	Enter 132 dots per inch for the next n bytes. Pn1 and Pn2 together specify the number of bytes according to the formula $n = (256 \times Pn2) + Pn1$ The total must be less than the remainder of bytes in the line buffer. If the buffer is empty, the total must be less than 960 (8 inch paper selected) or less than 1740 (13 inch paper selected). ESC Y prints every other dot.

Table 4-15   Mode 3 Escape and Control Sequence Summary (Cont)

Name (Mnemonic)	Sequence				Function
22Ø DPI graphics (ERGD24)	ESC Ø33	Z 132	Pn1 ***	Pn2 ***	Enter 22Ø dots per inch for the next n bytes. Pn1 and Pn2 together specify the number of bytes according to the formula

$$n = (256 \times Pn2) + Pn1$$

The total must be less than the remainder of bytes in the line buffer. If the buffer is empty, the total must be less than 192Ø (8 inch paper selected) or less than 2895 (13 inch paper selected). ESC Z prints one dot in any three consecutive positions.

CHAPTER 5
THEORY OF OPERATION

5.1   GENERAL

This chapter describes the LA210 Letterprinter's basic principles
of operation. The chapter also describes the functions that the
printer performs. Refer to the LA210 Field Maintenance Print Set
for circuit details while you study this chapter. Refer to the
programmer reference manual (EK-LA210-RM) for complete information
on character processing, control and escape sequences, and font
initialization.

5.2   PHYSICAL OVERVIEW

The LA210 Letterprinter has five basic components: the control
panel, control/logic board, printhead, printer mechanism, and
power supply. Figure 5-1 shows these components and how they work
together.

The control/logic board manages printing, paper advancing, and
communication. All other components connect to it. The
control/logic board has the following components.

A microprocessor to manage overall printer operation

24 Kbytes (8 Kbytes plus 16 Kbytes) of ROM that contain a
microprogram for operating the printer

8 to 40 Kbytes of ROM for character and font storage (1 to 5
ROMs)

4 Kbytes of RAM for microprocessor temporary storage and I/O
data storage

The DC305 printer controller that provides an interface
between the microprocessor and the electromechanical
components

An asynchronous, serial receiver/transmitter (USART) for data
exchange with the host computer
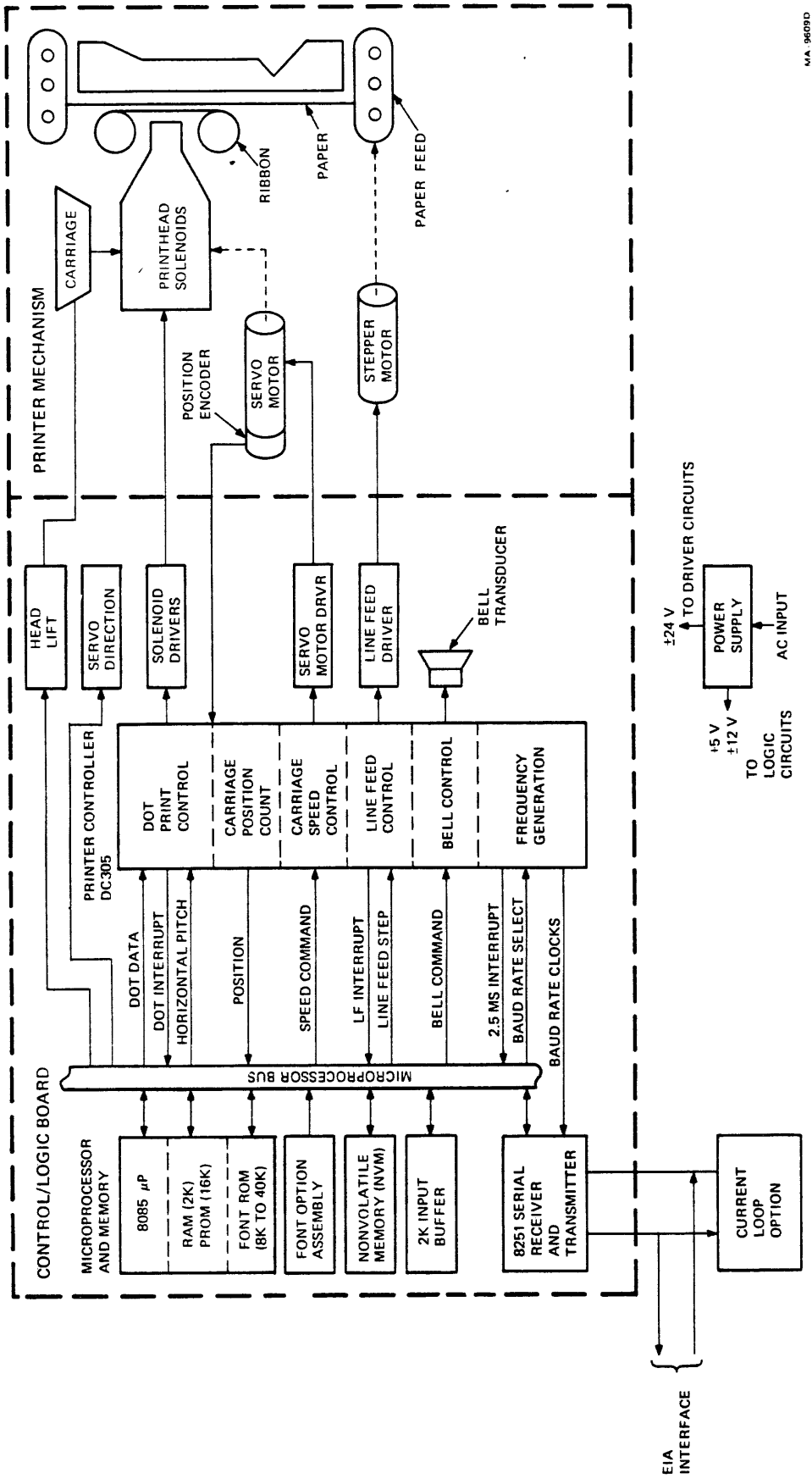
Figure 5-1   Block Diagram

The printer mechanism has the following mechanical and electromechanical components for impact printing and paper/forms control.

9-wire printhead

Servo motor and position encoder for horizontal printhead motion and position sensing

Stepper motor for vertical paper movement

Paper low/out sensors (if installed)

Platen, friction assembly, and other mechanisms for paper control

Printhead lift to allow dot overlap

The power supply converts the ac power line into dc voltages used by the printer. The power supply has a switching regulator for high efficiency operation.

5.3   FUNCTIONAL OVERVIEW

The printer examines (parses) characters it receives from the host processor and either treats them as printable characters or as commands. Specific character strings, called escape sequences, change parameters such as vertical and horizontal character pitch, tabs and margins, or alternate character sets.

I/O and processing are divided into the following functions. These functions, and how they work together to implement I/O, are examined in this chapter.

Microprocessor/control system
Communication and I/O data processing
Control panel
Printing process
Paper advance process
Power supply and power distribution

The printer is a microprocessor-controlled system that performs control functions and I/O data processing. The following chapter describes these functions and the hardware and firmware interactions that produce them.

5.4   MICROPROCESSOR CONTROL SYSTEM

An 8085A microprocessor is the center of the LA210 Letterprinter control system. This microprocessor fetches instructions and data from ROM and RAM, and responds to service requests from various devices in the system. Figure 5-2 shows the microprocessor control system logic. This includes the microprocessor chip, ROM and RAM, address decode logic, some command and status buffering, and associated timing logic.

The wake-up (WU) signal holds the microprocessor RESET IN input low until the +5 V logic voltage reaches its normal level. When WU goes high, the microprocessor's program counter addresses location 0000 and the microprocessor fetches and executes the first instruction from memory.

The microprocessor addresses memory and other devices with a 16-line address bus (A15 through A0). The high address byte (A15 through A8) is asserted on the bus for the duration of the processor cycle. But the low address byte is asserted on the multiplexed 8-line address/data bus (AD7 through AD0) for a short time at the beginning of the cycle, so it must be captured in a register. Signals AD7 through AD0 pass through the low address latch and are frozen for the remainder of the cycle by the falling edge of the address lines enable (ALE) signal. Then the AD lines are free for instructions and other I/O data for the remainder of the cycle.

Although the microprocessor has a 16-bit address (64 Kbytes), only part of the address range is decoded and used. Table 5-1 summarizes the system address map.

The microprocessor addresses devices on the address and data buses as either memory or I/O. The output signal IO/not memory (IO/M) makes the distinction. When low, IO/M enables ROM and RAM and other devices addressed as memory, such as the 8251A USART and DC305 printer controller. When high, IO/M enables I/O devices. The I/O devices in the printer are the many receivers and transmitters that communicate certain command and status information. An I/O write to address 0000_{16} sends a command to turn the power and ready indicators on or off. This I/O write also enables the data terminal ready (DTR) modem line, and sends motion commands to the servo motor drivers. An I/O read from address 0000_{16} gets the status of the cover interlock switch, paper out, and paper low switches, and the communication carrier detect signal. An I/O read from address 0001_{16} reads the setting of the configuration switches.
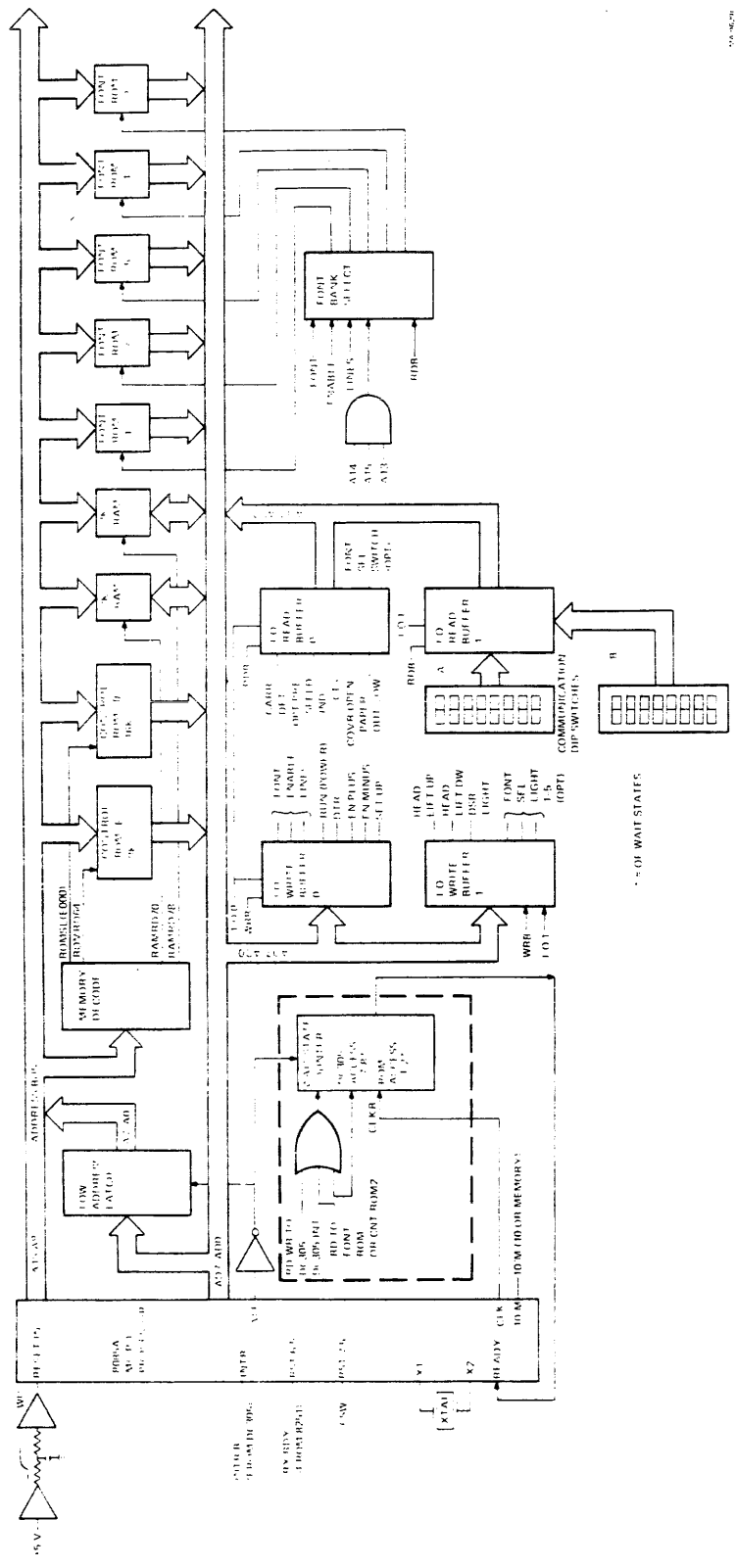
Figure 5-2   Microprocessor/Control System Logic

Table 5-1   LA210 System Address Map

Address Range (Hexadecimal)	Decoded Enabling Signal (E33)	Responding Device
0000 -- 0FFF	$\overline{ROM0+A}$	ROM 0
1000 -- 1FFF		ROM E
2000 -- 23FF	--	
2400 -- 2FFF	--	
3000 -- 300F	KBDSEL	Control Panel
3010 -- 3FFF	KBDRD	Control Panel
4000 -- 4003	DC305SL	Printer controller
4004 -- 4FFF	DC305SL	Not used
5000 -- 5001	COMSEL	USART
5002 -- 5FFF	COMSEL	Not used
6000 -- 6FFF	CE7	NVM
7400 -- 77FF	RAMRD70	RAM (2K)
7800 -- 7BFF	RAMRD78	
8000 -- 8FFF	--	
9000 -- 9FFF	--	Not used
A000 -- BFFF		ROM 0
C000 -- DFFF	CHRAD0	ROMs (8K each)
E000 -- FFFF	--	ROM (8K)

The microprocessor receives hardware interrupts from the DC305 printer controller and the 8251A USART.* The DC305 raises the INTR B line to the INTR input. Then the DC305 responds to INTR A by asserting an interrupt vector address on lines AD7 through AD0. The 8251A USART raises the RXRDY line to the RST6.5 input. The interrupt types, vector addresses (new program counter value), and descriptions are in Table 5-2.

System timing is established by a crystal connected to the microprocessor. The microprocessor and the D-type latch jointly divide the crystal operating frequency (running at 8 MHz) by 4 and produces the 2 MHz clock B (CLK B) output. CLK B (Figure 5-6) runs to other functional areas and produces printing and communication timing. The microprocessor usually runs continuously, fetching and executing instructions from memory while its READY input is high. The wait state logic (Figure 5-2) pulls READY low whenever there is a write to, read from, or interrupt from the DC305 printer controller. READY low causes a short pause in the microprocessing cycle. This is called a wait state. It allows more time for the DC305 to respond.

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* The microprocessor also receives hardware interrupts from the ROM cartridge microswitch in the font option assembly.

Table 5-2   Hardware Interrupt Vectors.

Restart Interrupt Name	Interrupt Vector Address	Microprocessor Interrupt Input	Reason for Interrupt
RST0	0000	RESET IN (WU)	Power-up.
RST1	0008	INTR (INTR B)	Both RST3 and RST5.
RST3	0018	INTR (INTR B)	2.5 ms tick from DC305.
RST5	0028	INTR (INTR B)	DC305 real-time clock timeout (while line feeding) or dot FIFOs are half empty.
RST6.5	0034	RST6.5 (RXRDY)	Character present at USART receiver output.
RST7.5	003C	RST7.5 (CART SW)	DPS cartridge being inserted or removed.

The microprocessor continuously runs a ROM resident microprogram called the monitor. Figure 5-3 shows the basic monitor program loop. While the actual monitor program differs from one printer to another (depending on options present -- graphics, etc.), this figure shows the elements that are common to all.

When you turn the power on, the microprocessor runs a short initialization routine before the printer starts the monitor loop. The microprocessor's sequence of actions in this routine is as follows.

1. Disables all hardware interrupts
2. Performs a write/read check on RAM area
3. Performs a read check on ROM area
4. Displays errors in code ROMs or RAM (level 1)
5. Initializes the DC305 dot print FIFOs
6. Moves parameters from NVM to RAM
7. Initializes the DC305 printer controller
8. Initializes the I/O registers
9. Sets the print carriage to the first legal column
10. Initalizes the 8251A USART
11. Sets appropriate baud rates
12. Enables all hardware interrupts
13. Displays power-up and left margin errors (level 2)
14. Tests character ROMs
15. Displays errors in character ROMs (level 3)
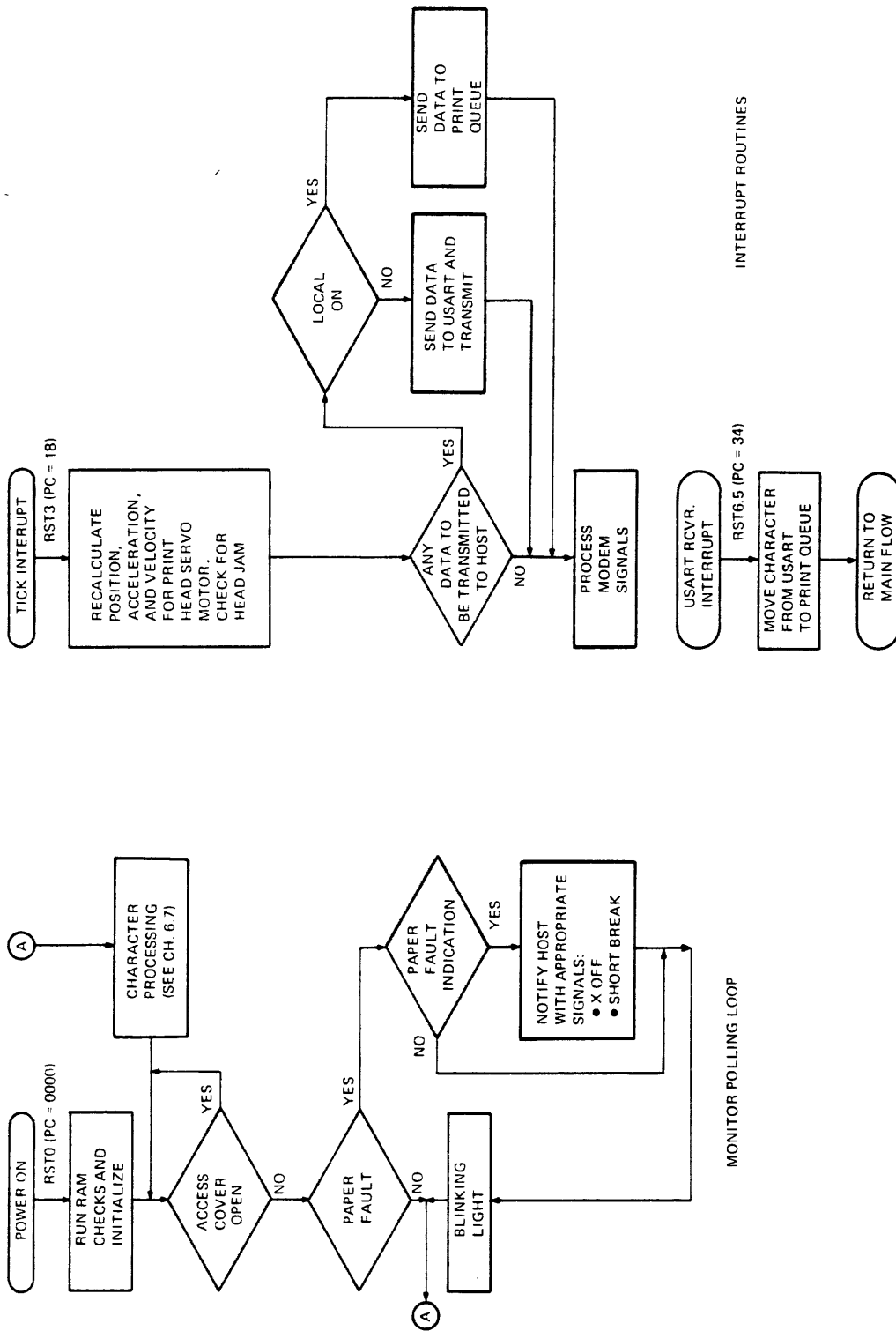
Figure 5-3   Monitor Polling Loop and Interrupt Routines

After executing the initialization routine, the microprocessor branches to the monitor loop. The monitor loop is a polling routine that looks for status information such as access cover open, paper out, and any data to print or process. Some internal status information may be too urgent for the monitor loop to poll. Hardware interrupts handle this critical information and also printer housekeeping. Items that must be handled in real-time, such as control panel scanning and processing high baud rate receiver data, are examples of this critical information. These interrupt routines are shown separately from the monitor loop in Figure 5-3.

5.5   COMMUNICATION AND I/O DATA PROCESSING

The printer interfaces with the host computer through a serial data port. The port includes an 8251A programmable USART and supporting logic. The USART translates parallel and serial data formats and adds or removes start and stop bits as needed.

> NOTE
> The printer has two sets of internal configuration switches (A and B) that allow the operator to change modes and adapt the printer to the communication requirements of different hosts. These switchpacks are described in Chapter 3, Paragraph 3.3.

5.5.1   Data Format

The printer communicates only asynchronously. In asynchronous communication, bits are added to each data character to synchronize transmission and reception. Figure 5-4 shows the ASCII data format exchanged between the printer and the host computer. Any two data exchanges can originate at random times with clock frequencies that have as much as one percent difference. The protocol assumes random arrival of any character of data, and relies on the synchronization information in the character. This synchronization consists of extra bits appended to the beginning and end of the character. One bit at each end (one start bit and one stop bit) is the most common configuration, although two stop bits are used in transmissions from printer to host.

The start and stop bits are defined with specific states. The state of start bit is different from the idling condition on the line. The data port looks for the transition from the idling state (called mark) to the start bit state (called space), and clocks in the character. The stop bit is the mark state (like the idling state), so the character immediately following the stop bit has the correct mark-to-space transition for synchronization. The data bits between a start and a stop bit are represented by a mark for a 1 and a space for a 0.
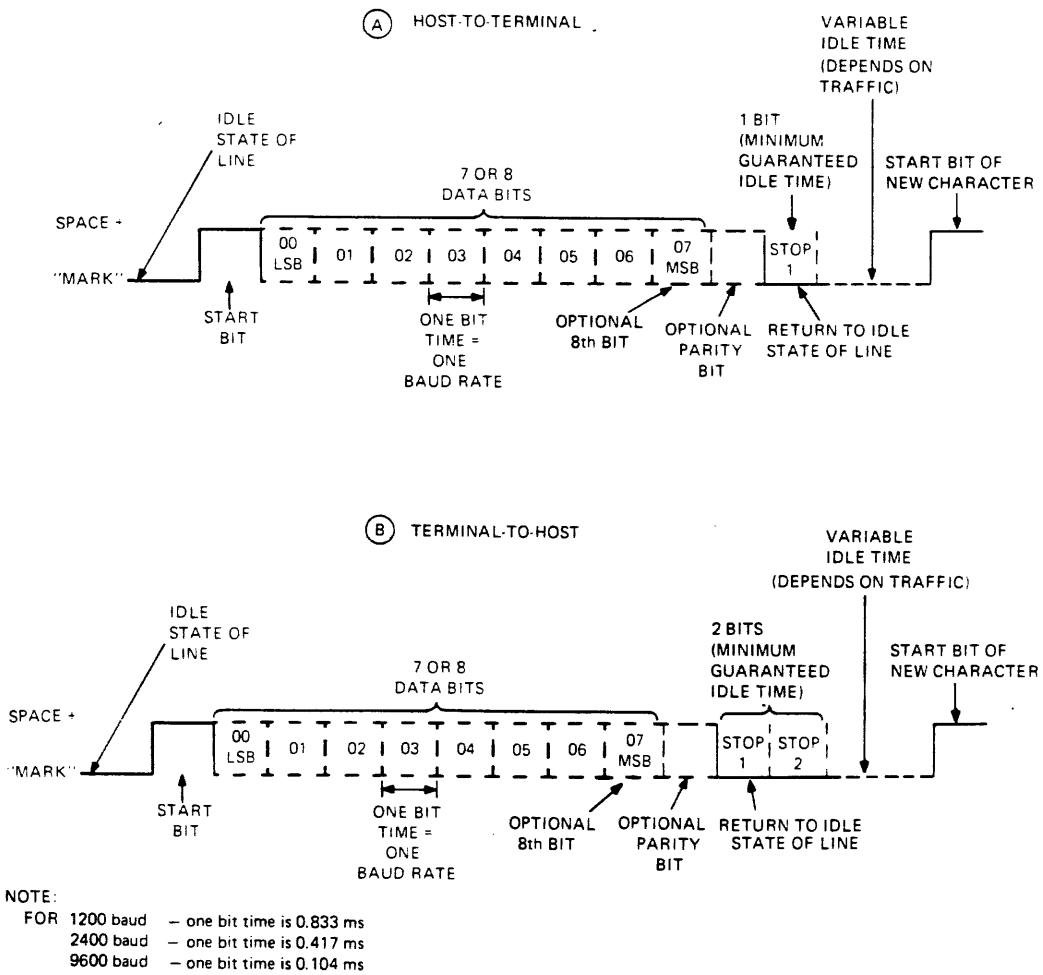
Figure 5-4   Serial Character Format

After the printer transmits the data bits, it sends two stop bits. The printer always ensures that the line is idle for at least two bit's time. The printer only receives data separated by at least one stop bit. Longer idle time is also acceptable.

The printer stays under the host's maximum interrupt rate by not transmitting data faster than 60 char/s (1 character in 16 ms). So, at a transmission speed of 600 baud or more, the idle time between two characters is always significantly longer than two bit's time. It will be a large multiple of the bit rate (for example, 150 times the bit rate at 9600 baud). The idle time is in the range of the bit rate only when transmission speed is 600 baud or less.

The printer receives serial characters using one start bit, seven or eight data bits, an optional bit, a selectable parity bit, and one stop bit. The data bits are transmitted with the least significant bit (LSB) first.

Use switchback B (switches 6, 7, and 8) to select data format and parity. For 7-bit data, the parity bit can be mark, space, odd, or even. For 8-bit data, the parity bit can be mark (or no parity), even, or odd.

NOTE
Even and odd parity may not be available
in certain 8-bit systems because of
modem limitations.

You select the speed at which the serial character is transmitted or received with baud rate (speed) switches 1 through 5 on switchpack B (Figure 3-9).

5.5.2   Data Handling Through the USART

The printer's microprogram controls the USART. The microprocessor sends a set of control bytes to initialize the USART to support the desired communication format. Once programmed, the USART is ready to perform its communication functions. Figure 5-5 shows how data is handled across the serial line and is transmitted and received in the printer.
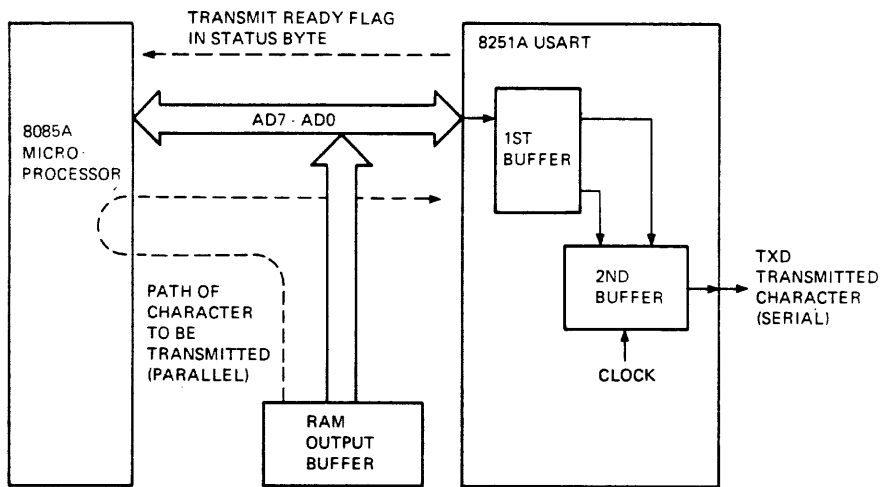
(a) TRANSMIT DATA
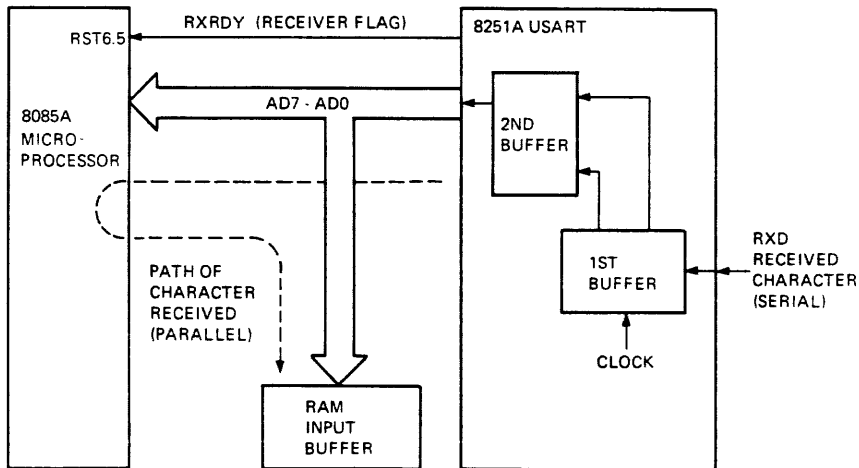
(b) RECEIVE DATA

MA-9608

Figure 5-5   Data Handling in the USART

5.5.2.1 Transmit Data -- When the microprocessor wants to send a character, it requests a status byte from the USART and checks the transmitter ready flag. If this flag is high, the transmit buffer is empty and can accept data. If the flag is low, the microprocessor continues its monitor program and checks the transmitter ready flag later.

When the flag is high, the microprocessor loads a data byte from the RAM output buffer into the USART transmit buffer. The USART is double buffered, meaning there is a second data buffer inside that loads automatically from the first buffer. Start and stop bits and parity (if enabled) are appended to the second buffer's contents and the contents are shifted out onto the transmit data (TXD) line by a continuously running clock. Immediately after the second buffer is loaded, the transmit ready flag goes high and the first transmit buffer can be loaded.

5.5.2.2 Receive Data -- Data from the receive data (RXD) line is shifted into the USART receive buffer (first buffer). When a full character enters the buffer, the start, stop, and parity bits are removed. Parity is checked, and if bad, the parity error flag in the status byte is set. Then the data transfers to the USART receive data buffer (second buffer), and the receive flag (RXRDY) is set. Then the USART requests an interrupt from the microprocessor. While the next character shifts in, the microprocessor has to read the first character. After reading the character, the microprocessor checks the USART status byte to verify the data. If the data is good, it is sent to the input queue in RAM. If the data is bad, the printer can either print the character as received or print the substitute (SUB) character (X or ς). The receiver error processing feature selects receiver error processing. If the microprocessor does not read the receive data buffer in time, the second character writes over the first one, and the first one is lost. Then, an overrun error is reported in the status byte.
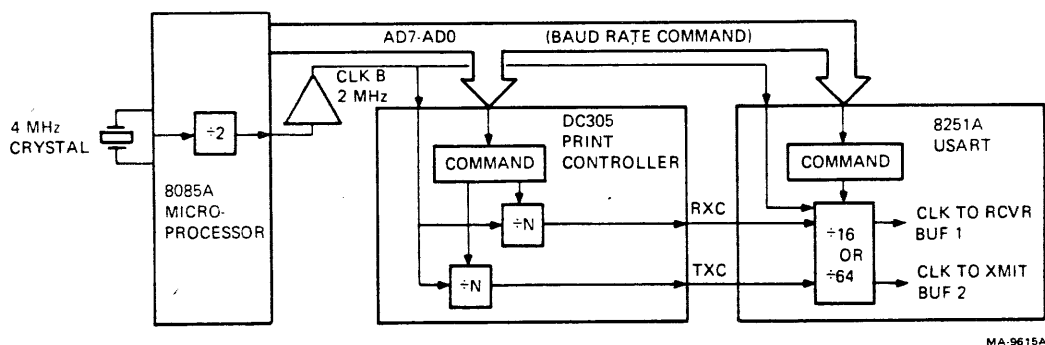
Figure 5-6   Creation of Baud Rate Clocks

5.5.3   Baud Rate Clocks

The printer can be set up or programmed for serial I/O communication at many different transmission rates. The transmission can range from 50 to 9600 baud (bits per second), including split baud rates. Figure 5-6 shows the hardware logic that creates the baud rate clocks. These clocks shift the serial data stream in or out of the USART.

The microprocessor and the D-type latch divide the 8 MHz crystal frequency by 4 and send a 2 MHz CLK B signal to the printer controller (DC305) and USART (8251A) chips. Both chips contain programmable frequency dividers to scale the CLK B input down to the correct baud rate clock. Based on the baud rate (selected with an escape sequence), the microprocessor sends command bytes to the printer controller and the USART. The command bytes specify the mathematical configuration (divisor value) of the frequency dividers. The printer controller has two dividers to allow different receive and transmit baud rates (split baud rates). These dividers send the intermediate transmit (TXC) and receive (RXC) clocks to the USART. Finally, the USART divides the intermediate clocks by 16 or 64 to create the baud rate clock for the transmit and receive buffers.

Table 5-3 shows the clock periods and serial bit rate for each baud rate available.

Table 5-3   USART Baud Rates and Clock Timing

| DC305 Output | | | | USART Serial I/O | |
| Baud Rate | | (USEC) | | Bit Rate | |
Tr.	Rec.	TXC	RXC	Transmit	Receive
50	50	312	312	20.0 ms	20.0 ms
75	75	208	208	13.3 ms	13.3 ms
110	110	142	142	9.1 ms	9.1 ms
134.5	134.5	116	116	7.4 ms	7.4 ms
150	150	104	104	6.67 ms	6.67 ms
200	200	312	312	5.0 ms	5.0 ms
300	300	208	208	3.3 ms	3.3 ms
600	600	104	104	1.67 ms	1.67 ms
1200	1200	13	13	883 USEC	883 USEC
1800	1800	8.7	8.7	556 USEC	556 USEC
2400	2400	6.5	6.5	417 USEC	417 USEC
4800	4800	3.3	3.3	208 USEC	208 USEC
7200	7200	8.7	8.7	139 USEC	139 USEC
9600	9600	6.5	6.5	104 USEC	104 USEC

Split Baud Rates

Tr.	Rec.				
75	600	208	26	13.3 ms	1.67 ms
75	1200	208	13	13.3 ms	883 USEC
150	600	104	26	6.67 ms	1.67 ms
150	1200	104	13	6.67 ms	883 USEC
300	2400	208	26	3.3 ms	417 USEC
300	4800	208	3.3	3.3 ms	208 USEC
600	2400	104	26	1.67 ms	417 USEC
600	4800	104	3.3	1.67 ms	208 USEC

Tr. = Transmit
Rec. = Receive

5.5.4   Interface Signals

The printer supports full-duplex communication. That is, it can send and receive data at the same time. The printer can also be controlled by a modem. With no modem control, data transmission and reception is always enabled while on-line. With modem control, the printer and the modem recognize the correct EIA signals before transmitting data.

The EIA communication interface complies with the EIA (RS232C) and CCITT (V.24) standards. The EIA connector (type DB-25) pins and signals are defined in Appendix B. The printer supports the following signals.

        Transmit data (TXD)
        Receive data (RXD)
        Request to send (RTS)
        Clear to send (CTS)
        Data set ready (DSR)
        Receive line signal detect (RLSD)
        Carrier detect (CD)
        Restraint (BUSY)
        Speed indicator (SPDI)
        Secondary request to send (SRTS)
        Speed select (SPDS)
        Data terminal ready (DTR)

Figure 5-7 shows how the printer recognizes and controls the interface signals. The TXD and RXD serial lines are discussed in Paragraph 5.5.2. All the modem control lines are controlled by the microprocessor, either directly or through the USART or I/O transmitter/receiver.

The microprocessor examines bit 7 in the USART status byte to determine the state of the DSR line and sets bit 5 in the USART control byte to assert the RTS line. The microprocessor also examines bit 0 of the internal I/O receiver to detect the state of the RLSD line and sets a bit 4 in the internal I/O transmitter to assert the DTR line. The CTS line is loaded into the I/O receiver (register), where the microprocessor examines it. As soon as DSR is present on the input line, the microprocessor activates the I/O transmitter, which raises the DSRL signal to the control panel and lights the DSR indicator on the control panel.
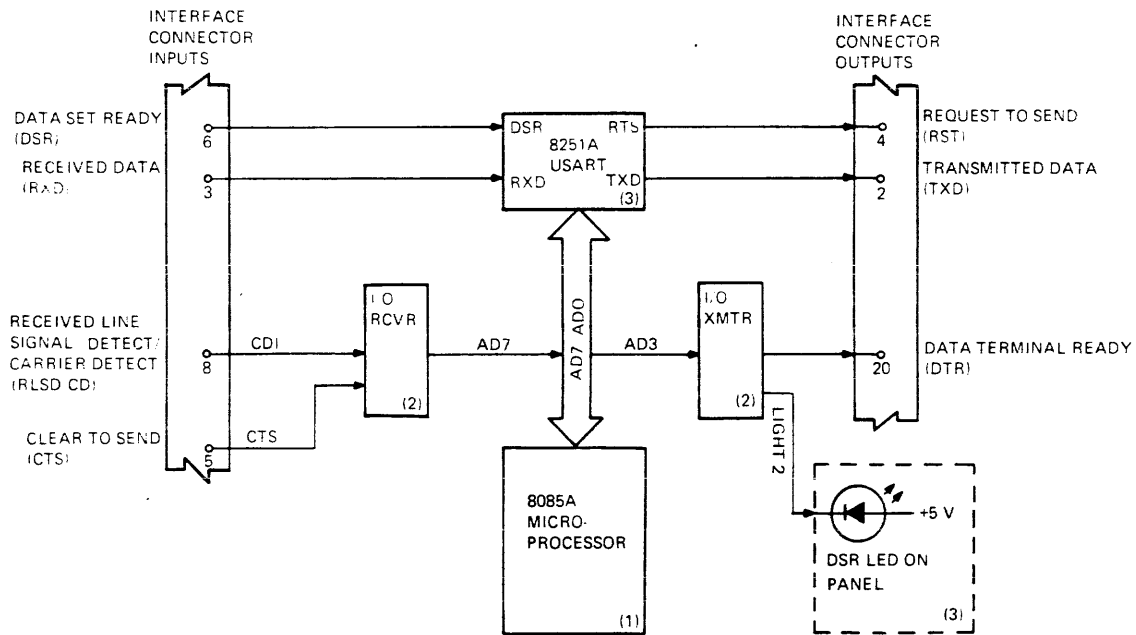
Figure 5-7   Interface Signal Recognition

5.5.5   Communication Modes

The LA210 controls data transmission and reception on its serial interface by using the modem control lines to generate the full-duplex protocol. Configuration switches let you set the printer for different modem and interface requirements.

NOTE
Refer to Figure 3-10 for the description of the communication switches.

5.5.5.1 Modes of Operation -- The printer operates in three basic modes: on-line, off-line, and self-test.

On-Line Mode -- The printer sends an XON signal when placed on-line (if transmit is enabled). If the appropriate modem signals are present, the printer transmits and receives data from the communication line and processes the received data.

Off-Line Mode -- In off-line mode, the printer stops processing data from the input buffer. The XOFF signal is not sent because the printer is off-line.

The printer goes off-line when you depress the On line/Off line switch or when a fault occurs.

5-17

Self-Test Mode -- When the printer is in self-test mode, all modem signals are unasserted, the input buffer clears, and the communication line is ignored. Characters normally sent to the communication line are looped back to the printer. To select this mode, press the Normal/Self Test switch on the control panel to the **Self Test** (down) position.

5.5.5.2 **Full Duplex Without EIA Controls** -- When the printer is on line, this mode asserts DTR and RTS, ignores modem signals to the printer, and enables receive and transmit. The break and speed/restraint functions described in Paragraphs 5.5.5.3 and 5.5.5.4 are operational, but the disconnect functions are nonoperational.

5.5.5.3 **Full Duplex With EIA Controls** -- This mode supports a full-modem interface. The following conditions are necessary to make a connection (Figure 5-7).

1. The printer asserts RTS and DTR, and then waits for DSR.

2. RLSD is asserted within 300 ms after DSR is asserted. Then, the printer enables transmit and receive.

This mode also provides automatic disconnect by using the DTR signal.

Full-Duplex Break -- The printer automatically generates a break when there is a fault condition, such as paper out. In full duplex, a break is a space asserted on the TXD line for 275 +/- 10 percent milliseconds if transmission is enabled. If transmission is disabled, the break waits until transmission is enabled or a disconnect is generated.

The host's response to the break signal varies among different host systems.

Full-Duplex Disconnect -- The printer turns DTR off for at least 0.2 seconds plus the DSR delay time, but not longer than 2 seconds. Any of the following conditions causes a full-duplex disconnect.

DSR disappears

RLSD stays unasserted for more than 2 seconds.

Receiver time out is wrong. (DSR is asserted, but then RLSD is not asserted within 20 seconds.)

Paper out switch is enabled and a paper out condition occurs.

Printer is switched to self-test mode.

End of transmission (EOT) control character received while coded disconnect is enabled.

5.5.6   Data Transfer Control Modes

The printer controls its data transfer operation through the speed control and restraint (BUSY) lines and the I/O buffer. The operator selects these functions with the configuration switches.

5.5.6.1 Restraint Mode -- In restraint mode, the printer controls the BUSY line to signal an approaching input buffer overflow. The function is like XON/XOFF. The BUSY signal represents the status of only the XON/XOFF state, not a receive-ready state. If BUSY is on, the host should temporarily suspend data transmission. If BUSY goes OFF, transmission can be resumed. To determine the receive-ready state of the printer, observe DTR and SRTS and set the printer in modem mode.

                              NOTE
            For some applications, the BUSY signal
            polarity can be inverted with jumper W5
            on the logic board (Table 5-4).

5.5.6.2 Speed Control Mode -- Speed control mode provides a control line to select and monitor the data transmission rate. If you select this mode with the configuration switch, the SDPI and SPDS lines exchange speed information between the printer and modem. In this mode, the host instructs the printer to operate at 1200 baud, regardless of the operator-selected rate, when SDPI is ON and at the operator-selected rate when SPDI is OFF.

If you select speed control mode and the receive rate is 1200 baud or greater, the printer asserts SPDS. Otherwise, SPDS is not asserted.

5.5.6.3 Modem/No Modem Mode -- You select this on-line mode through the configuration switches. This mode determines whether the printer responds to the modem input signals or ignores them.

When you select full duplex with no modem control, data transmission and reception are always enabled.

With no modem control, the printer communicates directly with a computer (null modem configurations) or with full-duplex modems that do not support DSR or RLSD.

Full duplex with modem control requires the printer and modem to recognize the correct EIA signals before transmitting data.

Modem control permits the printer to communicate through modems such as the AT&T 103, AT&T 212, Vadic 3400, or equivalent modems.

5.5.7   Input Buffer

The 2K input buffer allows the printer to receive characters faster than it prints them. All characters received, except nulls and deletes, are temporarily stored in the input buffer before further processing. The SUB character is substituted in the input buffer for any character received in error. If the input buffer overflows, a single SUB character is placed in the buffer and the bell sounds.

5.5.7.1 Input Buffer Control -- The input buffer can overflow if communication speed is greater than print speed or if the printer is out of paper or the cover is open. The printer prevents overflow by sending the host a pause/resume signal. This signal is the XON/XOFF or BUSY (restraint) signal. The BUSY signal is useful only for no modem, (hardwired) direct local interfaces. You can invert the BUSY signal polarity with the BUSY jumpers on the logic board.

The printer stores received characters (other than NUL and DEL), in the 2K input buffer. When the printer is ready, the characters are removed from the input buffer and printed. If the printer falls behind by more than 2K characters, the input buffer overflows. If an overflow occurs, the character is lost. A single SUB character is placed in the input buffer and the bell sounds.

There are three ways to avoid input buffer overflows.

1.   Use the XON/XOFF or BUSY signal to signal the data source to temporarily stop sending data. Using XON/XOFF or BUSY allows maximum throughput and eliminates fill character calculations and message size limits.

2.   Send data to the printer only as fast as it can be printed. When the printer is in draft mode, send data to be printed at a rate of 1800 baud or less. When the printer is in letter quality mode, send data at 300 baud or less. For short lines, multiple form feeds and transmissions faster than 1800 baud, use fill time characters to slow down the effective data transmission rate.

3. Limit the number of characters in the message to the input buffer size. If the buffer is empty, the printer can receive a message of 2K characters without a buffer overflow.

NOTE
In emulation mode, the LA210 gives you a choice of two input buffers -- a 2K buffer and a 0.13K buffer. If your application displays a timeout message, use the 0.13K buffer. Otherwise, use the 2K buffer to reduce the number of data requests from the printer to the host.

5.5.7.2 XON/XOFF and BUSY Signals -- XON/XOFF and BUSY (restraint) prevent input buffer overflows. When you select XON/XOFF and/or BUSY, the printer monitors the number of characters stored in the input buffer. The printer signals the computer to stop sending data by sending an XOFF control character or by turning on the BUSY signal. This happens under either of the following conditions.

The number of characters in the 2048 character input buffer exceeds 1024.

The printer transmits a second XOFF and then receives 60 characters.

The host resumes data transmission when the printer sends an XON control character or sets the BUSY signal to OFF. The printer does this under the following conditions.

The number of characters in the input buffer is less than 30. The printer is switched on-line (or powered up while on-line). Communication with the modem has just been established.

The XON/XOFF and BUSY signals are operator selectable features.

5.5.7.3 Fill Time Characters -- The printer can keep up with normal characters when receiving data in draft mode at 1800 baud or less and in letter quality mode at 300 baud or less. But for short lines and multiple form feeds the printer adds time fill characters to slow the overall transmission rate. They are stripped out of the data stream upon reception and do not enter the input buffer. They help the 2K input buffer to regulate data input.

5.5.8   Internal Data Manipulation

Figure 5-8 shows how the microprocessor manages I/O data. Data moved to or from the USART passes through one or both of two areas in RAM. These areas are called queues. There is an input queue and an output queue. Both queues are first-in/first-out (FIFO) buffers. The input queue can be up to 2048 characters long. The output queue is always 16 characters long.

Sources of data for the top of the input queue include the USART receiver and the bottom of the output queue. Sources of data for the top of the output queue are the areas in memory that hold answerback, printer ID, and font report.

During on-line operation, characters are taken off the bottom of the input queue and sent to the character processing routine (one of the microprograms run during monitor polling). Characters on the bottom of the output queue are sent to the USART transmit buffer. In off-line operation, characters on the bottom of the output queue are sent to the character processing routine.

The character processing routine determines character routing. This routine sends printable characters to the print line builder. The routine sends characters from the USART receiver to one of two areas. It sends escape control characters to the escape sequence parser and answerback characters to the answerback message handler. The builder, parser, or handler processes the character. Then the character either changes a parameter or is printed.

5.5.8.1 Nonvolatile Memory -- The nonvolatile RAM (NVM) stores the set-up parameters. The NVM can hold data for about 10 years. The nonvolatile memory is also considered an electrically alterable read only memory (EAROM). It retains the set-up parameters that would otherwise have to be re-entered at every power-up.

