LG31 Printer
Technical Manual

Order Number EK-LG31E-TM-002

Digital Equipment Corporation

The READER'S COMMENTS form on the last page of this document requests the user's critical evaluation to assist in preparing future documentation.

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Preface

Purpose

This manual provides technical information on the LG31 300 LPM Line Matrix Printer. It contains information on the functions, diagnostics, adjustments, and part replacements required in servicing the printer.

Manual Organization

This manual is organized as follows:

Chapter 1 Introduction

Contains an overview, features, Field Replaceable Units (FRUs), and specifications of the LG31 printer.

Chapter 2 Theory Of Operation

Provides a functional and operational description of the LG31 printer.

Chapter 3 Controls and Indicators

Describes functions of the inner and outer control panels.

Chapter 4 Printer and Host Configuration

Contains the parameter settings, the interface settings, and the default characteristics for the LG31 Printer.

Chapter 5 Troubleshooting

Contains a description of methods and procedures in maintaining and troubleshooting the LG31 printer. Describes the test diagnostics for power-on/test pattern, LED displays, remote-initiated self-test, and fault/font checksum code lists.

Chapter 6 Removal and Replacement Procedures

Consists of procedures that apply to removing and replacing LG31 printer Field Replaceable Units (FRUs).

Chapter 7 Print Quality Adjustment Procedures

Describes how to adjust print quality.

Appendix A LG31 System Fuses

Lists the fuses in the LG31.

Appendix B Control Codes and Control Sequence Summary

A list of the control codes and control sequences.

Appendix C LG31 Printed Circuit Board Summary

Contains additional details on the circuit board.

Appendix D LG31 Interconnection Diagrams

Contains the interconnection diagrams.

Related Documentation

This manual is one in a series of documents describing the LG31 printer, which are listed below.

Title	Document No.
LG31 Printer Pocket Service Guide	EK-LG31E-PS
LG31 Printer User's Guide	*
LG31 Printer Installation/Operator's Manual	*
LG31 Printer Technical Manual	EK-LG31E-TM
LG31 Printer Illustrated Parts Breakdown	EK-LG31A-IP

*These two books are ordered as a kit: EK-OLG31-DK.

Conventions

In writing this manual, the following conventions have been adopted for the mechanical objects listed below:

- Control Panel Pushbuttons = Capitalized pushbutton legend

  Example: ON LINE

- LED 3-Character Display = Bracketed three characters including flashing printer mode dots

  Example: [.8.8.8]

- Number Designated Pushbutton = Parenthesis enclosed number designation

  Example: (4)

Warnings, Cautions, and Notes

Throughout this manual Notes, Cautions, and Warnings have the following meanings:

NOTE: The information is important to the understanding of the
                process being described.

CAUTION: The information describes a process that can damage the
                equipment or software.

WARNING: The information describes a process that can harm the user.

Assistance

If you have a problem with the LG31 printer, perform the following steps:

1. Confirm the repeatability of the problem by recreating the identical conditions leading up to the problem. A vital step may have been overlooked, which is causing the problem.

2. Identify the problem using the "Troubleshooting" guide in Chapter 5, or the "Removal/Replacement" procedures in Chapter 6, to determine whether or not the problem can be resolved in-house, or if your local Digital Equipment Corporation Customer Service organization should be contacted.

3. If required, report the problem to Digital Equipment Corporation Customer Service. Consult your service contract for the required information to process your call.

FCC User Statement

Notice

This equipment generates, uses, and may emit radio frequency energy. The equipment has been type tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such radio frequency interference in which case the user at his own expense will be required to take whatever measure may be required to correct the interference.

Chapter 1

INTRODUCTION

1.1 Overview

This chapter contains an overview of the LG31 300 LPM Line Matrix Printer (LG31 printer). It includes a brief description of the printer and a listing of the electrical, mechanical, and operational specifications.

1.2 General Description

The LG31 300 LPM Line Matrix Printer (see Figure 1-1) is a serial I/O interface, high-speed, line matrix printer that is compatible with all low-end and mid-range PDP and VAX systems. The LG31 printer uses fan-folded, tractor-fed paper stock, and operates at 100-240 volts, 50-60 Hertz (Hz). The LG31 printer is primarily used for data processing and office environments, and can be operated by a non-technical user. However, the printer is installed, maintained, and supported by Digital Equipment Corporation.

Figure 1–1: LG31 Front and Rear Views

TOP
ENCLOSURE

DISPLAY
WINDOW

OUTER
CONTROL
PANEL

LEFT
COVER

FRONT
DOOR

PAPER
RACK

POWER
SWITCH
(CIRCUIT
BREAKER)

RIGHT
COVER

PAPER
STACKING
GUIDES

REAR
COVER

PAPER
SHELF

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1–2 INTRODUCTION
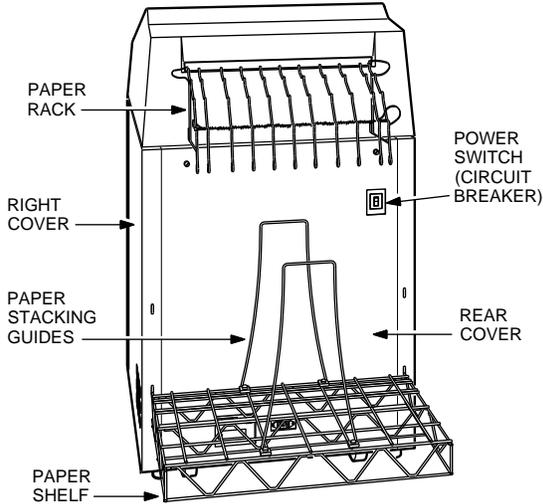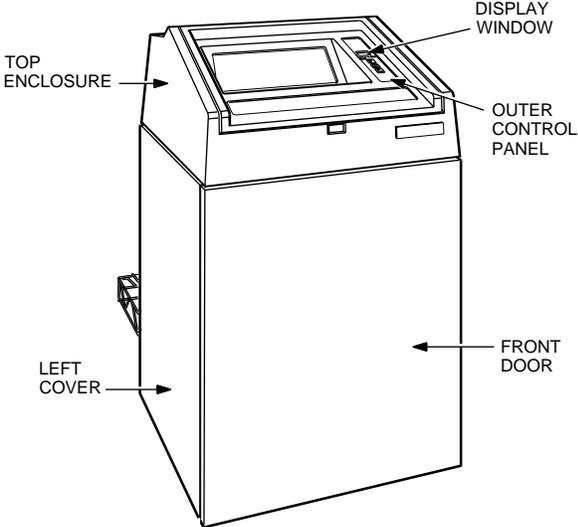
1.3 Major Components

The major components of the LG31 printer are:

- Control panels
- Printer mechanism
- Electronics

1.3.1 Control Panels

The printer has two control panels: the outer control panel and the inner control panel.

The outer control panel is on the outside of the top cover. It has keys for selecting normal operating functions and view window to the 3-digit display (seven segments each), which is a part of the inner control panel.

The inner control panel is below the top cover and is used for detailed operating functions such as:

- Running self-test
- Paper movement
- Resuming printing after fault clearance.
- Setting the printer configuration.
- Printing test patterns for printer alignment/adjustment.

The top cover should be raised to its highest position to defeat the top cover interlock before the inner control panel can be used.

Associated with the inner control panel are an audio alarm for power-up/fault detection and an initialization switch that erases the current configuration settings and restores the printer to factory settings. See Appendix B of this manual for a list of all the display codes.

1.3.2 Electronics

The electrical interfaces consist of the host communication port and the ac power inlet. The mechanical interfaces consist of the platen gap, the paper tension adjuster, the paper path tractors, ribbon cartridge, and the outer/inner control panels.

1.3.3 Printer Mechanism

The printer mechanism consists of the mechanical and electro-mechanical hardware in the printer. The printer mechanism performs ribbon and paper motion, and translates the binary print data to printed characters on paper through the print shuttle.

1.4 Features

1.4.1 U.S. ASCII 7-Bit and 8-Bit Codes

When the host computer interface is set to 8-bit mode, the LG31 printer processes all eight bits of the received characters. When the host computer interface is set to 7-bit mode, the LG31 printer processes seven bits of the received characters.

1.4.2 Electronic Vertical Forms Unit (EVFU)

An electronic vertical forms unit is provided for automatic print placement on forms up to 559 mm (22 in) long.

1.4.3 Diagnostics

The LG31 printer automatically self-tests and displays the diagnostic result on the control panel's three-character LED display. The 10-second self-test is performed at power-up, following a print test, and when commanded by an external device. If a fault is detected, a corresponding fault code is displayed, and the audio alarm sounds.

1.4.4 Print Actuator Modules

Line matrix impact printing is performed by three print actuator modules, which print one dot line on each horizontal swing cycle. Each print module contains 11 print actuators. Individual print actuators are activated at each position where a dot is required. After the first horizontal dot row is printed, the shuttle reverses direction and the paper is advanced to the next horizontal dot row.

1.4.5 Character Formation and Timing

Character formation and timing is accomplished in two different modes: data processing (draft) font and near letter quality (correspondence) font.

When data processing font is selected, dots are printed during each left-to-right movement of the shuttle. Individual print actuators are activated at each position where a dot is required, at a horizontal dot resolution of 60 dots/inch. After the first dot-row is printed, the shuttle reverses direction, while the paper is advanced a distance 1/72-inch to the next horizontal dot-row. The time to print one line is 24 ms, that is 18 ms to print one dot-row and 7 ms for shuttle turn-around and paper movement.

When NLQ font is selected, dots are printed during left-to-right and right-to-left movements of the shuttle. After the left-to-right dots are printed, the shuttle reverses direction, paper is not advanced, print actuators are again activated to print a second row of dots interlaced with the first, thus providing a horizontal resolution of 120 dots/inch. The paper is then advanced 1/144-inch to the next dot-row, thus providing a vertical resolution of 144 dots/inch. The time to print one line is 24 ms, that is 18 ms to print one dot-row and 7 ms for shuttle turn-around and paper movement.

Data Processing printing requires one shuttle pass per dot row. NLQ printing is performed by printing the same dot row on two consecutive shuttle passes. The second pass fills in adjacent dot positions in the same row. Data Processing dot rows are 0.23 mm (1/72 in) apart vertically; NLQ dot rows are 0.46 mm (1/144 in) apart vertically. Table 1-2 shows the dot patterns and Character Per Inch (CPI) of the standard fonts.

Table 1–1:   Standard Font Dot Pattern Chart

Characters Per Inch	Font (134 ASCII Characters)	Dot Pattern
10	Standard Gothic Data Processing (default)	9H x 9V
10	NLQ	9H x 18V
12, 13.3, 15	Data Processing	7H x 9V
12, 13.3, 15	NLQ	7H x 18V
10	Italic	9H x 18V
12, 13.3, 15	Italic	7H x 18V
16.7	Gothic Data Processing Emphasized	5H x 9V

1.4.6 Ribbon Cartridge

A cartridge type ribbon with re-inker is driven by the Ribbon Drive Motor, which is a dedicated data responsive motor. The ribbon is 59.45 m (65 yards) long by 25.4 mm (1 inch) wide, and has a rated life of 50 million characters.

1.4.7 Paper Tractors

Two synchronized sets of six-pin tractors handle paper from 76 to 420 mm (3 to 16.54 in) wide, and up to six ply thick. Paper is stored in the integral pedestal and fed upward through the tractors by the Line Feed Motor Assembly. The paper passes between the print actuator modules and the striker bar, which is situated at the upper rear of the printer.

1.4.8 Paper Out Limit Switch

A paper out sensor is used in printer operation.

1.4.9 Tabs

Horizontal and vertical tabbing in addition to perforation skip-over are provided with the LG31 printer.

1.5 Printing Features Summary

The following features can be selected both by the operator and by the host.

- Bolding
- Underlined text
- Single, double-width characters
- Single, double or triple-height characters
- Autowrap
- Line feed/new line mode
- Hex dumping
- Digital multinational 8-bit character set (U.S. ASCII)
- National Replacement Character (NRC) sets
- Text character processing
- Printable character range (21H-7EH, A1H-FEH)
- Vector drawing
- Bar code printing
- Sixel graphics
- Block character
- Digital Technical Character Set
- VT100 line drawing character set
- Italics
- Vertical Forms Unit
- OCR-A and OCR-B
- 6, 8, 10 LPI
- 5, 10, 12, 13.3, 15, 16.7 CPI

Not all of the above features are described in this manual. See the *LG31 Printer User's Guide* for detailed information.

1.6 Specifications

1.6.1 LG31 Printer Specification

Table 1–2:   LG31 Printer Specification

Printer Dimensions

Unpacked

Width	737.5 cm (29.0 in)
Depth	63.5 cm (25.0 in)
(with Paper Tray)	104.1 cm (41.0 in)
Height	123 cm (48.4 in)
Net Weight	131 kg (287 lbs)

Packaged

Width	77.5 cm (30.5 in)
Depth	88.9 cm (35 in)
Height	156.2 cm (61.5 in)
Weight	171 kg (376 lbs) (includes 16 kg (35.2 lbs) of accessories consisting of paper shelf, upper paper rack, and ribbon cartridge)

Installation Area Requirements

Width	137 cm (54 in) (To allow air flow clearance for printer side vents)
Depth	206.5 cm (104 in) (To allow free access to front and rear paper handling areas, the ON/OFF switch, and the power cables)

Electrical

Voltage Range	100 to 240 V ac

NOTE

The printer's universal power supply automatically
accepts international voltage and frequency variations.

Input Frequency Range	50 Hz to 60 Hz
Harmonic Distortion	5% maximum allowable
Power Rating	
Standby	50 W
Printing	400 W
Shuttle Frequency	20 Hz
Dissipated Power	
Standby	171 BTU/hr
Printing	1368 BTU/hr

Table 1–2 (Cont.):   LG31 Printer Specification

Radio Frequency Interference	Tested/certified to RFI standards FCC 15, Subpart J, Class A; VDE 0871 Class B
Acoustic Noise	LNPA 6.7 bels
	LPA 55 dBA
Operating	
Altitude	2.4 km (0 to 8,000 ft)
Temperature	10°C to 40°C (50°F to 104°F)
	Maximum allowable reduced by factor 1.8°C/1000 m (1°F/1000 ft)
Relative humidity	10% to 90% non-condensing with a maximum wet bulb temperature of 28°C (82.4°F) a minimum dew point 2°C (35.6°F)
Non-operating	
Altitude	4.9 km (0 to 17,700 ft)
Temperature	-40°C to 66°C (-40°F to 150.8°F)
	Maximum allowable reduced by factor 1.8°C/1000 m (1°F/1000 ft)
Relative Humidity	5% to 95% non-condensing
Printing	
Line Length	33.5 cm (13.2 in)
Lines Per Inch (LPI) Spacing	6, 8, 10
Characters Per Inch (CPI)	5, 10, 12, 13.3, 15, 16.7 (plus horizontal and vertical expansion of each)
Paper Slew	50.0 cm/sec (20 in/sec)
Line Feed	12.5 msec at 6 lines/inch
Horizontal Tabs	198 positions
Vertical Tabs	66 positions
Paper/Forms	
Paper width	76.2 mm (3 in) to 420.1 mm (16.54 in)
Form Length	8.4 mm (0.33 in) to 559 mm (22 in)
Fan Folds	152 mm (6 in) to 305 mm (12 in)
Paper weight	90 g/m² (24 lbs) for single ply paper
Form Thickness	Less than 0.63 mm (0.025 in)
Card Stock	Up to 163 g/m² (100 lbs) can be used

1.6.2 Recommended Paper Weights

Table 1–3: Recommended Paper Weights

Number of Parts	Recommended Paper Weight	Carbon Insert Sheet Weight
1	56 g/m² (15 lbs)	—
2, 3 or 4	50 g/m² (13.5 lbs)	19 g/m² (8 lbs)
5 or 6	45 g/m² (12 lbs)	19 g/m² (8 lbs)

1.6.3 Print Speeds

Print speeds are quoted in lines per minute (LPM) with the printer set at 6 LPI, for each available combination of font and horizontal pitch in characters per inch.

Table 1–4: Print Speeds

Font	Horizontal Pitch (CPI)					
	5	10	12	13.3	15	16.7
DP Upper-case only	300	300	300	300	300	147
DP Upper- and Lower-case	240	240	240	240	240	105
NLQ Upper-case only	82	82	82	82	82	147
NLQ Upper- and Lower-case	65	65	65	65	65	105
OCR-A Upper-case only†	-	65	-	-	-	-
OCR-B Upper-case only†	-	65	-	-	-	-

†The OCR-A and -B fonts are available in upper-case only.

1.6.4 Resident Fonts

Table 1–5: Resident Fonts

Font	Horizontal Pitch (CPI)					
	5	**10**	**12**	**13.3**	**15**	**16.7**
Data Processing	Yes	Yes	Yes	Yes	Yes	Yes
NLQ	Yes	Yes	Yes	Yes	Yes	Yes
OCR-A	NLQ	Yes	NLQ	NLQ	NLQ	NLQ
OCR-B	NLQ	Yes	NLQ	NLQ	NLQ	NLQ

"Yes" indicates that the horizontal pitch is available in the current font.

"NLQ" indicates that when either OCR-A or OCR-B font is selected, and a horizontal pitch other than 10 CPI is selected, the NLQ font is substituted automatically. If the horizontal pitch is subsequently changed to 10 CPI, the printer will return to the selected OCR font.

1.6.5 Resident Character Sets

The resident character sets are:

> Digital Supplemental
> U.S. ASCII
> ISO Great Britain
> Digital Holland
> Digital Finland
> ISO France
> Digital Technical
> VT100 Special Graphics
> Digital French Canada
> ISO Germany
> ISO Italy
> JIS Roman (Japan)
> Digital Norway/Denmark
> ISO Spain
> Digital Sweden
> Digital Switzerland
> ISO Norway/Denmark
> Digital Portugal

The complete character sets are given in Appendix A of the *LG31 User's Guide*.

Chapter 2

THEORY OF OPERATION

2.1 Overview

This chapter gives a brief explanation of the operation of the major elements in the LG31 printer:

1. The Enclosure and Environment. This includes:

    • Interlock switches

    • Fans

2. The Print Mechanism. The printer mechanical system includes:

    • The paper drive assembly

    • The ribbon assembly

    • Print actuator assembly

Figure 2–1: Major Components of the LG31 Printer

TOP COVER INTERLOCK SWITCH

SCPI

TOP ENCLOSURE

RIBBON ASSEMBLY

INNER CONTROL PANEL

TRACTORS (PAPER DRIVE MECHANISM)

SHUTTLE DRIVE ASSEMBLY

FRONT FAN

LEFT COVER

RIGHT COVER

CONTROL LOGIC MODULES
SMIH
SMIM
SMSM
SMMC

PAPER LOW SWITCH

PAPER SUPPLY

DOOR
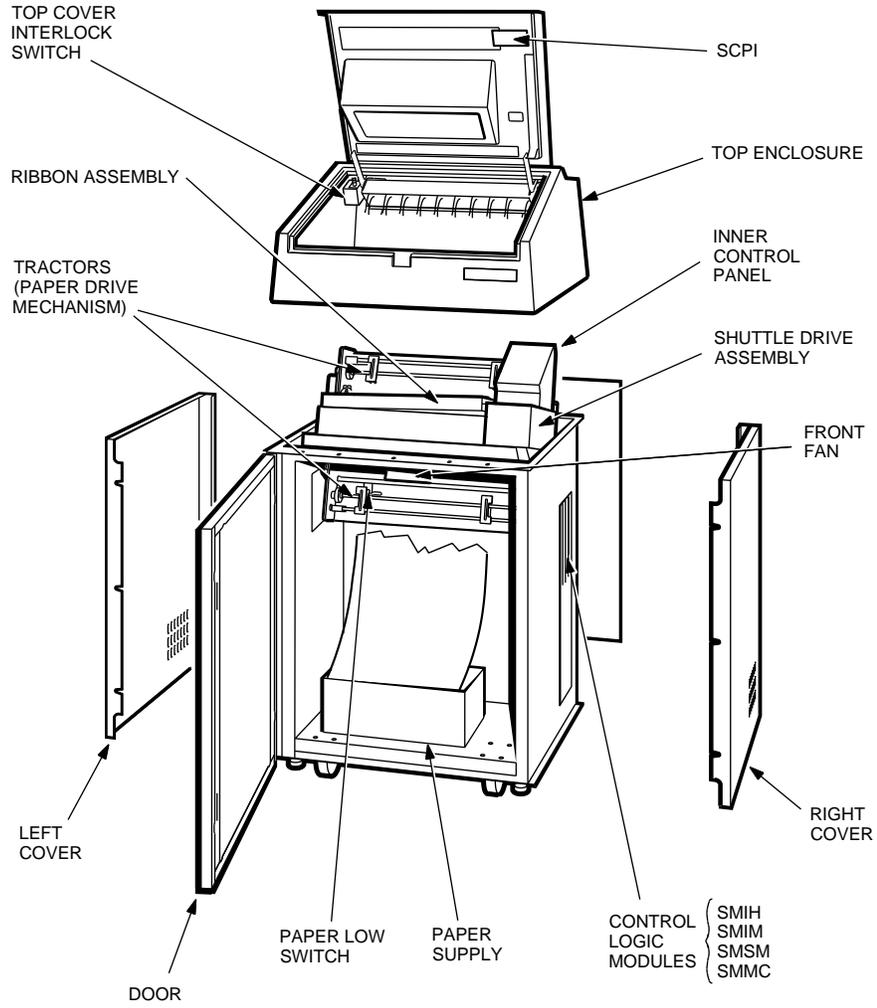
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2–2 THEORY OF OPERATION

Figure 2–2: Major Components of the LG31 Printer

SWITCH
BOX

REAR
FAN

POWER
MODULES

SPSM
SPSR

LINE FILTERS

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THEORY OF OPERATION   2–3
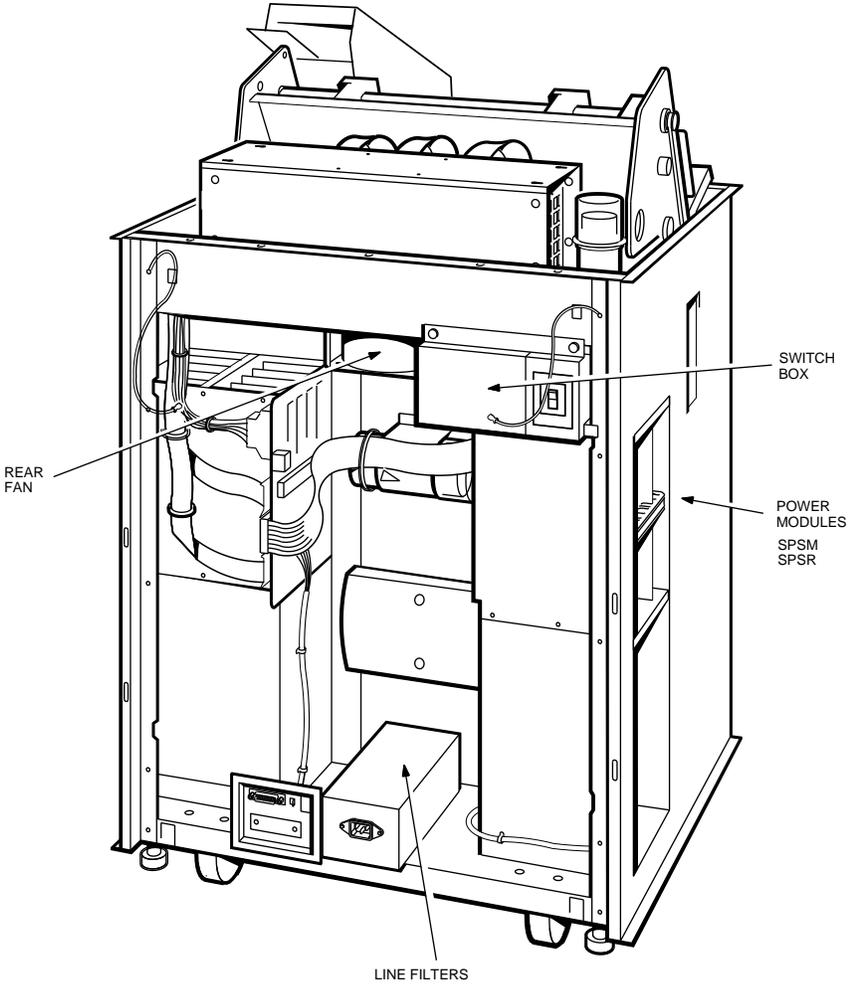
3. The Electronics. The electronics include:

- Four main control logic PCBs in the logic module

- Three additional printer control PCBs

- Connector circuitry

4. The Power Supply. The power supply includes:

- Two main PCBs located in the power module

- Two additional power supply PCBs

- A switch box

- Miscellaneous components

The location of the major components can be seen in Figures 2–1 and 2–2.

2.2 The Enclosure and Environment

This section describes the safety interlock switches and the cooling fans.

2.2.1 Interlock Switches

1. Striker Bar Open Switch

   This switch is located just behind and to the right of the paper thickness indicator. It provides a signal to the SMIM board which is used to inhibit printing and provide status information.

2. Ribbon Weld Sensor

   The absence of the ribbon cartridge is detected by the ribbon weld sensor.

3. Paper Low Switch

   This switch is located at the top of the bottom left hand tractor. It causes:

   - The printing action to cease.

   - An audible alarm.

   - [L o P] display on the display panel.

The operator can cause printing to continue by pressing TEST CLR momentarily. [L P P] then replaces [L o P] in the display, and the printing process continues until "end of paper" is reached. At this point [L P P] is replaced by [P o] and printing ceases.

4. Shuttle Access Door Interlock Switch

The function of the shuttle access interlock switch is to discharge the 85V and 42V bus voltages via the SPSD board as described in Section Section 2.5.5 and to remove the mains ac power input in the power supply circuit.

5. Top Cover Interlock Switch

This switch is located at the top left of the printer. It is a three-position safety interlock switch. When the top cover is raised, the printer will only operate when the switch is manually lifted.

2.2.2 Fans

The two fans are driven by the SMMC board. They are controlled in accordance with the printing duty cycle of the printer.

2.3 Print Mechanism

2.3.1 Description

The LG31 Printer uses dot matrix technology. There are 33 print actuators, arranged in three identical Print Actuator Modules with 11 actuators each. They span a printing width of 13.2 inches. Characters are built up by a print pin impacting the paper through an inked ribbon.

Each print pin is the moving core of a solenoid. The coil of the solenoid is known as the Print Actuator. Each print pin is driven by a pulse of current through the print actuator.

Each print pin prints in a horizontal space, 0.4 inches wide. This space can be organized into characters or graphics. When printing draft characters for example, each pin prints four characters.

The horizontal movement of the print actuators is powered by a resonant shuttle motor. This motor moves the complete assembly of 33 actuators across the width of the paper in 25 ms. Thus, one complete line of dots can be printed in 25 ms.

At the end of the travel of the shuttle motor, the paper is advanced by 1/72-inch (approximately one dot diameter), and the next row is printed in the reverse direction. In NLQ printing the paper is not advanced until the actuators have travelled back across the same line reprinting the same dots.

To build up a character the dots must be precisely located. This is achieved by developing a position signal derived from a Linear Velocity Transducer (LVT) attached to the actuator assembly.

The size and font of the chosen print affects the printing speed.

Figure 2–3 illustrates the formation of characters in Data Processing font.

Figure 2–3:   Character Formation with One Actuator Pin

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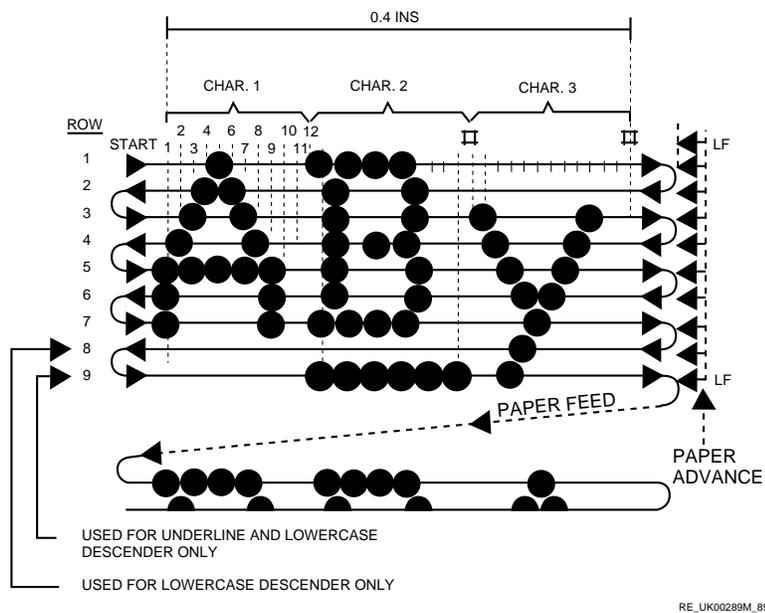
2.3.2 The Paper Drive Assembly

Two sets of synchronized six-pin tractors (upper and lower) control paper motion.

The motor driving the tractors is driven by drivers and logic on the SMMC board.

2.3.3 The Ribbon Assembly

The ribbon is housed in a plastic cartridge and is pulled between the print actuator modules and the paper by a data-responsive motor. The ribbon is about 60 meters (65 yards) long, 25 mm (1 inch) wide, and can be re-inked once only (see the *LG31 Installation/Operator's Manual*).

The ribbon is joined by welding the two ends together to form a Mobius strip. To prevent the weld causing problems to the print actuator mechanism, a ribbon weld sensor is fitted. This detects a hole in the ribbon weld and suspends printing for a few seconds to allow the weld to clear the printing area. This ribbon weld sensor also inhibits printing when the ribbon breaks.

2.3.4 Print Actuator Assembly

This assembly puts the dots on the paper. It is a set of three removable actuator modules, mounted on a horizontally moving bed.

This assembly, a balance weight, the mounting springs and the mass of the moving part of the motor, have been tuned to a resonant frequency of approximately 20 Hz. The SMMC board drives the motor at this frequency.

