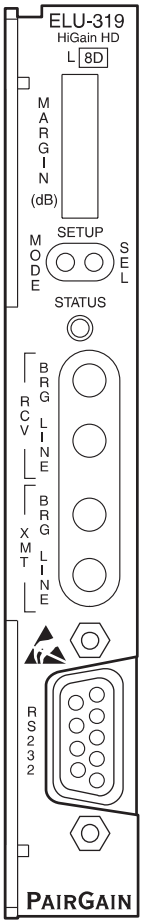
HIGAIN E1 LINE UNIT

Model	List Number	Part Number
ELU-319	7D	150-1236-74
ELU-319	8D	150-1236-84



PAIRGAIN TECHNOLOGIES, INC.
ENGINEERING SERVICES TECHNICAL PRACTICE
SECTION 150-319-274-01

Revision History of this practice.
Revision 01—July 30, 1997
A) Initial Release

PAIRGAIN
THE COPPEROPTICS COMPANY

TABLE OF CONTENTS

USING THIS TECHNICAL PRACTICE

Three types of messages, identified by icons, appear in the text:

A note informs you of special circumstances.

A caution indicates the possibility of equipment damage.

A warning indicates the possibility of personal injury.

A. PRODUCT OVERVIEW

1. Description and Features

1.1 This technical practice describes the PairGain® HiGain™ ELU-319 Lists 7D and 8D, E1 Line Units (ELUs) which function as the Central Office (CO) side of a repeaterless G.703 transmission system. When used with an E1 Remote Unit (ERU) and an E1 Doubler Unit (EDU), this HiGain E1 system provides 2.048 Mbps on two unconditioned copper pairs over the full Carrier Service Area (CSA) range. The "D" designation in the list number indicates that this line unit can be used in doubler applications to line power one doubler. The List 7D unit is used in 75-Ω circuits and the List 8D unit is used in 120-Ω circuits. This practice describes using the ELU-319 with and without an EDU.

1.2 Figure 1 shows a basic configuration for a E1 High-bit-rate Digital Subscriber Line (HDSL) circuit. The ELU is installed at the CO shelf and is connected to an ERU at the Customer Premises Equipment (CPE) site. The optional EDU provides the ability to double the transmission range for customer applications located outside the CSA. The CSA includes loops up to 12000 feet of 24 AWG or 9000 feet of 26 AWG wire, including bridged taps.

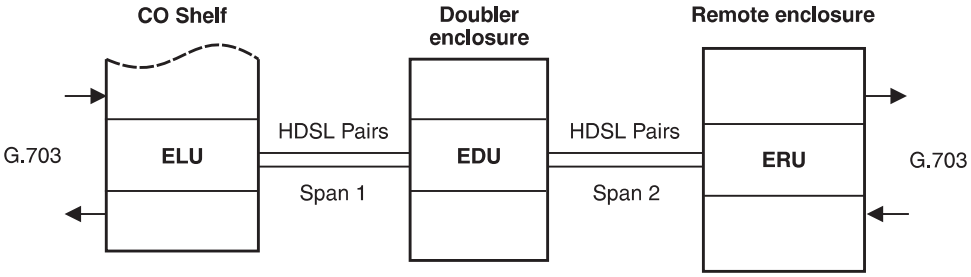


Figure 1. *Typical HiGain E1 System*

1.3 ELU-319 features:

- Optimum Unipolar or Bipolar HDSL line voltage
- Front panel:
  - – G.703 splitting and bridging access
  - – Four-character display of HDSL margin, configuration parameters, and alarms
  - – Mode and Select Setup buttons
  - – Status LED
- RS-232 connector for setting options from the Maintenance Terminal
- On-off front-panel display power saving feature
- G.703 Loss of Signal (LOS) detector (125 consecutive zeros)
- -130 Vdc line power for the ERU-412 or EDU-451

- Non-volatile configuration memory
- Lightning and power cross protection on HDSL interfaces
- 1040 kbps full-duplex two-bits-one quaternary (2B1Q) HDSL transmission on each of two pairs
- Margin threshold alarm
- Circuit ID option
- Improved tolerance to cable noise

1.4 Standards compliance. The HiGain system uses HDSL transmission technology as recommended by Bellcore TA-TSY-001210. HiGain complies with:

- TR-TSY-001210 Network Equipment Building System (NEBS) Generic Equipment Requirements
- TR-TSY-000499 Transport System Generic Requirements (TSGR) Common Requirements

1.5 Front Panel. Figure 2 and Table 1 describe the ELU-319 front panel.

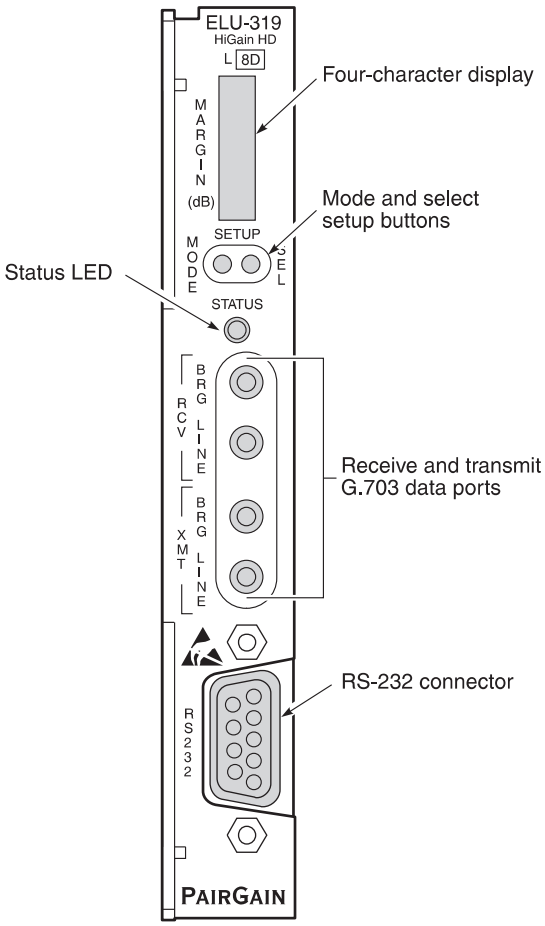


Figure 2. *ELU-319 Front Panel*

Table 1. *ELU-319 Front Panel Components*

Name	Function
Four-character display	Status messages for HDSL, Signal-to-Noise (S/N) margin, and configuration parameters (see Table 9). Alarm messages are shown in Table 7 and loopback messages are shown in Table 14.
Mode and select setup buttons	Buttons that permit you to determine system modes and select options.
Status LED	Tri–color LED that indicates system state (see Table 2).
Receive and transmit G.703 data ports	G.703 port for splitting access and bridging Bantam-type jacks.
RS-232 Connector	Configured as Data Circuit-Terminating Equipment (DCE) that allows you to control the ELU-319 through a dumb terminal (or a PC with terminal emulation software). See Section 11 for operation procedures.

Table 2. *Status LED messages*

Color	Definition
Steady green	Normal operation.
Flashing green	HDSL acquisition.
Flashing red	Minor Alarm (see Section 6).
Steady red	Fuse Alarm (see Section 6).
Yellow	Self-test in progress or a Customer Remote (CREM) or Network Local (NLOC) loopback is in effect.

1.6 The ELU– 319 is compatible with the PairGain products listed in Table 3.

Table 3. *ELU–319 PairGain Product Compatibility*

Model	Description	Part Number
ERU-412 List 1	E1 Remote Unit	150-1237-01
ERU-412 List 2	E1 Remote Unit	150-1237-02
EDU-451 List 1	E1 Doubler Unit	150-1272-01
EDU-451 List 2	E1 Doubler Unit	150-1272-02
HMS-317 List 2	HiGain Management Shelf	150-1128-02
HMS-318 List 2	HiGain Management Shelf	150-1129-02
HCP-322 List 1 (75 ohm)	G.703 HiGain Connector Panel	150-1274-01
HCP-322 List 2 (120 ohm)	G.703 HiGain Connector Panel	150-1274-02

1.7 The ELU-319 List 7D and 8D differ from the earlier ELU–319 List 5D and 6D models in that the newer 7D and 8D models cannot provide the –200V HDSL line voltage option. These units only provide the -130V HDSL line voltage. Thus, they can only power one remote device. As such, they are limited to a one doubler circuit that requires the ERU to be locally powered.