The NVM (ER1400) is a 1400-bit memory arranged as 100 14-bit words. Data and addresses enter and leave it in serial form through a single bidirectional line (BD7). Data is conditioned by a level converter before entering or leaving the NVM. Clock A0 shifts information in or out. The 8085A microprocessor decodes the bit stream by using three control lines (BA10, BA9, BA8) which specify the operation in progress. The 8085A microprocessor controls lines BA10 through BA8.
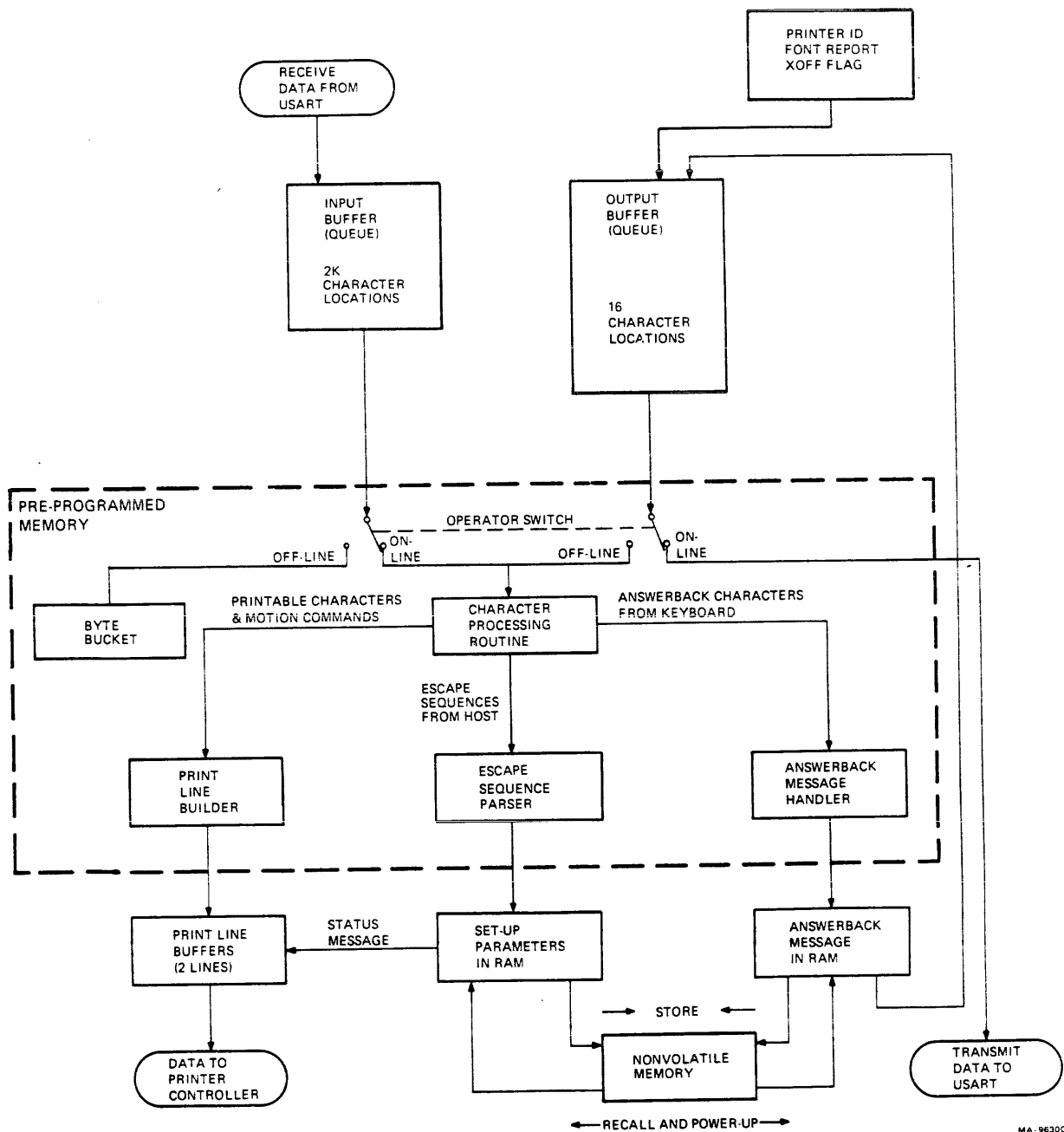
Figure 5-8   Internal Data Management

5.5.9 Communication Firmware

Figures 5-9 and 5-10 show the primary microprogramming tasks that run when a character is sent to or from the USART. Figure 5-9 shows the receive character processing routine. This routine runs when the USART raises the RXRDY line to the microprocessor and the microprocessor generates an RST6.5 interrupt. Figure 5-10 shows the transmit character processing routine. This routine runs when the microprocessor wants to send a character to the USART.
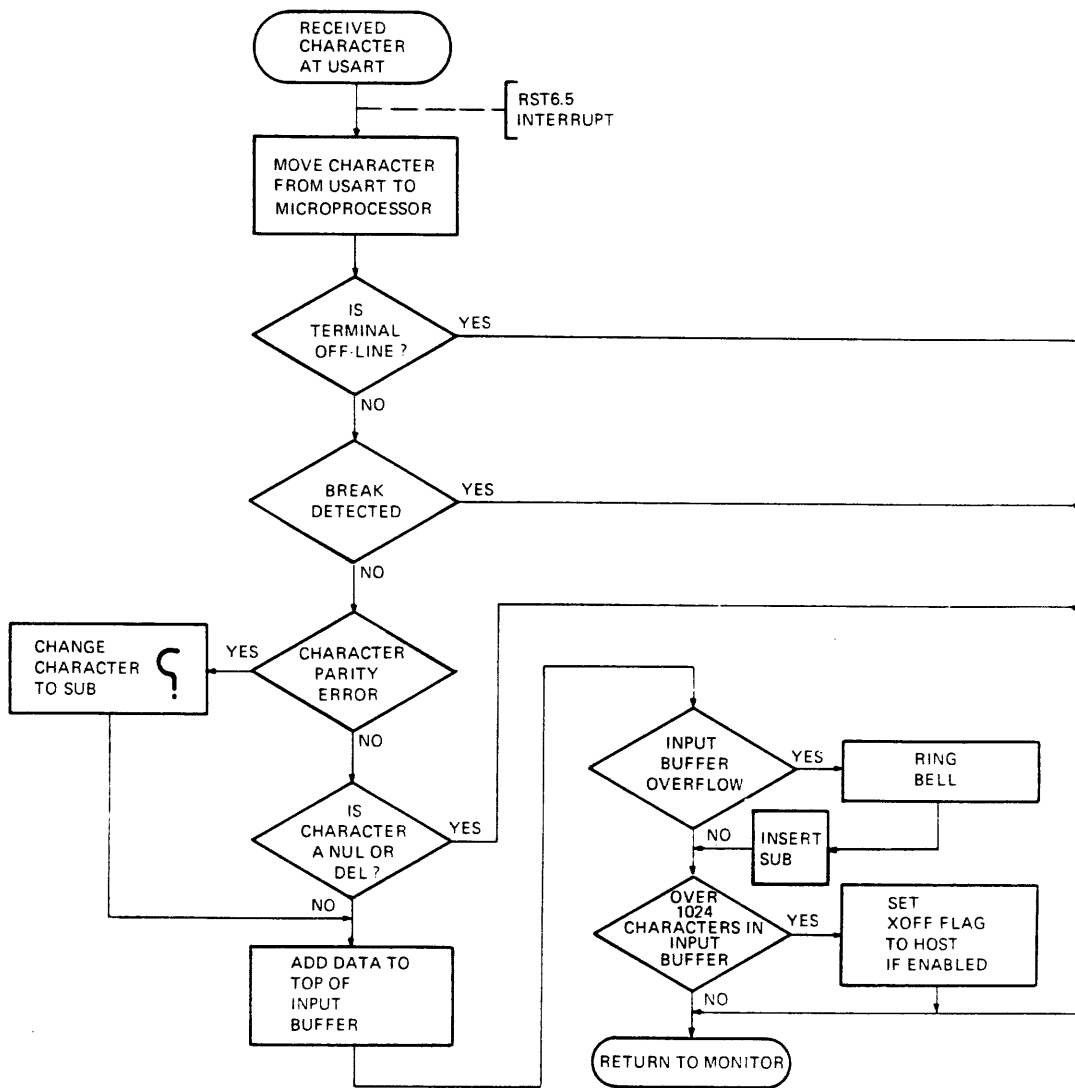
Figure 5-9   Receive Character Processing Routine
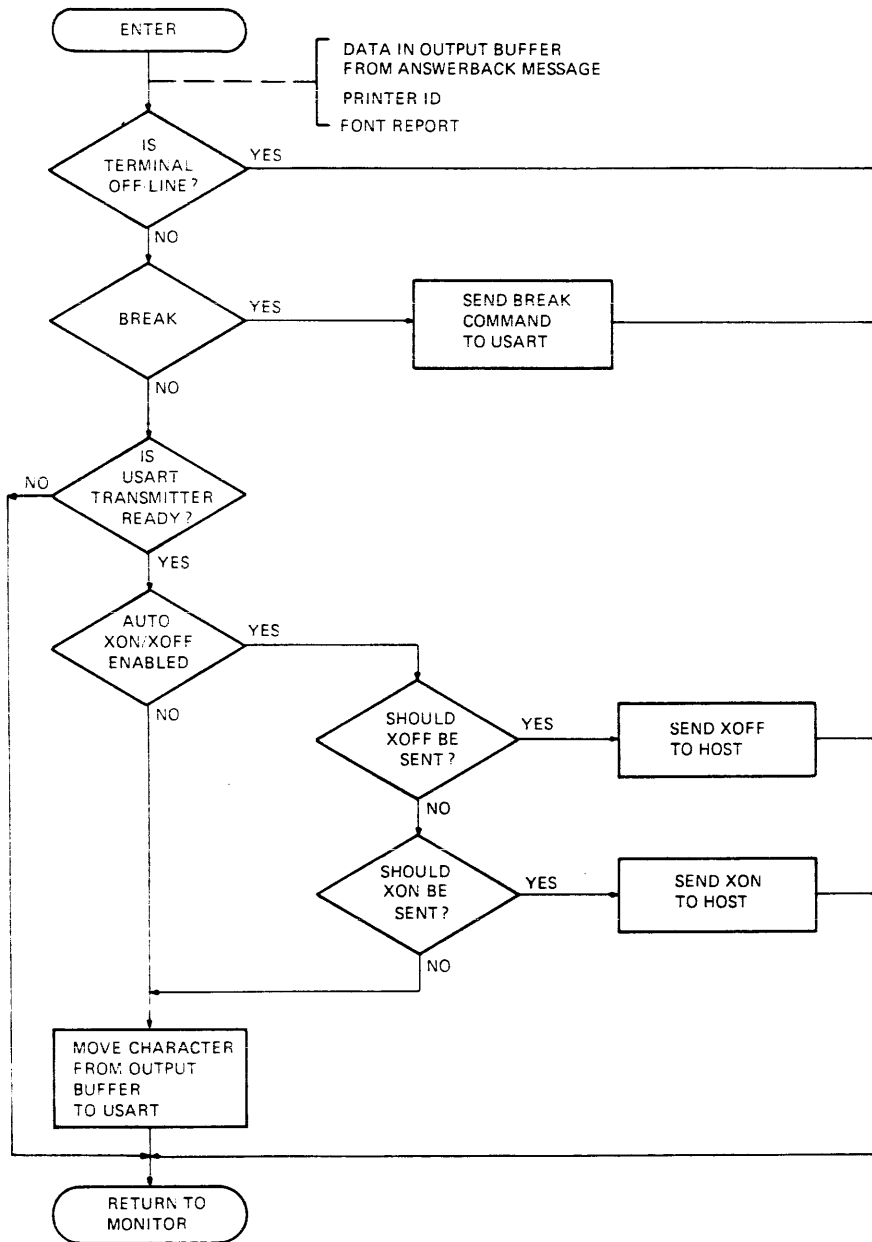
Figure 5-10   Transmit Character Processing Routine

5.5.10   EIA and Functional Jumpers

The printer's logic board has several jumpers for selecting operation and EIA circuit features (Figure 5-11). In standard board configuration, all jumpers are installed. You have to cut certain jumpers to disable some of the EIA communication circuits. You can remove some of the jumpers to change board configuration to meet European communication requirements. You can also remove the jumpers to provide some operator-selectable communication features.

Table 5-4 lists the EIA jumpers and other functional jumpers on the logic board. To change any of the jumper selectable features, remove the logic board (Paragraph 8.4).

MA-0186-84
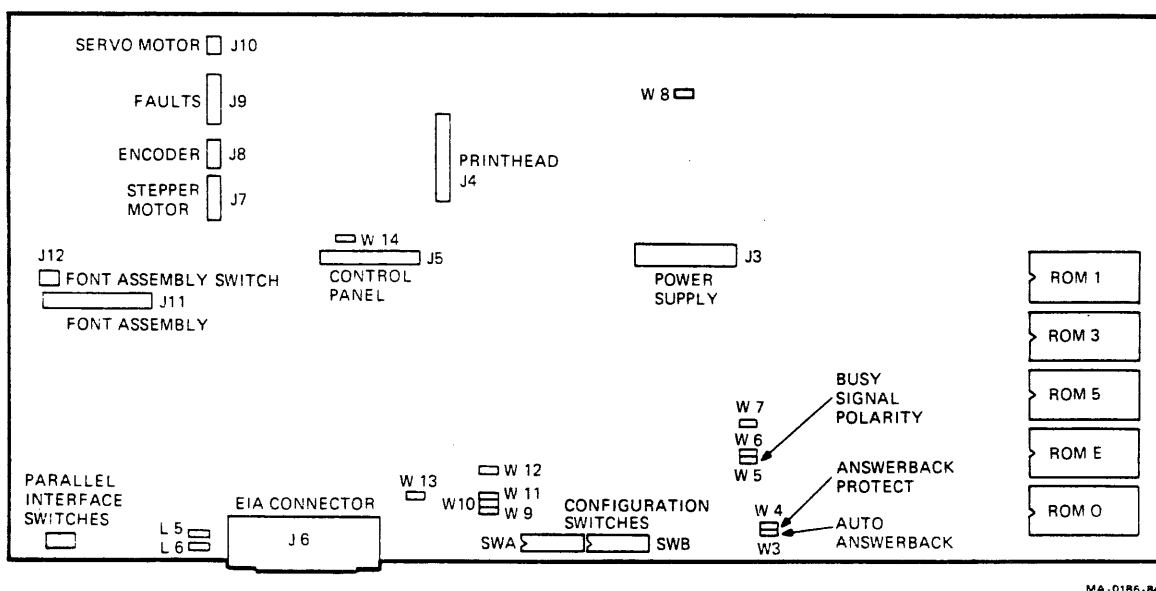
Figure 5-11   EIA and Functional Jumpers

Table 5-4   Jumper-Selectable Features.

Functional Jumpers	Functions
W1,W2	Not used
W3 -- Autoanswerback	
Installed	Disables auto answerback.
Removed	Enables auto answerback. (Answerback message is sent when communication link is established.)
W4 -- Answerback message protect	
Installed	Answerback message is unprotected. (Message can be erased or changed.)
Removed	Answerback message is protected. (Message cannot be erased or changed.)

EIA Jumpers	Function		
W5 -- BUSY signal polarity	Printer State	Busy Signal	
Installed (Standard)	Busy	On	(1)
	Ready	Off	(0)
Removed (Alternate)	Busy	Off	(0)
	Ready	On	(1)
W6, W7	Factory use		
W8 -- Protective ground			
Installed	Connects signal and protective ground for RS232 interface.		
Removed	Disconnects signal ground from protective ground for X21BIS interface.		
W9 -- Ring indicator	Not used		
W10 -- Speed indicator			
Installed	ON		
Removed	OFF		

Table 5-4   Jumper-Selectable Features (Cont)

Functional Jumpers	Functions
W12 -- Speed select	
Installed	ON
Removed	OFF
W13 -- Secondary request to send	
Installed	ON
Removed	OFF
W14	Reserved for future use

NOTE
ON means an EIA signal line is connected
to the EIA interface. OFF means an EIA
signal line is disconnected and the EIA
signal is not available on the EIA
interface.

5.6   PRINTING/PRINTHEAD POSITIONING PROCESS

This section describes how the printer processes data stored in
RAM buffers and forms printed characters. It also describes how
the printhead and carriage move to align the dots that make up
characters.

5.6.1   Overview

The LA210 is an impact printer that uses a 9-wire
solenoid-activated printhead. The printhead is driven horizontally
and bidirectionally, and prints characters within a 7(W) X 9(H)
(draft) or 33 X 18 (letter quality) dot matrix.

The printer can contain several DPSs (dot pattern sets) for
different fonts and character sets. You can select a DPS from
either the host computer or the printer. You usually select a DPS
in order to print in a different font.

In addition to defining fonts and character sets, the DPS defines the density, speed, and size of letter quality printing. A DPS always uses a 7(W) X 9(H) matrix for draft printing, and either 33 X 9 or 33 X 18 for letter quality printing. The matrix used for letter quality printing depends on the model of the DPS selected. The denser the matrix, the slower the print speed. DPSs are stored on the plug-in ROM chips or cartridges. The DPSs used with the LA210 Letterprinter are listed in Appendix C of this manual.

NOTE
For details about DPS operation see the Programmer Reference Manual. Paragraph 6.2 in this manual describes font ROMs on plug-in chips and cartridges.

In draft mode, the maximum print speed is 240 characters per second. In letter quality mode within a 33 X 18 matrix, the maximum printing speed is 40 characters per second.

NOTE
To select letter quality mode, use an appropriate plug-in ROM (see Appendix C).

The throughput for different combinations of horizontal pitch and line length, while printing in the standard letter quality mode within a 33 X 18 matrix, is as follows.

Pitch	Characters per Line		
	132	60	10
10	30 char/s	28 char/s	17 char/s
12	34 char/s	31 char/s	21 char/s

The maximum traversal rate while printing in graphic mode is 7 inches per second.

Regardless of printing mode or characters printed per second, no more than 2400 dots per second can be printed.

5.6.2   Printing Format

Each DPS has a standard spacing, usually 10 or 12 characters per inch. In letter quality mode you can print characters at the standard pitch and double the width of the standard pitch (5 and 10 or 6 and 12 characters per inch). In draft mode, you can print a DPS at all available pitches, regardless of the selected font. In letter quality printing, you can select only the pitch available on the installed font. The pitch is controlled by escape sequences. Table 5-5 shows the pitch parameters for draft and letter quality mode.

Table 5-5   Pitch Parameters

Draft Quality 10- or 12-Pitch DPS			Letter Quality 10-Pitch DPS		12-Pitch DPS	
Char. per Inch	Char. per Line		Char. per Inch	Char. per Line	Char. per Inch	Char. per Line
10	132		10	132	12	158
12	158		10	132	12	158
13.2	168		10	132	12	158
16.5	217		10	132	12	158
5	66		5	66	6	79
6	79		5	66	6	79
6.6	84		5	66	6	79
8.25	108		5	66	6	79

The printhead matrix provides three levels of printing quality and character resolution: draft quality, letter quality, and optional correspondence quality.

The dot resolution for the three printing modes is as follows.

Letter quality, high resolution	330 dots per inch horizontal 144 dots per inch vertical
Correspondence quality, medium resolution	330 dots per inch horizontal 72 dots per inch vertical
Draft quality, low resolution	70 dots per inch horizontal (10 pitch) 72 dots per inch vertical
Graphic printing	72 to 330 dots per inch horizontal 72 dots per inch vertical

5.6.2.1 Draft Quality (Low Density) -- Draft quality characters print on a 7 X 9 dot matrix to define 70 to 85 percent of the character cell (a character cell is 1/10 inch for a 10-pitch character). In draft mode, horizontally adjacent dots cannot be printed. In pitches 10, 12, 13.2, and 16.5, the matrix is 7 X 9 and the distance between dots varies to produce the needed character width. Pitches 5, 6, 6.6, and 8.25 expand the 7 X 9 matrix to 8 X 9, with 50 percent less horizontal resolution than single width pitches that can print adjacent dots.

5.6.2.2 Letter Quality (High Density) -- The 10-pitch letter quality characters print on a 33 X 18 matrix without printing horizontally adjacent dots. The 33-dot width defines the entire 1/10 inch of the character cell, including the space between characters. This wide matrix lets you print horizontal adjacent dots (for solid lines). In a 12-pitch character, the dots remain the same distance apart. But there are only 28 dots in the horizontal direction (28 X 18).

5.6.2.3 Optional Correspondence Quality (Medium Density) -- This mode is almost the same as letter quality, high density mode. The horizontal matrix is the same. You can print solid, horizontal lines. The only difference is that the vertical matrix is 9, not 18.

5.6.2.4 Graphic Printing -- The printer prints text characters as they are received. But in graphic printing, each character received equals a specific set of dots to be printed. Columns of dots are collected and printed in groups of 30. A group of columns is printed when 30 columns of dots accumulate in the buffer, or when an exit graphic mode command is received. Because any dot pattern may be specified, and because there is no space between characters in graphic mode, you can get high dot density in every address position. Because most graphic printing is contiguous, it is much slower than in text mode.

5.6.3   DC305 Control Functions

The DC305 printer controller chip controls printhead positioning and printing. The printer uses the DC305 for special functions that the microprocessor cannot perform. The DC305 performs the following functions.

        Printhead servo motor control
        Printhead position tracking
        Printhead solenoid control

Figure 5-12 shows a functional diagram of the printhead positioning process. The microprocessor/control logic sends commands to the DC305 to print from one character to a whole line of characters (up to 217 characters per line). These commands include a start print command which initializes printhead positioning, and a servo motor speed and direction command. Servo speed depends on the horizontal character pitch and the density selected. Figure 5-13 shows the flow of the print character logic routine.
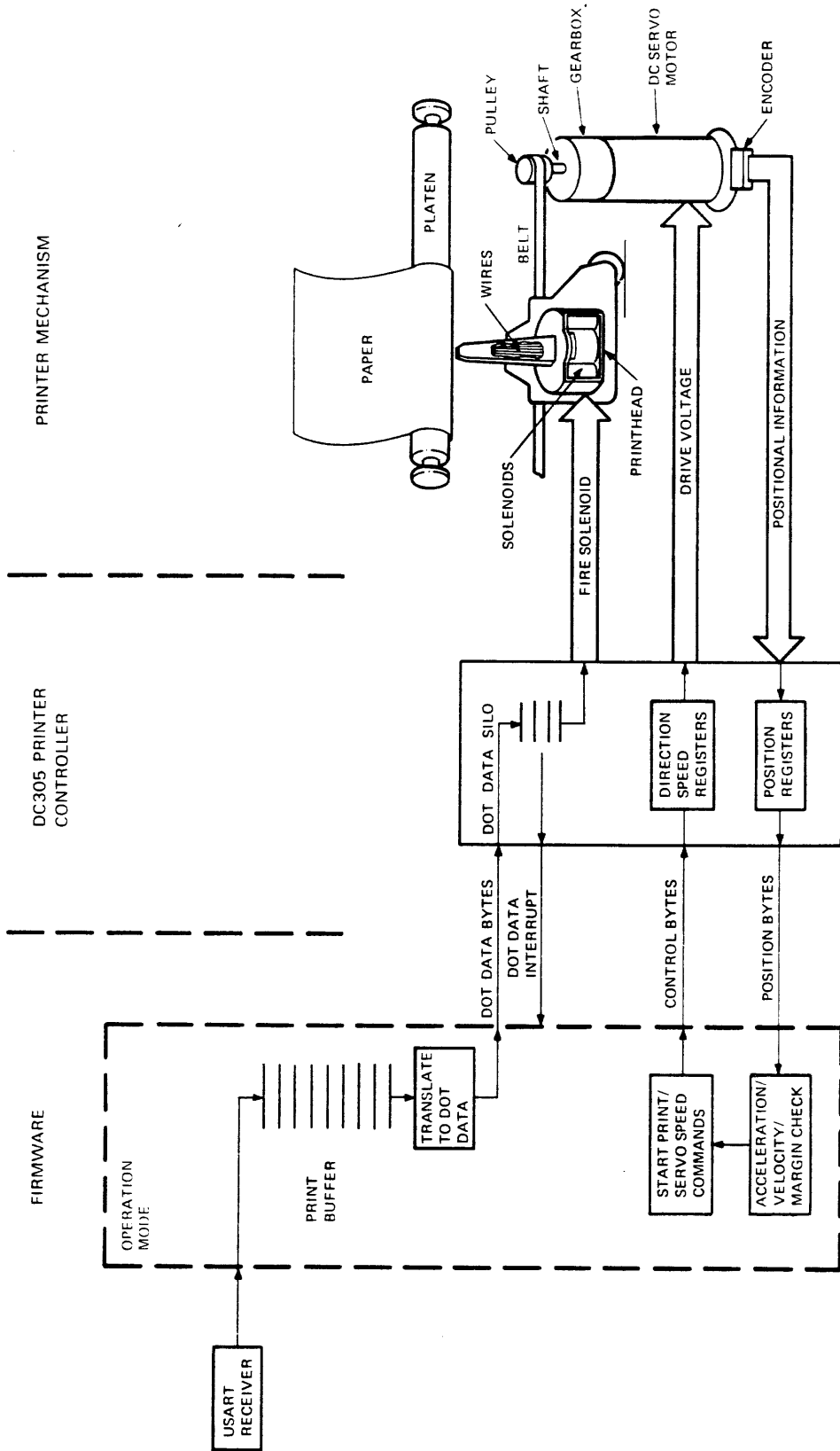
Figure 5-12 Printing/Head Positioning Process
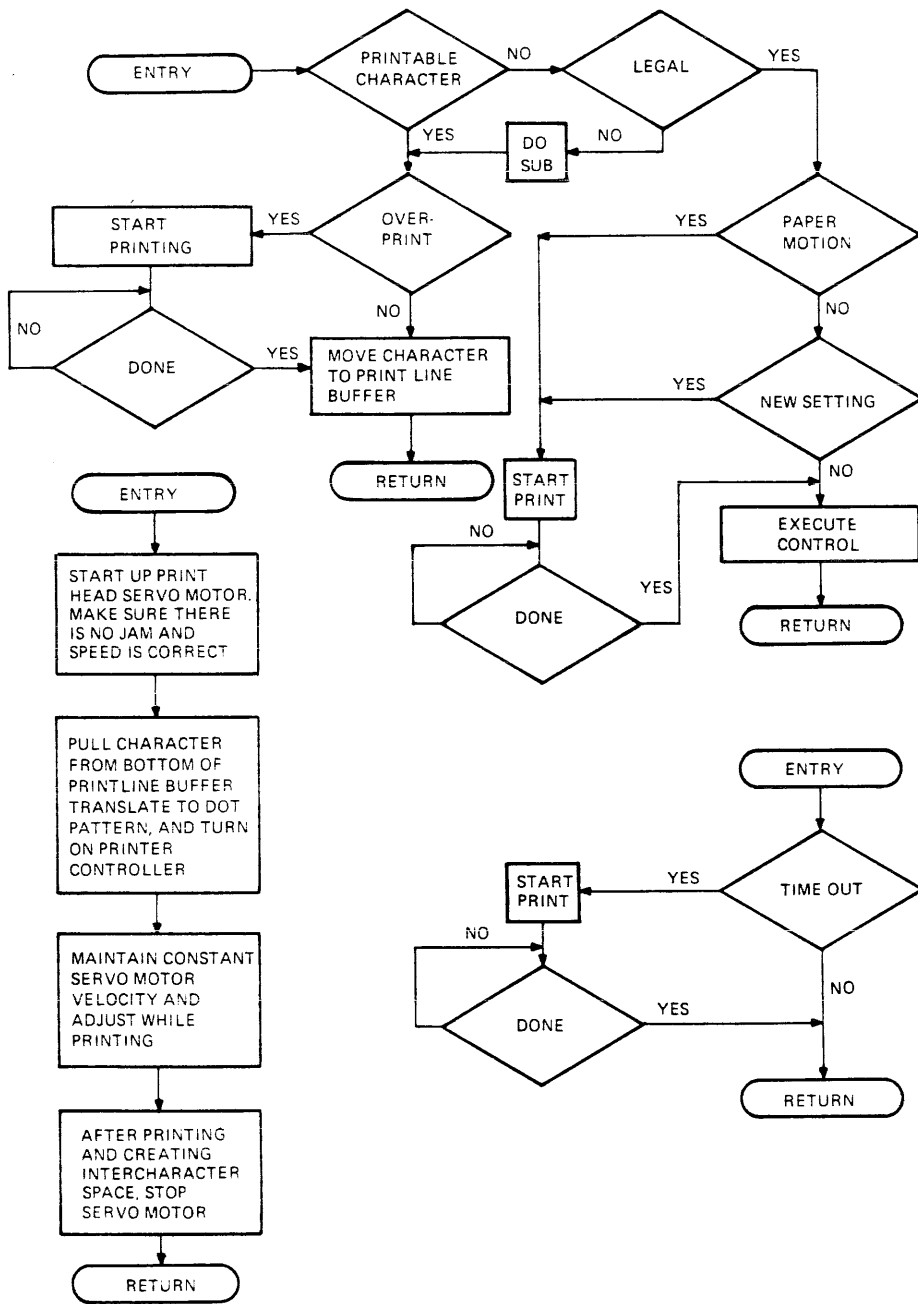
Figure 5-13   Print Character Routine

A position encoder mounted at the back of the servo motor connects directly to the motor shaft. The encoder sends a pulse train to the DC305. Then the DC305 uses a register to monitor the current head position anywhere across the carriage assembly. The microprocessor queries this position register regularly to determine printhead acceleration, velocity, and position relative to the selected left and right margins.

During printhead acceleration, the DC305 requests the first bits of character information required for printing. The ASCII representation of the character from RAM must be translated into a series of vertical dots. The microprocessor translates this data and sends groups of dot data bytes to the DC305 on request. Each dot data byte is an encoded pattern of dot bits. The DC305 uses these bits to fire specific head solenoids to create the desired characters on paper. In graphic mode, a different type of translation is performed. Each graphic character the host sends is processed and printed as a single vertical pattern of dots.

When the printhead is in the correct position, the DC305 fires the solenoids simultaneously for the first vertical dot column. After firing two dot columns, the DC305 shifts more dot data to output. At the same time, the DC305 sends a hardware interrupt to the microprocessor which requests more dot data bytes. This process continues until the characters are completely printed. Then the microprocessor signals the printhead servo motor to slow down and stop.

5.6.4   Servo/Head Positioning

The servo/head positioning logic and microcode accelerates the printhead (up to 25 inches per second), maintains printhead velocity during impact, and decelerates the printhead when printing is complete. For nonprinting motion (spaces, returns, line feeds), the printhead speed is maintained at 45 inches per second. Figure 5-14 shows the logic for this process.

The microprocessor sends speed and direction commands to the DC305 printer controller chip. The speed command specifies the direction of head movement and the carriage servo motor's speed. The binary value of the speed command is based on how far the printhead is from where it should be. The microprocessor adjusts the speed command as the printhead moves closer to the start print location. The printhead reaches the start print location at a speed that lets it start printing immediately.

The DC305 uses two pulse streams to control carriage speed. These are the output signals PLUS and MINUS. PLUS and MINUS are ANDed with EN PLUS and EN MINUS from the microprocessor/control logic to produce PULSE PLUS and PULSE MINUS.
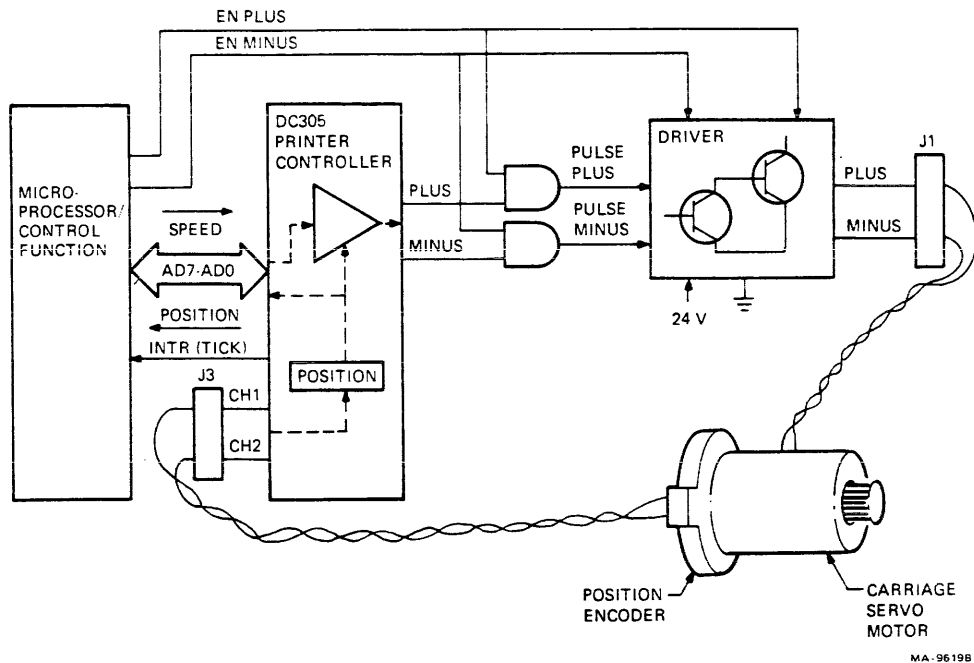
Figure 5-14   Servo/Head Positioning Logic

PULSE PLUS and PULSE MINUS are input to the servo driver network where they are conditioned and current-amplified. Both pulse streams are duty cycled to produce the correct output power to the servo motor. The output must be proportional to the binary value of the speed command.

The position of the printhead is measured by an incremental, 2-channel encoder mounted on the back of the servo motor. Channel 1 (CH1) and channel 2 (CH2) both have a square wave output. The output of one channel leads the output of the other channel by 90 degrees. Therefore, their binary states change in quadrature (00, 01, 11, 10, 00) as the carriage moves. The CH1 and CH2 position signals enter the DC305 where they accumulate in a position register. The microprocessor reads this register every tick interrupt (in 2.5 ms intervals). If necessary, the microprocessor corrects the printhead's speed and position over the carriage.

5.6.5 Character Printing

Figure 5-15 shows the logic for impact printing. When there is at least one character to print, the microprocessor/control logic clears the first-in/first-out dot buffers (dot FIFOs) in the DC305. Then the microprocessor/control logic loads the dot FIFOs with the first four columns of character or graphic dot data. The dot FIFOs are used to buffer and transmit character or graphic dot patterns from the microprocessor to the printhead solenoid drivers.

When the carriage speed and position are correct for printing, the microprocessor enables printing and the dot interrupt by sending commands to the DC305. Printhead motion signals from the carriage position encoder combine with horizontal pitch set-up data to trigger a countdown timer. The timer turns on selected head drivers, then turns them off at the end of the count. The dot FIFOs advance the next column of dot data to the solenoid driver inputs.

When there is room for more than two dot columns of data in the FIFOs, the DC305 sends a dot data interrupt (RST5) to the microprocessor, asking that it load more dot data. When there is no more dot data to be printed, the microprocessor disables the dot interrupt, and sends a print stop command to the DC305.

When the DC305 turns on a head driver, the driver output (PLUS signal) goes low for the corresponding solenoid of the SOL1 through SOL9 set. This energizes the head solenoid through the appropriate line and drives the assigned head wire out of the head to impact the ribbon and paper.
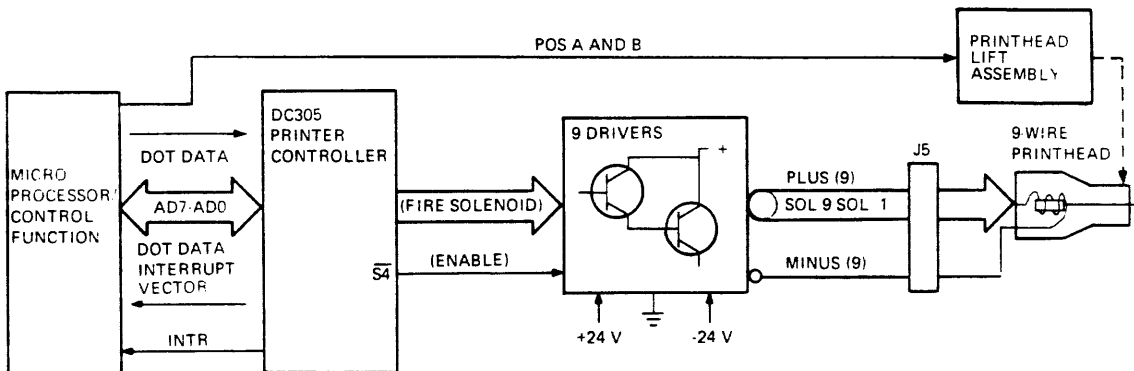
Figure 5-15   Printing Logic

5.6.6   Printhead Lift Function

Printhead lift is used in high density, letter quality printing when the character matrix is 33 X 18 dots. For this kind of printing, the printhead makes two passes along each line.

When letter quality printing is requested, the microprocessor commands the first pass of the printhead from left to right in the upper (normal) printing position (shift out) (Figure 5-15). The printhead position is controlled by a head lift magnet that connects to the printhead assembly (Figure 5-16). The POS A signal keeps the magnet and the linkage in the upper printing position. After the first pass, the carriage returns to the beginning of the line. The microprocessor sends the POS B SHIFT IN signal to energize the head lift magnet. The magnet is energized for approximately 200 milliseconds and is pulled into the SHIFT IN position. In the shift in position, the actuator (linkage) is on the lower part of the magnet. This pulls the printhead down by one half of one dot size. Then the printhead makes the second left-to-right pass along the line, to complete the characters. At the end of the line, POS B changes back to POS A and the head raises to normal position. Figure 5-17 shows some samples of head lift operation.

5.6.7   Microcode

Figure 5-13 shows a simplified flow of the internal microcode that controls printing and carriage motion.

MA 0586 83
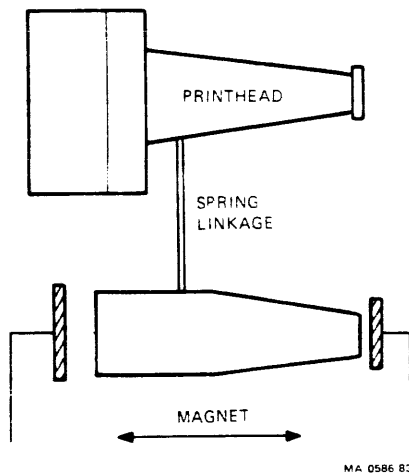
Figure 5-16   Simplified Headlift Functional Diagram

MA-0111-84A
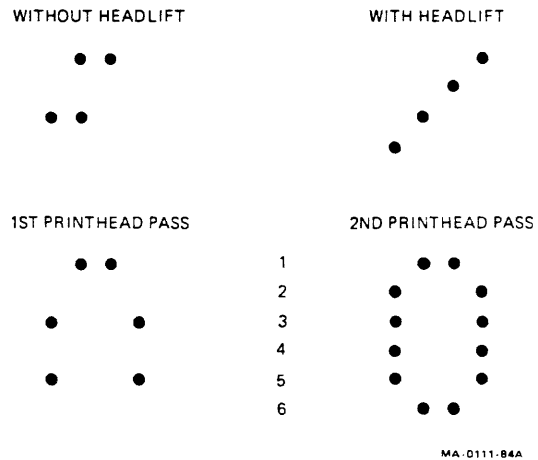
Figure 5-17   Headlift Operation Samples

5-37

5.6.8   Print Process Routines in IBM/Epson Emulation Mode

This section describes the print process routines used in emulation mode.

The printer uses an intermediate buffer to process characters and character attributes. For each character printed, the absolute position counter increments by the width of the character based on the pitch. The intermediate buffer translation occurs when the printer receives a line terminator. The printer creates a new print segment each time the pitch or resolution changes.

5.6.8.1 Line Printing -- To process the emulation attributes, the printer makes two printing passes on lines where the attributes are used. Processing for each attribute is as follows.

Double Height -- Performed by printing six dots in each of two passes with a partial line feed after the first pass.

High Resolution -- Requires two passes with a head shift after the first pass.

Superscript -- Requires two passes separated by a head shift.

The following tables show which dot lines are assigned to printwires for superscript. If no printwire is specified for a dot line, then the dot line is ignored in the printing pass.

First Pass

Dot Line	Printwire
1	1
2	--
3	4
4	--
5	--
6	--
7	--
8	--
9	5

Before the second pass, the headlift mechanism shifts the printhead down by one half of one dot.

Second Pass

Dot Line	Printwire
1	--
2	1
3	--
4	2
5	--
6	3
7	--
8	4
9	--

Figure 5-18 shows the algorithm for superscript implementation.

NOTE
An underlined superscript looks like a
dot line 9 underline.
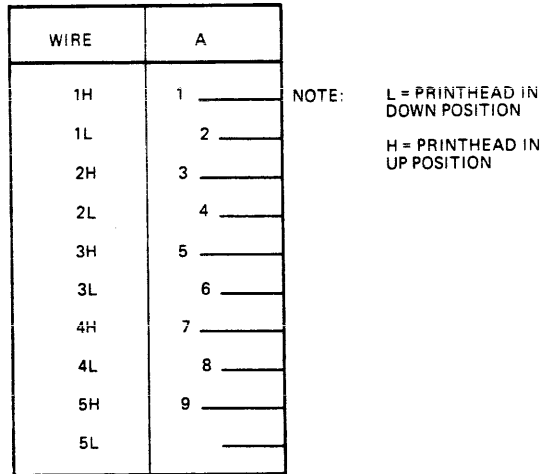
MA-0019-85

Figure 5-18   Superscript Algorithm
                Implementation

Subscript -- Requires two passes separated by a head shift. The
following tables show which dot lines are assigned to printwires.
If no printwire is specified for a dot line, the dot line is
ignored in the printing pass.

First Pass

Dot Line	Printwire
1	--
2	5
3	--
4	6
5	--
6	7
7	--
8	8
9	--

Before the second pass, the headlift mechanism shifts the
printhead down by one half of one dot.

Second Pass

Dot Line	Printwire
1	4
2	--
3	5
4	--
5	6
6	--
7	7
8	--
9	8

Figure 5-19 shows the algorithm for subscript implementation.

WIRE	B	
4L	1	
5H	2	
5L	3	
6H	4	
6L	5	
7H	6	
7L	7	
8H	8	
8L	9	

NOTE: H = PRINTHEAD
IN UP POSITION

L = PRINTHEAD
IN DOWN POSITION
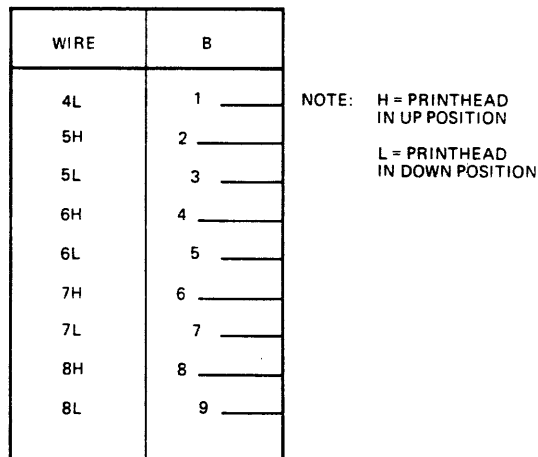
MA-0018-85

Figure 5-19   Subscript Algorithm
Implementation

Double Height With High Resolution -- Requires four passes. Six dots are printed in each pass.

Subscript or Superscript with High Resolution -- Translates to high resolution. Requires two printing passes with a head shift after the first pass.

Double-Height Subscript or Superscript -- Requires two passes. The print shrinks at the top half of the double-height character, and drops the bottom half.

Bolding -- Requires two passes. Second pass overprints dots printed on first pass.

5.6.8.2   Form Handling and Line Feed Routines in IBM/Epson Emulation Mode -- The 1/48 inch stepping motion together with the 1/144 inch head lift motion approximates the positioning requirements for emulation mode. In text mode, head lifts are used for high resolution, superscript, and subscript characters. In graphic mode, head lifts are used to approximate the requirements of 1/216 inch and 1/72 inch print motion commands. The bottom margin is expressed in 1/216 inch units. Vertical position counters keep track of the position within 1/216 inch.

There is no line resynchronization after a vertical pitch change.

When printing double-height characters, the printer moves the paper up slightly. The printer accounts for this motion before executing the next line feed. If the line spacing is smaller than the partial motion necessary to print the two halves of a double-height character, the next line feed is ignored.

5.7   PAPER ADVANCING

Paper is advanced by the paper feed subsystem, which has the following parts.

        Stepper motor
        Paper drive cluster gear
        Platen assembly
        Friction assembly
        Associated circuitry on the logic board
        Tractor assembly

Figure 5-20 shows the paper feed subsystem. When the microprocessor/control logic identifies a line feed character in the print buffer, it sends 3 control bytes to the DC305 printer controller chip. One of these control bytes sets up a real-time clock in the DC305. A line feed motor control byte issues a 2-bit state field to the motor drivers. This state field controls the polarity of the voltage to each of the line feed stepper motor windings. A third control byte issues a bit that controls the amplitude of the current in the stepper motor windings. A higher current is used to run the motor than to hold a steady position.
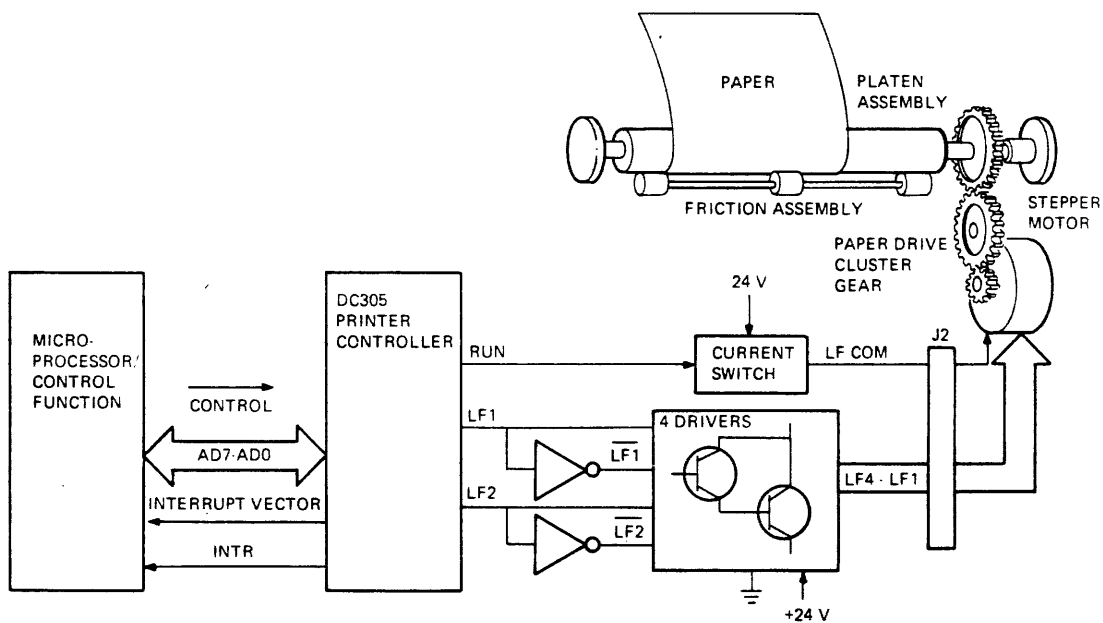
Figure 5-20   Paper Feed Subsystem Logic

The state field directly affects the DC305 motor control output lines LF1 and LF2. These lines and their complements are input to the line feed motor driver to form a 4-phase control field. The motor control outputs operate in the following sequence of states to control paper movement.

	Upward Paper Motion		Downward Paper Motion	
Paper Step	LF1	LF2	LF1	LF2
1	0	0	0	0
2	0	1	1	0
3	1	1	1	1
4	1	0	0	1
5	0	0	0	0

The four driver outputs, LF1 through LF4, connect to the stepper motor through jack J2. At any given time, two outputs are driving current through two stepper motor windings. The sequence in which the windings are energized determines which way the motor turns. The motor windings connect at a common point (LF COM) and return through the current switch. When the DC305 asserts the RUN signal, the current switch changes from the holding current mode to the higher, running current mode.

As the stepper motor advances through a paper step, the real-time clock (initialized at the beginning of the command) times out and causes an interrupt. The microprocessor recognizes the interrupt, reinitializes the clock, and sends the next state control command to the DC305, if needed. This enables a different combination of motor windings. The sequence of interrupts and state change commands continues until the line feed motor has advanced the other components of the paper feed subsystem to the correct point.

The paper drive cluster gear transfers the rotary motion of the stepper motor armature to the platen assembly. The platen turns, and the pressure caused by the friction assembly lets the platen move the paper. If the tractor assembly is installed, the friction assembly is disabled because the tractor pins pull the paper across the platen. Tractors permit flat surface feeding, which eliminates slippage in multipart forms. With tractors, most paper motion is upward only, because tractors cannot push the paper far back across the platen and down. But for printing subscript and superscript characters, the tractors pull the paper 1/12 inch in reverse.

5.8   FONT ASSEMBLY

The font assembly accesses the logic board through a cable bus buffer (81LS97).

When the ROM cartridge is inserted in a slot, the microswitch trips to the ON position and sends the CART SW FALSE signal to the 8085A microprocessor. When the cartridge is fully plugged into the slot, the microswitch returns to OFF position and sends the CART SW ON signal to the microprocessor. This signal evokes the internal microprocessor interrupt that suspends all printing operations until the cartridge status and font ROMs are verified. Through the microprocessor bus, the microprocessor sends the CART EN signal to the ROM cartridge. Then the microprocessor polls all font ROMs and uses their checksum to verify the presence of any ROM.* Then the microprocessor can send a read command to the ROM cartridge. It sends the read command upon receiving either an escape sequence from the host or when you depress a font select switch.

During power-up, font indicator 1 on the control panel turns off while all the other indicators turn on. This indicates the default condition when DPS selection is made via computer select sequence. During automatic operation, the indicator that is off shows which DPS was selected from the host.

---

* If the font cartridge is removed from the slot, the microprocessor cannot verify the presence of the ROM and reacts accordingly.

You can select the DPS manually (with or without the ROM cartridges installed) with the DPS select switch. Each time you press the switch, the counter in the microprocessor increments from 0 (computer select status) by 1 to a maximum of 5. The microprocessor polls the available ROMs and selects one corresponding to the contents of the counter.

The first time you press the switch, DPS 1 is forced, overriding the previous selection. All characters print in the first DPS only. Indicator 1 is on and all others are off. Each time you press the switch, the lit indicator goes off, the next DPS is forced, and the corresponding indicator turns on. This sequence continues until you select the fifth DPS. The sixth time you depress the switch, the font counter overflows. Then the count returns to 0 and the stand-by host selection is forced. All the indicators light, except for the host-selected DPS indicator. The printer returns to the computer select condition and prints characters in this DPS.

5.9 POWER SUPPLY AND DISTRIBUTION

The printer uses the H7844 power supply. The H7844 provides additional input filtering to satisfy FCC Class B requirements. The power supply is a completely self-contained module. It is in the rear of the printer enclosure.

5.9.1 Power Distribution

Power is distributed through the printer as shown in Figure 5-21. Line voltage (115/230 Vac) enters the supply through a detachable power cord. The supply transforms line voltage into five direct current voltages: +5, +12, -12, +24, and -24 Vdc. The dc power exits the supply at connector J2, is conducted across an 8-wire cable, and enters the control/logic board through the power connector.

The control/logic board uses the +5 Vdc supply for general logic voltage, the +/-12 Vdc supplies for communication line conditioning, and the +/-24 Vdc supplies for the printhead/servo motor and stepper motor driver circuits.
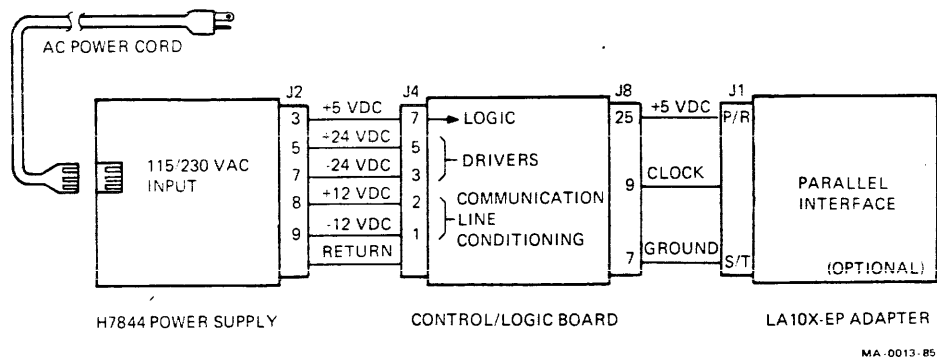
Figure 5-21   Power Distribution

5.9.2   H7844 Power Supply

This section lists the specifications for the H7844 power supply and describes its functions.

5.9.2.1 Specifications -- The H7844 is a pulse-width modulated, flyback, switch-mode power supply. The following list shows the I/O specifications for the H7844.