2.4 Electronics

2.4.1 Overview

There are seven main elements to this subassembly. Of these, four boards plug into a mother board on which there are no active elements. Figure 2–4 is a simplified block diagram of the printer electronics. The seven main elements are:

1. Shuttle Control Panel Interface (SCPI)

2. Shuttle Matrix Display Panel (SMDP)

3. Shuttle Matrix System Microprocessor (SMSM)

4. Shuttle Matrix Imaging Microprocessor (SMIM)

5. Shuttle Matrix Image Hardware (SMIH)

6. Shuttle Matrix Shuttle Head Actuator Driver (SHAD)

7. Shuttle Matrix Motor Control (SMMC)

Figure 2–4: Simplified Block Diagram


```
                          HOST
                          INPUT
                            │
                            ▼
                    ┌────────────────┐
                    │   CONNECTOR    │
                    │     PANEL      │
                    └────────────────┘
  ┌──────────────────────────┼─────────────────────────────┐
  │ ┌──────────────┐         │                              │
  │ │ EXTERNAL     │         │                              │
  │ │ CONTROL      │         │                              │
  │ │ PANEL AND    │         │                              │
  │ │ SCPI         │         │                              │
  │ └──────────────┘      SERIAL                            │
  │        │              DATA                              │
  │        ▼                 │                              │
  │ ┌──────────────┐   ┌────────────┐    ┌──────────────┐  │
  │ │ INTERNAL     │   │ SM         │    │ SM           │  │
  │ │ CONTROL      │◄─►│ SYSTEM     │    │ IMAGE        │  │
  │ │ PANEL AND    │   │ PROCESSOR  │    │ HARDWARE     │  │
  │ │ SMDP         │   │ (SMSM)     │    │ (SMIH)       │  │
  │ └──────────────┘   └────────────┘    └──────────────┘  │
  │                         │  CONTROL         │ DOT BIT    │
  │                         ▼                  ▼ COMMAND    │
  │                   ┌────────────┐    ┌──────────────┐   │
  │                   │ SM         │    │ SHUTTLE      │   │
  │                   │ IMAGING    │    │ HEAD         │   │
  │                   │ PROCESSOR  │    │ ACTUATOR     │   │
  │                   │ (SMIM)     │    │ DRIVER       │   │
  │                   └────────────┘    │ (SHAD)       │   │
  │                         │ CONTROL   └──────────────┘   │
  │                         ▼                  │           │
  │                   ┌────────────┐           │           │
  │                   │ SM         │           │           │
  │                   │ MOTOR      │           │           │
  │                   │ CONTROL    │           │           │
  │                   │ (SMMC)     │           │           │
  │                   └────────────┘           │           │
  └─────────────────────────┼──────────────────┼───────────┘
                            │                  │
                    CONTROL │           DRIVE  │
                    AND DRIVE           SIGNALS│
                    VOLTAGE │                  │
                            ▼                  ▼
                    ┌────────────┐      ┌──────────────┐
                    │ MOTORS     │      │ SHUTTLE      │
                    │ AND        │      │ MODULES      │
                    │ FANS       │      │ 1,2,&3       │
                    └────────────┘      └──────────────┘
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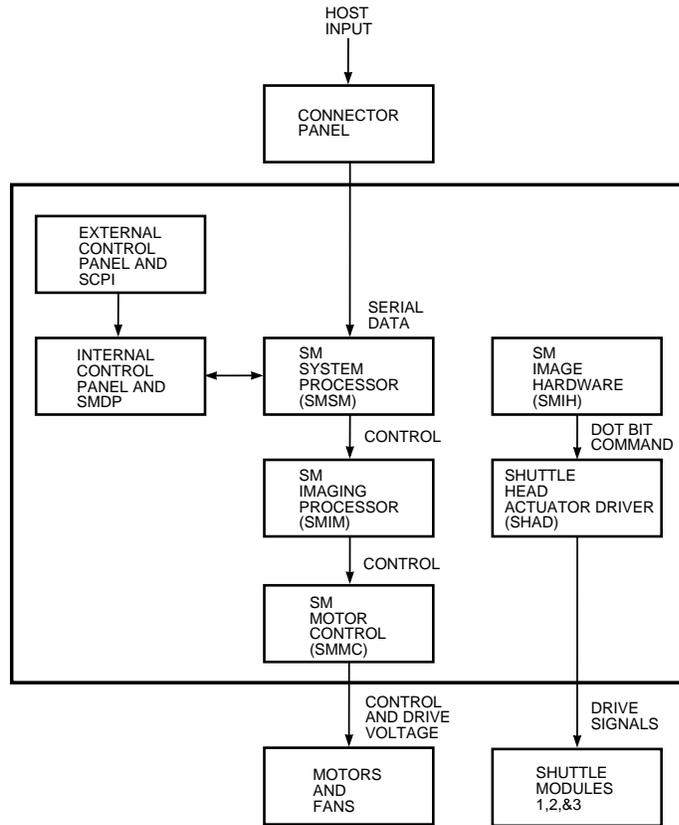
WHERE SM = SHUTTLE MATRIX

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2–8 THEORY OF OPERATION

2.4.2 Shuttle Control Panel Interface (SCPI)

The SCPI is secured to the top cover. It provides the electrical connection between the external and internal control panels.

There are no active components on this board.

2.4.3 Shuttle Matrix Display Panel (SMDP)

The SMDP board is secured beneath the inner control panel, which is mounted on top of the shroud. This board contains the following:

- Three 7-segment displays
- An audio alarm
- A printer initialization switch

The SMDP board sends information to, and receives information from, the SMSM board in the logic module. It is the interface for the 10 membrane switches on the inner control panel, and provides the electrical connections to the three membrane switches in the external control panel.

2.4.3.1 Seven-Segment Displays

This display is used to indicate:

- Printing parameters
- Error Codes
- Font error codes
- Specific "not ready" reasons

Also included in each display is a period. This is used to indicate that the code refers to a mode of operation or test pattern.

2.4.3.2 Audio Alarm

The audio alarm provides:

- Audible feedback to the operator when the membrane switches are operated
- A warning when the printer log detects an alarm condition

2.4.3.3 Printer Initialization Switch

This slide switch is used in one of the two initialization procedures which is described in the section on "Initializing a Locked-up Printer".

2.4.3.4 Inner Control Panel

In on-line and off-line, these switches perform the functions printed on them. More functions are available by operating the PRG and FCT switches while in the off-line state.

The PRG switch enters the programming mode. In this mode the operator can use the switches to alter the printing and host interface parameters.

The *LG31 Installation/Operator's Manual* contains full instructions on the use of the switches in Normal, Programming and Function modes.

The FCT switch enters the function mode. In this mode the keys are redefined to provide a selection of functions related to:

- Forms setup

- Initialization

- Print Quality Adjustment

2.4.3.5 External Control Panel

This panel has the three most commonly used controls; they are repeats of the controls of the same name on the Inner Control Panel. Thus, these controls can be used without opening the cover of the printer.

2.4.4 Shuttle Matrix System Microprocessor (SMSM)

The SMSM board is located in the card cage on the right side of the printer. It receives data from the RS-232 interface, the user-operated control panel, and the SMIM board.

Data received from the RS-232 interface is combined with parameters (font, line spacing, print density, and so forth) and transmitted to the imaging microprocessor (SMIM).

SMSM scans the input lines from the internal control panel and decodes the input to take the appropriate action.

SMSM receives fault information from the SMIM. When a fault condition is sensed, the system microprocessor informs the host CPU of this fault by way of the RS-232 interface.

2.4.5 Shuttle Matrix Imaging Microprocessor (SMIM)

The SMIM is located in the card cage on the right side of the printer. It sends commands to the SMIH board for dot imaging. That is, it builds the dot rows for font characters or graphic displays. The SMIM board also controls the ribbon and shuttle motors and paper movement. It also interfaces to the paper motion detector, cover interlock switch, paper out switch, and striker bar open switch.

2.4.6 Shuttle Matrix Image Hardware (SMIH)

The SMIH is located in the card cage on the right side of the printer. This board is directly concerned with laying down an image of a single horizontal line of dots. It receives serial data from the SMIM boards in bursts of 33 bits for printing. It sends command signals to the SHAD board, to enable printing, one bit for each actuator in the print modules.

2.4.7 Shuttle Head Actuator Driver (SHAD)

The SHAD board is vertically mounted in the top rear of the printer. It receives dot image information in serial form from the SMIH board, converts it to parallel form, and drives the appropriate print head actuators.

The SHAD board contains 33 actuator drivers.

The SHAD also contains the Actuator Test circuit. This is activated each time the printer is turned ON. It checks for open circuit print actuator coils.

If the printer actuator assembly temperature exceeds a factory set level, a circuit in the SHAD reduces the printing rate by enabling printing on every seventh shuttle swing.

2.4.8 Shuttle Matrix Motor Control (SMMC)

The SMMC is located in the card cage on the right side of the printer. It provides circuits necessary to operate the ribbon weld detector, and to run three motors in the printer; the shuttle motor, the paper motor, and the ribbon motor.

This board also controls the fans. The rear fan is switched to high during printing and low when not printing. The front fan is switched ON when printing and OFF when not printing. The front fan is switched OFF when the shuttle is stopped (standby) to ease paper loading and reduce standby noise.

The SMMC powers the shuttle motor, maintaining the motion sine wave at a fixed amplitude. It uses signals from the interlock switches and LVT to stop the shuttle motion, and senses and informs the printer logic if the shuttle becomes mechanically jammed. If the printer logic fails to respond to this information, the shuttle motor is shut down through an internal crowbar circuit.

2.5 Power Supply

Figure 2–5 shows a simplified block diagram of the power supply.

Figure 2–5: Power Supply Simplified Block Diagram
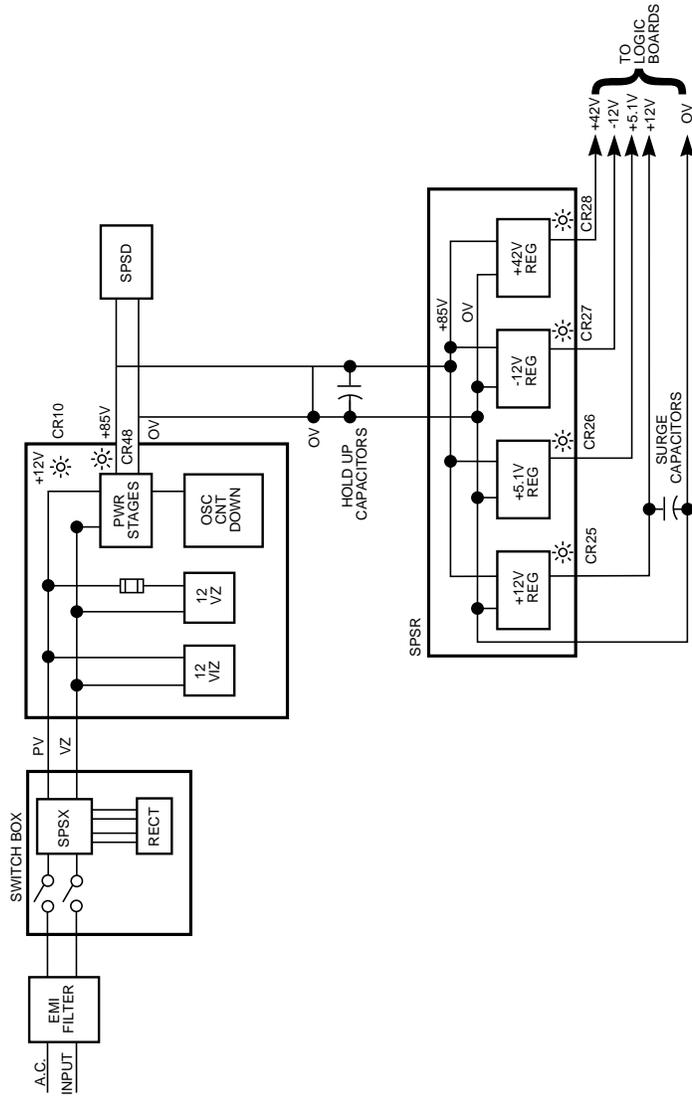
2.5.1 Description

The power supply provides the following voltages:

    5.10V @ 6A
    12V @ 1A
    -12V @ 1A
    42V @ 12A
    85V @ 4A

The major components of the power supply are:

    The Power Supply Filter (SPSX)
    The Power Supply Master (SPSM)
    The Power Supply Regulator (SPSR)
    The Power Supply Discharge (SPSD)

There are also two chassis mounted capacitors distributed in the printer.

2.5.2 Shuttle Power Supply Filter (SPSX)

The SPSX board is located in the ac switch box at the rear of the printer near the power ON/OFF switch. It provides the following functions:

- High frequency filtering.

- Transient voltage limiting on the ac input line.

- Conversion of the ac input to full wave rectified dc, by using an external bridge rectifier mounted inside the ac switch box.

2.5.3 Shuttle Power Supply Master (SPSM)

The SPSM board is located in the power module on the left side of the printer. It converts incoming full wave rectified voltage to 85V from the SPSR for the input to the SPSR board.

The SPSM is protected, so it will not be damaged if the output is shorted.

Since the SPSM has a high current usage, it has forced air cooling.

If the 12V bus exceeds 16.5 V, an internal crowbar will operate to bring the bus down to 3 V. When this happens, a fuse will blow (F1, or F2, or F3, or F4, or F5).

The SPSM also contains an active bleed-down circuit. It is a non-linear current dumping circuit across the 85V bus. In operation it removes the energy remaining in all the buses after the printer has been turned OFF.

2.5.4 Shuttle Power Supply Regulator (SPSR)

The SPSR board is located in the power module on the left side of the printer. It provides the four regulated dc voltages needed by the printer: 5.10 V, 12 V, -12 V, and 42 V.

Visual LED indicators on the board are used to indicate the presence of the voltages.

The SPSR board provides crowbar protection for the 5.10 V circuit.

A current limiting circuit is provided to protect the power switching transistor.

Since the SPSR has a high current usage, it has forced air cooling.

An internal crowbar circuit across the 5.10 V output activates at 6.5 V and reduces the output to at least 2.5 V ac input power must be removed for at least 30 seconds before the circuit resets and normal operation is possible.

The SPSR disables all voltages if the 5.10 V bus cannot attain full voltage.

All outputs can withstand a short for at least one minute.

The SPSR needs forced air cooling.

2.5.5 Shuttle Power Supply Discharge (SPSD)

The SPSD board is located in the lower rear enclosure of the printer. Its purpose is to discharge the 85V bus voltage maintained by the 85 V holdup capacitor, and hence the 42V bus voltage derived from it, to less than 18 V in one second. This occurs only when the shuttle access door in the top enclosure is opened, operating an interlock switch.

Chapter 3

CONTROLS AND INDICATORS

There are two control panels: the Inner Control Panel and the Outer Control Panel.

3.1 Inner Control Panel

The inner control panel, which is located inside the top cover contains the keys that control all operational functions of the LG31. These include:

- Performing the same functions as the outer control panel.

- Modifying print parameters.

- Modifying serial interface parameters.

- Performing diagnostics.

The inner control panel has three modes of operation:

1. NORMAL

   In **NORMAL** (off-line) mode, the pushbuttons perform the functions indicated by their respective legends. See Figure 3–1.

2. PROGRAM

   In **Program** (PRG) mode the 10 keys are assigned new functions. These new functions, are automatically printed in menu form, to guide the operator. In this mode the printer parameters can be selected and altered, using the information on the printout. See Figure 3–2.

3. FUNCTION

This mode is selected by pressing the (9) FCT key. In **FUNCTION** (FCT) mode the 10 keys are assigned new functions. See Figure 3–3.

Table 3–1 outlines the features of the printer which are available for setting up in different modes of the control panel.

Table 3–1:   Mode Dependent Control Panel Features

| | MODE | | |
SETTING	NORMAL	FUNCTION	PROG.
FONT	YES	-	YES
LPI	YES	-	YES
CPI	YES	-	YES
FORMS SETUP/CONTROL	-	YES	YES
INTERFACE CNTL STRAPS	-	-	YES
MARGIN SETUPS	-	YES	YES
HORIZONTAL TABS	-	-	YES
VERTICAL TAB STOPS	-	-	YES
PRINTER CNTL STRAPS	-	-	YES
PRINTER INITIALIZATION	-	YES	-
PRINT ADJUSTMENT	-	YES	-
BUFFER CLEAR	-	YES	-
REVERSE FORM FEED	-	YES	-
SET TOF	YES	YES	YES
FORM ADJUSTMENT	-	YES	YES

**Figure 3–1: The Inner Control Panel showing Display, Audio Alarm,
Initialization Switch**

INNER CONTROL PANEL

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Figure 3–2: Configuration Menu with Program Mode Parameters

FONT
0. Exit
1. Style
2. CPI
3. Country
4. Mode
5. Horizontal Expansion
6. Vertical Expansion

Style (as applicable)
0. Exit
1. 44AXXXXXX-DATA PROCESSING
2. CORRESPONDENCE
3. 44AXXXXXX-OCR-A
4. 44AXXXXXX-OCR-B

CPI -
0. Exit
1. 5 CPI
2. 10 CPI
3. 12 CPI
4. 13.3 CPI
5. 15 CPI
6. 16.7

Country -
0. EXIT
1. US ASCII
2. Great Britain
3. DEC Dutch
4. DEC Finland
5. French
6. DEC French (Canada)
7. Germany
8. Italy
9. Continue

Country -
0. Exit
1. US ASCII
2. DEC Norway/Denmark
3. Spain
4. DEC Sweden
5. DEC Swiss
6. ISO Norway/Denmark
7. DEC Portuguese

Mode -
0. Exit

Horizontal Expansion
0. Exit
1. X1
2. X2

LPI
0. Exit
1. 6 lpi
2. 8 lpi
3. 10 lpi

Form Control
0. Exit
1. Form Feed
2. Line Feed (Forward)
3. Line Feed (Reverse)
4. Set Top of Form
5. Set Top Margin
6. Set Bottom Margin
7. 1/72 inch Paper (Forward)
8. 1/72 inch Paper (Reverse)

Interface Control
0. Exit
1. Interface Type
2. Interface Straps A
3. Interface Straps B
4. Speed
5. Parity

Interface Type -
0. Exit
1. Serial

Straps
0. Exit
1. Strap "in"
2. Strap "out"
3. Forward Without Change
4. Reverse Without Change
5. (See Notes 1 and 2)

Speed -
0. Exit
1. 110
2. 300
3. 800
4. 1200
5. 1800
6. 2400
7. 4800
8. 9600
9. 19200

Parity -
0. Exit
1. Even
2. Odd

Vertical Expansion
0. Exit
1. X1

Margin Settings
0. Exit
1. Advance Left (See Note 6)
2. Advance Right (See Note 6)
3. Set Left Margin
4. Set Right Margin
5. Clear Margin (Default Note 4)
6. Display Left Margin
7. Display Right Margin
8. Display Current Position

Horizontal Tab Stops
0. Exit

Vertical Tab Stops
0. Exit

Straps -
0. Exit
1. Strap "IN"
2. Strap "OUT"
3. Advance Without Change (See Note 6)
4. Reverse Without Change (See Note 6)
(See Notes 1 and 2)

EXAMPLE OF CONFIGURATION MENU
THE PRESENT CONFIGURATION IS
(44A511526 SY - 44A511527 (M)
 FIRMWARE REVISION LEVEL V2.3
1. Font
   Style - 44A511367 Dataprocessing
   CPI - 10CPI
   Country - US ASCII
   Mode - Normal
   Horizontal Expansion - X1
   Vertical Expension - X1
2. LPI - 6lpi
3. Forms Control (Lines)
   Forms Length - 66
   Top Margin - 01
   Bottom Margin - 66
4. Interface Control:
   Interface Type - Serial
   Input Buffer Length 2304
   Interface Straps A:
   0   1   2   3
   12345678901234567890123456789012
   00001000000010000000100000000000

   Interface Straps B:
   0   1   2   3
   12345678901234567890123456789012
   01000100000000000000000000000000
   Speed - 9600
   Parity - Even
5. Margin Settings (Columns)
   Left Margin - None
   Right Margin - 132
6. Horizontal Tabs (Columns)
   009 017 025 033 041 049 057 065 073 000
   089 097 105 113 121 129 137 145 000 000
   169 177 185 193 201 209 217
7. Vertical Tab Stops:
8. Printer Control Straps:
   Printer Straps A:
   0   1   2   3
   12345678901234567890123456789012
   00000000000000000000000001110010

   Printer Straps B:
   12345678901234567890123456789012
   10000000000000000000000000000000

Press the number '0' to return to normal operation
to continue modification select (1.8)

NOTES
1. 1-Strap IN. 0-Strap OUT. Serial interface has 64 Straps.
2. Display positions begin in first option position. For example, to modify
   strap 8, press control panel button "3" until 8 is displayed, then press
   button "1" or "2" as appropriate. The three-digit display is the counter
   for strap numbers.
3. When number of selections exceeds eight, the ninth selection is used
   to continue menu.
4. Horizontal margin settings at default are columns 001 and 132 at 10 CPI.
5. Display is counter fgor margin or strap. It wraps when maximum
   or minimum value is encountered.
6. When a new font is selected, the horizontal spacing is initially set to the
   default spacing for the particular font.
7. Space and mark are applicable to 7-bit operation only Menu item 4 strap B1
   (display33) must be OUT.

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Figure 3–3: Function Mode

CONTROL PANEL PUSHBUTTON FUNCTIONS

FCT 9 ENTER FUNCTION MODE

PRG — PRINTER INITIALIZATION
- TEST CLR 0 — NO CHANGE / RETURN TO OFF LINE
- ON LINE 3 — RESET TO USERS MENU PARAMETERS
- FCT 9 — INITIALIZE TO FACTORY DEFAULT CONDITIONS

FEED FORM 2 — FORMS SETUP
- TEST CLR 0 — EXIT OFF LINE / FEED TO TOP
- PRG 1 — FORM FEED
- FEED FORM 2 — FORWARD LINE FEED
- ON LINE — REVERSE LINE FEED
- SET TOP 8 — 1/72" FORWARD
- FCT 9 — 1/72" REVERSE
- LINE FEED 4 — SET TOP OF FORM
  - TEST CLR 0 — FEED TO TOP / EXIT TO OFF LINE
  - FEED FORM 2 — INCREMENT LINE COUNT
  - ON LINE 3 — DECREMENT LINE COUNT
  - LINE FEED 4 — SET TOP OF FORM
  - CPI LPI 5 — SET TOP MARGIN
  - PAPER REV 6 — SET BOTTOM MARGIN
  - FONT 7 — SET BOTTOM OF FORM / EXIT TO OFF LINE

ON LINE 3 — PRINT ADJUSTMENT
- TEST CLR 0 — EXIT TO OFF LINE
- PRG 1 — PRINTER SIGNATURE PATTERN
- FEED FORM 2 — FORM FEED
- ON LINE 3 — AMPLITUDE PATTERN (continuous)
- LINE FEED 4 — LINE FEED
- CPI LPI 5 — HORIZONTAL TIMING (continuous)
- PAPER REV 6 — VERTICAL TIMING (continuous)
- FONT 7 — INTERMODULE GAP (continuous)

CPI LPI 5 — MARGIN SETUP
- TEST CLR 0 — EXIT OFF LINE
- PRG 1 — DECREMENT COLUMN COUNT (to left)
- FEED FORM 2 — INCREMENT COLUMN COUNT (to right)
- ON LINE 3 — SET LEFT MARGIN
- LINE FEED 4 — SET RIGHT MARGIN
- CPI LPI 5 — SET DEFAULT MARGINS (001 & 132 for 10 cpi)
- PAPER REV 6 — DISPLAY RIGHT MARGIN
- FONT 7 — DISPLAY LEFT MARGIN
- SET TOP 8 — DISPLAY COLUMN COUNT

LINE FEED 4 — FORMS ADJUSTMENT
- TEST CLR 0 — EXIT TO OFF LINE
- PRG 1 — PRINT TEST PATTERN
- LINE FEED 4 — 1/72" FORWARD
- PAPER REV 6 — 1/72" REVERSE

FONT 7 — BUFFER CLEAR
- TEST CLR 0 — EXIT TO LINE
- FONT 7 — BUFFER CLEAR

PAPER REV 6 — REVERSE FORM FEED (FORMS SAVER MODE)
- TEST CLR 0 — EXIT TO OFF LINE
- PAPER REV 8 — REVERSE FORM FEED

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3.2 Outer Control Panel

The Outer Control Panel keys only perform the functions indicated by their respective legends. See Figure 3–4.

Figure 3–4: Outer Control Panel

3.2.1 Forms Setup

The following sections show how the inner control buttons change the position of the form. (The form is the area where printing occurs. It is not where the perforations in the paper occur.) Before the printing area is selected you must align the the perforations of the paper with the marks on the upper tractors.

Table 3–2: Forms Setup Procedure

Action	Results	Display
Press (3) ON LINE	Printer goes to OFF LINE.	[O F L]
Press (9) FCT	Printer enters Mode Selection state.	[.F n c]
Press (2) FORM FEED	Printer enters Form Setup mode.	[F S U]
At this point, choices are:		
(0) TEST CLR	Exits from Form Setup to OFF LINE, and feeds to top of next form in accordance with current length.	[O F L]
(1) PRG	Form feeds one form length.	[.F S U]
(2) FORM FEED	Forward line feed in accordance with current LPI setting. If pressed and held for more than one second, consecutive line feeds occur at the rate of one each half-second.	[.F S U]
(3) ON LINE	Reverse line feed in accordance with current LPI setting. If pressed and held down for one second, consecutive paper reverse line feed steps occur at the rate of one each half-second.	[.F S U]
(8) SET TOF	Advances paper 0.23 cm (1/72 inch).	[.F S U]
(9) FCT	Moves paper 0.23 cm (1/72 inch) in reverse direction.	[.F S U]
(4) LINE FEED	Sets top of form.	[0 0 0]
At this point the choices are:		
(2) FORM FEED	Forward line count display only to required position of: Top Margin, i.e. Bottom Margin, i.e. Bottom of Form, i.e.	[0 0 4] [0 6 2] [0 6 6]
(3) ON LINE	Reverse line count display only to required position	
(5) CPI LPI	Sets top margin.	[0 0 4]

Table 3–2 (Cont.):   Forms Setup Procedure

Action	Results	Display
(6) PAPER REV	Sets bottom margin.	[0 6 2]
(7) FONT	Sets bottom of form and returns to OFF LINE.	[O F L]

Prior to pressing key (4) LINE FEED, press any paper motion key to advance paper as appropriate, and the display will not change. After pressing set key (4) LINE FEED, the display will change to a counter that will count the line feeds forward as key (2) FORM FEED is pressed or backwards, as key (3) ON LINE is pressed. However, the paper will not move again until key (7) FONT LINE FEED is pressed to set bottom of form. The top of form is actually set when key (4) LINE FEED is pressed. At this point, the 0.23 cm (1/72 inch) paper control keys (8) SET TOF and (9) FCT are disabled. Also, key (2) FORM FEED cannot be enabled because it is being used to increment line feed counts without moving the paper. Pressing the bottom of form key (7) FONT will cause the form parameters entered to be saved, move the paper to align the top of the next form with the print line, and exit the Form Setup mode.

3.2.2 Top Of Form (TOF) Set Procedure

Figure 3–5 shows the same form size when Top Of Form (TOF) is set by using key (4) LINE FEED while the printer is in the Form Setup mode. In performing the following TOF set procedure, it is assumed that the Form Setup mode has already been entered, but key (4) LINE FEED has not been pressed. Also, the printer is set for 6 LPI.

1. Press key (2) FORM FEED again, and hold down to move the first line of the form, which is level with the notches in the upper tractor doors. The display remains [.F S U]. Key (3) ON LINE will give reverse line feed action; keys (8) SET TOP and (a) will give 1/72 in forward and reverse motion for greater accuracy.

2. Press key (4) LINE FEED to set top of form. Display is [0 0 0].

3. One-inch top margin is desired at 6 LPI. Press and hold (2) FORM FEED, count six lines, release pushbutton. Display counts one line feed per half-second. Final display is [.0 0 6].

4. Press key (5) CPI/LPI to set top margin. Display remains at [.0 0 6].

5. The body of the form is 21.6 cm (8½ inches) or 51 lines. Press and hold key (2) FORM FEED, count 51 lines (51 + 6 = 57 total), release pushbutton. Display counts to [.0 5 7] and stops.

6. Press key (6) PAPER REV to set bottom margin. Display remains at [.0 5 7].

7. Form is 27.9 cm (11 in) or 66 lines. Press and hold key (2) FORM FEED, count nine lines, release pushbutton. Display is [.0 6 6].

8. Press key (7) FONT to set bottom of form, save form setup, form feed to first print line of next form, and exit Form Setup. Paper moves forward to first print line of next form. Display is [O F L].

During steps 3, 5, or 7 in the above TOF set procedure, if the counter goes beyond the desired number of lines, press key (3) ON LINE to subtract excess lines from the display counter.

NOTE

1. When a new supply of forms is needed and the same form is used, it is only necessary to align the top perforation with the notches in the paper locking levers (upper tractors) and press keys (0) TEST CLR and (8) SET TOF to set the top of form position. The form will move forward to place the first line of the next form in printable position. Do not use key (4) LINE FEED for this purpose. Press key (3) ON LINE to resume printing.

2. After the form parameters have been entered by pressing key (7) FONT, changing the vertical pitch will not change form length. Example: changing from 6 to 8 LPI on a 27.9 cm (11 inches) page will not shorten page to 21.0 cm (8¼ inches) or 66 lines/8 LPI=8¼ inches.

3. See Table 4–6 for procedure to adjust form up or down.

Figure 3–5: Key (4) Form Size Setup Example
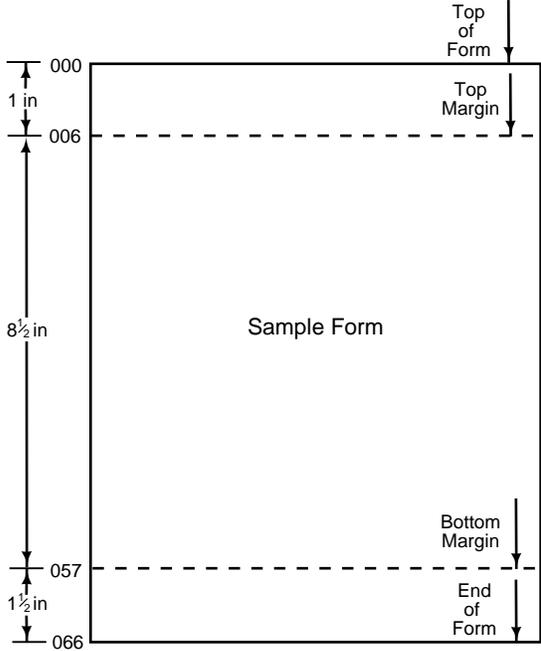
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Chapter 4

PRINTER AND HOST CONFIGURATION

4.1 Printer Parameters

4.1.1 Factory Parameter Settings

The factory settings for the printer are listed in Table 4–1.

Table 4–1:   Factory Settings

Selectable Parameter	Factory Set Condition
Print Status	Off-Line
Horizontal Pitch	10 characters per 2.54 cm/inch
Vertical Pitch	6 lines per inch
Font	Data Processing
Form Length	66 lines (11 inches)
Active Position	Column 1, Line 1
Top Margin	Line 1
Bottom Margin	Line 66
Left Margin	Column 1
Right Margin	Column 132
Underlining	Disabled
Bolding	Disabled
Italics	Disabled
Character Expansion	Disabled
GL Character Set	U.S. ASCII
GR Character Set	Digital Supplemental
G0 Character Set	U.S. ASCII

Table 4–1 (Cont.):   Factory Settings

Selectable Parameter	Factory Set Condition
G1 Character Set	VT100 Graphic Character Set
G2 Character Set	Digital Supplemental
G3 Character Set	U.S. ASCII
Autowrap	Autowrap Enabled
Line Feed/New Line Mode	Set
Horizontal Tabs	At every 8 columns (9, 17..137)
Unsolicited Reports	Disabled
Super/Subscripts	Disabled
Carriage Return New Line Mode	Reset
Vertical Tabs	Every line (1, 2, ... 66)
Number of data bits	8-bit mode
Number of stop bits	1 stop bit
Baud rate	9600 baud
Parity	Disabled

4.1.2 Power-Up Parameters Set

Table 4–2 lists the default conditions upon power-up of the LG31 printer.

Table 4–2:   Pre-Set Printer Parameters Power-Up Set

Selectable Parameter	Power-Up Condition
Print Status	Off Line
Active Position	Column 1, Line 1
Underlining	Disabled
Bolding	Disabled
Unsolicited Reports	Disabled
Super/Subscripts	Disabled

4.1.3 Power-Up Parameters Retained

Upon power-up of the LG31 printer, the parameters that will be retained from the previous power-on session are listed in Table 4–3.

Table 4–3:   Customer Printer Parameters Retained on Power-Up

Selectable Parameter

Horizontal Pitch
Vertical Pitch
Font
Top of Form
Forms Length
Top and Bottom Margin
Left and Right Margin
Autowrap
Line Feed/New Line
Carriage Return/New Line Mode
Horizontal Tabs
Vertical Tabs
GL Character Set
GR Character Set
G0 Character Set
G1 Character Set
G2 Character Set
G3 Character Set
All Interface Settings

4.1.4 Reset State

When the LG31 printer receives a reset sequence from the host computer or the inner control panel (operator's input), the printer is set to the default settings (see Table 4–4).

Table 4–4:   Reset State Default Parameters

Selectable Parameter	Reset Default Condition
Printing Status	On-line (ready)
Horizontal Pitch	10 Characters-Per-Inch (CPI)
Vertical Pitch	6 Lines-Per-Inch (LPI)
Font	Data Processing
Forms Length	66 Lines (11 in/27.94 cm)

Table 4–4 (Cont.): Reset State Default Parameters

Selectable Parameter	Reset Default Condition
Active Position	Column 1, Line 1
Top Margin	Line 1
Bottom Margin	Line 66
Left Margin	Column 1
Right Margin	Column 132
Underlining	Disabled
Bolding	Disabled
Italics	Disabled
Expansion	Disabled
GL Character Set	U.S. ASCII or the last NRC if selected
GR Character Set	Digital Supplemental
G0 Character Set	U.S. ASCII or the last NRC if selected
G1 Character Set	VT100 Graphic Character Set
G2 Character Set	Digital Supplemental
G3 Character Set	U.S. ASCII
Autowrap	Enabled
Line Feed/New Line Mode	Set
Horizontal Tabs	At every 8 columns (9, 17, ...137)
Unsolicited Reports	Disabled
Super/Subscripts	Disabled
Carriage Return New Line Mode	Reset
Vertical Tabs	Every Line (1, 2, ... 66)

A RESET sequence does not change the following:

- Any interface settings

- National Replacement Character (NRC) set

- Top of Form

The above parameters remain as previously selected, either through escape sequences or through the inner control panel.

4.2 Control Strap Configuration

There are two groups of strapping options in the printer, interface and printer control. Both are accessed and modified in the same manner using the configuration menu. Table 4–5 and Table 4–6 describe the strap functions briefly. For detailed description see the LG31 User's Guide.

Table 4–5: Printer Control Strap, Default Factory Settings and Descriptions

Strap Number	Factory Setting	Function and Description
A1-A16		Not Assigned
A17	0 (OUT)	Selects LG31 Product ID
A18-A20		Not Assigned
A21	0 (OUT)	Disable Line Feed to Slew Conversion.
A22	0 (OUT)	Disable Slew Truncation at TOF.
A24	0 (OUT)	Printer come up OFL after self-test.
A25		Not Assigned.
	1 (IN)	Enable paper motion keys when ONL.
	1 (IN)	Enable auto wrap.
	1 (IN)	Enable Linefeed/ New line mode (LNM)
A29	0 (OUT)	Disable carriage return/new line
A30	0 (OUT)	Enable Delete <DEL>
A31	1 (IN)	DP font line underline raised to baseline.
A32	0 (OUT)	Disable HEX Dump mode.
B1	1 (IN)	Right margin to max. column when font changed.
B2-B32		Not Assigned.

Table 4–6: Interface Control Strap Descriptions

Strap Number	Action	Function and Description
A1-A3		Not Assigned
A4	0 (OUT)	Ready/Busy by SCA pins 11 & 19 disabled
A5	1 (IN)	Ready/Busy by XON & XOFF disabled
A6	0 (OUT)	Ready/Busy at 200 ms break disabled
A7	0 (OUT)	Ready/Busy by DTR, pin 20 disabled
A8	0 (OUT)	Ready/Busy by RTS, pin 4 disabled
A9-A11		Not Assigned
A12	0 (OUT)	No Fault/Fault by SCA pins 11 & 19 disabled
A13	0 (IN)	No Fault/Fault by XON & XOFF enabled
A14	0 (OUT)	No Fault/Fault at 200 ms break disabled
A15	0 (OUT)	No Fault/Fault by DTR, pin 20 disabled
A16	0 (OUT)	No Fault/Fault by RTS, pin 4 disabled
A17-A19		Not Assigned
A20	0 (OUT)	ONL/OFL by SCA pins 11 and 19 disabled
A21	1 (IN)	ONL/OFL by XON & XOFF enabled
A22	0 (OUT)	ONL/OFL at 200 ms break disabled
A23	1 (IN)	ONL/OFL by CD pin 20 enabled
A24	0 (OUT)	ONL/OFL by CA pin 4 disabled
A25		Not Assigned
A26	0 (OUT)	ETX/ACK Protocol disabled
A27	0 (OUT)	Reverse SCA polarity disabled
A28	0 (OUT)	Reverse DTR polarity disabled
A29	1 (IN)	Parity check disabled
A30	0 (OUT)	Two stop bits disabled
A31	0 (OUT)	Printer Transmission disabled
A32	0 (OUT)	Reverse RTS polarity disabled
B1		Not Assigned
B2	1 (IN)	Parity Bit disabled
B3	0 (OUT)	Auto Input Buffer Expansion disabled
B4	0 (OUT)	Printer transmit inhibit enabled
B5	0 (OUT)	Replace Underline with carriage return disabled
B6	1 (IN)	Accept 7 and 8 bit data enabled
B7-B32		Not Assigned

4.3 Host to LG31 Printer Set-up Procedure

4.3.1 Interface Control Strap Settings

Figure 3-14 of the *LG31 Printer User's Guide* states that parity is disabled at interface strap B2. This is the factory setting and the recommended setting. This means that the serial interface must be set-up with no parity.

4.3.2 Serial Interface Settings for VAX/VMS

Before using the printer, the serial interface must be set-up correctly. The system manager must issue the following commands for the VAX/VMS operating system.

1. If the terminal line that will support the LG31 has not been set-up to support a spooled device then, go to instruction 3, otherwise, issue a DCL command such as the following:

   ```
   $ stop/que que_name
   ```

   where que_name is the name of the queue.

2. Stop the spooling on the terminal by issuing the DCL command:

   ```
   $ set dev/nospool txa1:
   ```

   where **txa1** is the name of the terminal in this case.

3. Set up the terminal line to have the following characteristics as shown below:

   Terminal: _TXA1:
   Device_Type: Unknown
   Owner: SYMBIONT_0001
   Username: SYSTEM

Input: 9600	LFfill: 0	Width: 300	Parity: None
Output: 9600	CRfill: 0	Page: 66	

Terminal Characteristics

Interactive	Echo	Type_ahead	No Escape
No Hostsync	TTsync	Lowercase	Tab
Wrap	Scope	No Remote	Eightbit
No Broadcast	No Readsync	Form	Fulldup
No Modem	No Local_echo	No Autobaud	No Hangup
No Brdcstmbx	No DMA	No Altypeahd	Set_speed
Line Editing	Overstrike editing	No Fallback	No Dialup
No Secure server	No Disconnect	Pasthru	No Syspassword
No SIXEL Graphics	No Soft Characters	No Printer Port	Numeric Keypad
No ANSI_CRT	No Regis	No Block_mode	No Advanced_video
No Edit_mode	No DEC_CRT	No DEC_CRT2	No DEC_CRT3

This can be accomplished by the DCL command:

```
$ set term txa1: /pasthru/speed=9600/etc
```

Note

PASTHRU SHOULD ALWAYS BE SET.

4. Set the terminal line to support a spooled device by issuing the DCL command:

```
$ set dev/spool=(queue_name) txa1:
```

where queue_name is the name of the queue.

5. Start the queue by issuing the DCL command:

```
$ ini/que/start/terminal queue_name/on=txa1:
```

The LG31 can now be used.

4.3.3 Default Characteristics

Table 4–7: Default Characteristics For The LG31 Line Printer

Name	Set	Name	Set
ADVANCED_VIDEO	no	INSERT/ OVERSTRIKE	*
ALTYPEAHD	no	INTERACTIVE/ PASSALL	*
ANSI_CRT	no	LFFILL	0
APPLICATION KEYPAD/ NUMERIC_KEYPAD	*	LINE EDITING	*
AUTOBAUD	no	LOCAL_ECHO	*
BLOCK_MODE	no	LOWERCASE/ UPPERCASE	low
BRDCSTMBX	no	MODEM	no
BROADCAST	no	PAGE	66
CRFILL	0	PARITY	no
DEC_CRT	no	PASTHRU	yes
DEC_CRT2	no	PRINTER_PORT	no
DIALUP	no	READSYNC	*
DISCONNECT	*	REGIS	no
DMA	*	REMOTE	*
ECHO	*	SECURE_SERVER	*
EDIT_MODE	no	SET_SPEED	no
EIGHT_BIT	yes	SIXEL_GRAPHICS	yes
ESCAPE	*	SOFT_CHARACTERS	no
FALLBACK	*	SPEED	9600
FRAME	*	SYSPASSWORD	no
FORM	yes	TAB	yes
FULLDUP/ HALFDUP	*	TTSYNC	*
HANGUP	no	TYPE_AHEAD	*
HARDCOPY/ SCOPE	scope	WIDTH	220
HOSTSYNC	*	WRAP	*

Note

* Indicates that the current setting is not effected by the terminal type.

@ Optional terminal feature.

4.3.4 RSX Settings

The terminal characteristic PASTHRU should be set.

4.3.5 RT-11 Settings

A command of the form ASSIGN TT1: LP: should be issued. This assumes a multiterminal system. Refer to the RT-11 System User's Guide.

4.3.6 RSTS/E Settings

Refer to the RSTS/E System Manuals.

Chapter 5

TROUBLESHOOTING

5.1 Introduction

This chapter contains troubleshooting information for the LG31 printer. Troubleshooting the printer can involve the following:

- Diagnostic self-tests (see Section 5.2)

- Printer initialization (see Section 5.3)

- Mechanical fault finding (see Section 5.4)

- ASCII Print Test (see Section 5.5)

- Power supply troubleshooting (see Section 5.6)

Troubleshooting can also require configuring the printer: this is described in Chapter 4 of *LG31 Printer Installation/Operator's Manual*.

When a problem with the LG31 printer occurs, try to reconstruct the events that led up to the problem.

- Check for visual indications:

    — What is on the display panel readout? If it is other than [O F L] or [O n L], power down and power up the printer to see if the error code repeats (see Table 5–1). If there is no display, see Figure 5–1.

— What is the quality of the printed page? If the printing is erratic or skewed, check for a mechanical failure (Section 5.4). If it is poor quality, perform the print-quality adjustment procedure in Chapter 5.

• Check for audible indications:

— Did the audio alarm sound? Power down and then power up the printer to see if the problem repeats (see Figure 5–1).

— Were there any unusual sounds (grinding, chattering, and so forth)? Power down and then power up the printer to see if the problem repeats (see Section 5.4).

Figure 5–1 is a troubleshooting tree flow chart that follows a logical sequence to isolate a fault. Note that by removing the interface cable the host is removed as a possible trouble source.

Table 5–1 is a list of faults and their possible causes. This table provides a quick method of diagnosing printer faults of a more obvious nature.

The controls and indicators include the following:

— Outer control panel (for details, see the *LG31 Printer Installation/Operator's Manual*)

— Inner control panel (for details, see the *LG31 Printer Installation/Operator's Manual*)

— Power supply switch

— LEDs ON power supply board

— LEDs on logic boards

— Logic board potentiometers

— Logic board jumpers

Figure 5–1: Troubleshooting Tree


```
                    ┌─────────────────────┐
                    │ Operating problem   │   (1)
                    └─────────────────────┘
                              │
                    ┌─────────────────────┐
                    │ Power off           │
                    │ Remove serial       │
                    │ interface cable     │
                    │ Power on            │   (2)
                    └─────────────────────┘
                              │
                    ┌──────────┐   N   ┌──────────┐   N   ┌──────────────────┐
                    │ Is there │──────▶│ Are all  │──────▶│ Power supply     │
                    │ a control│       │ the LEDs │       │ troubleshooting  │
                    │ panel LED│       │ on the   │       │ procedure    (4) │
                    │ display  │       │ power    │       └──────────────────┘
                    └──────────┘       │ supply   │
                         │ Y           │ modules  │
                                       │ on   (3) │
                                       └──────────┘
                                           │ Y
                                       ┌──────────────────┐
                                       │ Control panel    │
                                       │ troubleshooting  │
                                       │ procedudure  (5) │
                                       └──────────────────┘

