LG31 Printer
User's Guide

Order Number EK-LG31E-UG-002

Digital Equipment Corporation

1st Edition, November, 1987
2nd Edition, June, 1989

Printed in U.S.A.

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Preface

This manual is written for personnel experienced in one or more programming languages, serial interface installation and printer configuration. This manual describes the LG31 control codes and control sequences, and describes how to configure the printer functions using the interface control straps and the printer control strap.

MANUAL ORGANIZATION

- **Chapter 1, LG31 Features** – Describes the printer, provides the theory of operation, and lists the printer's electrical, mechanical, and functional specifications.
- **Chapter 2, Printer Control Strap Configuration** – Shows how to print out the printer's configuration status, and how to access and reconfigure the printer control straps. Describes the printer control straps and their factory settings.
- **Chapter 3, Interface Configuration** – Describes the serial interface hardware, pin numbers and signals, XON/XOFF protocol, and input buffer processing. Shows how to print out the printer's configuration status, and how to access and reconfigure the interface control straps. Describes the interface control straps and their factory settings.
- **Chapter 4, Character Processing** – Describes how the LG31 printer processes control characters and printable characters in text mode.

- **Chapter 5, Text Mode Escape and Control Sequences** – Describes the escape and control sequences, and control strings used by the LG31 printer in text printing.
- **Chapter 6, Printer ID, Status, and Reset Sequences** – Contains information on how to implement device attributes, device status, and reset control sequences.
- **Chapter 7, Sixel Graphics** – Describes how to implement sixel graphics using LG31 control sequences.
- **Chapter 8, Vector, Bar Code, and Block Character Sequences** – Describes how to implement vector drawing, bar code printing, and block character sequences using LG31 control sequences.
- **Appendix A, Character Sets** – Shows the 16 character sets supported by the LG31.
- **Appendix B, Control Code and Control Sequence Summary** – Provides a summary of the control codes and control sequences used by the printer.
- **Appendix C, Factory, Power-up, and Reset Defaults** – Contains the configuration information of the LG31 printer as shipped from the factory, the list of parameters which are reset and saved on power-up, and a list of the parameters that are reset when a reset control sequence is sent to the LG31 printer.
- **Appendix D, VFU Cross Reference Table** – Provides a cross reference between the VFU Table byte pair bit patterns and the equivalent characters, decimal, and hexadecimal values.
- **Glossary**
- **Index**

Related Documentation

This manual is one in a series of documents listed, as follows, describing the LG31 printer.

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 Keys = Capitalized key legend

  Example: OFF LINE

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

  Example: [.8.8.8]

- Number Designated Keys = Parenthesis enclosed number designation

  Example: (4)

Notes, Cautions, and Warnings

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, carry out the following steps:

1. Confirm that the problem can be repeated 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" section in Chapter 7 and the list of LED display messages in Appendix A to determine if the problem can be resolved in-house. If not, the 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 information required to process your call.

WARNING

Dangerous voltages exist in the LG31 printer. There are no internal user serviceable parts. Refer servicing to qualified service personnel.

FCC Statement (A)

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. Operation of this equipment in a residential area may cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

Chapter 1

LG31 FEATURES

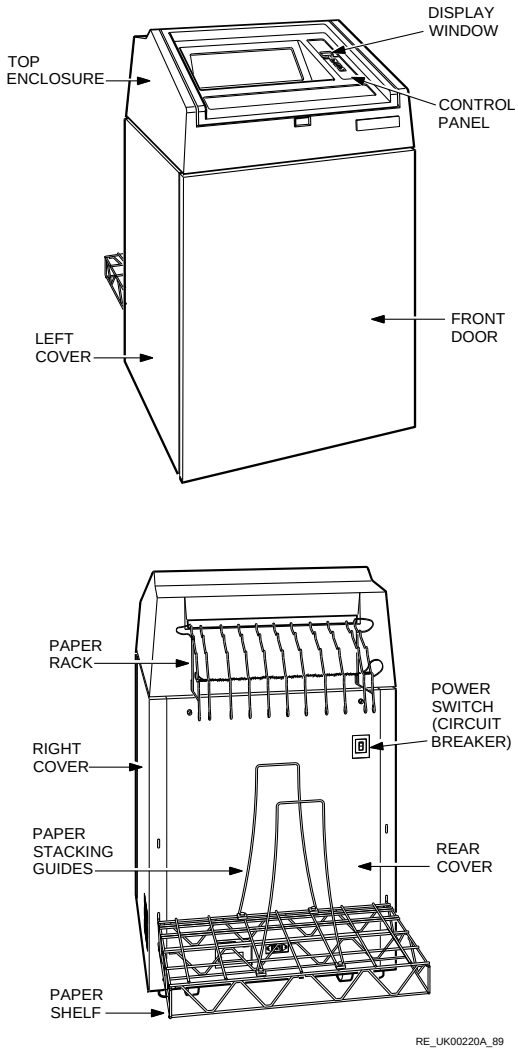
1.1 Overview

This chapter contains a general description of the LG31 300 LPM Line Matrix Printer. It includes a brief description of the printer, provides the theory of operation, and a lists the printer's electrical, mechanical, and operational specifications.

1.2 General Description

The LG31 Line Matrix Printer (see Figure 1–1) is a high-speed printer capable of printing up to 300 lines-per-minute through a serial interface. It has a universal power supply capable of operating at any voltage between 100 and 240 V, at 50 to 60 Hz, without any modifications.

Figure 1–1: LG31 Line Matrix Printer

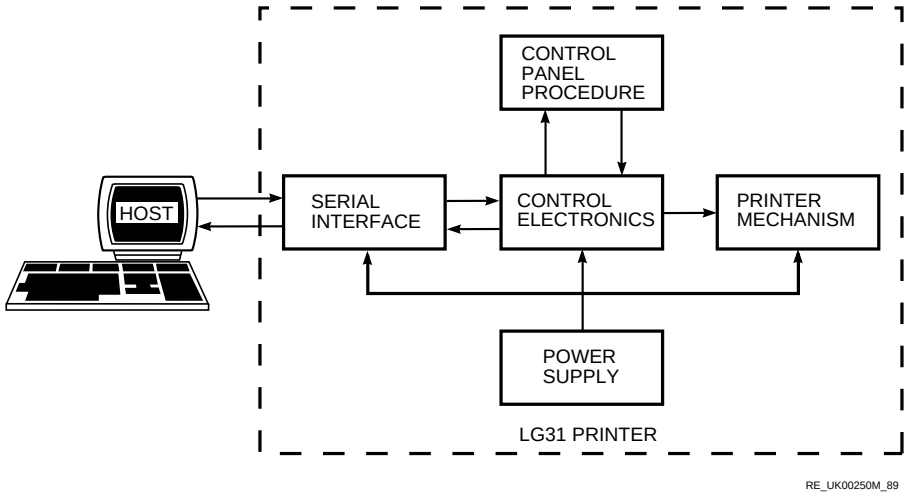


1.3 Theory of Operation

The LG31 is composed of five basic operational blocks (see Figure 1–2):

- The serial interface.
- Control panel.
- Control electronics.
- Power supply.
- Printer mechanism.

Figure 1–2: LG31 Functional Block Diagram



1.3.1 Serial Interface

The serial interface provides the bidirectional communications link between the host and the printer. Bidirectional communications allows data to be sent to the printer, and various types of data (XON/XOFF, status reports, printer ID) to be sent to the host from the printer.

1.3.2 Control Panel

The control panel provides the bidirectional communications link between the operator and the printer. Bidirectional communications allows the operator to send reconfiguration commands and basic print commands to the printer, and allows the printer to pass configuration, error, and printer status information to to the operator either through printouts or through the control panel indicators.

1.3.3 Printer Mechanism

The printer mechanism consists of the mechanical and electromechanical hardware in the printer. The printer mechanism performs ribbon and paper motion and converts the binary print data to printed characters on paper using the printer actuators.

1.3.4 Control Electronics

The control electronics coordinate the functions and operations of the serial interface, control panel, and printer mechanism.

1.3.5 Power Supply

The power supply provides regulated dc power to the printer's electronic and electromechanical devices. The raw ac power is rectified and regulated to assure reliable printer operation. The power supply automatically adjusts to ac input voltages in the range of 100 to 240 V at 50 to 60 Hz, and constantly monitors the dc voltages to provide correct voltage regulation.

1.4 Specifications

1.4.1 LG31 Printer Specifications

Table 1–1: LG31 Printer Specifications

Printer Dimensions	
Unpacked	
Width	73.75 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 1–1 (Cont.): LG31 Printer Specifications

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

1.4.2 Recommended Paper Weights

Table 1–2: 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)

1.4.3 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 1–3: Print Speeds

	Horizontal Pitch (CPI)					
Font	**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.

1.4.4 Resident Fonts

Table 1–4: Resident Fonts

	Horizontal Pitch (CPI)					
Font	**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.

1.4.5 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.

Chapter 2

PRINTER CONTROL STRAP CONFIGURATION

2.1 Printer Control Straps

The printer control straps are software switches that allow modification of the basic printer functions usually controlled by hardware switches or jumpers. This section shows how to print the configuration status of the printer and how to access and reconfigure the printer control straps from the control panel. Section 2.2 gives descriptions of the printer control straps and the factory settings.

2.1.1 Configuration Status Printout

With power applied and the printer in the off-line mode (printer display [O F L]), press the (1) (PRG) key. The printer display changes to [P r o], then a current configuration status (see Figure 2–1) is printed.

Figure 2–1: Factory Set Configuration Status Printout

```
THE PRESENT CONFIGURATION IS:  (44A511526 SY - 44A511527 IM)
FIRMWARE REVISION LEVEL  V2.3
1.  Font:
    Style - 44A511527 Dataprocessing
    CPI - 10 CPI
    Country - US ASCII
    Mode - Normal
    Horizontal Expansion - X1
    Vertical Expansion   - X1
2.  LPI - 6 lpi
3.  Forms Control (lines):
    Form 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
    00001000000010000000101000001000
    Interface Straps B:
    0        1         2         3
    12345678901234567890123456789012
    01000100000000000000000000000000
    Speed - 9600
    Parity - Even
5.  Margin Settings (columns):
    Left Margin  - None
    Right Martin - 132
6.  Horizontal Tabs (columns):
    009  017  025  033  041  049  057  065  073  081
    089  097  105  113  121  129  137  145  153  161
    169  177  185  193  201  209  217
7.  Vertical Tab stops:
8.  Printer Control Straps:
    Printer Straps A:
    0        1         2         3
    12345678901234567890123456789012
    00000000000000000000110001110010
    Printer Straps B:
    0        1         2         3
    12345678901234567890123456789012
    00000000000000000000000000000000
Press the number ‘0’ to return to normal operation. To continue
modification select (1-8).
```

2.1.2 Printer Control Straps

To select the Printer Control Straps menu, press key **(8).** The printer will print the menu shown in Figure 2–2.

Figure 2–2: Printer Control Straps Selection

```
Printer Control Straps:
  0.  Exit
  1.  Printer Straps A
  2.  Printer Straps B
```

2.1.2.1 Exit (0)

Pressing key **(0)** at this time will return the printer to the off-line mode (printer will display **[O F L]**) and result in a printout of the following message:

```
End of Program Mode
```

If the key is pressed after making the changes, the new configuration is printed out.

2.1.2.2 Printer Straps A or Printer Straps B

Let us assume that configuration status printout (see Figure 2-1) shows strap B25 is set to a **0** (strap **OUT**), and we want to set it to a 1 (strap **IN**). Press key (**2**) as defined in Figure 2-2 to access the printer straps B. The printer responds with a front panel display of **[3 3 o]** and prints the message shown in Figure 2-3.

Figure 2–3: Printer Control Strap Configuration Instruction

```
Straps:
0.  Exit
1.  Strap 'IN'
2.  Strap 'OUT'
3.  Forward Without Change
4.  Reverse Without Change
```

While the front panel display numbers the A Straps 01 to 32 and the B straps 33 to 64, the configuration status printout numbers both A and B straps 1 to 32. The i or o following the strap number in the front panel display defines that strap's setting (o for **OUT** and i for **IN**). See Table

2-1 for a cross reference between display and printout numbering of the printer control straps.

Table 2–1: Printer Control Straps Cross Reference Table

Paper Printout				
Strap "A"	0	1	2	3
- Numbering	12345678901234567890123456789012			
- Setting	yyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyy y = 1 or 0			
7 Segment Display	00000000001111111112222222222333			
Strap "A"	12345678901234567890123456789012			
Setting*	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx			

Paper Printout				
Strap "B"	0	1	2	3
- Numbering	12345678901234567890123456789012			
- Setting	yyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyy y = 1 or 0			
7 Segment Display	33333334444444444555555555566666			
Strap "B"	34567890123456789012345678901234			
Setting*	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx			

*x = i or o

Table 2–1 shows that printer control strap B25 on the printout is equivalent to the printer control strap 57 displayed on the front panel. Advance the display strap number **[3 3o]** to **[5 7 o]** by pressing key (**3**) until **[5 7 o]** is displayed. Change the strap setting from **[5 7 o]** (strap 57 **OUT**) to **[5 7 i]** (strap 57 **IN**) by pressing key (**2**), observe the **"o"** following the "57" has been replaced by an **"i"**, pressing key (1) changes **"i"** to **"o"**.

To verify the change has been sent to non-volatile memory, press key (**0**). The printer responds with a printout of the printer control straps shown in Figure 2-4, showing that the printer control strap B25 setting has been changed to a 1 (strap B25 **IN**).

Figure 2–4: Printer Control Strap Verification

```
     Printer Control Straps:

Printer Straps A:
01 2 3
12345678901234567890123456789012
00000000000000000000000000000000
Printer Straps B:
01 2 3
12345678901234567890123456789012
00000000000000000000000010000000
```

Press the number '0' to return to normal operation. To continue modification select (1-9).

2.1.2.3 Exit

If all required changes to the printer control straps have been verified, pressing key (**0**) will return the printer to the off-line mode (printer will display **[O F L]**) and print the following message:

```
End of Program
```

2.2 Printer Control Strap Descriptions

This section provides functional descriptions and factory settings (marked with an asterisk) of the printer straps A and B. Factory settings of the printer control straps taken from the configuration status menu are provided in Figure 2-5. Functional descriptions of the printer control straps are given in Table 2-2.

Figure 2–5: Printer Control Strap Factory Setting

```
     Printer Control Straps:

Printer Straps A:
01 2 3
12345678901234567890123456789012
00000000000000000000100001101010
Printer Straps B:
01 2 3
12345678901234567890123456789012
00000000000000000000000010000000
```

Table 2–2: Printer Control Strap Functional Descriptions

Strap	Function and Description
A1-A16	Not Assigned
A17	0 **(OUT)*** selects LG31 product ID 1 (**IN**) selects LG01 product ID
A18-A20	Not Assigned
A21	0 **(OUT)**—DISABLE LINE FEED TO SLEW CONVERSION Paper advances one line feed at a time. 1 (**IN**)*—ENABLE LINE FEED TO SLEW CONVERSION When strap 21 is IN, consecutive line feeds, or line feeds preceded by carriage returns, are stored in a buffer until other characters are received. At that point, all accumulated line feed commands are performed as a single paper slew of length equal to that of the line feeds if performed separately. The result is an increase in throughput which may be significant in many applications. If line feeds totaling more than 22 in are received, a slew will be performed each time the accumulation reaches 22 in, and the line counter will be reset to allow for the receipt of more line feeds.
A22	0 **(OUT)***—DISABLE SLEW TRUNCATION AT TOP OF FORM 1 (**IN**)—ENABLE SLEW TRUNCATION AT TOP OF FORM Allows the paper to slew no farther than the next Top Margin or first form boundary (if Top Margin is not in effect).
A23	1 (**IN**)—NLQ font underline reset to baseline.
A24	0 (**OUT**)*—PRINTER COMES UP OFF LINE AFTER SELF TEST Printer goes to the OFF LINE condition after termination of self test. 1 (**IN**)—PRINTER COMES UP ON-LINE AFTER SELF TEST Printer goes to the ON LINE condition after termination of self test. Note that the above conditions apply to self test initiated at power-up, following test print or printer initialization. Regardless of the switch setting, the printer will go to the ON LINE condition after a host-initiated self test.
A25	Not Assigned

Table 2–2 (Cont.): Printer Control Strap Functional Descriptions

Strap	Function and Description
A26	0 (**OUT**) - DISABLE PAPER MOTION KEYS WHEN ON LINE Paper motion keys (Form Feed, Line Feed, and Paper Rev) are disabled when the printer is on-line. 1 **(IN)*** - ENABLE PAPER MOTION KEYS WHEN ON LINE The paper motion keys (Form Feed, Line Feed, and Paper Rev) are enabled when the printer is on-line. Response to the keys will not occur if the printer is printing or communicating with the host.
A27	0 (**OUT**) - DISABLE AUTO WRAP A line of data exceeding the right margin will be printed on that line up to the right margin, but the data exceeding the right margin is truncated. 1 **(IN)*** - ENABLE AUTO WRAP A line of data exceeding the right margin will be printed on that line up to the right margin. Any data exceeding the right margin is wrapped around on the next line.
A28	0 (**OUT**) - DISABLE LINEFEED/NEW LINE MODE (LNM) This turns off the line feed/new line mode. A line feed character advances the paper one line. The active column does not move. 1 **(IN)*** - ENABLE LINEFEED/NEW LINE MODE (LNM) This turns on the line feed new line mode. A line feed character advances the paper one line and returns the active column to the left margin. Note that the setting of this strap (**IN** or **OUT**) is ignored if switch A29 (below) is set **IN**.
A29	0 (**OUT**)*—DISABLE CARRIAGE RETURN/NEW LINE The carriage return/new line mode is turned off. A carriage return character returns the active column to the left margin without advancing to a new line. 1 **(IN)**—ENABLE CARRIAGE RETURN/NEW LINE The carriage return/new line mode is turned on. A carriage return character returns the active column to the left margin and advances the page one line.

Table 2–2 (Cont.): Printer Control Strap Functional Descriptions

Strap	Function and Description
A30	0 **(OUT)*****—ENABLE DELETE **<DEL>** The delete character prints a checkerboard pattern. 1 (**IN**)—DISABLE DELETE **<DEL>** The delete character is ignored.
A31	1 (**IN**)—DP font underlined raised to baseline.
A32	0 **(OUT)*** DISABLE HEX DUMP MODE The characters are processed normally. 1 (**IN**) - ENABLE HEX DUMP MODE All data (including control codes and escape sequences) will be printed in hexadecimal format. HEX dump allows program debugging and system analysis of the data received by the printer.
B1-B32	Not Assigned

Chapter 3

INTERFACE CONFIGURATION

3.1 Introduction

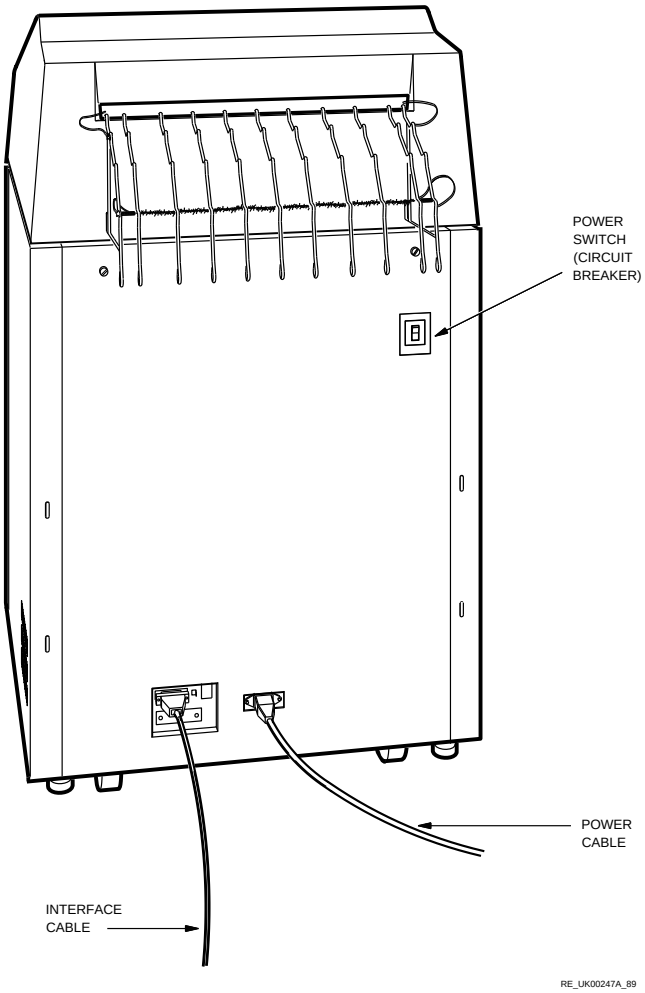
The LG31 printer uses an RS-232-C serial interface. This interface is compatible with other Digital serial printer interfaces. Connection of the host to the printer is made at the serial interface connector located at the back of the printer (see Figure 3-1).

Section 3.2 gives descriptions of the serial interface, pin numbers, and signals. Section 3.3 describes the XON/XOFF protocol and input buffer processing. This chapter also shows how to access and reconfigure the interface straps in Section 3.4, and provides descriptions of the interface control straps and the factory settings in Section 3.5.

3.2 Serial Interface

This section describes the serial interface connector (see Figure 3–1), defines the interface pin assignments, and describes the interface signals, the input buffer, and the XON/XOFF protocol.

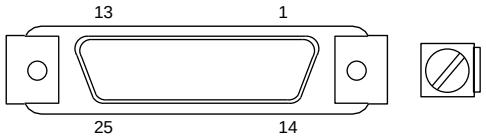
Figure 3–1: Serial Interface Connector Location



3.2.1 Serial RS-232-C Connector

Figure 3-2 shows the 25-pin serial RS-232-C interface connector.

Figure 3–2: Serial RS-232-C Interface Connector



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3.2.2 Pin Assignments and Signal Descriptions

Table 3–1 defines the serial interface pin numbers, the mnemonic, the source, and the description of the signals.

1. Pin 3 (RX) is the primary data input line carrying serial data from the host to the printer. The printer accepts the data as long as it is on line and for one second after the printer has been placed in the off-line state. A negative level is a Mark and a positive level is a Space. When released, the line level should be in a Mark condition.
2. When XON/XOFF protocol is used, the parity must be set to match the data source.
3. DSR is strap-dependent; CTS is not strap-dependent. Regardless of how the printer is strapped, the host may always use CTS to inhibit.
4. CTS must be positive or lead open-circuit for XON/XOFF protocol. For this protocol RTS or DTR cannot be tied to CTS.

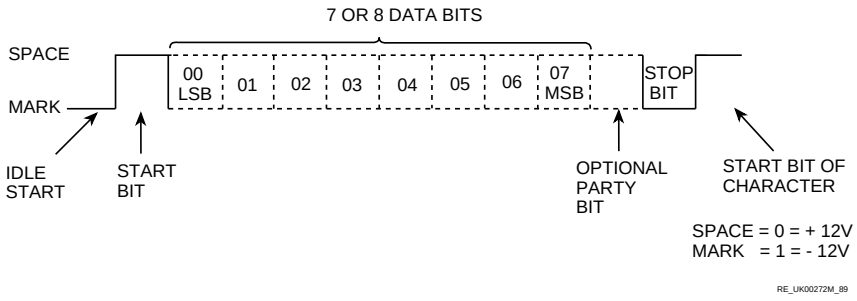
Table 3–1: Serial Pin Assignments and Descriptions

Pin number	Mnemonic	Source	Description
1	Protective Ground (PGND)	Common	Protective Ground.
2	Transmitted Data (TX)	Printer	Serial encoded data sent to the host.
3	Received Data (RX)	Host	Serial encoded data sent to the printer.
4	Request to Send (RTS)	Printer	When set the printer is on-line.
5	Clear to Send (CTS)	Host	Printer transmission is not inhibited.
6	Data Set Ready (DSR)	Host	Printer is ready to send.
7	Signal Ground (SGND)	Common	Logic Common.
11	Secondary Request to Send (SCA-1)	Printer	Printer is ready to send.
19	Secondary Request to Send (SCA-2)	Printer	Printer is ready to send.
20	Data Terminal Ready (DTR)	Printer	Indicates when printer is ready to receive data.

3.2.3 Serial Data Format

The serial interface requires that data is transmitted in a bit-serial, asynchronous character format. Figure 3-3 shows serial data format for host to printer and printer to host communications.

Figure 3–3: Serial Data Format



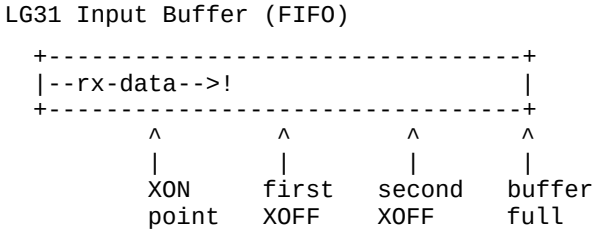
3.3 Input Buffer Control

The LG31 uses XON/XOFF protocol and a 2 Kbyte input buffer to avoid input buffer data overflow.