Input
90 to 128 Vac, 47 to 63 Hz @ 1.3 A
180 to 245 Vac, 47 to 63 Hz @ 0.7 A
154 W maximum

Output
+5.1 Vdc, +/-5% @ 3.0 A maximum
+12 Vdc, +/-5% @ 0.2 A maximum
-12 Vdc, +/-5% @ 0.2 A maximum
+24 Vdc, +/-10% @ 2.2 A maximum
-24 Vdc, +/-10% @ 1.0 A maximum

Voltage and current can be in any combination that equals 96.6 W. All outputs are overcurrent protected; +5 V is overvoltage protected at +5.4 Vdc.
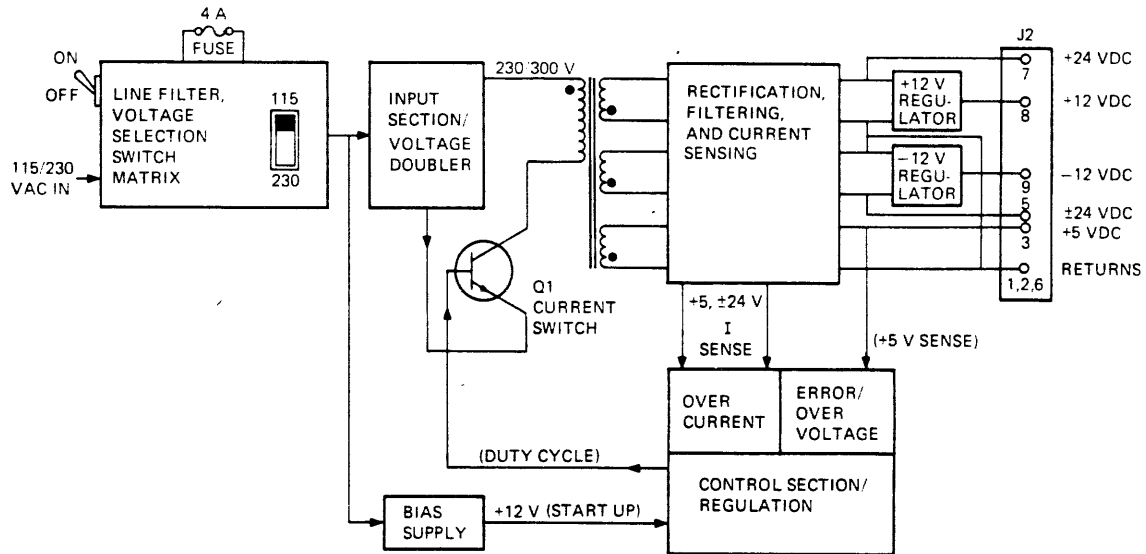
MA-9631A

Figure 5-22   Power Supply Functional Block Diagram

5.9.2.2 Functional Description -- Figure 5-22 is a functional block diagram of the H7844 power supply. AC line voltage entering the supply is filtered, fused, and passes through a voltage selection switch matrix. AC voltage from the matrix goes to a low current bias supply that provides a +12 startup voltage to the control circuitry. This bias voltage is provided so that, at power-up, the supply's switching elements start up in a predictable way.

AC voltage from the matrix also goes to the input section where it is rectified. When operating from a 230 Vac source, rectification is accomplished through a full-wave bridge and input to the transformer (T3) primary winding. If the source voltage is 115 Vac, it is rectified through a voltage doubler network and approximately 300 Vdc is input to the primary.

The control section starts up by producing a chopped waveform to the base of the switch transistor (Q1). The switch transistor turns on, causing current to conduct through the transformer primary. When the control section turns the switch transistor off, the stored energy in the transformer primary is transferred to the three secondaries. This constitutes the flyback action, making the effective energy profile in the transformer a leading-ramp sawtooth.

Secondary voltages are rectified and filtered to produce the +5, +24, and -24 V outputs. The +12 V regulated output is developed from the +24 V supply through a 3-terminal linear regulator. Similarly, the -12 V regulated output is developed from the -24 V supply through a 3-terminal linear regulator.

Resistors in the +5 and +/-24 V supplies develop current sense signals that provide part of the feedback input to the control section. The other part of the feedback is formed by +5 V sense. Together, the two feedback elements cause the control section to act as a regulator, varying the chopping frequency and duty cycling to the current switch. The duty cycle of the 34 kHz chopping frequency is changed as a function of the voltage sense feedback. The frequency is halved (17 kHz) when overcurrent is sensed.

The +/-24 V supplies do not have regulators, nor do their outputs return to the control section to form part of the feedback network. Instead, they are cross-regulated from the +5 V supply.
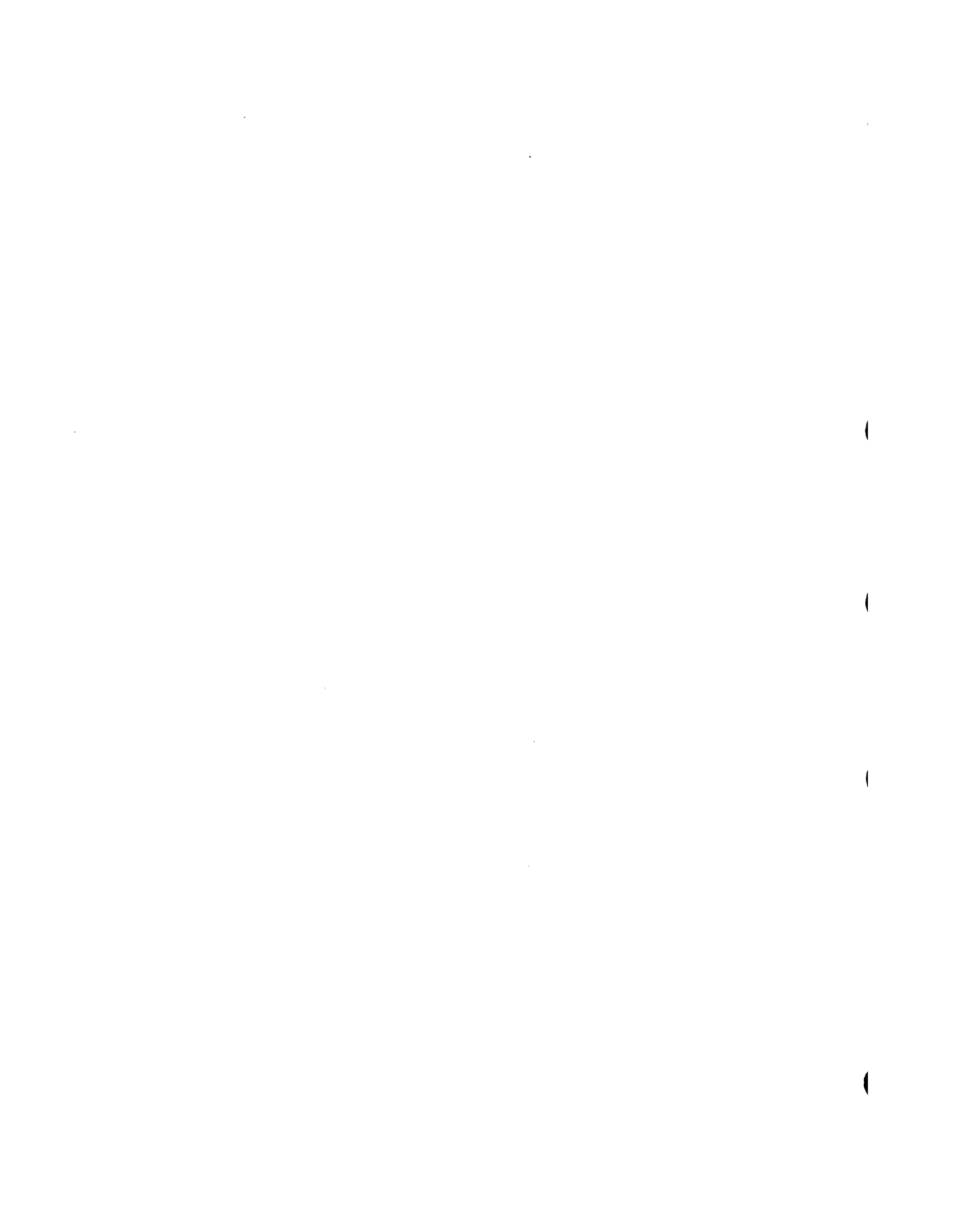
CHAPTER 6
OPTIONS

6.1   GENERAL

This chapter provides information on the following LA210 Letterprinter options.

Font cartridges
Font ROM chips
Parallel interface

Font cartridges and font ROM chips store dot pattern sets (DPSs). The parallel interface lets the printer receive parallel data from the host.

6.2   FONT CARTRIDGES AND ROM CHIPS

The LA210 Letterprinter uses dot pattern sets (DPSs) to select different fonts, character sets, or character pitches. The DPSs are stored on font cartridges and ROM chips. There are two types of ROM fonts: internal ROMs and ROM cartridges. Internal ROMs plug into slots on the logic board (Figure 5-11). The ROM cartridges are inserted in two slots on the font assembly (Figure 6-1).

The printer stores from one to five DPSs (three internal, two external) at any given time. A DPS consists of either one or two 94-character ROMs. A DPS consisting of only one standalone ROM is called a primary ROM. If the DPS consists of two ROMs, one is the primary ROM and the other is the complementary ROM, or overlay. Appendix C lists the different DPSs that you can order.

In the standard configuration, the printer has three internal DPS ROMs on the logic board. From the control panel, you can force (select) a DPS whether it is installed in the printer or on a ROM cartridge. You can also select a DPS by sending an escape sequence from the host.
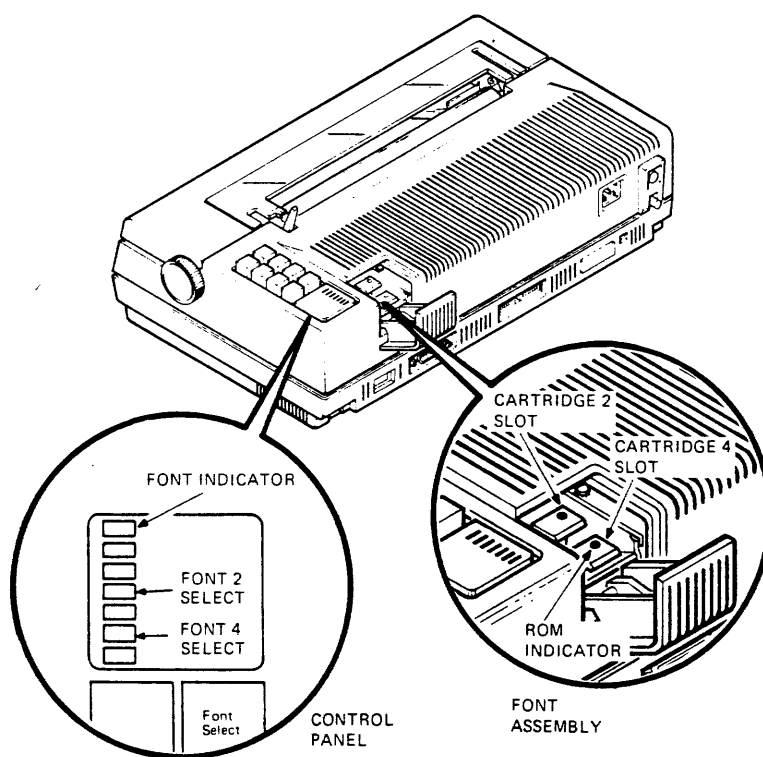
Figure 6-1   Font Assembly

6.2.1   Font Cartridges

The font assembly is under the door next to the control panel. The font assembly has two slots -- one for font cartridge 2 and one for font cartridge 4. Each slot has a microswitch that sends a signal when you insert or remove a cartridge. Use the Font Select switch on the control panel to select the fonts. The control panel also has five font indicators. Each indicator corresponds to a DPS.

You can insert a primary cartridge in either slot 2 or 4. When you install two cartridges, the primary must go in slot 2 and the overlay in slot 4. The overlay cartridge does not print when used alone.

6.2.1.1 Checkout -- The following tests and procedures check that the ROM cartridge is installed correctly.

Cartridge electrical insertion test (If correct, font cartridge indicator lights.)

Insertion power-up/checksum test

Status test

NOTE

The selected DPS remains active until you either turn off the power to the printer, remove the DPS, or press the Font Select switch again.

When you select a DPS by pressing the Font Select switch, only those DPSs installed (in the font ROMs) are available.

If the appropriate font indicator does not light when you insert a font cartridge, remove the cartridge and then reinstall it. If the indicator still does not light, replace the cartridge.

6.2.2 Power-Up Checksum Test -- When you turn on the power or insert a cartridge, the printer performs an internal check. It tries to access the DPS ROMs. Any DPS ROM present is tested. If the test fails, the printer indicates the faulty DPS ROM by flashing the data set ready and power/fault indicators (Table 7-1).

If the test detects an error, turn off the power to the printer. The test checks the DPS ROMs sequentially until it detects a failure. If there is a failure, make sure the cartridge is correctly installed. If there is still no change, replace the faulty cartridge and then turn the power back on.

6.2.2.1 Status Test -- Print the status message to check that the printer recognizes an installed DPS. The third line of the status message lists a different 3-digit ROM identification code for each DPS installed. Table 6-1 lists the DPSs available and the corresponding ROM identification codes.

Table 6-1   ROM Identification Codes

ROM Cartridges

ID Code	DPS
001	US/UK Gothic 10 high density primary
002	International Gothic 10 high density overlay
003	US/UK Gothic 12 high density primary
004	International Gothic 12 high density overlay
005	US/UK Courier 10 high density primary
006	International Courier 10 high density overlay
007	US/UK Courier 12 high density primary
008	International Courier 12 high density overlay
009	US/UK Orator 10 high density primary
010	International Orator 10 high density overlay
069	US/UK Courier 10 medium density primary
070	International Courier 10 medium density overlay
073	US/UK Orator 10 medium density primary
074	International Orator 10 medium density overlay
120	Symbol 10 high density primary
002	Multinational Gothic 10
004	Multinational Gothic 12
006	Multinational Courier 10
008	Multinational Courier 12
010	Multinational Orator 10
070	Multinational Courier 10
074	Multinational Orator 10
131	VT100 10 characters/inch
133	VT100 12 characters/inch
193	VT100 10 characters/inch
131	Olde English primary
136	DEC Technical
144	Katakana 10 overlay
169	Optical Character Reader A 10 primary
171	Optical Character Reader B 10 primary

Cartridges

ID Code	DPS
001	Gothic 10
002	Gothic 10 overlay
002	Multinational Gothic 10
004	Gothic 12 overlay
004	Multinational Gothic 12
005	Courier 10
006	Multinational Courier 10
008	Multinational Courier 12
008	Courier 12 overlay
010	Multinational Orator 10
011	Italics

Table 6-1   ROM Identification Codes (Cont)

ROM Cartridges	
ID Code	DPS

069	Courier 10 80 cps
070	Courier 10 80 cps overlay
070	Multinational Courier 10
073	Orator 10 80 cps
074	Orator 10 overlay
074	Multinational Orator 10
131	Olde English primary
131	VT100 10 characters/inch
135	DEC Technical
133	VT100 12 characters/inch
136	APL 10 overlay
137	MX80 Mosaic
139	IBM Line Drawing
141	IBM Foreign
143	Graftrax
144	Katakana 10 overlay
169	Optical Character Reader A 10 primary
171	Optical Character Reader B 10 primary
193	VT100 10 characters/inch
1 --	64 = High density standard DPS
65 --	128 = Medium density standard DPS
129 --	192 = High density special purpose DPS
192 --	200 = Medium density special purpose DPS

<p align="center">NOTE</p>
A standard DPS with an odd ID code
indicates a primary DPS containing the
US and UK character sets. A standard DPS
with an even ID code indicates an
overlay DPS containing the following
character sets.

ISO United Kingdom
US ASCII
Digital Finnish
Digital Norwegian/Danish
Digital Swedish
ISO German
Digital French Canadian
ISO French
ISO Italian
ISO Spanish
Digital Multinational or VT100 Line
Drawing

The printer prints a status message when the On Line/Off Line switch is in the off-line (down) position and the Normal/Self Test switch is pressed into the Self Test (down) position.

The status message has three parts: the DPS identification, the printer settings, and the communication settings. Figure 6-2 is a sample of the status message printout.

```
LA210  V2.1   RO
Emulation mode 0
2K Buffer
DPSs: 006...131......

*Printer Settings

Form Length (1/24):264
G0 Character set:United States
G1 Character set:Line drawing
G2 Character set:DEC Multinational
G3 Character set:United States
GL Set mapping:G0
GR Set mapping:G2
Pitch Mode:All Pitches
Horiz pitch (cpi):10
Vert pitch (lpi):6
End of line control:wrap mode
New Line request char.:none

*Communication Settings

Auto-answerback:Disabled
Disconnect on EOT:Disabled
Paper fault processing:XOFF (if enabled)
Parity:8/N
Receiver error:Print error block
Speed(bps):4800
Auto XON/XOFF:Enabled
Modem Control:No Modem Control-Restraint Mode
Cl receive:Disabled
Cl transmit:Disabled
```

MA-0085-84

Figure 6-2   Status Message

A DPS occupies a single position in the
status message whether it contains only
a primary DPS ROM or a primary DPS ROM
and its overlay.

To be sure that the primary and the
overlay ROMs are correctly installed,
check that the DPS number in the status
message matches the DPS ROM pair and not
just the primary DPS ROM.

If you do not install the primary DPS
ROM correctly, neither the primary DPS
ROM nor the overlay is reported.

There is always a DPS in slot 1 (inside the printer), so the
status message always prints a 3-digit code for DPS 1. If a DPS is
installed in slot 2, the message has a 3-digit code for slot 2.

6.3 FONT ROM CHIPS

The plug-in ROM options are listed in Appendix C. The following
paragraphs summarize functional and operational information. For
detail on each ROM option, refer to the option installation guide.

6.3.1 General

A minimum of one and a maximum of three DPS ROMs are plugged into
the printer's logic board at any given time.

A DPS is stored in a ROM. A single 64K ROM contains about 94
characters. A DPS can consist of either one or two 94-character
ROMs. If the DPS consists of just one ROM, this standalone ROM is
a primary ROM. When a DPS consists of two ROMs, one is a
standalone ROM and the other is a complementary ROM, or an
overlay. An overlay cannot be used by itself.

Three types of DPS ROMs are used with the printer.

    28-pin Texas Instruments 2564 and equivalent EPROMs
    24-pin Motorola 68766 and equivalent EPROMs
    24-pin 64K ROMs

                        CAUTION
        Use only DPS EPROMS approved for use in
        the LA210.

28-PIN SOCKET WITH
24-PIN ROM INSERTED

PIN 1

24-
PIN
ROM

PIN 1

28-
PIN
EPROM

EMPTY 28-PIN SOCKET

28-PIN SOCKET WITH
28-PIN EPROM INSERTED

MA-0555-83A
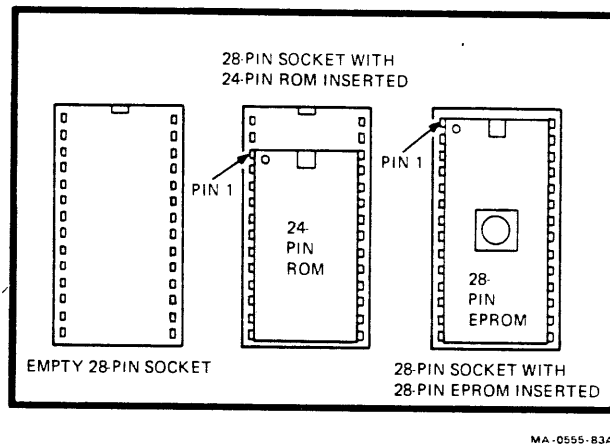
Figure 6-3   Inserting ROMs

Bottom justify 24-pin ROM/EPROMs by inserting pin 1 of the
ROM/EPROM into pin 3 of the socket (Figure 6-3).

Install 28-pin EPROMs with pin 1 of the EPROM inserted into pin 1
of the socket.

6.3.2   Installation

You can install up to five DPSs at one time. Sockets 1, 3, and 5
are inside the printer. Sockets 2 and 4 are in the font assembly
next to the control panel (Figure 6-1).

A DPS ROM must be installed in socket 1 or the printer cannot
function. When you install a DPS with an overlay, you must install
the primary ROM in socket 1 and the overlay in socket 5.

CAUTION
Always hold ROM chips by the plastic
body. Be careful not to touch the pins
with your hands. Static electricity
buildup on the hands can damage the
chip.

Remove a ROM chip as follows.

1.   Turn off the power and unplug the power cord.

2.   Remove the logic board (Paragraph 8.4).

3.   Find the ROM you want to remove on the logic board
      (Figure 5-11).
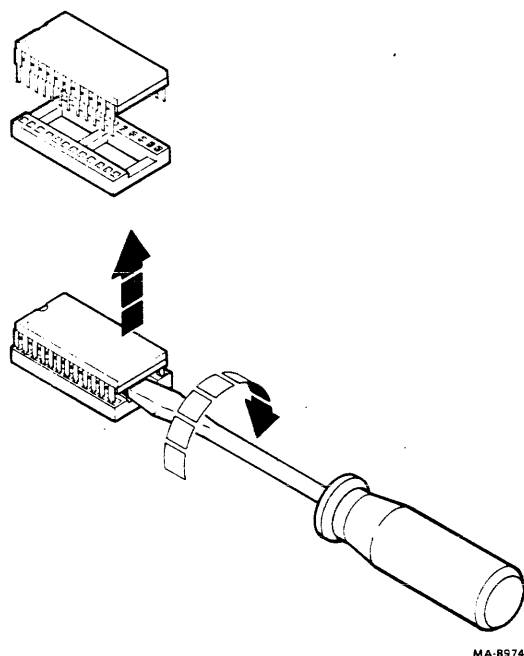
MA-8974

Figure 6-4   Removing Internal ROMs

4.   Insert the tip of a small slotted screwdriver between the
      ROM and the receptacle. Then turn the screwdriver gently
      from side to side until the pins are free (Figure 6-4).
      Do not use a rocking motion to remove the ROM.

5.   Remove the ROM. If you have a conductive carrier, mount
      the original ROM in the carrier for storage.

Install a ROM chip as follows.

1.   Unpack the ROM and remove it from the shipping carton.

2.   Ground your hand by touching a metal part on the printer
      mechanism assembly. Then check ROM for damage.

3.   With pin 1 of the ROM (identified by a small dot) in the
      upper-left corner, carefully engage all pins in the
      connector sockets. Make sure to install the chip as shown
      in Figure 6-3.

4.   Gently press the chip straight in until it is fully
      seated. Do not use a rocking motion to force the ROM in.

5.   Make sure all ROM pins are engaged and the dot is in the
      upper-left corner.

6.   Replace the logic board.

6.3.3   Checkout

Two tests verify that the DPS ROM is correctly installed -- a power-up test and the status test. Perform both tests to check for correct operation.

The most common mistakes made when installing the DPS ROMs are as follows.

Installing the DPS ROM in reverse (pin 1 of ROM inserted into pin 15 of socket)

Bent DPS ROM pins

24-pin ROM shifted (pin 1 of ROM in pin 1 or pin 2 of socket)

Wrong ROM slot used (inverting location of primary DPS ROM and overlay)

Installing an overlay with no primary DPS ROM

6.3.3.1 Power-Up Test -- When power is applied, the printer performs an internal check. The printer tries to access the DPS ROMs and if a DPS ROM is present, the printer performs the checksum test. If the test fails, the printer indicates the faulty DPS ROM by flashing the data set ready and power/fault indicators (Table 7-1).

NOTE
The DPS ROMs are checked sequentially and only the first failure is displayed.

Replacing a faulty DPS ROM incorrectly can cause another failure. For example, the printer may not power up at all, or it may be unable to access the ROMs.

Always reinstall the last DPS you inserted before replacing the DPS indicated by the power-up test. If the error persists after reinstalling the DPS, replace the DPS ROM.

6.3.3.2 Status Test -- You can print the status message to check if the printer recognizes an installed DPS (refer to Paragraph 6.2.2.3). The third line of the status message contains a different 3-digit code for each DPS installed. Table 6-1 lists the currently available DPSs and the corresponding ROM identification codes. Figure 6-5 shows the ROM identification codes in the status message.

There is always a DPS installed in slot 1 (inside the printer), so the status message always prints a 3-digit code for DPS 1. If a DPS is installed in slot 2, the message has a 3-digit code for slot 2.

For slots that do not have a DPS installed, or have a DPS installed incorrectly, the status message shows three periods. The status message in Figure 6-6 that the printer does not find a DPS in slot 2.

```
LA210   V2.1    RO
Emulation mode 0
2K Buffer
DPSs: 006...131......
```

DPS 1   DPS 2   DPS 3   DPS 4   DPS 5

MA-0132-85

Figure 6-5   ROM ID in Status Message

```
LA210   V2.1    RO
Emulation mode 0
2K Buffer
DPSs: 006...131......
```

SLOT 2
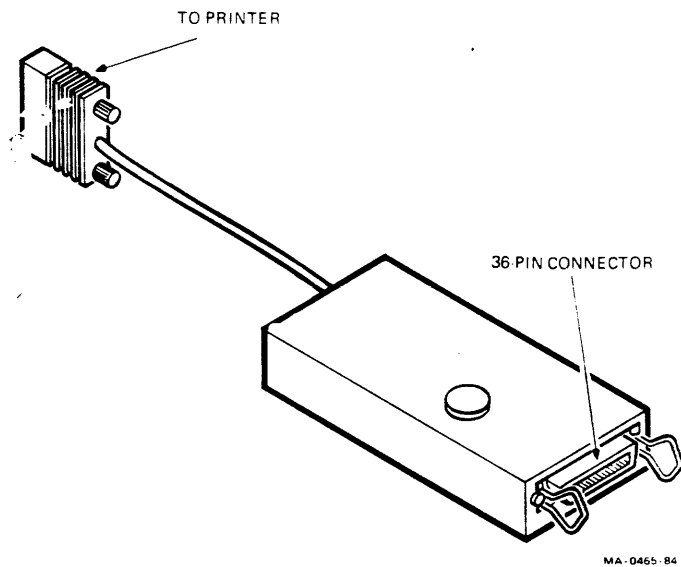
MA-0131-85

Figure 6-6   No DPS Found in Slot 2

Figure 6-7   LA1ØX-EP External Parallel
Interface Adapter

6.4   LA1ØX-EP EXTERNAL PARALLEL INTERFACE

The LA1ØX-EP parallel interface allows the printer to receive parallel data from a host. It converts parallel data to EIA RS232C format and transmits this data to the printer's control/logic board.

The LA1ØX-EP is a small, standalone metal box with a single-height board inside. The LA1ØX-EP connects to the printer by a hardwired cable with the standard EIA 25-pin connector. External interface with the host computer is through a 36-pin connector (Figure 6-7). The LA1ØX-EP is easy to remove and install.

For more information, see the LA1ØX-EP External Parallel Interface Adapter User Guide (EK-L1ØEP-UG).

6.4.1   Interface Cables

The LA1ØX-EP can use either a DEC communications cable (PN 7021511) or an IBM/TI/Centronics cable (vendor PN RØØ17).

CHAPTER 7
TROUBLESHOOTING

7.1   GENERAL

This chapter has troubleshooting and testing information for the LA210 Letterprinter. You can use this chapter together with Chapter 5 and the LA210 Field Maintenance Print Set to help identify and solve any failure in the printer.

7.2   TROUBLESHOOTING FLOW

Troubleshoot a failure by first identifying the symptoms. Refer to the troubleshooting chart (Figure 7-1) and the troubleshooting tables (Paragraph 7.2.3) to find out which field replaceable unit (FRU) probably caused the failure. Troubleshooting uses two kinds of tests -- the self-tests and the functional tests. The self-tests check the printer operating modes. The functional tests troubleshoot down to the component level.

The symptoms displayed can represent more than one failure. Also, the symptoms can change as you replace FRUs. Always base your troubleshooting on the current symptoms.

Newly replaced parts are sometimes faulty. Remember that a corrected failure can happen again, even though you have just replaced the faulty FRU.

```
                    ┌─────────────────┐
                    │   START HERE    │
                    └────────┬────────┘
                             │
                    ┌────────┴────────┐
                    │    PERFORM      │
                    │    POWER-UP     │
                    │    SELF-TEST    │
                    └────────┬────────┘
                             │
                    ┌────────┴────────┐
                    │ NORMAL          │
                    │ INDICATIONS     │
                    │ -POWER/FAULT    │
                    │ INDICATOR ON    │
                    │ -CARRIAGE MOVES │
                    │ TO LEFT MARGIN  │
                    └────────┬────────┘
                             │
                          ╱     ╲        NO        ┌──────────────┐
                      ╱ DID TEST PASS? ╲──────────▶│  REFER TO    │
                          ╲     ╱                  │  TABLE 7-1   │
                             │                     └──────────────┘
                            YES
                             │
                    ┌────────┴────────┐
                    │  PRINT STATUS   │
                    │    MESSAGE      │
                    └────────┬────────┘
                             │
                          ╱  DID  ╲
                      ╱  TERMINAL  ╲     NO        ┌──────────────┐
                     ╱ PRINT STATUS ╲────────────▶│  REFER TO    │
                      ╲  MESSAGE?  ╱               │  TABLES 7-2, 7-3 │
                          ╲     ╱                  │  AND 7-4     │
                             │                     └──────────────┘
                            YES
                             │
                    ┌────────┴────────┐
                    │PERFORMCHARACTER │
                    │PATTERN TEST     │
                    └────────┬────────┘
                             │
                          ╱  DID  ╲
                      ╱  TERMINAL  ╲     NO        ┌──────────────┐
                     ╱PRINT CHARACTER╲────────────▶│  REFER TO    │
                      ╲  PATTERN   ╱               │  TABLES 7-2, 7-3 │
                        ╲  TEST? ╱                 │  AND 7-4     │
                          ╲   ╱                    └──────────────┘
                            YES
                             │
                    ┌────────┴────────┐
                    │   PERFORM    *  │
                    │  LOOPBACK TEST  │
                    └────────┬────────┘
                             │
                          ╱  DID  ╲
                      ╱TERMINAL PASS╲    NO        ┌──────────────┐
                     ╱   LOOPBACK   ╲────────────▶│  REFER TO    │
                      ╲   TEST?    ╱               │  TABLE 7-5   │
                          ╲     ╱                  └──────────────┘
                            YES
                             │
                          ╱ DOES ╲
                      ╱  TERMINAL  ╲     NO        ┌──────────────┐
                     ╱ COMMUNICATE ╲────────────▶│  REFER TO    │
                      ╲  ON LINE?  ╱               │  TABLE 7-6   │
                          ╲     ╱                  └──────────────┘
                            YES
                             │
                         FINISHED
```

*ONLY WITH EIA/RS232-C INTERFACE

MA-8976A

Figure 7-1   Troubleshooting Chart

7.2.1   Self-Tests

The printer has self-tests that check printer operation and the major components. Paragraph 3.5 describes the power-up and printer self-tests. Most of the printer self-tests provide a printout. When troubleshooting, compare the test output with the examples in Paragraph 3.5. The status message printout (Figure 7-2) shows the current microcode version, the DPSs installed and the features set in operating memory.

                            NOTE
          Run a printer self-test and get a status
          message after performing any test or
          repair.

    LA210 V2.1   RO
    Emulation mode 0
    2K Buffer
    DPSs: 006...131......

    *Printer Settings

    Form Length (1/24):264
    G0 Character set:United States
    G1 Character set:Line drawing
    G2 Character set:DEC Multinational
    G3 Character set:United States
    GL Set mapping:G0
    GR Set mapping:G2
    Pitch Mode:All Pitches
    Horiz pitch (cpi):10
    Vert pitch (lpi):6
    End of line control:wrap mode
    New Line request char.:none

    *Communication Settings

    Auto-answerback:Disabled
    Disconnect on EOT:Disabled
    Paper fault processing:XOFF (if enabled)
    Parity:8/N
    Receiver error:Print error block
    Speed(bps):4800
    Auto XON/XOFF:Enabled
    Modem Control:No Modem Control-Restraint Mode
    C1 receive:Disabled
    C1 transmit:Disabled

                                        MA-0085-84

    Figure 7-2   Status Message
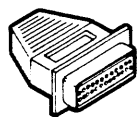
FROM PIN	TO PIN	TO PIN
2	3	—
4	5	..
20	6	—
19	22	—
12	23	8

EIA

MA-7266C

Figure 7-3   Loopback Connector

7.2.2   Loopback Test

The loopback test checks the printer's communication control signals. It also checks the printer's ability to transmit and receive characters. During the loopback test, the loopback connector connects the transmit and receive lines (Figure 7-3). The loopback test is described in the following paragraphs.

The loopback test requires an EIA/RS232-C interface. There is no loopback test for the parallel interface configuration. In the loopback test, the printer transmits characters on the transmit lines and receives the characters on its receive lines. The printer checks the control signals as well as the baud rate and parity. The printer compares the transmitted data with the received data and prints two of the following messages (one for the control lines, the other for the data path).

        Control line OK
        Control lines failed (20 mA ?, jumpers ?)
        Data path OK
        Data path failed
        Data path stopped

                        NOTE
            The printer prints

            Control lines failed

            when the EIA circuit jumpers are
            removed. In this case, the control lines
            are not used.

7-4

7.2.2.1 Loopback Test Procedure -- The following procedure describes how to run the loopback test. ·

1. Turn off the power.

2. Unplug the communication cable from the back of the printer.

3. Connect the loopback connector to the printer EIA interface connector.

4. Turn on the power.

5. Press and lock the On Line/Off Line switch in the Off Line (down) position.

6. Press and lock the Normal/Self Test switch in the Self Test (down) position. The printer prints the status message (Figure 7-2).

                           NOTE
        If the Normal/Self Test switch is
        already in the down position, release
        the switch and then return it to the
        down position.

7. Press the Set Top of Form switch to start the loopback test. When the test is complete (in about 2 minutes), the printer prints either a pass or fail message. Refer to Paragraph 7.2.2 for a sample pass message.

7.2.3   Troubleshooting Tables

Tables 7-1 through 7-7 list the most common printer failures, their symptoms, and corrective actions. Check for symptoms in the order given in the tables. Each table describes a different failure.

        Table 7-1 Power-Up Failures
        Table 7-2 Carriage Motion Failures
        Table 7-3 Paper Feed Failures
        Table 7-4 Print Quality Failures
        Table 7-5 Loopback Test Failures
        Table 7-6 Communication Failures

Table 7-1   Power-Up Failures

Symptom	Probable Cause	Solution
Data set ready (DSR) and Power/fault (P/F) indicators off, no carriage motion.	Power fuse (F1).	Replace fuse.
	Printer not plugged in.	Plug in.
	No power at wall receptacle.	Try a different receptacle. Next, check the breaker. Finally, call an electrician.
	Voltage select switch setting is incorrect.	Make sure voltage select switch on power supply is set to the proper range.
	Internal logic/ power cable.	Check cable.
	Power supply.	Replace power supply (Paragraph 8.6).
	Logic board.	Replace logic board (Paragraph 8.4).
DSR and P/F indicators off, but carriage moves.	Control panel cable.	Check control panel cable at J5 on logic board.
	Control panel assembly.	Replace control panel assembly (Paragraph 8.7).
	Logic board.	Replace logic board (Paragraph 8.4).
DSR and P/F flash one time.	ROM 1 defective or not present.	Replace logic board (Paragraph 8.4).
DSR and P/F flash two times.	Cartridge in slot 2 defective.	Replace cartridge (Figure 6-1).
	Bent pins in font assembly.	Replace font assembly (Paragraph 2.10).
DSR and P/F flash three times.	ROM 3 defective.	Replace logic board (Paragraph 8.4).

Table 7-1   Power-Up Failures (Cont)

Symptom	Probable Cause	Solution
DSR and P/F flash four times.	Cartridge in slot 4 defective.	Replace cartridge (Figure 6-1).
	Bent pins in font assembly.	Replace font assembly (Paragraph 2.10)
DSR and P/F flash five times.	ROM 5 defective.	Replace logic board (Paragraph 8.4).
DSR and P/F flash six times.	1st microcode ROM 0 defective.	Replace logic board (Paragraph 8.4).
DSR and P/F flash seven times.	2nd microcode ROM E defective.	Replace logic board (Paragraph 8.4).
DSR and P/F flash eight times.	RAM defective.	Replace logic board (Paragraph 8.4).
DSR and P/F flash nine times.	Input Buffer ROM defective.	Replace logic board (Paragraph 8.4).
DSR and P/F flash ten times.	ROM 0 defective.	Replace logic board (Paragraph 8.4).
DSR on or off, P/F flashing, no bell.	Access cover open, or paper fault.	Close cover, then press Local Form Feed/(Reset) switch.
	Cover interlock switch.	Replace interlock switch (Paragraph 8.16).
	Logic board.	Replace logic board (Paragraph 8.4).

NOTE
The access cover interlock switch is a magnetic proximity switch. Before replacing the switch, check the magnet in the access cover.

Table 7-1   Power-Up Failures (Cont)

Symptom	Probable Cause	Solution
DSR on or off, bell sounds, P/F flashing.	Head jam.	Clear jam. Check printhead gap. Press Local Form Feed/(Reset) switch.
	Carriage assembly.	Check carriage assembly to ensure that it moves freely.
	Servo motor/ encoder.	Check servo connector J1Ø on logic board, and connectors on servo motor/encoder assembly (Figure 8-6).
	Servo motor/ encoder assembly.	Replace servo motor/encoder assembly (Paragraph 8.1Ø).
	Logic board.	Replace logic board (Paragraph 8.4).
DSR and P/F on.	The printer is receiving the data set ready (DSR) signal and passes the power-up self-test.	
DSR off, P/F on.	The printer is not receiving the data set ready (DSR) signal and passes the power-up self-test.	

Table 7-2   Carriage Motion Failures

Symptom	Probable Cause	Solution
No printing, carriage does not move.	Paper-out switch.	If you are not feeding paper from bottom of printer, set switch to disable paper-out detection.
	Control panel cable.	Check cable connector at J5 on logic board (Figure 8-6).
	Control panel assembly.	Replace control panel assembly (Paragraph 8.7).
	Logic board.	Replace logic board (Paragraph 8.4).
	Power supply.	Replace power supply (Paragraph 8.6).
No printing, carriage moves.	Printhead adjustment.	Reset printhead adjust lever.
	Ribbon cartridge.	Replace ribbon cartridge.
	Printhead cable.	Check printhead cable connector at printhead and at J4 on logic board.
	Logic board.	Replace logic board (Paragraph 8.4).
	Printhead assembly.	Replace printhead assembly (Paragraph 8.2).
No printing, carriage slams to left or right.	Logic board.	Replace logic board (Paragraph 8.4).
	Servo motor/encoder assembly.	Check motor connections on logic board.
		Replace servo motor/ encoder assembly (Paragraph 8.10).
	Power supply.	Replace power supply (Paragraph 8.6).

Table 7-2   Carriage Motion Failures (Cont)

Symptom	Probable Cause	Solution
Printhead prints, but carriage does not move.	Logic board.	Replace logic board (Paragraph 8.4).
	Idler pulley.	Replace idler pulley (Paragraph 8.17).
	Timing belt broken or slipped out of carriage.	Check and replace timing belt if necessary (Paragraph 8.18).
	Servo motor/encoder assembly.	Replace servo motor/ encoder assembly (Paragraph 8.10).

Table 7-3   Paper Feed Failures

Symptom	Probable Cause	Solution
No line feeds.	Platen assembly not fully seated.	Check that drive gears are engaged correctly.
	Line feed motor connector.	Check line feed motor connector at J7 on logic board (Figure 8-6).
	Control panel cable.	Check cable connector at J5 on logic board (Figure 8-6).
	Control panel assembly.	Replace control panel assembly (Paragraph 8.7).
	Logic board.	Replace logic board (Paragraph 8.4).
	Line feed motor.	Replace motor (Paragraph 8.9).
	Antibacklash gear.	Replace gear.

Table 7-3   Paper Feed Failures (Cont)

Symptom	Probable Cause	Solution
No line feeds, cannot manually advance feed mechanism.	Logic board or line feed motor.	Replace board first. If problem continues, replace line feed motor (Paragraphs 8.4 and 8.9).
Bad line feeds (inconsistent vertical motion).	Paper path blocked.	Clear paper path.
	Platen assembly dirty.	Clean platen assembly.
	Platen assembly gears.	Check that gears are engaged correctly.
	Paper guide.	Check that paper guide is correctly seated.
	Line feed motor connector.	Check connector at J7 on logic board (Figure 8-6).
	Logic board.	Replace logic board (Paragraph 8.4).
	Line feed motor.	Replace line feed motor (Paragraph 8.9).
Continuous line feeds.	Control panel assembly.	Replace control panel assembly (Paragraph 8.7).
	Logic board.	Replace logic board (Paragraph 8.4).
Print line slanted up or or down during friction feed applications.	Friction feed.	Adjust or replace friction feed (Paragraph 8.11).
	Cams and paper release lever assembly.	Install new cam and lever assembly (Figure 8-10).
	Paper path blocked.	Clear paper path.

Table 7-3   Paper Feed Failures (Cont)

Symptom	Probable Cause	Solution
Print line slanted up or down during tractor feed applications.	Tractor assembly loose or twisted.	Check that sprockets are in line on both tractors. Check that tractor assembly is mounted correctly.
	Paper path.	Check that paper path is correct.
	Paper path blocked.	Clear paper path.
Flat descenders on characters (Figure 7-4).	Printhead cable.	Check printhead cable.
	Printhead/headlift cable assembly.	Replace cable assembly (Paragraph 8.14).

GOOD PRINT QUALITY
(WITH HEADLIFT)

FIRST PASS   SECOND PASS

POOR PRINT QUALITY
(WITHOUT HEADLIFT)

FIRST PASS   SECOND PASS

MA-0112-85
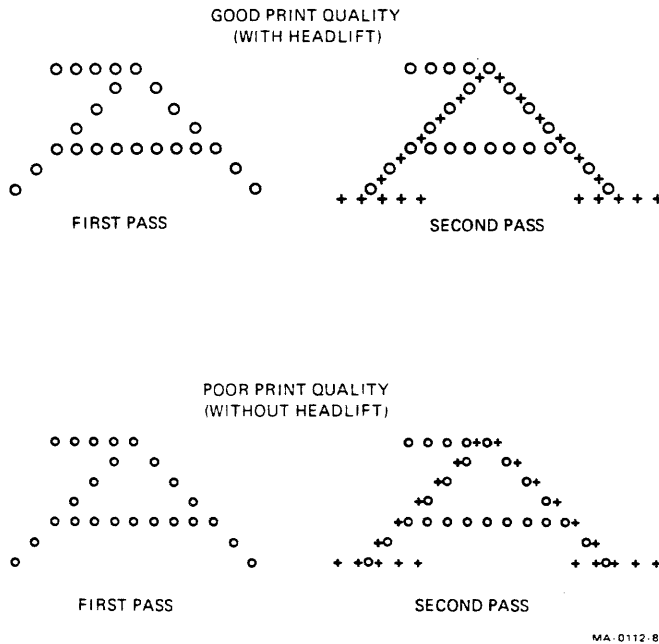
Figure 7-4   Flat Descenders Example

Table 7-4   Print Quality Failures

Symptom	Probable Cause	Solution
Characters missing.	Logic board.	Replace logic board (Paragraph 8.4).
Missing dots on all print characters. (Always same row missing.)	Printhead assembly.	Replace printhead assembly (Paragraph 8.2).
	Printhead cable.	Check connector at J4 on logic board (Figure 8-6).
	Logic board.	Replace logic board (Paragraph 8.4).
Missing dots on some characters.	Logic board.	Replace logic board (Paragraph 8.4).
	Ribbon cartridge.	Replace ribbon.
Incorrect characters print. (Character format correct.)	Incorrect character set selected.	Check character set selection.
	Logic board.	Replace logic board (Paragraph 8.4).
Print density drops off to no impression.	Printhead adjustment.	Reset printhead adjust lever.
	Ribbon cartridge.	Replace ribbon.
	Platen assembly.	Check if platen is seated correctly.
	Ribbon drive cables.	Check cables, replace if necessary (Paragraph 8.13).
	Ribbon drive pulley.	Replace printer mechanism (Paragraph 8.8).
Print density varies randomly across page.	Ribbon cartridge.	Replace ribbon.
	Ribbon drive cables.	Check cables and replace if necessary (Paragraph 8.13).
	Carriage assembly.	Replace printer mechanism (Paragraph 8.8).

Table 7-4   Print Quality Failures (Cont)

Symptom	Probable Cause	Solution
Prints light-to-dark or dark-to-light across page.	Printhead not parallel to platen.	Replace printer mechanism (Paragraph 8.8).
First few characters in line are light.	Ribbon cartridge.	Replace ribbon.
	Carriage bearings and shafts dirty.	Clean bearings and shafts. Relubricate.
	Ribbon drive cables.	Replace cables (Paragraph 8.13).
	Ribbon clutch.	Replace printer mechanism (Paragraph 8.8).
	Timing belt.	Replace timing belt (Paragraph 8.18).
Left or right margin moves in and out.	Timing belt.	Replace timing belt (Paragraph 8.18).
	Carriage bearings and shafts dirty.	Clean bearings and shafts. Relubricate.
	Ribbon cartridge.	Replace ribbon.
	Servo motor/encoder assembly	Replace servo motor/encoder assembly (Paragraph 8.10).
	Logic board.	Replace logic board (Paragraph 8.4)

Table 7-5   Loopback Test Failures

NOTE
Check communication switch settings and
jumpers on logic board.

Symptom	Probable Cause	Solution
Data error printout occurs.	Logic board.	Replace logic board (Paragraph 8.4).
	Power supply.	Replace power supply (Paragraph 8.6).
	Loopback connector.	Replace loopback connector.
Control line error occurs.	Logic board.	Replace logic board (Paragraph 8.4)
	Loopback connector.	Replace loopback connector.

NOTE
If a control line error occurs, check
the EIA communication jumpers on the
logic board. They must be in the factory
configuration for RS232 interface.

Table 7-6   Communication Failures

NOTE
Check communication switch settings and
jumpers on logic board.

Symptom	Probable Cause	Solution
No characters print.	Incorrect communication features selected.	Print status message. Check that correct features are selected.
	Modem unplugged or set up incorrectly.	Plug modem in. Check that correct features are selected. Refer to modem user guide.
Garbled characters print.	Incorrect communication features selected.	Print status message. Check that correct features are selected.
Double characters print.	Logic board	Replace logic board (Paragraph 8.4).
No answerback message.	Logic board.	Replace logic board (Paragraph 8.4).
No bell tone.	Control panel cable.	Check cable connector at J5 on logic board.
	Control panel assembly.	Replace control panel assembly (Paragraph 8.7).
	Logic board.	Replace logic board (Paragraph 8.4).

7.3   FUNCTIONAL TESTS

This section describes the functional tests that trained service
personnel can use to troubleshoot a failure in the printer.

WARNING
Be careful when checking internal parts
of the power supply. Exposed 120/230 Vac
line voltage and internal voltages
approaching 300 Vac are present.

CAUTION
The logic modules include static
sensitive components. Before you handle
these subassemblies for any reason,
touch the printer chassis or some large
metal object to remove static charges
from your body.

NOTE
The functional tests may include several
self-tests. These are described in
Paragraphs 3.5 and 7.2 of this manual.

Figure 7-5 is a physical/functional block diagram of the printer.
Refer to this figure when you perform the functional tests.

If you must remove the access cover for a functional test, first
disable the access cover interlock switch. To do this, unplug P9
(Figure 7-5) and jumper J9 pin 5 and 6 together.
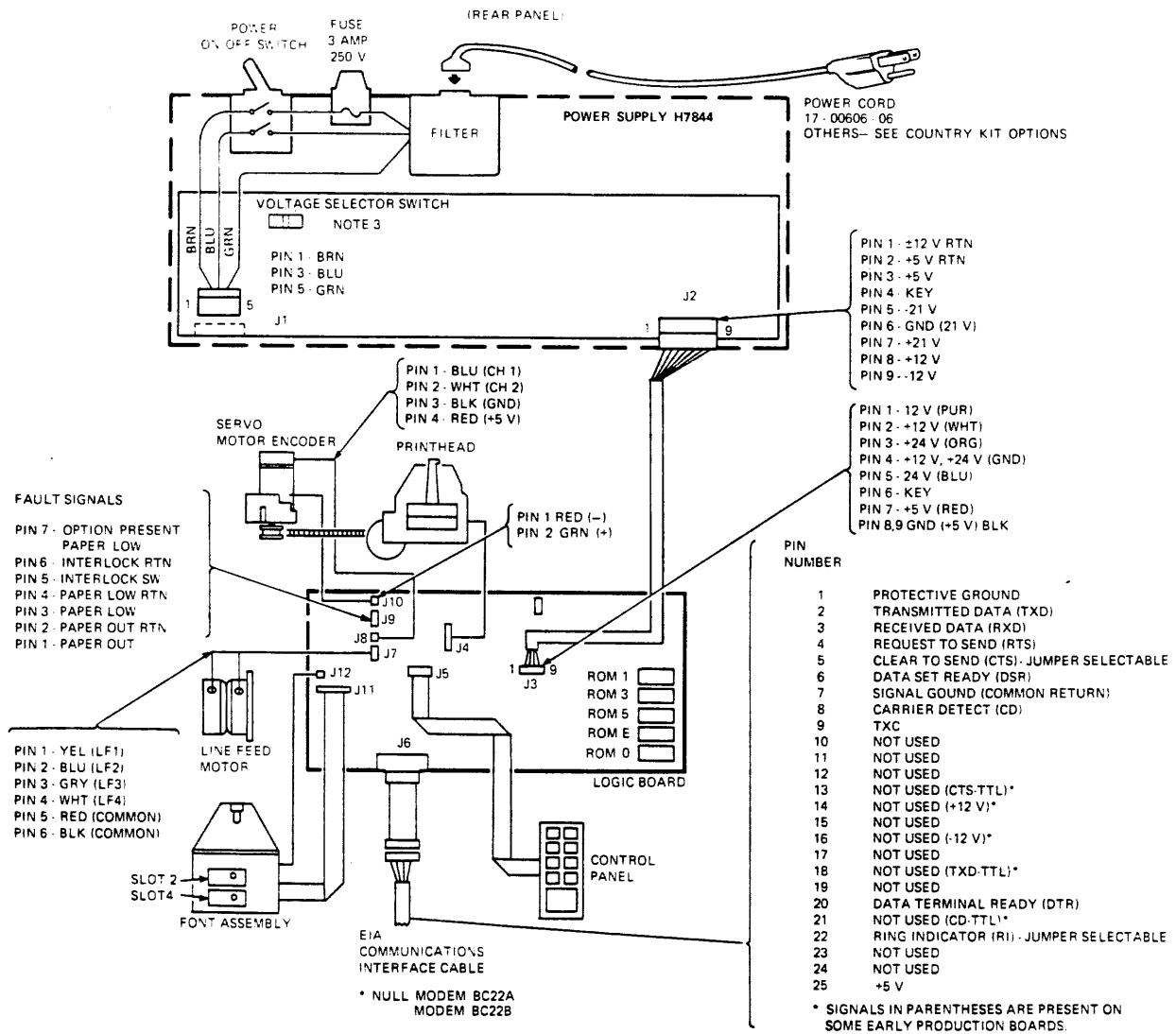
Figure 7-5   Physical/Functional Block Diagram

7.3.1   Power Supply Check

Table 7-7 lists the dc voltages and test points. You should check J3/P3 on the logic board with a digital voltmeter when under load. Do not unplug P3 from the logic board when making these measurements.

Table 7-7   DC Voltage Supply

Voltage (V)	Tolerance (V)	Logic Board Test Points (Figure 7-5)
+5.1	+/- 0.25	P3-7 (red)
+12	+/- 0.6	P3-2 (white)
-12	+/- 0.6	P3-1 (purple)
+24	+/- 2.4	P3-3 (orange)
-24	+/- 2.4	P3-5 (blue)
0-24 (ground)	--	P3-4 (black)
		P3-9 (black)
0 (logic ground)	--	P3-8 (black)

7.3.2   Basic Logic Board Tests

The following tests check the basic responses of the logic board.