                    ┌──────────┐   Y   ┌──────────────────┐
                    │ SELF     │──────▶│ Run ASCII        │
                    │ TEST     │       │ print test       │
                    │ pass (6) │       └──────────────────┘
                    └──────────┘
                         │ N                  ┌──────────┐   Y
                                              │ Print    │──────▶
                                              │ quality  │
                                              │ good     │
                                              └──────────┘
                                                   │ N
                                              ┌──────────────────┐
                    ┌──────────────────┐      │ Print & mechanical│
                    │ Printer          │      │ troubleshooting   │
                    │ initialization   │      │ procedure    (7)  │
                    │ procedure    (8) │      └──────────────────┘
                    └──────────────────┘
                    ┌──────────────────┐      ┌──────────────────┐
                    │ Error code       │      │ Check & perform  │
                    │ troubleshooting  │      │ print quality    │
                    │ procedure    (9) │      │ ajustments  (10) │
                    └──────────────────┘      └──────────────────┘
                                              ┌──────────────────┐
                                              │ Replace serial   │
                                              │ interface & test │
                                              │ total system     │
                                              └──────────────────┘
```

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TROUBLESHOOTING   5–3

Figure 5–1 is a troubleshooting flowchart that follows a logical sequence to isolate a basic printer fault. The following notes refer to the marked steps in the flowchart.

1. Communications problems are not dealt with by this flowchart and can be investigated by:

    a. Verifying the host and printer setup parameters (see the *LG31 Printer Installation and Operator's Guide*). The LG31 hex-dump facility can be of considerable use in the investigation of certain communication and setup problems.

    b. Using an alternative host communication port for input.

    c. Changing the printer serial interface (SMSI).

2. Before removing power from the printer, note should be made of any indicators and status information that will be lost when the printer is switched off. The removal of the serial interface isolates the printer from the host as a possible trouble source.

3. Note that the shuttle access cover interlock, when activated, will cause the power supply LEDs to go out.

4. See section 3.6.

5. Note that a major malfunction of the SMSM could also cause a blank control panel display.

6. See section 3.2.

7. See section 3.4.

8. See section 3.3. The printer initialization sequence should be used first where appropriate to try and clear an error or where the control panel is locked up and will lead back into the self test routine.

9. See section 3.2.3.

10. See Chapter 7.

Table 5–1: Problems and Possible Causes

Problem	Possible Cause
Inner Control Panel Malfunction	1. Incorrect strap setting 2. SMDP 3. Control panel 4. Cable assembly 15
Outer Control Panel Malfunction (Inner Control Panel OK)	1. Outer control panel 2. Cable assembly 25 connections at SCPI-P3 and SMDP-P3
Intermittent/erratic operation	1. If SPSR voltage LEDs vary in brilliance: a. SPSR b. SPSM c. SPSX 2. Interface cable/connector 3. Cable assembly 16 4. SMSM (check CR4 LED (ALE signal); indicates microprocessor operating) 5. SMIM (check CR3 LED (ALE signal); indicates microprocessor operating)
Garbled or no printout	1. SHAD 2. SMSM (check CR4 LED (microprocessor operating) and seating of chips) 3. SMIM (check CR3 LED (microprocessor operating) and seating of chips) 4. SMIH 5. Cable assembly 14, 19
Constant Paper Out Indication	1. Paper Out switch adjustment 2. Paper Out switch defective 3. Cable assembly 17 to switch 4. SMDP
Wavy print, columns or paper will not feed	1. Paper feed problem (binding, alignment) 2. Drive belt adjustment 3. SMMC 4. Cable assembly 17 to paper motor 5. Paper motor 6. See print adjustment procedures in Chapter 7

Table 5–1 (Cont.): Problems and Possible Causes

Problem	Possible Cause
Shuttle malfunction	1. Print actuator module (replace) 2. SHAD 3. SMMC 4. Shuttle motor 5. Cable assembly 19
Missing dots, light printing over portion printing area	1. Print actuator module (replace) 2. SHAD 3. SHAD to print module cable assembly 19
Printing too light or heavy, lighter at one end, poor quality	1. Print module - striker bar gap adjustment
Ribbon will not advance	1. Ribbon off guide rollers, jammed or misrouted 2. Ribbon cartridge 3. Ribbon drive motor 4. Cable assembly 17 5. SMMC
Fan control malfunction or fans inoperative	1. Fan 2. SMMC 3. Loose or defective fan cable
Slow printing	1. Thermal throttle senses high temperature due to prolonged high density printing (no corrective action required)

5.2 Diagnostic Self-Tests

The LG31 printer automatically initiates diagnostic self-tests at power-up, and after the ASCII print test.

5.2.1 Initiating Diagnostic Self-Tests

The diagnostic self-tests are the most powerful tool for isolating a faulty FRU. When the LG31 printer is powered up or when the ASCII print test is stopped, the printer automatically initiates diagnostic self-tests as defined below:

1. The first thing displayed after the printer is turned on or at the conclusion of an ASCII print test, is [.8.8.8] accompanied by audio alarm sounds for approximately two seconds. The [.8.8.8] display allows verification that the display LEDs (three decimal points and 21 segments that form the [.8.8.8] display) are all functioning.

2. The printer then displays [i P] for several seconds, indicating that the printer self-test is in progress. The display then changes back to [.8.8.8] for several seconds.

3. If necessary, the display then shows [S U S] for several seconds indicating printing is suspended until the ribbon weld moves past the striker bar.

4. When the printer successfully completes the self-tests, it enters the Off line (printer display is [O F L]) or the On Line (printer display is [O n L]) mode. The power-up mode is dependent on printer control Strap 24.

NOTE

Any display other than those described in steps 1 through 4 may indicate a diagnostic self-test failure, or an operator correctable fault. In this case, proceed directly to Section 5.2.3 for error code identification.

5.2.2 Diagnostic Self-Test Sequence

The diagnostic self-tests are a series of 27 tests; which exercise several of the printer's key FRUs. If an FRU fails, an error code is displayed. This means that if a fault code is displayed, all tests prior to the fault were good; however, tests following the error code may have errors.

Table 5-2 shows the sequence of diagnostic self-tests and the FRUs each test addresses.

Table 5–2: Diagnostic Self-Test Sequence

Test No.	Error Code	FRU Tested	Test No.	Error Code	FRU Tested
1	529	SMSM	17	I25-I32	SMIM
2	547-549	SMSM	18	420	SMIM
3	530	SMSM	19	440	SMIM
4	529	SMSM	20	i33	SMIM
5	020	SMSM	21	i14	SMIM
6	022	SMSM	22	490	SMIH
7	544	SMSM		"	SMMC
8	050	SMSM		"	LVT
9	055	SMSM	23	491	SMIH
10	080	SMSM		"	SMMC
11	531	SMSM		"	LVT
12	060	SMSM	24	493	SMIH
13	inF	SMSI	25	494	SMIH
14	700	SMIM	26	"	SMIH
15	i20-i22	SMIM	27	Ac1-Ac3	PAM†
16	i13	SMIM			SHAD

†PAM=Print Actuator Module 1, 2, or 3

5.2.3 Error Codes

There are two types of error codes displayed by the printer:

1. Self-Test Error Codes—These error codes are displayed if a problem occurs during the diagnostic self-test.

2. Run Time Error Codes—These error codes are displayed if (1) an operator correctable fault occurs, or (2) a fault occurs that may affect operation but not require corrective action. The operator information error codes can be displayed at any time; however, the self-test error codes take precedence over them at power-up, and after the ASCII print test is terminated.

Table 5-3 lists, in alphanumeric order, both types of error codes the printer displays, lists the FRU involved in the test, lists the removal and replacement procedure for the affected FRU, and describes the failure.

Table 5–3: Error Codes

Error Code	FRU Tested	R&R Proc.	Failure (Test/Component)
Ac1-Ac3	PAM SHAD	6.6 6.20	Print Actuator Module Test (Ac1=left module, Ac2=center module, Ac3=right module)
CO	- -	- -	Cover open
F_ _	SMIM	6.2	Font Checksum Error (see Table 3-4 for the fonts indicated by the error code)
inF	SMSI	6.22	Operational Interface Detection Test
i13	SMIM	6.22	8253 Timer Test (U13)
i14	SMIM	6.22	8259 Interrupt Controller Test (U14)
i20-i22†	SMIM	6.22	Program ROM Test (U20-U22)
i25-i32†	SMIM	6.22	Non-Volatile RAM Test (U25-U32)
i33	SMIM	6.22	2K RAM Test (U33)
LOP	—-	—-	Low Paper Condition
Po	—-	—-	Paper Out
rco	—-	—-	Ribbon Cartridge Out
Sbo	—-	—-	Striker Bar Open
Sdr	—-	—-	Shuttle Drive Jammed
SLo	—-	—-	Slow Printing
SUS	—-	—-	Suspend Printing
020*	SMSM	6.22	Lithium Battery Test (BT1)

*Note that these faults can occur after

- Transporting the printer
- Changing the SMSM board
- Changing the SMIM board

Clear these faults by using the control panel as described in Section 5.3.
†The last two digits of the error code correspond to the faulty chip number (548=U48, i27=U27).

Table 5–3 (Cont.):   Error Codes

Error Code	FRU Tested	R&R Proc.	Failure (Test/Component)
022	SMSM	6.22	Insufficient RAM installed on SMSM board
050	SMSM	6.22	Switchable Memory Test (U9-U13, U18-U25, U32-U35, U42)
055	SMSM	6.22	Switchable Memory Test (U11 and U21)
060	SMSM	6.22	8085 Interrupt Controller Test (U3)
080	SMSM	6.22	DMA Address Counter Test (U37, U38, U42, U43, U50-U54)
100	—-	—-	EVFU Fault
101	—-	—-	EVFU Fault
102	—-	—-	EVFU Fault
103	—-	—-	EVFU Fault
104	—-	—-	EVFU Fault
420*	SMIM	6.22	Lithium Battery Test (BT1)
440	SMIM	6.22	8K RAM Test (U19)
490	SMIH	6.22	Overcurrent Condition and MVL Signal Test
	SMMC	6.22	
	LVT	6.22	
491	SMIH,	6.22	Shuttle Frequency Test
	SMMC,	6.22	
	LVT	6.12	

*Note that these faults can occur after

• Transporting the printer
• Changing the SMSM board
• Changing the SMIM board

Clear these faults by using the control panel as described in Section 5.3.

5–10   TROUBLESHOOTING

Table 5–3 (Cont.):   Error Codes

Error Code	FRU Tested	R&R Proc.	Failure (Test/Component)
492	SMIH	6.22	Dot Buffer and Imaging Circuit Test
493	SMIH	6.22	STOP3 Signal Test
494	SMIH	6.22	Paper Motion Interrupt Signal Test
529	SMSM	6.22	Non-Volatile RAM/RAM Stack Test (U29)
530	SMSM	6.22	8253 Timer Test (U30)
531	SMSM	6.22	8259 Interrupt Controller Test (U31)
544	SMSM	6.22	8K RAM Test (U44)
547-549†	SMSM	6.22	ROM CRC Test (U47-U49)
700	SMIM	6.22	Image Processor Error Test

†The last two digits of the error code correspond to the faulty chip number (548=U48, i27=U27).

Table 5–4:   Font Error Codes

Font Error Code	Font
F00	Draft 10 CPI
F01	Draft 12 CPI
F02	Draft 13.3 CPI
F03	Draft 15 CPI
F04	Enhanced 16.7 CPI
F05	Draft 5 CPI
F10	Gothic NLQ 10 CPI
F11	Gothic NLQ 12 CPI
F12	Gothic NLQ 13.3
F13	CPI
	Gothic NLQ 15 CPI

5.3 Printer Initialization

Initializing the printer changes all the configuration parameters back to the factory settings. There are two means of initializing the printer: using the control panel keys, or using the initialization switch if the printer is locked up.

NOTE

Prior to initializing the printer, print a copy of the printer's current configuration status report (see the *LG31 Printer User's Guide* or the *LG31 Printer Installation/Operator's Manual*) to keep for future reconfiguration.

5.3.1 Front Panel Initialization

The procedure below shows how to initialize the printer using the control panel keys.

1. Verify that the printer is in the Off-line mode (printer display is [O F L]).

2. Press the (9) FCT key and observe that the printer enters the Mode Selection state (printer display changes to [.F n c]).

3. Press the (1) PRG key and observe that the printer enters the Initialization mode (printer display changes to [. S U]).

4. Press the (9) FCT key to initialize the printer. Observe that the printer display changes to [.I S U], then [.8.8.8] accompanied by the beeper sound, then [i P], then [.8.8.8], and finally [O F L].

5. If the printer does not return to the Off-line mode, press the TEST CLR (0) key and observe that the printer enters the Off-line mode (printer display changes to [O F L]).

5.3.2 Initializing a Locked-Up Printer

The procedure below shows how to initialize a printer if the printer/control panel is locked up.

1. Set the printer power switch to the OFF position.

2. Slide the Printer Initialization switch to the right (switch location is at the top of the Operator Display label beside the inner control panel).

3. Set the printer power switch to the ON position.

4. When the printer displays [. S U], press (a)FCT.

5. When the printer displays [. S U], move the INIT switch to the left (its normal position) to finish the initialization.

NOTE

If the printer initialization switch is not returned to its original position, the printer will display [. S U] each time the printer is powered-up or when the ASCII print test is run. The operator may then complete the initialization by performing step 4, above. If initialization is not required, return the Printer Initialization switch to the original position.

5.4 Mechanical Fault Troubleshooting

Mechanical faults are indicated by excessive noise, binding, or vibration, and can be isolated to the adjustment or replacement of the paper feed, ribbon drive, or shuttle mechanism FRUs.

5.4.1 Paper Feed Mechanical Faults

If the noise or binding exists during paper feeding, the fault may be one or more of the following.

Fault	Corrective Action
Insufficient clearance print module and striker bar.	1. Readjust Print Gap adjustment dial (see the *LG31 Printer Installation/Operator's Manual*).
	2. See Print Quality Adjustment Procedures (Chapter 7).
Incorrect paper tension.	1. Readjust Paper Tension adjustment lever (see the *LG31 Printer Installation/Operator's Manual*).
Paper feed misalignment.	1. Reload paper on top and bottom tractors (see the *LG31 Printer Installation/Operator's Manual*).
Tractor Belt misaligned and/or tension incorrect.	1. See Paper Handling Assembly (Section 6.21).
Line feed errors because of defective Feed Motor.	1. Remove and replace the Paper Feed Motor (Section 6.19).

5.4.2 Printing Mechanism Mechanical Faults

If excessive noise or binding exists during printing, the fault may be isolated to one or more of the following.

Fault	Corrective Action
Linear Velocity Transducer (LVT) misadjusted.	1. Adjust the Linear Velocity Transducer (LVT) Coil and Magnet (Section 6.14).
Shuttle Motor defective or unbalanced.	1. See Print Quality Adjustment Procedures (Chapter 7).
Ribbon Cartridge defective or not installed correctly.	1. Check installation, replace cartridge if required.
Ribbon Drive Motor not secured.	1. Tighten all hardware securing motor and mount.
Ribbon Drive Motor defective or drive shaft bent.	1. Remove and replace Ribbon Drive Motor (Section 6.11).
Print Actuator Module not secured.	1. See Print Module Adjustment Procedure (Chapter 7).

5.4.3 Vibration Faults

If excessive vibration exists during operation, the fault may be isolated to one or more of the following.

Fault	Corrective Action
Printer resting on carpeted or uneven surface.	1. Adjust leveling feet to minimize vibration.
Shuttle motor unbalanced.	1. See Print Quality Adjustment Procedures (Chapter 7).

5.5 ASCII Print Test

The ASCII print test pattern is an operator-initiated test verifying print quality and mechanical operation of the paper tension and paper gap adjustments.

5.5.1 Starting the ASCII Print Test

To start the ASCII printing test pattern, press the (0) TEST CLR key for more than 0.5 seconds. A rolling pattern (Figure 5–2) of all the printable ASCII characters in current font style, pitch, expansion, margins, and Lines Per Inch (LPI) setting is printed.

Figure 5–2: The ASCII Print Test Pattern

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

5.5.2 Stopping the ASCII Print Test

To stop the ASCII print test, again press the (0) TEST CLR key for longer than 0.5 seconds. The diagnostic self-test is automatically started (see Section 5.2). Using the test pattern as a guide, adjust the paper tension and the paper gap controls for the best print quality.

5.6 Testing the Power Supply

The power supply accepts single phase ac supply voltage of 88 to 264 V ac, 47 to 65 Hz, and delivers 300 Watts average dc power, with peaks to 450 Watts.

DANGER   STORED HIGH VOLTAGE

Wait five minutes after removing ac source before disassembling. Refer to manual for service instructions.

DANGER   HAUTE TENSION EMMAGASINEE

Attendre 5 minutes après avoir enlevé la source de courant
alternatif et avant de demonter la machine. Voir le manuel
pour les instructions d'entretien.

PELIGRO   ALTO VOLTAJE ALMACENADO

Antes de proceder a desensamblar esto, esperar 5 minutos
despues de haber removido la fuente de C.A. para instrucciones
de servicio de mantenimiento, vease el manual.

ACHTUNG, GEFAHR   HOCHSPANNUNG WIRD GESPEICHERT

Nach Abschalten der Wechselstromquelle, fünf Minuten warten,
bevor Teile demontiert werden. Bitte Bedienungsvorschrift im
Handbuch nachsehen.

5.6.1 Power Supply FRUs

The power supply see (Figure 5–3) consists of the following FRUs.

- ac Line Filter
- ac Switch Box
  - — SPSX board
  - — Power OFF/ON switch/circuit breaker
  - — Rectifier
- SPSM Board
  - — Located in left side power supply card cage
  - — Converts primary voltage to 85V
- HOLD UP Capacitor
  - — Located at back of the lower enclosure
  - — 21,000 µF at 100 V dc
- SPSR Board
  - — Located in left side power supply card cage
  - — Converts primary voltage to 42V, 12V, 5.1V, and -12V

Figure 5–3: Power Supply FRUs

SURGE CAPACITOR

POWER MODULES

HOLD UP
CAPACITOR

SPSR

DC POWER
DISTRIBUTION
CABLE

SPSM

SPSD

AC POWER
SOCKET

LINE
FILTER

AC SWITCH BOX

P2   P1

P3

SPSX   RECTIFIER

ON/OFF SWITCH/
CIRCUIT BREAKER

RE_UK00222A_89

5–18   TROUBLESHOOTING
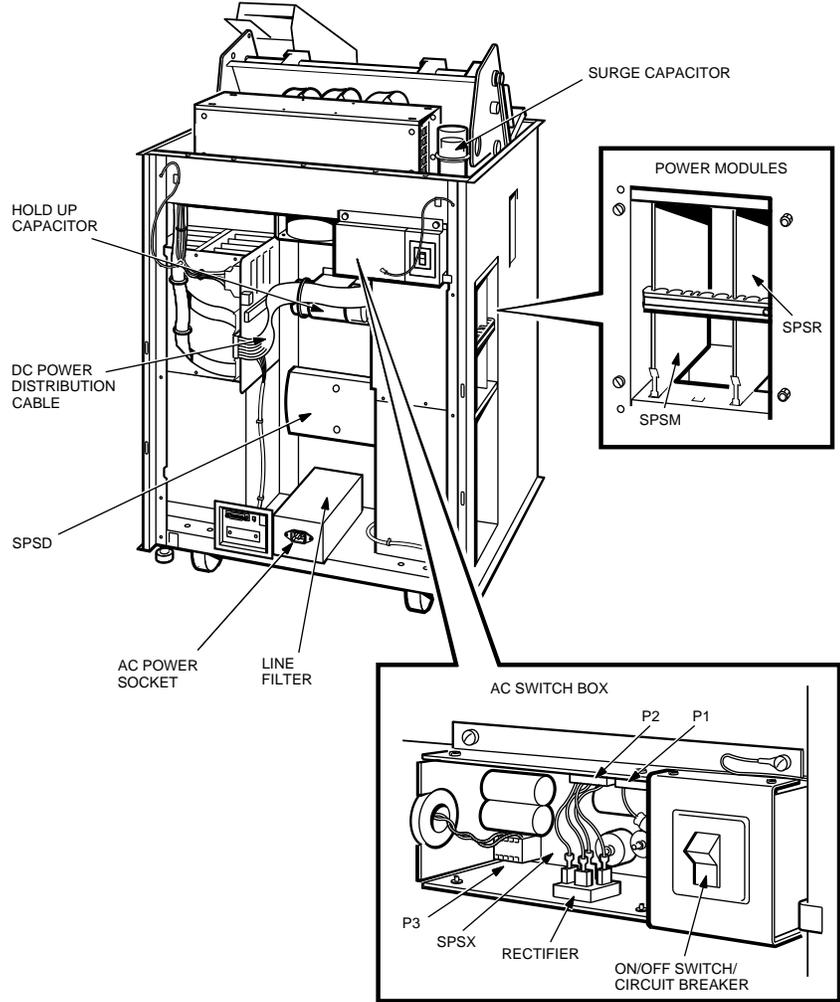
- SURGE Capacitor
    — Located at upper left corner of the enclosure
    — 40,000 μF at 50 Vdc
- SPSD Board
    — Located inside rear access panel below the capacitor
    — Shuttle power supply discharge

5.6.2 Finding and Correcting a Power Supply Problem

If you suspect a problem in the power supply, perform the following steps.

1. Turn the printer power off.

2. Remove the cover from the power supply card cage on the left side of the printer (see Figure 6–24).

3. Turn the printer power on.

4. Observe the four LEDs on the SPSR board:

    - If they are of equal and steady brilliance and the self-test was good, the power supply is probably good.

    - If they are of unequal brilliance or if some but not all are not lit, change the SPSR board

    - If the lower of two LEDs on the SPSM board is not lit, check the 85Vdc power supply.

    - If the lower LEDs on the SPSM board is lit, check the SPSR board fuses.

    - If one or more are exceptionally bright, one or more of the logic boards may be damaged.

      If the 42V bottom LED pulsates, especially when printing heavy density, change the SPSR board.

    - If the fuse on the SPSR board is blown, change the SPSR board.

    - If LED CR48 on SPSM (bottom) is not lit, replace SPSM and SPSX.

- If LED CR48 on SPSM is still not lit, check cable assembly 6 and the bridge rectifier.

NOTE

The voltage (12 V $_z$) indicated by CR10 is 12 V above the rectified output zero (z) and is not 12 V above ground.

- If LED CR48 (top) on SPSM is not lit, replace SPSM.

5. Check the SPSR output voltages by disconnecting P3 of CA8, and measuring the voltages at the connector. The voltages are:

PWR-UP	P3-6
-12V	P3-3
12V	P3-10
5.1V	P3-8
42V	P3-1, P3-12
0V	P3-2, P3-5, P3-7, P3-9, P3-11

5.7 Field Replaceable Units (FRUs)

Table 5–5 contains a list of the printed circuits boards. The rest of the FRUs are listed in Table 5–6.

NOTE

Parts that do not have a Digital Part Number should be ordered under the Vendor part number.

Table 5–5: Printed Circuit Boards (PCB) FRUs

Board	Meaning	Part No.	Location
SCPI	Shuttle Control Panel Interface	29-26721-00	On access door between outer and inner control panels.
SHAD	Shuttle Head Actuator Driver	29-26729-00	Vertically mounted in top rear of printer.
SMDP	Shuttle Matrix Display Panel	29-26720-00	On inner control panel.
SMMB	Shuttle Matrix Mother Board	29-27261-01	Inside rear access door. On the left
SMIH	Shuttle Matrix Image Hardware	29-26731-00-00	In logic module (right side).
SMIM	Shuttle Matrix Imaging Microprocessor	29-26730-00	In logic module (right side).
SMMC	Shuttle Matrix Motor Control	29-26735-00	In card cage (right side).
SMSI	Shuttle Matrix Serial Interface	29-26723-00	Piggyback on SMSM
SMSM	Shuttle Matrix System Microprocessor	29-26733-00	In logic module (right side).
SPSD	Shuttle Power Supply Discharge	29-26724-00	Inside rear access door below the capacitor.
SPSM	Shuttle Power Supply Master	29-26734-00	In power supply card cage (left side).
SPSR	Shuttle Power Supply Regulator	29-26732-00	In power module (left side).