3.3.1 XON/XOFF Protocol

To avoid input buffer overflows the LG31 printer uses XON/XOFF protocol to synchronize data exchange.

After power-up, the printer is set to Ready and it sends one XON control character, signaling that it is ready to receive data. The printer constantly monitors the number of characters in the input buffer. When the input buffer fills to within 150 characters of full (the first XOFF point), the printer sends an XOFF control character, signalling the data source to pause temporarily. Meanwhile, the printer continues to take characters from the input buffer for printing or processing. When data remaining in the input buffer drops back to 50 characters from empty (the XON point), the printer sends an XON control character, signalling that transmission may resume.



The host transmits characters to the printer which are stored in the printer buffer. When the number of characters in the buffer reach certain points, the printer transmits XOFF characters to control the flow of data. The transmission of these XOFF characters occur when:

1. The number of characters in the input buffer reaches the first XOFF point (150 characters from full).
2. The number of characters in the input buffer reaches the second XOFF point (100 characters from full). This may occur if the first XOFF had been ignored by the host.

If the host continues to send the characters after the second XOFF and the input buffer becomes full, the incoming data is disregarded and an error condition occurs.

Having sent the XOFF(s) to host, the printer continues to process the data in the input buffer. When the data decreases to 50 characters from empty (XON point), the printer sends a XON character to the host signifying that it is ready to receive more data.

3.3.2 Input Buffer Processing

All characters sent to the printer are temporarily stored in the standard 2 Kbyte (2048 characters) input buffer for further processing.

When the printer is in the Ready state and processing data from the input buffer, it moves characters to the print buffer. The processed data in the print buffer is printed when one of the following conditions are met:

1. Receipt of a line terminator **(<LF>, <FF>, <VT>**, or **<CR>)**.
2. Autowrap has been enabled and the print data active position is past the right margin.

3. Approximately 500 ms elapse without receipt of print data from the host.

When the received data is incorrect, the printer replaces each character with the error character (reverse question mark) when printing.

Unlike all other control codes and control sequences, the Device Status Request (DSR) sequence is processed immediately after it is received.

3.4 Interface Control

The interface control straps are software switches allowing the user to modify interface functions usually controlled by hardware switches or jumpers. This section will show how to get a printout of the configuration status, and how to access and reconfigure the interface straps.

3.4.1 Configuration Status Printout

With power applied and the printer in the OFF-LINE mode (printer display is **[O F L]**), press the **(1) PRG** key. The printer display will change to **[P r o]**, then print a current configuration status (see in Figure 3-4).

Figure 3–4: Factory Set Configuration Status Printout

```
THE PRESENT CONFIGURATION IS:  (44A511526 SY - 44A511527 IM)
FIRMWARE REVISION LEVEL  V2.3
1.  Font:
    Style - 44A511527 Dataprocessing
    CPI - 10 CPI
    Country - US ASCII
    Mode - Normal
    Horizontal Expansion - X1
    Vertical Expansion   - X1
2.  LPI - 6 lpi
3.  Forms Control (lines):
    Form 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
    00001000000010000000101000001000
    Interface Straps B:
    0        1         2         3
    12345678901234567890123456789012
    01000100000000000000000000000000
    Speed - 9600
    Parity - Even
5.  Margin Settings (columns):
    Left Margin  - None
    Right Martin - 132
6.  Horizontal Tabs (columns):
    009  017  025  033  041  049  057  065  073  081
    089  097  105  113  121  129  137  145  153  161
    169  177  185  193  201  209  217
7.  Vertical Tab stops:
8.  Printer Control Straps:
    Printer Straps A:
    0        1         2         3
    12345678901234567890123456789012
    00000000000000000000110001110010
    Printer Straps B:
    0        1         2         3
    12345678901234567890123456789012
    00000000000000000000000000000000
Press the number ‘0’ to return to normal operation. To continue
modification select (1-8).
```

3.4.2 Interface Type Control

To select the Interface Control menu, press key (**4**). The printer will print the menu shown in Figure 3-5.

Figure 3–5: Interface Control Selection

```
Interface Control

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

3.4.2.1 Exit

Pressing key (**0**) at this time will return the printer to the off-line mode (printer will display **[O F L]**) and result in a printout of the following message:

```
End of Program Mode
```

3.4.2.2 Interface Type

The RS-232-C is the only interface available for the LG31 Printer. However, pressing key (**1**) will result in the printout shown in Figure 3-6.

Figure 3–6: Interface Type Selection

```
0.  Exit
1.  Interface Type
```

If you press key (**0**), the printer will respond with a printout verifying the Interface Type in Figure 3-7.

Figure 3–7: Interface Type Verification

```
                Interface Type - Serial

      Press the number '0' to return to normal operation. To
      continue modification select (1-9).
```

If you press key (**1**), the printer will respond with the following printed message:

```
                Interface Control

                0.  Exit
                1.  Serial
```

Because the serial interface is the only interface available and pressing key (**1**) to select the serial interface would serve no function, press key (**0**) to Exit. The printer will respond with

```
     Interface Type - Serial
```

3.4.2.3 Interface Strap

A description of what each of the interface straps (A and B) do is given in Table 3-3. The following example describes how to change the straps. Press key (**2**), defined in Figure 3-5 as Interface Straps A. The printer responds with a front panel display of **[0 1 o]** and prints the message shown in Figure 3-8.

Figure 3–8: Strap Configuration Selection

```
Straps:
0.  Exit
1.  Strap 'IN'
2.  Strap 'OUT'
3.  Forward Without Change
4.  Reverse Without Change
```

On the front panel display, the strap numbers plus a letter (**i** or **o**) are displayed. The A straps are numbered 1 to 32 and the B straps are numbered 33 to 64. The letter **i** or **o** following the strap number in the front panel display defines that strap's setting (**o** for **OUT** and **i** for **IN**). See Table 3–2 for a cross reference between display and printout numbering of the interface control straps.

Table 3–2: Interface Strap Cross Reference Table

Printout	
Strap "A"	0 1 2 3
Numbering	12345678901234567890123456789012
Display	00000000011111111112222222222333
Strap "A"	12345678901234567890123456789012
Numbering*	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
Printout	
Strap "B"	0 1 2 3
Numbering	12345678901234567890123456789012
Display	33333334444444444555555555566666
Strap "B"	34567890123456789012345678901234
Numbering*	xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx

*x = i or o indicates configuration as shipped from the factory

Assume that configuration status printout (Figure 3-4) shows strap A15 is set to **0** (strap **OUT**), and you want to set it to **1** (strap **IN**).

Table 3-2 shows printer control strap A15 on the printout is equivalent to the printer control strap 15 displayed on the front panel. To change the strap setting from **[1 5 o]** (strap 15 **OUT**) to **[1 5 i]** (strap 15 **IN**), press key (**2**) and observe the "**o**" following the "15" has been replaced by an "**i**", pressing key (**1**) changes "**i**" to "**o**".

To verify the change has been sent to non-volatile memory, press key (**0**). The printer responds with a printout of the interface control straps and their settings, as shown in Figure 3-9. The printout shows interface strap A10 setting has been changed to a **1** (interface strap A10 **IN**).

Figure 3–9: Interface Control Strap Verification

```
                Interface Straps A:

                0 1  2  3
                12345678901234567890123456789012
                00000000010000000000000000000000


                Interface Straps B:

                0 1  2  3
                12345678901234567890123456789012
                00000000000000000000000000000000

      Press the number '0' to return to normal operation.
      To continue modification select (1-8).
```

3.4.2.4 Speed (Baud Rate)

Press key (**4**) to obtain the printout shown in Figure 3-10.

Figure 3–10: Speed Selection

```
                Speed -

                0. Exit
                1. 110
                2. 300
                3. 600
                4. 1200
                5. 1800
                6. 2400
                7. 4800
                8. 9600
                9. 19200
```

The speed (bits-per-second) shown above can be selected by the user to configure the LG31 serial interface. The higher the speed, the faster the data exchange between printer and host. However the speed must be set to match the host. The factory speed setting is 9600.

If you wish to select a speed other then 9600, press the corresponding key; (**7**) for example, to set the speed to 4800. Verify the new speed has been sent to non-volatile memory by pressing key (**0**). The printer should respond with a message verifying the speed has been changed to 4800 (Figure 3–11).

Figure 3–11: Speed (Baud Rate) Verification

```
            Speed - 4800
Press the number '0' to return to normal operation. To continue
modification select (1-8).
```

3.4.2.5 Parity (Select 5)

Pressing key (**5**) will result in the printout shown in Figure 3-12.

Figure 3–12: Parity Selection

```
When Interface Strap B6          When Interface strap B6
is OUT                           is IN (factory setting)

    Parity -                             Parity -

    0.  Exit                             0.  Exit
    1.  Even                             1.  Even
    2.  Odd                              2.  Odd
    3.  Space
    4.  Mark
```

Note

The space and mark options are available in 7-bit mode only. In 8-bit mode, these options are not selectable, and are not printed.

The parity (transmission error checking) options above can be selected by the user to configure the LG31 serial interface. The parity option selected must match the the parity option of the host.

Note

The parity options are disabled at the factory by setting interface strap A29 (front panel display is 29) to **IN**. Parity checking may be enabled by setting the strap to **OUT** (parity enabled).

If parity checking is enabled and you wish to change the parity option, press the corresponding key (**2**). For example, to select odd parity, verify the odd parity checking option has been sent to non-volatile memory by pressing the (**0**) key. The printer should respond with a message verifying the parity option has been changed to ODD (see Figure 3-13).

Figure 3–13: Parity Verification

```
            Parity - Odd
Press the number '0' to return to normal operation. To continue
modification select (1-8).
```

3.4.2.6 Exit

If all the required changes to the interface straps have been verified, pressing key (**0**) will return the printer to the off-line mode (printer will display **[O F L]**) and print the following message:

```
End of Program Mode
```

3.5 Interface Control Strap Descriptions

This section provides functional descriptions and factory settings of the interface straps A and B. Factory settings of the interface control straps taken from the configuration status printout is provided in Figure 3-14. Functional descriptions of the A and B interface control straps are provided in Table 3-3.

Figure 3–14: Interface Control Straps Factory Settings

```
Interface Control:        0        1         2         3
Interface Type - Serial   12345678901234567890123456789012
Interface Straps A:       00000000000000000000000000000000

Interface Straps B:       0        1         2         3
                          12345678901234567890123456789012
                          00000100000000000000000000000000
Speed - 9600
Parity - Even*