2. Specifications

HDSL

Line Code ..... 10 kbps, 2B1Q

Output ..... +13 dB ± 0.5 dB @ 135 Ω

Line Impedance ..... 135 Ω

Startup Time ..... 30 seconds (typical), 60 seconds (maximum)

Maximum Provisioning Loss

35 dB at 196 kHz, 135 Ω

Line Clock Rate

Internal Stratum 4 clock

Maximum Power Consumption

Without doubler ..... 12 W

With doubler ..... 21 W

Maximum Heat Dissipation

Without doubler ..... 6 W

With doubler ..... 8 W

Electrical Protection

Secondary surge protection on G.703 and HDSL ports. Power cross protection on HDSL ports.

Environmental

Operating Temperature ..... -40° to +149° F (-40° to +65° C)

Operating Humidity ..... 5 to 95% (non-condensing)

Mounting

Single slot of a PairGain HMS-317 or HMS-318

G.703

One-way delay ..... Less than 220 µs

Line Impedance ..... List 7D: 75 Ω, List 8D: 120 Ω

Input Level ..... +1.5 to –7.5 dB

Line Rate ..... 2.048 Mbps ± 200 bps

Line Format HDB3

Connectors

Maintenance Terminal DB-9

G.703 ..... RCV (BRG and LINE) and XMT (BRG and LINE)

Power

Fusing ..... Internal, 1.25 A at 125 V, connected to FUSEALARM output on pin 10

Span Voltage ..... – 130 Vdc (unipolar), ± 65 Vdc (bipolar)

Margin Indicator

Displays HDSL span Signal-to-Noise Ratio (SNR) margin relative to 10-7 Bit Error Ratio (BER) operation

Dimensions

Width ..... 0.7 in. (1.78 cm)

Depth ..... 10.5 in. (26.67 cm)

Height ..... 4.75 in. (12.07 cm)

Weight ..... 1 lb. 11 oz.

3. Applications

3.1 This HiGain System provides a cost-effective, easy-to-deploy method for delivering G.703 High Capacity Digital Service (HCDS) over metallic pairs. The fiber-like quality service is deployed over two unconditioned, non-loaded copper pairs. Conventional span repeaters are not required. Cable pair conditioning, pair separation and bridged tap removal, are also not required.

3.2 HiGain systems:

- operate with any number of other G.703, Plain Old Telephone Service (POTS), Digital Data Service (DDS), or other HiGain systems sharing the same cable binder group.
- can be used with customers requiring E1 service on a temporary or permanent basis.
- Provide a means of quickly deploying service in advance of fiber-optic transmission systems.
- are easily installed allowing service to be provided within hours. Fiber optic systems can be installed at a leisurely pace and cut-over from the installed HiGain system when convenient to do so. The installed HiGain system can then be easily removed and utilized elsewhere.

3.3 Table 4 provides a guide for the loss of various cable gauges at the HDSL line rate of 260 kHz and 135 Ω. The table applies to the HDSL cable pairs between the ELU, the EDU (for doubler applications), as well as between the EDU and ERU. Add 3 dB for each bridged tap and 1 dB for each cable gauge change.

Table 4. *HDSL Cable Loss*

Cable Gauge (AWG)	Loss @ 260 kHz (dB/km)	Ω per km
26/0.4 mm	13.94	272
24/0.51 mm	10.47	171
22/0.61 mm	8.14	105
19/0.91 mm	5.74	52

3.4 The ELU to ERU operating ranges, on unimpaired cable pairs, as a function of cable gauge and average margin are shown in Table 5.

Table 5. *HiGain E1 Ranges (km) on Unimpaired Cables versus average margin (M) in dB*

Cable Gauge (AWG)	M=11	M=7	M=3
26/0.4 mm	2.7 km	3.0 km	3.3 km
24/0.51 mm	3.6 km	4.0 km	4.4 km
22/0.61 mm	4.7 km	5.2 km	5.7 km
19/0.91 mm	6.6 km	7.3 km	8.0 km

3.5 The ELU-319 List 7D and 8D line units support one doubler only. They do not support two doublers. For single doubler systems, the EDU is line powered but the ERU must be locally powered.