SPSX	Shuttle Power Supply Filter	29-26722-00	In ac switch box, rear of printer, near power ON-OFF switch.

Table 5–6:   Non-PCB FRUs

Item	Part Number	Description
1	29-26707	Timing Belt
2	29-26708	Shuttle/Shroud Interlock Switch
3	29-26709	Circuit Breaker ON/OFF Switch
4	29-26710	Paper Out Limit Switch
5	29-26711	Cover Interlock Switch
6	29-26712	Striker Bar Switch Assembly
7	29-26714	Brushless Fan, Front and Rear
8	29-26715	Shuttle Motor Assembly Kit
9	29-26716	Tractor, Lower Left
10	29-26717	Tractor, Lower Right
11	29-26718	Tractor, Upper Left
12	29-26719	Tractor, Upper Right
13	29-26725	Ribbon Drive Motor
14	29-26726	Line Feed Motor Assembly
15	29-26727	LVT Coil Assembly
16	29-26728	Ribbon Weld Sensor
17	29-26736	Print Module
18	29-26737	Smudge Shield
19	29-26738	Pico Fuse 3A 125 V
20	29-26739	Fuse 3A 250 V
21	29-26740	Fuse 6.25A 250 V
22	29-26741	Fuse 0.50A 250 V
23	29-26742	Fuse 3.0A 250 V
24	17-00083-09	Power Cord - U.S./Canada
25	17-00310-01	Power Cord - Denmark

Table 5–6 (Cont.): Non-PCB FRUs

Item	Part Number	Description
26	17-00209-00	Power Cord - U.K./Ireland
27	17-00199-00	Power Cord - Germany - Austria - Belgium - France - Finland - Netherlands - Norway - Sweden - Portugal - Spain
28	17-00364-01	Power Cord - Italy
29	17-00210-00	Power Cord - Switzerland
30	17-00083-25	Power Cord - Japan
31	17-00457-01	Power Cord - Israel
32	17-00198-00	Power Cord - Australia - New Zealand
33	17-00456-01	Power Cord - India
34	00-BC22D-25	Serial Line Cable 25 foot
35	29-26744	Firmware Proms (SMSM)
36	29-26745	Firmware Proms (SMIM)
37	FD-14188-01	Inner Control Panel Assembly
38	29-27569-01	Outer Control Panel Assembly
	Special Tools	
39	29-26861	Nylon Gauge
40	29-26862	LVT Shims

5.8 Internal Wiring Numbers

Table 5–7:   Cable Part Numbers

Cable Assy.	From	To	Vendor Part Number
CA1	AC Power Source	Printer Power Connector	U.S.: 44A501951-001 International: 44A411452-G03
CA2	Line Filter	AC Power Switch	44A505271-G03
CA3	AC Power Switch	Line Fuse	44A505271-G07
CA4	Line Fuse	Shroud Interlock	44A505271-G01
CA5	SPSX-P2	Rectifier Bridge	44A505271-G05
CA6	SPSX-P3	SPSM-P3	44A505271-G06
CA7	SPSR-P2	Fans 1 and 2	44A505271-G08
CA8	SPSR-P3	SMMB-P3	44A505271-G09
CA10	SPSM-P1	85V Cap.	44A505271-G11
CA12	SPSR-P4	SHAD-P1 42V Cap.	44C430211-G01
CA14	SHAD-P6	SMMB-P2	44A505271-G17
CA15	SMMB-P4	SMDP-P4	44A505271-G18
CA16	SMMB-P5A (on rear of board)	J2	44C506014-G02 thru -G015
CA17	SMMB-P1	P5, P4, P9, P3, P6, P7, P2, fans	44D416362-G01
CA19	SHAD	Actuators	44D163339-G01
CA21	SPSM Sig. Gnd.	Frame Ground	44A505271-G21

Table 5–7 (Cont.): Cable Part Numbers

Cable Assy.	From	To	Vendor Part Number
CA22	SPSA Sig. Gnd.	Frame Ground	44A505271-G22
CA25	SMDP-P3	SCPI-P3	44A505271-G20
CA27	Line Filter	Ground	44A505271-G02
CA28	Line Filter	Power Receptacle	44A505271-G01
CA30	SPSR-P1	85V Cap.	44A505271-G13
CA31	In Line Connector	Shuttle Motor	44A505271-G24

Chapter 6

REMOVAL AND REPLACEMENT PROCE-DURES

6.1 Overview

This chapter provides removal and replacement procedures for the LG31 Field Replaceable Units (FRUs).

NOTE

Care should be taken when removing and replacing PCBs. All boards are slot dependent but are not keyed to prevent insertion into the wrong slot. The part description is marked both on the boards and on their respective slots.

DANGER   STORED HIGH VOLTAGE

Wait five minutes after removing ac source before disassembling. Refer to manual for service instructions.

DANGER   HAUTE TENSION EMMAGASINEE

Attendre 5 minutes après avoir enlevé la source de courant alternatif et avant de demonter la machine. Voir le manuel pour les instructions d'entretien.

PELIGRO   ALTO VOLTAJE ALMACENADO

Antes de proceder a desensamblar esto, esperar 5 minutos despues de haber removido la fuente de C.A. para instrucciones de servicio de mantenimiento, vease el manual.

ACHTUNG, GEFAHR HOCHSPANNUNG WIRD GESPEICHERT

Nach Abschalten der Wechselstromquelle, fünf Minuten warten,
bevor Teile demontiert werden. Bitte Bedienungsvorschrift im
Handbuch nachsehen.

6.2 Required Tools

The tools required to perform the LG31 removal and replacement proce-
dures are:

— Medium screwdriver (regular shank).

— Medium screwdriver (long shank).

— One pair of wire cutters.

— One metric socket set.

— A nylon gauge (DEC P/N 29-26861-00).

— Shim (DEC P/N 29-26862-00).

NOTE

All screwdrivers used for the following procedures are flathead,
unless specified within the procedure.

6.3 Preparing the Printer For Disassembly

The following steps must be completed before you proceed with the
removal and replacement procedures.

1. Set the power switch to OFF.

2. Unplug the power and interface cables from the printer (see Fig-
   ure 6–1).

Figure 6–1:   Power Switch and External Connectors

POWER
SWITCH
(CIRCUIT
BREAKER)

POWER
CABLE

INTERFACE
CABLE

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REMOVAL AND REPLACEMENT PROCEDURES   6–3
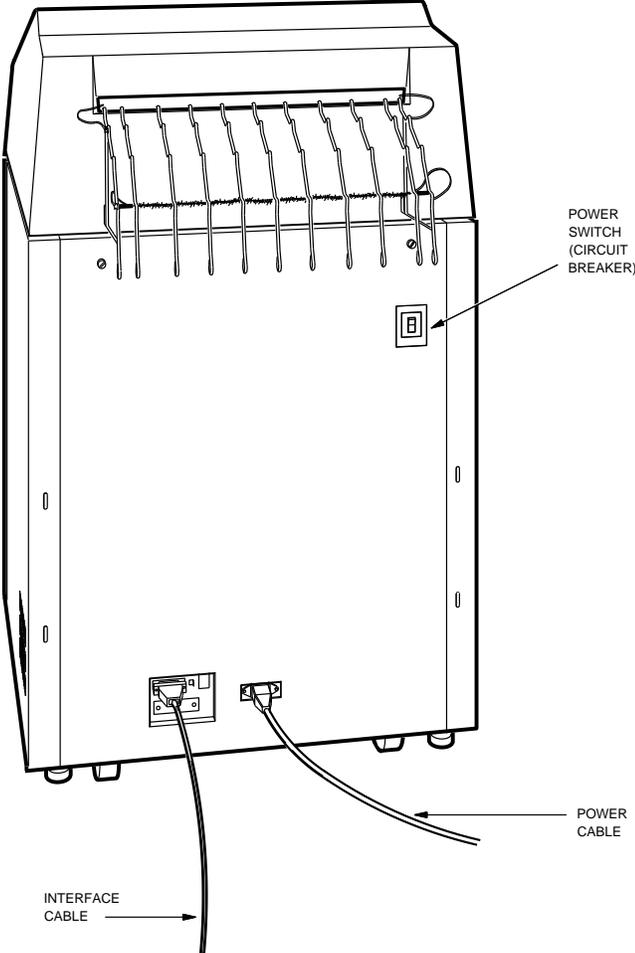
6.4 Paper Handling Hardware

The following procedure describes how to remove the paper handling hardware. Do the reverse of this procedure to reinstall the paper handling hardware (see Figure 6–2).

1. Disconnect the slide-on terminal ends of the ground cable from both sides of the paper shelf. Remove the cable and the paper shelf.

2. Disconnect the two ground cables from the paper rack by disconnecting the alligator clips on each cable from the rack. Remove the paper rack.

Figure 6–2:   Paper Handling Hardware

GROUND
CABLE

PAPER
RACK

PAPER
STACKING
GUIDES

PAPER
SHELF

RE_UK00248A_89

REMOVAL AND REPLACEMENT PROCEDURES   6–5
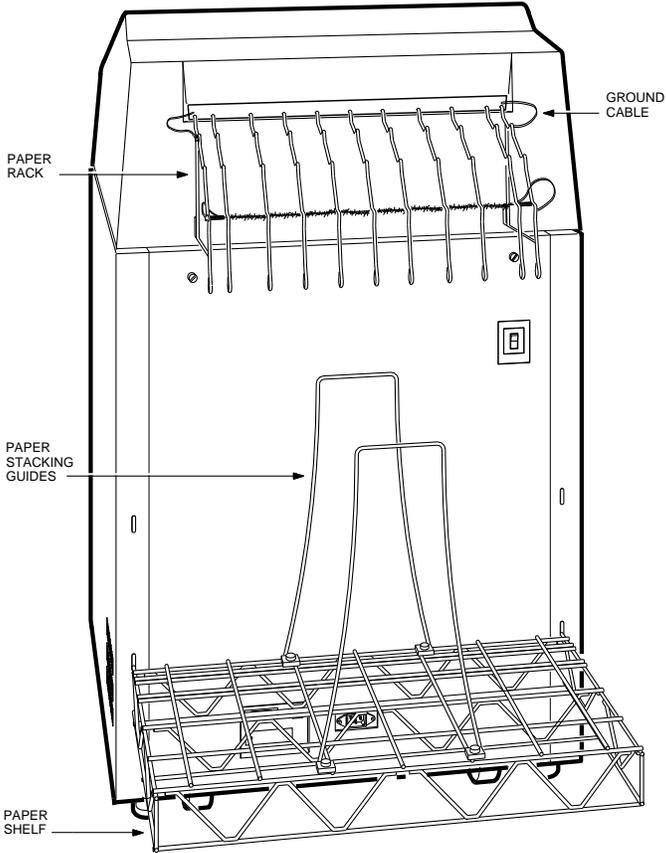
6.5 Installing Shipping Hardware

The following procedure describes how to install the LG31 shipping hardware.

1. Open the top cover.

2. Remove the ribbon cartridge.

3. Open the shroud cover.

4. Use an 8 mm socket wrench to install the hex head bolts, washers, and shipping bracket that are used as horizontal restraints during shipping (see Figure 6–3).

5. Use an 8 mm socket wrench to install the two red hex head bolts that secure the striker bar support blocks (see Figure 6–3).

Figure 6–3: Striker Bar Shipping Hardware

M5 CAP SCREWS SECURING STRIKER BAR SUPPORT BLOCKS DURING SHIPPING

SCREW, LOCKWASHER, PLAIN WASHER, AND SHIPPING BRACKET SECURING SHUTTLE
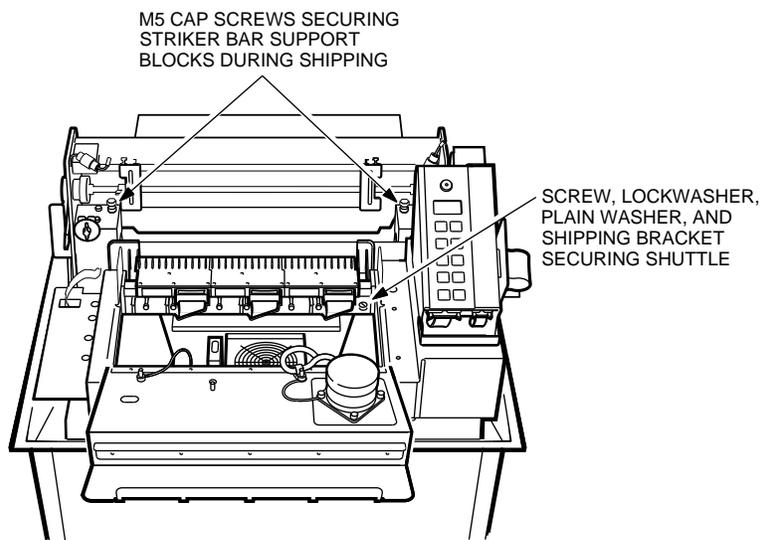
RE_UK00306A_89

6. Install the two red front shipping blocks.

7. Install the two red shipping blocks (see Figure 6–4) by reaching behind the paper handling assembly. Install the blocks through the printer front enclosure door.

Figure 6–4:   Shipping Blocks

SCREWS, LOCKWASHERS, PLAIN WASHERS
SECURE TO FRONT PAIR OF SHUTTLE
SHIPPING BLOCKS
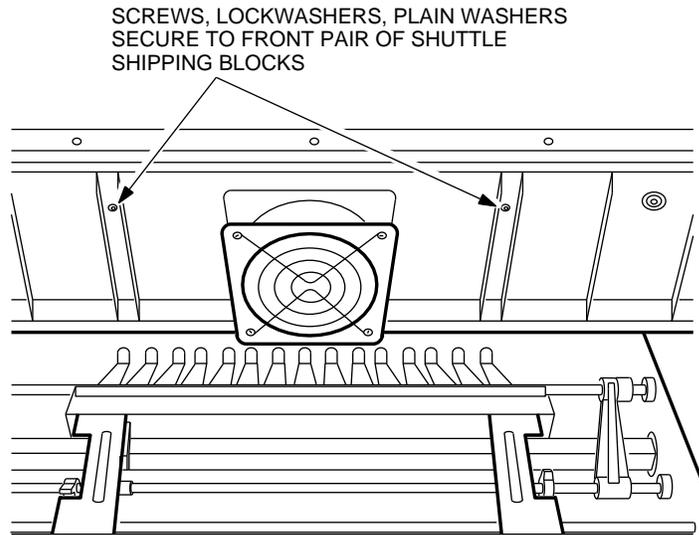
RE_UK00307A_89

8. Use an 8 mm socket wrench to install the two hex head cap bolts and washers holding the shuttle shipping blocks in place (see Figure 6–5). These bolts are located inside and under the printer.

9. Close the shroud cover and close the top cover.

REMOVAL AND REPLACEMENT PROCEDURES   6–7

Figure 6–5:   Shipping Block Attachment Hardware

RED SHUTTLE SHIPPING BLOCKS
(REAR PAIR)

RED SHUTTLE SHIPPING BLOCKS
(FRONT PAIR)
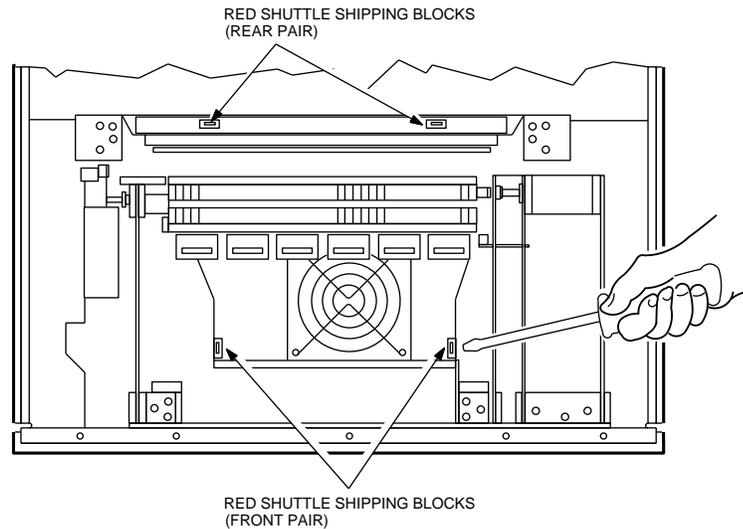
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6.6 Front Door and Rear Access Panels

Use the following procedure to remove the front door and rear access panels (see Figure 6–6). Do the reverse of this procedure to reinstall the front and rear access panel.

1. Open the the front door panel.

2. Use a medium screwdriver to lift the catch on the upper hinge pin.

3. Remove the front door panel by tilting it away from the door hinge.

4. Use a medium screwdriver to loosen the two captive screws on the rear access panel.

5. Remove the rear access panel by lifting it away from the printer.

Figure 6–6:   Front Door and Rear Access Panel

HINGE
PIN CATCH

HINGE RELEASE MECHANISM

LEFT
PANEL

FRONT
DOOR

FRONT DOOR

CAPTIVE
SCREWS

RE_UK00223A_89
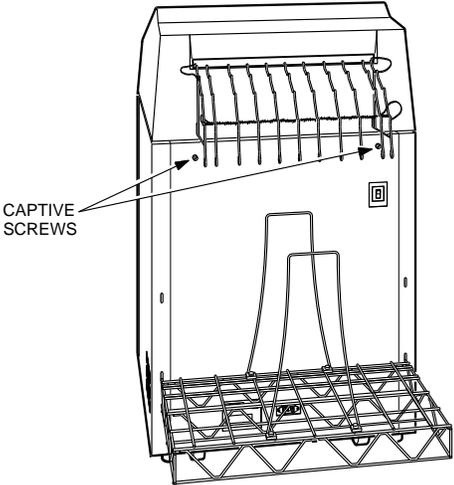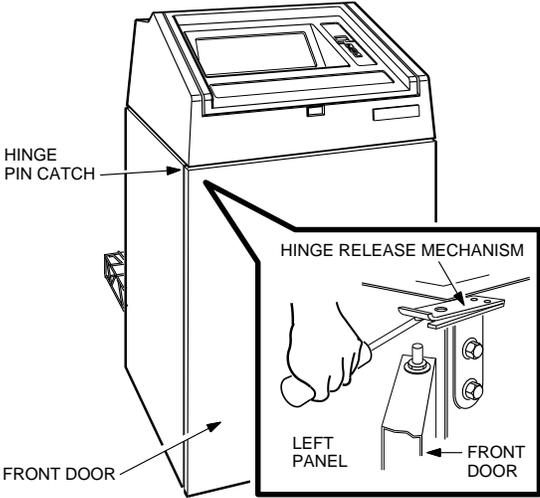
REMOVAL AND REPLACEMENT PROCEDURES   6–9

6.7 Top Cover

Use the following procedure to remove the top cover (see Figure 6–7). Do the reverse of this procedure to reinstall the top enclosure.

1. Remove the paper rack. Perform steps 1 and 3 of Section 6.4.

2. Open the cover, and disconnect the ground straps from the printer frame.

3. Use a narrow blade screwdriver to loosen the screw that secures the inner control panel cable access door. Carefully open the cable access door.

4. Disconnect cable assembly CA25 (the right-most connector) at the inner control panel by separating the connector clamps on either side of the connector.

5. Use a medium screwdriver to remove the two screws securing the CA25 clamp to the inner control panel. Carefully pull CA25 out from inside the inner control panel.

6. Remove the rear access panel (see Section 6.6).

7. Use a medium screwdriver to remove the four pan head screws and washers that hold the top enclosure in place.

8. Remove the top enclosure by lifting it up and away from the LG31 printer.

Figure 6–7: Top Cover

COVER DOOR

TOP ENCLOSURE GROUND STRAP

CA25 CABLE ASSEMBLY

PAPER GAP ADJUSTER

CA25 CLAMP

TOP ENCLOSURE

CARTRIDGE HOLDDOWN

CA25 CONNECTOR

2x TOP ENCLOSURE RETAINING SCREWS
(2x SCREWS SAME LOCATION AT REAR)

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REMOVAL AND REPLACEMENT PROCEDURES   6–11
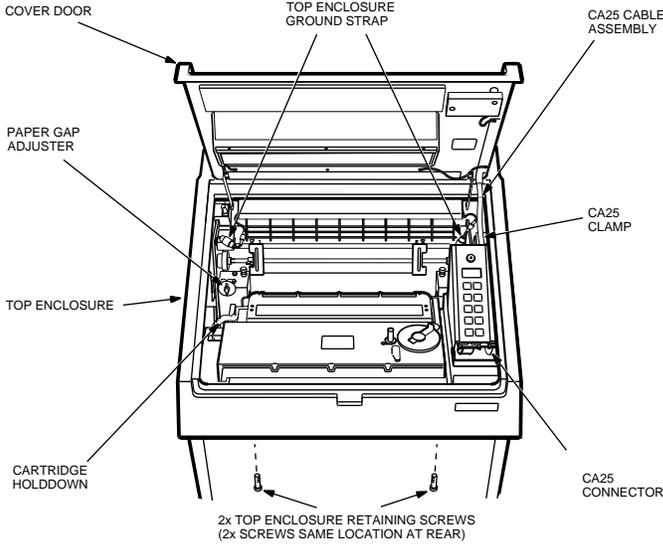
6.8 Print Actuator Modules

Use the following procedure to remove the print actuator modules (see Figure 6–8). Do the reverse of this procedure to reinstall the printer actuator modules.

NOTE

Print actuator modules must be removed in sequence from left to right. When installing the actuator modules, they must be installed in reverse sequence, from right to left.

1. Open the top cover.

2. Set the paper gap adjuster to the LOAD position.

3. Release the ribbon cartridge hold down.

4. Remove the ribbon cartridge. Instructions on how to remove and install the ribbon cartridge are visible on the shroud cover.

5. Open the shroud cover.

6. Disconnect the flat cable from the far left module.

7. Use a short shank medium-size screwdriver to loosen the three knurl head screws that secure the actuator module to the shuttle mechanism subassembly.

8. Remove the printer actuator module by rotating it toward the shuttle mechanism, and lifting it straight up away from the printer.

9. When replacing the actuator modules, press each module to the right while tightening the knurl head screws to ensure correct alignment.

10. Tighten the outer screws first, then the center screw, starting with the rightmost actuator.

11. Replace the ribbon cartridge.

12. Reset the paper gap adjuster to the desired setting.

Figure 6–8: Printer Actuator Module

PAPER GAP
ADJUSTER

PRINTER
ACTUATOR
MODULES

PRINTER
ACTUATOR
MODULE
CABLES

PRINTER ACTUATOR
MODULE RETAINING
SCREWS

SHUTTLE ACCESS
DOOR

RE_UK00225A_89

REMOVAL AND REPLACEMENT PROCEDURES   6–13
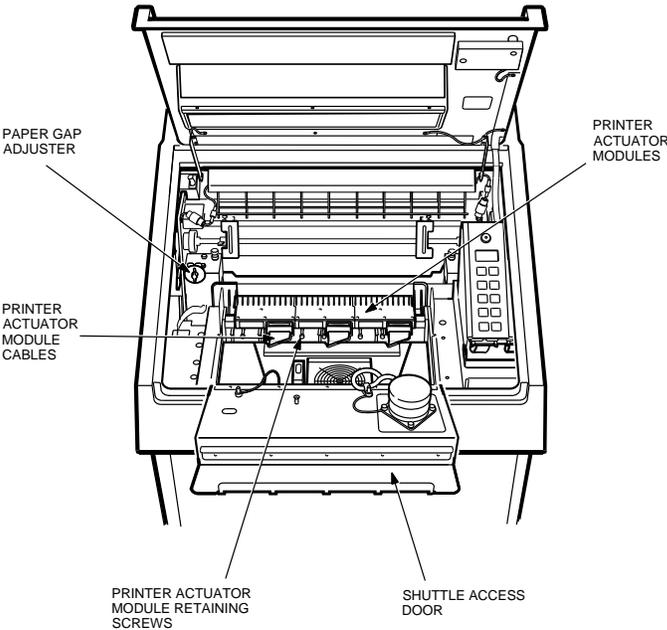
6.9 Inner Control Panel

Use the following procedure to remove the inner control panel (see Figure 6–9). Do the reverse of this procedure to reinstall the inner control panel.

1. Remove the top enclosure (see Section 6.7).

2. Disconnect cable CA15 located at the lower edge of the control panel.

3. Disconnect the inner control panel ground strap connected to the spade connector. The spade connector is located on the right side of the control panel.

4. Use a medium screwdriver to remove the four pan head screws and lock washers securing the inner control panel to the shroud and ribbon drive assembly.

5. Remove the inner control panel.

Figure 6–9:   Inner Control Panel

GROUND STRAP

CA25 RIBBON CABLE CLAMP

RETAINING SCREW

CABLE ACCESS DOOR

P4 CA15   P3 CA25
RIBBON CABLE CONNECTORS

INNER CONTROL PANEL

CA15 CABLE

RE_UK00226A_89

REMOVAL AND REPLACEMENT PROCEDURES   6–15
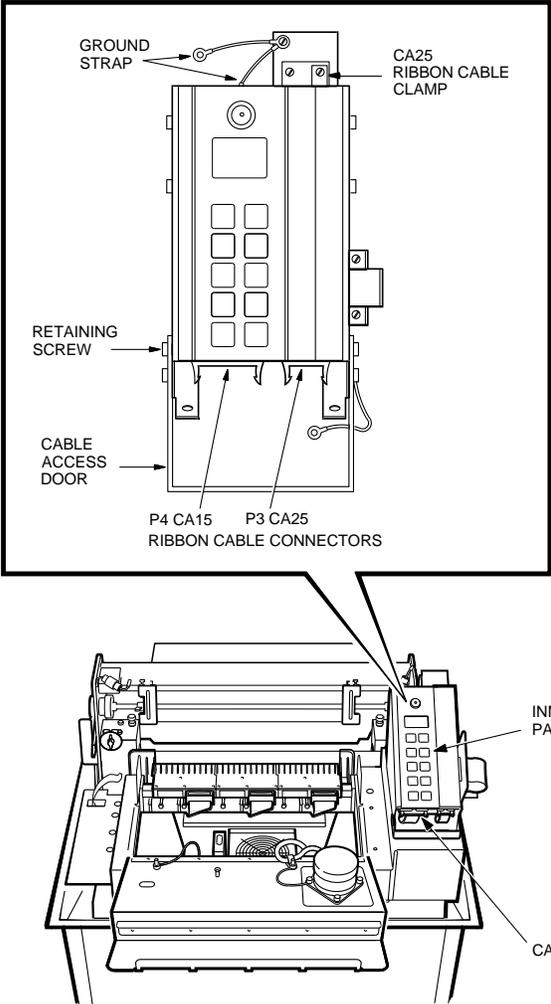
6.10 Shroud and Ribbon Drive Assembly

Use the following procedure to remove the shroud and ribbon drive assembly (see Figure 6–10). Do the reverse of this procedure to reinstall the shroud and ribbon drive assembly.

1. Remove the top enclosure (see Section 6.7).

2. Perform steps 2, 3, and 4 of Section 6.8

3. Disconnect both connectors at the inner control panel (see Section 6.9).

4. Disconnect cable CA25 at connector P2, located behind the inner control panel, and to the right of the paper feed motor.

5. Open the shroud cover and disconnect the the ribbon drive motor at cable connector CA17-P6.

6. Use a medium-size screwdriver to remove the seven pan head screws and washers securing the shroud assembly to the printer frame.

7. At the right rear of the inner control panel, remove the two 7 mm nuts, star washers, and the metal guard for the ribbon cable. Remove the 20-way ribbon socket from the lower left hand corner of the inner control panel assembly, then feed the ribbon cable under the control panel assembly.

8. Disconnect the ground wire that connects to the top inner control panel through the paper chute.

9. Remove the shroud and ribbon drive assembly by lifting it up and away from the printer.

Figure 6–10: Shroud and Ribbon Drive Assembly

GROUND WIRES

INNER CONTROL PANEL

CA15 RIBBON CABLE

METAL GUARD

VIEW ON ARROW 'A'

A

CA25-P3

SHUTTLE ACCESS DOOR

CA17-P6

CA15-P4

RE_UK00227A_89

REMOVAL AND REPLACEMENT PROCEDURES   6–17
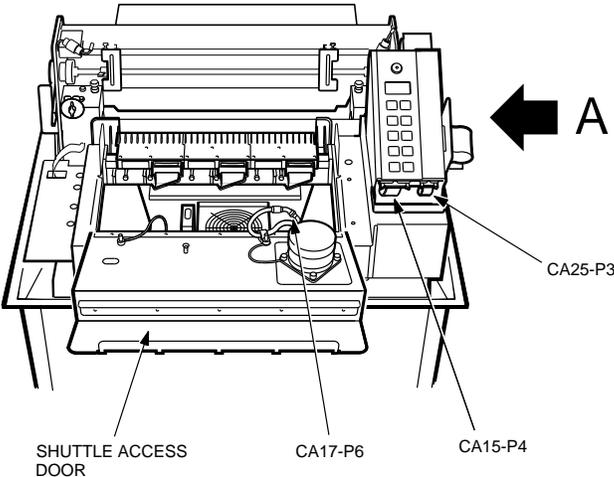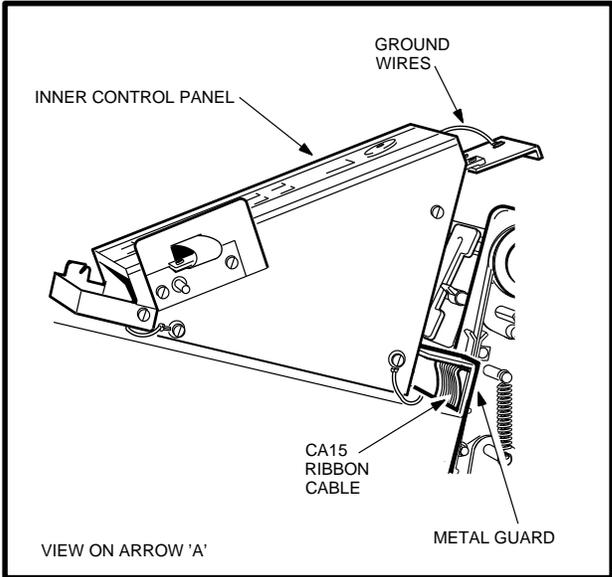
6.11 Ribbon Drive Motor

Use the following procedure to remove the ribbon drive motor (see Figure 6–11). Do the reverse of this procedure to reinstall the ribbon drive motor.

1. Open the top cover.

2. Remove the ribbon cartridge (steps 2, 3, and 4 of Section 6.9).

3. Open the hinged cover on the shroud and ribbon drive assembly.

4. Disconnect the motor cable connector CA17-P6 (see Figure 6–10).

5. Use a 7 mm wrench to remove the three self-locking nuts and washers.

6. Use a 7 mm wrench to remove the self-locking nut and washers securing the ground cable to the ribbon drive motor.

7. Remove the motor by carefully lifting it up and away from the printer.

Figure 6–11:   Ribbon Drive Motor

SHUTTLE ACCESS
DOOR

RIBBON DRIVE MOTOR

TORQUE M4x16 PAN HD SCREW
TO 0.22 Nm (4 PLACES)

M4 LOCKWASHER
(4 PLACES)

ISOLATION
PLATE

M4 LOCKWASHER
(3 PLACES)

M4 EXT. LOCKWASHERS   E2

TORQUE M4 SELF-LOCKING
TO 1.7 Nm (3 PLACES)

M4 SELF-LOCKING NUT
TORQUE TO 1.7 Nm

BLIND FASTENER
(4 PLACES)

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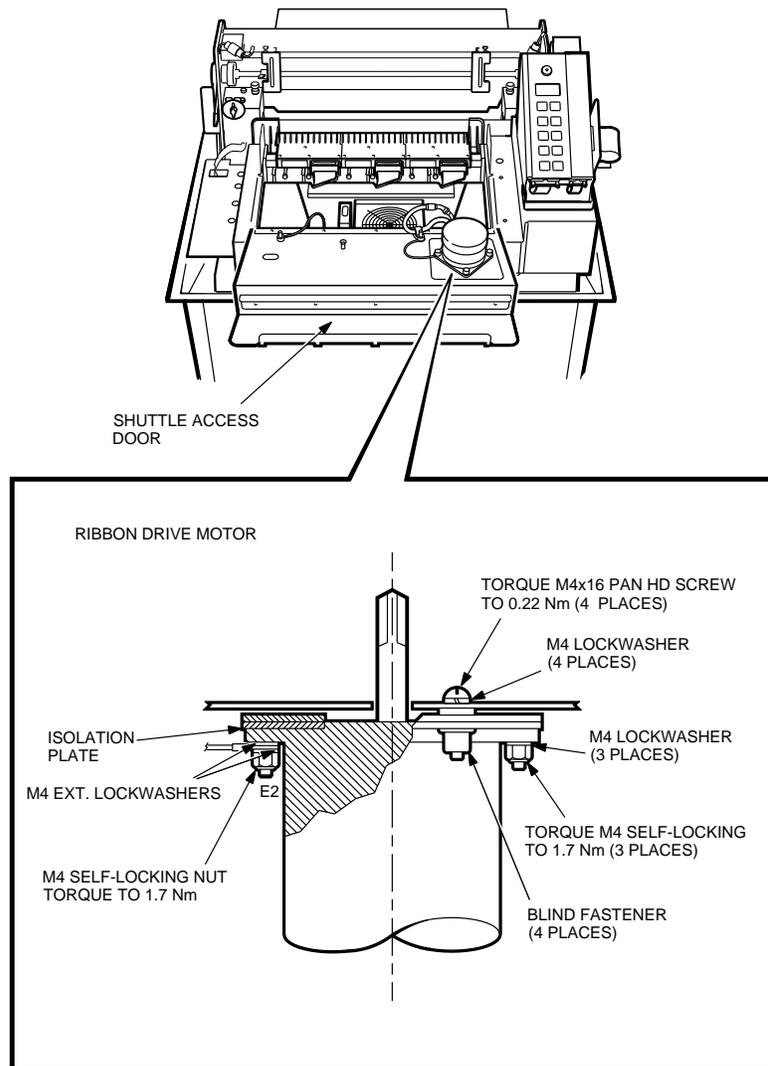
REMOVAL AND REPLACEMENT PROCEDURES   6–19

6.12 Ribbon Weld Sensor

Use the following procedure to remove the ribbon weld sensor (Figure 6–12). Do the reverse of this procedure in reverse order to reinstall the ribbon weld sensor.

DANGER   STORED HIGH VOLTAGE

Wait five minutes after removing ac source before disassembling. Refer to manual for service instructions.

DANGER   HAUTE TENSION EMMAGASINEE

Attendre 5 minutes après avoir enlevé la source de courant alternatif et avant de demonter la machine. Voir le manuel pour les instructions d'entretien.

PELIGRO   ALTO VOLTAJE ALMACENADO

Antes de proceder a desensamblar esto, esperar 5 minutos despues de haber removido la fuente de C.A. para instrucciones de servicio de mantenimiento, vease el manual.

ACHTUNG, GEFAHR   HOCHSPANNUNG WIRD GESPEICHERT

Nach Abschalten der Wechselstromquelle, fünf Minuten warten, bevor Teile demontiert werden. Bitte Bedienungsvorschrift im Handbuch nachsehen.

1. Open the top cover.

2. Remove the ribbon cartridge from the printer (steps 2, 3, 4, and 5 of Section 6.8).

3. Unplug P11, the two white connectors from each other, that lie to the left side of the fan.

4. Cut the four wire ties that secure the ribbon weld sensor wires to the wall of the ribbon shroud assembly.

5. Use a medium-size screwdriver to remove the screw attaching the ribbon guide to the printer, and remove the ribbon weld sensor.

Figure 6–12:   Ribbon Weld Sensor

FOUR WIRE
TIES

RIBBON WELD
SENSOR
SECURING
SCREW

RIBBON
WELD
SENSOR

P11

SHUTTLE
ACCESS
DOOR

RE_UK00229A_89

REMOVAL AND REPLACEMENT PROCEDURES   6–21
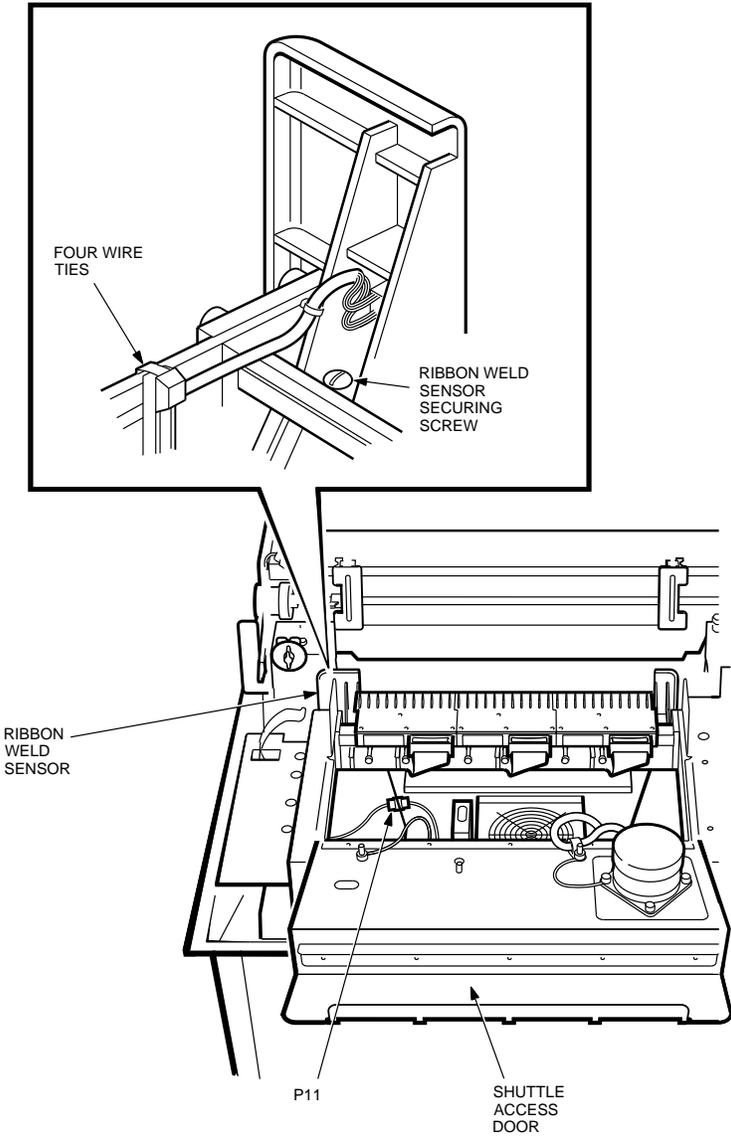
6.13 Smudge Shield

Use the following procedure to remove the smudge shield (see Figure 6–13). Do the reverse of this procedure to reinstall the smudge shield.

1. Open the top cover.

2. Remove all print actuator modules (see Section 6.8).

3. Use a medium-size screwdriver to remove three pan head screws and lock washers that secure the smudge shield to the shuttle bar.

4. Remove the smudge shield from the printer.

Figure 6–13: Smudge Shield

SMUDGE SHIELD
SECURING SCREW

STRIKER BAR

SMUDGE SHIELD

SECTION THROUGH
SHUTTLE BAR WITH
PRINT ACTUATOR
MODULES REMOVED.

PRINT ACTUATOR
MODULES

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REMOVAL AND REPLACEMENT PROCEDURES   6–23
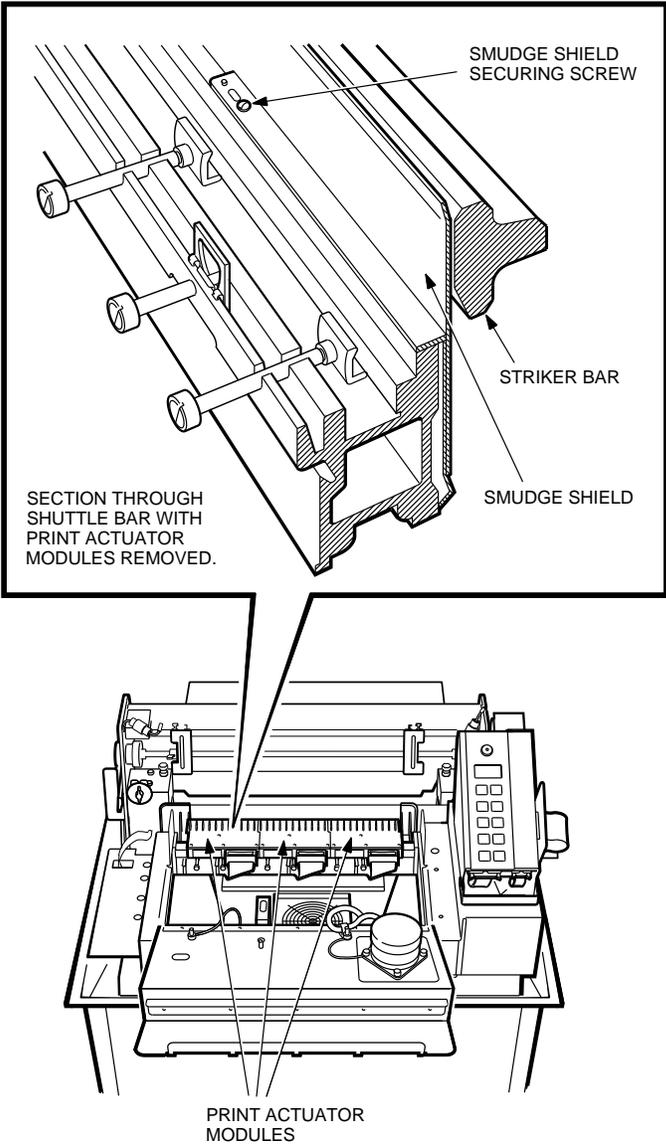
6.14 Linear Velocity Transducer (LVT) Coil and Magnet

Use the following procedure to remove and replace the LVT coil and magnet (Figure 6–14).

6.14.1 Removing the LVT Coil and Magnet

1. Remove the top enclosure (see Section 6.7).

2. Remove all print actuator modules (see Section 6.8).

3. Remove the shroud and ribbon drive assembly (see Section 6.10).

4. Disconnect the LVT at connector CA17-P7, located between the drive mechanism and the left side panel.

5. Use an 8 mm wrench to loosen the sensor support captive bolt.

6. Use an 16 mm open-end wrench to loosen the hex side of the LVT magnet assembly.

7. Remove the LVT coil and magnet from the printer.

6.14.2 Replacing the LVT Coil and Magnet

1. Use an 8 mm wrench to tighten the captive bolt that was loosened in step 5 of the previous section. Secure the bolt so that some resistance is provided to the movement of the LVT coil assembly.

2. Use a wrench to tighten the hex end of the magnet.

3. Using a nylon gauge P/N 29.26861, adjust the position of the LVT coil assembly over the magnet until the coil extends 7.84 + 0.25 mm beyond the end of the LVT magnet support tube.

4. Tighten the support bracket until the LVT coil is secure.

5. Ensure that there is visible clearance on all sides between the magnet and the opening in the coil assembly. If there is a lack of clearance on any side, correct by using shims P/N 29.26862, to realign the coil assembly.

Figure 6–14: LVT Coil and Magnet Assembly

LVT COIL ASSEMBLY

LVT BOBBIN

LVT MAGNET SUPPORT TUBE

AFTER ASSEMBLY, LVT MAGNET ASSEMBLY MUST HAVE VISIBLE CLEARANCE BETWEEN IT AND THE ADJACENT HOLE

MAGNET   MAGNET

7.84+0.25   (CAUTION MEASUREMENT MUST BE TO THE MAGNET SUPPORT TUBE, NOT TO THE EPOXY IN THE END OF TUBE.)

SECTION TROUGH LVT

M5 x 20 CAP SCREW IN SENSOR SUPPORT BRACKET

GAUGE

LVT COIL ASSEMBLY

USE SHIMS

AS REQUIRED TO PROPERLY ALIGN LVT MAGNET ASSEMBLY AND LVT COIL ASSEMBLY AS SHOWN IN DETAIL

NO GAP IS ALLOWED BETWEEN BLOCKS AND MACHINED SURFACES OF CASTING

SENSOR SUPPORT BRACKET

TORQUE LVT MAGNET TO 5.6 N.m

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REMOVAL AND REPLACEMENT PROCEDURES   6–25

6.15 Actuator Ribbon Cables

Use the following procedure to remove the actuator ribbon cables (see Figure 6–15). Do the reverse of this procedure to reinstall the actuator ribbon cables.

1. Remove the top enclosure (see Section 6.7).

2. Remove the shroud and ribbon drive assembly (see Section 6.10).

3. Disconnect all cables from the print actuator modules (see Section 6.8).

4. Use a medium-size screwdriver to loosen the four screws that secure the SHAD board enclosure cover and remove the cover.

5. Cut the following nylon cable ties:

   — The four ties securing the cables to the rear of the frame.

   — The three ties securing the cables to the left side panel.

   — The three ties that secure the cables to the inner side of the left shuttle spring on the drive mechanism.

6. Use a medium-size screwdriver to remove two pan head screws and their washers from the flat cable clamp that secures the cables to the left front corner of the printer.

7. Remove the four cable clamps that secure the cables below the print actuator modules. Remove the clamps by inserting a screwdriver, as shown in Figure 6–15 and twisting the screw driver to spread the clamp apart.

8. Remove the actuator ribbon cable assembly by lifting it carefully out from the printer.

Figure 6–15: Actuator Ribbon Cables

- SHAD BOARD
- SHAD ENCLOSURE
- CA14
- 42V CAPACITOR LEADS
- ACTUATOR CABLES CA19
- SHAD ENCLOSURE COVER
- SHAD ENCLOSURE
- PRINT ACTUATOR MODULES
- A
- ACTUATOR CABLES
- CABLE CLAMP
- PRESS DOWN
- INSERT SCREWDRIVER AND TURN
- PULL OUT
- VIEW ON ARROW 'A'

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REMOVAL AND REPLACEMENT PROCEDURES   6–27
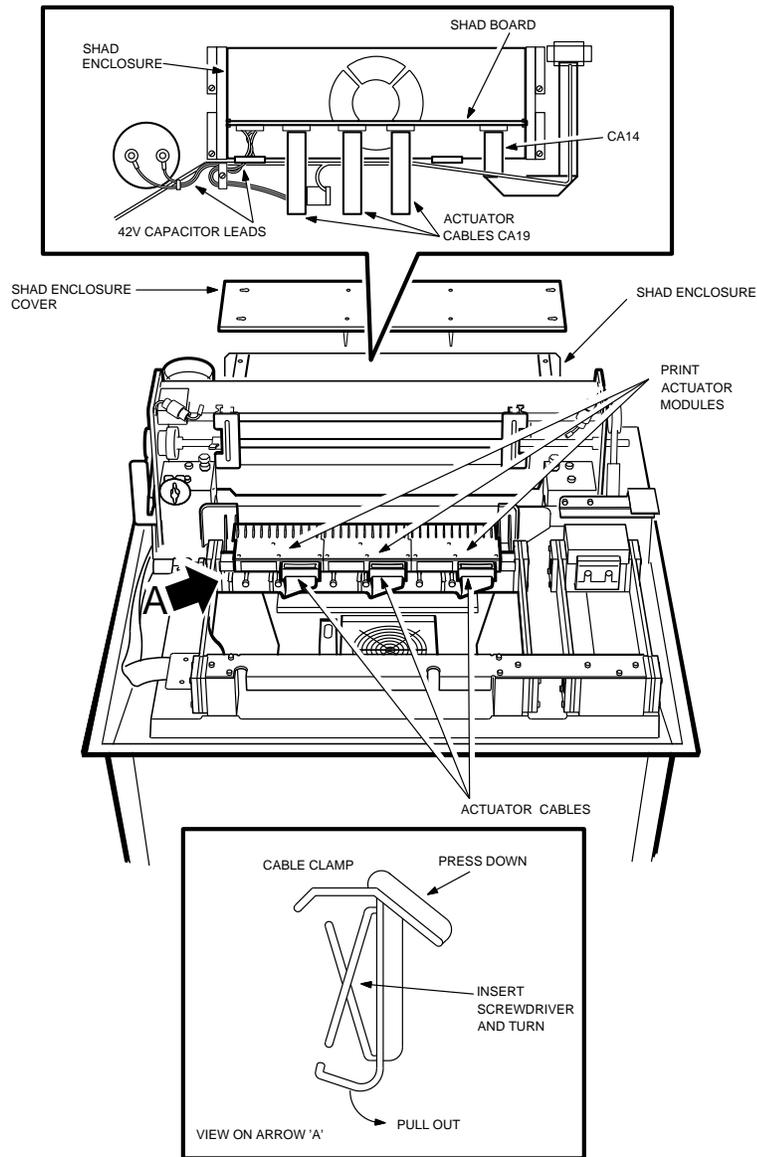
6.16 Line Filter Assembly

Use the following procedure to remove the line filter assembly (see Figure 6–16). Reverse this procedure to reinstall.

DANGER   STORED HIGH VOLTAGE

Wait five minutes after removing ac source before disassembling. Refer to manual for service instructions.

DANGER   HAUTE TENSION EMMAGASINEE

Attendre 5 minutes après avoir enlevé la source de courant alternatif et avant de demonter la machine. Voir le manuel pour les instructions d'entretien.

PELIGRO   ALTO VOLTAJE ALMACENADO