* Parity is disabled at interface strap B2.
```

Table 3–3: A and B Interface Strap Descriptions

Interface Strap	Factory Setting	Strap Function When Set to 1 (IN)
A1 - A3	Not Assigned	
A4	0 **(OUT)**	Enable **READY/BUSY** by way of **SCA** (pins 11 and 19). The lines are 12 V for READY and -12 V for BUSY.
A5	1 **(IN)**	Enable **READY/BUSY** by way of the **<XON>** and **<XOFF>** codes. **<XON>** is sent to the computer for **READY (BUSY** cleared) and **<XOFF>** is sent to the computer for **BUSY**.
A6	0 **(OUT)**	Enable **READY/BUSY** at the transmission of a 200 ms break. The 200 ms break is sent for **BUSY**, nothing is sent for **READY**.
A7	0 **(OUT)**	Enable **READY/BUSY** by way of **DTR** (pin 20). The line is 12 V for **READY** and -12 V for **BUSY**.
A8	0 **(OUT)**	Enable **READY/BUSY** by way of **RTS** (pin 4). The line is 12 V for **READY** and -12 V for **BUSY**.
A9 - A11	Not Assigned	
A12	0 **(OUT)**	Enable **NO FAULT/FAULT** by way of **SCA** (pins 11 and 19). The lines are 12 V for **NO FAULT** and -12 V for **FAULT**.
A13	1 **(IN)**	Enable **NO FAULT/FAULT** by way of the **<XON>** and **<XOFF>** codes. **<XON>** is sent to the computer for **NO FAULT (FAULT** cleared) and **<XOFF>** is sent to the computer for **FAULT**.
A14	0 **(OUT)**	Enable **NO FAULT/FAULT** at the transmission of a 200 ms break. The 200 ms break is sent for **FAULT**, nothing is sent for **NO FAULT**.
A15	0 **(OUT)**	Enable **NO FAULT/FAULT** by way of **DTR** (pin 20). The line is 12 V for **NO FAULT** and -12 V for **FAULT**.

Table 3–3 (Cont.): A and B Interface Strap Descriptions

Interface Strap	Factory Setting	Strap Function When Set to 1 (IN)
A16	0 **(OUT)**	Enable **NO FAULT/FAULT** by way of **RTS** (pin 4). The line is 12 V for **NO FAULT** and -12 V for **FAULT**.
A17 - A19		Not Assigned
A20	0 **(OUT)**	Enable **ONLINE/OFFLINE** by way of **SCA** (pins 11 and 19). The lines are 12 V for **ONLINE** and -12 V for **OFFLINE**.
A21	1 **(IN)**	Enable **ONLINE/OFFLINE** by way of the **<XON>** and **<XOFF>** codes. **<XON>** is sent to the computer for **ONLINE (FAULT** cleared) and **<XOFF>** is sent to the computer for **OFFLINE**.
A22	0 **(OUT)**	Enable **ONLINE/OFFLINE** at the transmission of a 200 ms break. The 200 ms break is sent for **OFFLINE** nothing is sent for **ONLINE**.
A23	0 **(OUT)**	Enable **ONLINE/OFFLINE** by way of **CD** (pin 20). The line is 12 V for **ONLINE** and -12 V for **OFFLINE**.
A24	0 **(OUT)**	Enable **ONLINE/OFFLINE** by way of CA (pin 4). The line is 12 V for **ONLINE** and -12 V for **OFFLINE**.
A25	Not Assigned	
A26	0 **(OUT)**	Enable **ETX/ACK** Protocol — The computer sends a block of data up to 1500 bytes long terminating it with **<ETX>**. When the printer has processed the data, it sends **<ACK>** to the computer indicating it is ready to receive more data. The computer cannot send data until it receives **<ACK>** from the printer. This protocol can be used by itself or in combination with any of the protocols previously described.

Table 3–3 (Cont.): A and B Interface Strap Descriptions

Interface Strap	Factory Setting	Strap Function When Set to 1 (IN)
A27	0 **(OUT)**	Reverse **SCA** Polarity — If the interface is configured to indicate status by way of **SCA** (pins 11 and 19), normal status will set the **SCA** lines to -12 V and a fault status will set the **SCA** lines to 12 V.
A28	0 **(OUT)**	Reverse **DTR** Polarity — If the interface is configured to indicate status by way of **DTR** (pin 20), normal status will set **DTR** to -12 V and a fault status will set **DTR** to 12 V.
A29	1 **(IN)**	Disable Parity Check—Sets the serial interface to accept any parity and not report parity errors.
A30	0 **(OUT)**	Enable Two Stop Bits—Sets the serial interface to require two stop bits to terminate a transmitted character. Typically two stop bits are used at the 110 baud transmission rate.
A31	0 **(OUT)**	Disable Printer Transmission—Inhibits the serial interface from transmitting data. The **XON/XOFF BREAK**, and **ETX/ACK** protocols cannot be used when this switch is **IN** because they require the interface to transmit.
A32	0 **(OUT)**	Reverse **RTS** Polarity – If the interface is configured to indicate status by way of **CA** (pin 4), normal status will set **CA** to -12 V and a fault status will set **CA** to 12 V.
B1	Not Assigned	
B2	1 **(IN)**	Disable the Parity Bit—Sets the serial interface to omit the parity bit when transmitting data to the computer.

Table 3–3 (Cont.): A and B Interface Strap Descriptions

Interface Strap	Factory Setting	Strap Function When Set to 1 (IN)
B3	0 **(OUT)**	Disable Auto Input Buffer Expansion—If the 8 KByte input buffer expansion option is installed, the input buffer is limited to 2048 Bytes of usable RAM. If the switch is **OUT**, all available RAM (10,240 Bytes) is used as the input buffer. This switch is ignored if the option is not installed.
B4	0 **(OUT)**	Disable Printer Transmission—The serial interface will not transmit if **DSR** (pin 6) is set to -12 V **(OFF)** by the computer. Use this switch with care if the **XON/XOFF, BREAK,** or **ETX/ACK** protocol is active, because the the printer must be able to transmit for these protocols to operate. Regardless of the switch setting, the computer can inhibit the printer transmission by setting **CB** (pin 5) to -12 V.
B5	0 **(OUT)**	Replace Underline With Carriage Return — Replaces the underline character **(5FH)** with a carriage return control code **(0DH)**.
B6	1 **(IN)**	Select 7- or 8-Bit Data—With the strap set to 1 **(IN)**, the serial interface accepts and processes 7-bit and 8-bit data. If the strap is set to 0 **(OUT)**, the interface will process all data as 7-bit data.
B7 - B32	Not Assigned	

Chapter 4

CHARACTER PROCESSING

4.1 General

This chapter describes how the LG31 processes printable and control characters when operating in the text mode. Control characters are interpreted by the LG31 printer as commands or as parts of control sequences. They affect how the LG31 processes, sends, and prints characters.

4.2 Coding Standards

The LG31 processes characters according to the American National Standards Institute (ANSI) standard X3.4-1977. The ANSI standard is based on character category, either printable or control. Categories are defined by the American Standard Code for Information Interchange (ASCII).

4.3 7-Bit and 8-Bit Environments

The LG31 is set to send and receive 7- or 8-bit data through the interface control straps (see Chapter 3). In a 7-bit environment, a total of 128 control and printable characters codes are available (see Figure 4-1). In an 8-bit environment a total of 256 control and printable codes are available (see Figure 4-2).

There are two sets of control characters, **C0** and **C1**. **C0** consists of the 7-bit control characters that is, the characters from **00H** to **1FH**. **C1** consists of the 8-bit control characters, that is characters from **80H** to **9FH**. **C1** characters may only be used in an 8-bit environment.

Two sets of printable characters may be used at one time. The LG31 stores the two active sets in areas called **GL** (graphics left) and **GR** (graphics right). The **GL** characters are the 7-bit printable characters. They range from **20H** to **7FH**. Character **20H** is a space and character **7FH** is a delete. The delete character may either be printed as checkerboard or be ignored depending on printer strap 30. The **GR** characters are the 8-bit printable characters. They range from **A0H** to **FEH**. The **GR** characters may only be printed in an 8-bit environment.

Figure 4–1: 7-bit U.S. ASCII Character Set

ROW	BITS B7 B6 B5 B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		0 0 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
0	0 0 0 0	NUL	0 0 0	DLE	20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	`	140 96 60	p	160 112 70
1	0 0 0 1	SOH	1 1 1	DC1 (XON)	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71
2	0 0 1 0	STX	2 2 2	DC2	22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72
3	0 0 1 1	ETX	3 3 3	DC3 (XOFF)	23 19 13	#	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73
4	0 1 0 0	EOT	4 4 4	DC4	24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74
5	0 1 0 1	ENQ	5 5 5	NAK	25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	e	145 101 65	u	165 117 75
6	0 1 1 0	ACK	6 6 6	SYN	26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76
7	0 1 1 1	BEL	7 7 7	ETB	27 23 17	’	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77
8	1 0 0 0	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78
9	1 0 0 1	HT	11 9 9	EM	31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79
10	1 0 1 0	LF	12 10 A	SUB	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	k	153 107 6B	{	173 123 7B
12	1 1 0 0	FF	14 12 C	FS	34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	l	154 108 6C	|	174 124 7C
13	1 1 0 1	CR	15 13 D	GS	35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	m	155 109 6D	}	175 125 7D
14	1 1 1 0	SO	16 14 E	RS	36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	~	176 126 7E
15	1 1 1 1	SI	17 15 F	US	37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	_	137 95 5F	o	157 111 6F	DEL	177 127 7F

KEY

ASCII CHARACTERS

ESC	33 OCTAL
	27 DECIMAL
	18 HEX

RE_UK00845M_89

Figure 4–2: 8-bit Digital Multinational Character Set

ROW	BITS B8 B7 B6 B5 → / B4 B3 B2 B1	0 (0000)	1 (0001)	2 (0010)	3 (0011)	4 (0100)	5 (0101)	6 (0110)	7 (0111)	8 (1000)	9 (1001)	10 (1010)	11 (1011)	12 (1100)	13 (1101)	14 (1110)	15 (1111)
0	0 0 0 0	NUL 0 0 0	20 16 10	SP 40 32 20	0 60 48 30	@ 100 64 40	P 120 80 50	` 140 96 60	p 160 112 70	200 128 80	DCS 220 144 90	240 160 A0	° 260 176 B0	À 300 192 C0	320 208 D0	à 340 224 E0	360 240 F0
1	0 0 0 1	1 1 1	DC1 (XON) 21 17 11	! 41 33 21	1 61 49 31	A 101 65 41	Q 121 81 51	a 141 97 61	q 161 113 71	201 129 81	221 145 91	¡ 241 161 A1	± 261 177 B1	Á 301 193 C1	Ñ 321 209 D1	á 341 225 E1	ñ 361 241 F1
2	0 0 1 0	2 2 2	22 18 12	" 42 34 22	2 62 50 32	B 102 66 42	R 122 82 52	b 142 98 62	r 162 114 72	202 130 82	222 146 92	¢ 242 162 A2	² 262 178 B2	Â 302 194 C2	Ò 322 210 D2	â 342 226 E2	ò 362 242 F2
3	0 0 1 1	3 3 3	DC3 (XOFF) 23 19 13	# 43 35 23	3 63 51 33	C 103 67 43	S 123 83 53	c 143 99 63	s 163 115 73	203 131 83	223 147 93	£ 243 163 A3	³ 263 179 B3	Ã 303 195 C3	Ó 323 211 D3	ã 343 227 E3	ó 363 243 F3
4	0 1 0 0	EOT 4 4 4	24 20 14	$ 44 36 24	4 64 52 34	D 104 68 44	T 124 84 54	d 144 100 64	t 164 116 74	IND 204 132 84	224 148 94	244 164 A4	264 180 B4	Ä 304 196 C4	Ô 324 212 D4	ä 344 228 E4	ô 364 244 F4
5	0 1 0 1	5 5 5	25 21 15	% 45 37 25	5 65 53 35	E 105 69 45	U 125 85 55	e 145 101 65	u 165 117 75	NEL 205 133 85	225 149 95	¥ 245 165 A5	µ 265 181 B5	Å 305 197 C5	Õ 325 213 D5	å 345 229 E5	õ 365 245 F5
6	0 1 1 0	6 6 6	26 22 16	& 46 38 26	6 66 54 36	F 106 70 46	V 126 86 56	f 146 102 66	v 166 118 76	206 134 86	226 150 96	246 166 A6	¶ 266 182 B6	Æ 306 198 C6	Ö 326 214 D6	æ 346 230 E6	ö 366 246 F6
7	0 1 1 1	7 7 7	27 23 17	’ 47 39 27	7 67 55 37	G 107 71 47	W 127 87 57	g 147 103 67	w 167 119 77	207 135 87	227 151 97	§ 247 167 A7	• 267 183 B7	Ç 307 199 C7	Œ 327 215 D7	ç 347 231 E7	œ 367 247 F7
8	1 0 0 0	BS 10 8 8	CAN 30 24 18	(50 40 28	8 70 56 38	H 110 72 48	X 130 88 58	h 150 104 68	x 170 120 78	HTS 210 136 88	230 152 98	¤ 250 168 A8	270 184 B8	È 310 200 C8	Ø 330 216 D8	è 350 232 E8	ø 370 248 F8
9	1 0 0 1	HT 11 9 9	31 25 19	) 51 41 29	9 71 57 39	I 111 73 49	Y 131 89 59	i 151 105 69	y 171 121 79	211 137 89	231 153 99	© 251 169 A9	¹ 271 185 B9	É 311 201 C9	Ù 331 217 D9	é 351 233 E9	ù 371 249 F9
10	1 0 1 0	LF 12 10 A	SUB 32 26 1A	* 52 42 2A	: 72 58 3A	J 112 74 4A	Z 132 90 5A	j 152 106 6A	z 172 122 7A	VTS 212 138 8A	232 154 9A	ª 252 170 AA	º 272 186 BA	Ê 312 202 CA	Ú 332 218 DA	ê 352 234 EA	ú 372 250 FA
11	1 0 1 1	VT 13 11 B	ESC 33 27 1B	+ 53 43 2B	; 73 59 3B	K 113 75 4B	[133 91 5B	k 153 107 6B	{ 173 123 7B	PLD 213 139 8B	CSI 233 155 9B	« 253 171 AB	» 273 187 BB	Ë 313 203 CB	Û 333 219 DB	ë 353 235 EB	û 373 251 FB
12	1 1 0 0	FF 14 12 C	34 28 1C	, 54 44 2C	< 74 60 3C	L 114 76 4C	\ 134 92 5C	l 154 108 6C	| 174 124 7C	PLU 214 140 8C	ST 234 156 9C	254 172 AC	¼ 274 188 BC	Ì 314 204 CC	Ü 334 220 DC	ì 354 236 EC	ü 374 252 FC
13	1 1 0 1	CR 15 13 D	35 29 1D	- 55 45 2D	= 75 61 3D	M 115 77 4D	] 135 93 5D	m 155 109 6D	} 175 125 7D	RI 215 141 8D	235 157 9D	255 173 AD	½ 275 189 BD	Í 315 205 CD	Ÿ 335 221 DD	í 355 237 ED	ÿ 375 253 FD
14	1 1 1 0	SO 16 14 E	36 30 1E	. 56 46 2E	> 76 62 3E	N 116 78 4E	^ 136 94 5E	n 156 110 6E	~ 176 126 7E	SS2 216 142 8E	236 158 9E	256 174 AE	276 190 BE	Î 316 206 CE	336 222 DE	î 356 238 EE	376 254 FE
15	1 1 1 1	SI 17 15 F	37 31 1F	/ 57 47 2F	? 77 63 3F	O 117 79 4F	_ 137 95 5F	o 157 111 6F	DEL 177 127 7F	SS3 217 143 8F	237 159 9F	257 175 AF	¿ 277 191 BF	Ï 317 207 CF	ß 337 223 DF	ï 357 239 EF	377 255 FF

ASCII CONTROL SET (columns 0–1) | ASCII GRAPHIC CHARACTER SET (columns 2–7) | ADDITIONAL CONTROL SET (columns 8–9) | DEC SUPPLEMENTAL GRAPHIC SET (columns 10–15)

DEC MULTINATIONAL CHARACTER SET (columns 0–15)

KEY

ASCII CHARACTERS		
ESC	1/11	COLUMN ROW
	33	OCTAL
	27	DECIMAL
	18	HEX

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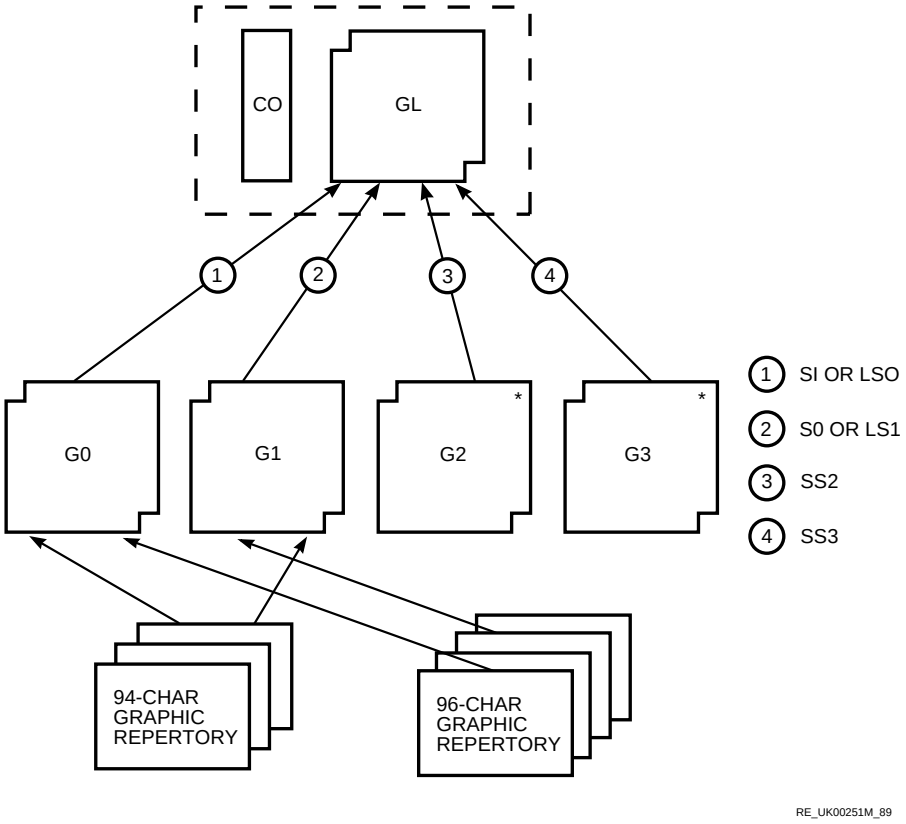
4.4 Character Set Mapping

LG31 allows the use of one **GL** and one **GR** at a time. The **GL** set may be used in a 7-bit environment (see Figure 4-3). In an 8-bit environment, both the **GL** and **GR** may be used (see Figure 4-4).

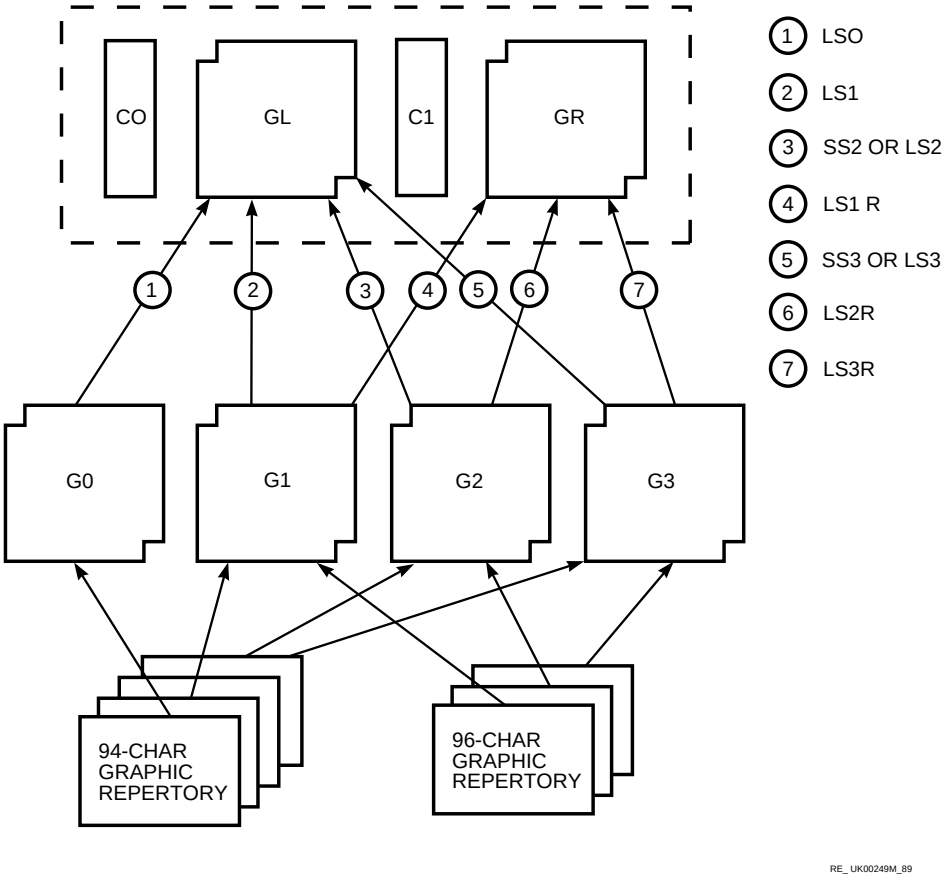
Printable characters are usually grouped into the two sets. A number of character sets are available in LG31 (see Appendix A). Each of these character sets may be mapped into either **GL** or **GR**. This is done by first designating the required character sets as **G0, G1, G2,** or **G3.** These **G0** to **G3** sets must then be mapped into either **GL** or **GR** using single and locking shift commands to facilitate the ease of use of more than two sets.

Figure 4–3: Designating and Mapping Character Sets (7-bit Environment)



*SS2 and SS3 affect only the first printable GL character following the single shift sequence. The printer processes non-printable characters (space, sequence, control codes) as usual. The locking shift (LS0, LS1, LS2, LS3, LS1R, LS2R, OR LS3R) remains in effect until another locking shift is received.

Figure 4–4: Designating and Mapping Character Sets (8-bit Environment)



4.5 7-bit Control Characters (C0)

This section describes the function of each of the LG31 **C0** control characters.

4.5.1 Bell <BEL>

The **<BEL>** control character sounds an electronic buzzer for approximately one-half second.

7-bit Control Code: **<BEL>**
Hex Value: **07**

4.5.2 Backspace <BS>

The **<BS>** control character moves the active line position one column to the left. If the active line position is at the left margin, **<BS>** is ignored.

7-bit Control Code: **<BS>**
Hex Value: **08**

If the horizontal pitch is changed within a line, **<BS>** will be implemented according to the new HAI value.

When the active column advances one HAI unit beyond the right margin and a **<BS>** character is received before another printable character is received, **<BS>** decreases the active column by one unit of HAI, allowing overprinting at the right margin. However, if the active column is more than one unit of HAI beyond the right margin, the **<BS>** function is ignored until the active column returns to the printable area.

4.5.3 Horizontal Tab <HT>

The **<HT>** control character advances the active horizontal tab position to the next preset horizontal tab stop. If horizontal tab stops do not exist, the active position goes to the right margin.

7-bit Control Code: **<HT>**
Hex Value: **09**

At power-up or on receipt of a reset (**RIS** or **DECSTR**), horizontal tab positions are set every 8 columns (9, 17, 25, ..., 137). If a horizontal tab stop exists to the right of the the active column, receipt of a **<HT>** advances the active position to that tab stop.

If no horizontal tab stops exist to the right of the active column and a **<HT>** is received, one of the two actions described below will occur, depending on whether autowrap is enabled or disabled.

When Autowrap is enabled, receipt of **<HT>** sets the active position to the right margin. Only the receipt of a printable character (including the space character) will change the horizontal column position and autowrap (carriage return and line feed).

When Autowrap is disabled, receipt of **<HT>** sets the active position to the right margin. Receipt of printable characters (including the space character) is ignored until the active column position is within the printable area by way of a carriage return or form feed for example.

4.5.4 Line Feed <LF>

The **<LF>** control character advances the active line position to the next line. If the active line is the last printable line on the page, receipt of Line Feed **<LF>** will advance the paper to the first printable line of the next page.

7-bit Control Code: **<LF>**
Hex Value: **0A**

4.5.5 Vertical Tab <VT>

The **<VT>** control character advances the active line position to the vertical tab position.

7-bit Control Code: **<VT>**
Hex Value **0B**

A vertical tab is a pre-selected line setting on a page. At power-up, vertical tabs are set at every line, and receipt of a **<VT>** will act as a line feed **<LF>**. If no vertical tabs remain on the current page, receipt of **<VT>** will perform a form feed **<FF>**.

Vertical tabs are set in the following way:

- Using the **DECSVTS** sequence.
- Using the 8-bit control code, **<VTS>**.

4.5.6 Form Feed <FF>

The **<FF>** control character advances the active line to the first printable line of the next page and sets the active horizontal print position at column 1.

7-bit Control Code: **<FF>**
Hex Value: **0C**

4.5.7 Carriage Return <CR>

The **<CR>** control character moves the active print position to the left most margin of the current line.

7-bit Control Code: **<CR>**
Hex Value: **0D**

4.5.8 Shift Out <SO>

The **<SO>** control character selects the **G1** character set as the **GL** active character set.

7-bit Control Code: **<SO>**
Hex Value: **0E**

4.5.9 Shift In <SI>

The **<SI>** control character selects the **G0** character set as the **GL** active character set.

7-bit Control Code: **<SI>**
Hex Value: **0F**

4.5.10 Device Control 1/XON <DC1>

The **<DC1>** control character is ignored if received by the printer. When sent by the printer, it signals to the host that the printer is ready to receive data.

7-bit Control Code: **<DC1>**
Hex Value: **11**

4.5.11 Device Control 3/XOFF <DC3>

When the **<DC3>** control character sent, it signals the host that the LG31 is not ready to receive data.

7-bit Control Code: **<DC3>**
Hex Value: **13**

This control code is ignored if received.

4.5.12 CANcel <CAN>

The **<CAN>** control character can perform one of two functions, depending upon the context:

7-bit Control Code: **<CAN>**
Hex Value: **18**

If the **<CAN>** control character is received in a sequence, it indicates the sequence is in error and causes the sequence in progress to be ended immediately. Characters following **<CAN>** are interpreted normally.

If the **<CAN>** control character received in a Device Control String (DCS), the string is immediately cancelled.

4.5.13 SUBstitute <SUB>

The **<SUB>** control character can perform one of three functions, depending upon the context.

7-bit Control Code: **<SUB>**
Hex Value: **1A**

If the **<SUB>** control character is received in a sequence, the sequence is canceled immediately, without execution of the sequence. In addition, **<SUB>** is interpreted as being in place of a character or characters received in error.

If the **<SUB>** control character is received during text printing, an the error character (reverse question mark) will be printed.

If the **<SUB>** control character is received during sixel graphics, **<SUB>** will be processed as **3FH** (Sixel space).

4.5.14 Escape <ESC>

The **<ESC>** control character introduces an escape control sequence (**<ESC>** followed by a sequence of printable characters) that control the printer's programmable features.

7-bit control code: **<ESC>**
Hex Value: **1B**

4.6 8-bit Control Codes and Equivalent Escape Sequences

This section describes the function of each of the LG31 **C1** control codes and gives a 7-bit equivalent escape sequence.

4.6.1 Forward INDex <IND>

The **<IND>** control character moves the active column position to the corresponding column position of the following line.

8-bit Control Code: **<IND>**
Hex Value: **84**

7-bit Escape Sequence: **<ESC>D**
Hex Value: **1B 44**

The **<IND>** command can move the active position past the page boundary into the next form.

4.6.2 Reverse Index <RI>

The **<RI>** control character moves the active column position to the corresponding column position of the preceding line.

8-bit Control Code: **<RI>**
Hex Value: **8D**

7-bit Escape Sequence: **<ESC>M**
Hex Value: **1B 4D**

The **<RI>** command does not cause the active position to be moved beyond the page boundary but stops at the top of form.

4.6.3 Horizontal Tab Set <HTS>

The **<HTS>** control character sets a horizontal tab stop at the active column.

8-bit Control Code: **<HTS>**
Hex Value: **88**

7-bit Escape Sequence: **<ESC>H**
Hex Value: **1B 48**

4.6.4 Vertical Tab Set <VTS>

The **<VTS>** control character sets a vertical tab stop at the active column.

8-bit Control Code: **<VTS>**
Hex Value: **8A**

7-bit Escape Sequence: **<ESC>J**
Hex Value: **1B 4A**

4.6.5 Partial Line Down <PLD>

The **<PLD>** control character moves the active column position to the corresponding column position approximately 3/72 inch down.

8-bit Control Code: **<PLD>**
Hex Value: **8B**

7-bit Escape Sequence: **<ESC>K**
Hex Value: **1B 4B**

The Partial Line Down **<PLD>** control character is used to position the characters following it as subscripts until returned to the active line using the Partial Line Up **<PLU>** cvontrol character.

4.6.6 Partial Line Up <PLU>

The **<PLU>** control character moves the active column position to the corresponding column position approximately 3/72 inch up.

8-bit Control Code: **<PLU>**
Hex Value: **8C**

7-bit Escape Sequence: **<ESC>L**
Hex Value: **1B 4C**

The Partial Line Up **<PLU>** control character is to position the characters following it as superscripts until returned to the active line using the Partial Line Down **<PLD>** control character.

4.6.7 Next Line <NEL>

The **<NEL>** control character moves the active column position to column one of the following lines.

8-bit Control Code: **<NEL>**
Hex Value: **85**

7-bit Escape Sequence: **<ESC>E**
Hex Value: **1B 45**

The **NEL** command does not move the active position beyond the page boundary (bottom of form).

4.6.8 Single Shift 2 <SS2>

The **<SS2>** control character sets the printer to select the next printable character from the **G2** character set.

8-bit Control Code: **<SS2>**
Hex Value: **8E**

7-bit Escape Sequence: **<ESC>N**
Hex Value: **1B 4C**

4.6.9 Single Shift 3 <SS3>

The **<SS3>** control character sets the printer to select the next printable character from the **G3** character set.

8-bit Control Code: **<SS3>**
Hex Value: **8F**

7-bit Escape Sequence: **<ESC>O**
Hex Value: **1B 4D**

4.6.10 Device Control String Introducer <DCS>

The **<DCS>** control character introduces the Sixel Graphics Mode device control string.

8-bit Control Code: **<DCS>**
Hex Value: **90**

7-bit Escape Sequence: **<ESC>P**
Hex Value: **1B 50**

4.6.11 Control Sequence Introducer <CSI>

The **<CSI>** control character introduces an 8-bit control sequence.

8-bit Control Code: **<CSI>**
Hex Value: **9B**

7-bit Escape Sequence: **<ESC>[**
Hex Value: **1B 5B**

4.6.12 String Terminator <ST>

The **<ST>** control character terminates an 8-bit control string.

8-bit Control Code: **<ST>**
Hex Value: **9C**

7-bit Escape Sequence: **<ESC>**
Hex Value: **1B 5C**

4.6.13 Operating System Command <OCS>, Privacy Message <PM>, and Application Program Command <APC>

The LG31 recognizes the start of these control strings, but will ignore all data following these sequences until terminated by the String Terminator **<ST>**.

Chapter 5

TEXT MODE ESCAPE AND CONTROL SEQUENCES

5.1 General

This chapter describes the escape sequences and control sequences used by the LG31 in text printing. The sequences are multi-byte control functions not provided by the single byte control codes.

5.2 Format

The LG31 uses escape and control sequences standardized by the American National Standards Institute (ANSI) to control many of its functions. Other LG31 functions have escape sequences defined within parameters of the ANSI standard. ANSI standards X3.4–1977 and X3.32–1973 define the escape and control sequences used in this chapter.

5.2.1 Escape Sequence Format

The general format of an escape sequence is:

<ESC>	I...I	F
1BH	20H - 2FH	30H - 7EH
Escape Sequence Introducer	Intermediate Characters (0 or more characters)	Final Character (1 character)

The escape sequence introducer is the **<ESC>** control character **(1BH)**. When the **<ESC>** is received, the next characters received within the proper range are not printed but are stored to be interpreted as part of the sequence.

If the characters following **<ESC>** are in the range of (**20H - 2FH**), they are "intermediate characters". The printer recognizes escape sequences with up to two intermediate characters. Therefore, only the first **two** intermediate characters are stored; subsequent intermediate characters are not stored. However, if more then two intermediate characters are received, the printer notes the event so that when the final character arrives, the entire escape is ignored.

If the character following the escape character or intermediate characters is in the range of **(30H - 7EH)**, it is defined as a "final character". The final character indicates the end of the escape sequence. The intermediate and final characters together define the function of the sequence. If recognized, the printer will perform the action specified by the sequence, then continue to process received text characters in the normal fashion.

If characters following the **<ESC>** code are not within the defined ranges, the entire sequence is ignored. If the characters following the **<ESC>** code are within the defined ranges but are not recognized, the entire sequence is also ignored.

Example:

```
Action:  Designate U.S. ASCII character set in G0

Sequence:
<ESC> (     B
1BH   28H   42H
|     |     |
|     |     |________Final Character, specifying ASCII
|     |______________________ Intermediate Character
|_____________________________  Escape Sequence Introducer
```

5.2.2 Control Sequence Format

The general format of a **<CSI>** sequence is:

(<CSI>)	P...P	I...I	F
9BH	30H - 3FH	20H - 2FH	40H - 7EH
Control Characters	Parameter Characters (0 or more characters)	Intermediate Character (0 or more characters)	Final Sequence Introducer (1 character)

The Control Sequence Introducer **<CSI>** has an 8-bit code of **(9BH)** which is equivalent to the 7-bit escape sequence of **<ESC> (1BH)** and **"[" (5BH)** characters. Both **<CSI>** and **<ESC>[** are recognized as the Control Sequence Introducer. After **<CSI>** or **<ESC>[** is received, all characters received within the proper range are not printed but stored to be used as part of the sequence.

Characters in the range of **(30H - 39H)**, following **<CSI>**, are defined as "parameter characters". A parameter character modifies the action or interpretation of the sequence. Generally, a parameter character is an **ASCII** representation of a decimal digit and signifies a numerical value to the sequence.

Parameters are interpreted as unsigned decimal integers, with the most significant digit sent first. Leading zeros are allowed but are ignored. A group of numeric parameters are separated by a semicolon **";" (3BH)**.

If a decimal value is not specified for a parameter character in a sequence, a value of zero is assumed for the parameter unless otherwise stated. The maximum value for a numeric parameter is 65535. Any larger value received is replaced by the maximum value allowed by that sequence, unless otherwise stated. There is a limit of 16 numeric parameters-per-string. If more than 16 numeric parameter values are received, only the first 16 are retained for evaluation.

If the printer receives the parameter characters **(3AH)**, **":"**, **(3DH)**, **"+"**, or **(3EH) ">"** anywhere in the parameter string, the printer performs no action until the "final character" is received, and then ignores the entire sequence. The parameter character **(3CH) "<"** is used to begin and end **VFU** load (see section on "Forms Control"). The parameter character **(3FH) "?"** is used in some Device Status Request **(DSR)** commands (see section on "Device Status Request").

If the printer receives a **<CSI>** sequence containing groups of parameters, and one or more group(s) is invalid, the printer does not ignore the entire sequence but processes those parameters which are recognized.

If all groups of parameters in a sequence are out of range or the sequence is recognized as invalid, the printer performs no action until the final character is received, and then ignores the entire sequence.

A character in the range of **(20H - 2FH)**, received after the **<CSI>** code or after the parameter character(s), is defined as an "intermediate character". The printer processes sequences with up to one intermediate character. Therefore, only one intermediate character is stored. If more than one intermediate character is received, the printer notes the event so that when the "final character" is received, the entire control sequence is ignored.

A character in the range of **(40H - 7EH)**, following **<CSI>** or after any number of parameter characters, is defined as a "final character". The final character indicates the end of the sequence. Any valid parameter characters together with the final character define the function of the sequence. If applicable, the printer performs the action specified by the sequence and then continues to process received characters in the normal fashion. If the sequence is not recognized as a function of the printer, it is be ignored.

Example:

```
  Action:  Set horizontal pitch to 12 characters-per-inch.
  Sequence:

  <ESC> [   2  w
  1BH   5BH   32H  77H
  |     |     |     |
  |     |     |     |_________  Final Character
  |     |     |_______________  Parameter Character
  |_____|_____________________  Control Sequence Introducer

Equivalent Sequence (for 8-bits only):