4. Theory of Operation

4.1 The ELU-319 block diagram is shown in Figure 3.

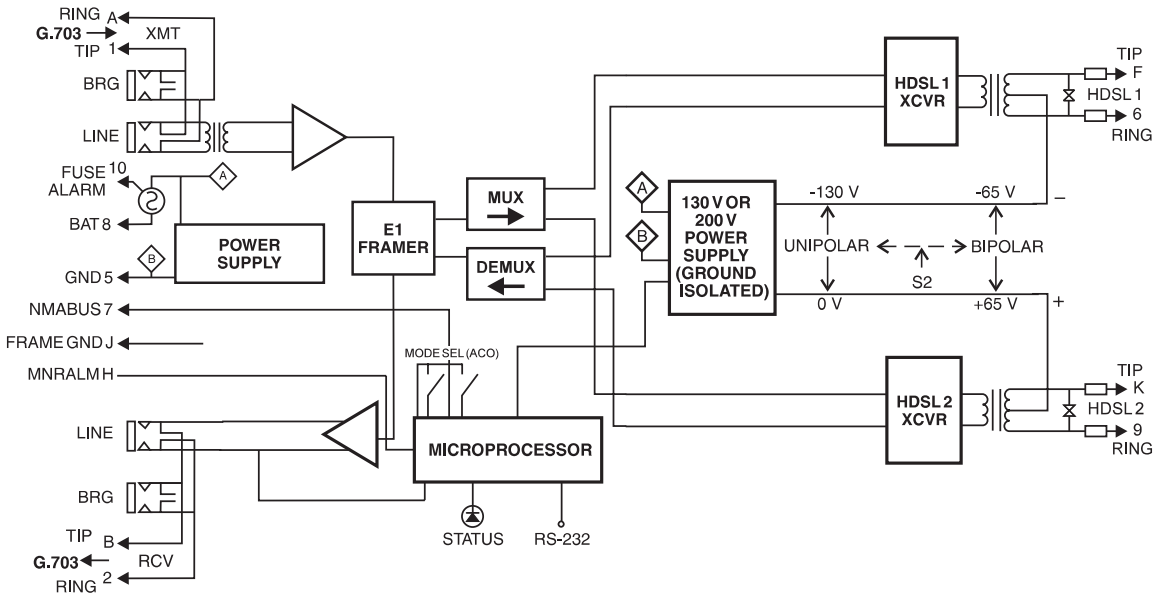


Figure 3. *ELU-319 Block Diagram*

4.2 The ELU-319 uses PairGain's 2B1Q HDSL transceiver systems to establish two full-duplex 1040 kbps data channels between the ELU-319 and an ERU-412 or EDU-451. This provides a total capacity of 2.080 Mbps between the two units: 2.048 Mbps for the G.703 interface and 32 kbps of overhead. The system operates using the following sequence:

1 The ELU-319 receives a 2.048 Mbps data stream from the G.703 digital cross-connect interface.

2 The demultiplexer generates two parallel 1040 kbps data streams. Each data stream consists of HDSL frames that are nominally 4704 bits (4.5 milliseconds) in length. Each frame contains a 14-bit Frame Sync Word (FSW), a 6-bit Cyclic Redundancy Check (CRC), an embedded operations channel and 16 of the 32 G.703 timeslots. The demultiplexer provides frame synchronization for each of the two HDSL channels.

The multiplexer and HDSL transceivers work under control of the ELU-319 microprocessor and compensate for data inversions caused by Tip-Ring reversals and for channel swaps caused by pair reversals. The HiGain system tolerates Tip-Ring reversals, HDSL cable pair reversals but does not tolerate split pairs.

3 The two formatted HDSL channels pass to the HDSL transceivers, which convert them to 2B1Q format. The 2B1Q line code operates in full-duplex mode on unconditioned pairs. The transceiver's digital echo cancelers and adaptive equalizers receive the signal from the remote end in the presence of impairments and noise on the copper pairs. Each of the two HDSL channels contain 16 G.703 timeslots.