Antes de proceder a desensamblar esto, esperar 5 minutos despues de haber removido la fuente de C.A. para instrucciones de servicio de mantenimiento, vease el manual.

ACHTUNG, GEFAHR   HOCHSPANNUNG WIRD GESPEICHERT

Nach Abschalten der Wechselstromquelle, fünf Minuten warten, bevor Teile demontiert werden. Bitte Bedienungsvorschrift im Handbuch nachsehen.

CAUTION

Misplacement of any wires in the line filter assembly will cause damage to the printer.

1. Remove the rear access panel (see Section 6.6).

2. Loosen the pan head screw at the top of the line filter box. Slide the cover toward the rear of the printer to remove.

3. Remove the green/yellow ground wire, brown wire, and blue wire from the slide-on terminals at the line end of the line filter assembly.

4. Remove the CA2 cable assembly (one brown wire and one blue wire).

5. Use a 7 mm wrench to remove the two hex nuts and lockwashers securing the line filter assembly to the printer.

6. Remove the line filter assembly.

Figure 6–16: Line Filter Assembly
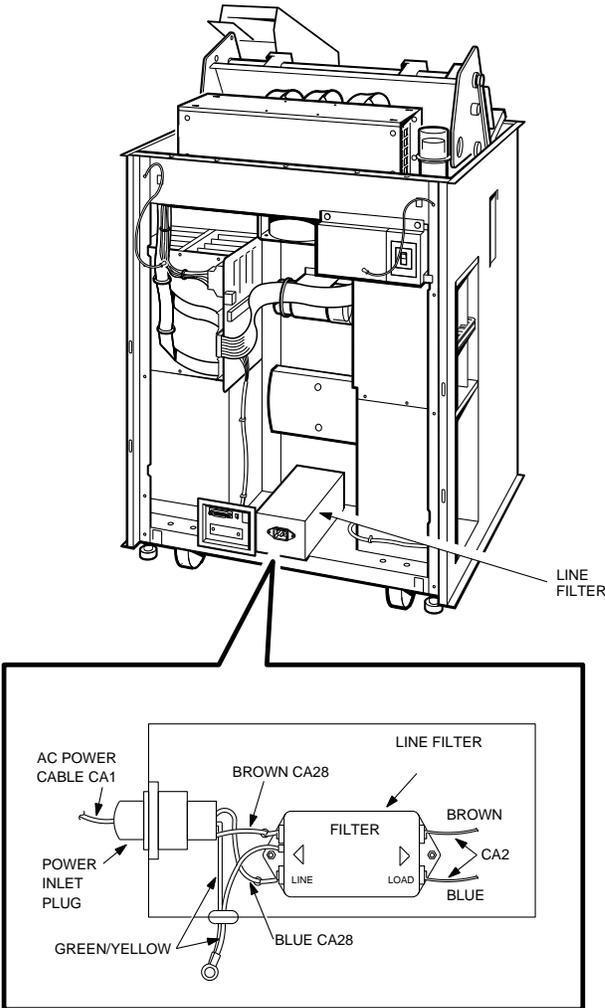
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6.17 AC Switch Box

Use the following procedure to remove the ac switch box assembly (see Figure 6–17). Do the reverse of this procedure to reinstall the ac switch box assembly.

DANGER   STORED HIGH VOLTAGE

Wait five minutes after removing ac source before disassembling. Refer to manual for service instructions.

DANGER   HAUTE TENSION EMMAGASINEE

Attendre 5 minutes après avoir enlevé la source de courant alternatif et avant de demonter la machine. Voir le manuel pour les instructions d'entretien.

PELIGRO   ALTO VOLTAJE ALMACENADO

Antes de proceder a desensamblar esto, esperar 5 minutos despues de haber removido la fuente de C.A. para instrucciones de servicio de mantenimiento, vease el manual.

ACHTUNG, GEFAHR   HOCHSPANNUNG WIRD GESPEICHERT

Nach Abschalten der Wechselstromquelle, fünf Minuten warten, bevor Teile demontiert werden. Bitte Bedienungsvorschrift im Handbuch nachsehen.

CAUTION

Misplacement of any wires in the ac switch box will cause damage to the printer.

1. Remove the rear access panel (see Section 6.6).

2. Use a medium-size screwdriver to loosen the four captive screws that secure the ac switch box cover. Slide the cover off of the switch box.

3. Remove the SPSX board as follows:

    a. Disconnect connectors P1, P2, and P3.

    b. Use a medium-size screwdriver to remove the four pan head screws and washers that secure the SPSX board.

    c. Remove the SPSX board.

Figure 6–17:   AC Switch Box

AC SWITCH BOX

ON/OFF SWITCH/
CIRCUIT BREAKER

BLUE   BROWN
TO   TO
FILTER   FILTER

2   1
2A   1A

SW1

BLUE   BROWN

VIEW ON FRONT OF SWITCH

RECTIFIER

SPSX P2

7   1   5   3
RED BROWN WHITE BLUE

S   -
-        S
+

REAR OF
PRINTER

AC SWITCH BOX

P2   P1

P3
SPSX   RECTIFIER   ON/OFF SWITCH/
                   CIRCUIT BREAKER

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REMOVAL AND REPLACEMENT PROCEDURES   6–31
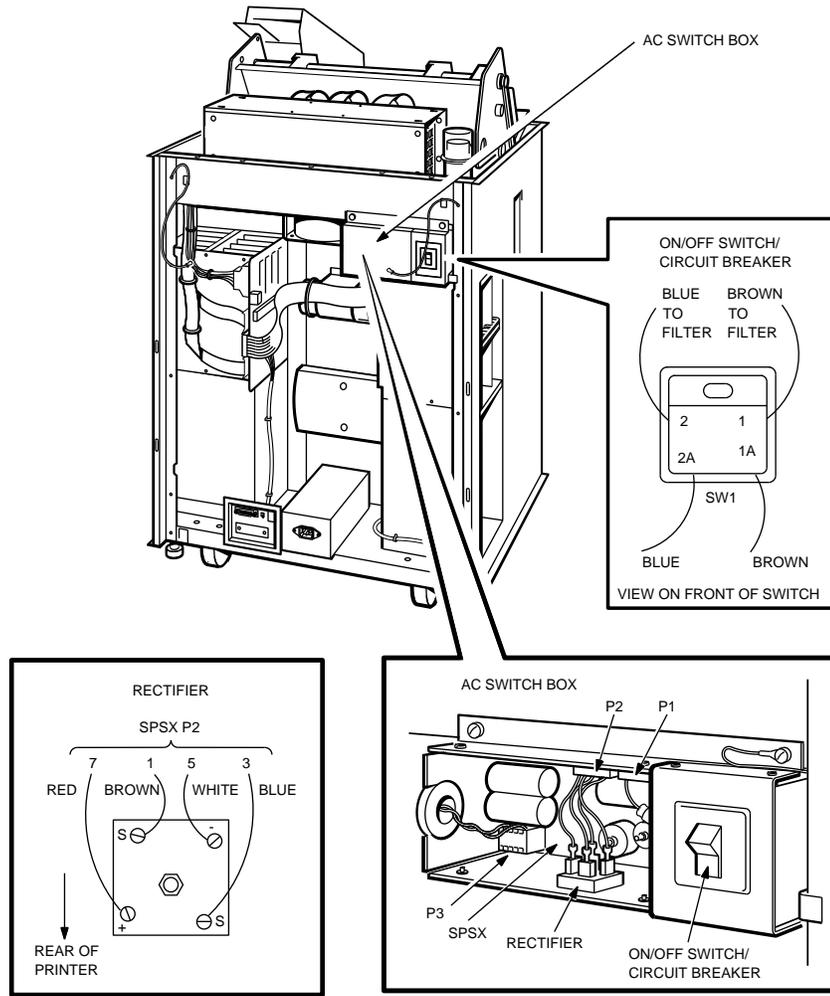
CAUTION

None of the ac switch box connector terminals are marked. Ensure that you replace each connector on the correct terminal. Mis-placement of any wires in the ac switch box will cause damage to the printer.

4. Remove the ac switch box rectifier as follows:

   a. Disconnect the four slide-on connectors and number them.

   b. Use a medium-size screwdriver to remove the pan head screw and washers that secure the rectifier.

   c. Remove the rectifier.

5. Use a medium-size screwdriver to remove the four pan head screws and lockwashers from the switch/fuse plate.

6.18 AC Circuit Breaker

Use the following procedure to remove the ac circuit breaker (see Figure 6–17). Do the reverse of this procedure to reinstall the ac circuit breaker.

1. Remove the ac switch box (see Section 6.15).

2. Remove the switch/fuse plate and disconnect the four slide-on connectors from the ON/OFF switch.

3. Remove the spring-secured ON/OFF switch.

6.19 Paper Feed Motor

Use the following procedure to remove and replace the paper feed motor (see Figure 6–18).

DANGER   STORED HIGH VOLTAGE

Wait five minutes after removing ac source before disassembling. Refer to manual for service instructions.

DANGER   HAUTE TENSION EMMAGASINEE

Attendre 5 minutes après avoir enlevé la source de courant alternatif et avant de demonter la machine. Voir le manuel pour les instructions d'entretien.

PELIGRO   ALTO VOLTAJE ALMACENADO

Antes de proceder a desensamblar esto, esperar 5 minutos despues de haber removido la fuente de C.A. para instrucciones de servicio de mantenimiento, vease el manual.

ACHTUNG, GEFAHR   HOCHSPANNUNG WIRD GESPEICHERT

Nach Abschalten der Wechselstromquelle, fünf Minuten warten, bevor Teile demontiert werden. Bitte Bedienungsvorschrift im Handbuch nachsehen.

Figure 6–18:   Paper Feed Motor

SEE TIMING NOTE
ON BOTTOM PULLEY

TORQUE THREE
M4x12 CAP
SCREWS TO
5.6 N.m (NOTE THAT
LOWEST ONE WAS
LOOSENED IN STEP 3)

RIGHT HAND SIDE
TIMING BELT

SHAD BOARD
ENCLOSURE

PAPER
FEED
MOTOR

A

BELT GUIDE

TENSION
PLATE

ADJUST BELT GUIDE
SUCH THAT IT HAS
SLIGHT CONTACT WITH
THE BELT'S SMOOTH
SIDE, ALONG THE
ENTIRE GUIDING
SURFACE (4 PLACES)

ACCESS APERTURE
(PANEL REMOVED)

TIMING MARK ON THE PULLEY TO BE
ALIGNED WITH TIMING MARK ON
SIDE FRAME, SIMULTANEOUSLY
WITH WHITE DOT ON TRACTORS
BEING POSITIONED AS SHOWN
IN DETAILED DRAWING 4-20a

VIEW ON ARROW 'A'

PAPER FEED MOTOR
TORQUE FOUR
M4x20 PAN HD
SCREWS TO 0.22 N.m
(FAR SIDE)

PAPER FEED MOTOR

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REMOVAL AND REPLACEMENT PROCEDURES   6–35

6.19.1 Removing the Paper Feed Motor

1. Remove the top enclosure (see Section 6.7).

2. Disconnect the motor electrical connectors at CA17-P2.

3. Use a wrench to loosen the three hex mounting bolts that secure the triangular plate. This lets you release the tension on the timing belt by pushing down on the spring in the upper left corner.

4. Remove the printer motor pulley belt by pushing down on the tension spring to release the belt tension.

5. Disconnect the four SHAD board cables. Remove the four screws and washers with a medium-size screwdriver to remove the SHAD board protective enclosure from the printer frame.

6. Use a medium-size screwdriver to remove the four motor mount screws.

7. Remove the paper feed motor.

6.19.2 Replacing the Paper Feed Motor

1. Mount the motor to the side frame using the four screws removed in step 6 of the previous section.

2. Reinstall the SHAD board and enclosure removed in step 5 of the previous section. Make sure you reconnect all SHAD board cables.

3. Top and Bottom Pulleys: Ensure that the timing mark (notch) on the pulley is aligned with the timing mark (elongated slit) in the side frame. Tighten the three screws removed in step 3 of the previous section.

4. Ensure that the belt guides have slight contact with the pulley belt's smooth side along the entire guide surface.

5. Reconnect the motor electrical cable disconnected in step 2 of the previous section.

6.20 Paper Tension Assembly

Use the following procedure to remove the paper tension assembly (see Figure 6–19). Do the reverse of this procedure to reinstall the paper tension assembly.

1. Open the front door (see Section 6.6).

2. Loosen the thumb screw on the yoke collar.

3. Remove the retaining ring on the paper tension assembly shaft.

4. Slide the paper tension assembly toward the left until it clears the right side of the frame, then slide it back to the right to remove it from the printer.

Figure 6–19: Paper Tension Assembly

TRACTORS
(PAPER DRIVE
MECHANISM)

PAPER
SUPPLY

RETAINING
RING

PAPER TENSION ASSEMBLY

THUMB SCREW

YOKE

ROUND
SHAFT

SQUARE
SHAFT

L.H.
SIDE
FRAME

TRACTOR

TRACTOR

R.H.
SIDE
FRAME

RE_UK00236A_89
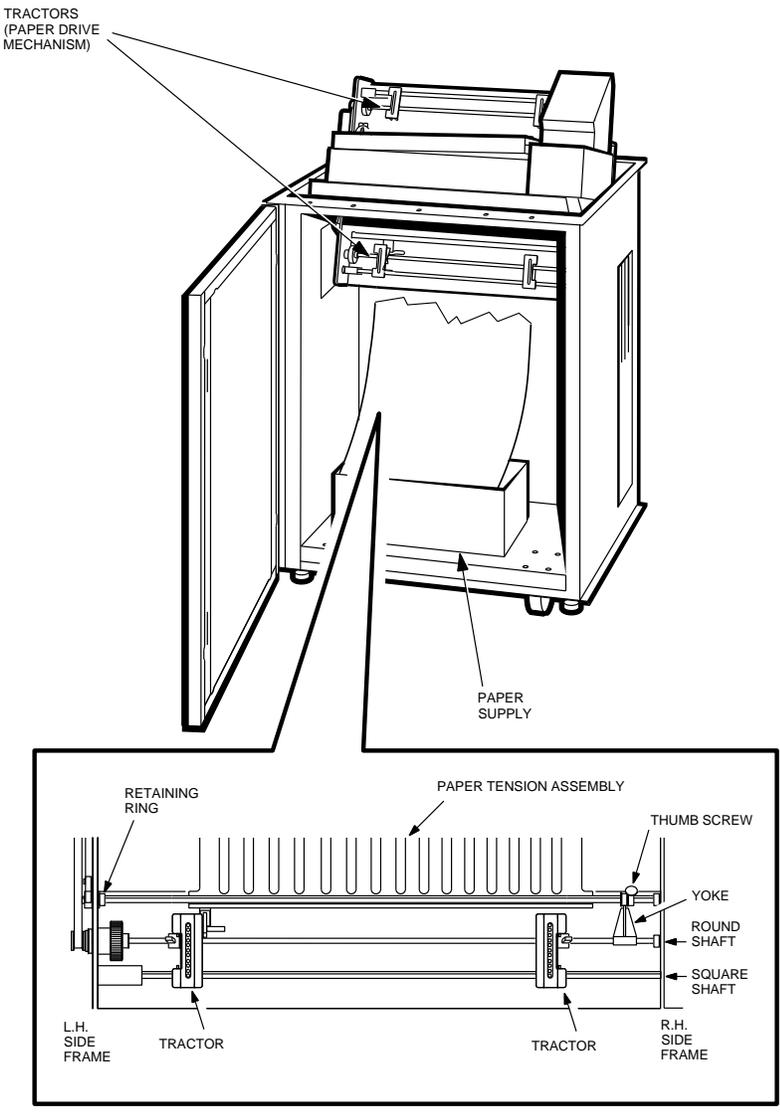
REMOVAL AND REPLACEMENT PROCEDURES   6–39

6.21 Paper Handling Assembly

Use the following procedure to remove and replace the paper handling assembly (refer to Figures 6–20 to 6–21).

1. Remove the top enclosure (see Section 6.7) and open the front access panel.

2. Use a medium-size screwdriver to loosen the screws at the front of each side panel and remove both side panels.

3. Right Side Timing Belt: Use a medium-size screwdriver to loosen the three screws on the triangular plate on the right side of the frame, and remove the right side timing belt (see Section 6.19).

NOTE

Disassemble only to extent necessary to replace defective component (usually a tractor). Use care in steps 1 and 2 of the following section to prevent inner bearings of square shaft from falling out of side frames and becoming lost.

Figure 6–20: Paper Handling Assembly (Part 1)

TRACTORS

SQUARE SHAFT

WHITE DOT

ALL 4 TRACTOR BELT WELDS OVERLAP FROM TOP AS SHOWN

'E' RING

ROUND SHAFT PULLEY NYLON SPRING & RETAINING RING

SQUARE SHAFT

ROUND SHAFT

HORIZONTAL VERNIER TIMING BELT

HORIZONTAL ADJUSTMENT KNOB

IDLER BRACKET ADJUSTMENT SCREW

BELT TENSION IDLER BRACKET ADJUSTMENT ARM

PAPER TENSION LEVER

TIMING BELT

LINK

'E' RING

ACCESS APERTURE

ROUND SHAFT PULLEY NYLON SPRING & RETAINING RING

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REMOVAL AND REPLACEMENT PROCEDURES   6–41

Figure 6–21: Paper Handling Assembly (Part 2)

ROUND SHAFT
BEARING STOP

SEE TIMING NOTE
ON BOTTOM PULLEY

TORQUE THREE
M4x12 CAP
SCREWS TO
5.6 N.m (NOTE THAT
LOWEST ONE WAS
LOOSENED IN STEP 3)

HORIZONTAL ADJUSTMENT KNOB

PAPER FEED MOTOR
TORQUE FOUR
M4x20 PAN HD
SCREWS TO 0.22 N.m
(FAR SIDE)

A

BELT GUIDE

ADJUST BELT GUIDE
SUCH THAT IT HAS
SLIGHT CONTACT WITH
THE BELT'S SMOOTH
SIDE, ALONG THE
ENTIRE GUIDING
SURFACE (4 PLACES)

ROUND SHAFT
BEARING STOP

ACCESS APERTURE
(PANEL REMOVED)

TIMING MARK ON THE PULLEY TO BE
ALIGNED WITH TIMING MARK ON
SIDE FRAME, SIMULTANEOUSLY
WITH WHITE DOT ON TRACTORS
BEING POSITIONED AS SHOWN
IN DETAILED DRAWING 4-20a

RIGHT HAND SIDE
TIMING BELT

HORIZONTAL
ADJUSTMENT
KNOB

PAPER LOW SWITCH

THUMB SCREW

YOKE

ROUND
SHAFT

SQUARE
SHAFT

TRACTOR

WHITE DOTS ON TRACTORS
AS DETAIL ON FIG. 4-20a

TRACTOR

VIEW ON ARROW 'A'

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6–42   REMOVAL AND REPLACEMENT PROCEDURES

6.21.1 Removing Upper Tractors

1. Remove the E-ring from the left end of the upper square shaft and pulley assembly.

2. Remove the square shaft and pulley assembly.

3. Turn the horizontal vernier knobs until the tractors reach full left stop.

4. Use a medium-size screwdriver to remove the two pan head screws and washers from the round shaft bearing stop at the right end of the round shaft. Remove the stop from the side frame.

5. Unlock the tractors from the round shaft. Hold the upper horizontal adjustment knob while unscrewing the round shaft from the hand knob. Move the shaft forward on the left end, then carefully withdraw it from the printer.

6. If the tractors are being replaced, remove them from the round shaft. If necessary, remove the pulley and hand knob from the round shaft.

7. To remove the pulley and hand knob from the round shaft, remove the retaining ring and nylon spring from the left outside end of the round shaft pulley. Remove the components inward through the side frame.

8. Install the new left and right tractors on the round shaft. Position the two tractors so that the white dots on the tractor bearings are facing forward.

9. Install the round shaft and tractors assembly into the LG31. Hold the horizontal adjustment hand knob from moving, and firmly screw the round shaft assembly onto the hand knob.

10. Using the assembly hardware removed in step 4 above, install the round shaft bearing stop.

6.21.2 Removing Lower Tractors

1. Remove the tractor feed (belt access) cover from the right hand side of the printer.

2. Remove the E-ring from the left end of the lower square shaft and pulley assembly.

REMOVAL AND REPLACEMENT PROCEDURES   6–43

3. Remove the square shaft and pulley assembly through the right side of the printer.

4. Turn the horizontal vernier knobs until the tractors reach full left stop. Use a medium-size screwdriver to remove the two pan head screws and washers from the round shaft bearing stop at the right end of the round shaft. Remove the stop from the side frame.

5. Remove the E-ring on the round shaft at the end of the yoke by loosening the thumb screw on the yoke location collar.

6. Disconnect cable assembly connector CA17-P9 from the paper out switch located on the left tractor.

7. Unlock the tractors from the round shaft. Hold the lower horizontal adjustment knob in place while unscrewing the the round shaft. Move the left end of the rounds shaft forward and then withdraw toward the left side of the printer to remove it from the LG31.

8. If the lower tractors are being replaced, remove them from the round shaft. If necessary, remove the pulley and hand knob from the round shaft.

9. To remove the pulley and hand knob from the round shaft, remove the retaining ring and nylon spring from the left outside end of the round shaft pulley.

10. Install the left and right lower tractors on the round shaft. Position the two tractors so that the white dots are facing forward.

11. Install the the round shaft and tractors assembly into the LG31. Hold the horizontal adjustment hand knob while screwing the assembly securely.

12. Using the assembly hardware removed in step 5 of the previous section, install the round shaft bearing stops.

13. Using the assembly hardware removed in step 4 above, install the round shaft bearing stop.

6.21.3 Replacing Upper and Lower Tractors

1. For both upper and lower tractors: slide the square shaft, bearings, and pulley assemblies onto the tractors from the right side. The four white dots must be facing forward.

2. Install the E-ring on the left end of each square shaft.

3. Set the right side top and bottom pulley timing marks in alignment with the timing marks on the right hand side frame.

4. Install the right side timing belt.

5. With the spring on the triangular plate maintaining proper belt tension, secure the triangular plate by tightening the three cap screws. Tighten the inner most screw to 5.6 Nm.

6. Ensure that all four sets of belt guides make slight contact with the belt's smooth side along its entire surface.

7. Replace all shaft and belt covers.

6.22 Horizontal Vernier Timing Belt

Use the following procedure to remove the horizontal vernier timing belt (refer to Figure 6–22). Do the reverse of this procedure to reinstall the timing belt.

1. Use a medium-size screwdriver to loosen the idler bracket adjustment screw.

2. Push down on the idler bracket to release tension and remove the timing belt.

3. Ensure both upper and lower tractors are positioned full left, then install the new timing belt. Route the belt as shown in Figure 6–22.

4. Adjust the timing belt tension by applying moderate force on the tension idler bracket adjustment arm so that the margin adjustment knob will turn easily. Then tighten the idler bracket adjustment screw.

5. Check the horizontal alignment of both tractor pairs with the upper and lower margin adjustment knobs set at the leftmost position. Do the the following to check horizontal alignment.

   a. Set the paper gap adjuster to the LOAD position and paper tension adjust lever to the upper position, then load paper into the LG31.

   b. Check the adjustment of the paper pin feed holes with the lower tractors.

   c. If the tractors are misaligned, first remove the timing belt. Then turn the upper margin adjustment knob to align the upper tractors with the lower tractors. If the lower tractors are to the left of the upper tractors and the upper tractors are to their leftmost limit, rotate the timing belt gear one tooth position on the upper pulley and recheck alignment. Repeat until both tractor pairs are aligned vertically.

   d. Reinstall the timing belt.

6. Power on the printer and execute several form feeds to check the alignment of the tractor pairs. If an elongation of the pin feed holes appears, this indicates a misalignment between the upper and lower tractor pairs.

7. Install the side panels.

8. Install the top enclosure and close the front access panel.

9. Before operating the LG31 printer, set the paper gap adjuster, paper tension adjust lever, and the margin adjustment knob to the desired operational positions.

Figure 6–22: Horizontal Vernier and Timing Belt

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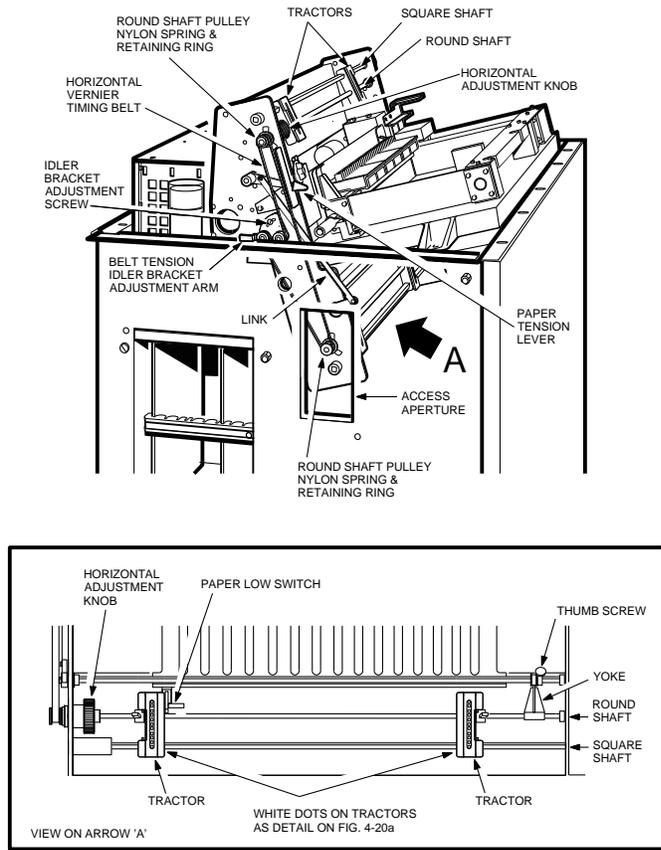
6.23 SHAD Board

Use the following procedure to remove the SHAD board (see Figure 6–23).
Do the reverse of this procedure to reinstall the SHAD board.

DANGER   STORED HIGH VOLTAGE

Wait five minutes after removing ac source before disassem-
bling. Refer to manual for service instructions.

DANGER   HAUTE TENSION EMMAGASINEE

Attendre 5 minutes après avoir enlevé la source de courant
alternatif et avant de demonter la machine. Voir le manuel
pour les instructions d'entretien.

PELIGRO   ALTO VOLTAJE ALMACENADO

Antes de proceder a desensamblar esto, esperar 5 minutos
despues de haber removido la fuente de C.A. para instrucciones
de servicio de mantenimiento, vease el manual.

ACHTUNG, GEFAHR   HOCHSPANNUNG WIRD GESPEICHERT

Nach Abschalten der Wechselstromquelle, fünf Minuten warten,
bevor Teile demontiert werden. Bitte Bedienungsvorschrift im
Handbuch nachsehen.

1. Remove the top enclosure (see Section 6.6).

2. Use a medium-size screwdriver to loosen the four screws on the
   SHAD board enclosure, and remove the SHAD board enclosure.

3. Disconnect cable assembly CA19 from connectors P2, P3, and P4.

4. Disconnect the 42 volt capacitor lead from connector P1.

5. Disconnect cable assembly CA14 from connector SMMB-P2.

6. Lift the SHAD board from the board guides and remove from the
   LG31 printer.

Figure 6–23: SHAD Board
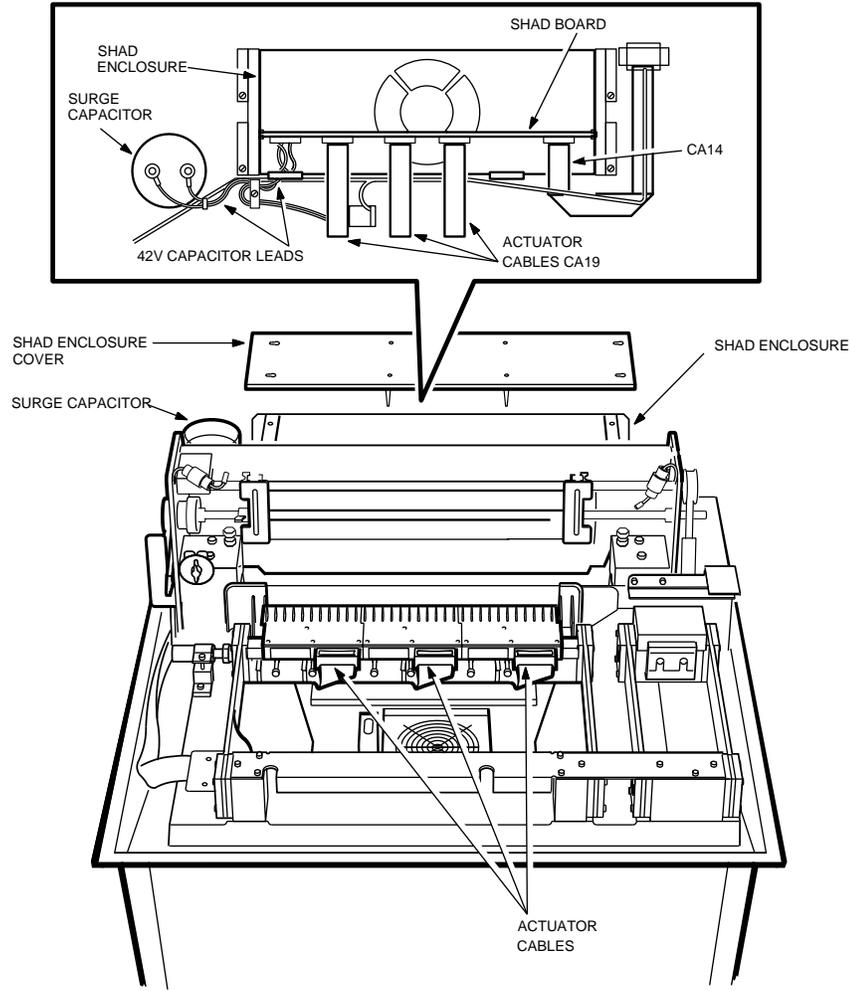
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6.24 Power Supply Boards

Use the following procedure to remove the power supply card cage boards (see Figure 6–24). Do the reverse of this procedure to reinstall the power supply card cage boards.

DANGER   STORED HIGH VOLTAGE

Wait five minutes after removing ac source before disassembling. Refer to manual for service instructions.

DANGER   HAUTE TENSION EMMAGASINEE

Attendre 5 minutes après avoir enlevé la source de courant alternatif et avant de demonter la machine. Voir le manuel pour les instructions d'entretien.

PELIGRO   ALTO VOLTAJE ALMACENADO

Antes de proceder a desensamblar esto, esperar 5 minutos despues de haber removido la fuente de C.A. para instrucciones de servicio de mantenimiento, vease el manual.

ACHTUNG, GEFAHR   HOCHSPANNUNG WIRD GESPEICHERT

Nach Abschalten der Wechselstromquelle, fünf Minuten warten, bevor Teile demontiert werden. Bitte Bedienungsvorschrift im Handbuch nachsehen.

1. Use a medium-size screwdriver to loosen the three screws at the front of the left side panel and remove the side panel.

2. Remove the power card cage cover.

3. Loosen the board retainer/spacer over the power supply card cage boards and remove.

4. Do the following to remove the boards listed below:

    SPSM: Disconnect ground cable assembly CA21 by removing the on-board pan head screw with a medium-size screwdriver.

    SPSR: Slide the board out from its board guides.

Figure 6–24:   Power Supply Boards

SPSM

SPSR

CA 21
GROUND
CABLE

BOARD
RETAINING
SPACER

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REMOVAL AND REPLACEMENT PROCEDURES   6–51
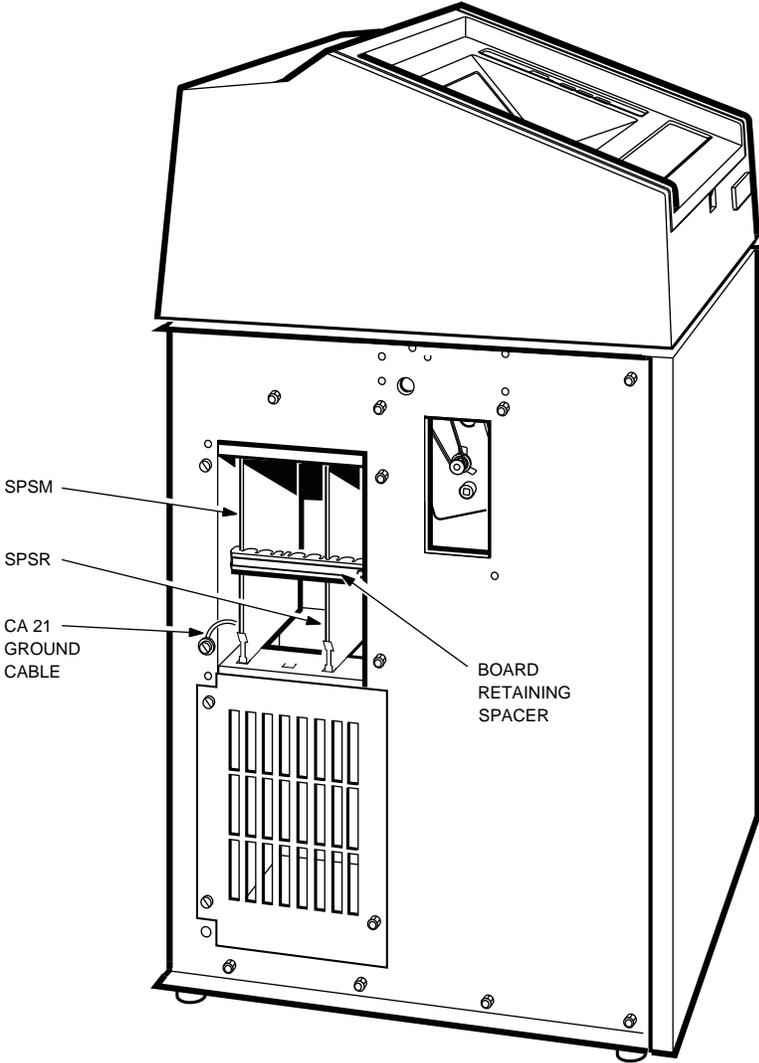
6.25 Logic Boards

Use the following procedure to remove the logic boards from the LG31 printer (see Figure 6–25). Do the reverse of this procedure in the reverse order to reinstall the card cage boards.

Note

Take care when replacing the PCBs. They are slot dependent but are not keyed. The part description (SMMC) is marked both on the boards and on their respective slots.

1. Use a medium-size screwdriver to loosen the three screws at the front of the right side panel, and remove the side panel.

2. Remove the card cage cover.

3. Loosen the board retainer/spacer over the card cage boards and remove.

4. Remove the card cage boards by sliding them out from their respective board guides.

Figure 6–25:   Logic Boards

SMIM

SMSM

SMMC

SMIH

BOARD
RETAINER
SPACER

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REMOVAL AND REPLACEMENT PROCEDURES   6–53
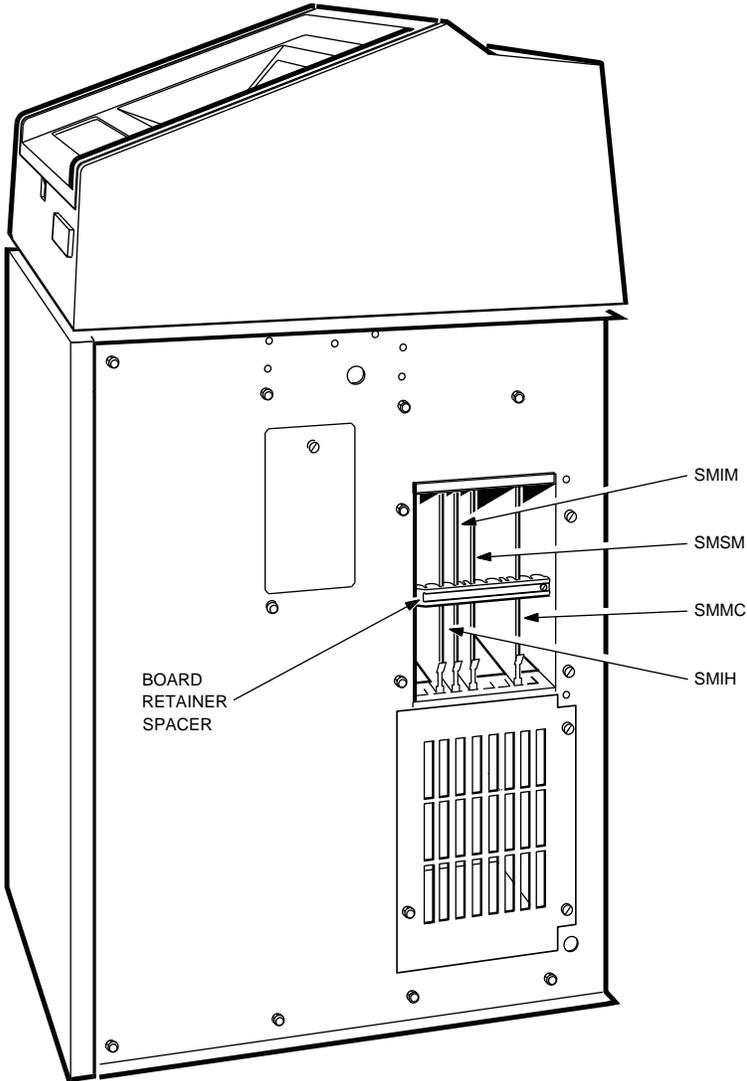
6.26 Printer Fans

Use the following procedure to remove the LG31 printer fans (see Figure 6–26). Do the reverse of this procedure to reinstall the printer fans.

6.26.1 Front Fan

1. Open the front access panel and the shroud assembly door to access the front fan.

2. Disconnect the two electrical spade connectors on the front fan.

3. Use a medium-size screwdriver to remove the four pan head screws and associated hardware securing the fan.

4. Remove the front fan.

6.26.2 Rear Fan

1. Remove the top enclosure (see Section 6.6).

2. Use a medium-size screwdriver to loosen the two captive screws at the top of the rear access panel and remove the door.

3. Remove the SHAD board (see Section 6.23).

4. Use a long shank medium-size screwdriver to remove the four pan head screws and associated hardware securing the rear fan.

5. Remove the rear fan.

Figure 6–26:   Printer Fans