7.3.2.1 Wake-Up Test -- This test checks the power-up response of the logic board.

> **CAUTION**
> Some logic board components get very hot. Wait at least 15 minutes before handling resistor R162 and transistors Q7 through Q24.

> **WARNING**
> Set the power switch to 0 (off) and disconnect the ac power cord.

1.   Place a cushion on the work surface.

2.   Rest the back of the printer on the cushion.
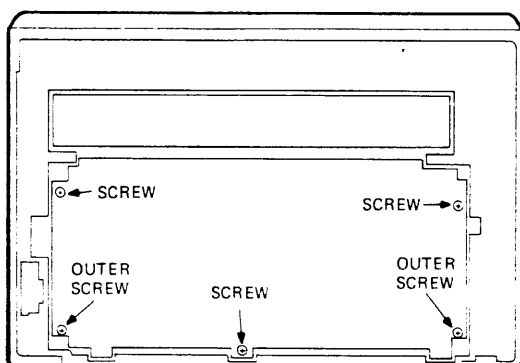
MA-0103-84

Figure 7-6   Logic Board Access

3.   Loosen the two outer screws holding the logic board to
      the back edge of the printer (Figure 7-6). Remove the
      other three screws.

4.   Carefully pull the logic board away from the printer.

5.   Connect channel 1 of a scope to E16-4/6 (+2.4 V). Connect
      channel 2 of the scope to signal WU at E16-1. Set the
      scope as shown in Figure 7-7.

6.   Apply power to the printer and check for the waveform in
      Figure 7-7. The wake-up (WU) signal should go high
      approximately 150 ms after +2.4 V reaches the peak of its
      ramp. Turn the power off and on to repeat the waveform.

                         NOTE
        Leave the power off for a few seconds to
        allow   for   capacitor   discharge.
        Otherwise, the +2.4 V ramp and WU delay
        will   not   appear   in   the   same
        relationship.

5.   Remove power from the printer and remove the scope
      leads.

7.3.2.2 **System Clocks** -- The clock test checks the operation of
the 8 MHz crystal and the divider network in the 8085A
microprocessor chip.

1.   Check crystal input to the microprocessor by connecting
      channel 1 of the scope to E26-1. The waveform should be
      sinusoidal with a period of 125 ns at approximately 4 V
      peak-to-peak.

SCOPE SETUP

VOLTS/DIV: 2 V
VERTICAL MODE: CHOPPED
SWEEP SPEED: 50 ms/DIV
TRIG MODE: NORMAL
TRIG SOURCE: CHAN 1, DC, INT, POS

MA-9668 C
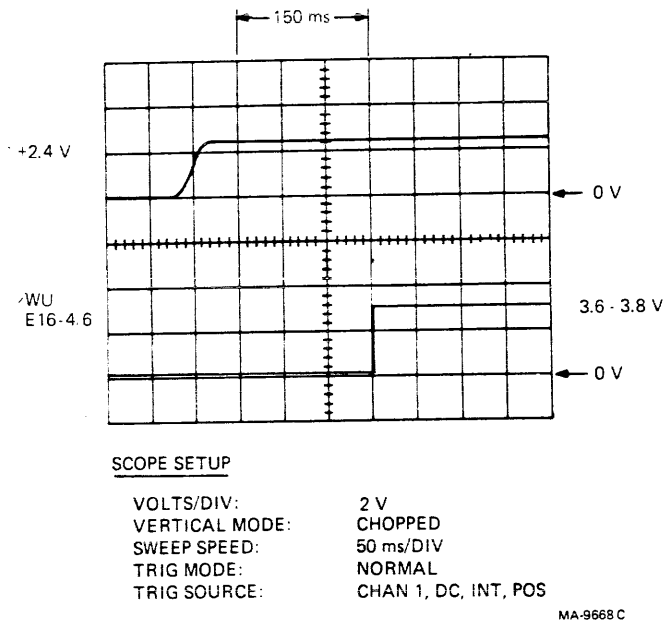
Figure 7-7   DC Wake-Up Waveform

2.   Move the scope probe to E26-37. The system clock output should be a 4 MHz (250 ns) square wave.

3.   Move the scope probe to E25-5. Clock input CLKB should be a 2 MHz (500 ns) square wave.

7.3.2.3 Interrupts -- The printer controller supplies a 2.5 ms interrupt to the microprocessor so it can perform certain software routines regularly. This test checks that an interrupt and the resulting acknowledge signal are returned from the microprocessor. If the test is successful, the microprocessor chip and supporting microprogram memory are probably operating correctly.

1.   Connect channel 1 of a scope to E26-10 (signal INTR B). A positive going pulse with a period of 2.5 ms indicates that the interrupt is operating correctly.

2.   Connect the scope probe to E26-11 (signal not INTA). A negative going pulse with a period of 2.5 ms indicates that the microprocessor is acknowledging the printer controller's interrupt.

7.3.3   Bell Test

Use the following procedure to test the sanity of the logic board.

1. Perform steps 1 through 4 of the procedure in Paragraph 7.3.2.1 to access the logic board.

2. Connect channel 1 of the scope to E69-3 (-BELL). Set up the scope according to Figure 7-8.

3. Use a jumper to defeat the interlock.

4. Apply power to the printer and set it to local.

5. Simulate a jam condition. The waveform displayed on the scope should be similar to Figure 7-8. The microprocessor and print controller generate a pattern of 8 chopping pulses every 400 microseconds, for a tone of 2.5 kHz.

7.3.4   DC Servo/Encoder Test

The following procedure tests the dc servo/encoder circuits on the logic board.

1. Perform steps 1 through 4 of the procedure in Paragraph 7.3.2.1 to access the logic board.

E69-3
BELL

─ 0 V
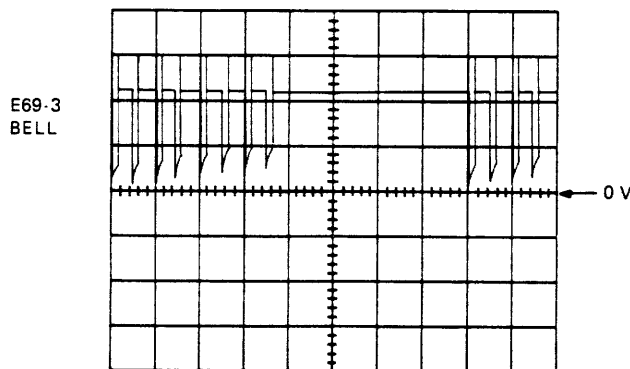
SCOPE SETUP

VOLTS/DIV:	10 V
VERTICAL MODE:	CH 1
SWEEP SPEED:	50 μs/DIV
TRIG MODE:	NORMAL
TRIG SOURCE:	CHAN 1, DC, INT, NEG

MA-9669C

Figure 7-8   Bell Test Waveform

2. Check the print carriage for freedom of movement on the
    carriage rails. Check the timing belt. If there is any
    sign of wear (fraying or teeth missing), replace the worn
    belt.

3. Perform the procedure in Paragraph 8.18 to remove the
    timing belt from the servo pulley assembly.

4. Disconnect the servo motor by pulling the two clips off
    the motor terminals.

5. Apply 5 V to the motor by connecting the positive motor
    terminal to +5 V at capacitor C14 on the logic board (+
    side) and the negative motor terminal to ground.

6. Connect the scope to E13-6 (encoder CH1). Set the scope
    as shown in Figure 7-9. Turn power on. The servo motor
    should turn counterclockwise. The waveform on the scope
    should be a square wave like Figure 7-9 with a duty cycle
    of 50 percent.

7. Move the scope probe to E13-7 (encoder CH2). Look for a
    similar waveform.

NOTE

The encoder duty cycle is not
adjustable.
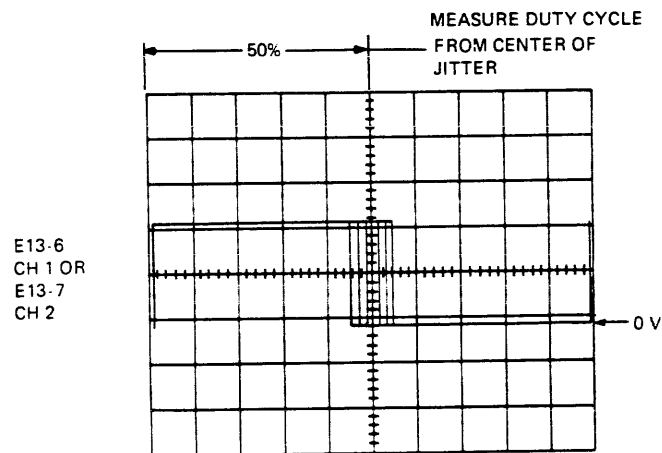
SCOPE SETUP

VOLTS/DIV:	2 V
VERTICAL MODE:	CHAN 1
SWEEP SPEED:	20 μs/DIV; ADJUST VARIABLE SWEEP SPEED FOR ONE CYCLE AS SHOWN
TRIG MODE:	NORMAL
TRIG SOURCE:	CHAN 1, DC, INT, POS

MA-9670C

Figure 7-9   Encoder Output Waveform

8. Connect the scope to the printer controller servo output.
    Connect channel 1 to E13-8 (not MINUS) and channel 2 to
    E13-9 (not PLUS). Set the scope as shown in Figure 7-10.
    The waveform on the scope should match the waveform in
    Figure 7-10.

9. Turn off the power to the printer and reverse the jumpers
    that supply +5 V to the servo motor. This will cause the
    motor to turn in a clockwise direction.
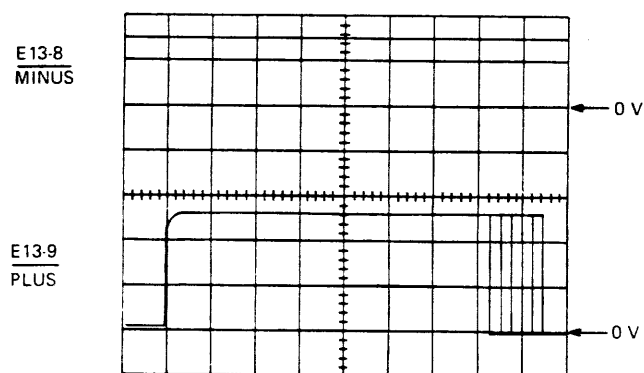
SCOPE SETUP

VOLTS/DIV:	2 V
VERTICAL MODE:	CHOPPED
SWEEP SPEED:	50 μs/DIV
TRIG MODE:	NORMAL
TRIG SOURCE:	NORM, DC, INT, NEG

MA-9671C

Figure 7-10   DC Servo Motor Driven
                Counterclockwise

7-24

10. Set the scope as shown in Figure 7-11 and apply power to the printer. The waveform on the scope should match the waveform in Figure 7-11.

11. Turn off the power, but leave the scope probes connected as in step 8.

12. Reassemble the timing belt and idler pulley assembly. Reconnect the servo motor wires.

NOTE
In the following steps, you look at waveforms while the printhead is in motion.

Tape the printhead cable to the logic board so it does not snag on the printhead carriage.

13. Set the scope to high resolution as shown in Figure 7-11 and apply power to the printer. Put the printer into self-test and press the Local Form Feed switch three times to start the carriage motion (nonprinting) test.
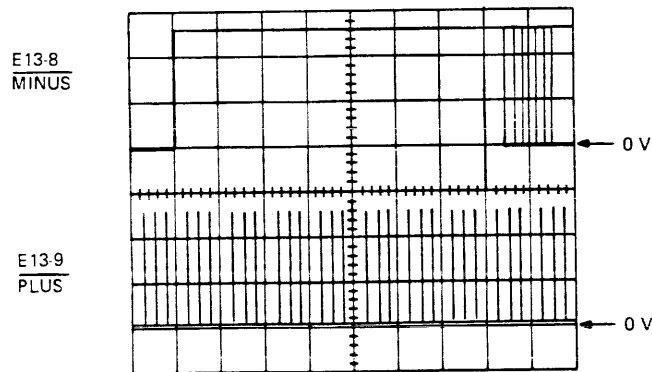
E 13-8
MINUS

◄— 0 V

E 13-9
PLUS

◄— 0 V

SCOPE SETUP

VOLTS/DIV:	2 V
VERTICAL MODE:	CHOPPED
SWEEP SPEED:	50 µs/DIV
TRIG MODE:	NORMAL
TRIG SOURCE:	CHAN 1, DC, INT, NEG

MA-9672C

Figure 7-11   DC Servo Motor Driven
Clockwise

14. During left-to-right carriage motion, the waveform on the scope should match the waveform in Figure 7-12. Channel 2 should be at or near 0 V and channel 1 should be pulsing high.

15. Select the high resolution scope settings -- sweep 10 USEC per DIV and NORMAL trigger source. The waveform on the scope during a right-to-left carriage return should match the waveform in Figure 7-13.

E13-8
MINUS

E13-9
PLUS

← 0 V

← 0 V

SCOPE SETUP

VOLTS/DIV:	2 V
VERTICAL MODE:	CHOPPED
SWEEP SPEED:	10 μs/DIV
TRIG MODE:	NORMAL
TRIG SOURCE:	NORM, DC, INT, POS

MA-9674C
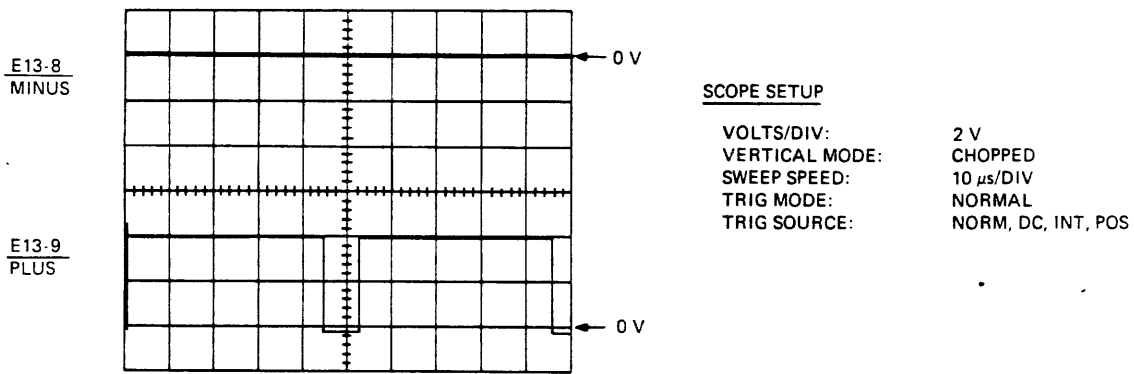
Figure 7-12   DC Servo Motor Driven Left to Right
During Carriage Return

E13-8
MINUS

E13-9
PLUS

← 0 V

← 0 V

SCOPE SETUP

VOLTS/DIV:	2 V
VERTICAL MODE:	CHOPPED
SWEEP SPEED:	5 μs/DIV
TRIG MODE:	NORMAL
TRIG SOURCE:	CHAN 1, DC, INT, POS

MA-9673C
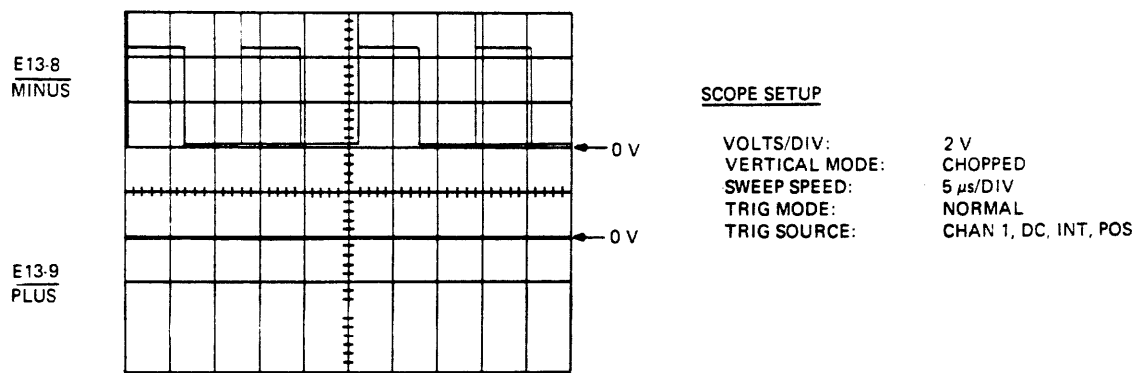
Figure 7-13   DC Servo Motor Stepped Right to Left

7.3.5   Print Character Test

The print character test checks printhead operation and the circuits that process the character signal before it goes to the printhead. The test bar character (|) is used for the waveforms in this test. It is an ideal test character because it fires all nine wires in the printhead and fires them only once for each character. Other characters produce different waveforms according to which wires are fired and how many times they are fired.

1.   Perform steps 1 through 4 of the procedure in Paragraph 7.3.2.1 to access the logic board.

NOTE
The following steps involve looking at waveforms while the printhead is in motion.

Tape the printhead cable to the logic board so it does not snag on the printhead carriage.

2.   Use an ohmmeter to check the continuity of the printhead solenoid in the defective channel. The resistance of a good printhead solenoid is about 9 ohms.

3.   Connect channel 1 of a scope to the output of the printer controller defective channel. Set the scope as shown in Figure 7-14.
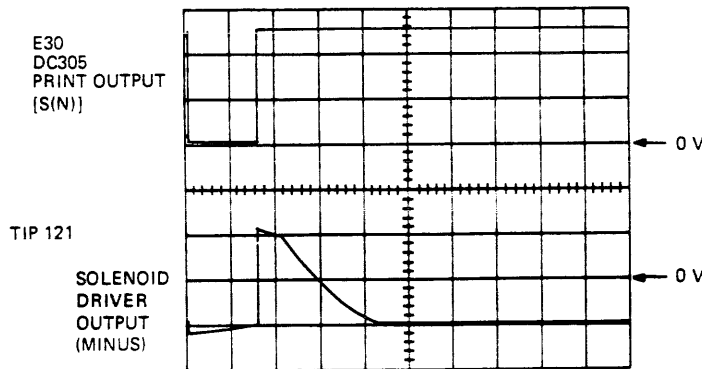
SCOPE SETUP

VOLTS/DIV:	CH1: 2 V, CH2, 20 V
VERTICAL MODE:	CHOPPED
SWEEP SPEED:	200 µs/DIV
TRIG MODE:	NORMAL
TRIG SOURCE:	CHAN 1, DC, INT, NEG

MA-9675B

Figure 7-14   Print Solenoid Input Versus
Output with Good Driver
and Good Solenoid

7-27

4. Apply power to the printer. Put the printer in off-line mode.

5. Run the horizontal registration test. The test generates four lines of characters, one of which is the test bar (|) character.

6. A good solenoid circuit produces a waveform like the one in Figure 7-15.

E30
DC305
PRINT OUTPUT
[S(N)]

TIP 121

SOLENOID
DRIVER
OUTPUT
(MINUS)

— 0 V

— 0 V

SCOPE SETUP

VOLTS/DIV:	CH1: 2 V, CH2, 20 V
VERTICAL MODE:	CHOPPED
SWEEP SPEED:	200 μs DIV
TRIG MODE:	NORMAL
TRIG SOURCE:	CHAN 1, DC, INT, NEG
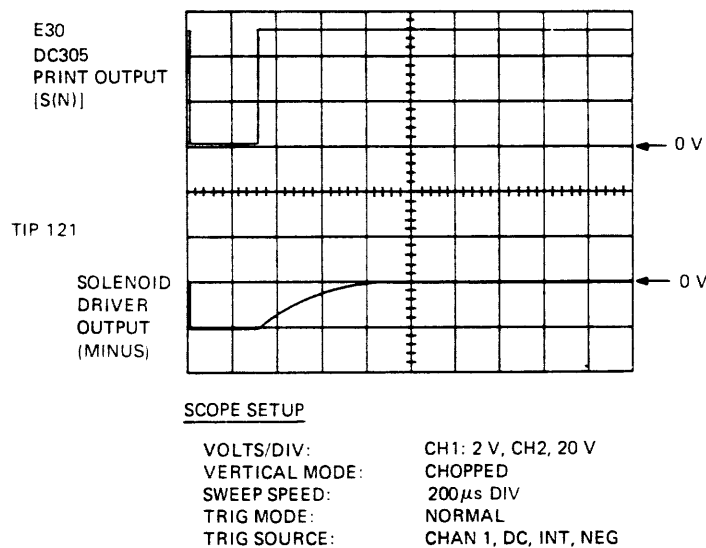
MA-9676 B

Figure 7-15   Print Solenoid Input Versus
Output with Good Driver
and Open Solenoid

7.3.6   Line Feed Test

The line feed test checks the printer controller, the line feed driver, and the stepper motor.

1.   Perform steps 1 through 4 of the procedure in Paragraph 7.3.2.1 to access the logic board.

2.   Disconnect the stepper motor connector from T2 on the logic board and check the stepper motor windings. Use an ohmmeter to check between the following pins on the stepper motor connector (not on the logic board).

     5 and 1
     5 and 2
     6 and 3
     6 and 4

     All four readings should be 17.5 ohms +/- 10 percent.

3.   Connect channel 1 of a scope to E13-13 (LF1). Connect channel 2 of the scope to E13-12 (LF2). Set the scope as shown in Figure 7-16.

4.   Apply power to the printer and place it in local mode.

5.   Press Local Form Feed and look at the two channel inputs to the line feed drivers. Check that the waveforms are like Figure 7-16.

LF1   ← 0 V

LF2   ← 0 V
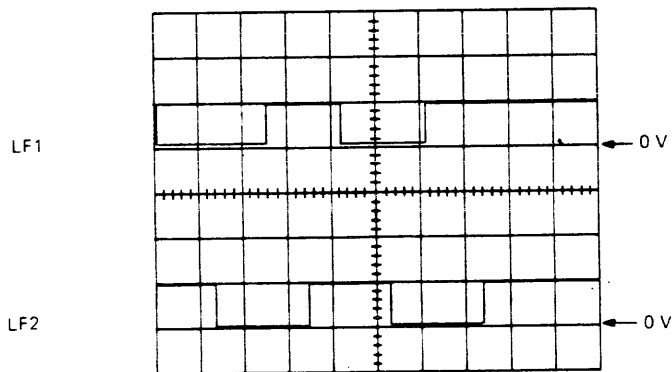
SCOPE SETUP

VOLTS/DIV:	5 V
VERTICAL MODE:	CHOPPED
SWEEP SPEED:	5 ms/DIV
TRIG MODE:	NORMAL
TRIG SOURCE:	CHAN 1, DC, INT, NEG

MA-9677C

Figure 7-16   Line Feed Signal Output
              of Printer Controller

6.   Check each phase of the quadrature phase line feed driver
      by connecting channel 1 of the scope to driver input and
      channel 2 to driver output. Set the scope as shown in
      Figure 7-17.

7.   Press Local Form Feed and check for a waveform like
      Figure 7-17. The example given in the figure is for
      channel LF1 or LF2. Channels LF3 and LF4 are similar,
      except that the input phase is reversed (switch scope
      trigger from - to +). If only one or two outputs look
      bad, then the line feed driver may be faulty. If all
      outputs look bad, then the RUN line darlington switch
      (Q2) is probably defective.
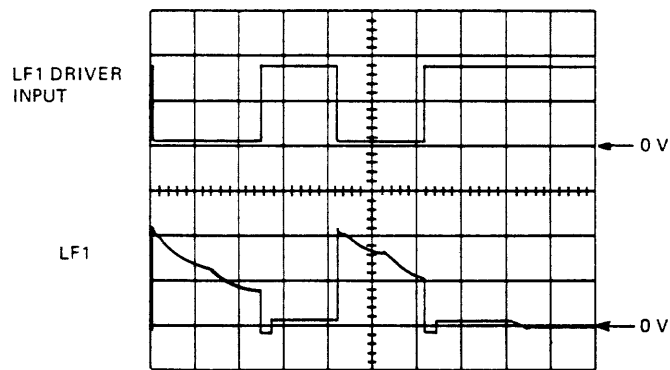
LF1 DRIVER
INPUT

0 V

LF1

0 V

SCOPE SETUP

VOLTS/DIV:	CH1: 2 V, CH 2, 20 V
VERTICAL MODE:	CHOPPED
SWEEP SPEED:	5 ms/DIV
TRIG MODE:	NORMAL
TRIG SOURCE:	CHAN 1, DC, INT, NEG

MA-9678C

Figure 7-17   Line Feed Input vs Output

7.3.7 USART Test

The USART test checks the baud rate generator section of the printer controller chip and the communication controller (USART) chip.

1. Perform steps 1 through 4 of the procedure in Paragraph 7.3.2.1 to access the logic board.

2. Connect the scope to E55-9 (TXC signal).

3. Set the speed to 1200 baud and parity to 7/space.

4. Observe a transmit clock with a period of 50 microseconds.

5. Move the scope probe to E55-25 (RXC signal).

6. Observe a receive clock with a period of 50 microseconds.

NOTE
You can run the test with different baud rates. Refer to Table 5-3 for a list of the different frequencies for each baud rate.

The following steps involve wrapping data transmitted by the printer back to its receive input. Use the loopback connector (PN 12-15336-01) for this purpose (Figure 7-3).

CHAPTER 8
MECHANICAL SERVICING

8.1　　GENERAL

This chapter describes how to remove, replace, and adjust the field replaceable units (FRUs) in the LA210 Letterprinter.

To access an FRU, sometimes you have to remove other FRUs. Figure 8-1 is a flowchart that shows you the sequence for removing FRUs. For example, to remove the line feed motor, you must first remove the logic board, top cover, and printer mechanism.
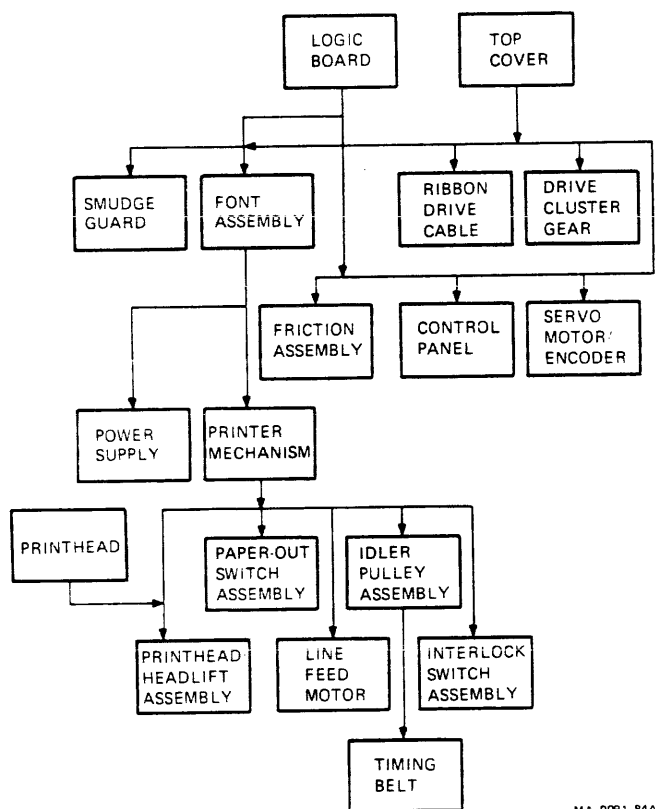
Figure 8-1　　FRU Removal Sequence

8.2   PRINTHEAD ASSEMBLY

Remove the printhead assembly as follows.

WARNING
Set the power switch to 0 (off) and disconnect the ac power cord.

1.   Remove the access cover by pulling it up and out.

2.   Remove the ribbon cartridge.

3.   Move the printhead adjustment lever to the right (Figure 8-2).
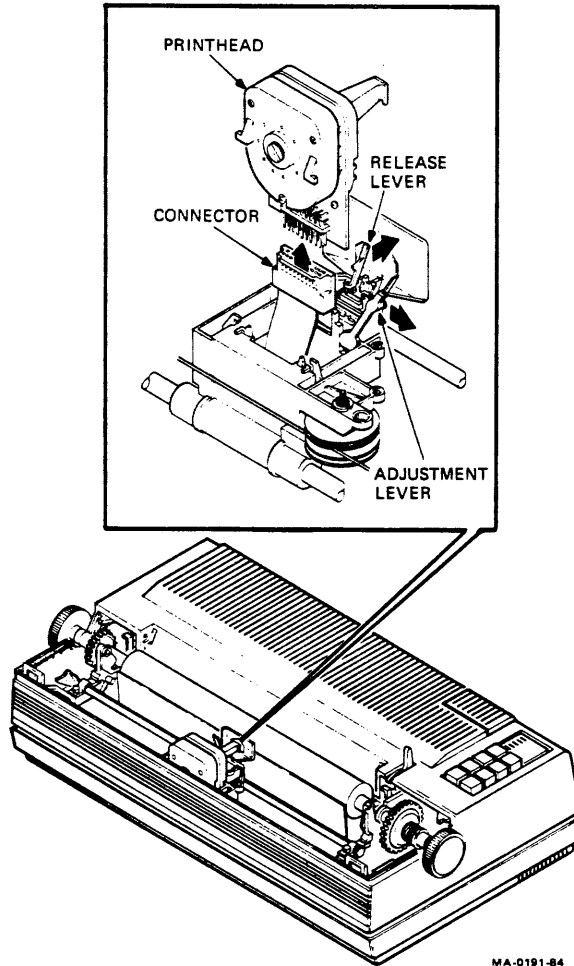
Figure 8-2   Printhead Assembly

4. Push the printhead release lever toward the back of the printer.

5. Lift the printhead up until you can grasp the printhead cable connector.

6. Disconnect the printhead from the printhead cable.

7. Remove the printhead.

To install the printhead assembly, reverse steps 1 through 7.

NOTE
When you install the printhead, make
sure the pins on the printhead correctly
match the holes in the printhead cable
connector.

8.3 TOP COVER

Remove and install the top cover as follows.

WARNING
Set the power switch to Ø (off) and
disconnect the ac power cord.

8.3.1 Removing the Top Cover

1. Remove paper from the printer.

2. If the printer is attached to a printer stand, remove the printer from the stand.

3. Remove the tractor assembly.

4. Remove the access cover.

5. Remove the ribbon cartridge.
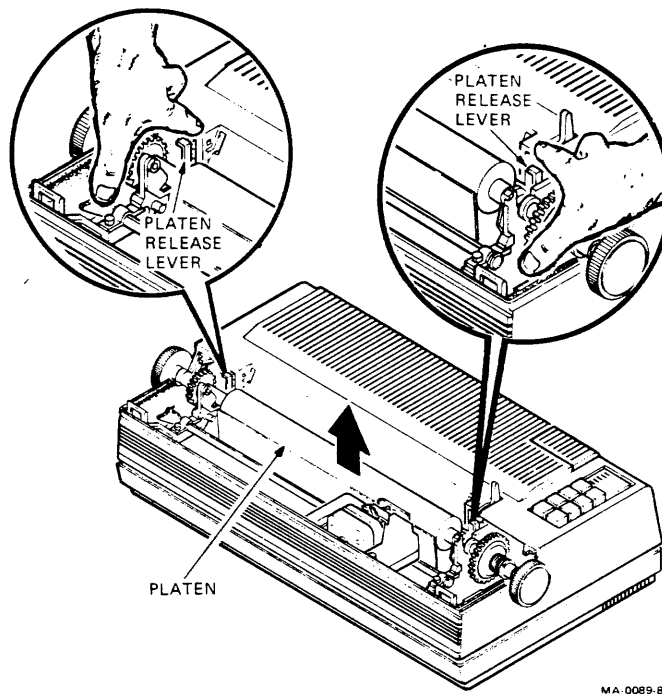
Figure 8-3   Removing the Platen

6.   Remove the platen by pressing the two platen release
      levers at the same time (Figure 8-3). Lift the platen
      straight up.

7.   Insert a flat blade screwdriver through the slots in the
      front of the bottom housing (Figure 8-4). While prying
      the two clips, lift the top cover. Swing the cover up and
      off the hinges on the rear of the printer.
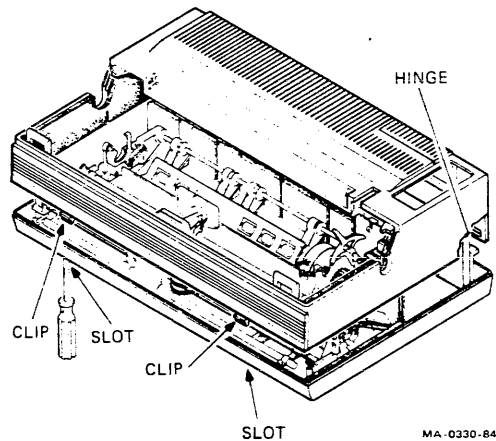
Figure 8-4   Removing the Top Cover

8.3.2   Installing the Top Cover

1. Line up the slots in the top cover with the hinges on the bottom housing (Figure 8-4).

2. Swing the top cover onto the hinges.

3. Press down on the front of the top cover until the clips in the top cover snap into the bottom housing.

4. Install the platen by pressing it into place. Rotate the paper adjust knob to check that the gears are properly engaged.

5. Install the ribbon cartridge.

6. Install the access cover and press it into place.

7. Install the tractor assembly.

8. If the printer stand is used, attach the printer to the stand. Load the paper.

9. Plug the ac power cord into the back of the printer. Then plug the power cord into a nonswitched, 3-prong, grounded wall receptacle.

8.4   LOGIC BOARD

Remove the logic board as follows.

CAUTION
Some logic board components get very
hot. Wait at least 15 minutes before you
handle resistor R162 and transistors Q7
through Q24.

WARNING
Set the power switch to Ø (off) and
disconnect the ac power cord.

1.   Place a cushion on the work surface.

2.   Rest the back of the printer on the cushion.

3.   Loosen the two outer screws holding the logic board at
     the back edge of the printer. Remove the other three
     screws (Figure 8-5).

4.   Carefully pull the logic board away from the printer.
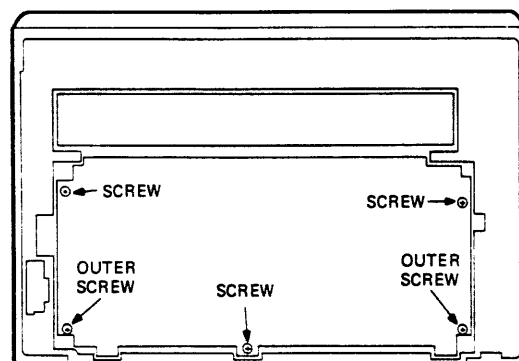
MA-0103-84

Figure 8-5   Logic Board Screws

5. Disconnect the connectors on the logic board (Figure 8-6)
    and remove the board.

NOTE
Before you remove the faulty logic
board, check that the jumper and ROM
configuration, and the communication
switches are set correctly.

Transfer any optional DPS ROMs from the
faulty logic board to the new logic
board. Cut the jumpers on the new board
that were cut on the faulty logic board
and set the configuration switches.
(Refer to Chapter 3.)

To replace the jumpers, you must first
remove the plate on the bottom of the
logic board.

To install the logic board, reverse steps 3 through 5. Refer to
Figure 8-6 for cable connector locations.
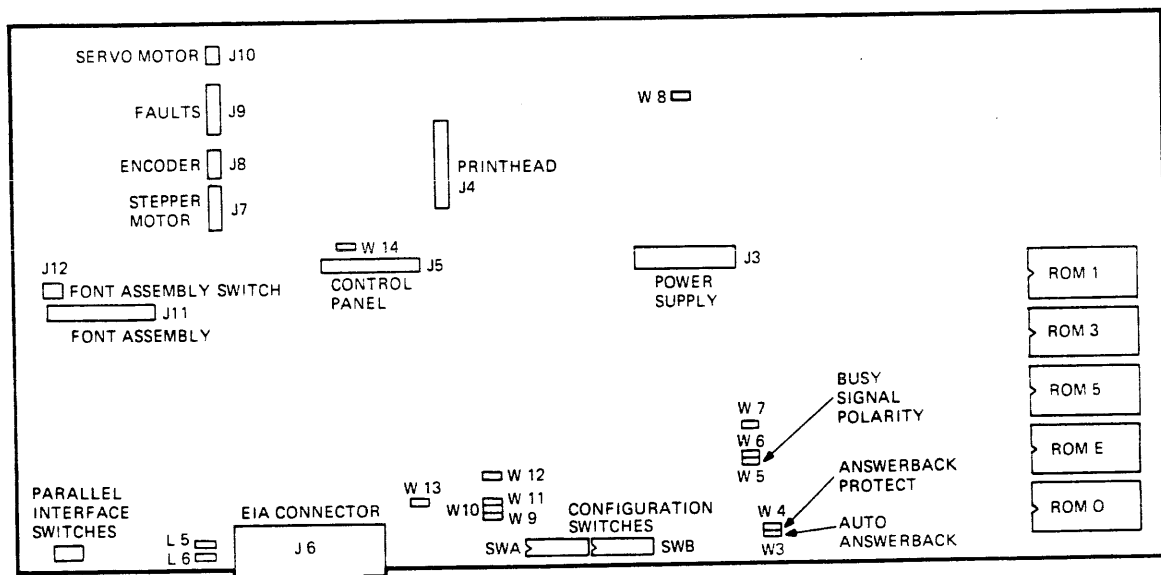
Figure 8-6   Logic Board Connector Locations

8.5   FONT ASSEMBLY

Remove the font assembly as follows.

WARNING
Set the power switch to 0 (off) and
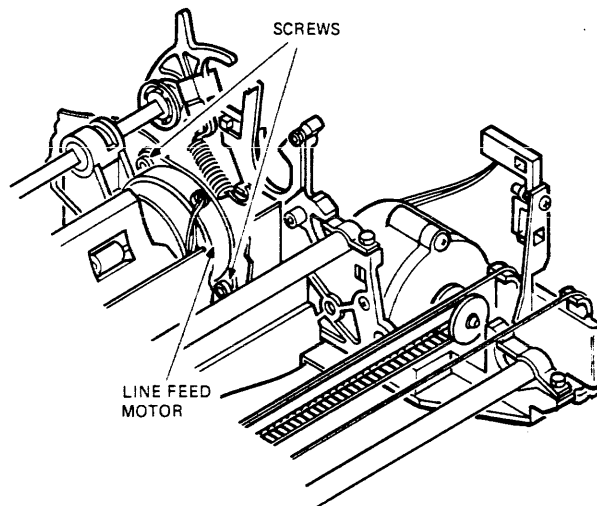disconnect the ac power cord.

First, remove the following FRUs in order.

Logic board (Paragraph 8.4)
Top cover (Paragraph 8.3.1)

1.   Loosen the three screws holding the font assembly to the printer base assembly (Figure 8-7).

2.   Remove the font assembly.

To install the font assembly, reverse steps 1 and 2.
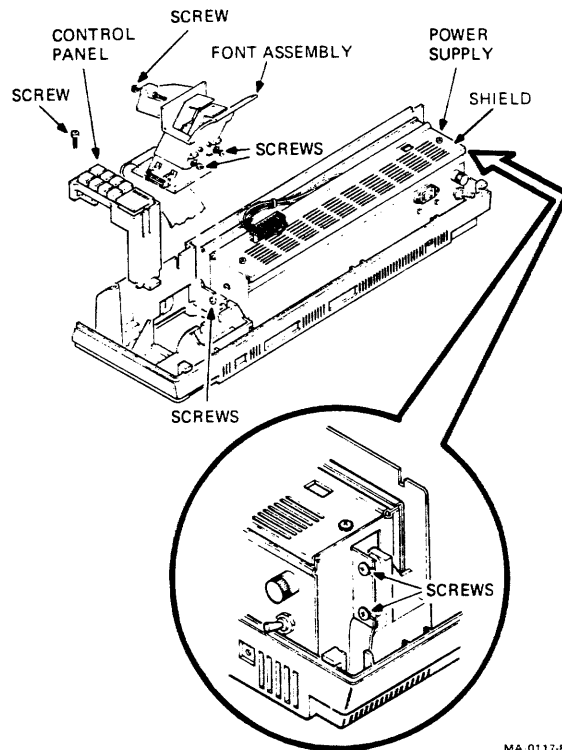
Figure 8-7   Font, Power Supply, and Control Panel Assemblies

8.6 POWER SUPPLY ASSEMBLY

Remove the power supply assembly as follows.

WARNING
Set the power switch to Ø (off) and
disconnect the ac power cord.

First, remove the following FRUs in order.

Top cover (Paragraph 8.3.1)
Font assembly (Paragraph 8.5)

1. Loosen the two screws that hold the power supply to the left side plate as viewed from the rear of the printer (Figure 8-7).

2. Remove the two screws that hold the power supply to the right side plate as viewed from the rear.

3. Remove the cable from the power supply.

4. Remove the power supply and the shield.

To install the power supply, reverse steps 1 through 4. Make sure the voltage selector switch on the replacement power supply is set to the correct voltage.

8.7 CONTROL PANEL ASSEMBLY

Remove the control panel as follows.

WARNING
Set the power switch to Ø (off) and
disconnect the ac power cord.

First, remove the following FRUs in order.

Logic board (Paragraph 8.4)
Top cover (Paragraph 8.3.1)

1. Remove the screw holding the control panel to the base assembly (Figure 8-7).

2. Remove the control panel.

To install the control panel, reverse steps 1 and 2.

8.8   PRINTER MECHANISM

Remove the printer mechanism as follows.

> ### WARNING
> Set the power switch to Ø (off) and disconnect the ac power cord.

> ### NOTE
> Be sure to reinstall the ground plane straps correctly.

First, remove the following FRUs in order.

    Logic board (Paragraph 8.4)
    Top cover (Paragraph 8.3.1)
    Font assembly (Paragraph 8.5)
    Power supply (Paragraph 8.6)

1.   Remove the interlock (Figure 8-16).

2.   Remove the wires from the paper-out switch (Figure 8-15).

3.   Remove the two clamps holding the printer mechanism (Figure 8-8).

4.   Swing the mechanism up and out of the bottom housing.

To install the printer mechanism, reverse steps 1 and 3.

CLAMPS
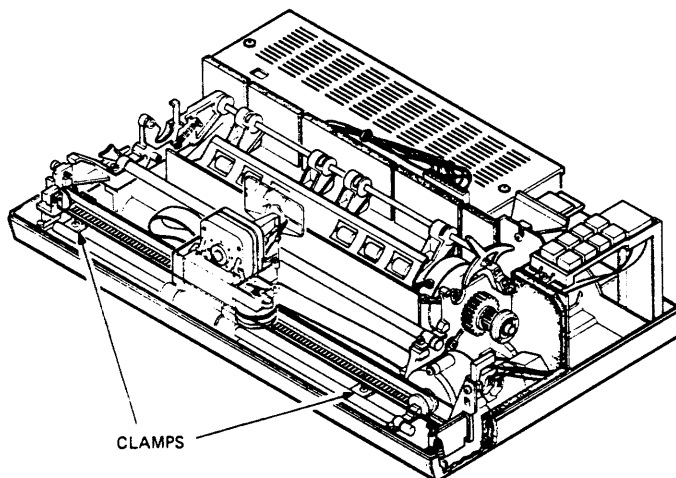
MA-0233-84A

Figure 8-8   Printer Mechanism

8.9   LINE FEED MOTOR ASSEMBLY

Remove the line feed motor assembly as follows.

WARNING
Set the power switch to Ø (off) and
disconnect the ac power cord.

First, remove the following FRUs in order.

   Logic board (Paragraph 8.4)
   Top cover (Paragraph 8.3.1)
   Printer mechanism (Paragraph 8.8)

1.   Remove the two screws holding the line feed motor to the printer mechanism (Figure 8-9).

2.   Remove the ground shield.

3.   Carefully feed the line feed motor cable through the printer mechanism and remove the motor assembly.

To install the line feed motor, reverse steps 1 through 3.

Figure 8-9   Line Feed Motor

8.10   SERVO MOTOR AND ENCODER ASSEMBLY

Remove the servo motor and encoder assembly as follows.

WARNING
Set the power switch to 0 (off) and
disconnect the ac power cord.

First, remove the following FRUs in order.

Logic board (Paragraph 8.4)
Top cover (Paragraph 8.3.1)

NOTE
Make sure to follow the original cable
routing when you install a new assembly.

1.   Loosen the timing belt (Figure 8-17) by turning the
tensioning screw clockwise.

2.   Remove the two screws holding the servo motor/encoder
assembly to the printer mechanism (Figure 8-10).

3.   Lift the assembly from the right side plate.

To install the servo motor encoder assembly, reverse steps 1
through 3. Readjust the timing belt (Paragraph 8.18).

8.11   FRICTION ASSEMBLY

Remove the friction assembly as follows.

WARNING
Set the power switch to 0 (off) and
disconnect the ac power cord.

First, remove the following FRUs in order.

Logic board (Paragraph 8.4)
Top cover (Paragraph 8.3.1)

1.   Remove the two clamps holding the printer mechanism
(Figure 8-8) and pull the mechanism forward.

2.   Remove the E-ring that secures the friction assembly end
cap to the right side plate (Figure 8-10).

NOTE
When you install the friction assembly,
make sure the spring is properly seated
in the right side plate.

E-RING

RIGHT SIDE
PLATE

FRICTION
ASSEMBLY

SERVO MOTOR/
ENCODER

SCREWS(2)
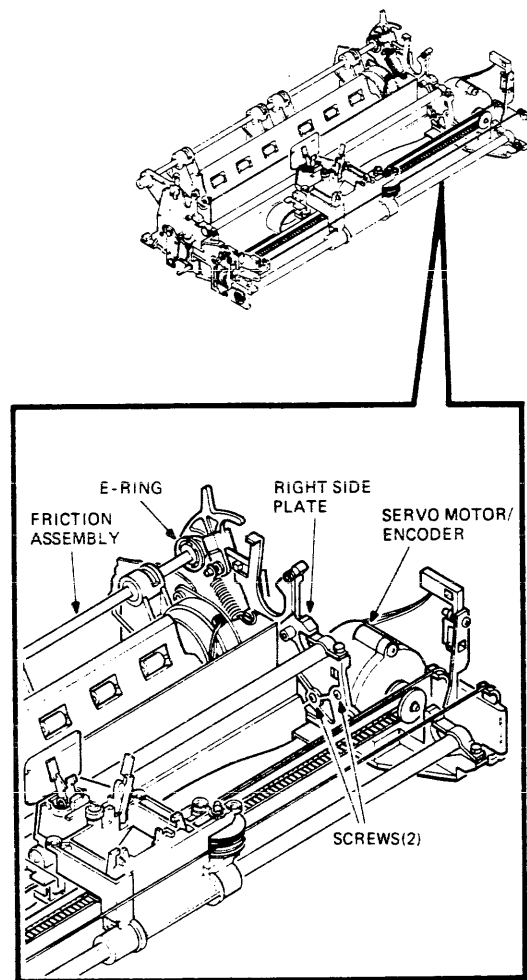
MA-0332-84

Figure 8-10   Servo Motor/Encoder
and Friction Assembly

3.   Pull the friction assembly towards the right side plate
     until the assembly is free from the left side plate.

     To install the friction assembly, reverse steps 1 through
     3.

8.12   DRIVE CLUSTER GEAR

Remove the drive cluster gear as follows.

WARNING
Set the power switch to 0 (off) and
disconnect the ac power cord.

First, remove the top cover (Paragraph 8.3.1).

1.   Use the retainer clip pliers to remove the C-clip that
     secures the drive cluster gear to the shaft (Figure
     8-11).

2.   Remove the drive cluster gear.

To install the drive cluster gear, reverse steps 1 and 2.

NOTE
Before you install the top cover, make
sure the drive cluster gear can move and
is not jammed.
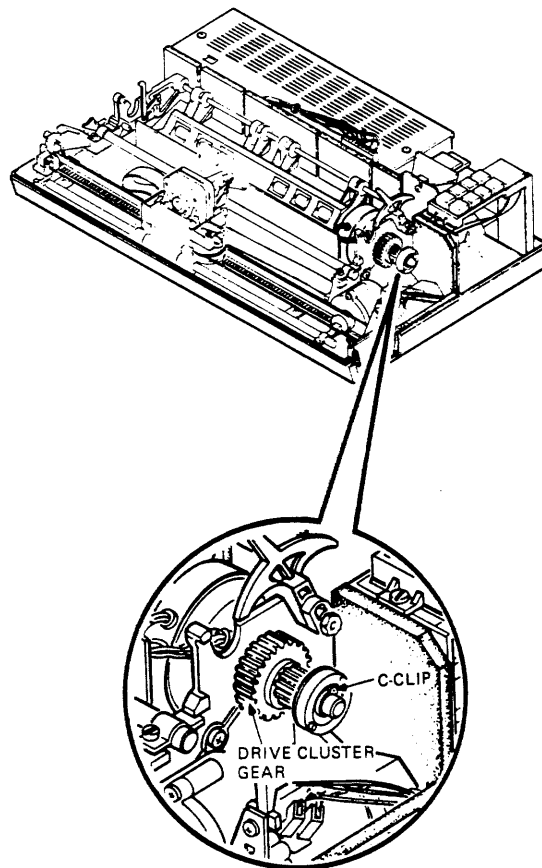
MA-0195-84

Figure 8-11   Drive Cluster Gear

8.13   RIBBON DRIVE CABLES

Remove the ribbon drive cables as follows.

WARNING
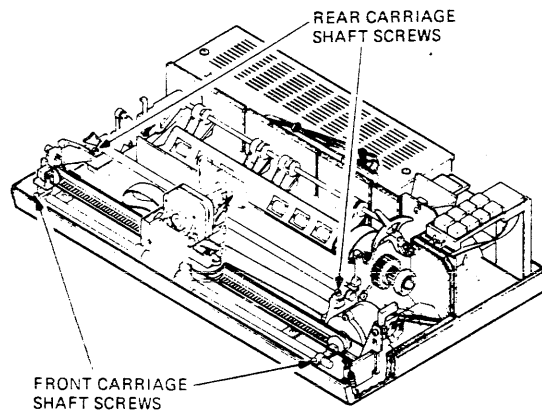Set the power switch to 0 (off) and disconnect the ac power cord.

First, remove the top cover (Paragraph 8.3.1).

1. Remove the two clamps holding the printer mechanism (Figure 8-7).

2. Remove the top ribbon cable by removing the cable ball from the left side plate, facing the front of the printer (Figure 8-12).

3. Remove the spring that holds the cable to the clamp.

4. Remove the ribbon drive cable.

5. Lift the printer mechanism. Remove the bottom ribbon cable by removing the cable ball from the right side plate (Figure 8-12).