  <CSI> 2w
  9BH   32H   77H
  |     |     |
  |     |     |___________________   Final Character
  |     |_________________________   Parameter Character
  |_______________________________   Control Sequence Introducer
```

5.3 Error Recovery

This section describes the printers actions when invalid parameters and control functions are specified, and when control characters are embedded in control functions. Generally, the printer will recover from these conditions by performing as much of the function as possible.

1. Sequences not recognized by the printer are ignored.
2. Unless otherwise stated, control sequences with an invalid selective parameter are ignored.
3. Unless otherwise stated, when a numeric parameter exceeds the specified limit, the maximum allowable value for that parameter is used.
4. If a **C0** control character is received within a sequence, the control character is executed as if it were received before the sequence. Processing of the sequence will then resume.

   The following are exceptions to this rule:

   If the control character is **<CAN> (18H)** or **<SUB> (1AH)**, the sequence is aborted and the control character is processed.

   If the control character is **<ESC> (1BH)**, the sequence is aborted and processing of a new sequence or text begins.
5. If a **C1** control character is received within an escape or control sequence, the sequence is aborted and the **C1** control character will be processed if it is recognized by the printer; otherwise it is ignored.
6. If character **(A0H)** is received within a control sequence, it is processed as a **<SP> (20H)** character and processing of the sequence will then continue.
7. If character **(FFH)** is received within a control sequence, it is processed as a **<DEL> (7FH)** character and processing of the sequence will continue.
8. If a **GR** character is received during a control sequence, the eighth bit is ignored. The remaining seven bits are processed as a **GL** character.
9. **SS2** and **SS3** Processing:

   If a **C0** or **C1** control character is received after a single shift control character (**<SS2> (8EH)** or **<SS3> (8FH))**, the control character is processed and the Single Shift Flag remains set.

If a Control Sequence is received after **SS2 (8EH)** or **SS3 (8FH)**, the sequence is processed and the Single Shift Flag remains set.

When **<SP> (20H)** or **<DEL> (7FH)** is received after **(SS2** or **SS3)**, one of the following will occur:

- If a 94-character character set resides in the set being accessed **(G2** or **G3)**, **<SP>** or **<DEL>** will be processed and the Single Shift Flag remains set.
- If a 96-character character set resides in the set being accessed (**G2** or **G3**), the printer images the corresponding character (**A0H** or **FFH**) of that set and then resets the Single Shift Flag.
- If a **GR** character is received after **SS2** or **SS3**, the eighth bit is ignored. The Single Shift Function is applied to the remaining seven bits (defining a **GL** character).

The occurrence of a **GR** character after **SS2** or **SS3** is considered an error. Future models of the LG31 may not process this error in the same way. Therefore, software should never send a **GR** after **SS2** or **SS3**.

When (**A0H**) or (**FFH**) is received after (**SS2**) or (**SS3**), the following will occur:

- If a 94-character character set resides in the set being accessed **(G2** or **G3)**, the printer will print the error character (Reverse Question Mark) and then reset the Single Shift Flag.
- If a 96-character character set resides in the set being accessed (**G2**) or (**G3**), the printer images the corresponding character (**A0H**) or (**FFH**) of that set and then resets the Single Shift Flag.

5.4 Text Mode Sequence Descriptions

The following sections describe the LG31 printer's Text Mode escape and control sequences.

5.4.1 Select Character Set (SCS)

The Select Character Set **(SCS)** escape sequences assign any one of the LG31 printer's character sets (see Appendix A) to the **G0, G1, G2,** or **G3** character set designators. These designators define the contents of the **GL** and **GR** printable sets and can be controlled with the single shift commands (see Chapter 4).

The character sets and the **SCS** sequences to select them are listed in Table 5–1.

5.4.2 Assigning Active Character Sets Using Single and Locking Shifts

In the 7-bit environment, only the **GL** active character set is available. Sequences referring to the **GR** active character set are ignored. In the 8-bit environment, the printer uses the **GL** active character set if the character's eighth bit is **0**, and the **GR** active character set if the eighth bit is **1**.

Table 5–2 lists and describes the escape sequences and control codes that assign available character sets to the **GL** and/or **GR** active character sets.

Table 5–1: Select Character Set Sequences

G0	G1	G2	G3	Character Set
<ESC>(B	<ESC>(B	<ESC>*B	<ESC>+B	U.S. ASCII
<ESC>(A	<ESC>)A	<ESC>*A	<ESC>+A	Digital Great Britain
<ESC>(5	<ESC>)5	<ESC>*5	<ESC>+5	Digital Finnish
<ESC>(R	<ESC>)R	<ESC>*R	<ESC>+R	ISO French (France)
<ESC>(9	<ESC>)9	<ESC>*9	<ESC>+9	Digital French Canadian
<ESC>(K	<ESC>)K	<ESC>*K	<ESC>+K	ISO German
<ESC>(Y	<ESC>)Y	<ESC>*Y	<ESC>+Y	ISO Italian
<ESC>(J	<ESC>)J	<ESC>*J	<ESC>+J	JIS Roman (Japan)
<ESC>(6	<ESC>)6	<ESC>*6	<ESC>+6	Digital Norwegian/Danish
<ESC>(Z	<ESC>)Z	<ESC>*Z	<ESC>+Z	ISO Spanish
<ESC>(7	<ESC>)7	<ESC>*7	<ESC>+7	Digital Swedish
<ESC>(0	<ESC>)0	<ESC>*0	<ESC>+0	Digital VT100 Special Graphics
<ESC>(>	<ESC>)>	<ESC>*>	<ESC>+>	Digital Technical Set
<ESC>(‘	<ESC>)‘	<ESC>*‘	<ESC>+‘	ISO Norwegian/Danish
<ESC>(4	<ESC>)4	<ESC>*4	<ESC>+4	Digital Dutch
<ESC>(=	<ESC>)=	<ESC>*=	<ESC>+=	Digital Swiss
<ESC>(%6	<ESC>)%6	<ESC>*%6	<ESC>+%6	Digital Portuguese
<ESC>(%5	<ESC>)%5	<ESC>*%5	<ESC>+%5	Digital Supplemental

Any other character following **<ESC>**, **<ESC>**), **<ESC>** *, or **<ESC>**+ will cause the entire escape sequence to be ignored.

Table 5–2: Assigning Character Sets

Name	Mnemonic	Sequence	Function
Single Shift 2	SS2*	<ESC>N 1BH 4EH	The character following SS2 will be selected from the G2 character set.
Single shift 3	SS3*	<ESC>O 1BH 4FH	The character following SS3 will be selected from the G3 character set.
Locking Shift 0	LS0	<SI> OFH	The G0 character set becomes the active GL character set.
Locking Shift 1	LS1	<SO> OEH	The G1 character set becomes the active GL character set.
Locking Shift 2	LS2	<ESC>n 1BH 6EH	The G2 character set becomes the active GL character set.
Locking Shift 3	LS3	<ESC>o 1BH 6FH	The G3 character set becomes the active GL character set.
Locking Shift 1 Right	LS1R	<ESC>~ 1BH 7EH	The G1 character set becomes the active GR character set.
Locking Shift 2 Right	LS2R	<ESC>} 1BH 7DH	The G2 character set becomes the active GR character set.
Locking Shift 3 Right	LS3R	<ESC> | 1BH 7CH	The G3 character set becomes the active GR character set.

*SS2 and SS3 only affect the first printable **GL** character following the single shift sequence. The printer processes non-printable characters (space, sequences, control codes) as usual.

The effect of a locking shift (**LS0, LS1, LS2, LS3, LS1R, LS2R,** or **LS3R**) remains in effect until another locking shift is received.

5.4.3 Selecting Fonts and Font Attributes (SGR)

Selecting fonts and font attributes are part of the same family of control and escape sequences called Select Graphic Rendition (SGR). The sequences in this section allow you to select one of four fonts and/or one or more font attributes.

7-bit Escape Sequence: **<ESC>[Pn;...;Pnm**
Hex Value: **1B 5B Pn 3B ... 3B Pn 6D**

8-bit Control Sequence: **<CSI>Pn;...;Pnm**
Hex Value: **9B Pn 3B ... 3B Pn 6D**

Font and/or font attributes are selected using the (**Pn**) values listed below:

(Pn) Value	**Font Selections**
10	Data processing font (DP)
11	Near Letter Quality Font (NLQ)
12	OCR-A Font
13	OCR-B Font

(Pn) Value	**Font Attribute Selections**
0	Disables All Font Attributes.
1*	Enables Bold Printing (double strike).
3†	Enables Italic Printing.
4‡	Enables Underlining of Spaces and Characters.
22	Disables Bold Printing.
23	Disables Italic Printing.
24	Disables Underlining.

*Bold printing can be used with the Data Processing and NLQ Fonts at all available pitches and font attributes.
†Italicized printing can be enabled while in any font but the printing of the characters will occur in an NLQ font. Italics is not available for the 16.7 CPI.
‡Underlining can be used with all fonts and pitches.

Receipt of the Bold Print attribute sets the printer to double-strike until disabled. Individual characters on a line can be bolded if the sequence is introduced at the position for bolding to start, and then cancelled when unbolded (normal) text starts using the **<ESC> [22m** sequence.

Italicized Print: receipt of the Italics attribute sets the printer to Italicize characters until the command is terminated using the **<ESC> [23m** sequence.

Underlined Print: receipt of the Underline attribute sets the printer to underline characters and spaces until the command is terminated using the **<ESC> [24m** sequence.

5.4.4 Graphic Size Modification (GSM)/Character Expansion

Allows the expansion of the vertical (height) and horizontal (width) dimensions of printed characters.

7-bit Escape Sequence: **<ESC>[Pn1;Pn2<SP>B**
Hex Value: **1B 5B Pn1 3B Pn2 20 42**

8-bit Control Sequence: **<CSI>Pn1;Pn2<SP>B**
Hex Value: **9B Pn1 3B Pn2 20 42**

The **Pn1** (vertical expansion) and **Pn2** (horizontal expansion) values are defined as follows:

Vertical Expansion	Pn1 Value	Horizontal Expansion	Pn2 Value
1x*	100	1x*	100
2x	200	2x	200
3x	300		

*Normal height/width characters

The graphic size modification (GSM) control sequence is ignored in the OCR-A and OCR-B fonts.

If **Pn1** and/or **Pn2** are missing, the default expansion (1x) is implemented for the missing value. An invalid Pn value will cause the best fit expansion to be implemented.

When double-width characters are set, the columns will be double width with the horizontal tabs set to the double width columns. When the double-width expansion is disabled, the horizontal tab stops are reset to normal width columns. Spaces are also expanded when double-width characters are set.

If vertical expansion is selected, vertical pitch is expanded by the same expansion factor.

Examples: **<ESC>[;200<SP>B** sets 1x vertical (normal) and 2x horizontal expansion.
<ESC>[200;200<SP>B sets 2x vertical and 2x horizontal expansion.
<ESC>[300;<SP>B sets 3x vertical and 1x (normal) horizontal expansion.

5.4.5 Horizontal and Vertical Character Spacing

This section describes the escape and control sequences affecting the horizontal spacing or pitch between characters (characters-per-inch) and vertical spacing or pitch between lines (lines-per-inch).

5.4.5.1 Set Horizontal Pitch (DECSHORP)

Sets character width and spacing in units of characters-per-inch **(CPI)**.

7-bit Escape Sequence: **<ESC>[Pnw**
Hex Value: **1B 5B Pn 77**

8-bit Control Sequence: **<CSI>Pnw**
Hex Value: **9B Pn 77**

The horizontal pitch selection values (Pn) are defined as follows:

Pn Value	Horizontal Pitch (CPI)*
0	10
1	10
2	12
3	13.3
5	5 (Normal width characters)
9	15
4	16.7

*CPI = characters per inch

If the **Pn** value is missing, the horizontal pitch will default to **10 CPI**. An invalid **Pn** value will cause the default **(10 CPI)** pitch to be selected. Horizontal pitch is automatically set to **10 CPI** after a font selection is made.

The following lists the horizontal pitches available in each font:

Current 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

*NLQ = Near Letter Quality
†"Yes" indicates that the horizontaL pitch is available in the current font.
‡"NLQ" indicates that the Near Letter Quality font is automatically substituted for the OCR-A and OCR-B fonts in all horizontal pitches, except the 10 CPI. If the horizontal pitch is changed to 10 CPI, the printer will return to the selected OCR font.

5.4.5.2 Vertical Pitch (DECVERP)

Sets spacing between between lines in units of Lines-Per-Inch **(LPI)**.

7-bit Escape Sequence: **<ESC>[Pnz**
Hex Value: **1B 5B Pn 7A**

8-bit Control Sequence: **<CSI>Pnz**
Hex Value: **9B Pn 7A**

If the Pn value is missing, the vertical pitch will default to 6 LPI. An invalid Pn value will cause the default (6 LPI) pitch to be selected.

The vertical pitch selection values (Pn) are listed as follows:

Pn Value	Vertical Pitch (LPI)
0	6
2	8
7	10

Changing vertical pitch changes changes the physical size of the form, since the form length is specified in terms of lines-per-page.

Ten lines/in is accomplished by reversing the paper. Since the paper will be reversed to produce 10 LPI. The lines will overlap by a maximum of two dot rows.

Changing vertical pitch will not change the row numbers at which the vertical tab stops are enabled. If at 6 LPI, line 15 had a vertical tab, changing to 8 or 10 LPI will not change the vertical tab set at row 15.

5.4.6 Print Area Parameters

This section describes the escape and control sequences defining the print area parameters. These parameters are defined by the line-per-physical-page, set top and bottom margins, and set left and right margins sequences.

5.4.6.1 Set Lines Per Physical Page (DECSLPP)

Sets the page length by selecting the number of lines (Pn) per page (form) at the current vertical pitch. The maximum form length is 22 in (55.9 cm).

7-bit Escape Sequence: **<ESC>[Pnt**
Hex Value: **1B 5B Pn 74**

8-bit Control Sequence: **<CSI>Pnt**
Hex Value: **9B Pn 74**

The table below shows the maximum number of lines (Pn) for a 22 in (55.9 cm) form with the printer's vertical pitch set at 6, 8, and 10 LPI:

Max Number of Lines (Pn)	LPI*	Inches (cm)-Per-Line
132 @ 22 in	6	1/6 in (0.42 cm)
176 @ 22 in	8	1/8 in (0.32 cm)
220 @ 22 in	10	1/10 in (0.25 cm)

*Changing vertical pitch (LPI) changes the physical size of the form because the form length is specified in lines.

The active line becomes the Top Of Form (TOF) when the DECSLPP sequence is received. Therefore the operator must first align the paper to the desired TOF before the sequence is sent.

5.4.6.2 Set Top and Bottom Margins (DECSTBM)

Sets the top margin (first printable line) and bottom margin (last printable line) parameters. Values (Pn1 and Pn2) are given in line numbers at the current vertical pitch (LPI).

7-bit Escape Sequence: **<ESC>[Pn1;Pn2r**
Hex Value: **1B 5B Pn1 3B Pn2 72**

8-bit Control Code: **<CSI>Pn1;Pn2r**
Hex value: **9B Pn1 3B Pn2 72**

See the table in Section 5.4.6.1 to calculate the maximum number of lines allowed for Pn1 (top margin) and Pn2 (bottom margin) values. Depending on the vertical pitch setting, Pn2 minus Pn1 cannot exceed the maximum number of lines allowed at that pitch.

Changing vertical pitch (LPI) changes the physical size of the form because the top and bottom margins are expressed in line units.

If the active line is above the new top margin, the active line is advanced to the new top margin.

If the active line is below the new bottom margin, a form feed is generated to advance the paper to the new top margin.

When the lines-per-page/form length **(DECSLPP)** is changed, the top and bottom margins are reset to default values (top margin is line 1 and bottom margin is the form length).

Pn Value	Action
If Pn1 > Pn2	The DECSTBM sequence is ignored.
If Pn1 is missing	The default value is line 1.
If Pn2 is missing	The default value is the form length.

5.4.6.3 Set Left and Right Margins (DECSLRM)

Sets the left margin (first printable column) and right margin (last printable column) parameters. Values (Pn1 and Pn2) are given in column numbers at the current horizontal pitch (CPI). Pn1 is the column number of the left margin and Pn2 is the column number of the right margin.

7-bit Escape Sequence: **<ESC>[Pn1;Pn2s**
Hex Value: **1B 5B Pn1 3B Pn2 73**

8-bit Control Code: **<CSI>Pn1;Pn2s**
Hex Value: **9B Pn1 3B Pn2 73**

The maximum allowable value of the Pn1 parameter is always one column less than the Pn2 parameter.

Pn Value	Action
If Pn1 = 0 or none	The left margin does not change.
If Pn2 = 0 or none	The right margin does not change.
If Pn1 > Pn2	The DECSLRM sequence is ignored.

If Pn2 is greater than the right-most printable position, the right margin is set to the right-most printable position.

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

If Autowrap is enabled, and the active position is past the right margin specified by this command, then the next printable character will generate a carriage Return/Line Feed before this character is printed.

If Autowrap is disabled (truncated), and the active position is past the right margin, printable characters that follow will be ignored until the cursor is brought within the printable area.

The margins set by this sequence are defined as hard margins because printing is not permitted outside them. The only exception to this rule is vector drawing. The vector sequence permits drawing outside the margins.

When character pitch is changed and the same physical margins are desired, it will be necessary to reset the margins using this escape sequence before any data is sent. Changing the horizontal pitch resets the left and right margins to their printable limits (column 1 and the right-most position respectively).

5.4.7 Active Column and Active Line Commands

This section describes the sequences and control codes affecting the active column and active line positioning.

5.4.7.1 Set Forward INDex (IND)

Causes the active position to move to the same horizontal position on the next line.

7-bit Escape Sequence: **<ESC>D**
Hex Value: **1B 44**

8-bit Control Code: **<IND>**
Hex Value: **84**

The **<IND>** command can move the active position past the page boundary onto the next form.

5.4.7.2 Set Reverse Index (RI)

Moves the active horizontal position (column) to the same position on the previous line.

7-bit Escape Sequence: **<ESC>M**
Hex Value: **1B 4D**

8-bit Control Code: **<RI>**
Hex Value: **8D**

The **<RI>** command does not move the the active position beyond the page boundary (top of form).

5.4.7.3 NExt Line <NEL>

Moves the active column position to column 1 of the following line.

7-bit Escape Sequence: **<ESC>E**
Hex Value: **1B 45**

8-bit Control Code: **<NEL>**
Hex Value: **85**

The **<NEL>** command can move the active position beyond the page boundary (bottom of form).

5.4.7.4 Horizontal Position Absolute (HPA)

Moves the active horizontal position to column Pn on the active line.

7-bit Escape Sequence: **<ESC>[Pn‘**
Hex Value: **1B 5B Pn 60**

See the table below for the maximum number of columns (dependent on CPI setting) on a 13.2 in (33.53 cm) print line.

CPI	Max. Columns	CPI	Max. Columns	CPI	Max. Columns
10	132	12	158	13.3	176
15	198	16.7	220		

If the column value (**Pn**) exceeds the right margin of the active line, **HPA** is set at the last column of the active line.

If the **Pn** value is missing or **0**, the default is column 1.

If an attempt is made to move the active position past the right margin, the active position stops at the right margin.

5.4.7.5 Set Horizontal Position Relative (HPR)

Moves the active horizontal position Pn columns to the right of the present position.

If column Pn exceeds the right margin of the active line, **HPR** is set at one column past the right margin of the active line.

7-bit Escape Sequence: **<ESC>[Pna**
Hex Value: **1B 5B Pn 61**

8-bit Control Sequence: **<CSI>Pna**
Hex Value: **9B Pn 61**

See the table in the previous escape sequence **(HPA)** for the maximum number of columns on a 13.2 in (33.53 cm) line.

If the **Pn** value is missing or **0**, the default is one column to the right of the active horizontal position.

If an attempt is made to move the active position past the right margin, the active position stops at the right margin.

5.4.7.6 Set Horizontal Position Backward (HPB)

Moves the active horizontal position Pn columns to the left of the present position.

If column Pn exceeds the left margin of the active line, **HPB** is set at one column to the left of the active horizontal position.

7-bit Escape Sequence: **<ESC>[Pnj**
Hex Value: **1B 5B Pn 6A**

8-bit Control Sequence: **<CSI>Pnj**
Hex Value: **9B Pn 6A**

If the **Pn** value is missing or **0**, the default is one column to the left of the active horizontal position.

If an attempt is made to move the active position past the right margin, the active position stops at the right margin.

5.4.7.7 Vertical Position Absolute (VPA)

Moves the active vertical position to line Pn of the current page, while maintaining the active horizontal position (column).

7-bit Escape Sequence: **<ESC>[Pnd**
Hex Value: **1B 5B Pn 64**

8-bit Control Sequence: **<CSI>Pnd**
Hex Value: **9B Pn 64**

If the **Pn** value is missing or 0, the default value of 1 is assumed. If an attempt is made to move the active position past the last printable line on the form, the active position stops on the last line. The **VPA** sequence does not move the active position beyond the page boundary (bottom of form).

5.4.7.8 Vertical Position Relative (VPR)

Moves the vertical position Pn lines down from the current active vertical position on the current page, while maintaining the horizontal position (column).

7-bit Escape Sequence: **<ESC>[Pne**
Hex Value: **1B 5B Pn 65**

8-bit Control Sequence: **<CSI>Pne**
Hex Value: **9B Pn 65**

If the **Pn** value is missing or **0**, the default value of 1 is assumed. If an attempt is made to move the active position past the last printable line on the form, the active position stops on the last line.

The **VPR** sequence does not move the active position beyond the page boundary (bottom of form).

5.4.7.9 Set Vertical Position Backward (VPB)

Moves the vertical position Pn lines up (reverse paper feed) from the active vertical position on the current page, while maintaining the horizontal position (column).

7-bit Escape Sequence: **<ESC>[Pnk**
Hex Value: **1B 5B Pn 6B**

8-bit Control Sequence: **<CSI>Pnk**
Hex Value: **9B Pn 6B**

If the **Pn** value is missing or 0, the default value of 1 is assumed.

The **VPB** sequence does not move the active position beyond the page boundary (top of form).

5.4.7.10 CUrsor Up (CUU)

Moves the vertical position Pn lines up (reverse paper feed) from the active vertical position on the current page, while maintaining the horizontal position (column).

7-bit Escape Sequence: **<ESC>[PnA**
Hex Value: **1B 5B Pn 41**

8-bit Control Sequence: **<CSI>PnA**
Hex Value: **9B Pn 41**

If the **Pn** value is missing or 0, the default value of 1 is assumed.

The CUU sequence does not move the active position beyond the page boundary (top of form).

5.4.7.11 Partial Line Down (PLD)

The default value is line 1.

Moves the active column position to the corresponding column position approximately 3/72 inch down.

7-bit Escape Sequence: **<ESC>K**
Hex Value: **1B 4B**

8-bit Control Code: **<PLD>**
Hex Value: **8B**

The **PLD** command is used to position printable characters following it as subscript characters until returned to the active line using the Partial Line Up (**PLU**) command.

5.4.7.12 Partial Line Up (PLU)

Moves the active column position to the corresponding column position approximately 3/72 inch up.

7-bit Escape Sequence: **<ESC>L**
Hex Value: **1B 4C**

8-bit Control Code: **<PLU>**
Hex Value: **8C**

The **PLU** command is used to position the characters following it as superscript characters until returned to the active line using the Partial Line Down (**PLD**) command.

5.4.8 Horizontal and Vertical Tab Commands

This section describes the sequences and control codes affecting horizontal and vertical tab commands.

5.4.8.1 Horizontal Tab Stop (HTS)

Sets a horizontal tab stop at the active column.

7-bit Escape Sequence: **<ESC>H**
Hex Value: **1B 48**

8-bit Control Code: **<HTS>**
Hex Value: **88**

5.4.8.2 Set Horizontal Tab Stops (DECSHTS)

Sets a maximum of 16 horizontal tab stops (Pn) on a print line-per-sequence. Two or more sequences can be combined to set a maximum of 198 horizontal tab stops-per-line.

Tab stop values (Pn) are specified in columns.

7-bit Escape Sequence: **<ESC>[Pn1;...;Pn16u**
Hex Value: **1B 5B Pn1 3B ... 3B Pn2 75**

8-bit Control Sequence: **<CSI>Pn1;...;Pn16u**
Hex Value: **9B Pn1 3B ... 3B Pn16 75**

See the following table for the maximum number of columns (dependent on CPI setting) on a 13.2 in (33.53 cm) print line.

CPI	Max. Columns	CPI	Max. Columns	CPI	Max. Columns
10	132	12	158	13.3	176
15	198	16.7	220		

Tab stops numbering more then 16-per-sequence or 198-per-line will be ignored.

5.4.8.3 Vertical Tab Set (VTS)

Sets a vertical tab stop at the active line.

7-bit Escape Sequence: **<ESC>J**
Hex Value: **1B 4A**

8-bit Control Code: **<VTS>**
Hex Value: **8A**

5.4.8.4 Set Vertical Tab Stops (DECSVTS)

Sets a maximum of 16 vertical tab stops (Pn)-per-sequence. Two or more sequences can be combined to set a maximum of 66 vertical tab stops-per-page.

Tab stop values (Pn) are specified in lines.

7-bit Escape Sequence: **<ESC>[Pn1;...;Pn16v**
Hex Value: **1B 5B Pn1 3B ... 3B Pn2 76**

8-bit Control Sequence: **<CSI>Pn1;...;Pn16v**
Hex Value: **9B Pn1 3B ... 3B Pn16 76**

Tab stops numbering more then 16-per- sequence or 66-per-page will be ignored.

5.4.8.5 Tabulation Clear (TBC)

Clears one or more horizontal or vertical tab stops depending on the Pn value.

7-bit Escape Sequence: **<ESC>[Png**
Hex Value: **1B 5B Pn 67**

8-bit Control Sequence: **<CSI>Png**
Hex Value: **9B Pn 67**

A listing of horizontal and vertical tab clear Pn values is provided in the following table:

Pn Value	**Description**
0	Clears the horizontal tab stop at the active column.
1	Clears the vertical tab stop at the active line.
2	Clears horizontal tab stops (including default settings) for the active line only. Any subsequent horizontal tab control code **(HT)** sets the active horizontal position on the right margin of the active line.
3	Clears all horizontal tab stops (including default settings). Any subsequent horizontal tab control code **(HT)** sets the active horizontal position on the right margin of the active line. Horizontal tabs will remain cleared until set with sequences, control codes or the reset facility.
4	Clears all vertical tab stops.

5.4.9 Set/Reset Controls

This section describes the control and escape sequences affecting the autowrap, carriage return, and linefeed functions of the printer.

5.4.9.1 Autowrap Mode (DECAWM)

This mode defines the printer's response when the print position is beyond the right margin.

Autowrap Mode Enabled
When **DECAWM** is enabled and the active position is beyond the right margin, all following printable characters are printed on the next line beginning at the left margin.

7-bit Escape Sequence: **<ESC>[?7h**
Hex Value: **1B 5B 3F 37 68**

8-bit Control Sequence: **<CSI>?7h**
Hex Value: **9B 3F 37 68**

Autowrap Mode Disabled
When **DECAWM** mode is disabled, all printable characters received beyond the right margin are ignored until the cursor is brought into the print area.

7-bit Escape Sequence: **<ESC>[?7l**
Hex Value: **1B 5B 3F 37 6C**

8-bit Control Sequence: **<CSI>?7l**
Hex Value: **9B 3F 37 6C**

5.4.9.2 Carriage Return/New Line Mode (DECCRNLM)

This mode defines the printer's response to the **<CR>** control code.

Carriage Return/New Line Mode Enabled
When **DECCRNLM** is enabled, a **<CR>** character returns the active column to the left margin and advances the paper one line.

7-bit Escape Sequence: **<ESC>[?40h**
Hex Value: **1B 5B 3F 34 40 68**

8-bit Control Sequence: **<CSI>?40h**
Hex Value: **9B 3F 34 40 68**

Carriage Return/New Line Mode Disabled
When **DECCRNLM** is disabled, a **<CR>** character returns the active column to the left margin without advancing to a new line.

7-bit Escape Sequence: **<ESC>[?40l**
Hex Value: **1B 5B 3F 34 40 6C**

8-bit Control Sequence: **<CSI>?401**
Hex Value: **9B 3F 34 40 6C**

5.4.9.3 Line Feed/New Line (LNM) Mode

This mode defines the printer's response to the **<LF>** control code.

Line Feed/New Line Mode Enabled
When **LNM** is enabled, a **<LF>** character advances the paper one line and returns the active column to the left margin.

7-bit Escape Sequence: **<ESC>[20h**
Hex Value: **1B 5B 32 30 68**

8-bit Control Sequence: **<CSI>20h**
Hex Value: **9B 32 30 68**

Line Feed/New Line Mode Disabled
When **LNM** is disabled, a **<LF>** character advances the paper one line. The active column does not change.

7-bit Escape Sequence: **<ESC>[20l**
Hex Value: **1B 5B 32 30 6C**

8-bit Control Sequence: **<CSI>20l**
Hex Value: **9B 32 30 6C**

5.4.10 Vertical Forms Unit (VFU)

The escape and control sequences described in this section control loading and access of the **VFU**.

Vertical forms control is accomplished by loading the **VFU** table. The **VFU** table contains 12 channels; channels 1 and 12 are designated as top of form and bottom of form respectively; and the other 10 channels are defined as individual vertical page formats. Any one of the 12 channels can be called to implement that format.

There are three **VFU** sequences described in this section; one to load the 12 channel **VFU** table, one to end loading of the **VFU** table, and one to access the **VFU** table. Also included are descriptions of how to create/load and use the **VFU** table.

5.4.10.1 Load Vertical Format Unit (VFU)

The Load **VFU** sequence prepares the printer for the loading of the 12 channel **VFU** table. The data following the Load **VFU** sequence is loaded into the **VFU** memory as the **VFU** table (see Section 5.4.10.4 for examples). The Load sequence, followed by the **VFU** table data must be terminated immediately by the End **VFU** Load sequence.

7-bit Escape Sequence: **<ESC>[<1h**
Hex Value: **1B 5B 3C 31 68**

8-bit Control Sequence: **<CSI><1h**
Hex Value: **9B 3C 31 68**

VFU also defines the top of form. The position of the paper when the load **VFU** is sent determines the **TOF**. Align the paper at the desired top of form before you send the **VFU**.

5.4.10.2 End VFU Load

Immediately after the **VFU** table has been loaded with the desired data, the End **VFU** Load sequence must be sent to notify the printer that **VFU** table loading is complete (see Section 5.4.10.4).

7-bit Escape Sequence: **<ESC>[<1l**
Hex Value: **1B 5B 3C 31 6C**

8-bit Control Sequence: **<CSI><1l**
Hex Value: **9B 3C 31 6C**

5.4.10.3 VFU Channel Command

The **VFU** Channel Command sequence allows access to the **VFU** table previously loaded into the **VFU** memory. The nnn value (see the following table for examples) defines the channel to be used and direction of vertical movement.

7-bit Escape Sequence: **<ESC>[nnn&y**
Hex Value: **1B 5B n n n 26 79**

8-bit Control Sequence: **<CSI>nnn&y**
Hex Value: **9B n n n 26 79**

The **VFU** Channel Command sequence can retrieve any 1 of the 12 **VFU channels** and specify forward or reverse paper movement each time it is received. Channel and paper control are defined by the nnn values in the following table:

nnn*	Move Forward To Channel	nnn*	To Channel
000	1	900	1
001	2	901	2
002	3	902	3
003	4	903	4
004	5	904	5
005	6	905	6
006	7	906	7
007	8	907	8
008	9	908	9
009	10	909	10
010	11	910	11
011	12	911	12

*Selecting a channel other that those listed above, or a channel that has not been defined (no vertical tab stops), will result in a default to channel 12 (**BOF**).

The **VFU** channel command can be sent to call the same channel each time data is to be printed. This means the paper is advanced to each successive tab stop when the command is received.

5.4.10.4 How to Create and Load the VFU Table

The data following the Load **VFU** sequence is made up of 12 channels of forms control data in **VFU** load format. Channels 1 and 12 are reserved for top of form and bottom of form formats. Channels 2-11 are reserved for vertical page formats.

If an error occurs during loading of the **VFU** table, the load is cancelled and the printer defaults to the forms established by the **DECSLPP** sequence or the control panel settings.

The **VFU** load format consists of two bytes (one byte pair) for each line of the **VFU** table. Since the maximum form length is 22 in (55.9 cm), the maximum number of lines (byte pairs) in the **VFU** table at 6, 8, and 10 LPI settings are 132, 176 and 220 lines (byte pairs) respectively. The byte pairs contain the data for each line of the vertical format as described below:

	Bit	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Byte No. 1	Value	x	1	C6	C5	C4	C3	C2	C1
Byte No.2	Value	x	1	C12	C11	C10	C9	C8	C7

Bits 1-6: represent channels 1-12 (C1-C6 and C7-C12) with binary 1's or 0's. If a binary 1 is present, a vertical tab stop is activated for that channel at that line, a binary 0 indicates the absence of a vertical tab stop for that channel at that line.

Bit 7: must be a binary 1
Bit 8: can be a binary 0 or 1 (x), the value does not matter.
C1: channel 1 is the top of form (TOF) channel.
C2-C11: channels 2 through 11 are the vertical form channels.
C12: channel 12 is the bottom of form (BOF) channel.

The lower bits (1 through 6) of each byte pair contain the the information designating the absence or presence of a vertical tab stop for that line in each of 12 channels. The table below shows the **VFU** table loaded with 7-line (7-byte pairs) vertical formats. Remember, load the **VFU** table with the number of byte pairs equal to the number of lines in the form.

	Byte No. 1								Byte No. 2							
Bit No.	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
Channel No.	1	2	3	4	5	6	-	-	7	8	9	10	11	12	-	-
Line No. 1	1	0	0	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 2	0	0	1	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 3	0	1	0	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 4	0	0	1	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 5	0	1	0	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 6	0	0	1	0	0	0	1	x	0	0	0	0	0	0	1	x
Line No. 7	0	0	0	0	0	0	1	x	0	0	0	0	0	1	1	x

The sample **VFU** table above shows the table loaded with two vertical page formats (channels 2 and 3), seven lines long. Channels 1 and 12 are designated as top and bottom of form formats.

Channel 1—Channel 1 specifies top of form **(TOF)**. The first byte pair (line 1) loaded channel 1 with a 1, all other lines in channel 1 should be loaded with zeros (0's). When channel 1 is called, the paper will advance (or reverse) to the next (or current) **TOF**.

Channel 2—Channel 2 has vertical tab stops at lines 3 and 5.

Channel 3—Channel 3 has vertical tab stops at lines 2, 4, and 6.

Channels 4 through 11—These channels are undefined (loaded with 0's) in that no vertical tab stops (top and bottom of form included) have been specified.

Channel 12—Channel 12 specifies bottom of form **(BOF)**. The last byte pair (last line) should load channel 12 with a 1, all other lines in channel 12 should be loaded with zeroes (0's). When channel 12 is called, the paper will advance (or reverse) to the next (or current) **BOF**.

The format used to load the data in the previous Table requires that the individual bytes be designated with the character equivalent of the binary value. After making up the **VFU** table as in the previous example, refer to Table D-1 in Appendix D for a cross reference of binary values (bit patterns) and the equivalent character. For example:

	Bit Pattern								Equivalent
	1	2	3	4	5	6	7	8	**Character**
Line 1, Byte 1	1	0	0	0	0	0	1	x	A
Line 1, Byte 2	0	0	0	0	0	0	1	x	@
Line 2, Byte 1	0	0	1	0	0	0	1	x	D
Line 2, Byte 2	0	0	0	0	0	0	1	x	@
Line 3, Byte 1	0	1	0	0	0	0	1	x	B
Line 3, Byte 2	0	0	0	0	0	0	1	x	@
Line 4, Byte 1	0	0	1	0	0	0	1	x	D
Line 4, Byte 2	0	0	0	0	0	0	1	x	@
Line 5, Byte 1	0	0	0	0	0	0	1	x	B
Line 5, Byte 2	0	1	0	0	0	0	1	x	@
Line 6, Byte 1	0	0	1	0	0	0	1	x	D
Line 6, Byte 2	0	0	0	0	0	0	1	x	@
Line 7, Byte 1	0	0	0	0	0	0	1	x	@
Line 7, Byte 2	0	0	0	0	0	0	1	x	@

When the individual bytes have been assigned equivalent characters, the **VFU** table can be loaded. The Load **VFU** control sequence **<ESC>[<1h** and the byte pair characters can be combined to load the **VFU** table. Remember to terminate the **VFU** table characters (equivalent byte pairs) with the End **VFU** Load control sequence **<ESC>[1l** as follows:

```
   |LOAD | VFU TABLE   |  END |
   |     |             |      |
<ESC>[<1hA@D@B@B@D@@@<ESC>[<1l
```

Chapter 6

PRINTER ID, STATUS, AND RESET SEQUENCES

6.1 General

This chapter contains information for use by experienced programmers to facilitate the implementation of implement device attributes (Product ID), device status, and reset control sequences.

6.2 Printer ID Sequences

The host sends a request sequence to the printer for identification (ID). The printer then responds with a reply sequence (printer ID) to the host.

6.2.1 Send Device Attributes (DA)

Either of the control sequences below (two 7-bit and 8-bit) request the printer to send the host the product ID sequence.

7-bit Control Code: **<ESC>[c** or **<ESC>[0c**
Hex Value: **1B 5B 63** or **<ESC>1B 5B 30 63**

8-bit Control Code: **<CSI>c** or **<CSI>0c**
Hex Value: **9B 63** or **9B 30 63**

On receipt of either of the escape sequences above, the printer will respond by sending the host the product identification (ID) sequence. Depending on the setting of printer control strap 23, the printer will respond with one of the following sequences:

Printer Control Strap Setting	Product ID Sequence	Identified Product
17 set at "**0**" Hex value	**<ESC>[?42c** **1B 5B 3F 34 32 63**	LG31 Printer
17 set at "**1**" Hex value	**<ESC>[?36c** **1B 5B 3F 33 36 63**	LG01 Printer

6.3 Device Status Request and Report Sequences (DSR)

The control sequences described in this section control the printer's reporting of its device identification (ID).

6.3.1 Device Status Request (DSR)

The device status request sequence is sent to the printer requesting solicited or unsolicited status reports in either brief or extended format.

7-bit Control Code: **<ESC>[Pnn**
7-bit Hex Value: **1B 5B Pn 6E**

8-bit Control Code: **<CSI>Pnn**
8-bit Hex Value: **9B Pn 6E**

By default, unsolicited status reports are disabled. The status report requests are selected by Pn values shown in the following table:

Pn Value	Printer Status Request
0	Send an extended, solicited status report immediately.
1	Disable all unsolicited status reports.
2	Enable brief, unsolicited status reports and send an extended report immediately.
3	Enable extended, unsolicited status reports and send an extended status report immediately.

The printer will send a device status report to the host:

1. Immediately, if a solicited status report is requested, regardless of the error status.
2. If unsolicited status reports are enabled, and a reportable status condition has occurred.

6.3.2 Device Status Report (DSR)

The printer responds to the Device Status Request with a Device Status Report sent to the host. The reports are brief or extended reports, solicited or unsolicited. Solicited status reports are sent immediately to the host. Unsolicited status reports (if enabled) are sent when a reportable error occurs.

7-bit Control Code: **<ESC>[Pnn**
7-bit Hex Value: **1B 5B Pn 6E**

8-bit Control Code: **<CSI>Pnn**
8-bit Hex Value: **9B Pn 6E**

Default: none

The Device Status Reports (brief or extended format) the printer transmits to the host are defined as follows:

Brief Status Report

Report	**Sequence**
No Error Condition Exists:	**<ESC>[0n** **1B 5B 30 6E**
An Error Condition Exists:	**<ESC>[3n** **1B 5B 33 6E**

Extended Status Report

Report	**Control Sequences**
No Error Condition Exists:	**<ESC>[0n** **1B 5B 30 6E**
	followed by:
	<ESC>[?20n **1B 5B 3F 32 30 6E**

An Error Condition Exists:	**<ESC>[3n** **1B 5B 33 6E**
	followed by:
	<ESC>[Pn1;Pn2;...;n **1B 5B 3F Pn1 3B Pn2 3B ... 3B 6E**

Where Pn1;Pn2 ... are one or more error codes defined as follows:

Values	Description of Error
21	Hardware Failure - The reportable hardware failures are all errors listed in the Self-test Error Messages and the Font Checksum Error Messages.
22*	Communication Failure - A communications failure may be caused by a parity error, framing error, or receipt of an erroneous character.
23*	Input Buffer Overflow Error.
24	Printer Deselected (Off-Line).
26	Cover Open Error.
27	Paper Out Error.
28	Ribbon Out Error.
47	Too Many Errors (More Than 29 Errors).

* Failures (communications and buffer overflow errors) defined as events can only be reset if an extended device status report is sent to the host. If the printer is set for solicited reports, the events can only be reset if the extended report is requested and sent to the host. If the printer is set for unsolicited reports, the extended report is immediately sent to the host and reset. The DECSTR and RIS resets clear any event which has not been reported.

Example: **<ESC>[3n<ESC>[?21;22n** is an Extended Status Report indicating a hardware and communications error condition.

6.4 Printer Reset Control Sequences

The sequences described in this section reset the printer features to the initial state.

6.4.1 Reset to Initial State (RIS)

Resets printer to default parameters without running the power-up self test. Data in the buffer is saved, and paper advances to the next top of form. See Appendix C for the power-up settings of parameters.

7-bit Control Code: **<ESC>c**
7-bit Hex Value: **1B 63**

8-bit Control Code: **None**
8-bit Hex Value: **None**

Upon receiving a reset sequence from the host computer or from the operators control panel, the LG31 defaults to the following conditions.

Table 6–1: LG31 Initial Conditions

Parameter	Parameter Initial State (Default)
Print Status	On-line (ready)
Horizontal Pitch	10 characters per 2.54 cm/in
Vertical Pitch	6 lines per inch
Font	Data Processing
Forms Length	66 lines (11 inches/27.94 cm)
Active Position	Column 1 on the following line
Top Margin	Line 1
Bottom Margin	Line 66
Left Margin	Column 1
Right Margin	Column 132
Underlining	Disabled
Bolding	Disabled
Italics	Disabled
Character Expansion	No character expansion
GL Character Set	U.S. ASCII or the last NCR if selected
GR Character Set	Digital Supplemental
G0 Character Set	U.S. ASCII or the last NCR if selected
G1 Character Set	VT100 Graphic Character Set
G2 Character Set	Digital Supplemental
G3 Character Set	U.S. ASCII

Table 6–1 (Cont.): LG31 Initial Conditions

Parameter	Parameter Initial State (Default)
Autowrap	Enabled
Line Feed/New Line Mode	Reset
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)

The following will not change:

All Interface Settings
The National Replacement Character Set
Top and Bottom Margins
Left and Right Margins

These parameters will remain as previously selected (either through escape sequences or through the control panel).

6.4.2 Soft Terminal Reset (DECSTR)

Same as the Reset to Initial State (RIS) sequence, **(<ESC>[!p)**. See Table 6–1 for the initial state of the parameters reset by **<ESC>[!p**.

7-bit Control Code: **<ESC>[!p**
7-bit Hex Value: **1B 5B 21 70**

8-bit Control Code: **<CSI>!p**
8-bit Hex value: **9B 21 70**

Chapter 7

SIXEL GRAPHICS

7.1 General

Sixel graphics are selected using the appropriate control sequence and cannot be selected by the operator at the operator control panels.

The Sixel Protocol is a bit-image rasterized method of transmitting and displaying graphic images. The LG31 is capable of receiving and printing Sixel files sent from the host. Although the Sixel protocol allows encoding of color information, printing will be in monochrome only.

A Sixel is a group of six vertical picture elements (SIX pixELs) that represents a section of a graphic image and can be sent in one byte (7 or 8 bits). The printer processes a Sixel byte such that a bit value of 1 signifies the presence of a pixel, and a bit value of 0 signifies no pixel.

The Sixel protocol incorporates a method for defining the horizontal and vertical grid sizes as well as the image aspect ratio.

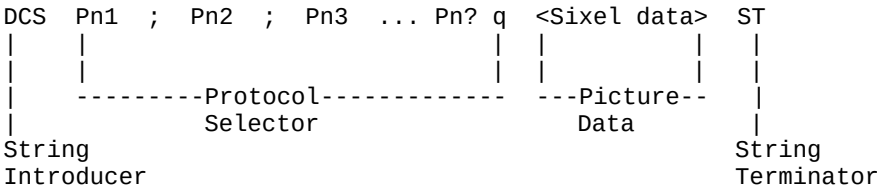
7.2 Sixel Protocol

Sixel Protocol is contained within a Device Control String **<DCS>** envelope. This envelope is initiated by the string introducer **<DCS>** control code and terminated by the String Terminator **<ST>** control code. The following components make up the complete Device Control String for the Sixel Protocol.

Sixel Protocol - Device Control String:

1. String Introducer.
2. Protocol Selector.
3. Picture Data.
4. String Terminator.

This control string is assembled as follows:



7.2.1 String Introducer

The string introducer **<DCS>** control code (**90H** in 8-bit mode) or **<ESC>P (1BH, 50H** in 7-bit mode) will identify the start of the Sixel Protocol.

7.2.2 Protocol Selector

The Protocol Selector may consist of a string of zero, one or more numeric parameters each separated by the parameter separator character ";" **(3BH)**. A valid numeric parameter consists of zero, 1 or more digits in the range of 0 - 9 **(30H - 39H)**. Any numeric parameter in combination with the valid final character **"q" (71H)**, will cause the printer to enter Sixel Mode.

If one or more of the following **C0** control characters are detected within the Protocol Selector, the LG31 printer processes them as follows:

Control Characters	**Action**
<SUB>	Terminates the Protocol Selector sequence and enters Text Mode, then processes **<SUB>**.
<CAN>	Terminates the Protocol Selector sequence and enters Text Mode, then processes **<CAN>**.
<ESC>	Terminates the Protocol Selector sequence and enters Text Mode, then processes **<ESC>**.

All other **C0** control codes, if received within the Protocol Selector, will be honored without terminating the sequence.

All **C1** control codes, if received within the Protocol Selector, will terminate the Protocol Selector sequence processing and cause the printer to exit from Sixel character processing. **C1** control codes applicable to this printer will then be processed.

The Protocol Selector has the following format:

Pn1	;2	Pn	Pn3	...	Pn?	q
****	3BH	***	***	...	***	71H

7.2.2.1 Macro Parameter (Pn1)

This is a selective parameter of fixed Horizontal Grid Size and Aspect Ratio combinations which are most often used. This parameter provides for backward compatibility with existing software and should not be used by new software.

Note

It is recommended that new software sets Pn1 to zero and explicitly defines the Horizontal Grid Size using Pn3 and the aspect ratio numerator and denominator using Pn1 and Pn2 of the Sixel data control sequence "Set Raster Attributes".

Pn1 Macro Value*	Horizontal Grid Size (Inches)	Aspect Ratio (Vert:Horz)	Image Scale Size
0 or None	1/140" (.0069)	200:100	Full Scale
1	1/140" (.0069)	200:100	Full Scale
2, default to:	1/180" (.0059)	250:100	Full Scale
3, default to:	1/180" (.0059)	250:100	Full Scale
4	1/180" (.0059)	250:100	Fu l Scale
5, default to:	1/140" (.0069)	200:100	Full Scale
6, default to:	1/140" (.0069)	200:100	Full Scale
7, default to:	1/140" (.0069)	200:100	Full Scale
8, default to:	1/140" (.0069)	200:100	Full Scale
9	1/70" (.0139)	100:100	Full Scale

* Macro Values 2,3,5,6,7 and 8 are default definitions required by the LG31 printer.

- If Pn1 is greater than 9, the printer defaults to Pn1 = 0.
- ; = Parameter Separator, marking the end of the current parameter.

7.2.2.2 Background Select (Pn2)

Pn2 is not used by the LG31 printer and will be ignored.

7.2.2.3 Horizontal Grid Size (Pn3)

Pn3 defines the horizontal grid size in decipoints (1/720 in) and in conjunction with the aspect ratio defines the grid size and image scale size.

The LG31 will perform default horizontal grid sizes for some decipoint values. This table identifies the horizontal grid size used for each Pn3 value.

Pn3 Decipoints (1/720")	**Horizontal Grid Size (Inches)**
0 or None*	No change to HGS (defined by Ps1)
1, 2, and 3 default to:	1/180" (0.0056")
4	1/180" (0.0056")
5	1/140" (0.0069")
6 defaults to :	1/140" (0.0069")
7 defaults to:	1/140" (0.0069")
8	1/140" (0.0069")
9 defaults to:	1/90" (0.0111")
10	1/90" (0.0111")
11 - 19 defaults to:	1/70" (0.0139")
20	1/70" (0.0139")
21, 22, ... default to :	1/35" (0.0278")
	1/35" (0.0278")

* If Pn3 is zero or not present, the horizontal grid size is determined by the Macro Parameter (Ps1). Otherwise, Pn3 will override the Horizontal Grid Size portion of the Macro Parameter while attempting to preserve the Aspect Ratio.

When the 2.5:1 Aspect Ratio is selected by Pn1, and the Pn3 parameter selects:

Pn3 Selection	**Resulting Aspect Ratio (A/R) and Horizontal Grid Size (HGS)**	**Resulting Image Scale Size**
1/180"	2.5:1 A/R and HGS = 1/180"	Full Scale
1/140"	2.5:1 A/R and HGS = 1/180"	Full Scale
1/90"	2.5:1 A/R and HGS = 1/90"	2x Full Scale
1/70"	2.5:1 A/R and HGS = 1/90"	2x Full Scale
1/35"	2.5:1 A/R and HGS = 1/90"	2x Full Scale

When the 2:1 Aspect Ratio is selected by Pn1, and the Pn3 parameter selects:

Pn3 Selection	Resulting Aspect Ratio (A/R) and Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180"	2.5:1 A/R and HGS = 1/180"	Full Scale
1/140"	2.5:1 A/R and HGS = 1/140"	Full Scale
1/90"	2.5:1 A/R and HGS = 1/120"	2x Full Scale
1/70"	2.5:1 A/R and HGS = 1/70"	2x Full Scale
1/35"	2.5:1 A/R and HGS = 1/70"	2x Full Scale

When the 1:1 Aspect Ratio is selected by Ps1, and the Pn3 parameter selects:

Pn3 Selection	Resulting Aspect Ratio (A/R) and Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180"	2.5:1 A/R and HGS = 1/180"	Full Scale
1/140"	1:1 A/R and HGS = 1/140"	Full Scale
1/90"	1:1 A/R and HGS = 1/140"	2x Full Scale
1/70"	1:1 A/R and HGS = 1/70"	2x Full Scale
1/35"	1:1 A/R and HGS = 1/35"	2x Full Scale

7.2.2.4 Additional Parameters (Pn?)

All other parameters are reserved for future use and, if received, will be ignored without terminating this sequence.

7.2.2.5 Final Character (q)

Identifies this sequence as the Sixel Protocol Selector and places the printer in Sixel Mode.

7.2.3 Picture Data

Picture Data includes Sixel Printable Characters and Sixel Control Characters. Characters are processed as defined in this section.

7.2.3.1 Sixel Printable Characters

While in Sixel Graphics Mode, **GL** characters in the range of **3FH - 7EH** are decoded as printable characters. Each of these 64 values represent an encoding of six vertical pixels to be printed. The actual pixel size is defined by the Horizontal Grid Size Parameter and the Pixel Aspect Ratio.

An offset of **3FH** is subtracted from each graphics printable character received, thus producing a binary value in the range of **00H - 3FH**. The 6-bit binary value obtained represents a six pixel column definition. For each bit set to one, a corresponding print element (or group of elements in 2x Scale) will be activated to form a dot. The least significant bit (bit 0) is associated with the top print element or group of elements.

Hex Code	ASCII Symbol	Binary Value	Pixels Activated	Action Performed
3F	?	000000	None	Advance by a Sixel Space.
40	@	000001	Top	Print top pixel only.
5F	-	100000	Print bottom pixel only.	
7E	~	111111	All	Print one full column.

GR characters in the range of **BFH - FEH** are processed as **GL** characters (the eighth bit is set to zero).

If an attempt is made to print past the right-most position, the printer truncates all remaining Sixel data until the next Graphics Carriage Return [$] or Graphics New Line [-].

7.2.3.2 Sixel Control Characters

Sixel Control Characters are **GL** characters in the range of **SP - > (20H - 3EH)**. Note that this range also includes the parameter separator ; **(3BH)** and parameter digits 0 - 9 **(30H - 39H)**.

GR characters in the range of **(A0H - BEH)** are processed as **GL** characters (the eighth bit is set to zero).

Those control characters assigned are processed as follows:

Hex Code	ASCII Symbol	Action Performed
21	!	Repeat Introducer
22	"	Set Raster Attributes
24	$	Graphic Carriage Return
2D	-	Graphic New Line
30 to 39	0 to =9	Numeric Parameters
3B	;	Parameter Separator

A sequence in Sixel Graphics Mode begins with a Sixel control character (not including **30H - 39H** and **3BH**) and ends with either a printable character or another Sixel control character. For example, if a Graphic New Line (GNL) is received within a Repeat Sequence, the Repeat Sequence is ignored and the Graphic New Line (GNL) is processed. Therefore, if the following data is received

! - 200 ~

the printer will ignore the Repeat control character, process the **GNL**, ignore 200 since it is meaningless by itself and print ~ only once.

Control characters not assigned are ignored along with any parameters or parameter separators until the next valid control character or **ST** is received.

Repeat Introducer [!] and Sequence

A repeat sequence will be defined as:

```
!       Pn      <printable character>
21H     ****
```

The numeric parameter specifies the number of times to print the character that follows. The numeric parameter is a string of characters in the range of **30H - 39H** which is evaluated as a decimal number. If a numeric parameter is not received a value of one is assumed. If the parameter evaluates to zero, a value of one is assumed. If the parameter evaluates to a value greater than 65535, a value of 65535 is assumed. All decimal digits are processed as part of the count.

The printable character (a character in the range of **3FH - 7EH)** will be printed as many times as specified by the numeric parameter count. A repeat sequence will have the same effect as receiving the printable character that number of times. All printable characters will end the repeat sequence processing and cause printing to start.

Repeat Sequence Examples:

Repeat Sequence	**Function**
! 1 0 ? 21H 31H 30H 3FH	Repeat 10 graphic spaces.
! 6 @ 21H 36H 40H	Repeat 6 patterns of top dot.

Set Raster Attributes

This sequence defines the pixel aspect ratio and applies to all sixel data that follows. After entering the Sixel Graphic mode, the Set Raster Attributes sequence must be received first or the printer recognized this sequence but will disregard all parameters and processing all following Sixel data and control codes as if this sequence was never received.

If Set Raster Attributes sequence is received before any other Sixel Control Code, the Set Raster Attribute sequence will be processed.

If Set Raster Attributes sequence is received after another Sixel Control Code, the following will occur:

- If the Sixel Control Code is one of the following; **(21H - 24H** or **2DH)**, the printer will process this control code and recognize but ignore all Set Raster Attributes sequences which may follow.
- If the Sixel Control Code is one of the following, yet unspecified DEC control codes, **(20H, 25H - 2CH, 2EH, 2FH, 30H - 3EH)**, process the following Set Raster Attribute sequence. This allows for specifying a future control code to be the first received.

The Set Raster Attributes sequence format is as follows:

"	Pn1	;	Pn2	;	Pn3	;	Pn4
22H	***	3BH	***	3BH	***	3BH	***

where:

" = Set Raster Attributes control character

Pn1 = Pixel Aspect Ratio Numerator

Pn2 = Pixel Aspect Ratio Denominator

Pn1 and Pn2 are numeric parameters. A numeric parameter is a string of characters in the range of **30H - 39H** which is evaluated as a decimal number. If the parameter evaluates to a value greater than 65535, the value 65535 will be assumed.

Pn3, Pn4 and all other parameters that are received before the next Sixel Control Code or Sixel Printable Character is received, will be ignored by the LG31.

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

For example, an aspect ratio of 2:1 represents a pixel twice as high as it is wide. The Aspect Ratio multiplied by the Horizontal Grid Size (HGS) yields the ideal Vertical Grid Size (VGS).

The LG31 supports the following aspect ratios:

Aspect Ratio	Sixel Scale	HGS (inch)	Horizontal Dots/Pixel	VGS (inch)	Vertical Dots/Pixel
2.5:1	Full	1/180	1	1/72	1
	2x	1/90	2	1/36	2
2:1	Full	1/140	1	1/72	1
	2x	1/70	2	1/36	2
1:1	0.5x	1/140	1	1/144	1/2
	Full	1/70	1	1/72	1
	2x	1/35	2	1/36	2

Other aspect ratios, if requested, will be processed by the printer as follows:

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

In determining the pixel size, the printer will attempt to preserve the aspect ratio without exceeding the selected Horizontal Grid Size.

When the 2.5:1 Aspect Ratio is selected:

Initial HGS	Resulting Aspect Ratio (A/R) and Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180"	2.5:1 A/R and HGS = 1/180"	Full Scale
1/140"	2.5:1 A/R and HGS = 1/180"	Full Scale
1/90"	2.5:1 A/R and HGS = 1/90"	Full Scale
1/70"	2.5:1 A/R and HGS = 1/90"	2x Full Scale
1/35"	2.5:1 A/R and HGS = 1/90"	2x Full Scale

When the 2:1 Aspect Ratio is selected:

Initial HGS	Resulting Aspect Ratio (A/R) and Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180"	2.5:1 A/R and HGS = 1/180"	Full Scale
1/140"	2:1 A/R and HGS = 1/140"	Full Scale
1/90"	2:1 A/R and HGS = 1/140"	Full Scale
1/70"	2:1 A/R and HGS = 1/70"	2x Full Scale
1/35"	2:1 A/R and HGS = 1/70"	2x Full Scale

When the 1:1 Aspect Ratio is selected by Ps1:

Initial HGS	Resulting Aspect Ratio (A/R) and Horizontal Grid Size (HGS)	Resulting Image Scale Size
1/180"	1:1 A/R and HGS = 1/180"	0.5x Full Scale
1/140"	1:1 A/R and HGS = 1/140"	0.5x Full Scale
1/90"	1:1 A/R and HGS = 1/140"	0.5x Full Scale
1/70"	1:1 A/R and HGS = 1/70"	Full Scale
1/35"	1:1 A/R and HGS = 1/35"	2x Full Scale

Therefore, each of the three image scale sizes (0.5x, Full, and 2x) supported by the LG31 are dependent on combinations of the corresponding aspect ratios, horizontal grid sizes and vertical grid sizes shown below:

Image Scale Size	Aspect Ratio	Horizontal Grid Size	Vertical Grid Size
0.5x	1:1	1/120-inch	1/144-inch
Full	2.5:1	1/180	1/72
	2:11	1/120	1/72
	1:1	1/70	1/72
2x	2.5:1	1/90	1/36
	2:1	1/70	1/36
	1:1	1/35	1/36

Graphic Carriage Return ($)

The Graphic Carriage Return **(GCR)** control code **$ (24H)** causes the active print position to return to the left-most position where the first Sixel data was printed after entering Sixel Mode. This feature allows overprinting lines of Sixel data starting at the same horizontal position.

Graphic New Line (-)

The Graphic New Line **(GNL)** control code - **(2DH)** ends a printed line of sixel graphics by:

- Returning the active print position to the graphic left margin.
- Advancing the paper by one Sixel line height (at current vertical grid size).

Numeric Parameters (0-9)

Some graphic control codes are followed by a numeric value (0-9 in the range of **30H - 39H)**. A numeric value is terminated by any non-digit, specifically another control code or a graphics printable character. The default value for any numeric parameter is zero.

Parameter Separator (;)

The parameter separator **; (3BH)** is used to separate a series of numeric parameters. If a numeric value does not precede the separator, the value zero (0) is assumed. If a numeric value does not follow the separator, then the value zero (0) is assumed.

7.2.3.3 ASCII Control Characters

While in Sixel Mode, the printer ignores all **C0** control characters except **<CAN>**, **<SUB>**, and **<ESC>**. The **ST** control code is a **C1** control code. When the above control codes are received, the printer performs the following actions:

Control Character	Printer Action
<CAN>	Leaves Sixel graphics Mode, enters Text Mode, then processes **<CAN> (18H)**.
<SUB>*	Processes **<SUB> (1AH)** as a Sixel space character to limit communications line errors.
<ESC>	Leaves Sixel graphics Mode, enters Text Mode, then processes **<ESC> (1BH)**.
<ST>	Leaves Sixel graphics Mode, and enters Text Mode.

* In Sixel Graphic Mode, the **<SUB>** character is interpreted as being in place of a character or characters received in error. The printer will remain in Sixel Mode and process this character as a Sixel space **(3FH)**. If a repeat sequence is being processed, the number of Sixel spaces required by the repeat count will be printed.

Note

All **C1** control codes, if received in Sixel graphics Mode, will cause the printer to leave the Sixel graphics Mode. The printer will then process recognized **C1** control codes.

Printer State After Leaving Sixel Graphics

After exiting Sixel Mode, the printer will return with the following conditions:

1. Horizontal position returns to the last active position prior to entering Sixel Mode.
2. Horizontal pitch returns to the selection used prior to entering Sixel Mode.
3. Vertical position will be modified according to the control characters received while in Sixel Mode. Also, the first text mode vertical motion command (that is, **<LF>,<VT>,** and so on) will cause the printer to advance to the next text mode line before executing the command.
4. Vertical pitch returns to the selection used prior to entering the Sixel Mode.
5. All **SGR** attributes are restored to those selections used prior to entering Sixel Mode.

7.2.3.4 String Terminator

The string terminator control character **<ST>** (**9CH**) is used to terminate the sixel protocol.

Chapter 8

VECTOR, BARCODE, AND BLOCK CHARACTER SEQUENCES

8.1 General

This chapter contains information that allows experienced programmers to implement vector drawing, barcode printing, and block character printing using the LG31 control sequences. Descriptions of vector drawing sequences can be found in Section 8.2; barcode and block character sequence descriptions can be found in Sections 8.3 and 8.4, respectively.

8.2 Drawing Vectors

This feature is selected by a control sequence and cannot be selected by the operator at the control panels. The LG31 is capable of drawing lines in accordance with the Digital Vector format (DECVEC). Vector commands are sent from the host in the form of control sequences. The user can select from the following vector parameters for printing.

- The x and y coordinates of the vector origin on the page.
- The direction of the vector from the origin (either the x or y direction).
- The length of the vector in decipoints.
- The width of the vector in decipoints.

Vector drawing does not affect the printer's active position. Vectors can only be printed in either the x or y direction (that is, no diagonal vectors).

This sequence defines and initiates the printing of vertical or horizontal lines on the page. Text margins do not apply to line drawing which can be printed up to the physical limits of the page. The printer draws vectors without modifying the active position.

7-bit Escape Sequence: **<ESC>[Pn1;Pn2;..Pn5! |**
Hex Value: **1B 5B Pn1 3B Pn2 3B..Pn5 21 7C**

8-bit Control Sequence: **<CSI> Pn1;Pn2;..Pn5! |**
Hex Value: **9B Pn1 3B Pn2 3B..Pn5 21 7C**

The Pn values are defined as follows:

- Pn1 selects a horizontal or vertical line (with respect to the shuttle orientation).

Pn1	**Function**
0/missing	Draws an x line (in the same direction of the shuttle motion).
1	Draws a y line (perpendicular to the direction of the shuttle motion).

- Pn2 specifies the x start position on the page in units of decipoints.
- Pn3 specifies the y start position on the page in units of decipoints.
- Pn4 specifies the line length in terms decipoints. A Pn4 value of zero results in a line of one decipoint in length.
- Pn5 specifies the line width in terms of decipoints. A Pn5 value of zero results in a line of one decipoint in Any other Pn values are illegal and cause the entire sequence to be ignored.

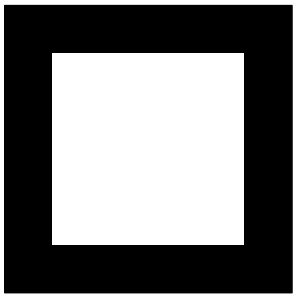
Note

For an x line, Pn4 specifies length in the x direction and Pn5 specifies width in the y direction. For a y line, Pn4 specifies length in the y direction and Pn5 specifies width in the x direction.

The following program shows how to use the vector sequence to generate the square in Figure 8–1.

```
<CSI>;30;2400;1200;120! |
<CSI>;30;3480;1200;120! |
<CSI>1;30;2400;1200;120! |
<CSI>1;1100;2400;1200;120! |
<FF>
```

Figure 8–1: Vector Drawing Example



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8.3 Barcodes

This feature is selected by a control sequence and cannot be selected by the operator at the control panels.

The following barcodes are available for printing:

- Interleaved 2 of 5
- EAN 8
- Code 11
- Codabar b/n
- Codabar d/e
- UPC-A
- UPC-E

Barcode printing will commence on reception of the correct control sequence from the host. Subsequent printable characters from the host will be encoded and printed in the designated barcode format. Barcode printing mode will remain in operation until the correct disable barcode printing control sequence is received from the host.

Barcode attributes may be set using the Select Barcodes Attributes control sequence. This sequence may specify the following parameters:

- Barcode type (Code 39, Interleaved 2 of 5, ...)
- Width of narrow bars and spaces
- Width of quiet zone
- Width of wide bars and spaces
- Width of the intercharacter gap
- Height of the barcode
- Encoding of control characters in the barcode
- Orientation of the barcode (for example, portrait, landscape)
- Printing of readable characters (characters printed using a non-machine readable font).

These parameters remain in operation until changed by another control sequence to set barcode attributes.

These barcode fonts and algorithms are resident in the printer. The end barcodes printing control sequence restores the font selection and other attributes to the state before the barcodes control sequence was received (see Appendix D for details on barcodes and section on "Select Barcodes Attributes Sequence").

The process of printing multiple barcodes on one line is described in Section 8.3.4. Section 8.3.5 describes the size and spacing parameters for barcodes.

The barcodes sequences allow the setting of barcodes parameters, starting the generation of the barcodes, and stopping barcode printing.

8.3.1 Select Barcodes Attributes Sequence (DECSBCA)

This sequence defines the parameters for barcodes. If any parameters of the sequence are illegal, the sequence is ignored and the last barcodes parameters remain unchanged. When barcodes parameters are defined, they remain valid until:

- A new valid barcodes select parameter sequence is sent.
- A reset command (sets to default values).
- On power up, the default values are set.

7-bit Escape Sequence: **<ESC>[Pn1;Pn2;..Pn9'q**
Hex Value: **1B 5B Pn1 3B Pn2 3B..Pn9 27 71**

8-bit Control Sequence: **<CSI> Pn1;Pn2;..Pn9'q**
Hex Value: **9B Pn1 3B Pn2 3B..Pn9 27 71**

Where the Pn parameters are:

- Pn1 selects the type of barcode encoding.

Pn1	Function
0/missing	Code 39 (default value)
1	Interleaved 2 of 5
2	Code 39
4	EAN-8
5	EAN-11
6	Code 11
7	Codabar a/t
8	Codabar b/n
9	Codabar c/*
10	Codabar d/e
11	UPC-A
12	UPC-E

- Pn2 sets the width of the narrow bars and spaces in units of decipoints.

  Minimum value = 12 decipoints (0.017 in.)
  Maximum value = 756 decipoints (1.050 in.)
  Default value = 12 decipoints (0.017 in.)

- Pn3 sets the width of the quiet zone in decipoints. The width of the quiet zone is permanently set set to 180 decipoints (0.25 in.) for leading edge and 180 decipoints (0.25 in.) for the trailing edge.

- Pn4 sets the width of the wide bars and wide spaces in decipoints.

  Minimum value = 12 decipoints (0.017 in.)
  Maximum value = 1524 decipoints (2.117 in.)
  Default value = 36 decipoints (0.050 in.)

- Pn5 sets the intercharacter gap in decipoints.

  Minimum value = 12 decipoints (0.017 in.)
  Maximum value = 756 decipoints (1.050 in.)
  Default value = 12 decipoints (0.017 in.)

- Pn6 sets the height of the bars in decipoints.

  Minimum value = 60 decipoints (0.083 in.)
  Maximum value = 7200 decipoints (10.000 in.)
  Default value = 540 decipoints (0.750 in.)

- Pn7 defines the control character encoding character.

  In the barcodes supported by the LG31, there are no control characters. Any value received in the position Pn7 is ignored.

- Pn8 sets the orientation for the barcodes. The barcode can be rotated in four orientations, but the characters under them are printed only in portrait or landscape orientation. The default value is 0.

Pn8	Function
0/missing	Horizontal (portrait)
1	Horizontal (portrait)
2	Vertical, rotation of -90 (landscape)
3	Vertical, rotation of +90
4	Horizontal, upside-down, rotation of 180

- Pn9 sets the alphanumeric character option.

Pn9	Function
0/missing	No alphanumeric characters printed
1	No alphanumeric characters printed
2	Alphanumeric characters printed
3	Alphanumeric characters printed
4	Alphanumeric characters printed

Note

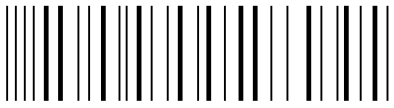
When the alphanumeric characters are printed underneath the barcode, the format used is either the currently selected font, when printing in horizontal (portrait) mode, or a special font (one that is used for block characters) when the barcodes are rotated.

This program example shows how to use the barcode sequences to generate the barcode square in Figure 8–2.

Example:

```
<CSI>1;;;;;;;;3'q
<ESC>% 00123456789
<ESC>%@
<FF>
```

Figure 8–2: Interleaved 2 of 5 Barcode Example



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8.3.2 Start Barcoding (DECBAR)

This sequences starts the generation of barcodes from the characters that follow the sequence. The barcode parameters are defined by the last Select Barcodes Attributes (DECSBCA) sequence. The printer continues to encode barcodes until the stop barcode sequence is received.

7-bit Escape Sequence: **<ESC>%<SP>0**
Hex Value: **1B 25 20 30**

The printer begins the barcode generation at the upper left-hand corner of the left quiet zone and ends at the lower right-hand corner of the right quiet zone. Barcodes that extend beyond the margins are truncated.

8.3.3 Stop Barcoding (DECBAR)

This sequence stops the generation of barcodes. The font selection and associated attributes are restored to the conditions prevailing before starting the barcodes printing.

7-bit Escape Sequence: **<ESC>%@**
Hex Value: **1B 25 40**

8.3.4 Multiple Barcodes

The LG31 can print multiple barcodes on the same line by using a sequence as shown below.