FRONT
FAN

REAR
FAN

RE_UK00243A_89

REMOVAL AND REPLACEMENT PROCEDURES   6–55
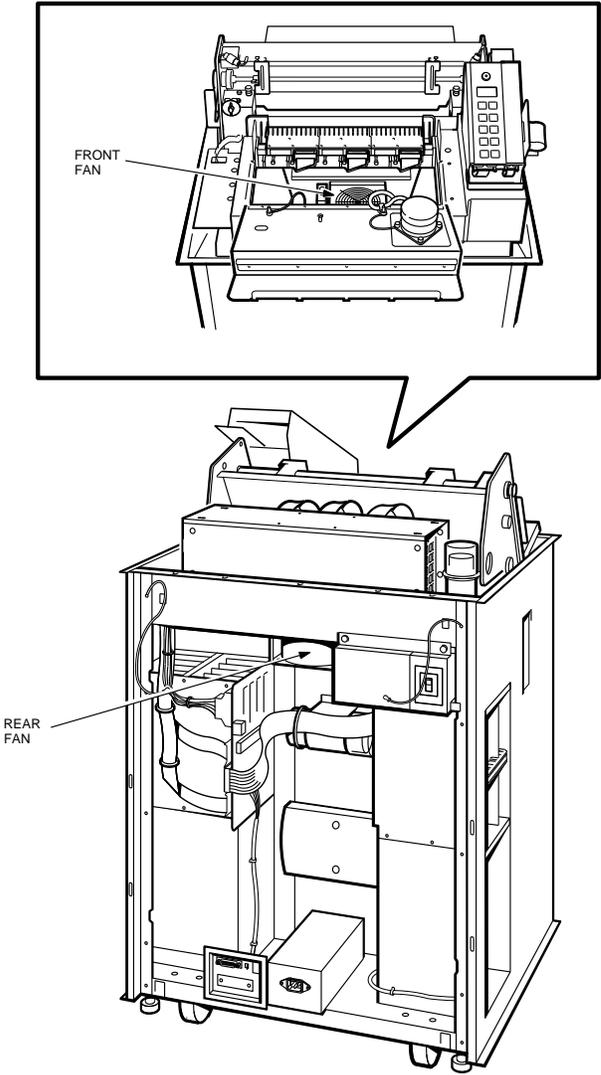
Chapter 7

PRINT QUALITY ADJUSTMENT PROCE-DURES

7.1 Introduction

This chapter describes how to obtain print quality test patterns and use them with print quality adjustment procedures to restore the best print quality possible. The procedures in this chapter are to be performed if print quality has degraded due to component wear and/or component replacement.

7.2 Print Quality Test Patterns

The Sample Print Quality Test Patterns printout consists of the software release number, model number, serial number, and date spaces, and short segments of all the test patterns and the key number used to access them. There are four test patterns, amplitude, horizontal timing, vertical timing, and intermodule gap, and a checkerboard pattern that is an overview of all the test patterns.

To obtain the Sample Print Quality Test Pattern:

1. With the printer in the Off-line mode (printer display is [O F L]), press the FCT (9) key and observe that the printer enters the MODE SELECTION state (printer display changes to [F n c]).

2. Press the ON LINE (3) key and observe that the printer enters the ADJUSTMENT mode (printer display changes to [A d j]). In ADJUSTMENT mode, any existing special print modes are canceled.

3. Press the PRG (1) key and observe that the printer display changes to [.5 i 9], and print the Sample Test Patterns shown in Figures 7–3 to 7–6.

Each of the test patterns can be accessed and run individually to enable the adjustment procedures to be performed quickly (see Section 7.6).

All of the adjustment procedures described in this chapter must be performed in the order given, because of the interactive affect produced when an adjustment is made:

• Shuttle movement amplitude adjustment procedure (see Section 7.3)

• Null voltmeter amplitude adjustment (see Section 7.4)

• Test pattern adjustment procedures (see Section 7.5)

    • Amplitude pattern adjustment procedure (see Section 7.5.1)

    • Vertical pattern adjustment procedure (see Section 7.5.2)

    • Horizontal timing pattern adjustment procedure (see Section 7.5.3)

    • Intermodule gap pattern adjustment procedure (see Section 7.5.4)

• Print actuator module adjustment procedure (see Section 7.6)

The tools required are:

1. 10x magnifying glass

2. Voltmeter with a 0.5 volt full scale

3. Small slotted-head screwdriver

Refer to Figure 7–1 to locate the logic boards, test points, and adjustments specified by the adjustment procedures that follow.

Figure 7–1: Logic Boards, Test Points and Adjustments

RIGHT SIDE

SMIH
SMIM
SMSM
SMMC

BOARD
RETAINER
SPACER

SPARE LOGIC LOCATION

SMIH

SMIM
ALE1

SMSM
ALE

SPARE LOGIC LOCATION

SPARE LOGIC LOCATION

SMMC

R26
R27

TP7
TP8

TP1
TP2
TP3
TP4
TP5
TP6
R52
R53

Potentiometer Locations on SMIH and SMMC Boards

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PRINT QUALITY ADJUSTMENT PROCEDURES   7–3
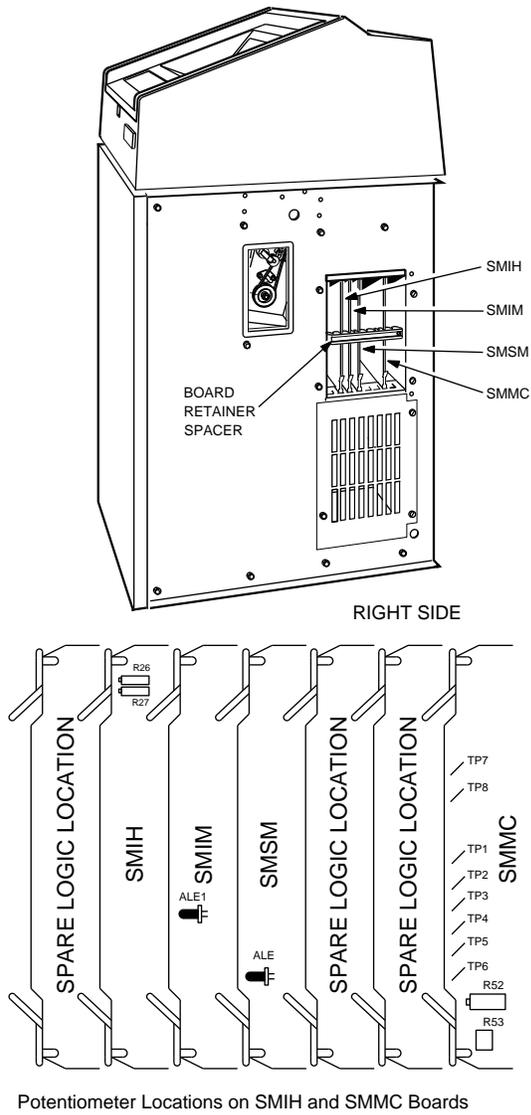
7.3 Shuttle Movement Amplitude Adjustment

The initial amplitude setting is based on observation of shuttle movement on an active print actuator module, and is a coarse adjustment.

1. Gain access to the print actuator modules by setting the power switch OFF, disconnecting the power cable, removing the ribbon cartridge, and swinging back the shroud cover (Section 6.8). Note the three print actuator modules: each one has a display label on it as shown in Figure 7–2A.

Figure 7–2: Print Actuator Module Display Label (Inactive and Active)

Example #1   Example #2

A.MODULE INACTIVE   B. MODULE ACTIVE
                                                         PROPERLY ADJUSTED
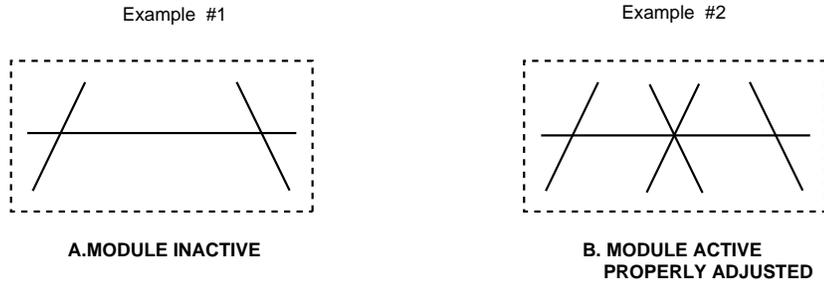
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2. The print shuttle must be set active (shuttle drive motor ON) by setting jumper J7/J8 to the J8 position on the SMMC board. Access and remove the SMMC board (see Section 6.25), change the jumper to J8, then reinstall the SMMC board in the proper slot.

3. Connect the power cable, set the power switch to ON; the print shuttle should be active.

4. Observe any one of the display labels. An X (intersecting the horizontal line) should appear on the label (see Figure 7–2B). The X indicates that the drive signal amplitude (left and right shuttle movement) is approximately equal.

5. If the display label looks like Figure 7–2B, proceed to step 8.

7–4 PRINT QUALITY ADJUSTMENT PROCEDURES

6. If the display label does not look like Figure 7–2B, adjust R152 (10 turn potentiometer) on the SMMC board until the display label looks like Figure 7–2B, or as close as possible.

7. Set the power switch OFF, disconnect the power cable, remove the SMMC board, set jumper J7/J8 to the J7 (normal) position, and replace the board. Close the shroud cover and replace the ribbon cartridge.

8. Run the ASCII print test. If the print quality is still unsatisfactory, proceed to Section 7.5. If the print quality is satisfactory, replace the logic board retainer, replace the left side panel, and return the printer to service.

7.4 Null Voltmeter Amplitude Adjustment

The null voltmeter amplitude setting is based on obtaining a null voltmeter reading at the SMMC board.

NOTE

Before proceeding to step 1, observe that potentiometer R153 on the SMMC board is not missing or factory set (glued to prohibit adjustment). If R153 is missing or factory set, proceed to Section 7.5.

1. The print shuttle must be set active (shuttle drive motor ON) by setting jumper J7/J8 to the J8 position on the SMMC board. Reinstall the SMMC board in its slot.

2. Connect the power cable, set the power switch to ON. The print shuttle should be active.

3. Set the voltmeter to 0.5 volts full scale, and connect the meter's positive (+) lead to TP6 and the negative (-) lead to TP5 of the SMMC board.

4. Adjust R153 (one turn potentiometer) for a reading on the voltmeter as close to 0.0 Vdc as possible. The ideal reading should be less than 0.1 V dc.

5. If the null reading is equal to or greater than 0.3 Vdc, replace the SMMC and/or the Linear Velocity Transducer (LVT) and return to step 1.

6. Set the power switch OFF, disconnect the power cable, remove the SMMC board, set jumper J7/J8 to the J7 (normal) position, and replace the SMMC board.

7. Run the ASCII print test. If the print quality is still unsatisfactory, proceed to Section 7.5. If the print quality is satisfactory, replace the logic board retainer, replace the left side panel, and return the printer to service.

7.5 Test Pattern Adjustments

The following test pattern adjustment procedures are based on obtaining correct test pattern printouts. There are five test pattern printouts (amplitude, horizontal timing, vertical timing, intermodule gap, and checkerboard) used with the print quality adjustment procedures. To adjust these print quality parameters, perform the test pattern adjustment procedures in the order given.

1. With the printer in the Off-line mode (printer display is [O F L]), press the FCT (9) key and observe that the printer enters the MODE SELECTION state (printer display changes to [F n c]).

2. Press the ON LINE (3) key and observe that the printer enters the ADJUSTMENT mode (printer display changes to [A d j]). In ADJUSTMENT mode, any existing special print modes are canceled.

7.5.1 Amplitude Pattern Adjustment Procedure

1. Press the ON LINE (3) key and observe that the printer display changes to [.A P L]. The Amplitude Test Pattern is printed. Figure 7–3A represents a magnified view of three of the 30 vertical bars that are actually printed. Press the FCT (9) key to stop printing the pattern; press the FCT (9) key again to resume printing the same pattern.

2. If the printout of the pattern consisting of six dot wide vertical lines is the same as Figure 7–3A, proceed directly to Vertical Pattern Adjustment (Section 7.5.2).

3. If the printout is not the same as Figure 7–3A, follow the instructions given with the figure (Figure 7–3B or C) that matches your printout. When the adjustment has been made to produce the printout shown in Figure 7–3A, proceed to Vertical Pattern Adjustment (Section 7.5.2).

Figure 7–3:   Amplitude Pattern Sample Printouts

A. Key 3: Amplitude pattern No. 1 Normal, no adjustment required.
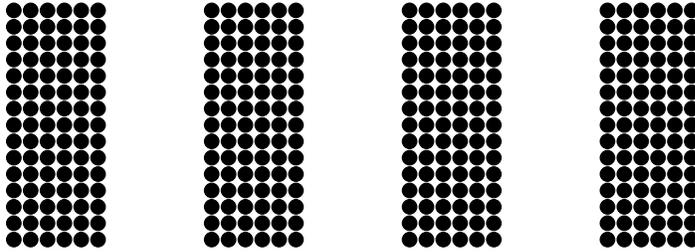
B. Key 3: Amplitude pattern No. 2. Amplitude swing too small (gap at center). Adjust R152 on SMMC board **clockwise** until amplitude pattern No. 1 is obtained.
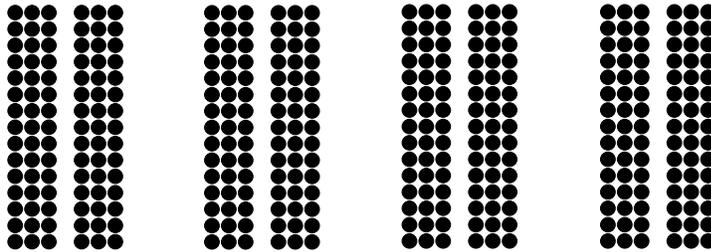
C. Key 3: Amplitude Pattern No. 3. Amplitude swing too large (dots overlap at center). Adjust R152 on SMMC board **counterclockwise** until amplitude pattern No. 1 is obtained.

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PRINT QUALITY ADJUSTMENT PROCEDURES   7–9
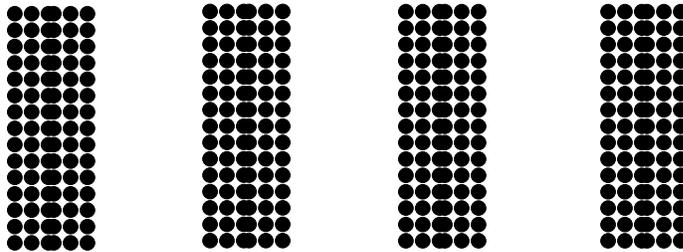
7.5.2 Vertical Timing Pattern Adjustment Procedure

1. Press the PAPER REV (6) key and observe that the printer display changes to [.U E P]. The Vertical Timing Pattern is printed. Figure 7–4A represents a magnified view of three of the 25 vertical bars that are actually printed. Press the FCT (9) key to stop printing the pattern; press the FCT (9) key again to resume printing the same pattern.

2. If the printout of the pattern consisting of three level evenly spaced dots flanking six level evenly spaced dots is the same as Figure 7–4A, proceed directly to Horizontal Timing Pattern Adjustment (see Section 7.5.3).

3. If the printout is not the same as Figure 7–4A, follow the instructions given with the figure (Figure 7–4B or C) that matches your printout. When the adjustments have been made to produce the printout shown in Figure 7–4A, proceed to Horizontal Timing Pattern Adjustment (see Section 7.5.3).

NOTE

In rare cases, the printer may lock up if R27 is overadjusted. This lockup can be cleared by turning the printer power switch OFF, then ON again.

Figure 7–4: Vertical Timing Pattern Sample Printouts

A. Key 6: Vertical timing pattern No. 1. Normal, no adjustment required.
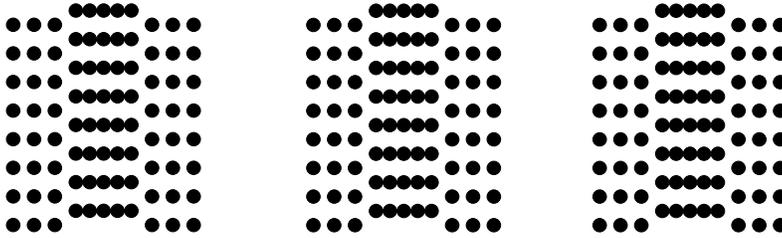
B. Key 6: Vertical timing pattern No. 2. If the five dots at the center of the columns form a ⌣ shape as in pattern No. 2, the vertical timing is too early. Adjust R27 on SMIH board **counterclockwise** until a normal pattern is obtained.
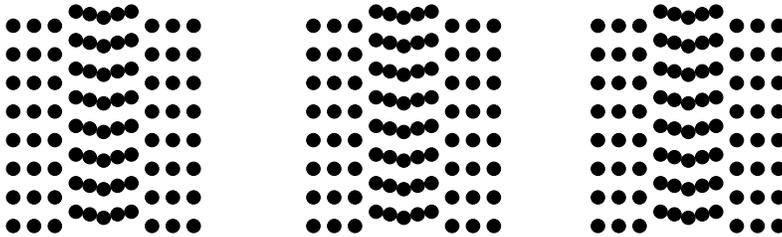
C. Key 6: Vertical timing pattern No. 3. If a few of the rows of three dots at one or other side of the column are sloped (the five dots in the center column may also become erratic) as shown below, the vertical timing is too late. in this case, adjust R27 **clockwise** until pattern No. 2 is obtained then adjust R27 **counterclockwise** until normal pattern No. 1 is obtained.

Note: In rare cases, printer lock up may result from over adjusting R27. This may be cleared by powering the printer down & up again.

RE7584

PRINT QUALITY ADJUSTMENT PROCEDURES   7–11
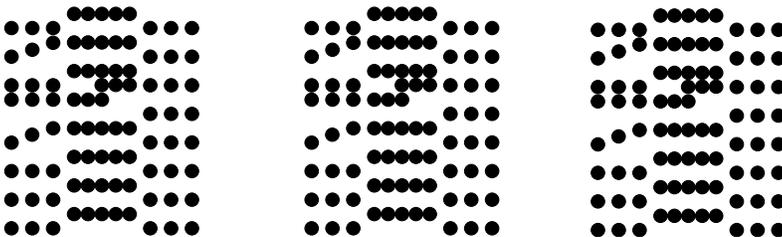
7.5.3 Horizontal Timing Pattern Adjustment Procedure

1. Press the CPI LPI (5) key and observe that the printer display changes to [.H E P]. The Horizontal Timing Pattern is printed. Figure 7–4A representts a magnified view of three of the 33 bar pattern that is actually printed. Press the FCT (9) key to stop printing the pattern; press the FCT (9) key again to resume printing the same pattern.

2. If the printout is not the same as Figure 7–4A, follow the instructions given with the figure (Figure 7–4B or C) that matches your printout. When the adjustments have been made to produce the printout shown in Figure 7–4A, proceed to Intermodule Gap Pattern Adjustment (see Section 7.5.4).

Figure 7–5: Horizontal Timing Pattern Sample Printouts

A. Key 5: Horizontal Timing Pattern No. 1. Normal, no adjustment required.
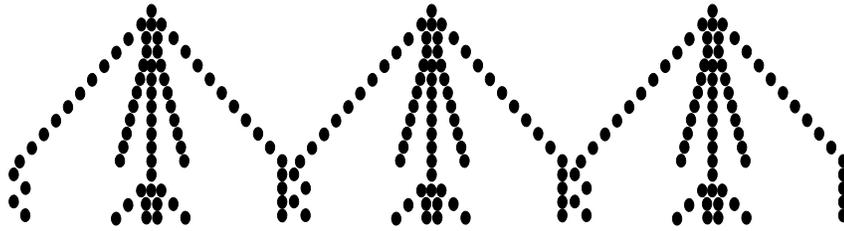
B. Key 5: Horizontal Timing Pattern No. 2. Left inner line uneven; right inner line straight.
   To correct, adjust R26 on SMIH board counterclockwise.

C. Key 5: Horizontal Timing Pattern No. 3. Left inner line straight; right inner line uneven.
   To correct, adjust R26 on SMIH board clockwise.

RE7585

PRINT QUALITY ADJUSTMENT PROCEDURES   7–13
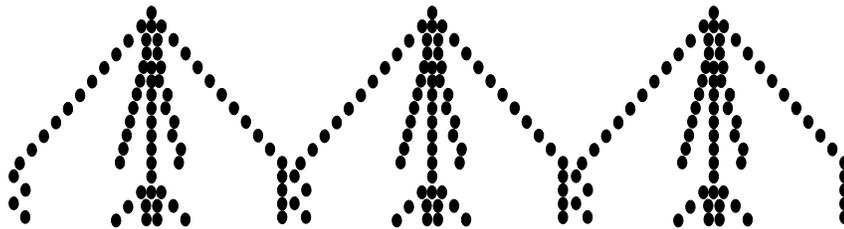
7.5.4 Intermodule Gap Pattern Adjustment Procedure

1. Press the FONT (7) key and observe that the printer display changes to [.i 9 P]. The Intermodule Gap Pattern is printed. Figure 7–6A) represents a portion of one of the two vertival bars actually printed at the junction between the three Printer Actuator Modules. Press the FCT (9) key to stop printing the pattern; press the FCT (9) key again to resume printing the same pattern.

2. If the printout of the Intermodule Gap Pattern is the same as Figure 7–6A, proceed directly to

3. If the printout is not the same as Figure 7–6 A, but looks like Figure 7–6 B, proceed directly to the procedure in Section 5.4 and perform the adjustment. When the print actuator modules have been reregistered to produce the printout shown in Figure 7–6A, proceed to

Figure 7–6:   Intermodule Gap Pattern Sample Printouts

A. Key 7: Inter-module Gap Pattern No.1. Normal, no adjustment required.
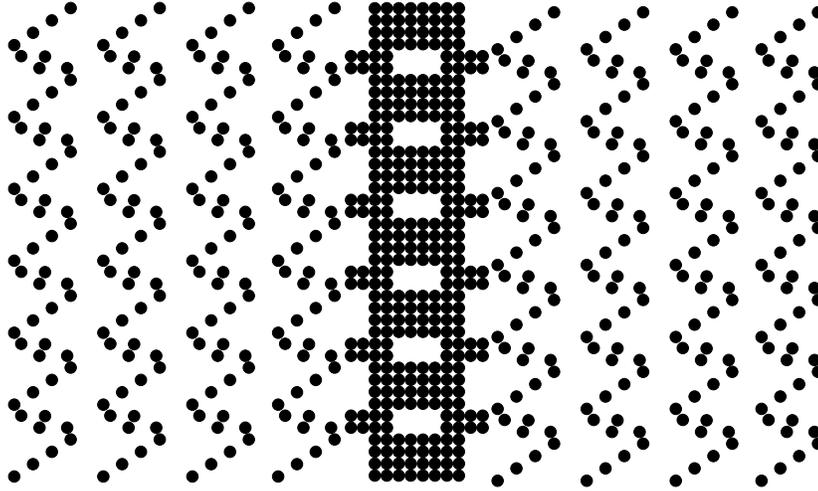
B. Key 7: Inter-module Gap Pattern No.2. Shows excessive gap between modules.
  Modules must be re-registered to the right, see section 7.3.

RE7587

PRINT QUALITY ADJUSTMENT PROCEDURES   7–15
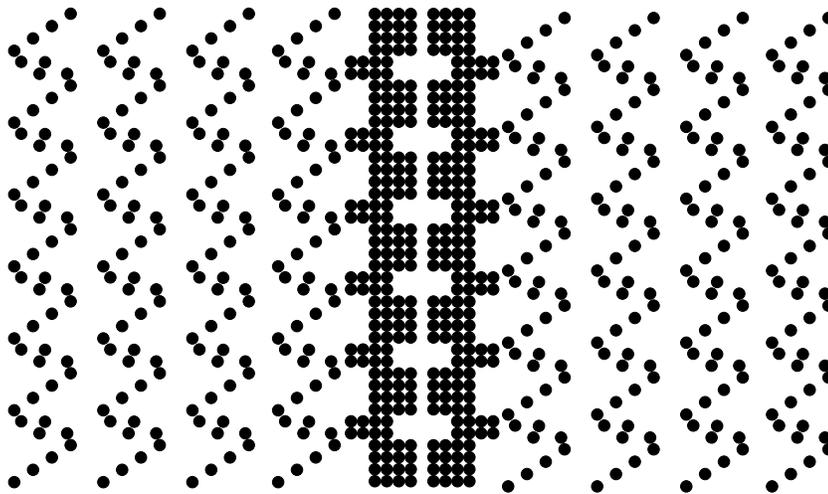
7.5.5 The Checkerboard Pattern

1. Press the SET TOF (8) key and observe that the printer display
    changes to [.c b P]. The Checkerboard Pattern is printed (see Fig-
    ure 7–7). Press the FCT (9) key to stop printing the pattern; press
    the FCT (9) key again to resume printing the same pattern.

2. The checkerboard pattern is an overview of the entire adjustment
    procedure. If all the adjustment procedures have been correctly
    performed and the hardware is operating correctly, the checkerboard
    pattern should appear as a uniform gray with no apparent streaks
    or zigzags. If the checkerboard pattern is the same as Figure 7–7,
    replace the logic board retainer, replace the left side panel, and
    return to normal operations.

3. If the checkerboard pattern is not the same as Figure 7–7 and the
    adjustment procedures have been correctly performed, it indicates
    the the print actuator modules should be swapped, realigned, or
    replaced.

Figure 7–7:   Checkerboard Pattern Sample Printout

KEY 8: CHECKERBOARD PATTERN
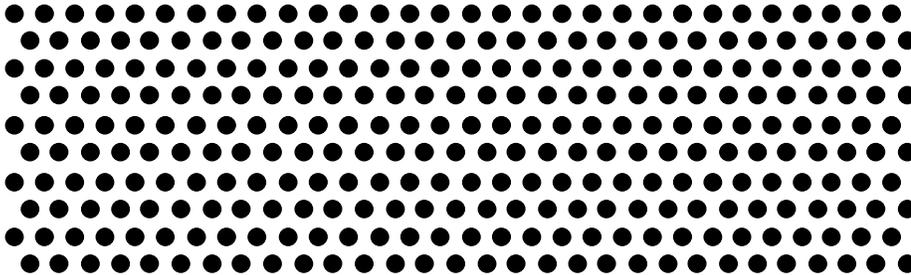
RE7586

7.6 Print Actuator Module Adjustment Procedure

Good alignment of the print actuator modules shows a vertical series
of black and white rectangles at the two gap areas (Figure 7–6 A). Bad
alignment (excessive gap between the modules) of the print actuator mod-
ules shows a vertical white line dividing the black and white rectangles
(Figure 7–6 B).

7–16   PRINT QUALITY ADJUSTMENT PROCEDURES

Perform the procedure below if the Intermodule Gap Pattern printout is not the same as the printout in Figure 7–6 A. A short shank, medium-size screwdriver is required.

1. Gain access to the print actuator modules by setting the power switch OFF, disconnecting the power cable, removing the ribbon cartridge, and swinging back the shroud cover.

2. Disconnect the ribbon cable connectors from each of the three print actuator modules.

3. Loosen the three knurled head screws securing each of the three print actuator modules to the print shuttle mechanism, but do not remove the modules.

4. Using your left hand, press the rightmost module to the right and back stop positions. Maintaining pressure with the left hand, tighten the two outer screws with the screwdriver, then tighten the center screw.

5. Repeat step 4 with the center module, and then the leftmost module.

NOTE

The module realignment sequence (right, center, left) must be adhered to each time the modules are realigned.

6. Reconnect the ribbon cable connectors to each of the three print actuator modules, and assure that the cable guards at connectors are located over the knurled screw heads to prevent abrasion to the ribbon cables.

7. Close the shroud cover, replace the ribbon cartridge, connect the power cable, and set the power switch to ON.

8. With the printer in the Off-line mode (printer display is [O F L]), press the FCT (9) key and observe that the printer enters the MODE SELECTION state (printer display changes to [F n c]).

9. Press the ON LINE (3) key and observe that the printer enters the ADJUSTMENT mode (printer display changes to [A d j]). In ADJUSTMENT mode, any existing special print modes are canceled.

10. Press the FONT (7) key and observe that the printer display changes to
[.i 9 P]. Compare the printout with that of the Intermodule Gap Pattern shown in Figure 7–6A. Press the FCT (9) key to stop printing

the pattern; press the FCT (9) key again to resume printing the same pattern.

11. If the printout of the Intermodule Gap Pattern is the same as Figure 7–6A, proceed to Section 7.5.4, step 5.

12. If the printout of the Intermodule Gap Pattern indicates bad module alignment (Figure 7–6 B), proceed directly to step 1 of this procedure.

Appendix   A

LG31 SYSTEM FUSES

Table A–1 locates, describes, and rates all LG31 system fuse and circuit breakers.

Table A–1:   The LG31 System Fuses

Location	Purpose/Description	Number
SMMC	Protects 42V ribbon motor and paper motor power stages.	F1 (3A, 125.1V)
	Protects 42V bus line.	F2 (3A, 125.1V)
	Protects 42V power line on Shuttle power stage.	F3 (3A, 125.1V)
SPSM	Input Voltage (100-240V)	F1 (0.5A, 250V)
	Protects each power stage.	F2, F3, F4, F5 (3A, 250 V)
SPSR	Backup for current limiting circuit protecting power transistor Q44. Fuse opens if Q44 is shorted.	F1 (6A, 250V)
SPSX†	Protects neutral power line if required (NOT SUPPLIED).	
Back Panel	Main power supply protection.	Circuit Breaker ON/OFF switch

†The SPSX board is found in the ac switch box.

Appendix B
CONTROL CODE AND CONTROL SEQUENCE SUMMARY

Table B–1 lists the 7-bit control characters, Table B–2 lists the 8-bit control characters, and Table B–3 lists the escape and control sequences. The section cross-references in all three tables refer to the *LG31 User's Guide.*

B.1 The 7-Bit Control Characters

Table B–1:   The 7-Bit Control Characters

Control Characters	Description	Section
<BEL>	Sounds Buzzer	4.5.1.1
<HT>	Horizontal Tab	4.5.1.3
<LF>	Line Feed	4.5.1.4
<FF>	Form Feed	4.5.1.6
<CR>	Carriage Return	4.5.1.7
<SO>	Shift Out	4.5.1.8
<SI>	Shift In	4.5.1.9
<ESC>	Escape	4.5.1.14
<BS>	Backspace	4.5.1.2
<VT>	Vertical Tab	4.5.1.5
<DC1>	Device Control 1/XON	4.5.1.10
<DC3>	Device Control 3/XOFF	4.5.1.11
<CAN>	CANcel	4.5.1.12
<SUB>	SUBstitute	4.5.1.13

B.2 The 8-Bit Control Characters

Table B–2:   The 8-Bit Control Characters

Control Characters	Description	Section
\<IND\>	Forward index	4.5.2.1
\<RI\>	Reverse Index	4.5.2.2
\<HTS\>	Horizontal Tab Set	4.5.2.3
\<VTS\>	Vertical Tab Set	4.5.2.4
\<PLD\>	Partial Line Down	4.5.2.5
\<PLU\>	Partial Line Up	4.5.2.6
\<NEL\>	Next Line	4.5.2.7
\<SS2\>	Single Shift 2	4.5.2.8
\<SS3\>	Single Shift 3	4.5.2.9
\<DCS\>	Device Control String Introducer	4.5.2.11
\<CSI\>	Control String Introducer	4.5.2.11
\<ST\>	String Terminator	4.5.2.12
\<OCS\>	Operating System Command	4.5.2.13
\<PM\>	Privacy Message	4.5.2.13
\<APC\>	Application Program Command	4.5.2.13

B.3 The LG31 Escape and Control Sequences

The escape and control sequences are shown in 8-bit format. Sequence characters are spaced for clarity. The spaces are not part of the format code. The row/column number below each character indicates the character's position in the 8-bit DEC Multinational character set.

Table B–3: LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
Forward Index (5.4.7.1)	IND	**IND** 8/4 Moves the active position to the same horizontal position on the next line
Horizontal Tab Stop (5.4.8.1)	HTS	**HTS** 8/8 Sets a horizontal tab stop at the active column
Reverse Index Set (4.5.2.2)	RI	**RI** 8/13 Moves the active horizontal position to the previous line
Partial Line Down (5.4.7.11)	PLD	**PLD** 8/11 Moves the vertical position 3/72 in down
Partial Line Up (5.4.7.12)	PLU	**PLU** 8/12 Moves the vertical position 3/72 in up
Tabulator Clear (5.4.8.5)	TBC	**CSI Pn g** 9/11 *** 6/7 Clears one or more horizontal or vertical tab stops
VFU Channel Command (5.4.10.3)	VFU	**CSI nnn & y** 9/11 *** 2/6 7/9 Allows access to a previously loaded VFU table through channel nnn
Cursor Up (5.4.7.10)	CUU	**CSI Pn A** 9/11 *** 4/1 Moves the vertical position Pn times up, retaining column position

Table B–3 (Cont.):   LG31 Escape and Control Sequences

Name	Mnemonic	Sequence			
VFU End Command (5.4.10.2)	VFU	**CSI** 9/11	**<** 3/12	**I** 3/1	**1** 6/12
		Send to indicate that the printer that the VFU table loaded is complete			
VFU Load (5.4.10.1)	VFU	**CSI** 9/11	**<** 3/12	**1** 3/1	**h** 6/8
		Prepares the printer for loading the 1L channel VFU table			
Autowrap Mode (5.4.9.1)	DECAWM	**CSI** 9/11	**?** 3/15	**7** 3/7	**h** 6/8
		Turns autowrap mode on.			
		CSI 9/11	? 3/15	7 3/7	l 6/12
		Turns autowrap mode off.			
Barcode Encoding (8.3.2, 8.3.3)	DECBAR	**CSI** 9/11	**%** 2/5	**SP** 2/0	**0** 3/0
		Starts the bar code sequence.			
		ESC 1/11			
		Stops the barcode sequence.			