6. Remove the spring that holds the cable to the clamp.

7. Remove the ribbon drive cable.

To install the ribbon drive cables, reverse steps 1 through 7.
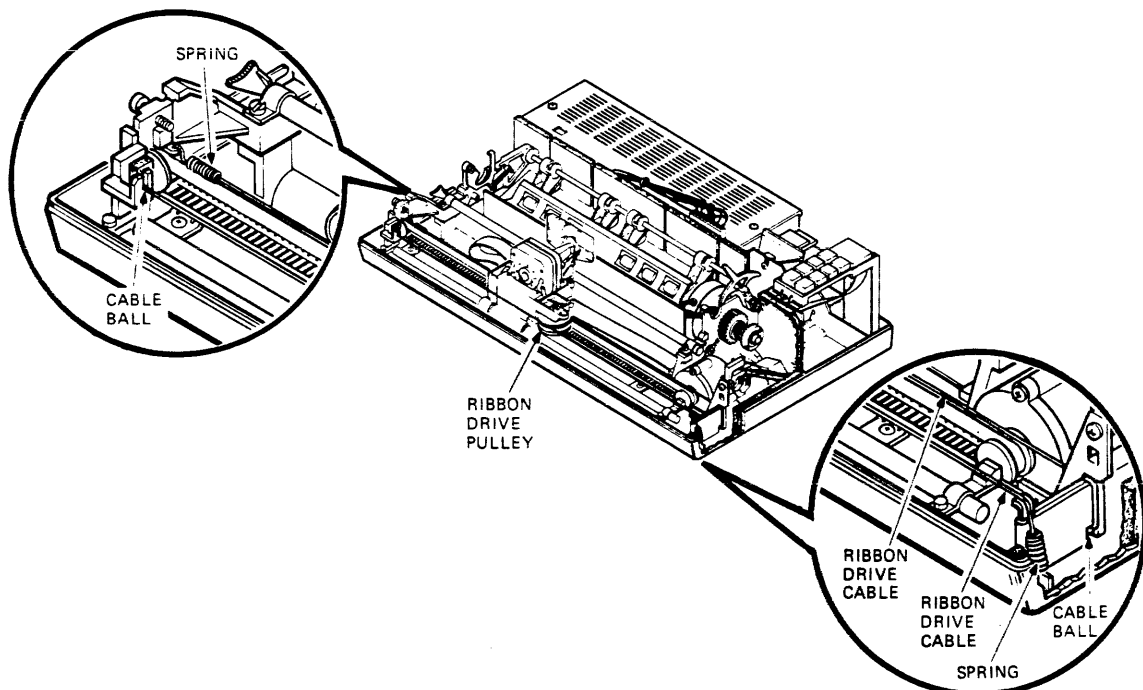
MA-0192-84

Figure 8-12   Ribbon Drive Cables

8-15

8.14   PRINTHEAD/HEADLIFT CABLE ASSEMBLY

Remove the printhead/headlift cable assembly as follows.

WARNING
Set the power switch to 0 (off) and
disconnect the ac power cord.

First, remove the following FRUs in order.

Top cover (Paragraph 8.3.1)
Printhead (Paragraph 8.2)
Printer mechanism (Paragraph 8.8)

1.   Disconnect the ribbon drive cables (Figure 8-12).

2.   Loosen the two rear carriage shaft screws (Figure 8-13).

3.   Remove the rear carriage shaft.

4.   Rotate the carriage towards the front of the printer (Figure 8-14).

5.   Remove the timing belt clips (Figure 8-14) and remove the belt from the carriage.

6.   Remove the nut from the printhead/headlift assembly and remove the clamp.

7.   Disconnect the printhead/headlift connector (Figure 8-14).

8.   Remove the printhead/headlift cable assembly from the carriage assembly.

9.   Disconnect the cable from the connector on the printer mechanism (if present).

To install the printhead/headlift cable assembly, reverse steps 1 through 4.

REAR CARRIAGE
SHAFT SCREWS

FRONT CARRIAGE
SHAFT SCREWS

MA-0233-84B

Figure 8-13   Carriage Shaft Screws

NUT

CLAMP

CONNECTOR

TAB

HEADLIFT
ASSEMBLY

CABLE

TIMING BELT
CLIPS (2)

CARRIAGE
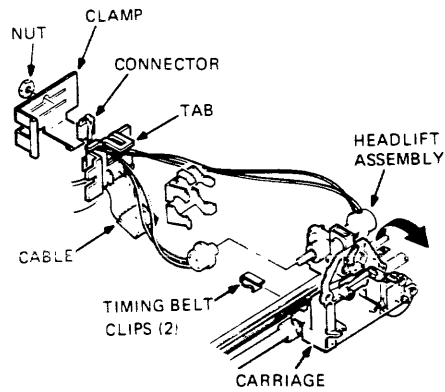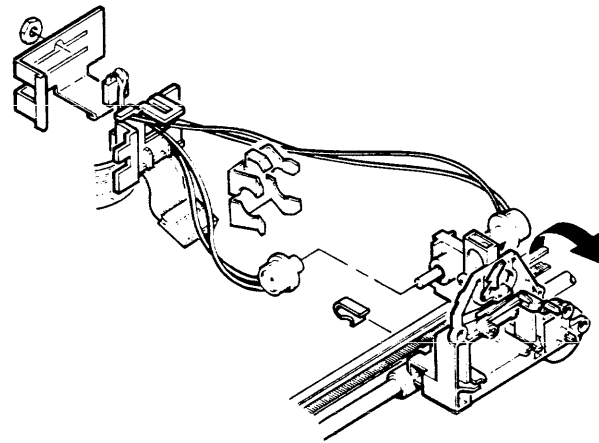
MA-0101-84

Figure 8-14   Printhead/Headlift
Cable Assembly

8.15   PAPER-OUT SWITCH ASSEMBLY

Remove the paper-out switch as follows.

WARNING
Set the power switch to Ø (off) and disconnect the ac power cord.

First, remove the following FRUs in order.

Logic board (Paragraph 8.4)
Top cover (Paragraph 8.3.1)
Printer mechanism (Paragraph 8.5)

1.   Disconnect the paper out cables at the microswitch (Figure 8-15).

MA-0329-84
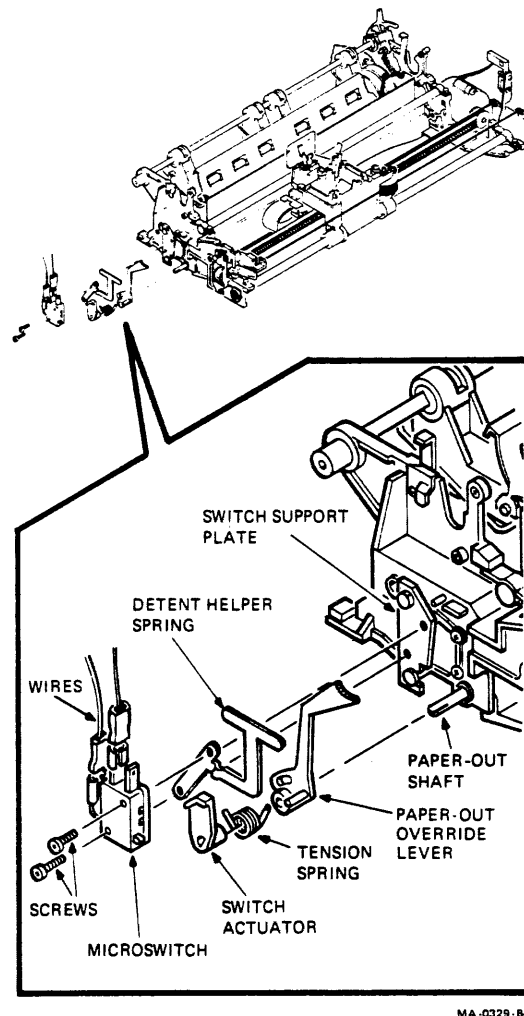
Figure 8-15   Paper-out Switch Assembly

2. Loosen the bottom screw holding the switch support plate.

3. Remove the top screw holding the switch support plate. Slide the switch support plate back off the bottom screw.

NOTE
When you install a new switch support plate, you must adjust the plate before securing it to the printer mechanism. Make sure the two screws are only finger-tight before you make this adjustment.

4. Remove the microswitch and detent helper spring from the switch support plate by removing the two screws and two kep nuts.

5. Press the ends of the tension spring slightly together, then slide the switch actuator and spring off the paper-out shaft.

NOTE
When you install a new assembly, make sure the spring is held in place between the retaining pins on the paper-out override lever and the switch actuator.

6. Remove the spring from the switch activator.

7. Slide the paper-out override lever off the paper-out shaft.

To install a new paper-out switch, reverse steps 1 through 6 and perform the following adjustment.

With the paper-out override lever in the detect position (toward the back of printer), adjust the switch support plate to activate (press) the microswitch. Then tighten the top switch support plate screw.

NOTE
The paper-out override lever must be in the detect position for the paper-out detection option to work.

8.16   INTERLOCK SWITCH ASSEMBLY

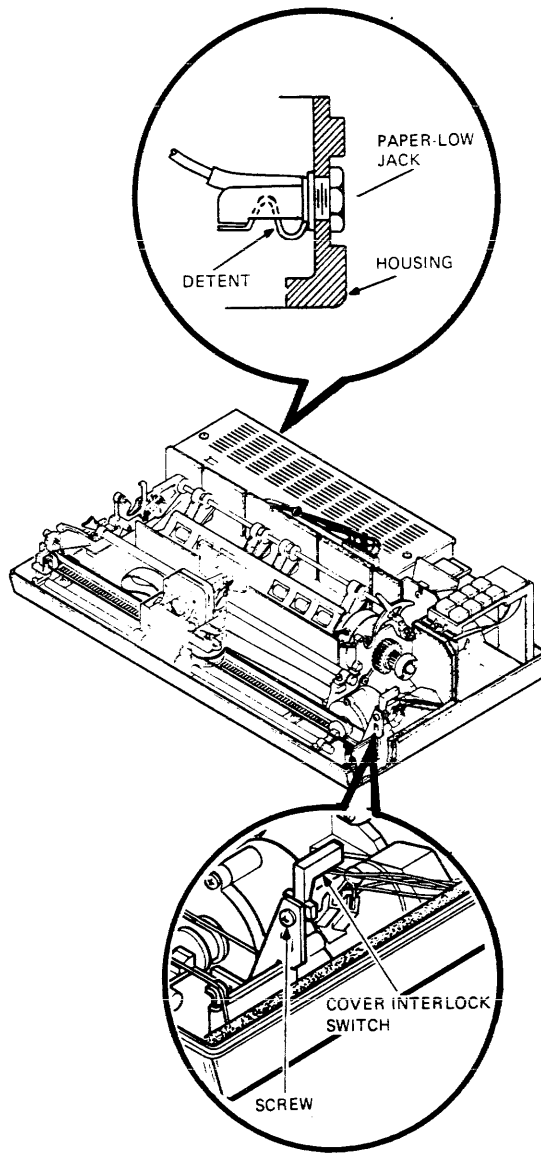Remove the interlock switch assembly as follows.

> WARNING
> Set the power switch to Ø (off) and
> disconnect the ac power cord at both
> ends.

First, remove the following FRUs in order.

    Logic board (Paragraph 8.4)
    Top cover (Paragraph 8.3.1)
    Printer mechanism (Paragraph 8.8)

1.   Remove the screw holding the cover interlock switch to
      the printer mechanism (Figure 8-16).

2.   Remove the paper-low jack from the rear of the bottom
      housing.

3.   Remove the interlock switch assembly.

To install the cover interlock switch, reverse steps 1 and 3. Be
sure to install the paper-low jack with the detent facing down
(Figure 8-16).

Figure 8-16   Interlock Switch Assembly

8.17   IDLER PULLEY ASSEMBLY

Remove the idler pulley assembly as follows.

WARNING
Set the power switch to Ø (off) and
disconnect the ac power cord.

First remove the following FRUs in order.

    Top cover (Paragraph 8.3.1)
    Printer mechanism (Paragraph 8.5)

1.   Remove the two screws holding the servo motor to provide slack to the timing belt (Figure 8-9).

2.   Remove the belt tensioning screw and locking nut holding the flexure retainer (Figure 8-17).

3.   Pull the retainer from the printer mechanism to remove the belt from the pulley.

4.   Remove the flexure retainer.

5.   Remove the pulley and tension assembly.

To install a new idler pulley assembly, reverse steps 1 through 5 and perform the adjustments as follows.

1.   Disconnect the ribbon drive cable spring (Figure 8-18).

2.   Position flats on the idler pulley shaft. Line them up with the flats on the flexure retainer.

3.   Install the belt-tensioning screw and turn the screw until it touches the flexure retainer without changing the initial position of the tension spring.

4.   Lock the setting with the lock nut.

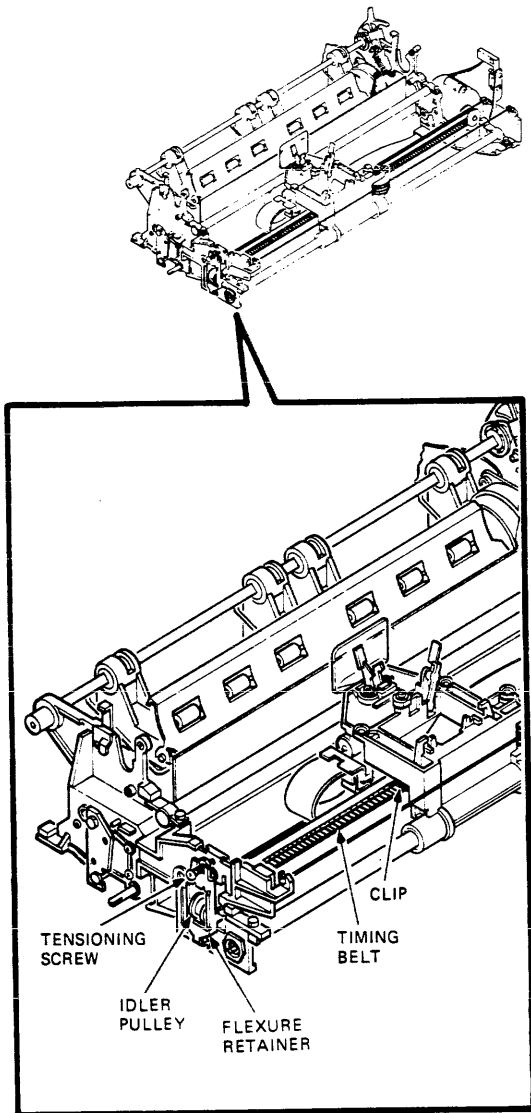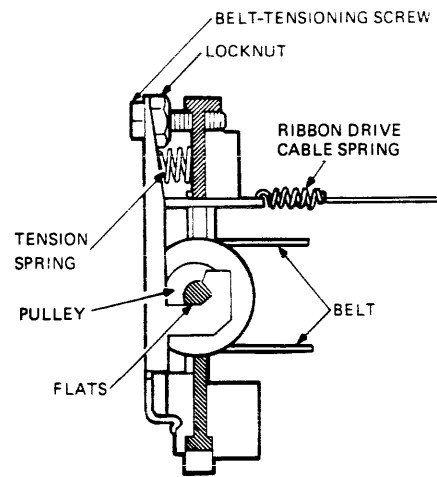5.   Reconnect the ribbon drive cable spring.

Figure 8-17   Idler Pulley
Assembly

BELT-TENSIONING SCREW
LOCKNUT
RIBBON DRIVE
CABLE SPRING
TENSION
SPRING
PULLEY
BELT
FLATS

MA-1321-84

Figure 8-18   Flexure Retainer

CLIP
TENSIONING
SCREW
TIMING
BELT
IDLER
PULLEY
FLEXURE
RETAINER

MA-0331-84

8.18   TIMING BELT

Remove the timing belt (Figure 8-17) as follows.

WARNING
Set the power switch to 0 (off) and
disconnect the ac power cord.

First, remove the following FRUs in order.

    Top cover (Paragraph 8.3.1)
    Printer mechanism (Paragraph 8.5)
    Idler pulley (Paragraph 8.17)

1.   Remove the timing belt from the servo motor pulley
     (Figure 8-10).

2.   Remove the two clips that hold the timing belt to the
     carriage assembly (Figure 8-14).

3.   Slip the timing belt out of the carriage assembly and
     remove the timing belt.

To install a new timing belt, reverse steps 1 through 3. When you
install the idler pulley, perform the following adjustments
(Figure 8-18).

1.   Disconnect the ribbon drive cable spring.

2.   Position the flats on the idler pulley shaft to line up
     with the flats on the flexure retainer.

3.   Tighten the belt-tensioning screw until the screw touches
     the flexure retainer, without changing the initial
     position of the tension spring.

4.   Lock the setting with the lock nut.

5.   Reconnect the ribbon drive cable spring.

8.19   CARRIAGE ASSEMBLY

The following procedure describes how to remove and install the
carriage assembly.

WARNING
Set the power switch to Ø (off) and
disconnect the ac power cord.

First, remove the following FRUs in order.

Logic board (Paragraph 8.4)
Top cover (Paragraph 8.3.1)
Printer mechanism (Paragraph 8.5)
Printhead (Paragraph 8.2)

1.   Remove the clips that secure the timing belt to the
      carriage assembly (Figure 8-14).

2.   Slide the timing belt from the carriage assembly.

3.   Remove the ribbon drive cables (Paragraph 8.12). Slide
      the carriage to the left.

4.   Remove the rear carriage shaft by removing the two hex
      screws and shaft clamps at each end of the rear carriage
      shaft (Figure 8-13).

5.   Loosen the two hex screws at each end of the front
      carriage shaft.

6.   Remove the front carriage shaft by sliding it out toward
      the left side plate.

7.   Remove the carriage assembly.

To install a new carriage assembly, reverse steps 1 through 7.

NOTE
Slide the new carriage assembly fully to
the right and then to the left. If it
does not slide smoothly, rotate both
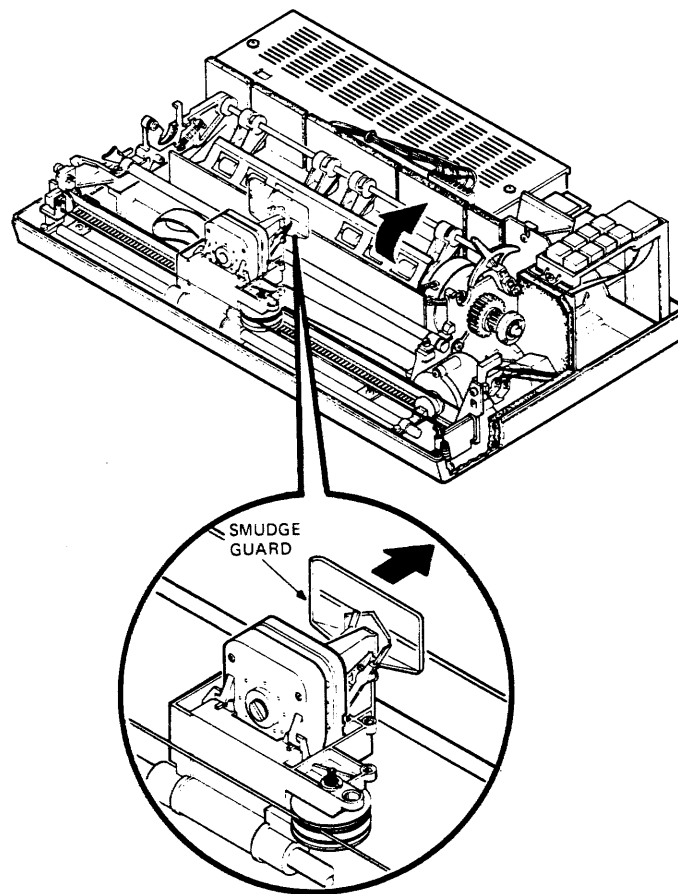front and rear carriage shafts as
needed.

8.20   Smudge Guard

Remove the smudge guard (Figure 8-19) as follows.

First, remove the top cover (Paragraph 8.3.1).

    1.   Swing back the friction assembly (Figure 8-19).
    2.   Pull the smudge guard toward the back of the printer.

To install the smudge guard, reverse steps 1 and 2, then replace the top cover.


MA-0111-85

Figure 8-19   Smudge Guard

8.21   RECOMMENDED SPARES LIST (RSL)

Table 8-1 lists the recommended spares for the LA210 Letterprinter.

Table 8-1   Recommended Spares

Description	Part Number
Access cover (safety window assy)	70-20797-01
Base housing	74-20800-01
Carriage assembly	70-20694-01
Control panel	70-21151-01
EIA loopback connector	12-15336-01
Font assembly	70-20810-01
Friction assembly	70-15733-01
Friction feed cam	74-22987-00
Ground strap (left)	74-29690-01
Ground strap (right)	74-29691-01
Idler pulley assembly	70-15735-00
Interlock switch assembly	70-21241-01
Line feed motor	12-17474-00
Logic board	70-20689-01
Paper drive cluster gear	70-21225-01
Paper-out shaft	12-15782-00
Paper-out release lever	74-28715-00
Paper-out switch	12-16371-00
Platen	70-20684-01
Power cord (120 V)	17-00606-06
Power supply	H7844
Printer mechanism assembly	70-20693-01
Printhead	70-19655-01
Printhead adjustment lever	70-18639-00
Printhead/headlift cable assembly	70-19655-01
Printhead release lever	74-25720-00
Ribbon cartridge	36-25798-01
Ribbon drive cable	12-15348-00
Servo motor/encoder assembly	70-20681-01
Smudge guard	70-19659-01
Timing belt	12-15362-00
Timing belt spring clip	74-30386-01
Top cover	70-21249-01
Tractor assembly	70-21248-00
4 amp fuse	90-07219-02
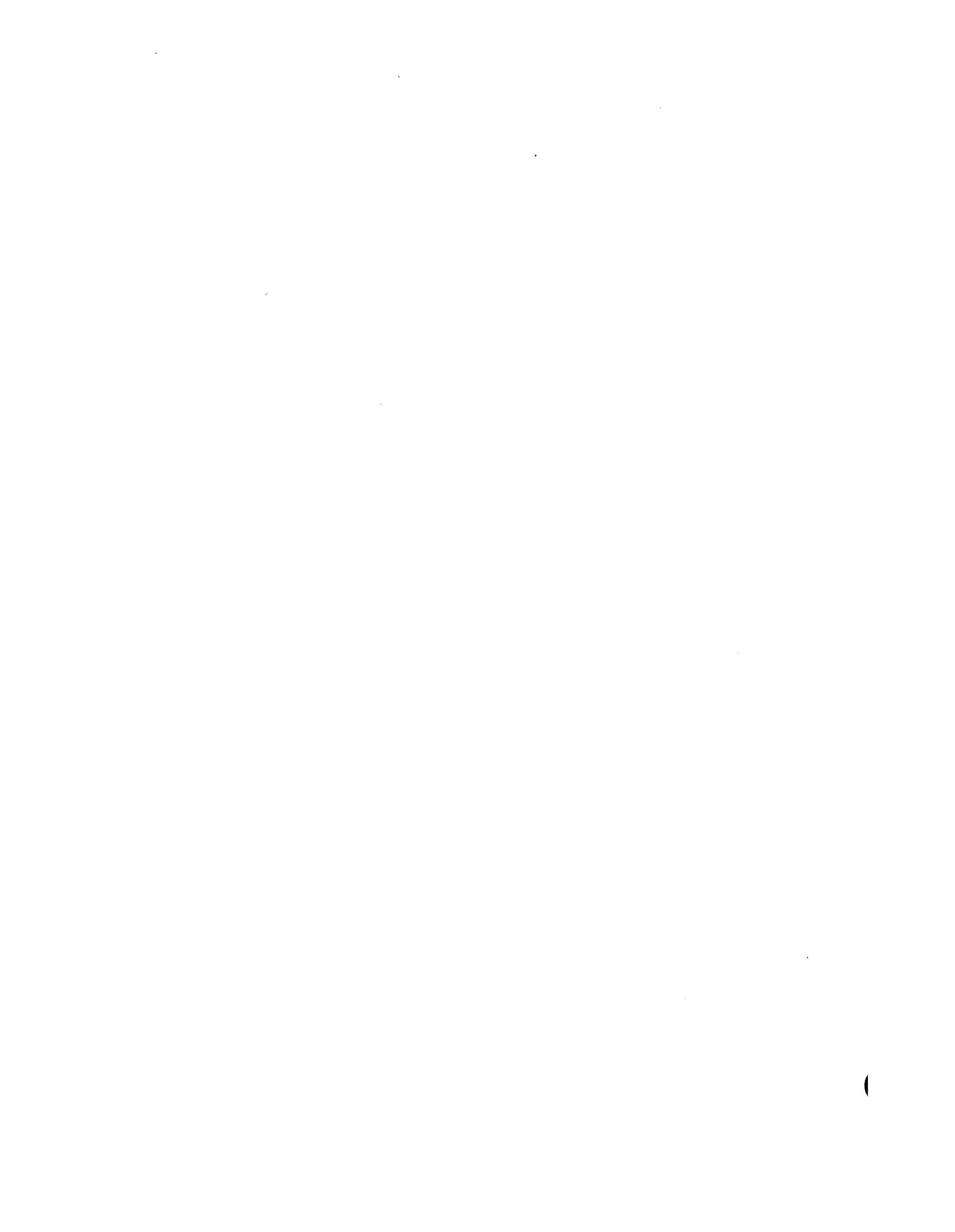
APPENDIX A
BASE MODELS

There are three models of the LA210 Letterprinter. All models are supplied with a tractor. The International and European models are supplied with a country kit.

Model Number   Description

LA210-AA   United States model

LA210-A2   International model, operates on 120 volts

LA210-A3   European model, operates on 240 volts

The options for the LA210 Letterprinter include: fonts, the parallel interface, the bidirectional forms tractor, and the single-sheet feeder.

B.1   EIA INTERFACE

Table B-1 describes the EIA interface pin assignments. Figure B-1
shows the DB-25 (EIA RS232-C) connector at the rear of the
terminal.

For special applications, you can disable the PGND (pin 1), BUSY
(pin 11), SDPI (pin 12), SRTS (pin 19), and SPDS (Pin 23) signal
lines by removing the corresponding jumpers. (See Paragraph 5.5.10
and Table 5-4.)
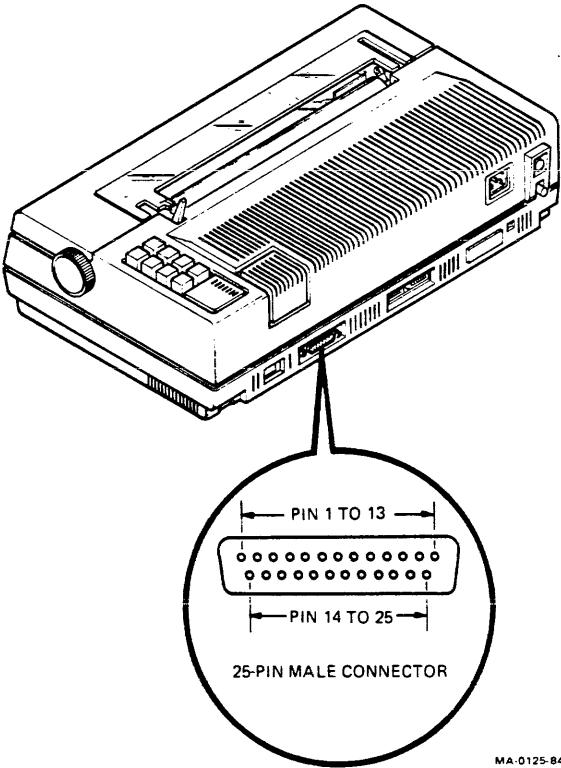
Figure B-1   DB-25 (EIA RS232-C) Connector

Table B-1   EIA Interface Pin Assignments

Pin	Name	Mnemonic	CCITT/EIA Designation	Description
1	Protective ground	PGND	101/AA	Connected to the chassis. Also connected to external ground through the third wire of the power cord.
2	Transmitted data	TXD	103/BA	Serially encoded characters generated by the printer.
3	Received data	RXD	104/BB	Serially encoded characters received by the printer.
4	Request to send	RTS	105/CA	When the RTS signal is on, the printer is ready to receive data.
5	Clear to send	CTS	106/CB	The modem sends CTS in response to RTS to indicate that it is ready to transmit data.
6	Data set ready	DSR	107/CC	DSR is on when the modem is ready. The printer does not receive data until this signal is on.
7	Signal ground	SGND	102/AB	Establishes a common ground reference potential for all interface circuits. This circuit is permanently connected to protective ground.
8	Receive line signal detect (carrier detect)	RLSD (CD)	109/CF	When RLSD is on, the modem has received the data carrier signal. The printer does not receive data until this signal is on.

Table B-1   EIA Interface Pin Assignments (Cont)

Pin	Name	Mnemonic	CCITT/EIA Designation	Description
9	Clock baud rate (switched)	RXC	--	Clock for parallel interface option.
10	No connection	--	--	--
11	Restraint signal	BUSY	--	In restraint mode, when BUSY is on, the printer requests the host to temporarily stop sending data because the input buffer is almost overflowed. In speed mode, BUSY is the same as SPDS.
12	Speed indicator	SDPI	CI	In speed mode, with SDPI on, the printer operates at 1200 baud regardless of operator selection. With SDPI off, speed mode is operator selected. In restraint mode, SPDS is the same as BUSY.
13-18	No connection	--	--	--
19	Secondary request to send	SRTS	120/SCA	In restraint mode, SRTS defines the receive ready state of the printer. SRTS functions as XON/XOFF or BUSY signals. In speed mode, SRTS is the same as SPDS.
20	Data terminal ready	DTR	108.2/CD	When the DTR signal is on, the printer can receive data.
21-22	No connection	--	--	--

Table B-1   EIA Interface Pin Assignments (Cont)

Pin	Name	Mnemonic	CCITT/EIA Designation	Description
23	Speed select	SPDS	111/CH	In speed mode and with the receive baud rate 1200 baud or higher, SPDS is on. In restraint mode, SPDS is the same as BUSY.
24	No connection	--	--	--
25	+5 volts (switched)	--	--	Printer supplies power to parallel interface option through this pin.

B.2   PARALLEL INTERFACE

When using the parallel interface option (Figure 6-7), refer to the LA10X-EP External Parallel Interface Adapter User Guide (EK-L10EP-UG) for pin assignment and signal information.

APPENDIX C
OPTIONS AND ACCESSORIES

C.1   OPTIONS

The following options for the LA210 Letterprinter are currently available.

Part Number	Description
LA21X-BT	Bidirectional tractor
LA21X-SF	Cut sheet feeder
LA10X-AA	High resolution Courier 10 US/UK primary ROM cartridge
LA10X-AB	High resolution Courier 12 US/UK primary ROM cartridge
LA10X-AC	High resolution Gothic 12 US/UK primary ROM cartridge
LA10X-AD	High resolution Orator 10 US/UK primary ROM cartridge
LA10X-AF	High resolution Gothic 10 US/UK primary ROM cartridge
LA10X-AH	Medium resolution Courier 10 US/UK primary ROM cartridge
LA10X-AJ	Medium resolution Orator 10 US/UK primary ROM cartridge
LA10X-AP	Italics ROM cartridge
LA10X-AR	DEC Technical ROM cartridge
LA10X-AS	Optical Character Reader A 10 primary ROM cartridge
LA10X-AT	Optical Character Reader B 10 primary ROM cartridge

Part Number	Description
LA10X-AU	Olde English primary ROM cartridge
LA10X-BA	High resolution Courier 10 international overlay ROM cartridge
LA10X-BB	High resolution Courier 12 international overlay ROM cartridge
LA10X-BC	High resolution Gothic 12 international overlay ROM cartridge
LA10X-BD	High resolution Orator 10 interntaional overlay ROM cartridge
LA10X-BF	High resolution Gothic 10 international overlay ROM cartridge
LA10X-BH	Medium resolution Courier 10 international overlay ROM cartridge
LA10X-BJ	Medium resolution Orator 10 international overlay ROM cartridge
LA10X-BN	APL 10 overlay ROM cartridge
LA10X-BV	Katakana 10 overlay ROM cartridge
LA10X-CA	High resolution Courier 10 US/UK primary ROM chip
LA10X-CB	High resolution Courier 12 US/UK primary ROM chip
LA10X-CC	High resolution Gothic 12 US/UK primary ROM chip
LA10X-CD	High resolution Orator 10 US/UK primary ROM chip
LA10X-CF	High resolution Gothic 10 US/UK primary ROM chip
LA10X-CH	Medium resolution Courier 10 US/UK primary ROM chip
LA10X-CJ	Medium resolution Orator 10 US/UK primary ROM chip
LA10X-CR	DEC Technical ROM chip
LA10X-CS	Optical Character Reader A 10 primary ROM chip
LA10X-CT	Optical Character Reader B 10 primary ROM chip
LA10X-CU	Olde English primary ROM chip
LA10X-DA	High resolution Courier 10 international overlay ROM chip

Part Number	Description
LA10X-DB	High resolution Courier 12 international overlay ROM chip
LA10X-DC	High resolution Gothic 12 international overlay ROM chip
LA10X-DD	High resolution Orator 10 international overlay ROM chip
LA10X-DF	High resolution Gothic 10 international overlay ROM chip
LA10X-DH	Medium resolution Courier 10 international overlay ROM chip
LA10X-DJ	Medium resolution Orator 10 international overlay ROM chip
LA10X-DN	APL 10 overlay ROM chip
LA10X-DV	Katakana 10 overlay ROM chip
LA10X-GA	High resolution Courier 10 LA10X-AA and LA10X-BA
LA10X-GB	High resolution Courier 12 LA10X-AB and LA10X-BB
LA10X-GC	High resolution Gothic 12 LA10X-AC and LA10X-BC
LA10X-GD	High resolution Orator 10 LA10X-AD and LA10X-BD
LA10X-GF	High resolution Gothic 10 LA10X-AF and LA10X-BF
LA10X-GH	Medium resolution Courier 10 LA10X-AH and LA10X-BH
LA10X-GJ	Medium resolution Orator 10 LA10X-AJ and LA10X-BJ
LA10X-HA	High resolution Courier 10 LA10X-CA and LA10X-DA
LA10X-HB	High resolution Courier 12 LA10X-CB and LA10X-DB
LA10X-HC	High resolution Gothic 12 LA10X-CC and LA10X-DC
LA10X-HD	High resolution Orator 10 LA10X-CD and LA10X-DD
LA10X-HF	High resolution Gothic 10 LA10X-CF and LA10X-DF
LA10X-HH	Medium resolution Courier 10 LA10X-CH and LA10X-DH
LA10X-HJ	Medium resolution Orator 10 LA10X-CJ and LA10X-DJ
LA10X-JA	Courier 10 Multinational ROM cartridge
LA10X-JB	Courier 10 Multinational ROM cartridge

Part Number	Description
LA10X-JC	Orator 10 Multinational ROM cartridge
LA10X-JD	Orator 10 Multinational ROM cartridge
LA10X-JF	Gothic 10 Multinational ROM cartridge
LA10X-JH	Courier 10 Multinational ROM cartridge
LA10X-JJ	Orator 10 Multinational ROM cartridge
LA10X-JN	VT100 10 characters/inch ROM cartridge
LA10X-JP	VT100 12 characters/inch ROM cartridge
LA10X-JR	VT100 10 characters/inch ROM cartridge
LA10X-KA	Courier 10 Multinational ROM chip
LA10X-KB	Courier 12 Multinational ROM chip
LA10X-KC	Gothic 12 Multinational ROM chip
LA10X-KD	Orator 10 Multinational ROM chip
LA10X-KF	Gothic 10 Multinational ROM chip
LA10X-KH	Courier 10 Multinational ROM chip
LA10X-KJ	Orator 10 Multinational ROM chip
LA10X-KN	VT100 10 characters/inch ROM chip
LA10X-KP	VT100 12 characters/inch ROM chip
LA10X-KR	VT100 10 characters/inch ROM chip
LA10X-LA	IBM Line Drawing ROM cartridge
LA10X-LB	MX-80 Mosaic ROM cartridge
LA10X-LC	Graftrax ROM cartridge
LA10X-LD	IBM Foreign ROM cartridge

NOTE
Primary font ROMs contain US and UK ASCII character sets. International overlay fonts contain ASCII German, French, Italian, Spanish, Finnish, Norwegian/Danish, Swedish, French Canadian, and VT100 line drawing character sets.

C.2   ACCESSORIES AND SUPPLIES

The following LA210 Letterprinter accessories, supplies, components, and spares are available. Check with your sales representative or Digital's Installed Base group for the latest information.

Part Number	Description
LA10R-06	6 ribbon cartridges
DF02-AA	Direct-connect, AT&T 103J equivalent, 300 bits per second, full-duplex, asynchronous modem with EIA RS232-C interface
DF03-AA	Direct-connect, AT&T 212A equivalent, 300/1200 bits per second, full-duplex, synchronous modem with EIA RS232-C interface
BCC22A-10 (standard)	EIA RS232 female shielded null modem cable, 3 m (10 ft)
BCC22-25 (optional)	EIA RS232 female shielded null modem cable, 7.6 m (25 ft)
DF01-A	Acoustic telephone coupler, 300 baud
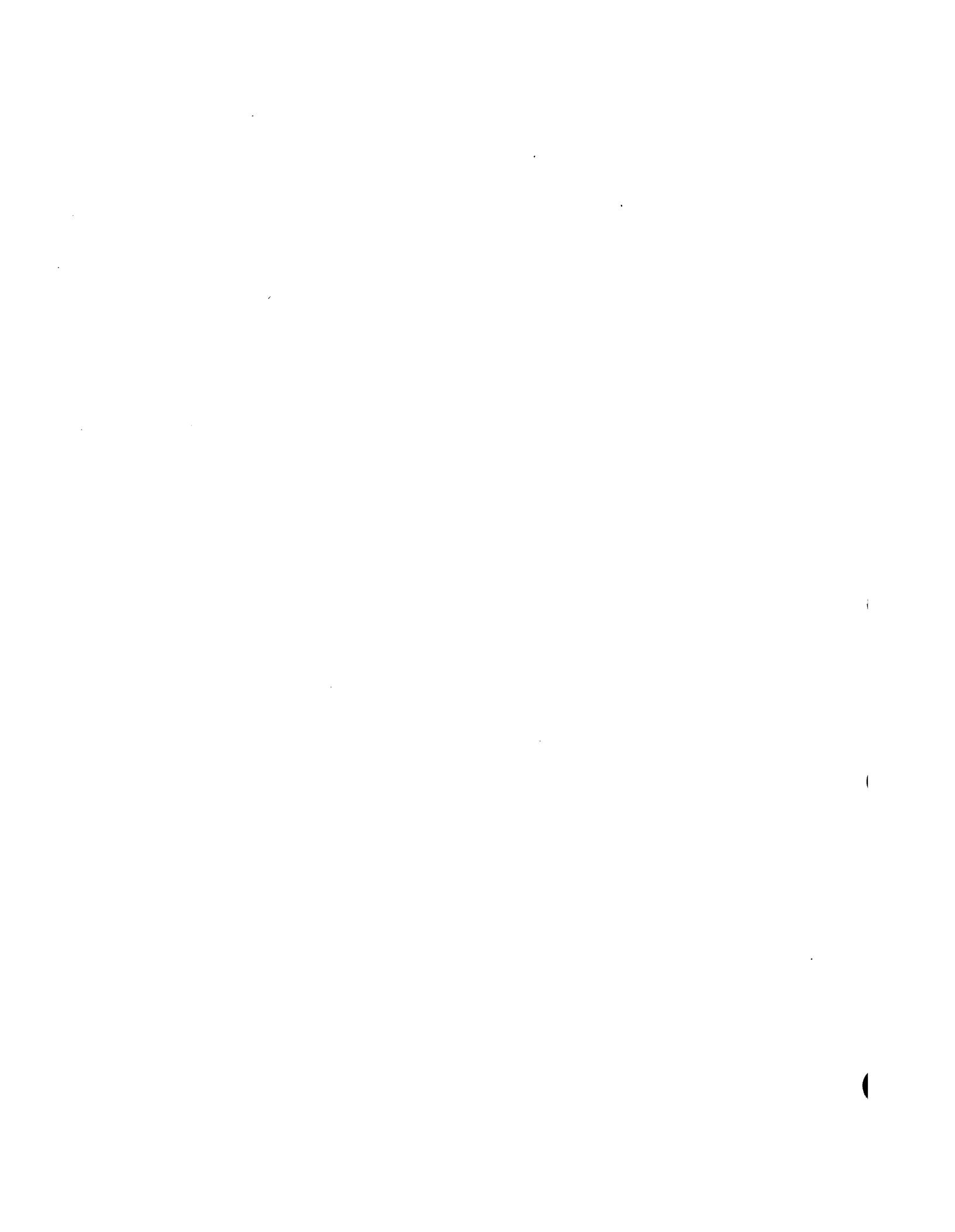
APPENDIX D
SPECIFICATIONS

This appendix lists the specifications for the LA21Ø Letterprinter.

Physical Characteristics

Dimensions
    Width   54.6 cm (21.5 in)
    Depth   34.3 cm (13.5 in)
    Height   12.7 cm (5 in) without tractor
                               22.8 cm (9 in) with tractor
    Weight   11.3 kg (25 lb)

Power Supply

    Model LA21ØA   90 to 128 Vac
    Model LA21ØB   180 to 256 Vac

                               47 to 63 Hz

    Power consumption   154 W

Temperature

    Operating 10° to 40°C (50° to 104°F),
                               noncondensing

    Nonoperating -40° to 66°C (-40° to 151°F),
                               noncondensing

Relative humidity

    Operating   10% to 90% with maximum

Operating Characteristics

Printing technique   Impact dot matrix

Print matrix	DEC Mode	IBM/Epson Emulation (extended height)
Draft mode	7 X 9 dots/char	9 X 12 dots/char
Letter mode (high density)	330 X 144 dots/in (33 X 18 dots/char at 10 chars/in)	33 X 24 dots/char
	(28 X 18 dots/char at 12 chars/in)	28 X 24 dots/char
Letter mode (medium density)	330 X 72 dots/in (33 X 9 dots/char at 10 chars/in)	33 X 12 dots/char
	(28 X 9 dots/char at 12 chars/in)	28 X 12 dots/char

NOTE

In emulation mode, vertical resolution
is 144 dots/inch, with an algorithm to
approximate 216 dots/inch.

Graphic mode	73 X 72 dots/in
	82.5 X 72 dots/in
	94.29 X 72 dots/in
	110 X 72 dots/in
	132 X 72 dots/in
	165 X 72 dots/in
	220 X 72 dots/in
	330 X 72 dots/in

Maximum print rate

Draft mode (7 X 9 matrix)	240 chars/s (maximum) 185 chars/s (throughput) (10 chars/in, 132 columns)
Letter mode (33 X 18 matrix	40 chars/s (maximum) 30 chars/s (throughput) (10 chars/in, 132 columns)
Graphic mode	7 in/s (up to 2400 dots per sec)

Control System

Microprocessor	8085A
Control ROM	128K (16K X 8) and 64K (8K X 8)
RAM	2K (2K X 8)
Font PROMs	8K X 8
Input buffer 2K characters	2K X 8

Printing Characteristics

Horizontal slew rate	45 in/s
Single line feed time	50 ms
Vertical slew rate	5 in/s
Paper feed	Pin feed tractor drive, friction feed platen drive
Vertical pitch	2, 3, 4, 6, 8, or 12 lines per inch
	Host-selectable
Horizontal pitch	Low resolution/draft quality, 10, 12, 13.2, or 16.5 single-width characters per inch and 5, 6, 6.6, or 8.25 double-width characters per inch
	High resolution/letter quality, 10 single-width characters per inch or 5 and 6 double-width characters per inch
	Host-selectable

Maximum line length
(varies with horizontal pitch)

Chars/inch	Columns
10	132
12	158
13.2	168
16.5	217
5	66
6	79
6.6	84
8.25	108

Margins	Left, right, top, bottom
	Host-selectable
Tabs	216 horizontal 168 vertical
Character sets	USASCII
	VT100 Line Drawing
	Digital Finnish Digital Norwegian/Danish Digital Swedish Digital French Canadian Digital Multinational Digital Symbol-10
	ISO United Kingdom ISO French ISO Spanish ISO Italian ISO German Operator and host-selectable
Dot pattern sets	Courier 10, Courier 10 Multinational, VT100 line drawing set
	Additional DPSs in EPROMs or ROMs and cartridges (Appendix C)
Answerback	Up to 30 characters
Positioning commands	Horizontal and vertical, absolute and relative
Feature storage	True nonvolatile memory (no batteries)
Other printer features	Cover open interlock, self-test, status message, auto and manual last character visibility

Communication Features

Interface   EIA standard
                                  Parallel optional

Baud rates   50, 75, 110, 134.5, 150, 200, 300,
                                  600, 1200, 1800, 2400, 4800, 7200,
                                  and 9600 baud

Split baud rates

                                  Send / Receive
                                   75   600
                                   75   1200
                                  150   600
                                  150   1200
                                  300   2400
                                  300   4800
                                  600   2400
                                  600   4800

Character format   7- or 8-bit ASCII, serial,
                                  asynchronous

Parity   Even/odd, mark/space. Eighth,
                                  ninth or tenth bit set to mark
                                  or space

Input buffer   2K characters standard

Modem control   Full-duplex with or without EIA
                                  control (switch selectable)

Ribbon Specifications

Cartridge dimensions

    Length   10.64 cm (4.188 in)
    Width   14.15 cm (5.570 in)
    Height   1.42 cm X 0.051 cm
                                  (0.560 in X 0.02 in)

Ribbon fabric

    Material   Nylon, nontextured

    Thickness   0.086 mm X 0.1076 mm
                                  (0.0034 in X 0.0042 in)

    Width   1.27 cm X 0.0381 cm
                                  (0.5 in X 0.15 in)

Ribbon life   From 3.5M to 10M characters
                                  in continuous printing

Paper Specifications

Width	7.62 cm to 37.78 cm (3 in to 14.87 in)
Weight (single-part)	6.8 kg (15 lb) paper min 0.25 mm (0.010 in) card stock max
Weight (multipart)	1 to 4 parts (see note)
Thickness	0.50 mm (0.020 in) max

NOTE

Multipart forms may have only one card. The card must be on the back. First-surface impact paper is not recommended. Dot or line glue margins are acceptable (if line is on one margin only). Split forms (forms with a different number of sheets on each side) are not recommended. Single-part paper may be used with the cut-sheet feeder option. Stapled forms are not recommended.

INDEX

D

E

T

U

V

W

X

READER'S COMMENTS

Your comments and suggestions will help us in our efforts to improve the quality and usefulness of our publications.

1. **Which of the following most closely describes your job?**

   (a) Administrative support   (d) Scientist/Engineer   (g) Educator/Trainer

   (b) Programmer/Analyst   (e) Systems Manager   (h) Computer Operator

   (c) Software support   (f) Sales   (i) Other _____

   1 ca⊃ cb⊃ cc⊃ cd⊃ ce⊃
      cf⊃ cg⊃ ch⊃ ci⊃

2. **How many years of experience do you have with computers?**

   (a) Less than 1   (b) 1 to 3   (c) 4 to 6   (d) 7 to 9   (e) 10 or more

   2 ca⊃ cb⊃ cc⊃ cd⊃ ce⊃

3. **What did you like _most_ about this manual?**

4. **What did you like _least_ about this manual?**

5. **How do you rate this manual?**

   Indicate your opinion of the quality of the manual. For each aspect of quality, darken your response on the five-point scale, where (1) = POOR and (5) = EXCELLENT

(a) Accuracy	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(b) Completeness	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(c) Usefulness of Examples/Figures	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(d) Clearness of Language	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(e) Helpfulness of Index/Table of Contents	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(f) Consistency in Presenting Information	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(g) Logical Organization	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(h) Visual Appeal	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(i) Relevance of Information	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(j) Ease of Learning	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(k) Ease of Use	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(l) YOUR OVERALL IMPRESSION	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(m) Quality Relative to Other Digital Manuals	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃
(n) Quality Relative to Other Companies' Manuals	c1⊃	c2⊃	c3⊃	c4⊃	c5⊃

6. **List any errors you found in the manual. (Reference page, table, or figure numbers.)**

7. **Do you have any additional comments?**

Name _____ Company _____

Title _____ Department _____

Street _____ City _____ State/Country _____ Zip _____

Telephone No. [_____] Date [_____]

MY

digital

BUSINESS REPLY MAIL

FIRST CLASS   PERMIT NO. 33   MAYNARD, MA.

POSTAGE WILL BE PAID BY ADDRESSEE

DIGITAL EQUIPMENT CORPORATION
Educational Services/Quality Assurance
12 Crosby Drive BUO/E08
Bedford, MA 01730

ILLUSTRATED
PARTS
BREAKDOWN

LA210
LETTERPRINTER

HOW TO USE THE IPB

GENERAL
This IPB is compiled following the organization and nomenclature of the engineering drawing structure.

MAJOR ASSEMBLY LOCATOR
The Major Assembly Locator (first illustration) is an index that provides a description and a figure reference for all illustrations used in this manual.

INDENTED PARTS LIST
This manual identifies each assembly being broken down (figure reference callout), and all parts of that assembly. Further breakdown of an assembly is shown by an asterisk (*) preceding the item callouts in the Description Column. The number of asterisks preceding an item is used to denote the subordination of that item with respect to the Major Assembly. A single asterisk preceding an item description indicates that the item is part of the major assembly being illustrated. Items that are subordinate to single asterisks items, are denoted by two asterisks (**) and immediately follow the related single asterisk item. Additional asterisks are used, as required, to denote further subordination. This system of part identification, provides a means for the user to identify the next higher assembly item and make alternate selections for parts when the required replacement part or assembly is not immediately available.

COLUMN CALLOUT DESCRIPTION
Figure & Item — Indicates the figure number and item number of each part.

Description — Lists the name of the part and pertinent specifications (when required). Asterisks preceding the description denote the subordination of the part to the next higher assembly.

DEC Part No. — Lists the DEC part ordering number. A blank in this column indicates a DEC part number was not assigned at the time of publication.

ECO Cut-In — The notation at the top of this column indicates the ECO level of the system (option), at which the IPB was initially prepared. Subsequent ECO level designations, that modify existing parts or add new parts to the device, are inserted in the ECO Cut-In column next to the part that is added or modified. A bracket ([) preceding the item description is used to indicate the parts affected by ECO's.

Vendor Code/Part No. — Indicates vendor parts that are not stocked by DEC. Refer to the Field Service Spares Catalog (vendor part number to DEC part number) for the vendor code cross-reference.

Used On Code — Letters in this column correspond to the variation codes assigned in Figure 1. Parts with an Alpha notation(s) are used only in those option variations. A blank indicates that the part is used on all option variations.

Ref Fig No. — A cross reference between illustrations. For each Major Assembly, the number in this column denotes the figure of the next higher assembly. For all subassemblies, the number in this column denotes the figure showing additional detailed breakdown.

SYMBOL USAGE
Hardware Designators — Alpha designators for screws (S), washers (W), nuts (N), and retaining rings (R) are inserted after the item number callouts on the illustration when stacked item numbers are used.