```
  Sel     Print    Stop     SOME   Sel Next  Print    Stop
Barcode  Barcode  Barcode  SPACES  Barcode  Barcode  Barcode
============================================================
```

Using this method to print multiple barcodes results in the barcodes being printed on one line, but by means of multiple passes. Therefore, print the first barcode, reverse the paper, and then print the next barcode.

Multiple barcodes can be printed on the same horizontal line in one pass by using delimiters. The three delimiters that can be used are the space, the comma (,), and the horizontal tab characters. Each space character adds 0.1 inches between the barcodes. A comma does not add any space, and the horizontal tab adds white space relative to the tab settings.

Sel Barcode	Print Barcode	Delimiters	Print Barcode	Stop Barcode

8.3.5 Size and Spacing Between Barcodes

8.3.5.1 Horizontal Barcodes (0 and 180 Degree Rotation)

The width of a horizontal barcode is determined by of the number of characters in the barcode symbol, the style of the barcode symbol, and the ratio of the wide light and dark bars to the narrow light and dark bars. The barcode height has a default value of 0.75 inch. This does not include the alphanumeric line. If the alphanumeric line is printed, a gap of 0.1 inch is inserted between the bottom of the barcode symbol and the alphanumeric line.

Horizontal barcodes (0 and 180 degree rotation) are printed at 120 Dots Per Inch (DPI) horizontally and 144 DPI vertically.

Horizontal Spacing Between Horizontal Barcodes

There is a 0.25 inch leading and trailing space before and after a barcode symbol and a 0.25 inch trailing space after a barcode symbol. These spaces are quiet zones. Therefore, there will be at least 0.5 inch space between the stop and the start of any two barcodes.

If a line of input, that is the width of the encoded barcode symbol plus any spacing code symbol, exceeds the right margin (whatever part can be printed), then the rest of the barcode is truncated. In the alphanumeric line, a diamond appears at the point where the barcode could not be continued.

Vertical Spacing Between Horizontal Barcodes

If the alphanumeric line is printed, there is at least the vertical inter-character gap between the alphanumeric line and the top of a barcode symbol on the next line, plus any line feeds.

If there is no alphanumeric line, then the vertical spacing is the inter-character gap plus the line feed.

The vertical limit for a barcode symbol is 10 inches. When the alphanumeric line is printed, the 0.1 inch gap plus character size and the barcode symbol is the total vertical distance.

8.3.5.2 Vertical Barcodes (90 and 270 Degree Rotation)

The width of the rotated barcode is equal to the height of the original horizontal barcode. If the alphanumeric line is printed, it is included in the total horizontal distance traveled.

The vertical height of the rotated barcode includes the 0.25 inch leading space, the light and dark bars that make up the symbol, and the 0.25 inch trailing space.

Vertical barcodes are printed with a horizontal density of 120 DPI and a vertical density of 144 DPI.

Horizontal Spacing Between Vertical Barcodes

You must ensure proper horizontal spacing between two vertical barcodes. Note that the leading and trailing spaces are also rotated with the vertical barcodes.

Once again the horizontal limit is the width of the paper, which is 13.2 inches. In the case of rotated barcodes where "N" barcode symbols are being printed and HEIGHT equals the height entered in as a parameter for the original barcode,

(N)*(HEIGHT) + any spacing between two or more symbols

must be less than or equal to 13.2 inches.

If an alphanumeric line is printed, it is also included when computing the total horizontal distance.

If a barcode exceeds the right margin, what can be printed is printed. Nothing else is done to flag the user.

Vertical Spacing Between Vertical Barcodes

Vertical spacing is set by line feeds. The vertical limit of any vertical barcode (90 or 270 degree rotation) is the current forms length. For a line of ASCII input, the resulting encoded barcode symbol (including the quiet zones) is less than or equal to the current printable forms length. If forms length is exceeded, the barcode symbol is printed as far as possible and if an alphanumeric line is printed, a diamond is printed where printing was no longer able to continue.

8.4 Block Characters

This feature is selected by using the appropriate control sequence and is not selected at the operator control panels.

The LG31 is capable of printing block characters in accordance with the DIGITAL block character format (**DECBCS** and **DECBCM**). Block character attributes are sent from the host in the form of control sequences. The size of the block character to be printed is specified within the control sequence in the form of horizontal and vertical magnification factors.

The following block character parameters are selectable.

- Horizontal magnification factor
- Vertical magnification factor
- Inverse video characters
- National Replacement Character Sets

The control characters **<CAN> (18H)** and **<SUB>** (**1AH**) cause the printer to exit from the block character mode. Block characters which extend beyond the right margin and the bottom margin will be truncated.

Block characters are not governed by the spacing or the pitch select commands. Print attributes (such as bolding, underline, autowrap) do not apply to the block characters.

The block character sequences define the parameters of the block characters, initiates the generation of block characters and exits back to normal printing.

8.4.1 Setting Block Character Parameters (DECBCS)

This sequence defines the parameters for block characters.

7-bit Escape Sequence: **<ESC>[Pn1;Pn2;..P5'r**
Hex Value: **1B 5B Pn1 3B P2 3B..P5 27 72**

8-bit Control Sequence: **<CSI>[Pn1;Pn2;..P5'r**
Hex Value: **9B Pn1 3B P2 3B..P5 27 72**

If any parameters (Pn1 - Pn5) are illegal, the entire sequence is ignored. When block character parameters are defined, they remain valid until:

- A new valid block character select parameter sequence is sent.
- A reset command occurs (sets the default values).
- On power up, the default values are set.

The Pn parameters define the height, width, background color and character set of the block characters.

The magnification values specified in P1 and P2 operate on the basic character cell.

The character exists entirely and centrally within the character cell. The line feed distance is equal to the basic cell height multiplied by the vertical magnification factor. The distance between the character cells is 3/16 in multiplied by the magnification factor.

- Pn1 defines the horizontal magnification factor.

Pn1	**Function**
0/1/missing	Magnification of 2 (default)
2 - 156	Defines the horizontal magnification factor
> 156	Maximum value used

- Pn2 defines the vertical magnification factor. The maximum value is limited by the page length.

Pn2	**Function**
0/1/missing	Magnification of 2 (default)
2 - 156	Defines the vertical magnification factor
> 156	Sequence ignored maximum value used

- Pn3 defines the background.

Pn3	Function
0/missing	White background (default)
1*	Black background (inverse video)

- Pn4 is the international character set designator.

Pn4	Function
0/missing	U.S. ASCII (default)
1	Germany
2	DEC Norway/Denmark
3	France
4	UK
5	Spain
6	Sweden

- Pn5 specifies the orientation of the block characters.

Pn5	Function
0/missing	Portrait (0 degree rotation)
1	Portrait (0 degree rotation)
2	Landscape (90 degree rotation)
3*	Reverse landscape (270 degree rotation)
4	Portrait upside-down (180 degree rotation)

Note

When the sequence selects character rotation, each of the characters is rotated about its axis by the specified amount.

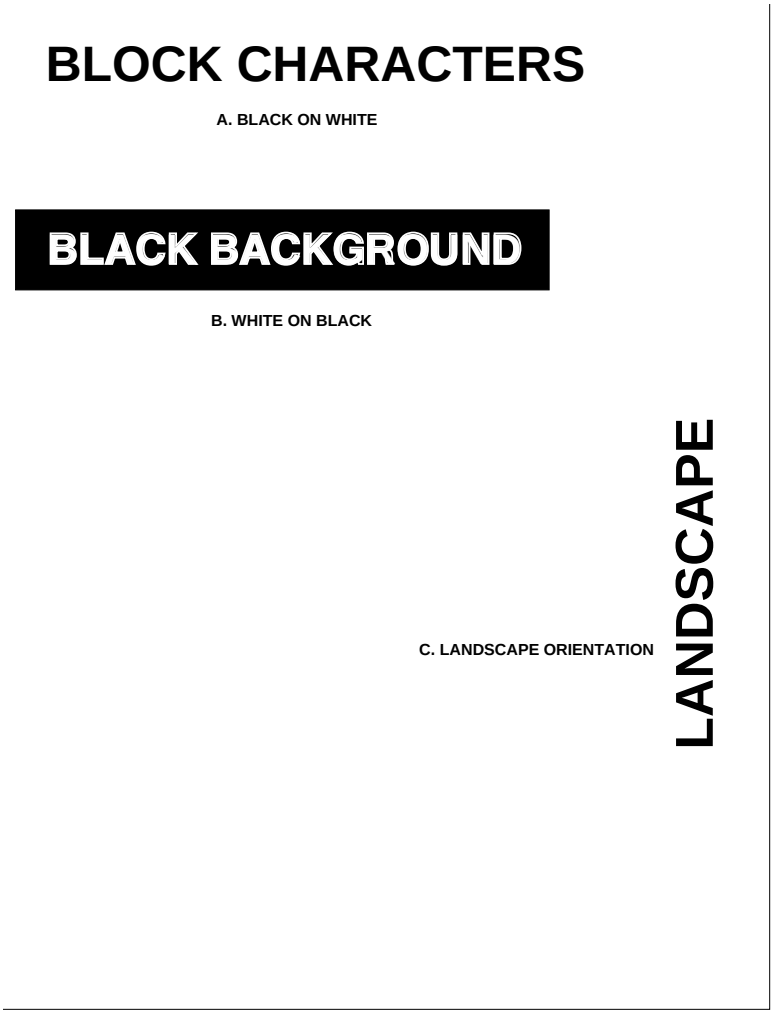
* When selecting inverse video, surround the text with spaces to achieve good effect (see Figure 8-3).

8.4.2 Start Block Character Mode (DECBCM)

The start block character sequence starts the generation of block characters from the characters immediately following the sequence.

7-bit Escape Sequence: **<ESC>%<SP>1**
Hex Value: **1B 25 20 31**

Figure 8–3: Block Character Examples



The block character parameters are defined from the last defined block character parameters. If no prior sequence has been defined, this sequence will be printed with a 0 degree rotation, in U.S. ASCII character set, a horizontal and vertical magnification factor of 2, with a white background.

The program examples show how to use the block character sequences to generate the block characters in Figure 8–3.

Example A: **<CSI>3;3;0;0;0'r**
<ESC>% 1 BLOCK CHARACTERS
<ESC>%@

Example B: **<CSI>4;2;1;0;0'r**
<ESC>% 1 BLOCK CHARACTERS
<ESC>%@

Example C: **<CSI>2;4;0;0;2'r**
<ESC>% 1 BLOCK CHARACTERS
<ESC>%@

8.4.3 Stop Block Character Mode (DECBCM)

The stop block character sequence stops the generation of block characters.

7-bit Escape Sequence: **<ESC>**%@
Hex Value: **1B 25 40**

The font attributes, Characters-Per-Inch (CPI) and Lines-Per-Inch (LPI) set prior to entering the block character mode, will be restored.

Appendix A
CHARACTER SETS

Figures A–1 to A–18 show the 18 character sets supported by the LG31 printer.

Figure	Character Set
A-1	U.S. ASCII
A-2	Digital Great Britain
A-3	Digital Finnish
A-4	French
A-5	Digital French Canadian
A-6	ISO German
A-7	ISO Italian
A-8	JIS Roman (Japanese)
A-9	Digital Norwegian/Danish
A-10	ISO Spanish
A-11	Digital Swedish
A-12	VT100 Special Graphics
A-13	Digital Technical Set
A-14	ISO Norwegian/Danish
A-15	Digital Dutch
A-16	Digital Swiss
A-17	Digital Portuguese
A-18	Digital Supplemental

Figure A–1: U.S. ASCII Character Set

ROW	BITS B7 B6 B5 B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		0 0 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
0	0 0 0 0	NUL	0 0 0		20 16 10	SP	40 32 20	0	60 48 30	@	100 64 40	P	120 80 50	`	140 96 60	p	160 112 70
1	0 0 0 1		1 1 1	DC1 (XON)	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71
2	0 0 1 0		2 2 2		22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72
3	0 0 1 1		3 3 3	DC3 (XOFF)	23 19 13	#	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73
4	0 1 0 0		4 4 4		24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74
5	0 1 0 1		5 5 5		25 21 15	%	45 37 25	5	65 53 35	E	105 69 45	U	125 85 55	e	145 101 65	u	165 117 75
6	0 1 1 0		6 6 6		26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76
7	0 1 1 1		7 7 7		27 23 17	′	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77
8	1 0 0 0	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78
9	1 0 0 1	HT	11 9 9		31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79
10	1 0 1 0	LF	12 10 A	SUB	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	[	133 91 5B	k	153 107 6B	{	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	\	134 92 5C	l	154 108 6C	|	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	]	135 93 5D	m	155 109 6D	}	175 125 7D
14	1 1 1 0	SO	16 14 E		36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	~	176 126 7E
15	1 1 1 1	SI	17 15 F		37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	_	137 95 5F	o	157 111 6F	DEL	177 127 7F

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

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Figure A–2: Digital Great Britain Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00836M_89

Figure A–3: Digital Finnish Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11
	33
	27
	18

COLUMN ROW
OCTAL
DECIMAL
HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00832M_89

Figure A–4: French Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11	COLUMN ROW
	33	OCTAL
	27	DECIMAL
	18	HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

NOTE
QUOTATION MARKS (") ARE USED AS AN APPROXIMATION FOR THE DIAERESIS MARK (¨), COLUMN 7/ROW 14.

RE_UK00833M_89

Figure A–5: Digital French Canadian Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11	COLUMN ROW
	33	OCTAL
	27	DECIMAL
	18	HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00834M_89

Figure A–6: ISO German Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00835M_89

Figure A–7: ISO Italian Character Set

ROW	BITS B7 B6 B5 B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		0 0 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
0	0 0 0 0	NUL	0 0 0		20 16 10	SP	40 32 20	0	60 48 30	§	100 64 40	P	120 80 50	ù	140 96 60	p	160 112 70
1	0 0 0 1		1 1 1	DC1 (XON)	21 17 11	!	41 33 21	1	61 49 31	A	101 65 41	Q	121 81 51	a	141 97 61	q	161 113 71
2	0 0 1 0		2 2 2		22 18 12	"	42 34 22	2	62 50 32	B	102 66 42	R	122 82 52	b	142 98 62	r	162 114 72
3	0 0 1 1		3 3 3	DC3 (XOFF)	23 19 13	£	43 35 23	3	63 51 33	C	103 67 43	S	123 83 53	c	143 99 63	s	163 115 73
4	0 1 0 0		4 4 4		24 20 14	$	44 36 24	4	64 52 34	D	104 68 44	T	124 84 54	d	144 100 64	t	164 116 74
5	0 1 0 1		5 5 5	%	25 21 15	5	45 37 25	E	65 53 35	U	105 69 45	e	125 85 55		145 u101 65		165 117 75
6	0 1 1 0		6 6 6		26 22 16	&	46 38 26	6	66 54 36	F	106 70 46	V	126 86 56	f	146 102 66	v	166 118 76
7	0 1 1 1		7 7 7		27 23 17	’	47 39 27	7	67 55 37	G	107 71 47	W	127 87 57	g	147 103 67	w	167 119 77
8	1 0 0 0	BS	10 8 8	CAN	30 24 18	(	50 40 28	8	70 56 38	H	110 72 48	X	130 88 58	h	150 104 68	x	170 120 78
9	1 0 0 1	HT	11 9 9		31 25 19	)	51 41 29	9	71 57 39	I	111 73 49	Y	131 89 59	i	151 105 69	y	171 121 79
10	1 0 1 0	LF	12 10 A	SUB	32 26 1A	*	52 42 2A	:	72 58 3A	J	112 74 4A	Z	132 90 5A	j	152 106 6A	z	172 122 7A
11	1 0 1 1	VT	13 11 B	ESC	33 27 1B	+	53 43 2B	;	73 59 3B	K	113 75 4B	°	133 91 5B	k	153 107 6B	à	173 123 7B
12	1 1 0 0	FF	14 12 C		34 28 1C	,	54 44 2C	<	74 60 3C	L	114 76 4C	ç	134 92 5C	l	154 108 6C	ò	174 124 7C
13	1 1 0 1	CR	15 13 D		35 29 1D	-	55 45 2D	=	75 61 3D	M	115 77 4D	é	135 93 5D	m	155 109 6D	è	175 125 7D
14	1 1 1 0	SO	16 14 E		36 30 1E	.	56 46 2E	>	76 62 3E	N	116 78 4E	^	136 94 5E	n	156 110 6E	ì	176 126 7E
15	1 1 1 1	SI	17 15 F		37 31 1F	/	57 47 2F	?	77 63 3F	O	117 79 4F	_	137 95 5F	o	157 111 6F	DEL	177 127 7F

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00837M_89

Figure A–8: JIS Roman (Japanese) Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00838M_89

Figure A–9: Digital Norwegian/Danish Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00839M_89

Figure A–10: ISO Spanish Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00842M_89

Figure A–11: Digital Swedish Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11	COLUMN ROW
	33	OCTAL
	27	DECIMAL
	18	HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00843M_89

Figure A–12: VT100 Special Graphics Character Set

ROW	BITS B7 B6 B5 B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
	0 0 0		0		20		40		60		100		120		140		160
0	0 0 0 0	NUL	0		16	SP	32	0	48	@	64	P	80	♦	96	— SCAN 3	112
			0		10		20		30		40		50		60		70
	0 0 0		1		21		41		61		101		121		141		161
1	0 0 0 1		1	DC1 (XON)	17	!	33	1	49	A	65	Q	81	▒	97	— SCAN 6	113
			1		11		21		31		41		51		61		71
	0 0 1		2		22		42		62		102		122		142		162
2	0 0 1 0		2		18	"	34	2	50	B	66	R	82	HT	98	— SCAN 7	114
			2		12		22		32		42		52		62		72
	0 0 1		3		23		43		63		103		123		143		163
3	0 0 1 1		3	DC3 (XOFF)	19	#	35	3	51	C	67	S	83	FF	99	— SCAN 9	115
			3		13		23		33		43		53		63		73
	0 1 0		4		24		44		64		104		124		144		164
4	0 1 0 0		4		20	$	36	4	52	D	68	T	84	CR	100	├	116
			4		14		24		34		44		54		64		74
	0 1 0		5		25		45		65		105		125		145		165
5	0 1 0 1		5		21	%	37	5	53	E	69	U	85	LF	101	┤	117
			5		15		25		35		45		55		65		75
	0 1 1		6		26		46		66		106		126		146		166
6	0 1 1 0		6		22	&	38	6	54	F	70	V	86	¤	102	┴	118
			6		16		26		36		46		56		66		76
	0 1 1		7		27		47		67		107		127		147		167
7	0 1 1 1	BEL	7		23	′	39	7	55	G	71	W	87	±	103	τ	119
			7		17		27		37		47		57		67		77
	1 0 0		10		30		50		70		110		130		150		170
8	1 0 0 0	BS	8	CAN	24	(	40	8	56	H	72	X	88	NL	104	┃	120
			8		18		28		38		48		58		68		78
	1 0 0		11		31		51		71		111		131		151		171
9	1 0 0 1	HT	9		25	)	41	9	57	I	73	Y	89	VT	105	≤	121
			9		19		29		39		49		59		69		79
	1 0 1		12		32		52		72		112		132		152		172
10	1 0 1 0	LF	10	SUB	26	*	42	:	58	J	74	Z	90	┘	106	≥	122
			A		1A		2A		3A		4A		5A		6A		7A
	1 0 1		13		33		53		73		113		133		153		173
11	1 0 1 1	VT	11	ESC	27	+	43	;	59	K	75	[	91	┐	107	π	123
			B		1B		2B		3B		4B		5B		6B		7B
	1 1 0		14		34		54		74		114		134		154		174
12	1 1 0 0	FF	12		28	,	44	<	60	L	76	\	92	┌	108	≠	124
			C		1C		2C		3C		4C		5C		6C		7C
	1 1 0		15		35		55		75		115		135		155		175
13	1 1 0 1	CR	13		29	-	45	=	61	M	77	]	93	└	109	£	125
			D		1D		2D		3D		4D		5D		6D		7D
	1 1 1		16		36		56		76		116		136		156		176
14	1 1 1 0	SO	14		30	.	46	>	62	N	78	^	94	┼	110	≈	126
			E		1E		2E		3E		4E		5E		6E		7E
	1 1 1		17		37		57		77		117		137		157		177
15	1 1 1 1	SI	15		31	/	47	?	63	O	79	(BLANK)	95	— SCAN 1	111	DEL	127
			F		1F		2F		3F		4F		5F		6F		7F

KEY

ASCII CHARACTERS

ESC	1/11	COLUMN ROW
	33	OCTAL
	27	DECIMAL
	18	HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00830M_89

Figure A–13: Digital Technical Character Set

ROW	BITS B4 B3 B2 B1	* 0 0 0	GL	GR	* 0 0 1	GL	GR	* 0 1 0	GL	GR	* 0 1 1	GL	GR	* 1 0 0	GL	GR	* 1 0 1	GL	GR	* 1 1 0	GL	GR	* 1 1 1	GL	GR
	B8 B7 B6 B5	0			1			0			1			0			1			0			1		
	COLUMN		**2**			**3**	**11**		**4**	**12**		**5**	**13**		**6**	**14**		**7**	**15**
0	0 0 0 0				}	60 48 30	260 176 80	∴	100 64 40	300 192 C0	Π	120 80 50	320 208 D0	¬	140 96 60	340 224 E0	π	160 112 161	360 240 361
1	0 0 0 1	√	41 33 21	241 161 A1	—	61 49 31	261 177 B1	∝	101 65 41	301 193 C1	Ψ	121 81 51	321 209 D1	α	141 97 61	341 225 E1	ψ	161 113 71	361 241 F1
2	0 0 1 0	⌀	42 34 22	242 162 A2	∠	62 50 32	262 178 B2	∞	102 66 42	302 194 C2	ς	122 82 52	322 210 D2	ß	142 98 62	342 226 E2	ρ	162 114 72	362 242 F2
3	0 0 1 1	_	43 35 23	243 163 A3	\	63 51 33	263 179 B3	÷	103 67 43	303 195 C3	Σ	123 83 53	323 211 D3	χ	143 99 63	343 227 E3	σ	163 115 73	363 243 F3
4	0 1 0 0	⌠	44 36 24	244 164 A4	/	64 52 34	264 180 B4	Δ	104 68 44	304 196 C4		124 84 54	324 212 D4	δ	144 100 64	344 228 E4	τ	164 116 74	364 244 F4
5	0 1 0 1	⌡	45 37 25	245 165 A5	¬	65 53 35	265 181 B5	∇	105 69 45	305 197 C5		125 85 55	325 213 D5	ε	145 101 65	345 229 E5		165 117 57	365 245 F5
6	0 1 1 0	⎮	46 38 26	246 166 A2	⌀	66 54 36	266 182 B6	Φ	106 70 46	306 198 C6	√	126 86 56	326 214 D6	ϕ	146 102 66	346 230 E6	*f*	166 118 76	366 246 F6
7	0 1 1 1	⎡	47 39 27	247 167 A7	〉	67 55 37	267 183 B7	Γ	107 71 47	307 199 C7	Ω	127 87 57	327 215 D7	ϒ	147 103 67	347 231 E7	ω	167 119 77	367 247 F7
8	1 0 0 0	⎣	50 40 28	270 168 A8		70 56 38	270 184 B8	~	110 72 48	310 200 C8	Ξ	130 88 58	330 216 D8	η	150 104 68	350 232 E8	ξ	170 120 78	370 248 F8
9	1 0 0 1	⎤	51 41 29	251 169 A9		71 57 39	271 185 B9	≃	111 73 49	311 201 C9	γ	131 89 59	331 217 D9	ι	15 10 69	351 233 E9	υ	171 121 79	371 249 F9
10	1 0 1 0	⎦	52 42 2A	252 170 AA		72 58 3A	272 186 BA	Θ	112 74 4A	312 202 CA	Ǝ	132 90 5A	332 218 DA	θ	152 106 6A	352 234 EA	ζ	172 122 7A	372 250 FA
11	1 0 1 1	⎛	53 43 2B	253 171 AB		73 59 3B	273 187 BB	×	113 75 4B	313 203 CB	⊃	133 91 5B	333 219 DB	κ	153 107 6B	353 235 EB	←	173 123 7B	373 251 FB
12	1 1 0 0	⎝	54 44 2C	254 172 AC	≤	74 60 3C	274 188 BC	Λ	114 76 4C	314 204 CC	Ǝ	134 92 5C	334 220 DC	λ	154 108 6C	354 236 EC	↑	174 124 7C	374 252 FC
13	1 1 0 1	⎞	55 45 2D	255 173 AD	=	75 61 3D	275 189 BD	⇔	115 77 4D	315 205 CD	⅁	135 93 5D	335 221 DD		155 109 6D	355 237 ED	→	175 125 7D	375 253 FD
14	1 1 1 0	⎠	56 46 2E	256 174 AE	≥	76 62 3E	276 190 BE	⇒	116 78 4E	316 206 CE	∧	136 94 5E	336 222 DE	ν	156 110 6E	356 238 EE	↓	176 126 7E	376 254 FE
15	1 1 1 1	⎨	57 47 2F	257 175 AF	∫	77 63 3F	277 191 BF	≡	117 79 4F	317 207 CF	∨	137 95 5F	337 223 DF	∂	157 111 6F	357 239 EF			

LEGEND

CHARACTER → ∝

4/1	COLUMN ROW
101	OCTAL
65	DECIMAL
41	HEX

* NOTE
WHEN SET IS MAPPED INTO GR.
BIT B8 IS 1

RE_UK00848M_89

Figure A–14: ISO Norwegian/Danish Character Set

ROW	BITS B4 B3 B2 B1	COLUMN 0 B7 0 B6 0 B5 0	1 0 0 1	2 0 1 0	3 0 1 1	4 1 0 0	5 1 0 1	6 1 1 0	7 1 1 1
0	0 0 0 0	NUL 0 0 0	 20 16 10	SP 40 32 20	0 60 48 30	@ 100 64 40	P 120 80 50	′ 140 96 60	p 160 112 70
1	0 0 0 1	 1 1 1	DC1 (XON) 21 17 11	! 41 33 21	1 61 49 31	A 101 65 41	Q 121 81 51	a 141 97 61	q 161 113 71
2	0 0 1 0	 2 2 2	 22 18 12	" 42 34 22	2 62 50 32	B 102 66 42	R 122 82 52	b 142 98 62	r 162 114 72
3	0 0 1 1	 3 3 3	DC3 (XOFF) 23 19 13	# 43 35 23	3 63 51 33	C 103 67 43	S 123 83 53	c 143 99 63	s 163 115 73
4	0 1 0 0	 4 4 4	 24 20 14	$ 44 36 24	4 64 52 34	D 104 68 44	T 124 84 54	d 144 100 64	t 164 116 74
5	0 1 0 1	 5 5 5	 25 21 15	% 45 37 25	5 65 53 35	E 105 69 45	U 125 85 55	e 145 101 65	u 165 117 75
6	0 1 1 0	 6 6 6	 26 22 16	& 46 38 26	6 66 54 36	F 106 70 46	V 126 86 56	f 146 102 66	v 166 118 76
7	0 1 1 1	BEL 7 7 7	 27 23 17	′ 47 39 27	7 67 55 37	G 107 71 47	W 127 87 57	g 147 103 67	w 167 119 77
8	1 0 0 0	BS 10 8 8	CAN 30 24 18	(50 40 28	8 70 56 38	H 110 72 48	X 130 88 58	h 150 104 68	x 170 120 78
9	1 0 0 1	HT 11 9 9	 31 25 19	) 51 41 29	9 71 57 39	I 111 73 49	Y 131 89 59	i 151 105 69	y 171 121 79
10	1 0 1 0	LF 12 10 A	SUB 32 26 1A	* 52 42 2A	: 72 58 3A	J 112 74 4A	Z 132 90 5A	j 152 106 6A	z 172 122 7A
11	1 0 1 1	VT 13 11 B	ESC 33 27 1B	+ 53 43 2B	; 73 59 3B	K 113 75 4B	Æ 133 91 5B	k 153 107 6B	æ 173 123 7B
12	1 1 0 0	FF 14 12 C	 34 28 1C	, 54 44 2C	< 74 60 3C	L 114 76 4C	Ø 134 92 5C	l 154 108 6C	ø 174 124 7C
13	1 1 0 1	CR 15 13 D	 35 29 1D	- 55 45 2D	= 75 61 3D	M 115 77 4D	Å 135 93 5D	m 155 109 6D	å 175 125 7D
14	1 1 1 0	SO 16 14 E	 36 30 1E	. 56 46 2E	> 76 62 3E	N 116 78 4E	^ 136 94 5E	n 156 110 6E	~ 176 126 7E
15	1 1 1 1	SI 17 15 F	 37 31 1F	/ 57 47 2F	? 77 63 3F	O 117 79 4F	_ 137 95 5F	o 157 111 6F	DEL 177 127 7F

KEY

ASCII CHARACTERS

ESC	1/11	COLUMN ROW
	33	OCTAL
	27	DECIMAL
	18	HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

RE_UK00840M_89

Figure A–15: Digital Dutch Character Set

ROW	BITS B7 B6 B5 B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		0 0 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
0	0 0 0 0	**NUL**	0 0 0		20 16 10	**SP**	40 32 20	**0**	60 48 30	**¾**	100 64 40	**P**	120 80 50	**`**	140 96 60	**p**	160 112 70
1	0 0 0 1		1 1 1	**DC1** (XON)	21 17 11	**!**	41 33 21	**1**	61 49 31	**A**	101 65 41	**Q**	121 81 51	**a**	141 97 61	**q**	161 113 71
2	0 0 1 0		2 2 2		22 18 12	**"**	42 34 22	**2**	62 50 32	**B**	102 66 42	**R**	122 82 52	**b**	142 98 62	**r**	162 114 72
3	0 0 1 1		3 3 3	**DC3** (XOFF)	23 19 13	**£**	43 35 23	**3**	63 51 33	**C**	103 67 43	**S**	123 83 53	**c**	143 99 63	**s**	163 115 73
4	0 1 0 0		4 4 4		24 20 14	**$**	44 36 24	**4**	64 52 34	**D**	104 68 44	**T**	124 84 54	**d**	144 100 64	**t**	164 116 74
5	0 1 0 1		5 5 5		25 21 15	**%**	45 37 25	**5**	65 53 35	**E**	105 69 45	**U**	125 85 55	**e**	145 101 65	**u**	165 117 75
6	0 1 1 0		6 6 6		26 22 16	**&**	46 38 26	**6**	66 54 36	**F**	106 70 46	**V**	126 86 56	**f**	146 102 66	**v**	166 118 76
7	0 1 1 1		7 7 7		27 23 17	**'**	47 39 27	**7**	67 55 37	**G**	107 71 47	**W**	127 87 57	**g**	147 103 67	**w**	167 119 77
8	1 0 0 0	**BS**	10 8 8	**CAN**	30 24 18	**(**	50 40 28	**8**	70 56 38	**H**	110 72 48	**X**	130 88 58	**h**	150 104 68	**x**	170 120 78
9	1 0 0 1	**HT**	11 9 9		31 25 19	**)**	51 41 29	**9**	71 57 39	**I**	111 73 49	**Y**	131 89 59	**i**	151 105 69	**y**	171 121 79
10	1 0 1 0	**LF**	12 10 A	**SUB**	32 26 1A	*****	52 42 2A	**:**	72 58 3A	**J**	112 74 4A	**Z**	132 90 5A	**j**	152 106 6A	**z**	172 122 7A
11	1 0 1 1	**VT**	13 11 B	**ESC**	33 27 1B	**+**	53 43 2B	**;**	73 59 3B	**K**	113 75 4B	**ij**	133 91 5B	**k**	153 107 6B	**¨**	173 123 7B