4 The transceiver processes the HDSL channels it receives and passes them on to the multiplexer. The multiplexer removes data link messages from the HDSL channels and passes them to the microprocessor. This enables the ELU-319 and the ERU-412 to exchange operations messages and status. By synchronizing to the FSW of each channel, the multiplexer can reconstruct the original 2.048 Mbps G.703 stream from the payloads of the two HDSL channels. The CRC fields on the HDSL streams enable the ELU-319 to determine if errors are present on the channel due to excessive impairments caused by impulse or crosstalk noise.

5 The reconstructed HDSL data channel is buffered in a first-in-first-out (FIFO) buffer within the multiplexer. A frequency synthesizer in conjunction with the buffer regulates the output bit rate and reconstructs the G.703 clock at the exact rate received from the remote end. The HiGain system operates at G.703 rates of 2.048 Mbps with up to ±50 ppm of offset.

6 A G.703 interface driver converts the G.703 channel to a High Density Bipolar 3 (HDB3) format.

7 The main power supply converts -48 V local battery to logic power for the ELU-319 circuits. The line power supply converts the -48 V battery to -130 V. This provides simplex power feed on the HDSL loops. The line power can be turned on or off by the microprocessor and automatically shuts down in the presence of line short-circuits or microprocessor failure.

4.3 The transmit (XMT) and receive (RCV) G.703 ports have splitting access and bridging (BRG) Bantam-type jacks. Connecting one cable between the two BRG jacks and another between the two LINE jacks splits the XMT and RCV ports, creating metallic loopbacks towards the customer equipment and HDSL line.

5. Power Consumption

5.1 The three most important power demands of an ELU-319 on the shelf power supply are its maximum power consumption, its maximum power dissipation, and its maximum current drain. These three parameters are listed in Table 6 on a per slot and per shelf basis.

Table 6. *Power Demands*

Power*	Per Slot	Per Shelf
Maximum Power Consumption	12 W	264 W
Maximum Power Dissipation	6 W	132 W
Maximum Current Drain	0.28 A	6.2 A

* The worst case conditions under which these parameters were measured include a 3.3km, 0.4 mm loop, a fully loaded 22-slot shelf and a -42.5 V shelf battery voltage.

5.2 **Maximum Power Consumption.** The maximum power consumption is the total power the ELU-319 consumes or draws from its -48 V shelf power source. This parameter is needed when the ELU-319 is located remotely from its serving CO and determines the battery capacity required to maintain an eight-hour stand-by battery reserve for emergency situations. This limits the maximum number of plugs per remote enclosure. Use the data in Table 6 to perform this analysis on a case by case basis.

5.3 **Maximum Power Dissipation.** The maximum power dissipation measures the power that is converted into heat built up within the unit that contributes to the total heat generated in the space around the unit. This measurement determines the maximum number of fully loaded shelves per bay that do not exceed the maximum allowable power dissipation density in Watts per square foot.

5.4 **Maximum Current Drain.** The maximum current drain is the maximum current drawn from the shelf power supply when it is at its minimum voltage (-42.5 V). This determines the shelf fusing requirements. The HMS-318 (19 in.) HiGain Management Shelf (HMS) and HMS-317 (23 in.) are partitioned into two equal halves. Each should be fused at 10 A for a total of 20 A per shelf. A fully loaded shelf draws 6.2 A worse case. This is within the 10 A fuse limit.

5.5 **Thermal Loading Limitations.** The thermal loading limitations imposed when using the ELU-319 in a Controlled Environmental Vault (CEV) or other enclosures are determined by applying the ELU-319 power parameters to the manufacturer's requirements for each specific housing.

6. Alarms

6.1 The ELU-319 generates two types of alarms:

- Minor Alarm (MNRALM)
- Fuse Alarm (FUSEALARM)

6.2 **Minor Alarm.** Minor alarms appear in either the front panel four-character display or in the Alarms field of the View Span Status screen (see Section 16). Table 7 lists the alarms that can appear in the four-character display:

- The four-character message that accompanies each alarm condition is listed in the Alarm column.
- Since more than one alarm condition can exist at any time, but only one message can be displayed, only the highest priority alarm is displayed if more than one alarm condition exists.
- The alarms are listed in order of priority.

The message ALRM appears one time in the four-character display prior to the display of the alarm condition message. The first part of the alarm message (first four-character block) and the second part of the alarm message (second four-character block) display for one second each respectively.