Attaching Hardware — The @ symbol is inserted before any part that is used as attaching hardware. Attaching hardware is denoted as those parts that are not an integral part of the referenced assembly.

(NFR) Not Field Repairable — The (NFR) symbol is inserted after any assembly that is not to be field dismantled.

Other Symbols — Any other symbols that are required for kits, accessories, etc., will be explained and appear as part of the item description.

REVISION HISTORY			OTHER IPB MANUALS REQUIRED
PRINTING	**ECO LEVEL**	**DATE**	**TO SUPPORT THIS OPTION........**
1st Printing	LA210 00003-00003 70-20681 00001-00001 70-20797 00000-00000 70-15733 00002-00002 70-21249 00000-00000 70-21859 00000-00000 70-20798 00000-00000 70-20679 00000-00000 70-20810 00001-00001 70-21242 00003-00003 70-21248 00000-00000 70-21151 00001-00001 70-21241 00000-00000 70-20693 00006-00006 70-20685 00000-00000 70-20680 00002-00002 70-20684 00000-00000		9-23-85	EK-H7844-IP-001

Figure 1. LA210 Letterprinter (Sheet 1 of 2)

LA210-01

Figure 1. LA210 Letterprinter (Sheet 2 of 2)

LA210-01A

FIG. & ITEM NO.	DESCRIPTION	C DEC PART NO.	ECO CUT-IN LA210 00003	USED ON CODE	REF FIG NO.
1—	LA210 LETTERPRINTER				
	Code A — Used on Model LA210-A2 120V	LA210-A2		A	
	Code B — Used on Model LA210-A3 240V	LA210-A3		B	
1	*Print Head Assembly (Laminated)	70-19655-01			
2	*PLATEN ASSEMBLY	70-20684-01			12
3	*TOP ACCESS COVER ASSEMBLY	70-20797-01			2
4	*BASE HOUSING/MECHANISM ASSEMBLY	70-20798-01			4
5	*INTERMEDIATE COVER ASSEMBLY	70-21249-01			3
6	*TRACTOR OPTION ASSEMBLY	70-21248-01			6
7	*Plug, Dip Switch	74-29952-01			
8	*Plug, Parallel Interface	74-29951-01			
9	*Plug, Keyboard	74-30158-01			
10	*LA210 USER KIT (Consists of items . .)	70-20809-01			
11	**Paper, Pkg. (132 Column) (Not Shown)	74-12103-00			
12	**Connector Assembly, Self-Test (Not Shown)	12-15336-01			
13	**Ribbon Cartridge (Not Shown)	36-20798-01			
	Labels (Not Shown)				
	*Label, "Serial LA210"	36-22760-01			
	*Label, "Warning, 100V-120V"	36-17905-16		A	
	*Label, "Warning, 220V-240V"	36-17905-17		B	
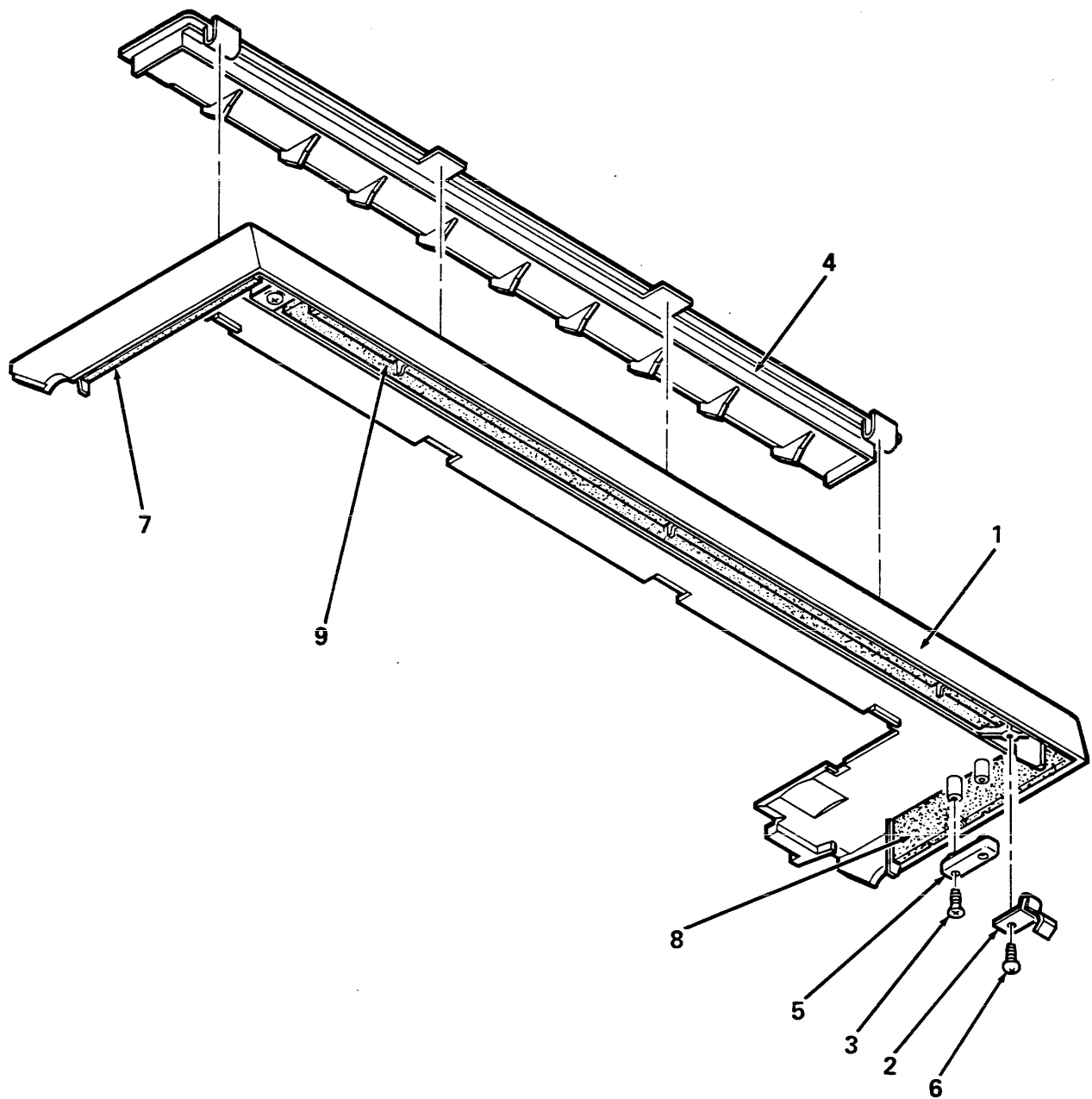
LA210-02

Figure 2. Top Access Cover Assembly

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO. ^A	ECO CUT-IN 70-20797 00000	USED ON CODE	REF FIG NO.
2–	TOP ACCESS COVER ASSEMBLY	70-20797-01			1
1	*Cover, Top	74-28396-01			
2	*Latch	74-29468-01			
3	*Screw, Phl Flat Hd No. 4-40 x 1/2 (Self Tapping)	90-09138-02			
4	*Window, Safety	74-28397-01			
5	*Switch Assembly, Reed, Magnetic	12-16697-02			
6	*Screw, Sems Phl Pan Hd No. 6-32 x 1/4	90-10174-00			
7	*Pad, Cover Side, L.H.	74-30154-01			
8	*Pad, Cover Side, R.H.	74-30154-02			
9	*Pad, Cover	74-30155-01			
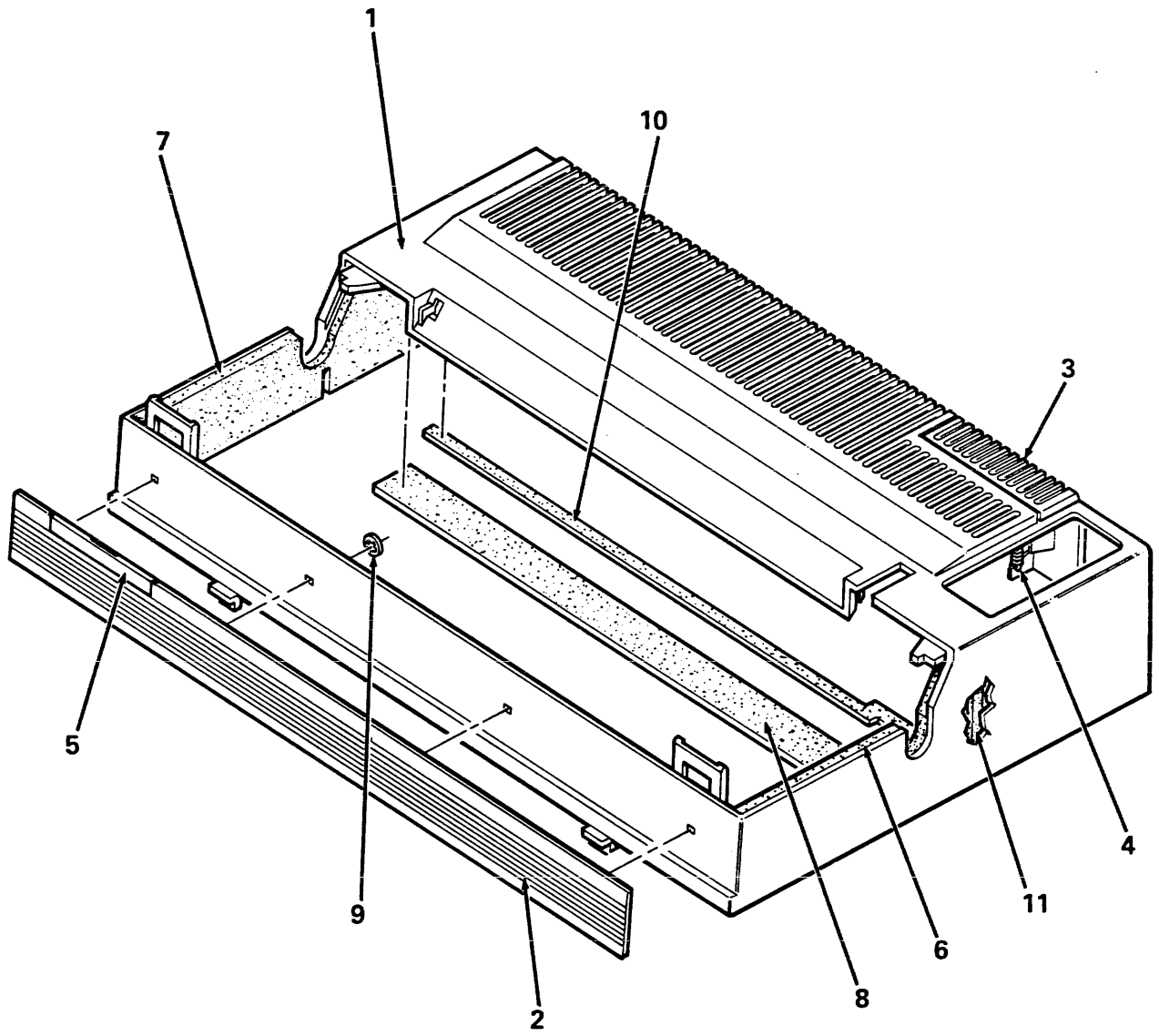
Figure 3. Intermediate Cover Assembly

LA210-03

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO.	A ECO CUT-IN 70-21249 00000	USED ON CODE	REF FIG NO.
3—	INTERMEDIATE COVER ASSEMBLY	70-21249-01			1
1	*Cover, Intermediate	74-28393-01			
2	*Panel, Trim	74-28400-01			
3	*Cover, ROM	74-28395-01			
4	*Spring, Extension	90-09278-00			
5	*Logo, "LA210 Letterprinter"	74-29867-01			
6	*Pad, R.H., Cover	74-30156-01			
7	*Pad, L.H., Cover	74-30157-01			
8	*Pad, Top Intermediate Cover	74-30396-01			
9	*Retaining Ring	90-09257-00			
10	*Pad, Top Cover	74-28723-01			
11	*Pad, Side Cover	74-28722-01			

Figure 4.   Base Housing/Printer Mechanism Assembly

LA210-04

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO.	ECO CUT-IN 70-20798 00000	USED ON CODE	REF FIG NO.
4—	BASE HOUSING/PRINTER MECHANISM ASSEMBLY	70-20798-01			1
1	*PRINTER MECHANISM ASSEMBLY	70-20693-01			9
2	*Base Housing Assembly	70-20800-01			
3	*ROM CHIMNEY ASSEMBLY	70-20810-01			5
4	*SERVO MOTOR CABLE ASSEMBLY	70-21242-YA			13
5	*Logic/Power Cable Assembly	70-21240-YA			
6	*LA100 POWER SUPPLY (See H7844 IPB)	H7844-00			
7	*CONTROL PANEL ARRAY ASSEMBLY	70-21151-01			7
8	*Bracket, Panel	74-28401-01			
9	*Plane, Ground, L.H.	74-29576-01			
10	*Strap, Ground, L.H.	74-29690-01			
11	*Strap, Ground, R.H.	74-29691-0 i			
12	*Clamp, Mechanism	74-29405-01			
13	*Washer, Lock	90-07649-00			
14	*Screw, Hex Washer Hd No. 8-32 x 1/2	90-10063-00			
15	*Screw, Sems Slotted Hex Hd No. 6-32 x 3/8	90-06453-00			
16	*Screw, Sems Phl Pan Hd No. 6-32 x 1/4	90-10174-00			
17	*Screw, Hex Washer Hd No. 8-32 x 3/8	90-10075-00			
18	*Screw, Hex Washer Hd No. 6-32 x 1/4	90-10074-00			
19	*Screw, Sems Phl Pan Hd No. 6-32 x 1/4	90-10174-01			
20	*Nut, Speed No. 6-32	90-09301-00			
21	*Screw, Slotted Binder Hd No. 6-32 x 1/4	90-06020-04			
22	*Washer, Flat	90-09232-00			
23	*Cover, Safety, Power Supply	74-30775-01			
24	*INTERLOCK SWITCH ASSEMBLY	70-21241-01			8
25	*Nut, Kep	90-06563-00			
26	*Screw, Hex Washer Hd No. 8-32 x 1/2 (Self Tapping)	90-10075-01			
27	*Washer, Flat	90-06661-00			
28	*MODULE/ACCESS PANEL ASSEMBLY	70-20689-01			
29	**LA210 Control Logic Board	54-16163-01			
30	**Panel, Access	74-28413-01			
31	**Screw, Sems Phl Pan Hd No. 6-32 x 1/4	90-10174-00			
32	**Screw, Sems Phl Pan Hd No. 4-40 x 5/8	90-00049-55			
33	**Nut, Hex No. 4-40 x 1/4 x 3/32	90-06556-00			
34	**Spacer	90-00034-04			

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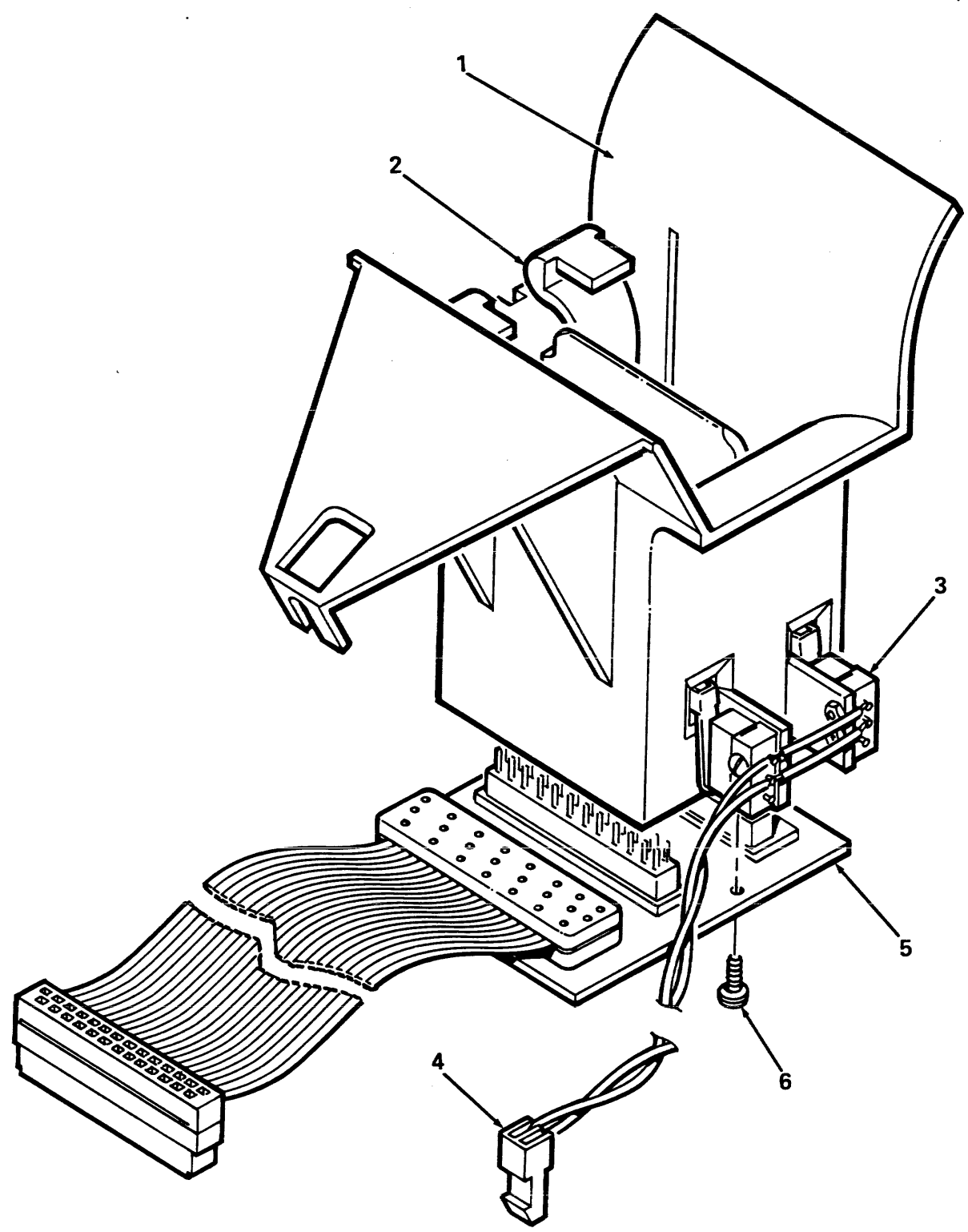
LA210-05

Figure 5.   ROM Chimney Assembly

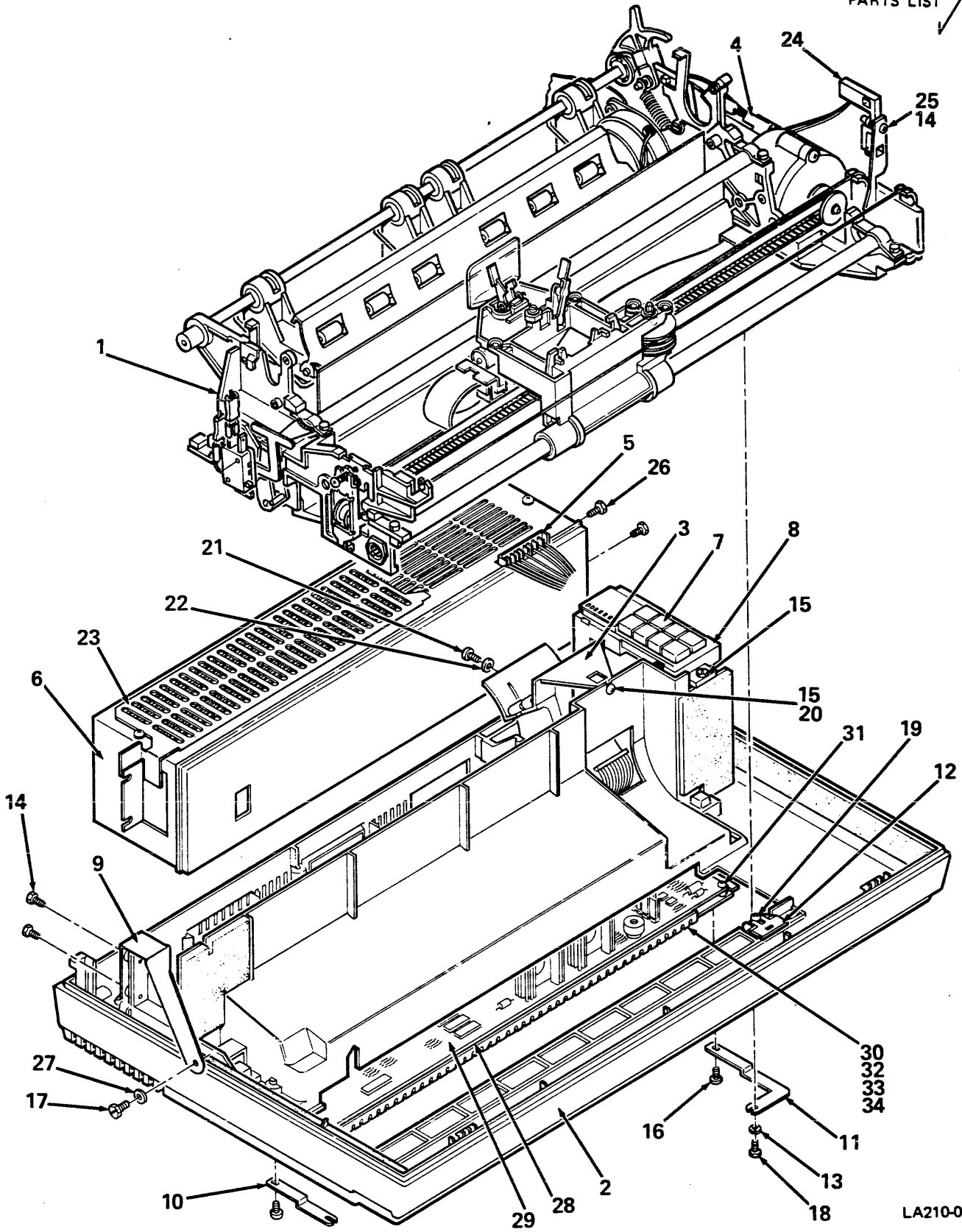| FIG. & ITEM NO.	DESCRIPTION	DEC PART NO. ᴮ	ECO CUT-IN 70-20810 00001	USED ON CODE	REF FIG NO.
5—	ROM CHIMNEY ASSEMBLY	70-20810-01			4
1	*Holder, ROM Cartridge	74-29465-01			
2	*Retainer, ROM Cartridge	74-29539-01			
3	*Micro Switch	12-17786-00			
4	*Font Switch Cable Assembly	70-21250-0J			
5	*LA100/LA200 ROM Module	54-16167-01			
6	*Screw, Bind, Slot No. 4-40 x 3/16	90-07650-04			
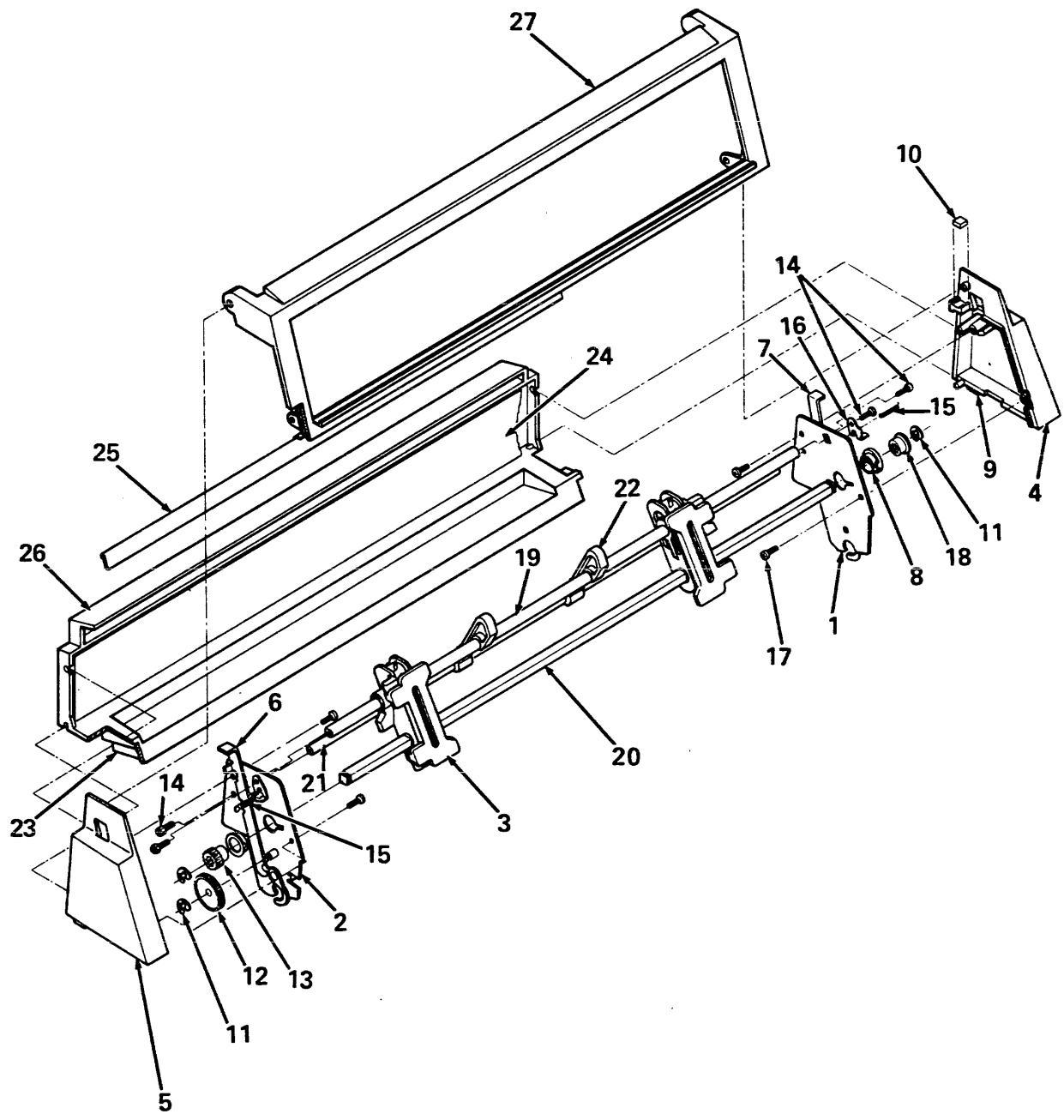
LA210-06

Figure 6.   Tractor Assembly

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO.	ECO CUT-IN 70-21248 00000	USED ON CODE	REF FIG NO.
6—	TRACTOR ASSEMBLY	70-21248-01			1
1	*Side Plate Assembly (R.H.)	70-16650-00			
2	*Side Plate Assembly (L.H.)	70-20749-01			
3	*Tractor, (1 Pair)	12-18685-05			
4	*Cap, Tractor (L.H.)	74-29579-01			
5	*Cap, Tractor End (R.H.)	74-29065-01			
6	*Push Rod, Latch (L.H.)	74-21622-00			
7	*Push Rod, Latch (R.H.)	74-21622-01			
8	*Tractor Bushing Assembly	12-16192-00			
9	*Pad, Tractor Support	74-31015-01			
10	*Bumper, Tractor	74-29899-01			
11	*Retaining Ring	90-09644-00			
12	*Gear, Tractor Idler	12-16193-00			
13	*Drive Gear Tractor Assembly	12-16194-00			
14	*Screw, Slotted Hex Hd No. 6-32 x 3/8	90-06453-00			
15	*Spring, Extension	90-09279-01			
16	*Clip, Spring	74-21664-00			
17	*Screw, Phl Pan Hd No. 6 x 3/8	90-09800-06			
18	*Support, Tractor	12-16021-00			
19	*Shaft, Tractor Support	74-21666-00			
20	*Shaft, Tractor Guide	74-21665-00			
21	*Shaft, Round	74-22555-00			
22	*Support, Tractor Paper	74-22870-00			
23	*Pad, Acoustic	74-29759-02			
24	*Pad, Acoustic	74-29759-01			
25	*Gasket, Tractor	74-30322-01			
26	*Cover, Tractor	74-29623-01			
27	*Front Tractor Cover Assembly	70-21854-01			
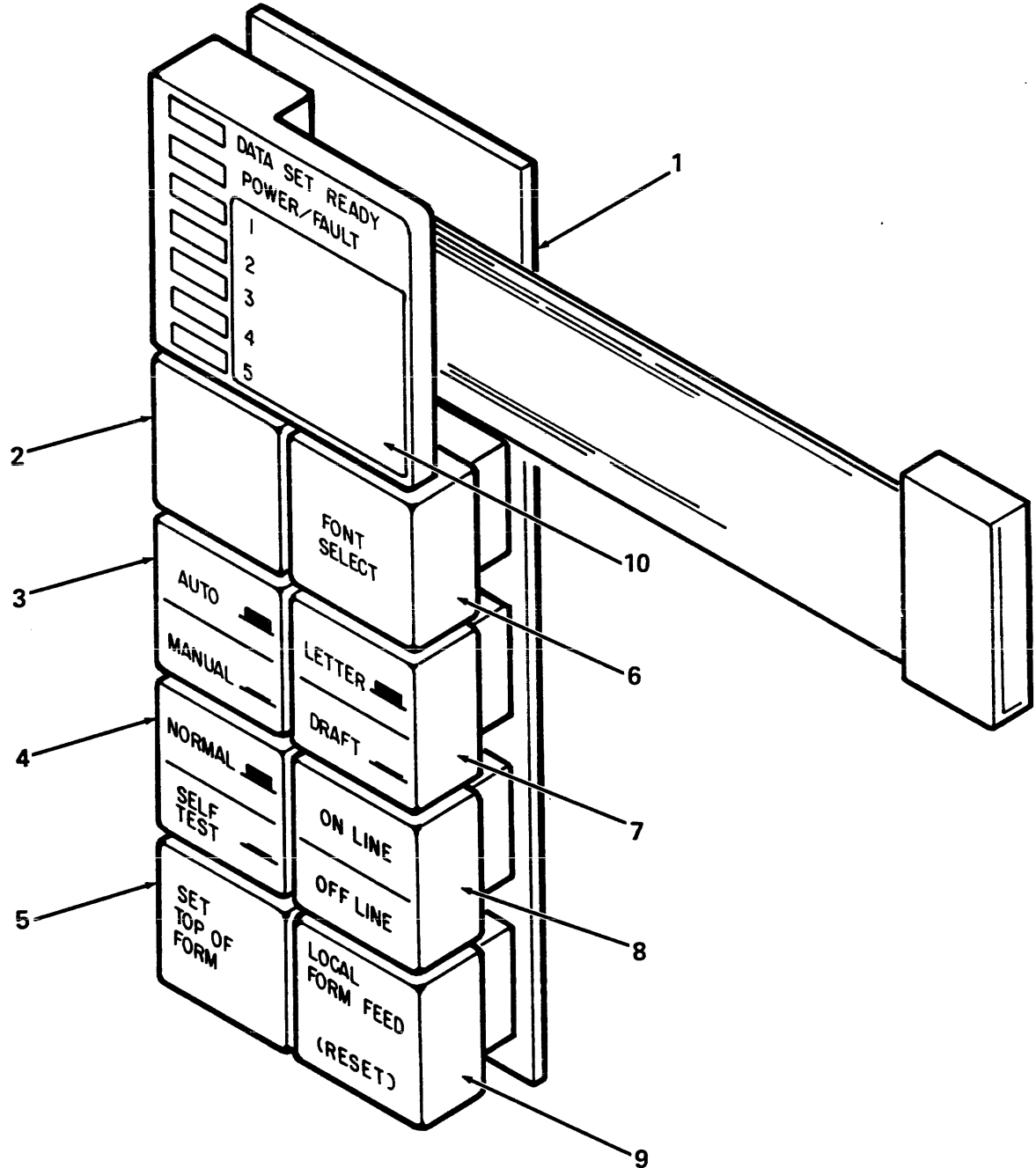
Figure 7. Control Panel Array Assembly

LA210-07

15

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO. ᴮ	ECO CUT-IN 70-21151 00001	USED ON CODE	REF FIG NO.
7–	CONTROL PANEL ARRAY ASSEMBLY	70-21151-01			4
1	*Control Panel Module Assembly	54-16165-01			
2	*Keycap, Blank	12-22223-01			
3	*Keycap, "Auto/Manual"	12-22223-02			
4	*Keycap, "Normal/Self Test"	12-22223-03			
5	*Keycap, "Set Top of Form"	12-22223-04			
6	*Keycap, "Font Select"	12-22223-05			
7	*Keycap, "Letter/Draft"	12-22223-06			
8	*Keycap, "Line/Local"	12-22223-07			
9	*Keycap, "Local Form Feed/Reset"	12-22223-08			
10	*Label, "Control Panel"	36-22761-01			
	Label (Not Shown)				
	*Label, "Power"	36-22441-01			

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO.	ECO CUT-IN 70-21241 00000	USED ON CODE	REF FIG NO.
8–	INTERLOCK SWITCH ASSEMBLY	70-21241-01			4
1	*Reed Mini Magnetic Switch Assembly	12-16687-01			
2	*Connector, (P3) Pin Contact	12-14979-01			
3	*Connector, (P3) 5 Pin Housing	12-15047-01			
4	*Terminal, (P1, P2) Quick Disconnect	90-08836-00			
5	*Plug, Phone Jack (J1)	12-15474-00			
6	*Label, "I.D"	36-16073-00			
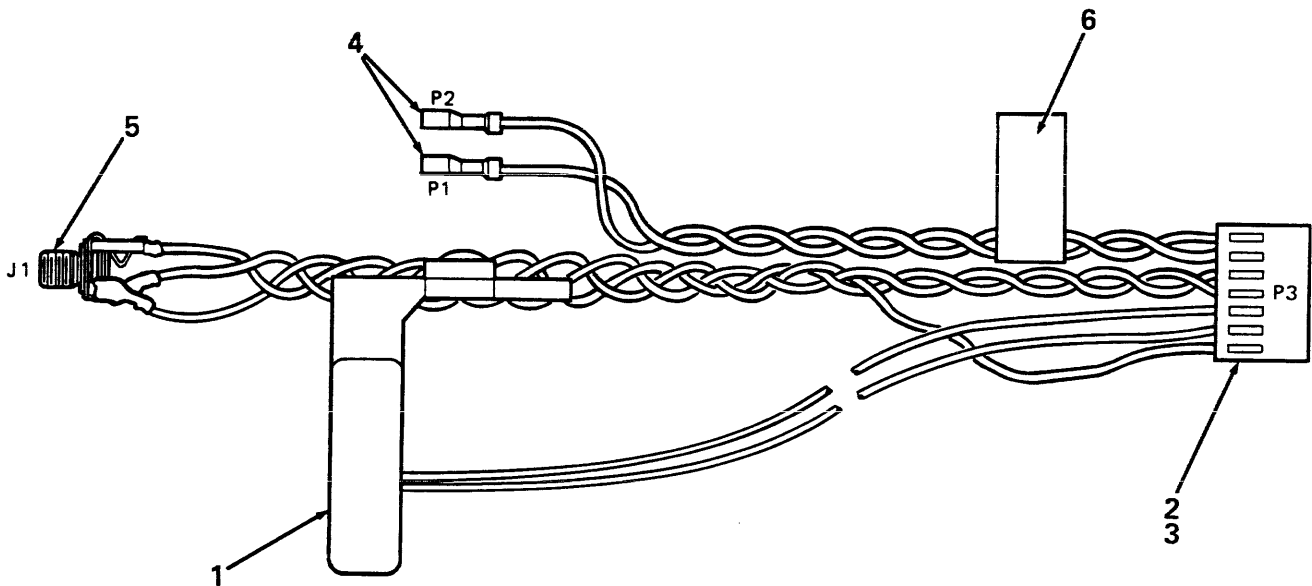
LA210-08

Figure 8.   Interlock Switch Assembly
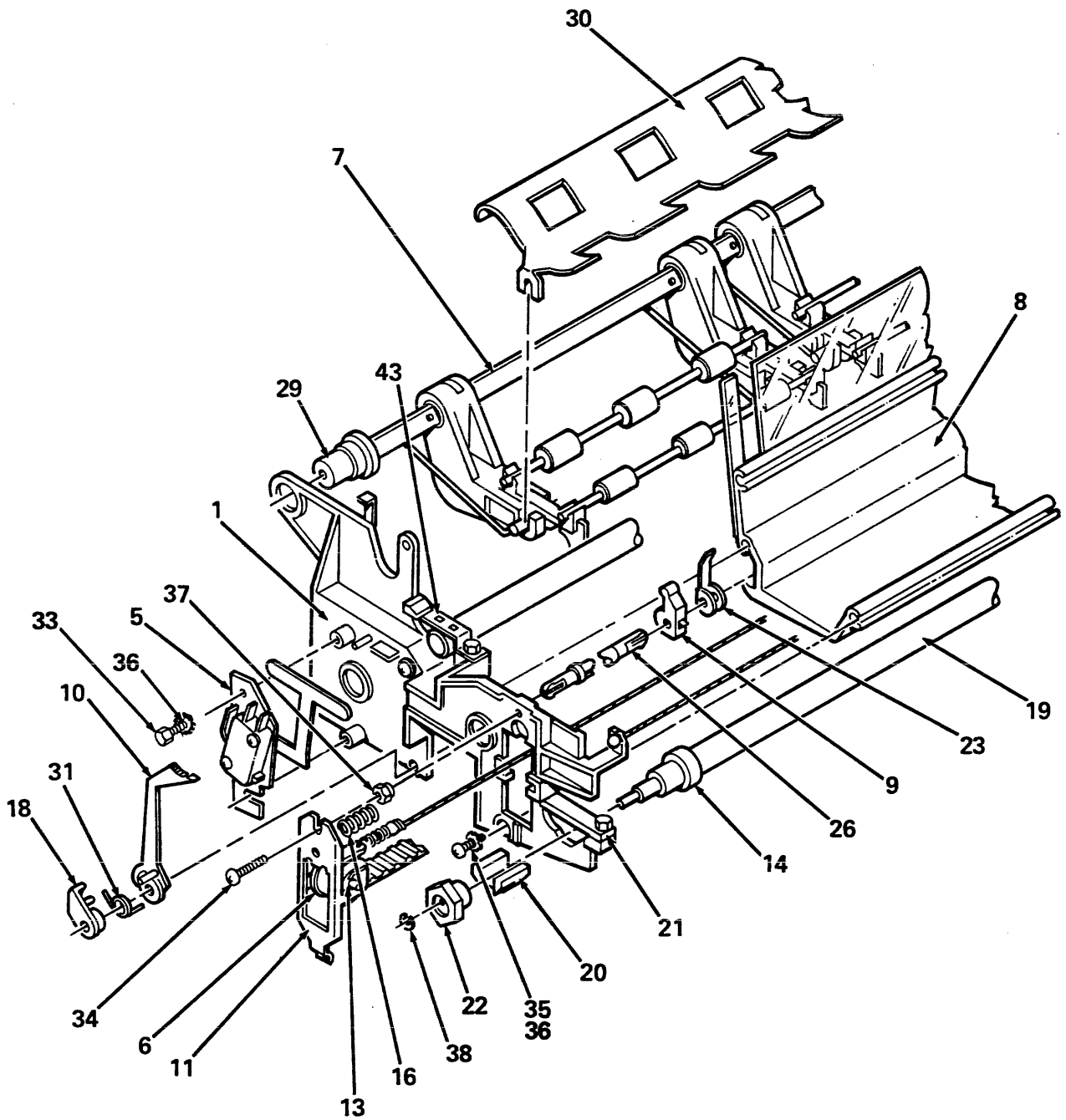
LEFT SIDE VIEW

LA210-09

Figure 9.   Printer Mechanism Assembly (Sheet 1 of 2)
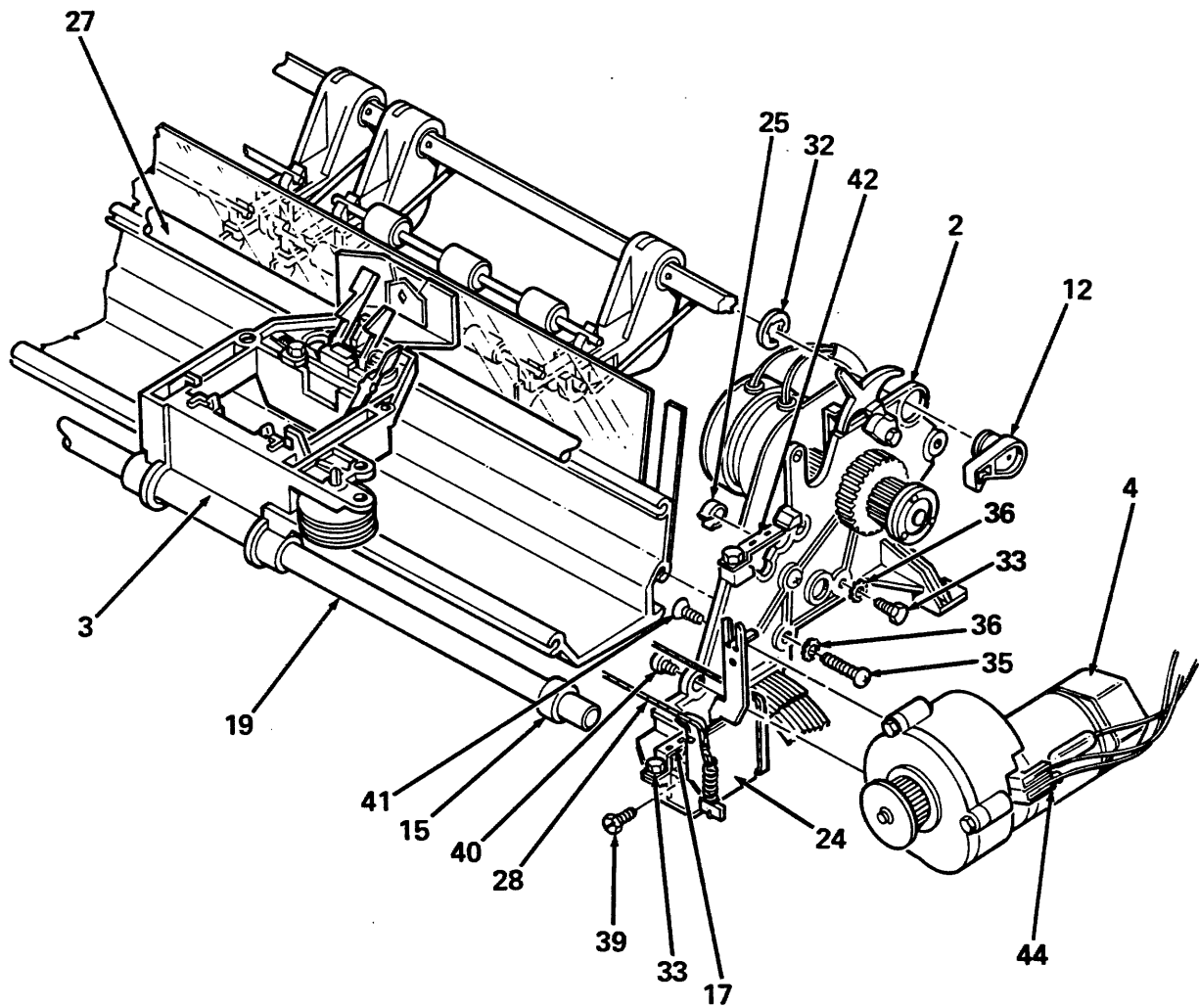
RIGHT SIDE VIEW

LA210-09A

Figure 9.   Printer Mechanism Assembly (Sheet 2 of 2)

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO. H	ECO CUT-IN 70-20693 00006	USED ON CODE	REF FIG NO.
9—	PRINTER MECHANISM ASSEMBLY	70-20693-01			4
1	*SIDE PLATE ASSEMBLY (L.H.)	70-20679-01			16
2	*SIDE PLATE ASSEMBLY (R.H.)	70-20680-01			11
3	*CARRIAGE ASSEMBLY	70-20685-01			10
4	*Servo Motor Housing Assembly	70-20681-01			
5	*PAPER OUT SWITCHPLATE ASSEMBLY	70-21859-01			15
6	*Pulley Idler Assembly	70-20646-01			
7	*FRICTION ASSEMBLY	70-15733-01			14
8	*Cross Member Assembly	70-20802-01			
9	*Bearing, Support	74-28637-01			
10	*Lever, Switch Release	74-29229-01			
11	*Tensioner, Belt	74-28755-01			
12	*Cam	74-22987-00			
13	*Spacer	74-28758-01			
14	*Bumper (L.H.)	74-29040-01			
15	*Bumper (R.H.)	74-29040-02			
16	*Spring, Compression	74-29035-01			
17	*Clip, Retaining	74-30271-01			
18	*Cam, Paper Out	74-28717-01			
19	*Shaft, Rear	74-29045-01			
20	*Cradle, Rear Shaft	74-29048-01			
21	*Clamp, Shaft	74-31694-01			
22	*Cam, Rear Shaft	74-29047-01			
23	*Trigger, Paper Out	74-29739-01			
24	*Bracket, Termination	74-28417-01			
25	*Clip, Compression	74-30497-01			
26	*Shaft, Paper Out	12-15782-00			
27	*Shaft, Carriage	12-15315-00			
28	*Ribbon Drive Cable Assembly	12-15348-00			
29	*Rod, Cap	12-15506-00			
30	*Paper Guide	74-31185-01			
31	*Spring, Torsion	12-16305-00			
32	*Retaining Ring	90-10052-00			
33	*Screw, Hex Washer Hd No. 8-32 x 3/8 (Self Tapping)	90-10075-00			
34	*Screw, Phl Pan Hd No. 6-32 x 5/8	90-06025-01			
35	*Screw, Phl Pan Hd No. 8-32 x 7/8 (Self Tapping)	90-08221-01			
36	*Washer, External Tooth Lock No. 8	90-08072-00			
37	*Nut, Hex No. 6-32	90-08055-00			
38	*Retaining Ring	90-07784-01			
39	*Screw, Sems Slotted Hex Hd No. 6-32 x 5/16	90-00049-08			
40	*Screw, Phl Pan Hd No. 10-24 x 7/16	90-08011-01			
41	*Screw, Phl Flat Hd No. 10-24 x 1/2	90-00039-15			
42	*Clip, Retaining, (R.H.)	74-30271-02			
43	*Clip, Retaining, (L.H.)	74-30271-03			
44	*SERVO MOTOR CABLE ASSEMBLY	70-21242-YA			13

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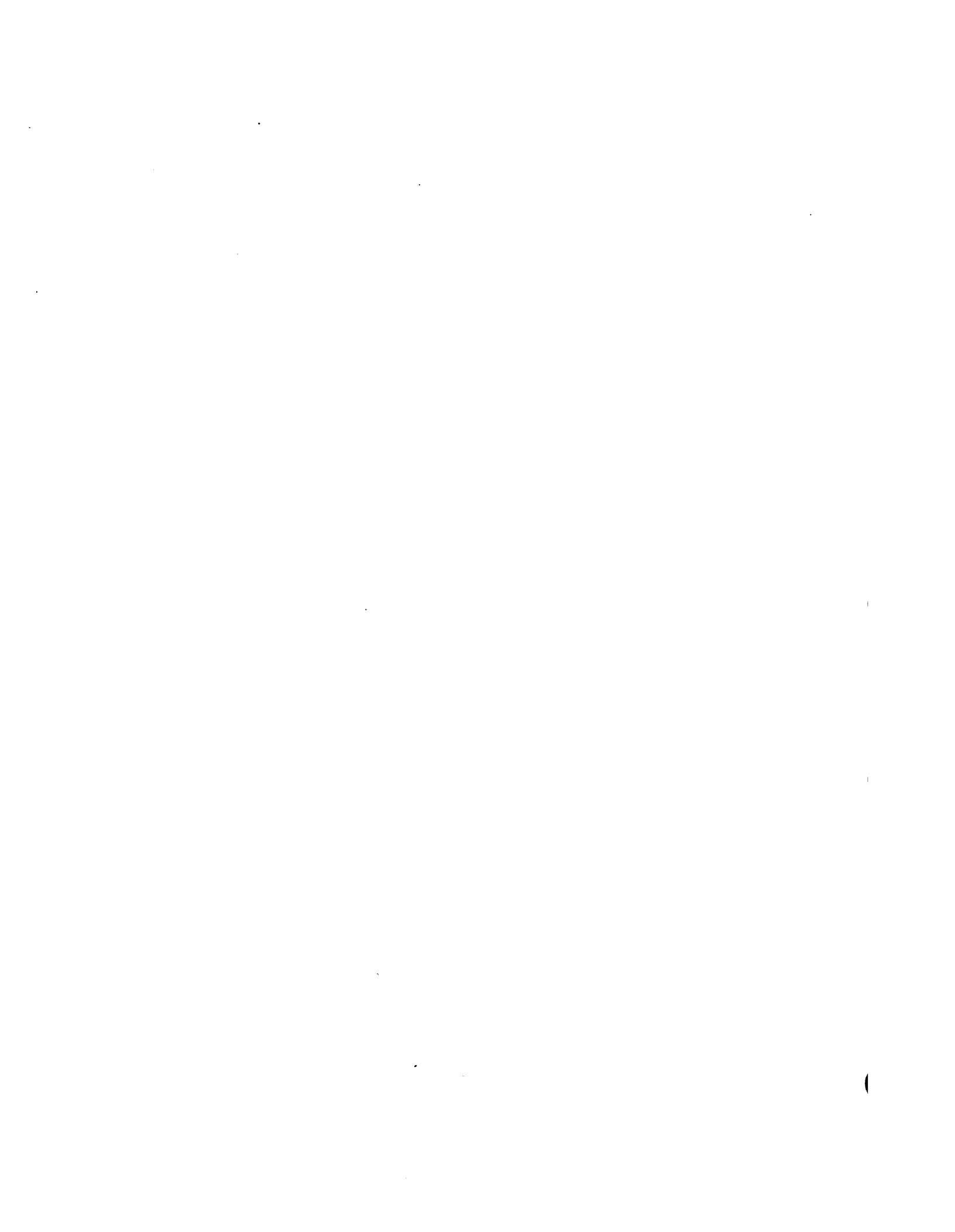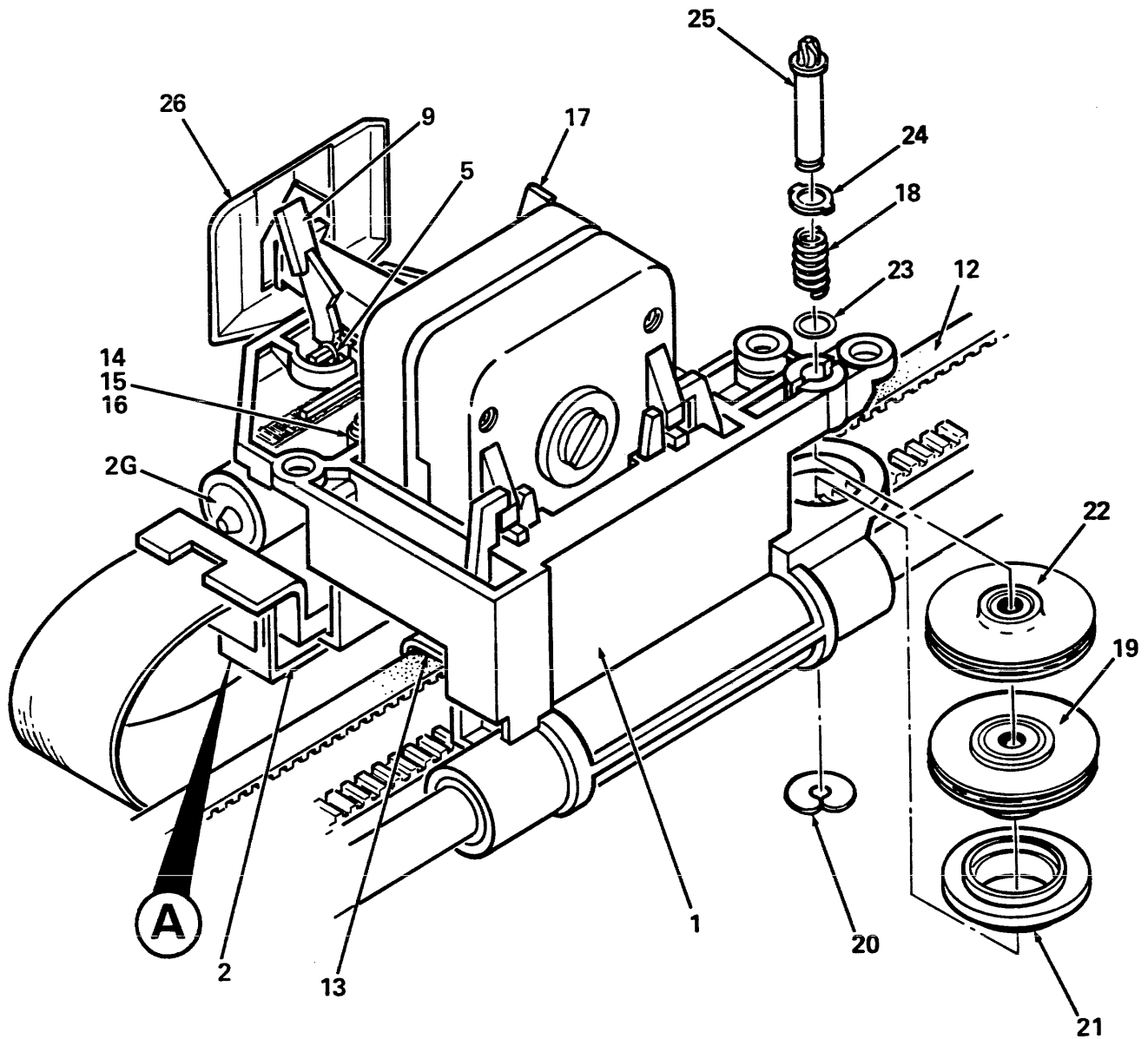
LA210-10