12	1 1 0 0	**FF**	14 12 C		34 28 1C	**,**	54 44 2C	**<**	74 60 3C	**L**	114 76 4C	**½**	134 92 5C	**l**	154 108 6C	***f***	174 124 7C
13	1 1 0 1	**CR**	15 13 D		35 29 1D	**-**	55 45 2D	**=**	75 61 3D	**M**	115 77 4D	**|**	135 93 5D	**m**	155 109 6D	**¼**	175 125 7D
14	1 1 1 0	**SO**	16 14 E		36 30 1E	**.**	56 46 2E	**>**	76 62 3E	**N**	116 78 4E	**^**	136 94 5E	**n**	156 110 6E	**´**	176 126 7E
15	1 1 1 1	**SI**	17 15 F		37 31 1F	***/***	57 47 2F	**?**	77 63 3F	**O**	117 79 4F	**_**	137 95 5F	**o**	157 111 6F	**DEL**	177 127 7F

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

NOTE:
THE FOLLOWING TABLE INDICATE THE APPROXIMATION THAT ARE USE TO REPRESENT THE DUTCH CHARACTER THAT ARE NOT AVAILABLE IN THE DECMCS SET. (THESE APPROXIMATIONS ARE TO BE COMPATIBLE WITH THE VT220 AND VT240.) THE CHARACTER POSITION IN THE CHART IS LISTED BY COLUMN/ROW.

COLUMN/ ROW	CHARACTER SET NAME (SYMBOL)	APPROXIMATION NAME (SYMBOL)
4/0	THREE QUARTERS (3/4)	SUPERSCRIPT (³)
5/11	LOWERCASE ij LIGATURE (ij)	LOWERCASE y WITH DIAERESIS (ÿ)
7/11	DIAERESIS (¨)	QUOTATION MARKS (")
7/12	FLORIN SIGN (f)	LOWERCASE f (f)
7/14	ACUTE ACCENT (´)	APOSTROPHE, SINGLE QUOTATION MARK, ASCII ACUTE ACCENT (´)

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Figure A–16: Digital Swiss Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

HIGHLIGHTS DIFFERENCES FROM ASCII

NOTE:
AT COLUMN/ROW 5/15LOWERCASE e WITH GRAVE ACCENT REPLACES UNDERLINE (_) WHICH IS USED IN ASCII AND ALL OTHER NRC SETS.

RE_UK00844M_89

Figure A–17: Digital Portuguese Character Set

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

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

RE_UK00841M_89

Figure A–18: Digital Supplemental Character Set

ROW	BITS B7 B6 B5 B4 B3 B2 B1	COLUMN 0		1		2		3		4		5		6		7	
		0 0 0		0 0 1		0 1 0		0 1 1		1 0 0		1 0 1		1 1 0		1 1 1	
0	0 0 0 0	**NUL**	0 0 0		20 16 10	**SP**	40 32 20	º	60 48 30	**À**	100 64 40	**Ŝ**	120 80 50	**à**	140 96 60		160 112 70
1	0 0 0 1		1 1 1	**DC1** (XON)	21 17 11	**¡**	41 33 21	±	61 49 31	**Á**	101 65 41	**Ñ**	121 81 51	**á**	141 97 61	**ñ**	161 113 71
2	0 0 1 0		2 2 2		22 18 12	**¢**	42 34 22	**2**	62 50 32	**Â**	102 66 42	**Ò**	122 82 52	**â**	142 98 62	**ò**	162 114 72
3	0 0 1 1		3 3 3	**DC3** (XOFF)	23 19 13	**£**	43 35 23	**3**	63 51 33	**Ã**	103 67 43	**Ó**	123 83 53	**ã**	143 99 63	**ó**	163 115 73
4	0 1 0 0		4 4 4		24 20 14	**Ŝ**	44 36 24	**Ŝ**	64 52 34	**Ä**	104 68 44	**Ô**	124 84 54	**ä**	144 100 64	**ô**	164 116 74
5	0 1 0 1		5 5 5		25 21 15	**¥**	45 37 25	µ	65 53 35	**Å**	105 69 45	**Õ**	125 85 55	**å**	145 101 65	**õ**	165 117 75
6	0 1 1 0		6 6 6		26 22 16	**Ŝ**	46 38 26	¶	66 54 36	**Æ**	106 70 46	**Ö**	126 86 56	**æ**	146 102 66	**ö**	166 118 76
7	0 1 1 1		7 7 7		27 23 17	**§**	47 39 27	•	67 55 37	**Ç**	107 71 47	**Œ**	127 87 57	**ç**	147 103 67	**œ**	167 119 77
8	1 0 0 0	**BS**	10 8 8	**CAN**	30 24 18	**¤**	50 40 28	**Ŝ**	70 56 38	**È**	110 72 48	**Ø**	130 88 58	**è**	150 104 68	**ø**	170 120 78
9	1 0 0 1	**HT**	11 9 9		31 25 19	©	51 41 29	**1**	71 57 39	**É**	111 73 49	**Ù**	131 89 59	**é**	151 105 69	**ù**	171 121 79
10	1 0 1 0	**LF**	12 10 A	**SUB**	32 26 1A	**a**	52 42 2A	**o**	72 58 3A	**Ê**	112 74 4A	**Ú**	132 90 5A	**ê**	152 106 6A	**ú**	172 122 7A
11	1 0 1 1	**VT**	13 11 B	**ESC**	33 27 1B	**«**	53 43 2B	**»**	73 59 3B	**Ë**	113 75 4B	**Û**	133 91 5B	**ë**	153 107 6B	**û**	173 123 7B
12	1 1 0 0	**FF**	14 12 C		34 28 1C	**Ŝ**	54 44 2C	$^1/_4$	74 60 3C	**Ì**	114 76 4C	**Ü**	134 92 5C	**ì**	154 108 6C	**ü**	174 124 7C
13	1 1 0 1	**CR**	15 13 D		35 29 1D	**Ŝ**	55 45 2D	$^1/_2$	75 61 3D	**Í**	115 77 4D	**Ÿ**	135 93 5D	**í**	155 109 6D	**ÿ**	175 125 7D
14	1 1 1 0	**SO**	16 14 E		36 30 1E	**Ŝ**	56 46 2E	**Ŝ**	76 62 3E	**Î**	116 78 4E	**Ŝ**	136 94 5E	**î**	156 110 6E	**Ŝ**	176 126 7E
15	1 1 1 1	**SI**	17 15 F		37 31 1F	**Ŝ**	57 47 2F	**¿**	77 63 3F	**Ï**	117 79 4F	**ß**	137 95 5F	**ï**	157 111 6F	**DEL**	177 127 7F

KEY

ASCII CHARACTERS

ESC	1/11 COLUMN ROW
	33 OCTAL
	27 DECIMAL
	18 HEX

SUPPLEMENTAL GRAPHIC SET

RE_UK00847M_89

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: 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** < **I** **1** 9/11 3/12 3/1 6/12 Send to indicate that the printer that the VFU table loaded is complete
VFU Load (5.4.10.1)	VFU	**CSI** < **1** **h** 9/11 3/12 3/1 6/8 Prepares the printer for loading the 1L channel VFU table
Autowrap Mode (5.4.9.1)	DECAWM	**CSI** **?** **7** **h** 9/11 3/15 3/7 6/8 Turns autowrap mode on. CSI ? **7** **l** 9/11 3/15 3/7 6/12 Turns autowrap mode off.
Barcode Encoding (8.3.2, 8.3.3)	DECBAR	**CSI** **%** **SP** **0** 9/11 2/5 2/0 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
Block Character Entering (8.4.2 8.4.4)	DECBCM	**ESC % SP 1** 1/11 2/5 2/0 3/1 Starts the block character sequence. **ESC @** 1/11 4/0 **%** 2/5 Stops the block character sequence.
		NOTE **This stop sequence is also used to stop barcodes.**
Block Character	DECBCS	**CSI P1 ; P5 ' r** 9/11 *** 3/11 *** 2/7 7/2

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 Printing (5.4.3)	SGR	**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 Attribute (Product ID) (5.9)	DA	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 Status Request (from host) (6.3.1)	DSR	**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.

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

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

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, Clearing (5.4.8.5)	TBC	**CSI Ps g** 9/11 *** 6/7 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 Pitch (5.4.5.2)	DECVERP	**CSI Ps z** 9/11 *** 7/10 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 Position Absolute (5.4.7.7)	VPA	**CSI Pn d** 9/11 *** 6/4 Selects vertical line without changing the active column. Pn = new active line, in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.
Vertical Position Backward (5.4.7.9)	VPB	**CSI Pn k** 9/11 *** 6/11 Subtracts Pn from active vertical line. Pn = value in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.

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

Name	Mnemonic	Sequence
Vertical Position Relative (5.4.7.5)	VPR	**CSI Pn e** 9/11 *** 6/5 Adds Pn to active vertical line. Pn = value in character, decipoint, or pixel units (selected by SSU sequence). Default value = 1.
Vertical Tabs, Set (5.4.8.4)	DECSVTS	**CSI Pn ; ... ; Pn v** 9/11 *** 3/11 ... 3/11 *** 7/6 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 Tab Stop (5.4.8.3)	VTS	**<VTS>** 8A Sets a vertical tab stop at the active line

Appendix C

FACTORY, POWER-UP, AND RESET DEFAULTS

These tables list the LG31 factory settings, power-up defaults, power-up reset conditions, and reset defaults.

Table C–1: Factory Settings at Initial Power-Up

Parameter	Control Function	Factory Setting
Printer Status		Off line
Horizontal Pitch	(DECSHORP)	10 Characters-Per-Inch (CPI)
Vertical Pitch	(DECVERP)	6 Lines-Per-Inch (LPI)
Font	(SGR)	Data Processing
Forms Length	(DECSLPP)	66 Lines (11 in/27.94 cm)
Active Position	Column 1 on the active line (line 1)	
Top Margin	Line 1	
Bottom Margin	Line 66	
Left Margin	Column 1	
Right Margin	Column 132	
Underlining	(SGR)	Disabled
Bolding	(SGR)	Disabled
Italics	(SGR)	Disabled
Character Expansion	(SGR)	Disabled
GL Character Set		U.S. ASCII

Table C–1 (Cont.): Factory Settings at Initial Power-Up

Parameter	Control Function	Factory Setting
GR Character Set		Digital Supplemental
G0 Character Set		U.S. ASCII
G1 Character Set		VT100 Graphic Character Set
G2 Character Set		Digital Supplemental
G3 Character Set		U.S. ASCII
Autowrap	(DECAWM)	Enabled
Line Feed/New Line Mode		Set
Horizontal Tabs		Set every 8 columns (9, 17, ... 137)
Unsolicited Reports		Disabled
Super/Subscripts		Disabled
Carriage Return		Reset
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
Speed (Baud Rate)		9600 Baud
Parity		Disabled

Table C–2: Power-Up Conditions Retained from Last Work Session

Parameter	Control Function
Horizontal Pitch	(DECSHORP)
Vertical Pitch	(DECVERP)
Font	(SGR)
Top of Form	
Forms Length	(DECSLPP)
Top and Bottom Margin	(DECSTBM)
Left and Right Margin	(DECSLRM)
Autowrap	(DECAWM)
Line Feed/New Line	(LNM)
Carriage Return/ New Line Mode	(DECCRNLM)
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	

Table C–3: Power-Up Conditions Reset at the Start of New Work Session

Selectable Parameter	Control Function	Power-Up Condition
Printing Status		Off Line
Active Position		Column 1 on current active line
Underlining	(SGR)	Disabled
Bolding	(SGR)	Disabled
Expansion	(SGR)	Disabled
Unsolicited Reports		Disabled
Super/Subscripts		Disabled

Table C–4: Default Settings After Receipt of a Reset

Parameter	Control Function	Factory Setting Default
Printing Status		On Line (Ready)
Horizontal Pitch	(DECHORP)	10 Characters-Per-Inch (CPI)
Vertical Pitch	(DECSVERP)	6 Lines-Per-Inch (LPI)
Font	(SGR)	Data Processing
Forms Length	(DECSLPP)	66 Lines (11 in/27.94 cm)
Active Position		Column 1 on the current active
Top Margin		Line 1
Bottom Margin		Line 66
Left Margin		Column 1
Right Margin		Column 132
Underlining	(SGR)	Disabled
Bolding	(SGR)	Disabled
Italics	(SGR)	Disabled
Expansion	(GSM)	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		Set every 8 columns (9, 17,...137)
Unsolicited Reports	(DSR)	Disabled
Super/Subscripts		Disabled
Carriage Return		Reset
New Line Mode		Reset
Vertical Tabs		Every Line (1, 2, ... 66)

The following will not change:

All interface settings

The National Replacement Character Set

These parameters will remain as previously selected, either by escape sequence or control panel.

Appendix D

VFU CROSS REFERENCE TABLE

Table D-1 provides a cross reference between the VFU Table byte pair bit patterns and the equivalent characters (CHAR), decimal (DEC) values, and hexadecimal (Hex) values.

Table D–1: VFU Table Cross Reference

Char	DEC	Hex	Bit Pattern 12345678	Char	DEC	Hex	Bit Pattern 12345678
@	64	40	0000001x	‘	96	60	0000011x
A	65	41	1000001x	a	97	61	1000011x
B	66	42	0100001x	b	98	62	0100011x
C	67	43	1100001x	c	99	63	1100011x
D	68	44	0010001x	d	100	64	0010011x
E	69	45	1010001x	e	101	65	1010011x
F	70	46	0110001x	f	102	66	0110011x
G	71	47	1110001x	g	103	67	1110011x
H	72	48	0001001x	h	104	68	0001011x
I	73	49	1001001x	i	105	69	1001011x
J	74	4A	0101001x	j	106	6A	0101011x
K	75	4B	1101001x	k	107	6B	1101011x
L	76	4C	0011001x	l	108	6C	0011011x
M	77	4D	1011001x	m	109	6D	1011011x
N	78	4E	0111001x	n	110	6E	0111011x
O	79	4F	1111001x	o	111	6F	1111011x
P	80	50	0000101x	p	112	70	0000111x
Q	81	51	1000101x	q	113	71	1000111x
R	82	52	0100101x	r	114	72	0100111x
S	83	53	1100101x	s	115	73	1100111x
T	84	54	0010101x	t	116	74	0010111x
U	85	55	1010101x	u	117	75	1010111x
V	86	56	0110101x	v	118	76	0110111x
W	87	57	1110101x	w	119	77	1110111x
X	88	58	0001101x	x	120	78	0001111x
Y	89	59	1001101x	y	121	79	1001111x
Z	90	5A	0101101x	z	122	7A	0101111x
[	91	5B	1101101x	{	123	7B	1101111x
\	92	5C	0011101x	|	124	7C	0011111x
]	93	5D	1011101x	}	125	7D	1011111x
^	94	5E	0111101x	~	126	7E	0111111x
_	95	5F	1111101x	DEL	127	7F	1111111x

Glossary

Active column

The horizontal position on the paper where the next character will print. After printing a character, the printer increments the active column.

Active line

The vertical position on the paper where the next character will print. After printing a character, the printer increments the active line.

Active position

The absolute position on the paper where the next character will print. The active position is defined by the active column (horizontal position) and active line (vertical position).

ANSI

American National Standards Institute.

Autowrap mode

An operating feature of the printer that lets you control what happens to print characters that exceed the right margin on the page.

Barcode

A graphic (printed or photographically reproduced) barcode composed of parallel bars and spaces of various widths. A barcode symbol contains a leading quiet zone, a start character, one or more data characters including in some cases a check character, a stop character, and a trailing quiet zone.

Baud rate

The speed at which the printer communicates with the host computer.

Block character

A mode of operation in the LG31 printer. Characters are plotted in sizes selected.

Character attribute

A feature of a highlighted character. These include underlining, bold printing, italic printing.

Character cell

An imaginary rectangle used as a unit of spacing. The height of a cell is equal to the current line spacing, and the width is equal to the current character spacing.

Character set

A set of modes that describe the general appearance of a set of characters. For example, a character set might contain the code for an uppercase A or the number 1. Character sets do not describe the style of a printing character. See Font.

Code table

A list of characters and codes for a specific character set. The table is divided into columns and rows that show each character with its binary, octal, decimal, and hexadecimal code. An 8-bit code table has twice as many columns as the 7-bit table.

Control characters

Characters that do not print, but cause the printer to perform some action. For example, the HTS control character sets a horizontal tab. There are two groups of control characters, C0 (0/0 - 1/15) and C1 (8/0 - 9/15).

C0 (control 0) and C1 (control 1) codes

C0 codes represent 7-bit ASCII control characters. C1 codes represent 8-bit control characters that let you perform more functions than possible with C0 codes. You can only use C1 codes directly in an 8-bit environment.

Control function

A method of controlling how the printer processes, sends, and prints characters. Control functions include control characters, control strings, and escape and control sequences. Appendix C compares the control functions used in the LG31 printer and the LN03 printer.

Control sequence

Two or more bytes that define a specific control function. Control sequences usually include variable parameters.

CR

Carriage return.

Decipoint

A unit of measure equal to 1/720 inch.

DEC Multinational Character Set

This 8-bit character set is the default character set when you turn the printer on. The left half of this set is the ASCII graphic set (7-bit compatible). The right half includes the C1 control characters and DEC Supplemental Graphic Set (8-bit compatible).

DEC Private

Digital control sequences not yet recognized by ANSI. The mnemonics for these sequences begin with DEC.

Default values (for escape sequences)

Standard values used for parameters. The printer uses a default value when you specify a 0 value or omit a value. For most sequences, the default value is 1.

Density

Dots-per-inch of the printed image.

Device control strings (DCS)

Like control sequences, a DCS uses two or more bytes to define a specific control function. However, a DCS also includes a command string.

Error code

A numeric code of four digits, used to report printer problems. See the LG31 Installation/Operator's Manual.

Error messages

Displayed messages that describe printer problems. See the LG31 Installation/Operator's Manual.

Escape sequence

Two or more bytes that define a control function. Escape sequences do not include variable parameters, but may include intermediate characters.

Extended page format

The page home line is at the top margin, and the page end line is at the bottom margin.

FF

Form feed.

Font

A size and style of type to use for printed characters. For example, a Data Processing 10 CPI font describes a certain style (data processing) and size (10 CPI) of a printed character. Fonts and character sets are independent of each other. You need to specify both a font and a character set to print characters.

Font attributes

The seven characteristics of a font that define how printed characters will look when you use that font: type family, spacing type size, scale factor, typestyle, character weight, and character proportion. These attributes are not affected by the character set you use.

Font file

The data for a unique combination of one font and one character set. You can assign a font to any character set available in the printer. The font files that come with the printer are stored in ROM.

Font file attributes

A set of 12 characteristics for the font and character set in a given font file. These include the seven font attributes plus the character set images, rotation, character subset, file encoding, and resolution.

Font ID

A 16-character code (no lowercase letters) that describes the seven basic font attributes (including type family) of the ROM fonts.

Font file ID

A 31-character code that describes the character set and font attributes for a given font file. Appendix D lists all standard type family, font, and font file IDs for the ROM font files.

Form

A string of text and control sequences in a specific format that can be stored in printer memory and repeatedly printed.

Form length

The vertical size of the printed area on a page. The maximum form length depends on the setting.

GL (graphic left) and GR (graphic right) codes

Two code tables in memory, reserved for printable characters. You store the character sets you want to print from in GL and GR.

The printer uses the graphic left (GL) table in memory when the character code format is 7-bit, or when the character code format is 8-bit and the graphic characters are in the 2/1 through 7/14 range.

The printer uses the graphic right (GR) table in memory when the character code format is 8-bit and the graphic characters are in the 10/0 through 15/15 range.

Input buffer

An area in the printer that can hold up to 1,000 characters received from the host computer before printing them. This buffer allows the printer and host computer to communicate independent of printing speed.

Initial values (for escape sequences)

The LG31 has permanently stored values for some escape sequences that control basic printing functions. The printer uses these initial values after you power up the printer or send a reset sequence.

ISO

International Standards Organization.

Justification

The alignment of printed text at the right margin. When you justify text, you change the spacing between the words. Justified lines have the first character of the first word at the left margin (or the line home position, if different), and the last character of the last word at the right margin.

Landscape printing

A method of printing characters vertically from the bottom to the top of the paper loaded in the printer.

Line home position

The active position on the printed page after a carriage return (CR). The line home position serves as the left edge of the page for justified text. A CR may move the active position forward or backward in order to reach the line home position.

Line end position

The right edge of the printed page for justified text.

Logo

A graphic image that can be printed by the LG31.

Margin

A setting that defines the printing area on the page. The printer cannot print outside a right margin, except when drawing vectors or doing justification. The left horizontal margin specifies the first printable position on a line. The right horizontal margin specifies the last printable position on a line.

Normal page format

The page home line is 1/2-inch below the top margin, and the page end line is 5/6-inch above the bottom margin.

Origin

The starting point for printing on the page. You can select either the corner of the printable area, or the corner of the physical page.

Page end line

Usually the last printable line on a page. When the printer receives a line feed (LF) on the page end line, the active position moves to the page home line on the next page.

Page format select (PFS)

An escape sequence that lets you select a page format from a list of standard formats. These formats select the character size, characters-per-line, and lines per page.

Page home line

The active line on the page after a form feed (FF). The page home line specifies where a form feed positions the first printable line on the page.

Parameter

A character that modifies the action or interpretation of a control sequence. All parameters are unsigned, positive decimal integers, with the most significant digit sent first.

- A numeric parameter indicates a numeric value such as a tab or margin location. In this manual, numeric param eters appear as actual values or as Pn, Pn1, Pn2, and so on.
- A selective parameter selects an action associated with the specific parameter value. In this manual, selective parameters appear as Ps, Ps1, Ps2, and so on.

Pixel

The smallest displayable picture element on a video screen. The printer prints pixels as dots. A pixel in LG31 is 1/600".

Portrait printing

A method of printing characters horizontally across the paper loaded in the printer.

Printable area

The printable part of a page. On the LG31 (and most printers) you cannot print to the physical left or right edge of the page.

Printable characters

The characters the LG31 recognizes to print.

RAM

Random access memory.

Received characters

Printable characters and control functions that the printer receives from the host computer. The printer can process 7-bit and 8-bit data.

Reset sequence

An escape sequence that resets several printer operating features to an initial state. There are two sequences you can use to reset the LG31.

Resolution

The number of dots printed in a defined area. The maximum resolution of the LG31 is 200 dots-per-inch.

ROM-resident fonts

The standard fonts that come with the printer. These fonts are permanently stored in the printer's Read Only Memory (ROM).

Select graphic rendition (SGR) number

A number you must assign to a font file to make it available for printing.

Serial character format

The sequential arrangement of the bits of a data character. The printer sends and receives characters in this format. A serial character has a start bit (space), 7 or 8 data bits (1 = mark, 0 = space), a selectable parity bit, and a stop bit (mark).

Sixel

A single character code representing six vertical bits of an image.

Sixel protocol

A protocol that enables printing of black and white bit map data at various sizes. It is encoded as a Device Control String.

Tab stop

A preselected point that the active position moves to when you send the printer a tab control character. The active position is where the next character prints.

Type family

A group of fonts with a similar design, but differing in the six other font attributes. For example, Data Processing is a type family used in the LG31.

Vectors

Lines drawn with length, width, and horizontal or vertical direction. Margins do not affect line drawing. If you try to draw a line beyond the physical limits of the page, the printer will print the part of the line that occurs within the page. The printer draws lines without modifying the active position.

XON/XOFF protocol

A method of synchronizing data communication between the printer and the computer. The printer sends XON and XOFF signals to tell the computer when to start or stop sending data. The XON/XOFF protocol prevents the printer's input buffer from overflowing. Otherwise, data might be lost if the printer stops for some reason (a paper-out condition, for example) or if the communication speed is greater than the print speed.

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