Table 7. *Minor Alarms Listed by Priority*

Alarm	Description
LOSW	Loss of synchronization in either HDSL loop.
LLOS	Loss of ELU-319 G.703 input signal.
RLOS	Loss of ERU-412 G.703 input signal.
TLOS	An ERU logic loopback initiated by loss of the G.703 E1 input from the CI is in effect.
H1ES	An HDSL Loop 1 transceiver has exceeded the 24-hour user-selected Errored Seconds (ES) threshold.
H2ES	An HDSL Loop 2 transceiver has exceeded the 24-hour user-selected ES threshold.
G.703	The total number of bipolar violations (BPV) at the ELU or ERU G.703 inputs exceeded the 24-hour user-selected threshold.
MAL1 (2)	The margin on HDSL Loop 1 (Loop 2) has dropped below the Margin Alarm Threshold value set from the Maintenance Terminal menus.

6.3 **Fuse Alarm.** A fuse alarm occurs whenever the ELU-319's on-board fuse opens. The Status LED lights steady red if this condition occurs.

6.4 **Alarm Pinouts.** The ELU-319 pinouts are shown in Figure 4. Pin H (MNRALM) remains grounded for the duration of the alarm condition. The active pins are highlighted in black.

The ELU-319 drives pin 10 (FUSEALARM) to -48V whenever its on-board fuse opens. Its normally floating output must never operate above ground or below -80V. It can sink a current of 10 mA.

Pin H is the minor alarm (MNRALM) output pin. This pin must never operate at a setting above 0V or below -60V. The ELU-319 forces pin H to ground (maximum of 10 mA) for any of the conditions listed in Table 7.

6.5 The ELU-319 Status LED flashes red for the duration of a minor alarm condition. You can terminate the MNALRM condition by pressing and holding down the front panel Select button for five seconds.

6.6 Setting the ALM option to *DIS* (disable) only prevents the unit from activating the MNRALM output alarm bus on pin H on a minor alarm event. The Status LED still flashes red and the ALRM message still appears.

6.7 **Provisioning.** The alarms are provisioned using either the Front-Panel Mode and Select Setup buttons or the Maintenance Terminal menus:

- The ALRM HES and ALRM G.703 alarms can be suppressed by selecting *NONE* for the Errored Seconds Alarm (ESAL) system option using the Mode and Select Setup buttons (see Section 12) or the Maintenance Terminal menus (see Section 18.6).
- The Margin Alarm (MAL) can be disabled by setting the margin alarm threshold to *0*.
- A Minor Alarm can be turned off by pressing the Select Setup button. This action causes an Alarm Cut Off (ACO), which in turn causes the front panel display to read ACO. The second part of the ALRM message, which defines the cause of the alarm, remains. Both messages remain until the alarm condition clears or another alarm occurs.

6.8 When an HDSL loop is in a Loss of Sync Word (LOSW) condition, a minor alarm occurs. This causes the ELU-319 to enter a self test cycling mode during which the front panel Status LED lights yellow instead of red, and the SELF TEST message appears instead of an alarm message.

See Table 13 in Section 16 for alarm messages that display in the Alarms field of the View Span Status screen.

7. ELU-319 Card Edge Pin-Out Diagram

7.1 The ELU-319 occupies one slot in a PairGain HMS-317 or HMS-318 shelf. The card edge pin-out diagram for the ELU-319 is shown in Figure 4.