Figure 10. Carriage Assembly (Sheet 1 of 2)
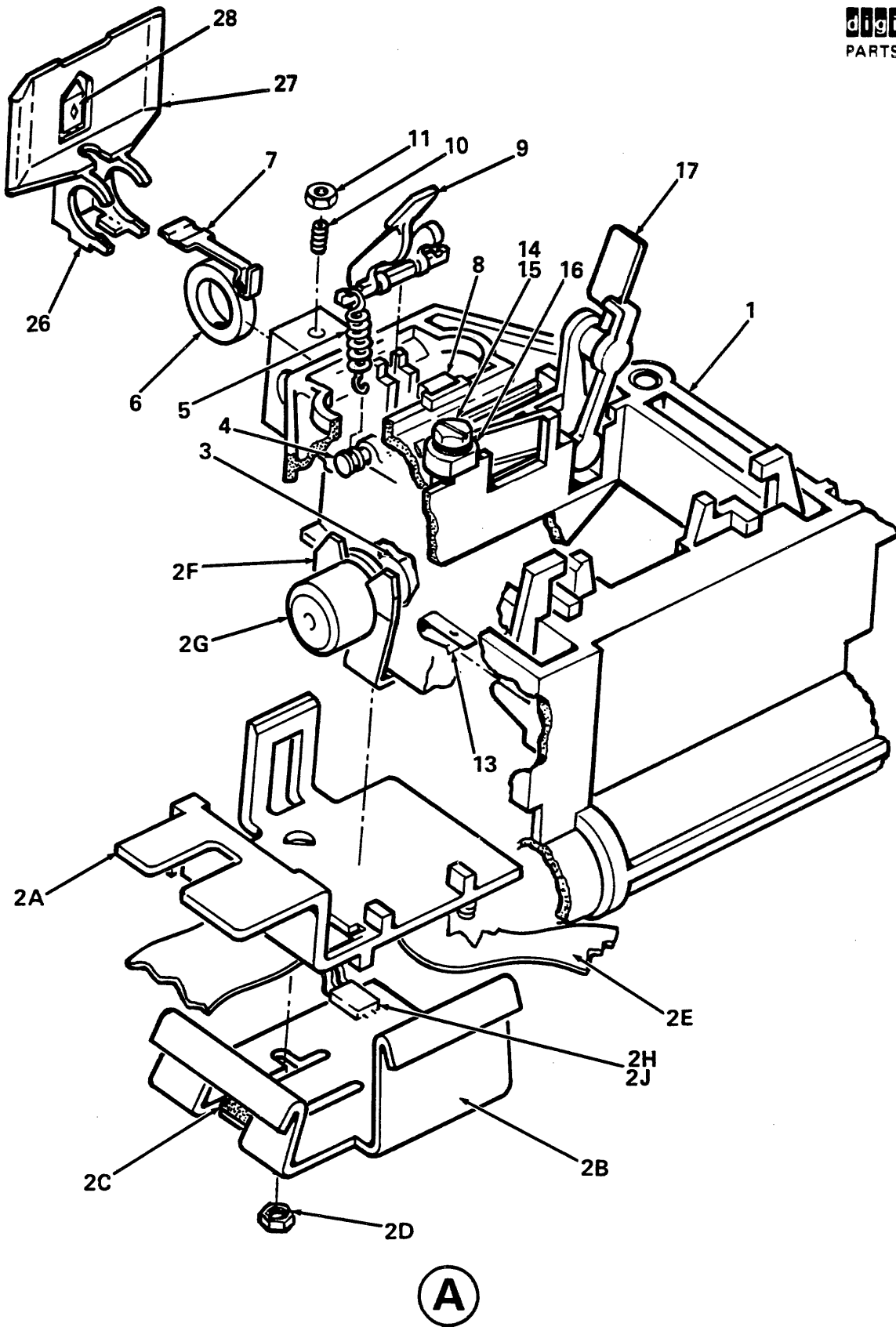
Figure 10. Carriage Assembly (Sheet 2 of 2)

LA210-10A

FIG. & ITEM NO.	DESCRIPTION	A DEC PART NO.	ECO CUT-IN 70-20685 00000	USED ON CODE	REF FIG NO.
10–	CARRIAGE ASSEMBLY	70-20685-01			9
1	*Carriage Bearing Assembly	70-20799-01			
2	*HEAD CABLE ASSEMBLY	70-20805-01			
2A	**Mount, Head Cable	74-28958-01			
2B	**Clamp, Ribbon Cable	74-28959-01			
2C	**Pad, Sponge Rubber	12-19681-01			
2D	**Nut, Push-On	90-10311-00			
2E	**Cable Assembly, 16 Cond w/Conn. 42"	17-00307-02			
2F	**Clip, Actuator Retainer	74-29580-01			
2G	**Housing Assembly	70-17563-00			
2H	**Terminal, Pin Contact	12-12220-02			
2J	**Housing, Mini-Pod	12-21775-01			
3	*Actuator Assembly	70-17564-00			
4	*Pin, Grooved	90-10093-00			
5	*Spring, Extension	12-20072-01			
6	*Bearing, Carriage Front	12-20069-01			
7	*Spring, Front Bearing	74-26722-01			
8	*Arm, Head Lift	74-30106-01			
9	*Lever, Head Retaining	74-25720-00			
10	*Screw, Set Cup Hex Hd No. 2-56 x 25/64	90-00044-11			
11	*Nut, Hex	90-06555-00			
12	*Belt, Timing	12-15362-00			
13	*Clip, Carriage	74-30386-01			
14	*Screw, Hex Washer Hd No. 6 x 3/8 (Self Tapping)	90-09680-02			
15	*Washer, Flat	90-06653-00			
16	*Spacer, Slide Friction	12-19528-01			
17	*Head Lever Slide Assembly	70-18639-00			
18	*Spring, Compression	74-29466-01			
19	*Pulley/Clutch Assembly	70-20795-01			
20	*Retaining Ring	90-09703-04			
21	*Bearing, Flanged	74-28411-01			
22	*Pulley Clutch Assembly	70-21873-01			
23	*Spacer, Locator	74-30851-01			
24	*Retainer, Spring	74-30323-01			
25	*Shaft, Ribbon Drive	74-30326-01			
26	*SMUDGE GUARD ASSEMBLY	70-19659-01			
27	**Guide, Paper	74-27151-01			
28	**Guard, Ribbon	74-29574-01			

Figure 11. Side Plate Assembly (R.H.) (Sheet 1 of 2)
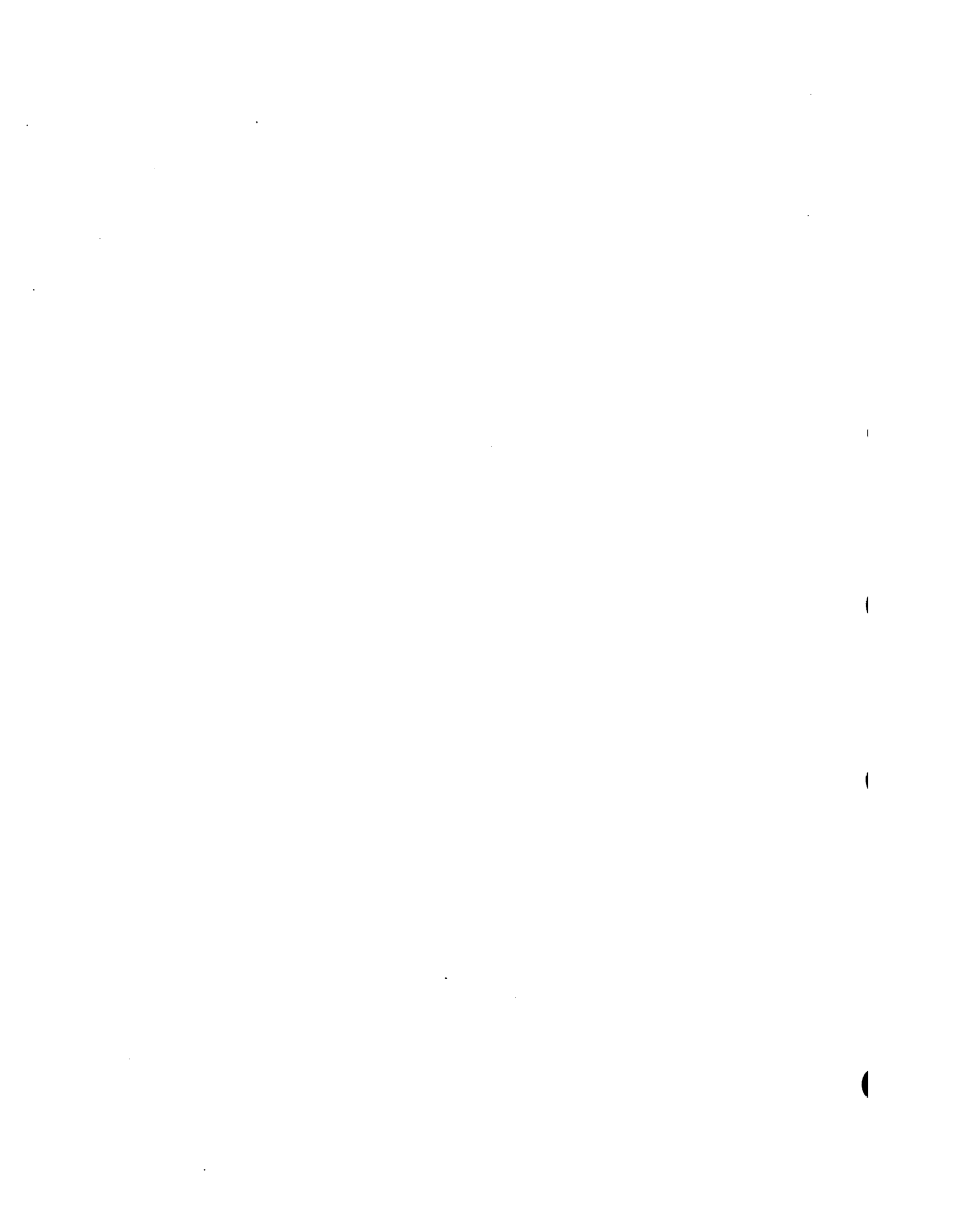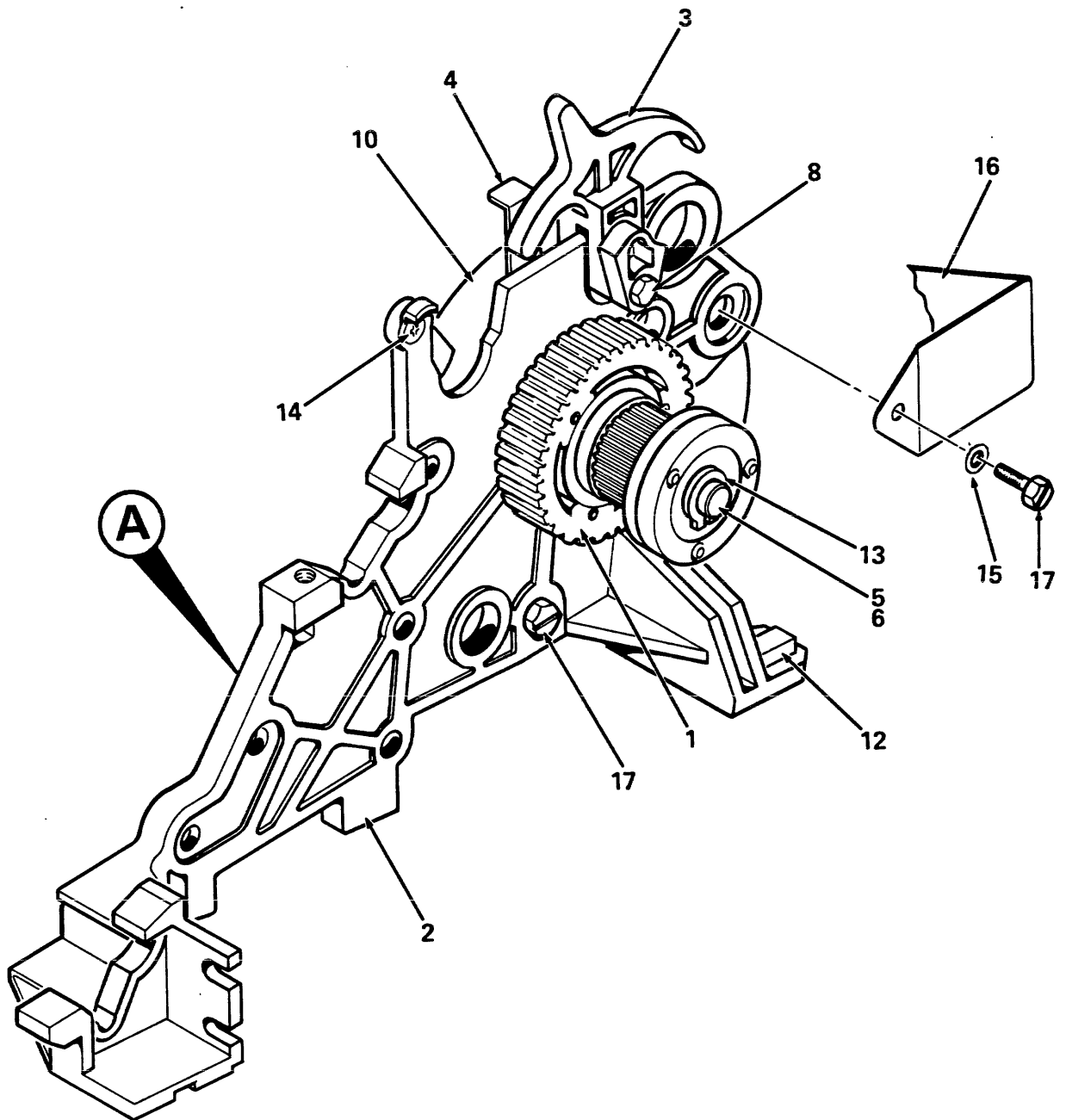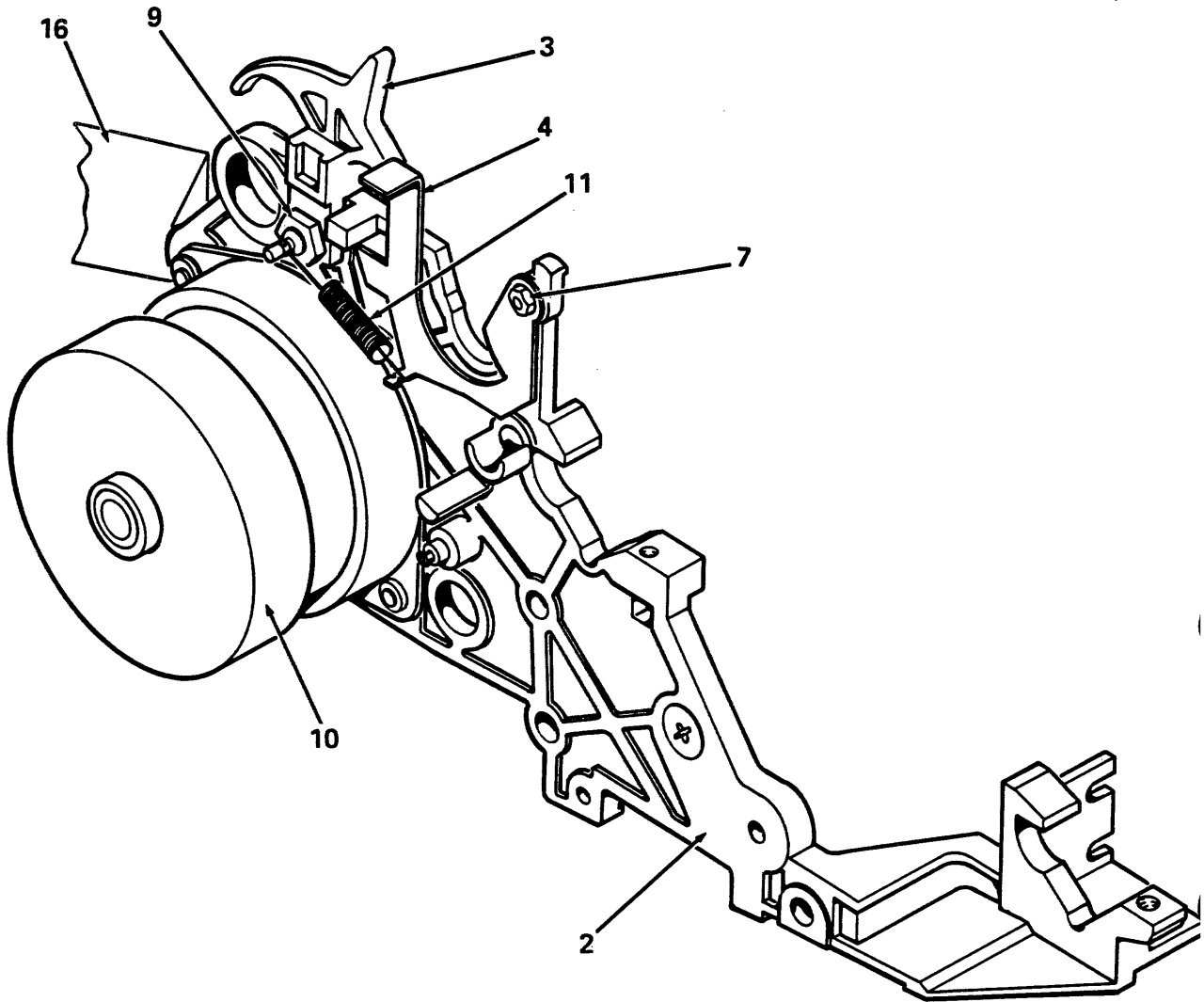
LA210-11

Figure 11. Side Plate Assembly (R.H.) (Sheet 2 of 2)

LA210-11A

FIG. & ITEM NO.	DESCRIPTION	B DEC PART NO.	ECO CUT-IN 70-20680 00002	USED ON CODE	REF FIG NO.
11–	SIDE PLATE ASSEMBLY (R.H.)	70-20680-01			9
1	*Anti-Backlash Gear Assembly	70-21225-01			
2	*Plate, R.H. Side	74-28416-01			
3	*Lever, Release	74-28715-01			
4	*Latch, R.H. Platen	74-28721-02			
5	*Pin, Dowel	74-29037-01			
6	*Washer, Flat	90-06714-00			
7	*Spacer, Platen	12-15557-00			
8	*Screw, Lever	12-15452-00			
9	*Spacer, Lever	12-15453-00			
10	*Stepper Motor Assembly	12-17474-00			
11	*Spring, Latch	12-15508-00			
12	*Pad, Top	74-29603-01			
13	*Retaining Ring	90-08137-00			
14	*Screw, Flat Phl Hd No. 4-40 x 5/16	90-06010-02			
15	* Washer, Flat No. 6	90-06659-00			
16	*Plane, Ground R.H.	74-29577-01			
17	*Screw, Sems Hex Hd No. 6-32 x 3/8	90-06453-00			
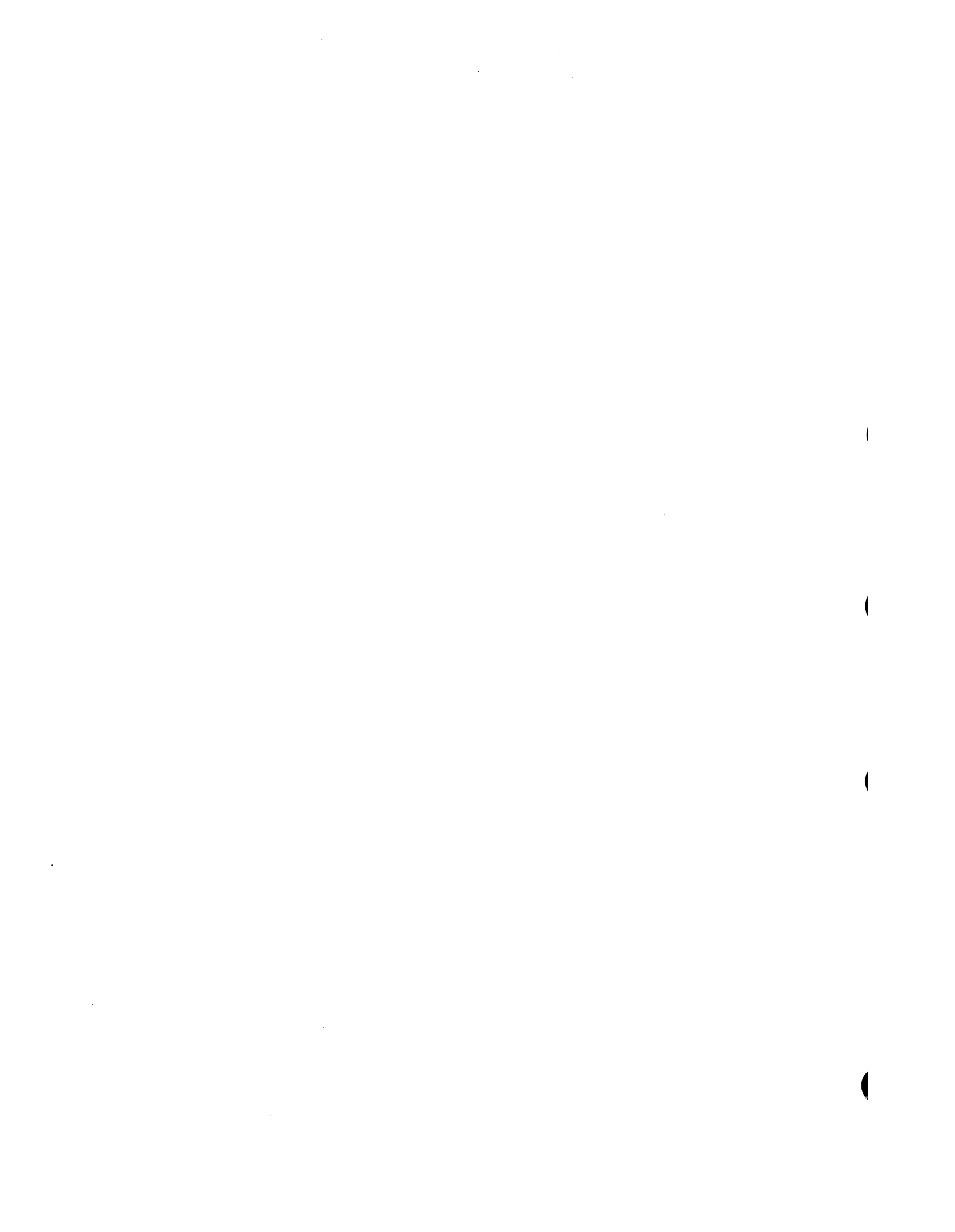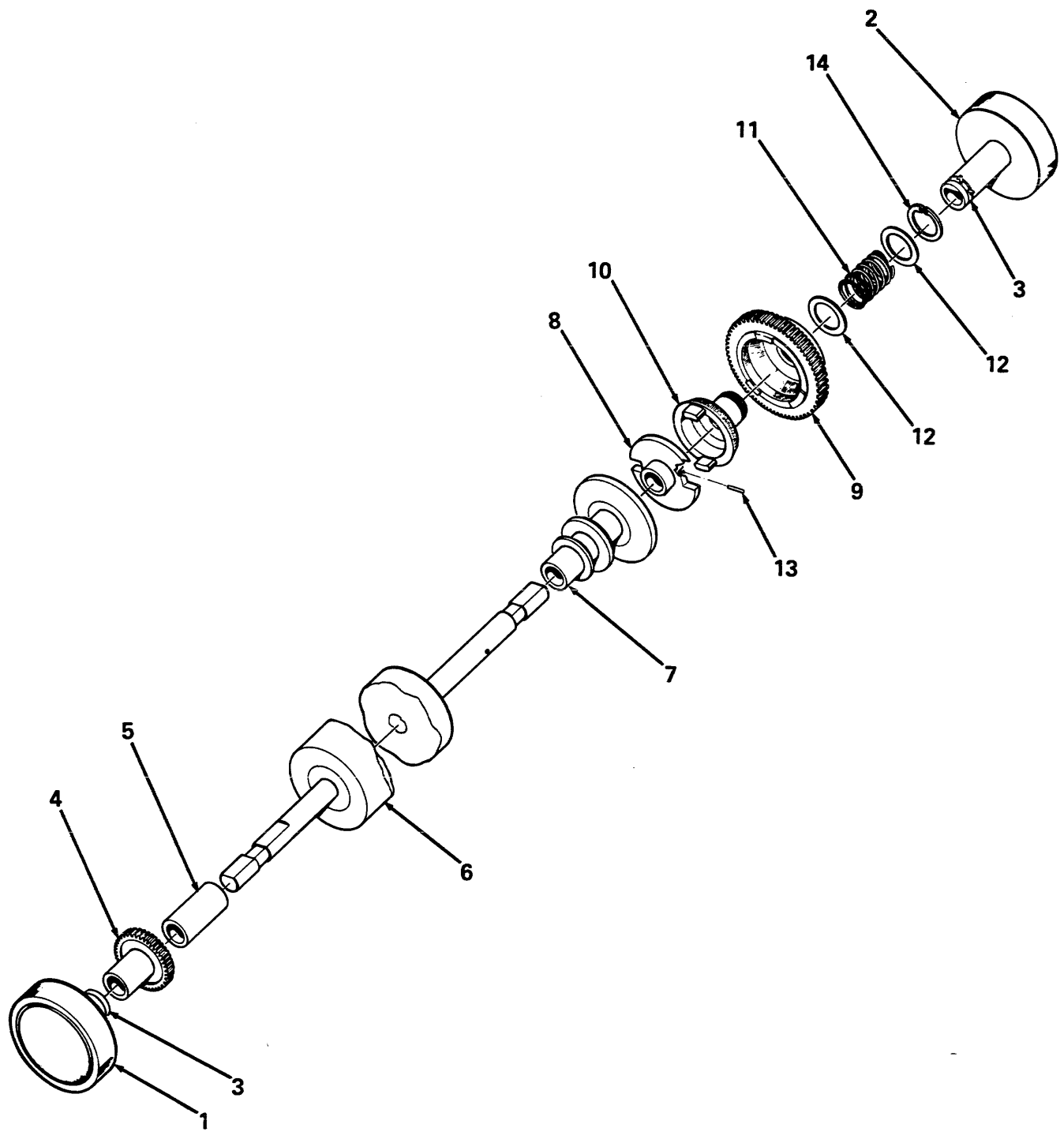
LA210-12

Figure 12. Platen Assembly

31

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO. ^A	ECO CUT-IN 70-20684 00000	USED ON CODE	REF FIG NO.
12–	PLATEN ASSEMBLY	70-20684-01			1
1	*Knob, Platen, L.H.	74-29036-01			
2	*Knob, Platen, R.H.	74-29036-02			
3	*Retaining Ring	74-29043-00			
4	*Gear, Tractor	12-15288-00			
5	*Bearing, Plain	12-15289-01			
6	*Platen	12-20076-01			
7	*Bearing, Plastic	12-15353-01			
8	*Clutch, Disk	12-15400-00			
9	*Clutch, Gear	12-15352-00			
10	*Clutch, Hub, Paper Drive	12-15354-00			
11	*Spring, Clutch	12-15552-00			
12	*Washer, Clutch	12-15562-00			
13	*Roll Pin	90-09324-00			
14	*Retaining Ring	90-10050-00			

FIG. & ITEM NO.	DESCRIPTION	D DEC PART NO.	ECO CUT-IN 70-21242 00003	USED ON CODE	REF FIG NO.
13—	SERVO MOTOR CABLE ASSEMBLY	70-21242-YA			4
1	*Connector, (P1) 2 Position Housing	12-15322-01			
2	*Terminal, (P1) Cantilever Crimp	12-14979-01			
3	*Terminal, (P2, P3) Quick Disconnect, Flag	12-18056-00			
4	*Housing, (P2, P3) 1 Position Terminal	12-18055-00			
5	*Capacitor, 100V +80—20%	10-01610-02			
6	*Tubing, Teflon	91-07256-11			
7	*Resistor, 1.0K 5.0W 10%	13-03365-00			
8	*Label, "I.D"	36-16073-00			
9	*Inductor, Toroidal, 10uH	16-24814-01			
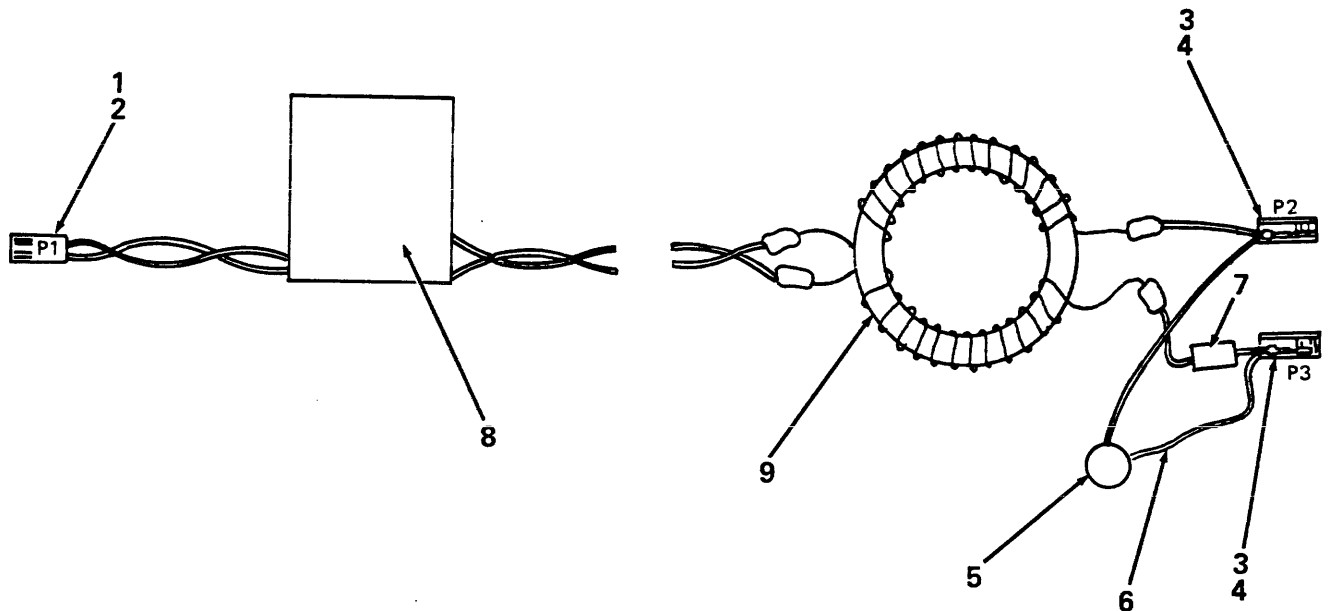
LA210-13

Figure 13. Servo Motor Cable Assembly

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO. ^B	ECO CUT-IN 70-15733 00002	USED ON CODE	REF FIG NO.
14–	FRICTION ASSEMBLY	70-15733-01			9
1	*Shaft, Friction	12-15358-00			
2	*Arm, Rocker	12-15349-00			
3	*Bushing	12-15524-00			
4	*Rocker	12-15355-00			
5	*Spring	12-15551-00			
6	*Front Paper Roller Assembly	70-18601-00			
7	*Rear Paper Roller Assembly	70-18602-00			
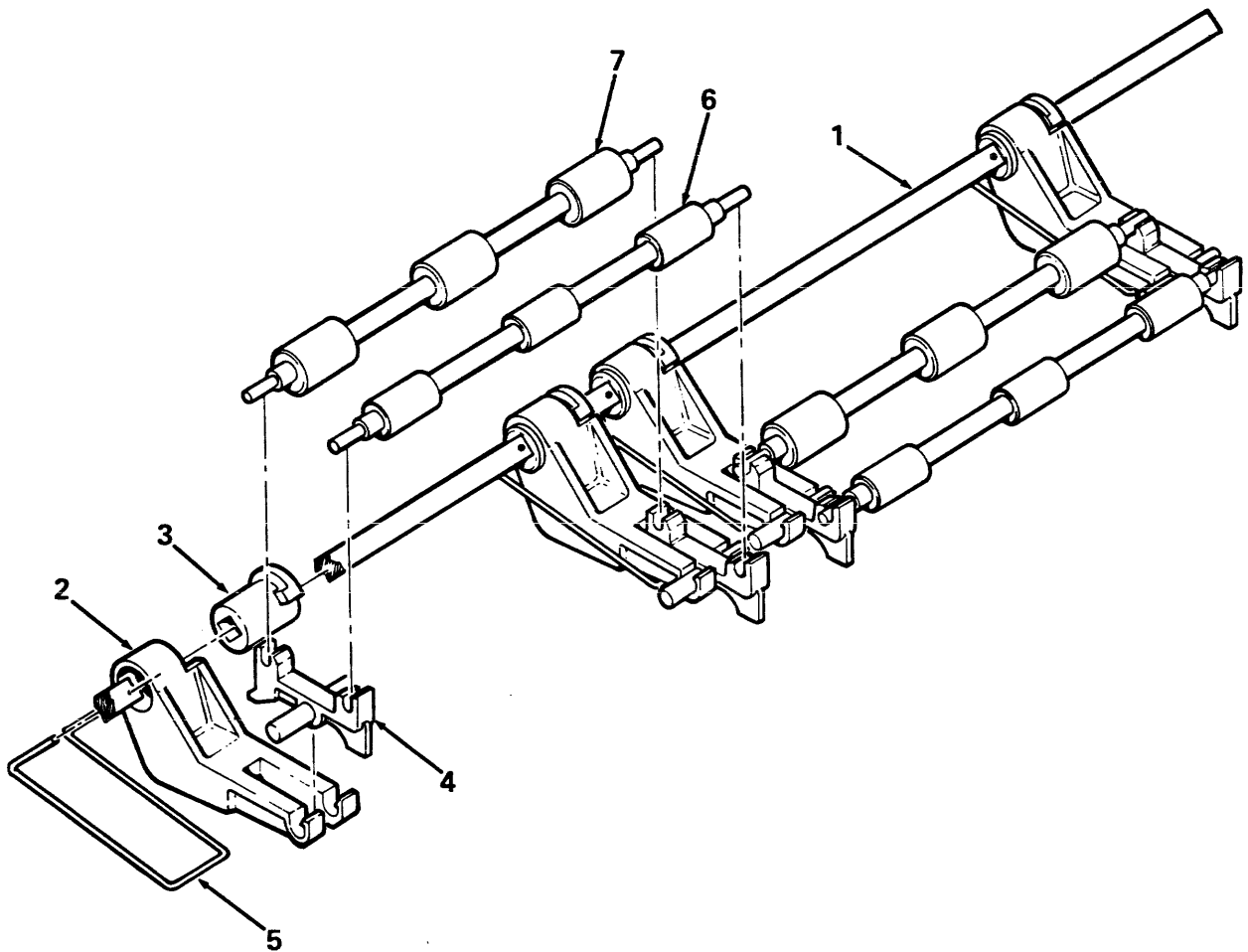
LA34-12

Figure 14. Friction Assembly

1   35/36   IPB-LA210
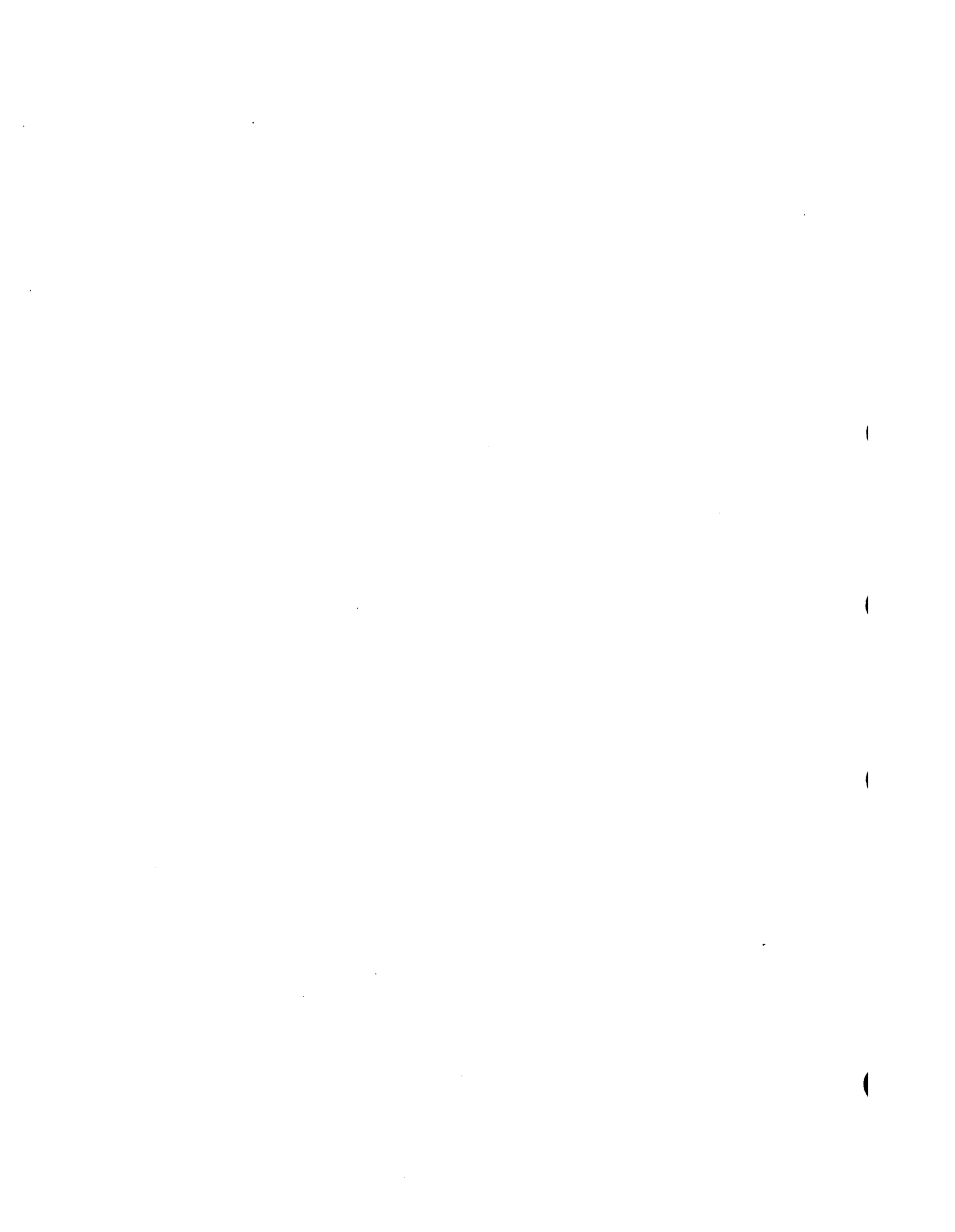
FIG. & ITEM NO.	DESCRIPTION	A DEC PART NO.	ECO CUT-IN 70-21859 00000	USED ON CODE	REF FIG NO.
15—	PAPER OUT SWITCH PLATE ASSEMBLY	70-21859-01			9
1	*Plate, Switch Support	74-22505-00			
2	*Retainer, Detent	74-29295-01			
3	*Switch, Micro	12-16371-00			
4	*Screw, Phl Pan Hd No. 4-40 x 5/8	90-06014-01			
5	*Nut, Kep No. 4-40 x 1/4	90-06557-00			
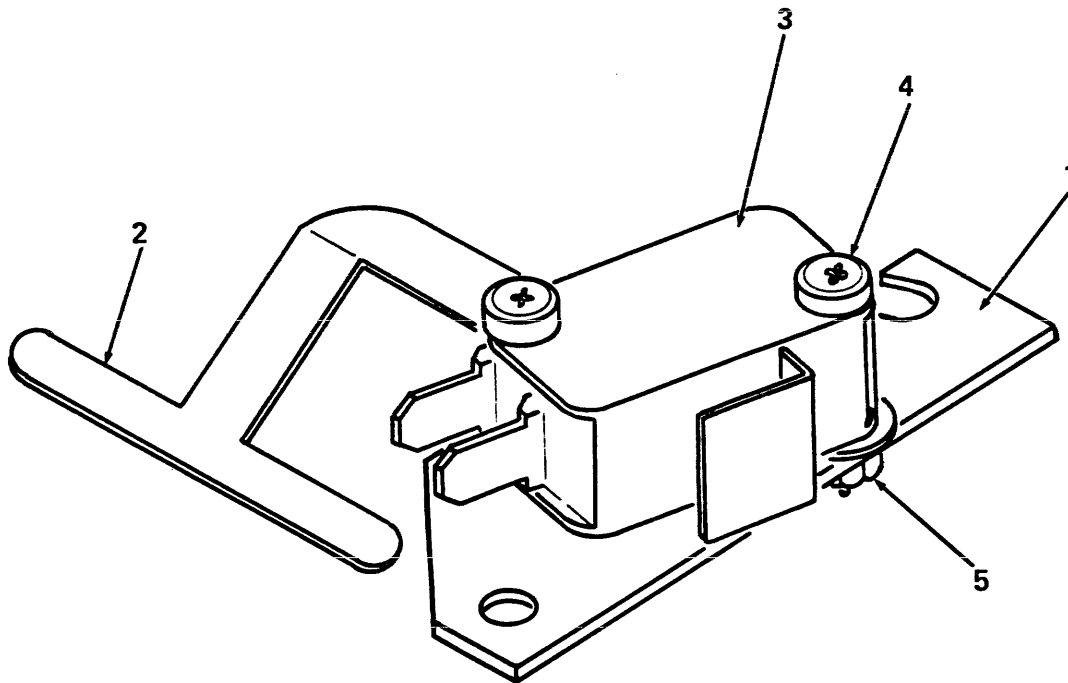
LA210-15

Figure 15. Paper Out Switch Plate Assembly
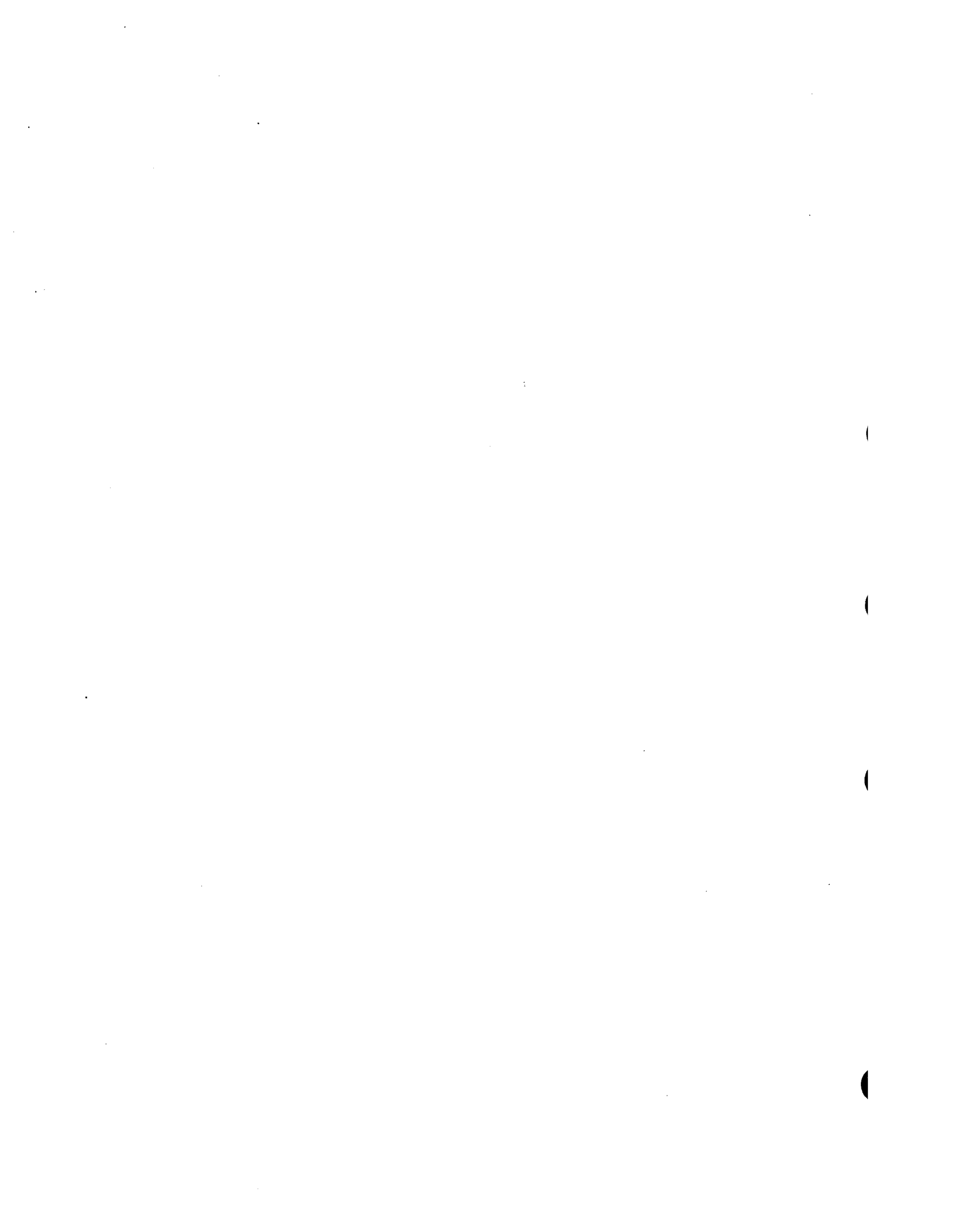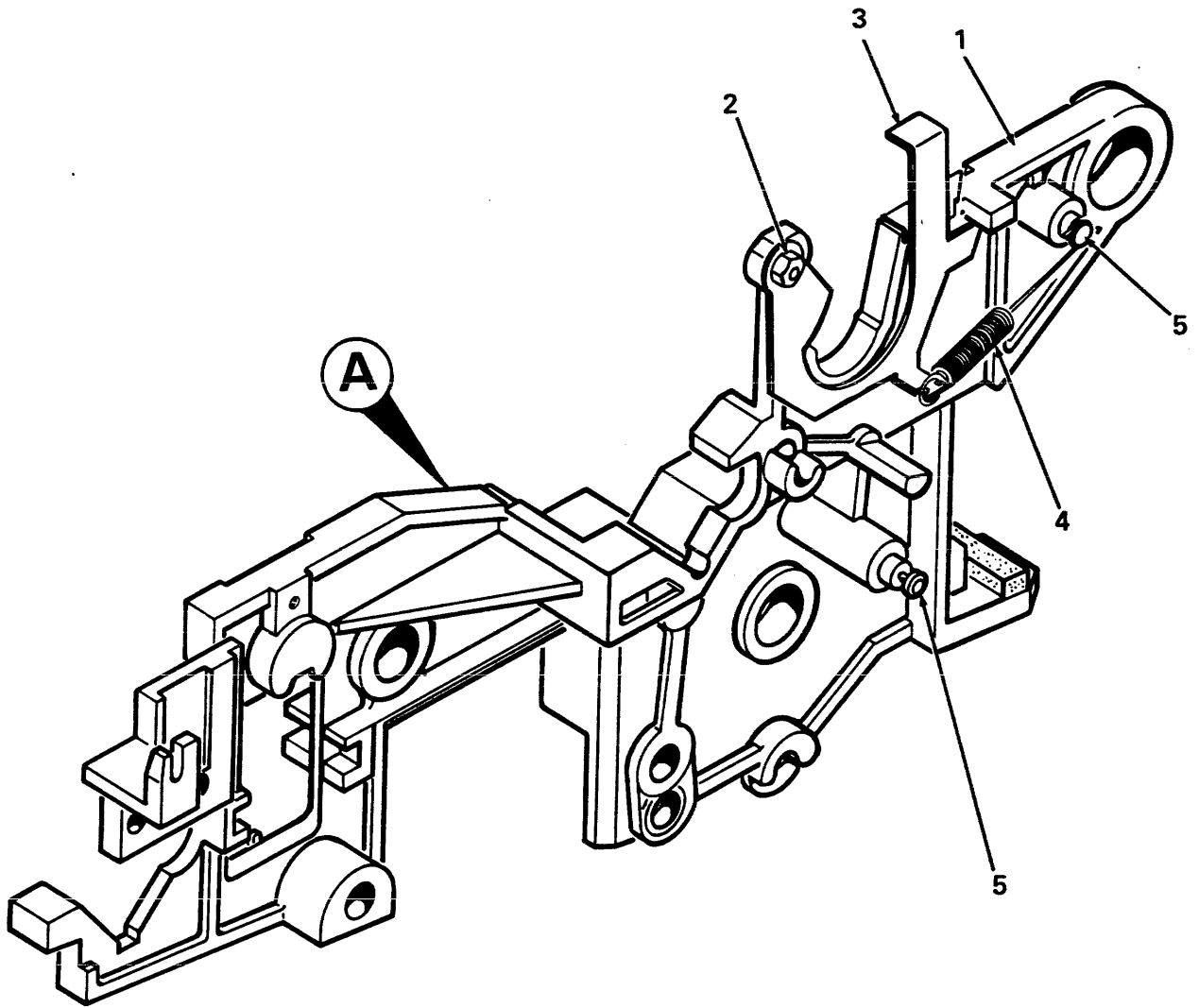
LA210-16