Barcode Select (8.3.1)	DECSBCA	**CSI** **P1** **;** **...** **;** **P9** **,** **q** 9/11 *** 3/11 ... 3/11 *** 2/7 7/1			
		Defines parameters for barcodes that are to be printed.			

Ps	Function
P1	Type of encoding 0 = Default value (Code 39) 1 = Interleaved Two of Five 2 = Code 39 3 = Extended Code 39
P2	Width of narrow bars and spaces 0/missing = default value
P3	Width of quiet zone 0/missing = default value

Table B–3 (Cont.):   LG31 Escape and Control Sequences

Name	Mnemonic	Sequence			
		P4	Width of wide bars and spaces		
			0/missing = default value		
		P5	Gap between characters		
			0/missing = default value		
		P6	Height of bars		
			0/missing = default value		
		P7	Control-character encoding character		
			0 = no encoding of control characters		
			n = the decimal ASCII value of the character		
		P8	Orientation		
			0 = Same as current page		
			1 = Horizontal (portrait)		
			2 = Vertical, rotation of -90(landscape)		
			3 = Vertical, rotation of +90 (landscape)		
			4 = Horizontal, upside down, rotation of 180		
			Other values = disregard sequence		
			Missing = Default value		
		P9	Characters option		
			0 = Default		
			1 = No Characters		
			2 = Characters in currently selected plot font		
			3 = Characters in OCR A		
			4 = Characters in OCR B		
			Other = Disregard sequence		
			Missing = Default value		

Name	Mnemonic	Sequence			
Block	DECBCM	**ESC**	**%**	**SP**	**1**
Character		1/11	2/5	2/0	3/1
Entering		Starts the block character sequence.			
(8.4.2					
8.4.4)		**ESC**	**@**		
		1/11	4/0		
		%			
		2/5			
		Stops the block character sequence.			

<div align="center">

NOTE

This stop sequence is also used to stop barcodes.

</div>

Name	Mnemonic	Sequence					
Block	DECBCS	**CSI**	**P1**	**;**	**P5**	**'**	**r**
Character		9/11	***	3/11	***	2/7	7/2

B–6   CONTROL CODE AND CONTROL SEQUENCE SUMMARY

Table B–3 (Cont.):   LG31 Escape and Control Sequences

Name	Mnemonic	Sequence

Size Select
(8.4.1)

Defines the parameters for block characters.

P1   specifies the width of the block characters.
P2   specifies the height of the block characters.
P3   specifies the color of background.
P4   specifies the international character set designator.
P5   specifies the orientation of the block characters.

Bold   SGR
Printing
(5.4.3)

CSI	**Ps**	**m**
9/11	***	6/13

Turns the bold printing on or off.

Ps	Function
0	All attributes off
1	Turns bold on
22	Turns bold off

Device   DA
Attribute
(Product
ID) (5.9)

Requests device's product ID from host (only) through serial port.

CSI	**c**	or	**CSI**	**0**	**c**
9/11	6/3		9/11	3/0	6/3

Printer ID response, which is dependent upon strap setting:

CSI	**?**	**4**	**2**	**c**	(LG31)
9/11	3/15	3/4	3/2	6/3	
CSI	**?**	**3**	**6**	**c**	(LG01)
9/11	3/15	3/3	3/6	6/3	

Device   DSR
Status
Request
(from host)
(6.3.1)

CSI	**n**	or	**CSI**	**0**	**n**
9/11	6/14		9/11	3/0	6/14

Send extended report.

CSI	**6**	**n**
9/11	3/6	6/14

Send the cursor position report (active column and active line).

CSI	**?**	**1**	**n**
9/11	3/15	3/1	6/14

Disable unsolicited reports.

CONTROL CODE AND CONTROL SEQUENCE SUMMARY   B–7

Table B–3 (Cont.):   LG31 Escape and Control Sequences

Name	Mnemonic	Sequence

		CSI **?** **2** **n**
		9/11 3/15 3/2 6/14
		Enable brief unsolicited reports and send extended report.
		CSI **?** **3** **n**
		9/11 3/15 3/3 6/14
		Enable extended unsolicited reports and send extended report.
Device Status Report (from printer) (6.3.2)	DSR	Brief Report:
		CSI **0** **n**
		9/11 3/0 6/14
		No malfunction detected.
		CSI **3** **n**
		9/11 3/3 6/14
		Malfunction detected.
		Extended Report:
		CSI **0** **n**
		9/11 3/0 6/14
		followed by
		CSI **?** **2** **0** **n**
		9/11 3/15 3/2 3/0 6/14
		No malfunction detected.
		CSI **3** **n**
		9/11 3/3 6/14
		followed by
		CSI **?** **Pn** **;** **...** **Pn** **n**
		9/11 3/15 *** 3/11 ... *** 6/14
		Malfunction detected.

Pn   **Function**

20 to 215   Error code (Table 5-9)

Cursor status report:

CSI **Pn1** **;** **Pn2** **R**

9/11 *** 3/11 *** 5/2

B–8   CONTROL CODE AND CONTROL SEQUENCE SUMMARY

Table B–3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
		Pn1 is the active line.
		Pn2 is the active column.

Draw
Vector
(8.2.1)

DECVEC

CSI	**Pn1**	**;**	**...**	**Pn5**	**!**	**|**
9/11	***	3/11	...	***	2/1	7/12

Draw a line with length, width, and direction.

Pn1	**Function**
0	Draw x line, horizontal
1	Draw y line, vertical
Pn2	= x start position
Pn3	= y start position
Pn4	= line length
Pn5	= line width

Pn2 through Pn5 are in character, decipoint, or pixel units (selected by SSU sequence). The default value of each parameter is 0.

Graphic
Size
Modification
(5.4.4)

GSM

CSI	**Pn1**	**;**	**Pn2**	**SP**	**B**
9/11	***	3/11	***	2/0	4/2

Modify font height and width set by GSS sequence.

Pn1	=	decimal percentage of height set by GSS. Default value is 100.
Pn2	=	decimal percentage of width set by GSS. Default value is 100.

Horizontal
Pitch
(5.4.5.1)

DECSHORP

CSI	**Ps**	**w**
9/11	***	7/7

Selects horizontal pitch (characters/inch).
Controlled by DECPSM.

Ps	**Horizontal Pitch**
0	Determined by current font (default)
1	10
2	12
3	13.3
4	16.7
5	5
9	15

CONTROL CODE AND CONTROL SEQUENCE SUMMARY   B–9

Table B–3 (Cont.):   LG31 Escape and Control Sequences

Name	Mnemonic	Sequence					

Horizontal Position Absolute (5.4.7.4) — HPA

CSI	**Pn**	'
9/11	***	6/0

Selects the active column on current active vertical line.

Pn =   numeric value in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.

Horizontal Position Relative (5.4.7.5) — HPR

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

Adds Pn to the current active column.

Pn =   numeric value in character, decipoint or pixel units (selected by SSU sequence). Default value = 1.

Horizontal Position Backward (5.4.7.6) — HPB

CSI	**Pn**	j
9/11	***	6/10

Subtracts Pn from current active column.

Pn =   numeric value in character, decipoint or pixel units (selected by SSU sequence). Default value = 1.

Horizontal Tabs, Set (5.4.8.2) — DECSHTS

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

Sets up to 32 horizontal tabs (16 horizontal tabs at one time).

Pn =   tab stop in character, decipoint, or pixel units (selected by SSU sequence).

Italic Printing (5.4.3) — SGR

CSI	**Ps**	m
9/11	***	6/13

Selects italic print if font file has italic attribute.

Ps	**Function**
0	All attributes off
3	Italic printing on
23	Italic printing off

Margins, Left and Right (4.5.6.3) — DECSLRM

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

Sets left and right margins in character, deci-point, or pixel units (selected by SSU sequence).

Pn1   = left margin and line home setting

Pn2   = right margin setting

Table B–3 (Cont.):   LG31 Escape and Control Sequences

Name	Mnemonic	Sequence						

Margins, Top and Bottom (5.4.6.2) — DECSTBM

CSI	**Pn1**	**;**	**Pn2**	**r**
9/11	***	3/11	***	7/2

Sets top and bottom margins in character, deci-point, or or pixel units (selected by SSU sequence).

Pn1   = top margin and page home setting
Pn2   = bottom margin setting

Reset to Initial State (5.13) — RIS

ESC	**c**
1/11	6/3

Resets the printer's operating features to initial values.

Select Font (5.4.3) — SGR

CSI	**Ps**	**m**
9/11	***	6/13

Selects a font for printing.

Ps	**Function**
10	Primary font (default)
11	First alternate font
.	
.	
19	Ninth alternate font

Sixel Graphics Sending (7.3) — DCS

DCS	**Ps1**	**;**	**Ps3**	**q**	**SD**	**ST**
9/0	***	3/11	***	7/1	*****	9/12

Ps1	**Function**
0 - 9	Select standard horizontal grid size
Ps2	**Function**
n	Select a background color - ignored
Ps3	**Function**
0 - 9	Select horizontal grid size other than standard sizes
SD= Sixel data	Printable data and control characters

Soft Terminal Reset (6.4.2) — DECSTR

CSI	**!**	**p**
9/11	2/1	7/0

Resets the printer's operating features to the initial values.

Table B–3 (Cont.):   LG31 Escape and Control Sequences

Name	Mnemonic	Sequence
Tabs, Setting		See horizontal tabs (DECSHTS) and vertical (DECSVTS) tabs.

Tabs,   TBC   **CSI   Ps   g**
Clearing   9/11   ***   6/7
(5.4.8.5)   Clears horizontal or vertical tabs.

Ps	Function
0	Clears one horizontal tab at active column.
1	Clears one vertical tab at active line.
2	Clears all horizontal tabs.
3	Clears all horizontal tabs.
4	Clears all vertical tabs.

Vertical   DECVERP   **CSI   Ps   z**
Pitch   9/11   ***   7/10
(5.4.5.2)   Selects the vertical pitch (lines-per-inch).

Ps	Pitch
0	Determined by current font (default)
1	6
2	8
3	12
4	2
5	3
6	4
7	10
11	Selects pitch to fit 66 lines on 11-inch forms (6 lines/inch)

Vertical   VPA   **CSI   Pn   d**
Position   9/11   ***   6/4
Absolute   Selects vertical line without changing the active column.
(5.4.7.7)   Pn   =   new active line, in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.

Vertical   VPB   **CSI   Pn   k**
Position   9/11   ***   6/11
Backward   Subtracts Pn from active vertical line.
(5.4.7.9)   Pn   =   value in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.

B–12   CONTROL CODE AND CONTROL SEQUENCE SUMMARY

Table B–3 (Cont.): LG31 Escape and Control Sequences

Name	Mnemonic	Sequence						

Vertical   VPR   **CSI**   **Pn**   **e**
Position   9/11   ***   6/5
Relative   Adds Pn to active vertical line.
(5.4.7.5)   Pn   =   value in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.

Vertical   DECSVTS   **CSI**   **Pn**   **;**   **...**   **;**   **Pn**   **v**
Tabs, Set   9/11   ***   3/11   ...   3/11   ***   7/6
(5.4.8.4)   Sets up to 16 vertical tabs at one time (67 available vertical tab positions).
                     Pn   =   vertical tab stop in character, decipoint, or pixel units (selected by SSU sequence).

Vertical   VTS   **<VTS>**
Tab Stop   8A
(5.4.8.3)   Sets a vertical tab stop at the active line

Appendix C

LG31 PRINTED CIRCUIT BOARD SUM-MARY

This appendix provides the part number, description, and location of the LG31 printed circuit board FRUs. Also provided is information about the board's fuses, controls, indicators, and jumper settings where appropriate. The boards are listed in alphabetical order as follows.

C.1 SCPI—Shuttle Control Panel Interface

The SCPI board (P/N 29-26721-00) provides the interface (electrical connection) between the inner and outer control panels.

Cable assembly 24 connects the outer control panel to the SMPI at Header P2, and cable assembly 25 connects the SMPI at header P3 to the SMPD board under the inner control panel.

Fuses: None
Controls: None
Indicators: None
Jumpers: None

C.2 SHAD—Shuttle Head Actuator Driver

The SHAD board (P/N 29-26729-00) receives serial dot image information from the SMIH board and converts it to parallel information to drive (fire) the appropriate print head actuator. The SHAD board contains 33 actuator drivers.

The SHAD board is located in the front row of connectors in the top back area of the printer Figure 6–23 is a layout diagram of the SHAD board, showing the location of the jumpers, and a potentiometer.

Fuses: None
            R58 - Factory adjusted for an average actuator current of 2.5 amps.
Indicators: None
Jumpers: J5 - IN
            J6 - OUT
            J7 - IN

Figure C–1:   SHAD Board

RE_UK00264M_89

C–2   LG31 PRINTED CIRCUIT BOARD SUMMARY
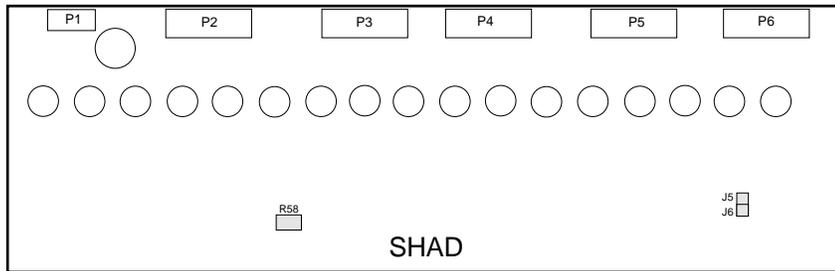
C.3 SMDP—Shuttle Matrix Display Panel

The SMDP board (P/N 29-26720-00) exchanges digital information with the SMSM board (located in the card cage). The SMDP board is also an interface for the inner control panel and the outer control panel. Mounted on the SMDP board is an audio beeper, the printer initialization switch (SW1), and three 7-segment LED displays.

The SMDP board (see Figure C-2) is located under the inner control panel.

Fuses: None
Controls: SW1 (Initialization Switch) - A backup to the normal
            initialization procedure (see Chapter 3, Section 3.4). After
            installing the board, ensure that SW1 is set to the far left
            position.
Indicators: Three 7-segment LEDs for operator/diagnostic use. Audio alarm.
Jumpers: None

Figure C–2:   SMDP Board
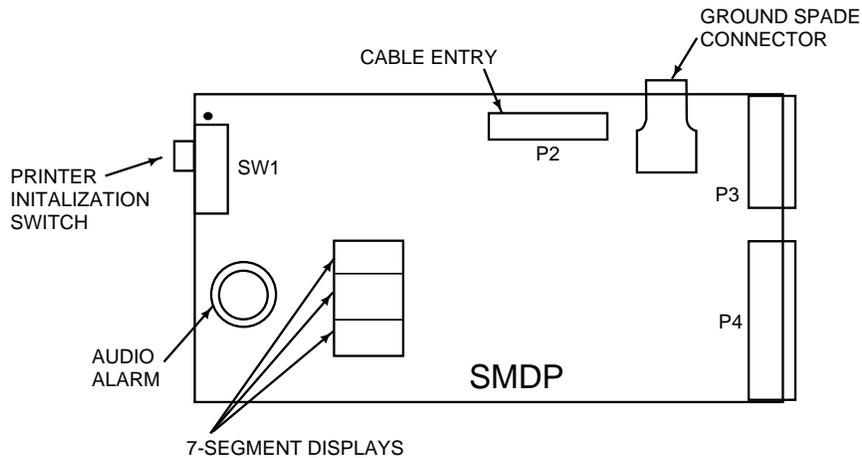
RE_UK00287M_89

C.4 SMIH—Shuttle Matrix Image Hardware

The SMIH board (P/N 29-26731-00-00) receives serial data from the SMIM board (located in the card cage) in 33-bit strings, and sends it as serial dot image information to the SHAD board.

The SMIH board (see Figure C-3) is located in the card cage.

Fuses: None
Controls: R26 and R27 (see Chapter 5, Section 5.3, Print Quality Adjustment Procedures).
Indicators: None
Jumpers: All 31 jumpers (J2-J32) are factory set to the X (left) position for normal operation—any other jumper settings can cause a 493 error code (see Chapter 3, Section 3.3, Error Codes).

Figure C–3:   SMIH Board
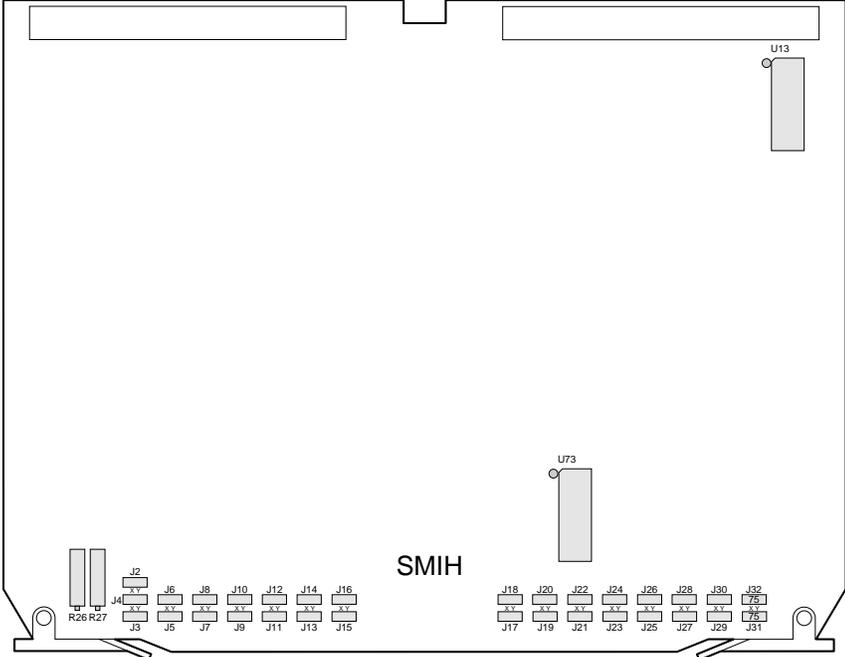
RE_UK00258M_89

C.5 SMIM—Shuttle Matrix Imaging Microprocessor

The SMIM board (P/N 29-26730-00) sends command signals to the SMIH board, building dot rows to form font characters and sixel displays. The SMIM board also controls ribbon and paper movement.

Four ROM chip locations (U23, U24, U38, U39) constitute the location of the resident font.

The SMIM board (see Figure C-4) is located in the card cage.

Fuses: None
Controls: None
Indicators: CR3 (LED)—Indicates the microprocessor (8088) is running
Jumpers: J1 - Factory set (wire jumper) for battery backup

             J3, J5, J7, J9, J11, J13, J15, J17, J18, J20, J22, J24, and J27
             must be IN. J2 must be removed.

             The setting of the other jumpers is not relevant.

Figure C–4: SMIM Board
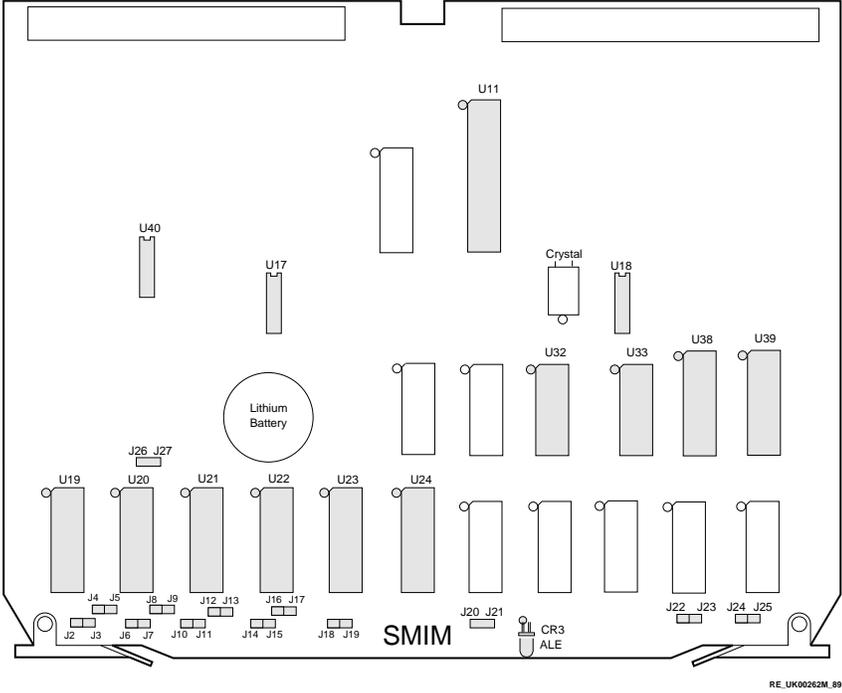
C.6 SMMB—Shuttle Matrix Mother Board

The SMMB board (P/N 29-27261-01) serves as the motherboard for the following four boards:

SMIHSMSM	Provision
SMMC	for
SMIH	three
	spare
	boards

The SMMB (see Figure C-5) is located in the base of the logic module.

Fuses: None

Controls: None

Indicators: None

Jumpers: J1 through J22 (wire jumpers) are not presently used

C–8 LG31 PRINTED CIRCUIT BOARD SUMMARY

Figure C–5:   SMMB Board

P5
(REVERSE
SIDE)

RE_UK00404A_89
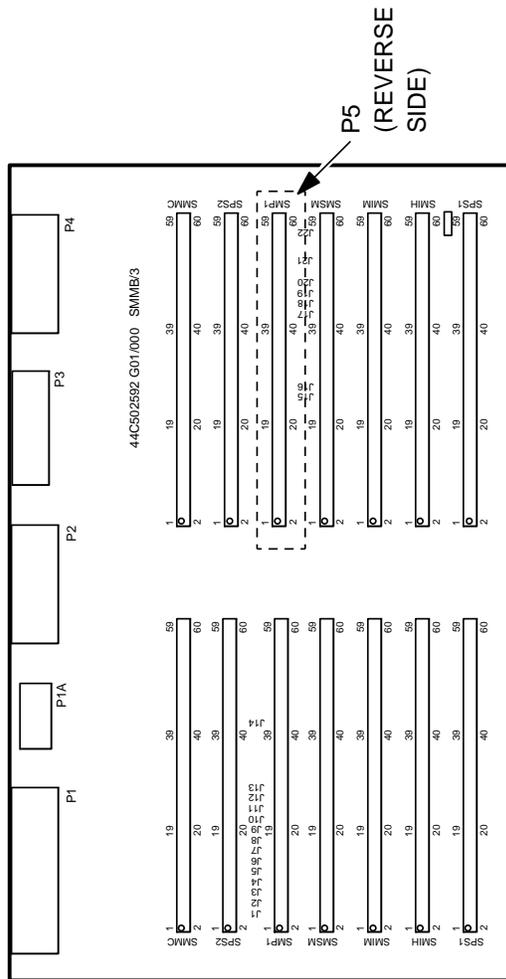
LG31 PRINTED CIRCUIT BOARD SUMMARY   C–9

C.7 SMMC—Shuttle Matrix Motor Control

The SMMC board (P/N 29-26735-00) provides drive voltages and control signals for the shuttle motor, paper motor, and ribbon motor. The SMMC board also controls the front and rear fans. The front is switched ON during printing, and OFF when not printing, while the rear fan is switched HI during printing, and LOW when not printing. Both fans are switched OFF when the shuttle is stopped (standby) to allow ribbon cartridge loading and to reduce standby noise.

The SMMC board (see Figure C-6) is located in the card cage.

Fuses: F1, F2, F3 (see Appendix A, LG31 System Fuses)
Controls: R152, R153 (see Chapter 5, Section 5.3, Print Quality
              Adjustment Procedures)
Indicators: None
Jumpers: J1/J2 - Factory set at J1 for normal operation
              J3/J4 - Factory set at J4 for normal operation
              J5 - Factory set OPEN for normal operation
              J7/J8 - Factory set at J7 for normal operation (for J8
              setting, see Chapter 5, Section 5.3, Print Quality Adjustment
              Procedures)

Figure C–6: SMMC Board

LG31 PRINTED CIRCUIT BOARD SUMMARY   C–11
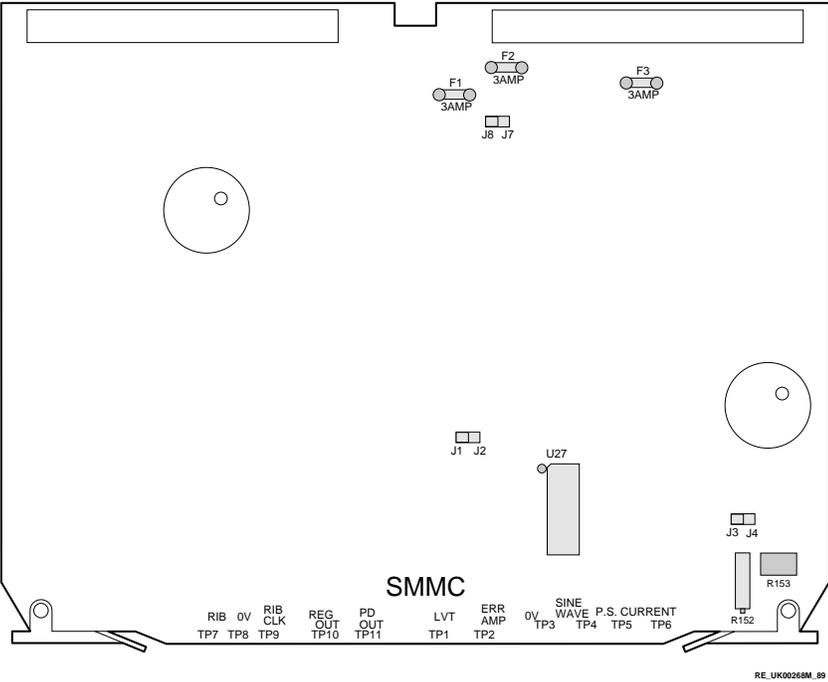
C.8 SMSM—Shuttle Matrix System Microprocessor

The SMSM board (P/N 29-26733-00) provides interfacing and prelimi-
nary processing with the incoming serial data, and sends information to
the control panels.

NOTE

The SMSI board (mounted on the SMSM board) is part of the
serial interface.

The SMSM board (see Figure C-7) is located in the card cage.

Fuses: None
Controls: None
Indicators: CR4 (LED) - Indicates the microprocessor (8085) is running (the
            ALE signal ON)
Jumpers: J1 - Factory set SHORTED for battery backup of non-volatile
            RAM
            J3, J5, J14, J17, J18, J21, J22, and J25 must be IN.

Figure C–7:   SMSM Board

CRYSTAL

U3

SERIAL INTERFACE
SMSI
PIGGYBACK

U11   U11A

U21   U21A

U28

U29   U30   U31

LITHIUM
BATTERY

J1

U44   U45   U46   U47   U48   U49

J2 J4   J6 J8   J10 J12   J14 J16   J18 J20   J22 J24
J3 J5   J7 J9   J11 J13   J15 J17   J19 J21   J23 J25

SMSM

CR4

ALE

RE_UK00266M_89

LG31 PRINTED CIRCUIT BOARD SUMMARY   C–13
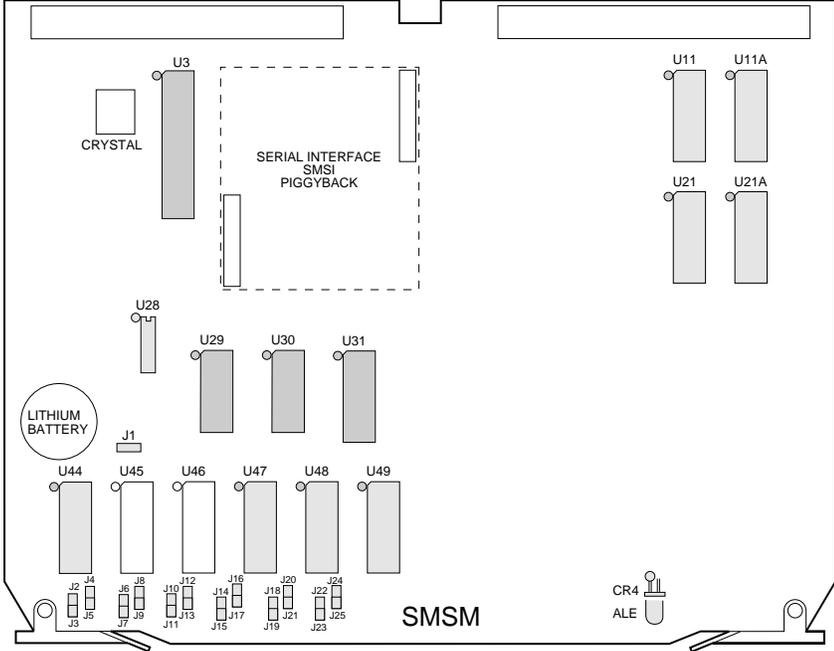
C.9 SPSM—Shuttle Power Supply Master

WARNING

The input voltage to the SPSM board is full wave rectified line voltage. Exercise care in troubleshooting this board to ensure personnel safety.

The SPSM board (P/N 29-26734-00) converts full wave rectified line voltage to 85V by way of four driver and four power stages. The 85V is sent to the SPSR board (located in the power supply card cage).

The SPSM board contains two LEDs (CR10 and CR48). CR10 glows when the 12V is at its operational level. If the internal crowbar circuit operates, CR10 goes out. CR48 may flicker dimly if the -85 volt bus is lightly loaded. This is normal.

The SPSM board (see Figure C-8) is located in the power supply card cage.

Fuses: F1, F2, F3, F4, F5 (see Appendix A, LG31 System Fuses)
Controls: R102, R118 - Factory preset adjustments for 85V and current limiting; do not adjust
Indicators: CR10 - Indicates 12V is present when illuminated
             CR48 - Indicates 85V is present when illuminated – CR85 can flicker dimly to indicate varying load conditions
Jumpers: None

Figure C–8:   SPSM Board
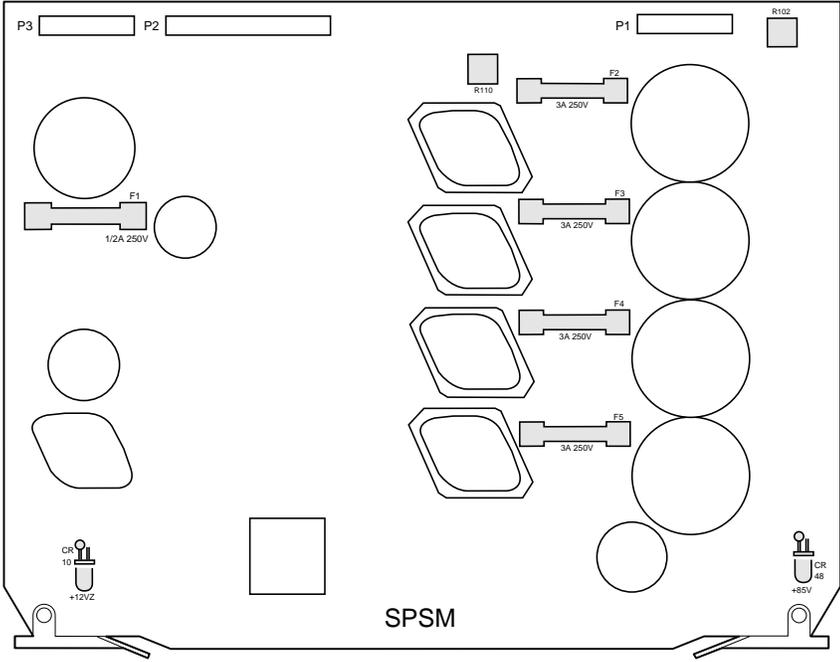
C.10 SPSR—Shuttle Power Supply Regulator

WARNING

The input voltage to the SPSM board is 85 V. Exercise care in troubleshooting this board to ensure personnel safety.

The SPSR board (P/N 29-26732-00) provides all regulated voltages (42 V, 12 V, 5.1 V, and -12 V) required by the printer. Four LEDs indicate the presence of these voltages.

NOTE

If the crowbar on this board operates, the LG31 must be turned off for at least 30 seconds before power can be restored.

The SPSR board is located in the power supply card cage (see Figure C-9).

Fuses: F1 (see Appendix X, LG31 System Fuses)
Controls: R87 - A factory preset adjustment for 5.1V; do not adjust
Indicators: CR25 - Indicates the presence of 12V
              CR26 - Indicates the presence of 5.1V
              CR27 - Indicates the presence of -12V
              CR28 - Indicates the presence of 42V

Jumpers: J1 - Factory set shorted for normal operations

C–16 LG31 PRINTED CIRCUIT BOARD SUMMARY

Figure C–9: SPSR Board
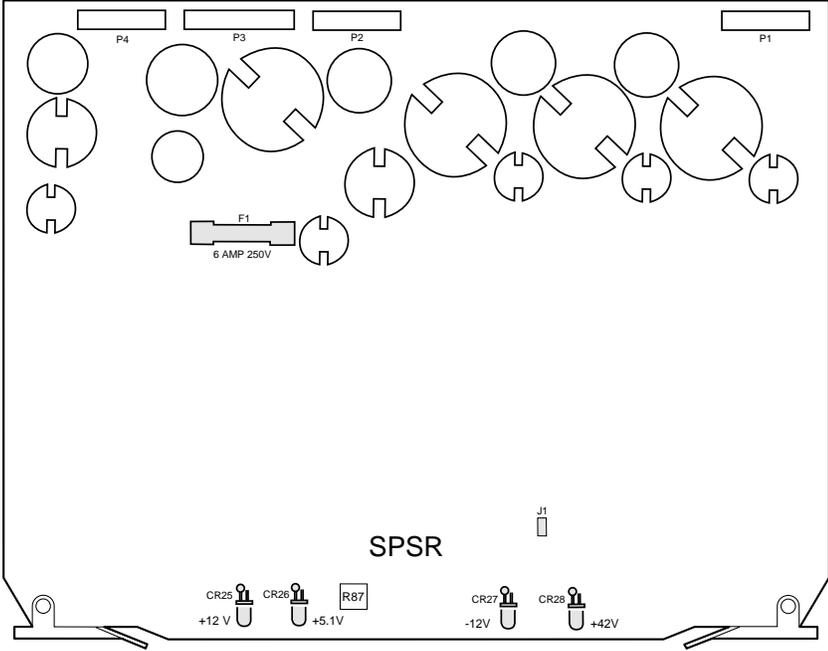
RE_UK00271M_89

C.11 SPSX—Shuttle Power Supply Filter

This board (P/N 29-26722-00) provides:

- High frequency filtering.
- Conversion of ac input voltage to dc voltage.

The power supply filter assembly (see Figure C-10) is located at the rear base of the LG31 printer.

Figure C–10:   SPSX Board
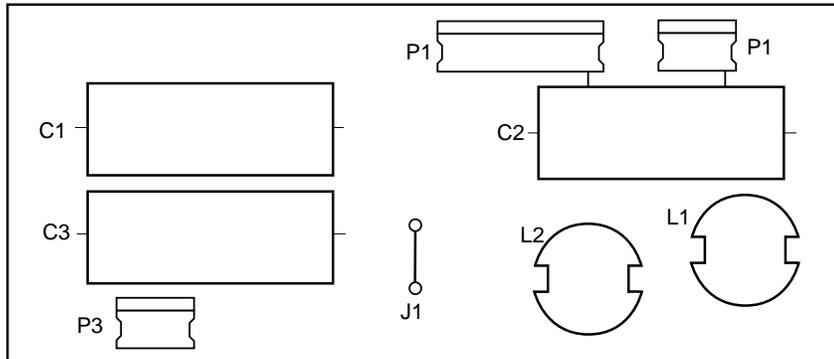
RE_UK00286M_89

C.12 SPSD—Shuttle Power Supply Discharge

This board (P/N 29-26724-00) is mounted inside the rear panel (see Figure C-11).

Figure C–11:   SPSD Board
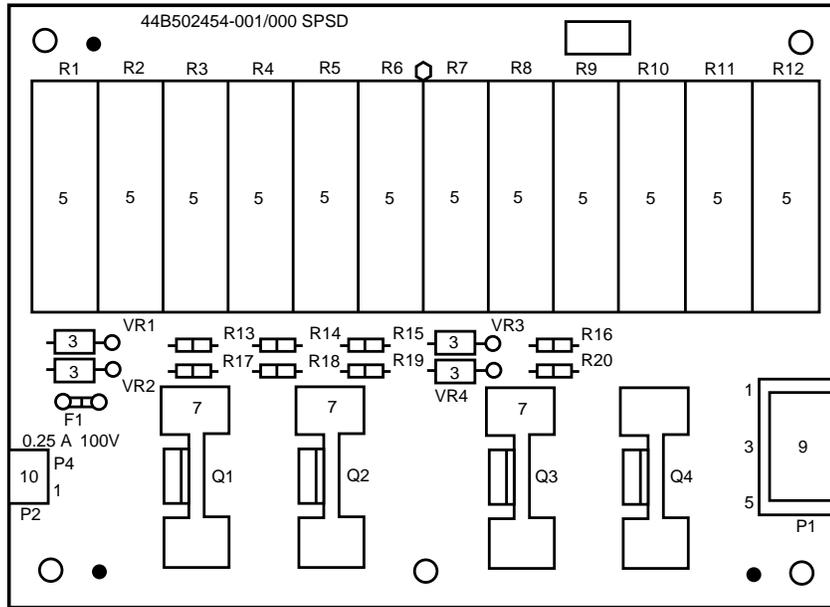
RE_UK00290M_89

C.13 SMSI—Shuttle Matrix Serial Interface

The SMSI board (P/N 29-26723-00) is a piggyback board on the SMSM (see Figure C-12).

Figure C–12: SMSI Board
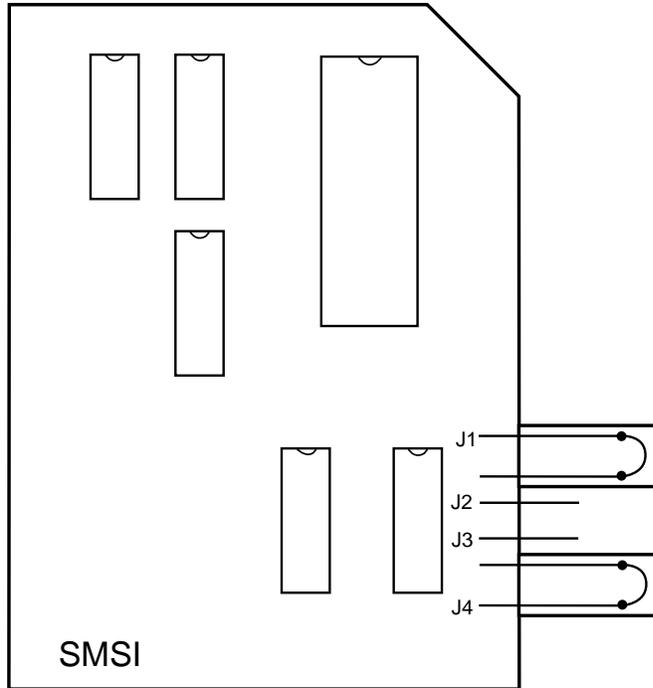
SMSI BOARD
JUMPER J1 FITTED
JUMPER J4 FITTED

RE_UK00288M_89

C–20   LG31 PRINTED CIRCUIT BOARD SUMMARY

Appendix   D
LG31 INTERCONNECTION DIAGRAMS

Figure D–1:   Interconnection Flow Diagram

RE_UK01415M_89

D–2   LG31 INTERCONNECTION DIAGRAMS
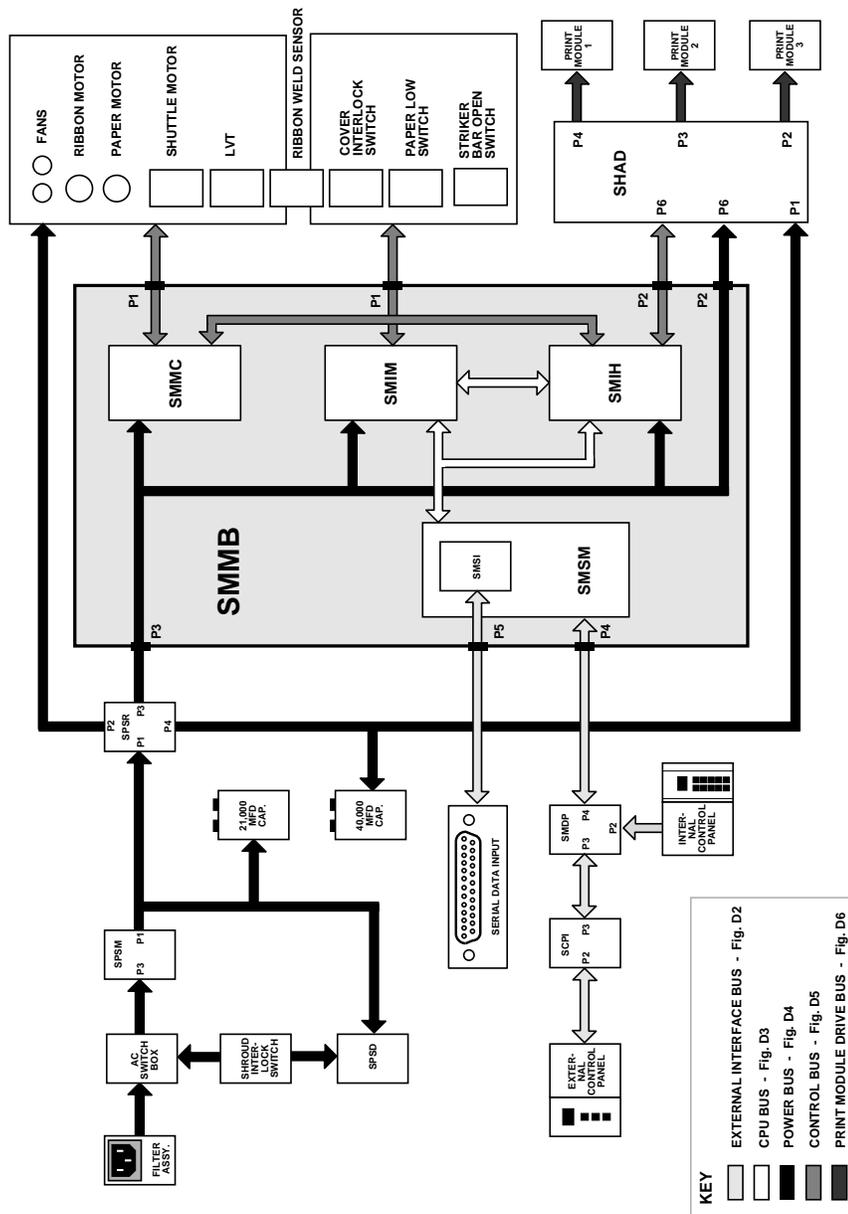
Figure D–2: External Interface Bus

RE_UK01416M_89

LG31 INTERCONNECTION DIAGRAMS D–3
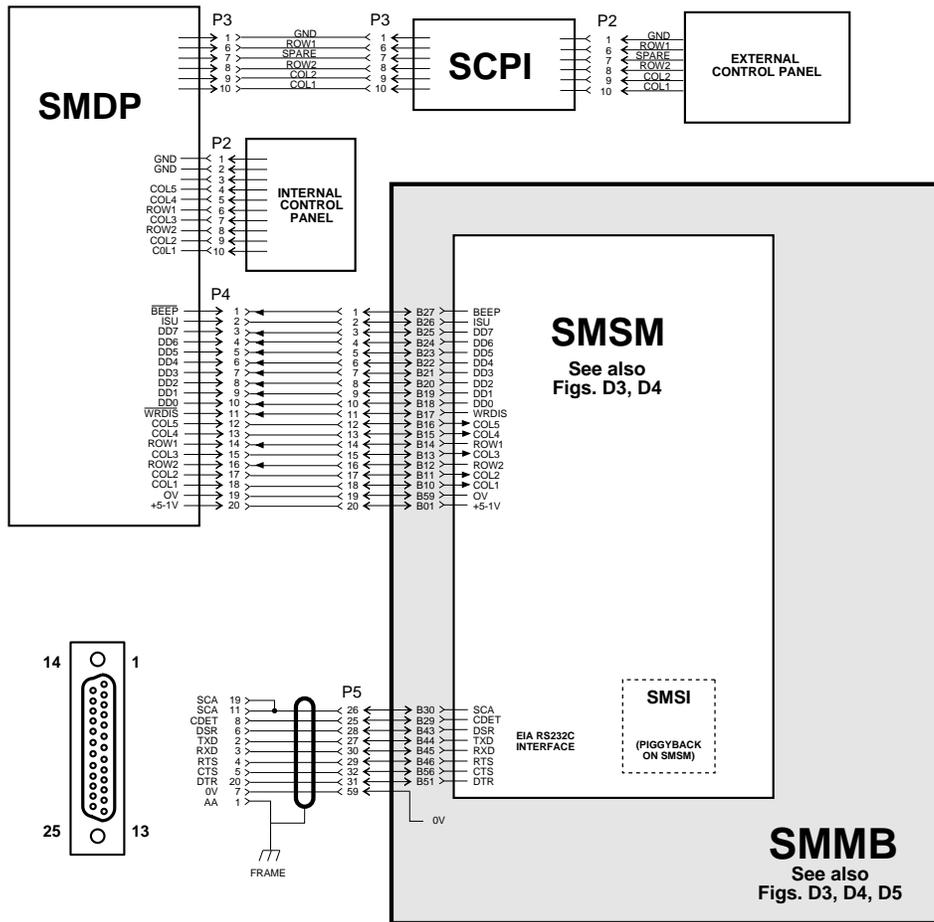
Figure D–3: CPU Bus

RE_UK01417M_89

D–4   LG31 INTERCONNECTION DIAGRAMS
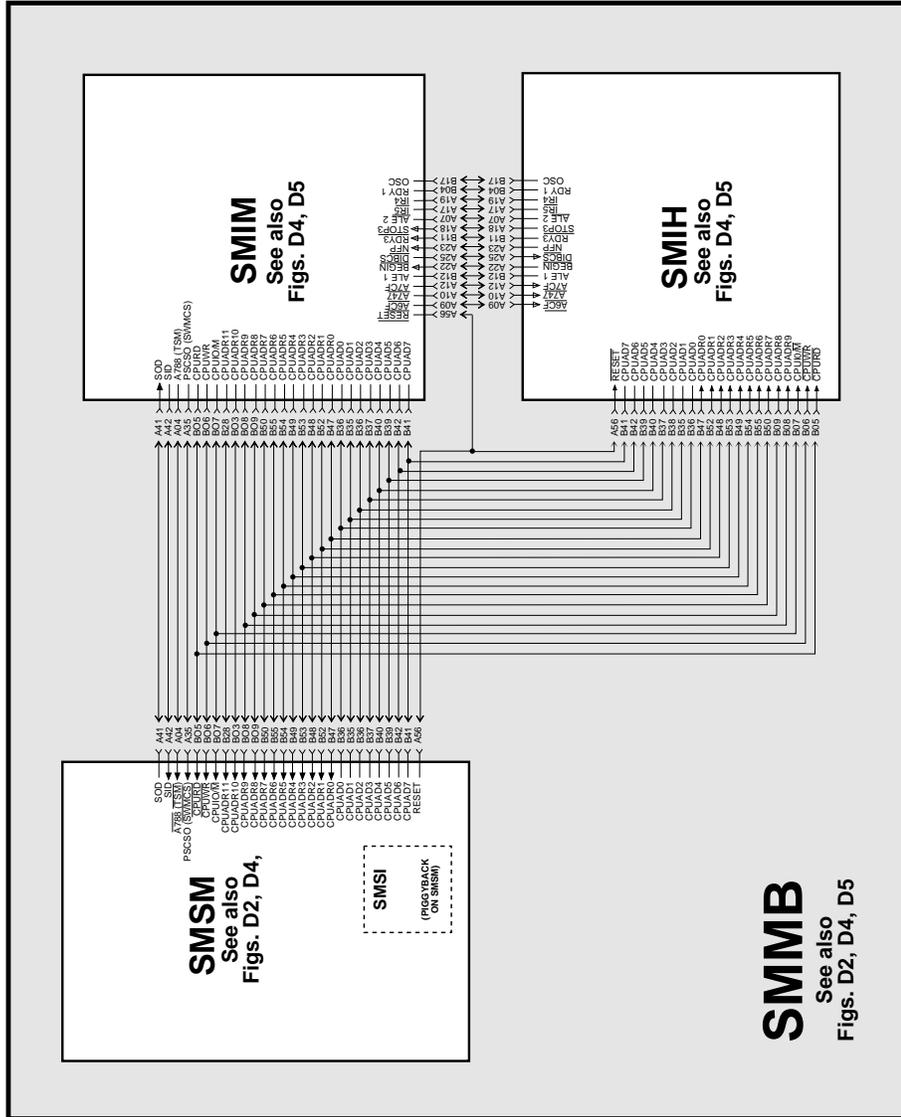
Figure D–4:   Power Bus

RE_UK01418M_89

Figure D–5:   Control Bus

RE_UK01419M_89

D–6   LG31 INTERCONNECTION DIAGRAMS
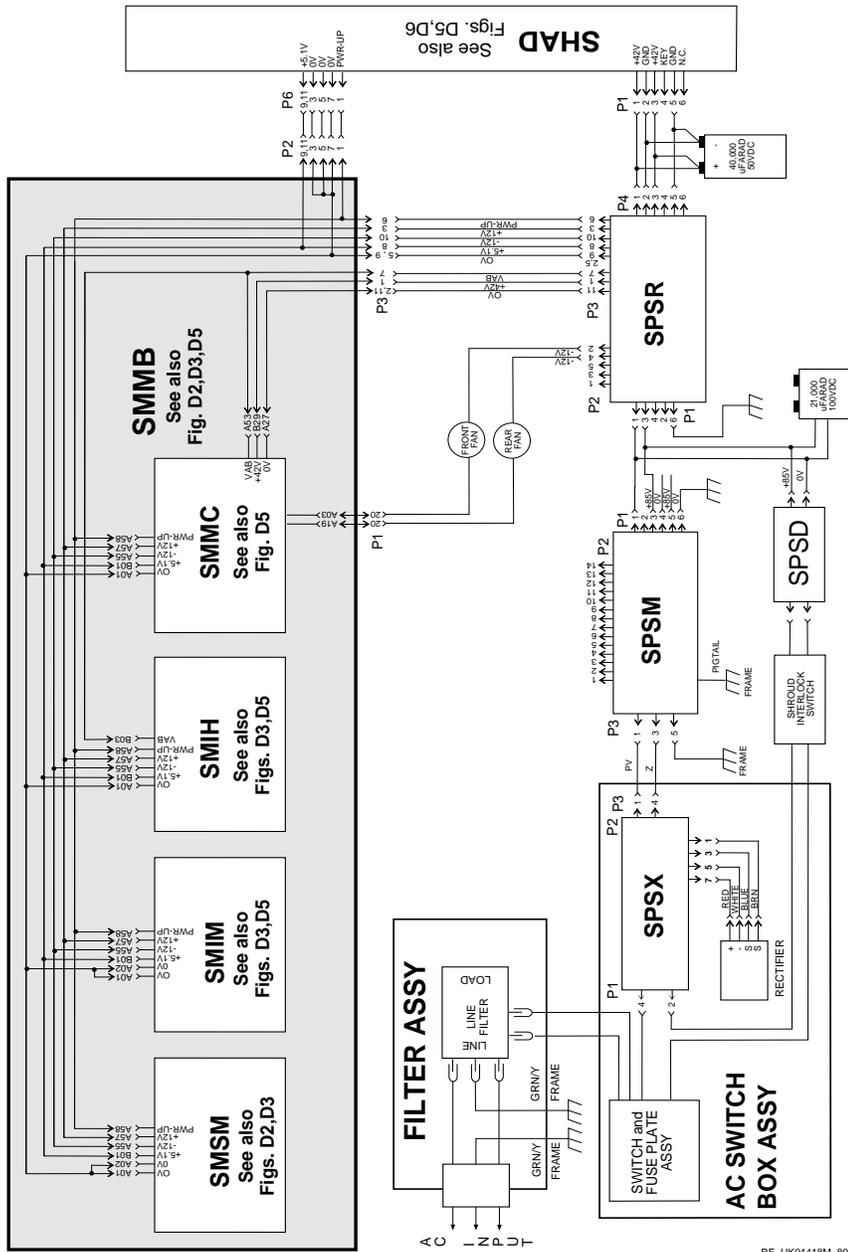
Figure D–6:   Print Module Driver Bus

		P4		
TP-VREF	1	1	N.C.
TP-GND	2	2	N.C.
THERM 0	3	3	THERM O
THERM 1	4	4	THERM 1
NWDO	5	5	1
PWDO	6	6	1
NWD1	7	7	2
PWD1	8	8	2
NWD2	9	9	3
PWD2	10	10	3
NWD3	11	11	4
PWD3	12	12	4
NWD4	13	13	5
PWD4	14	14	5
NWD5	15	15	6
PWD5	16	16	6
NWD6	17	17	7
PWD6	18	18	7
NWD7	19	19	8
PWD7	20	20	8
NWD8	21	21	9
PWD8	22	22	9
NWD9	23	23	10
PWD9	24	24	10
NWD10	25	25	11
PWD10	26	26	11

PRINT MODULE 1

		P3		
TP-VREF	1	1	N.C.
TP-GND	2	2	N.C.
THERM 0	3	3	THERM O
THERM 1	4	4	THERM 1
NWD11	5	5	1
PWD11	6	6	1
NWD12	7	7	2
PWD12	8	8	2
NWD13	9	9	3
PWD13	10	10	3
NWD14	11	11	4
PWD14	12	12	4
NWD15	13	13	5
PWD15	14	14	5
NWD16	15	15	6
PWD16	16	16	6
NWD17	17	17	7
PWD17	18	18	7
NWD18	19	19	8
PWD18	20	20	8
NWD19	21	21	9
PWD19	22	22	9
NWD20	23	23	10
PWD20	24	24	10
NWD21	25	25	11
PWD21	26	26	11

SHAD

See also Figs. D4, D5

PRINT MODULE 2

P5

1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

Not connected

		P2		
TP-VREF	1	1	N.C.
TP-GND	2	2	N.C.
THERM 0	3	3	THERM O
THERM 1	4	4	THERM 1
NWD22	5	5	1
PWD22	6	6	1
NWD23	7	7	2
PWD23	8	8	2
NWD24	9	9	3
PWD24	10	10	3
NWD25	11	11	4
PWD25	12	12	4
NWD26	13	13	5
PWD26	14	14	5
NWD27	15	15	6
PWD27	16	16	6
NWD28	17	17	7
PWD28	18	18	7
NWD29	19	19	8
PWD29	20	20	8
NWD30	21	21	9
PWD30	22	22	9
NWD31	23	23	10
PWD31	24	24	10
NWD32	25	25	11
PWD32	26	26	11

PRINT MODULE 3

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