Figure 16. Side Plate Assembly (L.H.) (Sheet 1 of 2)
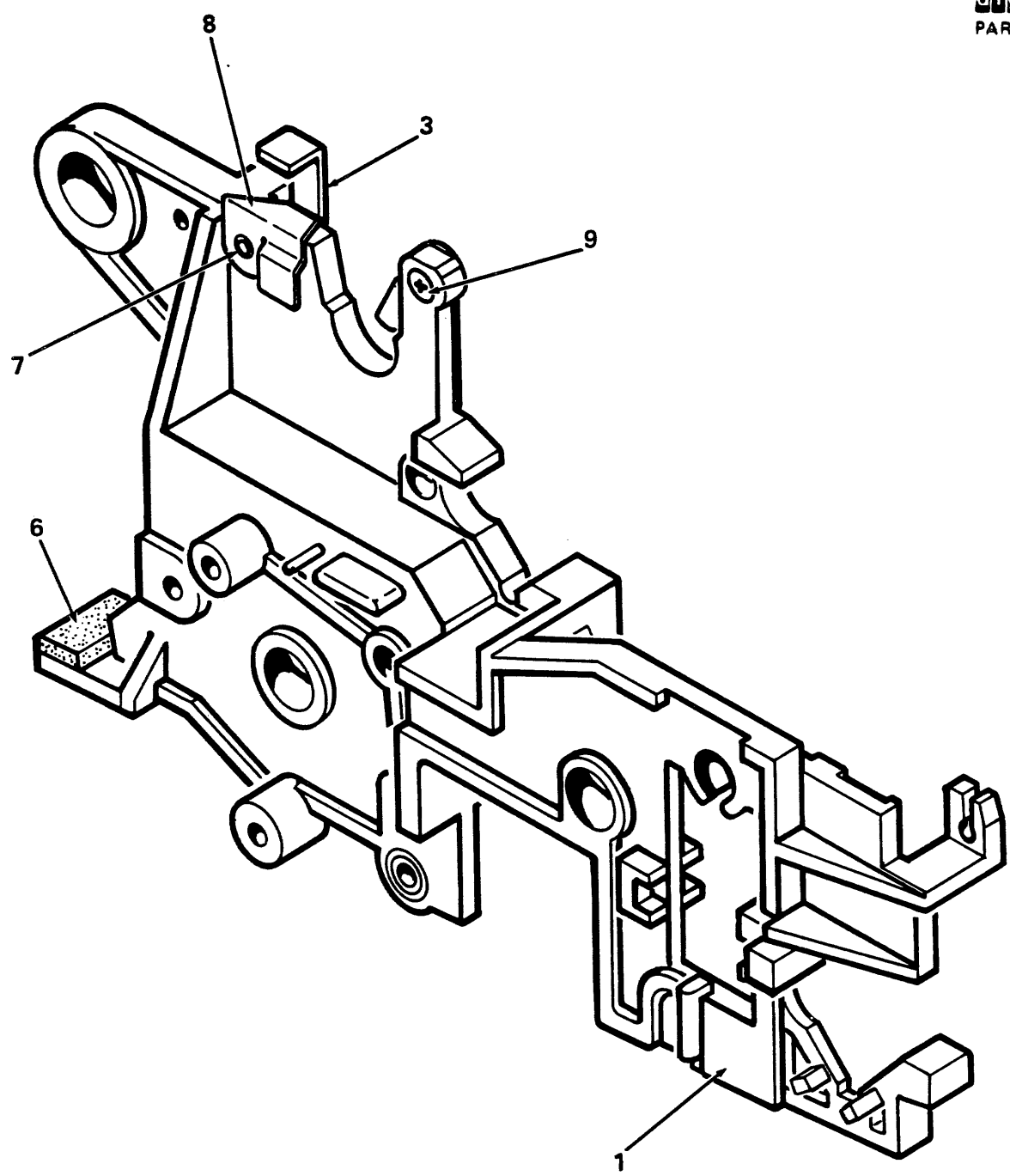
Figure 16. Side Plate Assembly (L.H.) (Sheet 2 of 2)

LA210-16A

FIG. & ITEM NO.	DESCRIPTION	DEC PART NO.	A ECO CUT-IN 70-20679 00000	USED ON CODE	REF FIG NO.
16—	SIDE PLATE ASSEMBLY (L.H.)	70-20679-01			9
1	*Plate, Side	74-28414-01			
2	*Spacer, Platen Latch	12-15557-00			
3	*Latch, Platen	74-28721-01			
4	*Spring, Extension, Latch	12-15508-00			
5	*Pin	90-10093-00			
6	*Pad, Top	74-29603-01			
7	*Eyelet, Rolled	90-09000-00			
8	*Clip, Tractor Ground	74-29042-01			
9	*Screw, Phl Flat Hd No. 4-40 x 5/16	90-06010-02			

digital
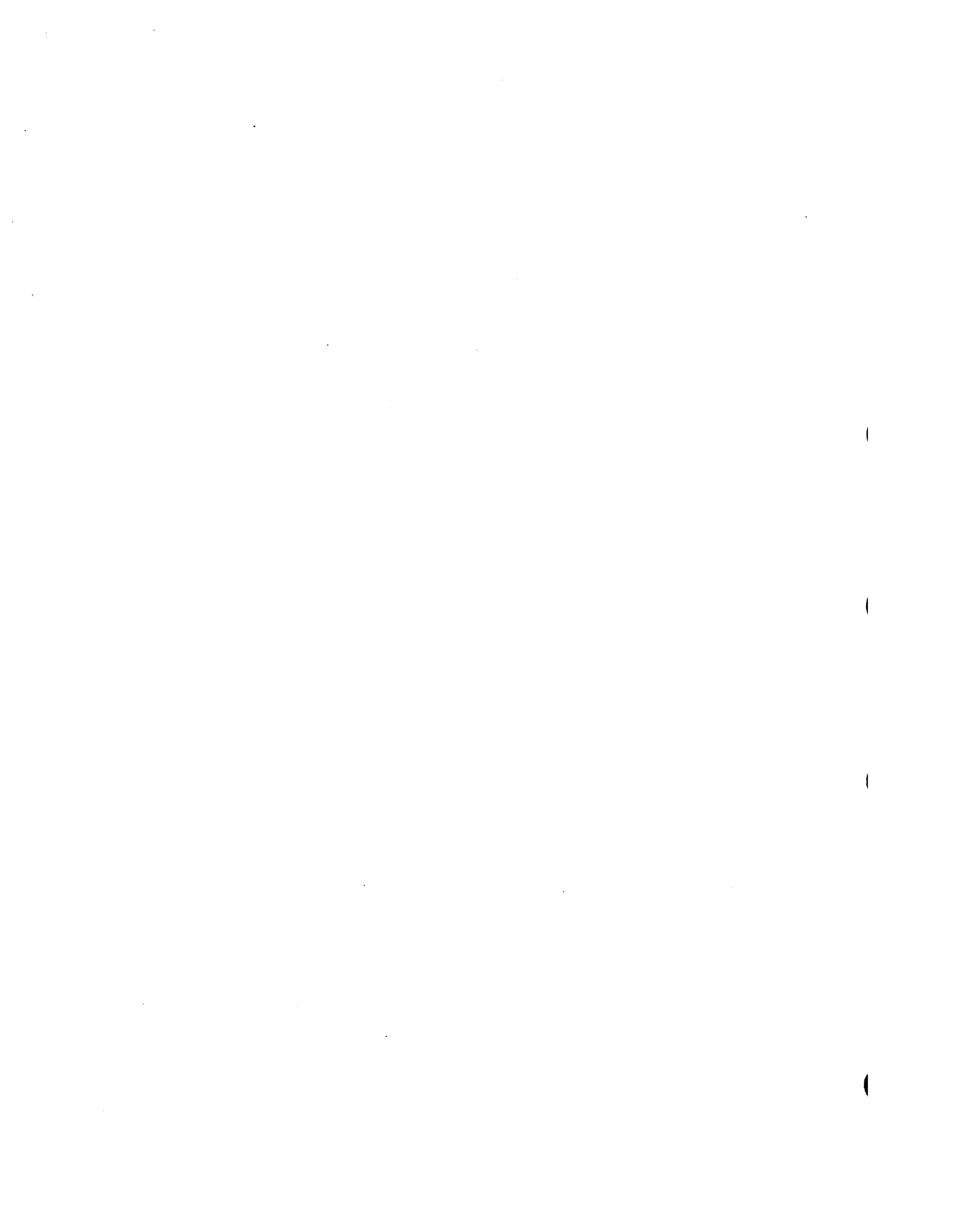
PART NUMBER/DESCRIPTION SORT
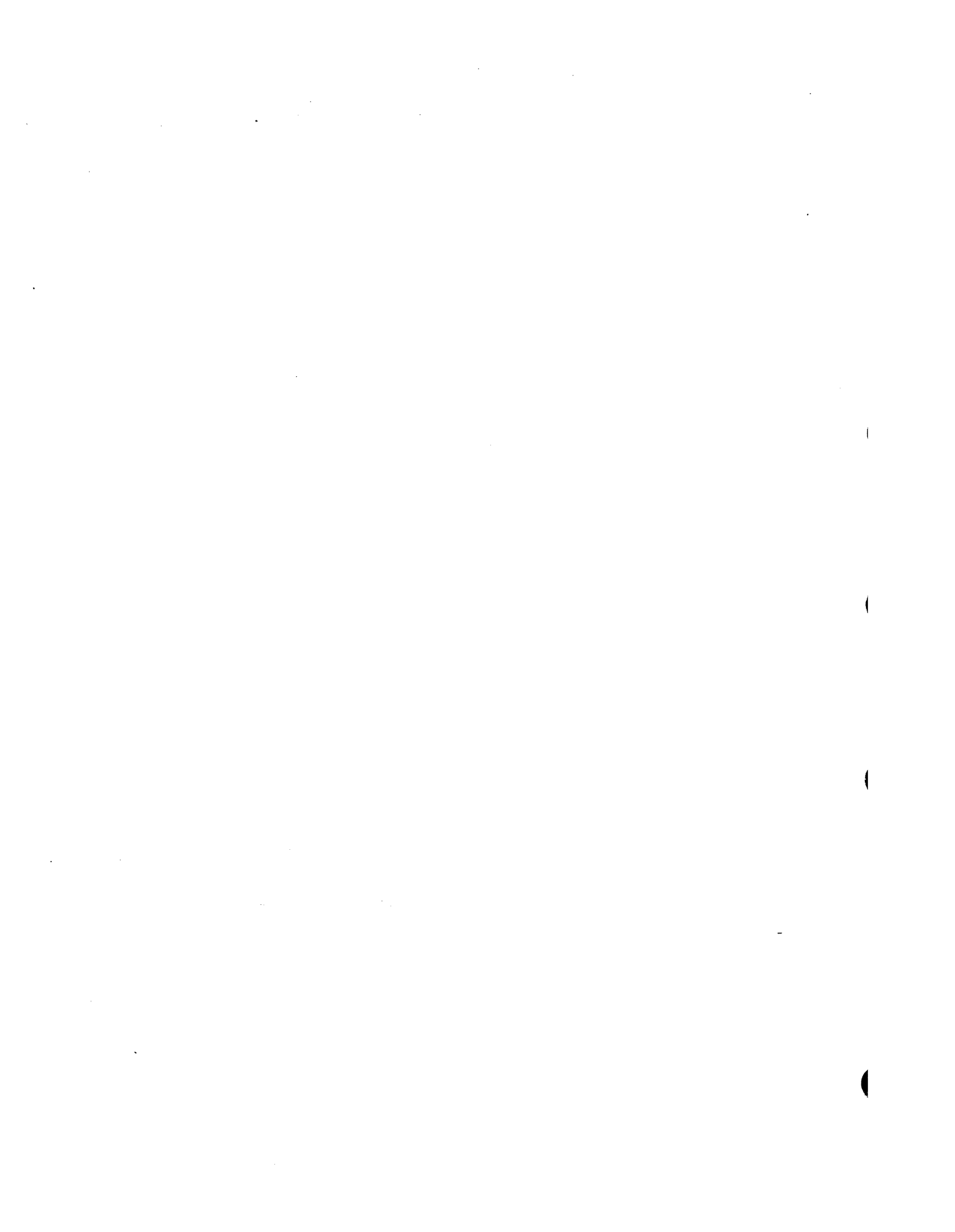
PART NO.	DESCRIPTION	FIG. NO.	ITEM
10-01610-02	Capacitor, 100V +80-20%	17	5
12-12220-02	Conn, P&S 1 Pin 18-20 AWG	10	2H
12-14979-01	Connector, (P3) Pin Contact	8	2
12-14979-01	Contact, (P1) Cantilever Crimp	17	2
12-15047-01	Connector, (P3) 5 Pin Housing	8	3
12-15288-00	Gear, Tractor	12	4
12-15289-01	Bearing, Plain	12	5
12-15315-00	Shaft, Carriage	9	27
12-15322-01	Connector, (P1) 2 Position Housing	17	1
12-15336-01	Connector Assembly, Self-Test	1	12
12-15348-00	Ribbon Drive Cable Assembly	9	28
12-15349-00	Arm, Rocker	14	2
12-15352-00	Clutch, Gear	12	9
12-15353-01	Bearing, Plastic	12	7
12-15354-00	Clutch, Hub, Paper Drive	12	10
12-15355-00	Rocker	14	4
12-15358-00	Shaft, Friction	14	1
12-15362-00	Belt, Timing	10	12
12-15400-00	Clutch, Disk	12	8
12-15452-00	Screw, Lever	11	8
12-15453-00	Spacer, Lever	11	9
12-15474-00	Plug, Phone Jack (J1)	8	5
12-15506-00	Rod, Cap	9	29
12-15508-00	Spring, Extension, Latch	16	4
12-15508-00	Spring, Latch	11	11
12-15523-02	Ball Bearing	13	5
12-15524-00	Bushing	14	3
12-15551-00	Spring	14	5
12-15552-00	Spring, Clutch	12	11
12-15557-00	Spacer, Platen	11	7
12-15557-00	Spacer, Platen Latch	16	2
12-15562-00	Washer, Clutch	12	12
12-15782-00	Shaft, Paper Out	9	26
12-16021-00	Support, Tractor	6	18
12-16192-00	Tractor Bushing Assembly	6	8
12-16193-00	Gear, Tractor Idler	6	12
12-16194-00	Drive Gear Tractor Assembly	6	13
12-16305-00	Spring, Torsion	9	31
12-16371-00	Switch, Micro	15	3
12-16687-01	Reed Mini Magnetic Switch Assembly	8	1
12-16697-02	Switch Assembly, Reed, Magnetic	2	5
12-17474-00	Stepper Motor Assembly	11	10
12-17786-00	Micro Switch	5	3
12-18055-00	Terminal, (P2, P3) Housing	17	4
12-18056-00	Terminal, (P2, P3) Quick Disconnect	17	3
12-18685-05	Tractor, (1 Pair)	6	3
12-19266-00	Motor-Encoder, Magnetic, W/Drive	13	7
12-19528-01	Spacer, Slide Friction	10	16
12-19681-01	Pad, Sponge Rubber	10	2C
12-20069-01	Bearing, Carriage Front	10	6
12-20072-01	Spring, Extension	10	5
12-20076-01	Platen	12	6

PART NO.	DESCRIPTION	FIG. NO.	ITEM
12-21775-01	Housing, Mini-Pod	10	2J
12-22223-01	Keycap, Blank	7	2
12-22223-02	Keycap, "Auto/Manual"	7	3
12-22223-03	Keycap, "Normal/Self Test"	7	4
12-22223-04	Keycap, "Set Top of Form"	7	5
12-22223-05	Keycap, "Font Select"	7	6
12-22223-06	Keycap, "Letter/Draft"	7	7
12-22223-07	Keycap, "Line/Local"	7	8
12-22223-08	Keycap, "Local Form Feed/Reset"	7	9
13-03365-00	Resistor, 1.0K 5.0W 10%	17	7
16-24814-01	Inductor, Toroidal, 10uH	13	9
17-00307-02	Cable Assembly, 16 Cond w/Conn. 42"	10	2E
36-16073-00	Label, "I.D."	8	6
36-16073-00	Label, "I.D."	17	8
36-17905-16	Label, "Warning, 100V-120V"	1	Not Shown
36-17905-17	Label, "Warning, 220V-240V"	1	Not Shown
36-20798-01	Ribbon Cartridge	1	13
36-22441-01	Label, "Power"	7	Not Shown
36-22760-01	Label, "Serial LA210"	1	Not Shown
36-22761-01	Keycap, "Control Panel"	7	10
54-16163-01	LA210 Control Logic Board	4	29
54-16165-01	Control Panel Module Assembly	7	1
54-16167-01	LA100/LA200 ROM Cartridge	5	5
70-15733-01	FRICTION ASSEMBLY	14	0
70-15733-01	FRICTION ASSEMBLY	9	7
70-15735-00	Pulley Idler Assembly	9	6
70-16650-00	Side Plate Assembly (R.H.)	6	1
70-17563-00	Housing Assembly	10	2G
70-17564-00	Actuator Assembly	10	3
70-18601-00	Front Paper Roller Assembly	14	6
70-18602-00	Rear Paper Roller Assembly	14	7
70-18639-00	Head Lever Slide Assembly	10	17
70-19655-01	Print Head Assembly (Laminated)	1	1
70-19659-01	SMUDGE GUARD ASSEMBLY	10	26
70-20679-01	SIDE PLATE ASSEMBLY (L.H.)	9	1
70-20679-01	SIDE PLATE ASSEMBLY (L.H.)	16	0
70-20680-01	SIDE PLATE ASSEMBLY (R.H.)	11	0
70-20680-01	SIDE PLATE ASSEMBLY (R.H.)	9	2
70-20681-01	SERVO MOTOR/HOUSING ASSEMBLY	9	4
70-20682-01	Gear Drive Cover Assembly	13	1
70-20684-01	PLATEN ASSEMBLY	12	0
70-20684-01	PLATEN ASSEMBLY	1	2
70-20685-01	CARRIAGE ASSEMBLY	10	0
70-20685-01	CARRIAGE ASSEMBLY	9	3
70-20689-01	MODULE/ACCESS PANEL ASSEMBLY	4	28
70-20693-01	PRINTER MECHANISM ASSEMBLY	4	1

PART NO.	DESCRIPTION	FIG. NO.	ITEM
70-20693-01	PRINTER MECHANISM ASSEMBLY	9	0
70-20749-01	Side Plate Assembly (L.H.)	6	2
70-20795-01	Pulley/Clutch Assembly	10	19
70-20797-01	TOP ACCES COVER ASSEMBLY	2	0
70-20797-01	TOP ACCESS COVER ASSEMBLY	1	3
70-20798-01	BASE HOUSING/MECHANISM ASSEMBLY	1	4
70-20798-01	BASE HOUSING/PRINTER MECHANISM ASSEMBLY	4	0
70-20799-01	Carriage Bearing Assembly	10	1
70-20800-01	Base Housing Assembly	4	2
70-20802-01	Cross Member Assembly	9	8
70-20805-01	HEAD CABLE ASSEMBLY	10	2
70-20809-01	LA210 USER KIT	1	10
70-20810-01	ROM CHIMNEY ASSEMBLY	5	0
70-20810-01	ROM CHIMNEY ASSEMBLY	4	3
70-21151-01	CONTROL PANEL ARRAY ASSEMBLY	7	0
70-21151-01	CONTROL PANEL ARRAY ASSEMBLY	4	7
70-21225-01	Anti-Backlash Gear Assembly	11	1
70-21240-YA	Logic/Power Cable Assembly	4	5
70-21241-01	INTERLOCK SWITCH ASSEMBLY	4	24
70-21241-01	INTERLOCK SWITCH ASSEMBLY	8	0
70-21242-YA	SERVO MOTOR CABLE ASSEMBLY	13	0
70-21242-YA	SERVO MOTOR CABLE ASSEMBLY	4	4
70-21248-01	TRACTOR OPTION ASSEMBLY	1	6
70-21248-01	TRACTOR ASSEMBLY	6	0
70-21249-01	INTERMEDIATE COVER ASSEMBLY	3	0
70-21249-01	INTERMEDIATE COVER ASSEMBLY	1	5
70-21250-0J	Font Switch Cable Assembly	5	4
70-21854-01	Front Tractor Cover Assembly	6	27
70-21859-01	PAPER OUR SWITCHPLATE ASSEMBLY	9	5
70-21859-01	PAPER OUT SWITCH PLATE ASSEMBLY	15	0
70-21873-01	Pulley Clutch Assembly	10	22
74-12103-00	Paper, Pkg. (132 Column)	1	11
74-21622-00	Push Rod, Latch (L.H.)	6	6
74-21622-01	Push Rod, Latch (R.H.)	6	7
74-21664-00	Clip, Spring	6	16
74-21665-00	Shaft, Tractor Guide	6	20
74-21666-00	Shaft, Tractor Support	6	19
74-22505-00	Plate, Switch Support	15	1
74-22555-00	Shaft, Round	6	21
74-22870-00	Support, Tractor Paper	6	22
74-22987-00	Cam	9	12
74-25720-00	Lever, Head Retaining	10	9
74-26722-01	Spring, Front Bearing	10	7
74-27151-01	Guide, Paper	10	27
74-28393-01	Cover, Intermediate	3	1
74-28395-01	Cover, ROM	3	3
74-28396-01	Cover, Top	2	1
74-28397-01	Window, Safety	2	4
74-28400-01	Panel, Trim	3	2
74-28401-01	Bracket, Panel	4	8
74-28411-01	Bearing, Flanged	10	21
74-28413-01	Panel, Access	4	30

PART NO.	DESCRIPTION	FIG. NO.	ITEM
74-28414-01	Plate, Side	16	1
74-28416-01	Plate, R.H. Side	11	2
74-28417-01	Bracket, Termination	9	24
74-28418-01	Pulley, Timing	13	2
74-28623-01	Housing, Gear Drive	13	8
74-28637-01	Bearing, Support	9	9
74-28715-01	Lever, Release	11	3
74-28717-01	Cam, Paper Out	9	18
74-28721-01	Latch, Platen	16	3
74-28721-02	Latch, R.H. Platen	11	4
74-28722-01	Pad, Side Cover	3	11
74-28723-01	Pad, Top Cover	3	10
74-28755-01	Tensioner, Belt	9	11
74-28758-01	Spacer	9	13
74-28958-01	Mount, Head Cable	10	2A
74-28959-01	Clamp, Ribbon Cable	10	2B
74-29035-01	Spring, Compression	9	16
74-29036-01	Knob, Platen, L.H.	12	1
74-29036-02	Knob, Platen, R.H.	12	2
74-29037-01	Pin, Dowel	11	5
74-29040-01	Bumper (L.H.)	9	14
74-29040-02	Bumper (R.H.)	9	15
74-29042-01	Clip, Tractor Ground	16	8
74-29043-00	Retaining Ring	12	3
74-29045-01	Shaft, Rear	9	19
74-29047-01	Cam, Rear Shaft	9	22
74-29048-01	Cradle, Rear Shaft	9	20
74-29065-01	Cap, Tractor End (R.H.)	6	5
74-29229-01	Lever, Switch Release	9	10
74-29295-01	Retainer, Detent	15	2
74-29405-01	Clamp, Mechanism	4	12
74-29465-01	Holder, ROM Cartridge	5	1
74-29466-01	Spring, Compression	10	18
74-29468-01	Latch	2	2
74-29539-01	Retainer, ROM Cartridge	5	2
74-29574-01	Guard, Ribbon	10	28
74-29576-01	Plane, Ground, L.H.	4	9
74-29577-01	Plane, Ground R.H.	11	16
74-29579-01	Cap, Tractor (L.H.)	6	4
74-29580-01	Clip, Actuator Retainer	10	2F
74-29603-01	Pad, Top	11	12
74-29603-01	Pad, Top	16	6
74-29623-01	Cover, Tractor	6	26
74-29690-01	Strap, Ground, L.H.	4	10
74-29691-01	Strap, Ground, R.H.	4	11
74-29739-01	Trigger, Paper Out	9	23
74-29759-01	Pad, Acoustic	6	24
74-29759-02	Pad, Acoustic	6	23
74-29867-01	Logo, "LA210 Letterprinter"	3	5
74-29899-01	Bumper, Tractor	6	10
74-29951-01	Plug, Parallel Interface	1	8
74-29952-01	Plug, Dip Switch	1	7
74-30106-01	Arm, Head Lift	10	8

PART NO.	DESCRIPTION	FIG. NO.	ITEM
74-30154-01	Pad, Cover Side, L.H.	2	7
74-30154-02	Pad, Cover Side, R.H.	2	8
74-30155-01	Pad, Cover	2	9
74-30156-01	Pad, R.H., Cover	3	6
74-30157-01	Pad, L.H., Cover	3	7
74-30158-01	Plug, Keyboard	1	9
74-30271-01	Clip, Retaining	9	17
74-30271-02	Clip, Retaining, (R.H.)	9	42
74-30271-03	Clip, Retaining, (L.H.)	9	43
74-30322-01	Gasket, Tractor	6	25
74-30323-01	Retainer, Spring	10	24
74-30326-01	Shaft, Ribbon Drive	10	25
74-30386-01	Clip, Carriage	10	13
74-30396-01	Pad, Top Intermediate Cover	3	8
74-30497-01	Clip, Compression	9	25
74-30775-01	Cover, Safety, Power Supply	4	23
74-30851-01	Spacer, Locator	10	23
74-31015-01	Pad, Tractor Support	6	9
74-31185-01	Paper Guide	9	30
74-31694-01	Clamp, Shaft	9	21
90-00034-04	Spacer	4	34
90-00039-15	Screw, Phl Flat Hd No. 10-24 x 1/2	9	41
90-00044-11	Screw, Set Cup Hex Hd No. 2-56 x 25/64	10	10
90-00049-08	Screw, Sems Slotted Hex Hd No. 6-32 x 5/16	9	39
90-00049-55	Screw, Sems Phl Pan Hd No. 4-40 x 5/8	4	32
90-06010-02	Screw, Phl Flat Hd No. 4-40 x 5/16	16	9
90-06010-02	Screw, Flat Phl Hd No. 4-40 x 5/16	11	14
90-06014-01	Screw, Phl Pan Hd No. 4-40 x 5/8	15	4
90-06020-04	Screw, Slotted Binder Hd No. 6-32 x 1/4	4	21
90-06025-01	Screw, Phl Pan Hd No. 6-32 x 5/8	9	34
90-06453-00	Screw, Sems Slotted Hex Hd No. 6-32 x 3/8	4	15
90-06453-00	Screw, Sems Hex Hd No. 6-32 x 3/8	11	17
90-06453-00	Screw, Slotted Hex Hd No. 6-32 x 3/8	6	14
90-06555-00	Nut, Hex	10	11
90-06556-00	Nut, Hex No. 4-40 x 1/4 x 3/32	4	33
90-06557-00	Nut, Kep No. 4-40 x 1/4	15	5
90-06563-00	Nut, Kep	4	25
90-06653-00	Washer, Flat	10	15
90-06659-00	Washer, Flat	11	15
90-06661-00	Washer, Flat	4	27
90-06714-00	Washer, Flat	11	6
90-07649-00	Washer, Lock	4	13
90-07650-04	Screw, Bind, Slot No. 4-40 x 3/16	5	6
90-07784-01	Retaining Ring	9	38
90-08011-01	Screw, Phl Pan Hd No. 10-24 x 7/16	9	40
90-08055-00	Nut, Hex No. 6-32	9	37
90-08137-00	Retaining Ring	11	13
90-08221-01	Screw, Phl Pan Hd No. 8-32 x 7/8 (Self Tapping)	9	35
90-08836-00	Terminal, (P1, P2) Quick Disconnect	8	4
90-09000-00	Eyelet, Rolled	16	7

PART NO.	DESCRIPTION	FIG. NO.	ITEM
90-09138-02	Screw, Phl Flat Hd No. 4-40 x 1/2 (Self Tapping)	2	3
90-09232-00	Washer, Flat	4	22
90-09257-00	Retaining Ring	3	9
90-09278-00	Spring, Extension	3	4
90-09279-01	Spring, Extension	6	15
90-09301-00	Nut, Speed No. 6-32	4	20
90-09324-00	Roll Pin	12	13
90-09644-00	Retaining Ring	6	11
90-09644-01	Retaining Ring	13	3
90-09680-02	Screw, Hex Washer Hd No. 6 x 3/8 (Self Tapping)	10	14
90-09680-04	Screw, Hex Washer Hd No. 6 x 1/2 (Self Tapping)	13	4
90-09703-04	Retaining Ring	10	20
90-09800-06	Screw, Phl Pan Hd No. 6 x 3/8	6	17
90-10050-00	Retaining Ring	12	14
90-10052-00	Retaining Ring	9	32
90-10052-00	Washer, Lock	9	36
90-10063-00	Screw, Hex Washer Hd No. 8-32 x 1/2	4	14
90-10074-01	Screw, Hex Washer Hd No. 6-32 x 1/4	4	18
90-10075-00	Screw, Hex Washer Hd No. 8-32 x 3/8	4	17
90-10075-00	Screw, Hex Washer Hd No. 8-32 x 3/8 (Self Tapping)	9	33
90-10075-01	Screw, Hex Washer Hd No. 8-32 x 1/2 (Self Tapping)	4	26
90-10093-00	Pin, Grooved	10	4
90-10093-00	Pin	16	5
90-10174-00	Screw, Sems Phl Pan Hd No. 6-32 x 1/4	4	31
90-10174-00	Screw, Sems Phl Pan Hd No. 6-32 x 1/4	2	6
90-10174-00	Screw, Sems Phl Pan Hd No. 6-32 x 1/4	4	16
90-10174-00	Screw, Sems Phl Pan Hd No. 6-32 x 1/4	13	6
90-10174-01	Screw, Sems Phl Pan Hd No. 6-32 x 1/4	4	19
90-10311-00	Nut, Push-On	10	2D
91-07256-11	Tubing, Teflon	17	6
H7844-00	LA100 POWER SUPPLY (See H7844 IPB)	4	6
LA210-A2	Code A - Used on Model LA210-A2 120V	1	0A
LA210-A3	Code B - Used on Model LA210-A3 240V	1	0B
	LA210 LETTERPRINTER	1	0

DESCRIPTION	PART NO.	FIG. NO.	ITEM
Actuator Assembly	70-17564-00	10	3
Anti-Backlash Gear Assembly	70-21225-01	11	1
Arm, Head Lift	74-30106-01	10	8
Arm, Rocker	12-15349-00	14	2
Ball Bearing	12-15523-02	13	5
Base Housing Assembly	70-20800-01	4	2
BASE HOUSING/MECHANISM ASSEMBLY	70-20798-01	1	4
BASE HOUSING/PRINTER MECHANISM ASSEMBLY	70-20798-01	4	0
Bearing, Carriage Front	12-20069-01	10	6
Bearing, Flanged	74-28411-01	10	21
Bearing, Plain	12-15289-01	12	5
Bearing, Plastic	12-15353-01	12	7
Bearing, Support	74-28637-01	9	9
Belt, Timing	12-15362-00	10	12
Bracket, Panel	74-28401-01	4	8
Bracket, Termination	74-28417-01	9	24
Bumper (L.H.)	74-29040-01	9	14
Bumper (R.H.)	74-29040-02	9	15
Bumper, Tractor	74-29899-01	6	10
Bushing	12-15524-00	14	3
Cable Assembly, 16 Cond w/Conn. 42"	17-00307-02	10	2E
Cam	74-22987-00	9	12
Cam, Paper Out	74-28717-01	9	18
Cam, Rear Shaft	74-29047-01	9	22
Cap, Tractor (L.H.)	74-29579-01	6	4
Cap, Tractor End (R.H.)	74-29065-01	6	5
Capacitor, 100V +80-20%	10-01610-02	17	5
CARRIAGE ASSEMBLY	70-20685-01	10	0
CARRIAGE ASSEMBLY	70-20685-01	9	3
Carriage Bearing Assembly	70-20799-01	10	1
Clamp, Mechanism	74-29405-01	4	12
Clamp, Ribbon Cable	74-28959-01	10	2B
Clamp, Shaft	74-31694-01	9	21
Clip, Actuator Retainer	74-29580-01	10	2F
Clip, Carriage	74-30386-01	10	13
Clip, Compression	74-30497-01	9	25
Clip, Retaining	74-30271-01	9	17
Clip, Retaining, (L.H.)	74-30271-03	9	43
Clip, Retaining, (R.H.)	74-30271-02	9	42
Clip, Spring	74-21664-00	6	16
Clip, Tractor Ground	74-29042-01	16	8
Clutch, Disk	12-15400-00	12	8
Clutch, Gear	12-15352-00	12	9
Clutch, Hub, Paper Drive	12-15354-00	12	10
Code A - Used on Model LA210-A2 120V	LA210-A2	1	0A
Code B - Used on Model LA210-A3 240V	LA210-A3	1	0B
Conn, P&S 1 Pin 18-20 AWG	12-12220-02	10	2H
Connector Assembly, Self-Test	12-15336-01	1	12
Connector, (P1) 2 Position Housing	12-15322-01	17	1
Connector, (P3) 5 Pin Housing	12-15047-01	8	3
Connector, (P3) Pin Contact	12-14979-01	8	2

DESCRIPTION	PART NO.	FIG. NO.	ITEM
Contact, (P1) Cantilever Crimp	12-14979-01	17	2
CONTROL PANEL ARRAY ASSEMBLY	70-21151-01	4	7
CONTROL PANEL ARRAY ASSEMBLY	70-21151-01	7	0
Control Panel Module Assembly	54-16165-01	7	1
Cover, Intermediate	74-28393-01	3	1
Cover, ROM	74-28395-01	3	3
Cover, Safety, Power Supply	74-30775-01	4	23
Cover, Top	74-28396-01	2	1
Cover, Tractor	74-29623-01	6	26
Cradle, Rear Shaft	74-29048-01	9	20
Cross Member Assembly	70-20802-01	9	8
Drive Gear Tractor Assembly	12-16194-00	6	13
Eyelet, Rolled	90-09000-00	16	7
Font Switch Cable Assembly	70-21250-0J	5	4
FRICTION ASSEMBLY	70-15733-01	14	0
FRICTION ASSEMBLY	70-15733-01	9	7
Front Paper Roller Assembly	70-18601-00	14	6
Front Tractor Cover Assembly	70-21854-01	6	27
Gasket, Tractor	74-30322-01	6	25
Gear Drive Cover Assembly	70-20682-01	13	1
Gear, Tractor	12-15288-00	12	4
Gear, Tractor Idler	12-16193-00	6	12
Guard, Ribbon	74-29574-01	10	28
Guide, Paper	74-27151-01	10	27
HEAD CABLE ASSEMBLY	70-20805-01	10	2
Head Lever Slide Assembly	70-18639-00	10	17
Holder, ROM Cartridge	74-29465-01	5	1
Housing Assembly	70-17563-00	10	2G
Housing, Gear Drive	74-28623-01	13	8
Housing, Mini-Pod	12-21775-01	10	2J
Inductor, Toroidal, 10uH	16-24814-01	13	9
INTERLOCK SWITCH ASSEMBLY	70-21241-01	8	0
INTERLOCK SWITCH ASSEMBLY	70-21241-01	4	24
INTERMEDIATE COVER ASSEMBLY	70-21249-01	1	5
INTERMEDIATE COVER ASSEMBLY	70-21249-01	3	0
Keycap, "Auto/Manual"	12-22223-02	7	3
Keycap, "Control Panel"	36-22761-01	7	10
Keycap, "Font Select"	12-22223-05	7	6
Keycap, "Letter/Draft"	12-22223-06	7	7
Keycap, "Line/Local"	12-22223-07	7	8
Keycap, "Local Form Feed/Reset"	12-22223-08	7	9
Keycap, "Normal/Self Test"	12-22223-03	7	4
Keycap, "Set Top of Form"	12-22223-04	7	5
Keycap, Blank	12-22223-01	7	2
Knob, Platen, L.H.	74-29036-01	12	1
Knob, Platen, R.H.	74-29036-02	12	2

DESCRIPTION	PART NO.	FIG. NO.	ITEM
LA100 POWER SUPPLY (See H7844 IPB)	H7844-00	4	6
LA100/LA200 ROM Cartridge	54-16167-01	5	5
LA210 Control Logic Board	54-16163-01	4	29
LA210 LETTERPRINTER		1	0
LA210 USER KIT	70-20809-01	1	10
Label, "I.D"	36-16073-00	17	8
Label, "I.D."	36-16073-00	8	6
Label, "Power"	36-22441-01	7	Not Shown
Label, "Serial LA210"	36-22760-01	1	Not Shown
Label, "Warning, 100V-120V"	36-17905-16	1	Not Shown
Label, "Warning, 220V-240V"	36-17905-17	1	Not Shown
Latch	74-29468-01	2	2
Latch, Platen	74-28721-01	16	3
Latch, R.H. Platen	74-28721-02	11	4
Lever, Head Retaining	74-25720-00	10	9
Lever, Release	74-28715-01	11	3
Lever, Switch Release	74-29229-01	9	10
Logic/Power Cable Assembly	70-21240-YA	4	5
Logo, "LA210 Letterprinter"	74-29867-01	3	5
Micro Switch	12-17786-00	5	3
MODULE/ACCESS PANEL ASSEMBLY	70-20689-01	4	28
Motor-Encoder, Magnetic, W/Drive	12-19266-00	13	7
Mount, Head Cable	74-28958-01	10	2A
Nut, Hex	90-06555-00	10	11
Nut, Hex No. 4-40 x 1/4 x 3/32	90-06556-00	4	33
Nut, Hex No. 6-32	90-08055-00	9	37
Nut, Kep	90-06563-00	4	25
Nut, Kep No. 4-40 x 1/4	90-06557-00	15	5
Nut, Push-On	90-10311-00	10	2D
Nut, Speed No. 6-32	90-09301-00	4	20
Pad, Acoustic	74-29759-02	6	23
Pad, Acoustic	74-29759-01	6	24
Pad, Cover	74-30155-01	2	9
Pad, Cover Side, L.H.	74-30154-01	2	7
Pad, Cover Side, R.H.	74-30154-02	2	8
Pad, L.H., Cover	74-30157-01	3	7
Pad, R.H., Cover	74-30156-01	3	6
Pad, Side Cover	74-28722-01	3	11
Pad, Sponge Rubber	12-19681-01	10	2C
Pad, Top	74-29603-01	16	6
Pad, Top	74-29603-01	11	12
Pad, Top Cover	74-28723-01	3	10
Pad, Top Intermediate Cover	74-30396-01	3	8
Pad, Tractor Support	74-31015-01	6	9
Panel, Access	74-28413-01	4	30
Panel, Trim	74-28400-01	3	2
Paper Guide	74-31185-01	9	30
PAPER OUR SWITCHPLATE ASSEMBLY	70-21859-01	9	5
PAPER OUT SWITCH PLATE ASSEMBLY	70-21859-01	15	0
Paper, Pkg. (132 Column)	74-12103-00	1	11

DESCRIPTION	PART NO.	FIG. NO.	ITEM
Pin	90-10093-00	16	5
Pin, Dowel	74-29037-01	11	5
Pin, Grooved	90-10093-00	10	4
Plane, Ground R.H.	74-29577-01	11	16
Plane, Ground, L.H.	74-29576-01	4	9
Plate, R.H. Side	74-28416-01	11	2
Plate, Side	74-28414-01	16	1
Plate, Switch Support	74-22505-00	15	1
Platen	12-20076-01	12	6
PLATEN ASSEMBLY	70-20684-01	1	2
PLATEN ASSEMBLY	70-20684-01	12	0
Plug, Dip Switch	74-29952-01	1	7
Plug, Keyboard	74-30158-01	1	9
Plug, Parallel Interface	74-29951-01	1	8
Plug, Phone Jack (J1)	12-15474-00	8	5
Print Head Assembly (Laminated)	70-19655-01	1	1
PRINTER MECHANISM ASSEMBLY	70-20693-01	9	0
PRINTER MECHANISM ASSEMBLY	70-20693-01	4	1
Pulley Clutch Assembly	70-21873-01	10	22
Pulley Idler Assembly	70-15735-00	9	6
Pulley, Timing	74-28418-01	13	2
Pulley/Clutch Assembly	70-20795-01	10	19
Push Rod, Latch (L.H.)	74-21622-00	6	6
Push Rod, Latch (R.H.)	74-21622-01	6	7
Rear Paper Roller Assembly	70-18602-00	14	7
Reed Mini Magnetic Switch Assembly	12-16687-01	8	1
Resistor, 1.0K 5.0W 10%	13-03365-00	17	7
Retainer, Detent	74-29295-01	15	2
Retainer, ROM Cartridge	74-29539-01	5	2
Retainer, Spring	74-30323-01	10	24
Retaining Ring	90-09257-00	3	9
Retaining Ring	90-09644-00	6	11
Retaining Ring	90-10050-00	12	14
Retaining Ring	90-09644-01	13	3
Retaining Ring	90-10052-00	9	32
Retaining Ring	74-29043-00	12	3
Retaining Ring	90-09703-04	10	20
Retaining Ring	90-07784-01	9	38
Retaining Ring	90-08137-00	11	13
Ribbon Cartridge	36-20798-01	1	13
Ribbon Drive Cable Assembly	12-15348-00	9	28
Rocker	12-15355-00	14	4
Rod, Cap	12-15506-00	9	29
Roll Pin	90-09324-00	12	13
ROM CHIMNEY ASSEMBLY	70-20810-01	5	0
ROM CHIMNEY ASSEMBLY	70-20810-01	4	3

DESCRIPTION	PART NO.	FIG. NO.	ITEM
Screw, Bind, Slot No. 4-40 x 3/16	90-07650-04	5	6
Screw, Flat Phl Hd No. 4-40 x 5/16	90-06010-02	11	14
Screw, Hex Washer Hd No. 6 x 1/2 (Self Tapping)	90-09680-04	13	4
Screw, Hex Washer Hd No. 6 x 3/8 (Self Tapping)	90-09680-02	10	14
Screw, Hex Washer Hd No. 6-32 x 1/4	90-10074-01	4	18
Screw, Hex Washer Hd No. 8-32 x 1/2	90-10063-00	4	14
Screw, Hex Washer Hd No. 8-32 x 1/2 (Self Tapping)	90-10075-01	4	26
Screw, Hex Washer Hd No. 8-32 x 3/8	90-10075-00	4	17
Screw, Hex Washer Hd No. 8-32 x 3/8 (Self Tapping)	90-10075-00	9	33
Screw, Lever	12-15452-00	11	8
Screw, Phl Flat Hd No. 10-24 x 1/2	90-00039-15	9	41
Screw, Phl Flat Hd No. 4-40 x 1/2 (Self Tapping)	90-09138-02	2	3
Screw, Phl Flat Hd No. 4-40 x 5/16	90-06010-02	16	9
Screw, Phl Pan Hd No. 10-24 x 7/16	90-08011-01	9	40
Screw, Phl Pan Hd No. 4-40 x 5/8	90-06014-01	15	4
Screw, Phl Pan Hd No. 6 x 3/8	90-09800-06	6	17
Screw, Phl Pan Hd No. 6-32 x 5/8	90-06025-01	9	34
Screw, Phl Pan Hd No. 8-32 x 7/8 (Self Tapping)	90-08221-01	9	35
Screw, Sems Hex Hd No. 6-32 x 3/8	90-06453-00	11	17
Screw, Sems Phl Pan Hd No. 4-40 x 5/8	90-00049-55	4	32
Screw, Sems Phl Pan Hd No. 6-32 x 1/4	90-10174-00	2	6
Screw, Sems Phl Pan Hd No. 6-32 x 1/4	90-10174-00	4	16
Screw, Sems Phl Pan Hd No. 6-32 x 1/4	90-10174-01	4	19
Screw, Sems Phl Pan Hd No. 6-32 x 1/4	90-10174-00	4	31
Screw, Sems Phl Pan Hd No. 6-32 x 1/4	90-10174-00	13	6
Screw, Sems Slotted Hex Hd No. 6-32 x 3/8	90-06453-00	4	15
Screw, Sems Slotted Hex Hd No. 6-32 x 5/16	90-00049-08	9	39
Screw, Set Cup Hex Hd No. 2-56 x 25/64	90-00044-11	10	10
Screw, Slotted Binder Hd No. 6-32 x 1/4	90-06020-04	4	21
Screw, Slotted Hex Hd No. 6-32 x 3/8	90-06453-00	6	14
SERVO MOTOR CABLE ASSEMBLY	70-21242-YA	13	0
SERVO MOTOR CABLE ASSEMBLY	70-21242-YA	4	4
SERVO MOTOR/HOUSING ASSEMBLY	70-20681-01	9	4
Shaft, Carriage	12-15315-00	9	27
Shaft, Friction	12-15358-00	14	1
Shaft, Paper Out	12-15782-00	9	26
Shaft, Rear	74-29045-01	9	19
Shaft, Ribbon Drive	74-30326-01	10	25
Shaft, Round	74-22555-00	6	21
Shaft, Tractor Guide	74-21665-00	6	20
Shaft, Tractor Support	74-21666-00	6	19
SIDE PLATE ASSEMBLY (L.H.)	70-20679-01	16	0
Side Plate Assembly (L.H.)	70-20749-01	6	2
SIDE PLATE ASSEMBLY (L.H.)	70-20679-01	9	1
SIDE PLATE ASSEMBLY (R.H.)	70-20680-01	9	2
SIDE PLATE ASSEMBLY (R.H.)	70-20680-01	11	0

DESCRIPTION	PART NO.	FIG. NO.	ITEM
Side Plate Assembly (R.H.)	70-16650-00	6	1
SMUDGE GUARD ASSEMBLY	70-19659-01	10	26
Spacer	90-00034-04	4	34
Spacer	74-28758-01	9	13
Spacer, Lever	12-15453-00	11	9
Spacer, Locator	74-30851-01	10	23
Spacer, Platen	12-15557-00	11	7
Spacer, Platen Latch	12-15557-00	16	2
Spacer, Slide Friction	12-19528-01	10	16
Spring	12-15551-00	14	5
Spring, Clutch	12-15552-00	12	11
Spring, Compression	74-29035-01	9	16
Spring, Compression	74-29466-01	10	18
Spring, Extension	90-09278-00	3	4
Spring, Extension	90-09279-01	6	15
Spring, Extension	12-20072-01	10	5
Spring, Extension, Latch	12-15508-00	16	4
Spring, Front Bearing	74-26722-01	10	7
Spring, Latch	12-15508-00	11	11
Spring, Torsion	12-16305-00	9	31
Stepper Motor Assembly	12-17474-00	11	10
Strap, Ground, L.H.	74-29690-01	4	10
Strap, Ground, R.H.	74-29691-01	4	11
Support, Tractor	12-16021-00	6	18
Support, Tractor Paper	74-22870-00	6	22
Switch Assembly, Reed, Magnetic	12-16697-02	2	5
Switch, Micro	12-16371-00	15	3
Tensioner, Belt	74-28755-01	9	11
Terminal, (P1, P2) Quick Disconnect	90-08836-00	8	4
Terminal, (P2, P3) Housing	12-18055-00	17	4
Terminal, (P2, P3) Quick Disconnect	12-18056-00	17	3
TOP ACCES COVER ASSEMBLY	70-20797-01	2	0
TOP ACCESS COVER ASSEMBLY	70-20797-01	1	3
TRACTOR ASSEMBLY	70-21248-01	6	0
Tractor Bushing Assembly	12-16192-00	6	8
TRACTOR OPTION ASSEMBLY	70-21248-01	1	6
Tractor, (1 Pair)	12-18685-05	6	3
Trigger, Paper Out	74-29739-01	9	23
Tubing, Teflon	91-07256-11	17	6
Washer, Clutch	12-15562-00	12	12
Washer, Flat	90-09232-00	4	22
Washer, Flat	90-06653-00	10	15
Washer, Flat	90-06661-00	4	27
Washer, Flat	90-06714-00	11	6
Washer, Flat	90-06659-00	11	15
Washer, Lock	90-07649-00	4	13
Washer, Lock	90-10052-00	9	36
Window, Safety	74-28397-01	2	4

ILLUSTRATED PARTS BREAKDOWN
COMMENT SHEET

Any and all comments and suggestions for correcting errors and/or additional information to improve this manual will be reviewed and researched for possible use when this manual is revised and/or reprinted. Enter your comments and suggestions in the form provided below and return to Technical Documentation.

MODEL <u>LA210 LETTERPRINTER</u>　　　　**PUBLICATION NO.** <u>EK-LA210-IP-001</u>

FIGURE NO. _____　ITEM NO. _____　　FIGURE NO. _____　ITEM NO. _____

CHANGE FROM _____　　CHANGE FROM _____

CHANGE TO _____　　CHANGE TO _____

FIGURE NO. _____　ITEM NO. _____　　FIGURE NO. _____　ITEM NO. _____

CHANGE FROM _____　　CHANGE FROM _____

CHANGE TO _____　　CHANGE TO _____

FIGURE NO. _____　ITEM NO. _____　　FIGURE NO. _____　ITEM NO. _____

CHANGE FROM _____　　CHANGE FROM _____

CHANGE TO _____　　CHANGE TO _____

ADDITIONAL COMMENT(S)

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