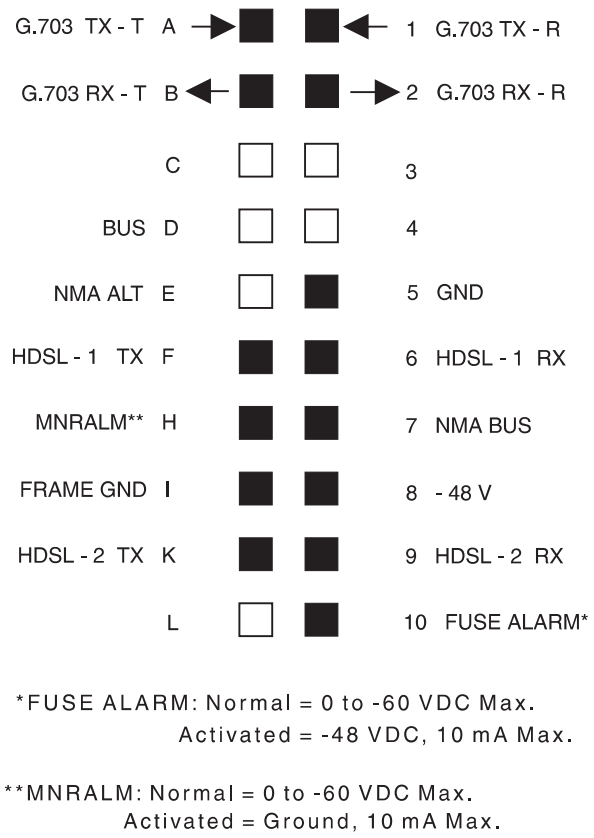


***Figure 4**. ELU-319 Card Edge Pinout Diagram*

B. INSTALLATION

8. Inspecting Your Shipment

8.1 When you receive the equipment, inspect it for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to PairGain.

8.2 Your shipment should consist of:

- One ELU-319 List 1.
- This document.

9. Setting the HDSL Line Voltage Option

9.1 The symmetry of the HDSL line powering voltage is set through the S2 switch (Figure 5):

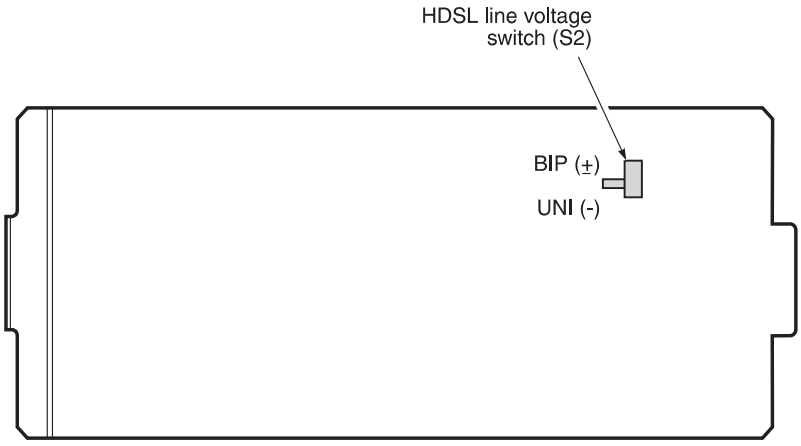


***Figure 5**. HDSL Line Voltage Switch S2*

- **BIP (±) Bipolar:** Sets the HDSL line voltage to +65 V on loop 2 and -65 V on loop 1. This setting reduces the maximum ground referenced voltage to 65 V, but applies positive voltage to the cable pairs, which could accelerate corrosion on the cable pairs.
- **UNI (—) Unipolar:** Sets the HDSL line voltage to 0 V on loop 2 and to -130 V on loop 1 (factory default). This setting keeps the HDSL cable pair voltage at or below ground potential, thereby avoiding corrosion problems caused by cable voltages more positive than ground.

9.2 **Line Voltage Power Supply.** The line voltage power supply, used for both options, is ground referenced, but also ground isolated by 200 kΩ. This ground isolation reduces problems due to induced noise currents and large surge voltages, which are ground referenced. It also reduces ground fault currents, which improves the product's safety. The safety issue thus depends solely on the differential voltage across loop 1 and loop 2, and is independent of the S2 setting.

10. Installing the ELU-319

10.1 The ELU-319 mounts in a PairGain HMS-317 or HMS-318 card shelf (Figure 6). The auxiliary HiGain Connector Panel, HCP-322 (see the *Quick Installation Guide for PairGain Technologies HiGain Connector Panel, Section 100-322-100* for more information) mounts in the HMS-318 shelf and provides G.703, BNC connector access (75 ohm or 120 ohm) to each of the 22 slots.

10.2 To install the ELU-319 (Figure 6):

1 Set the HDSL Line Voltage Options as described in Section 9.

2 Slide the ELU-319 into the card guides for the desired slot, then push the unit in until it touches the card shelf backplane and card-edge connector.

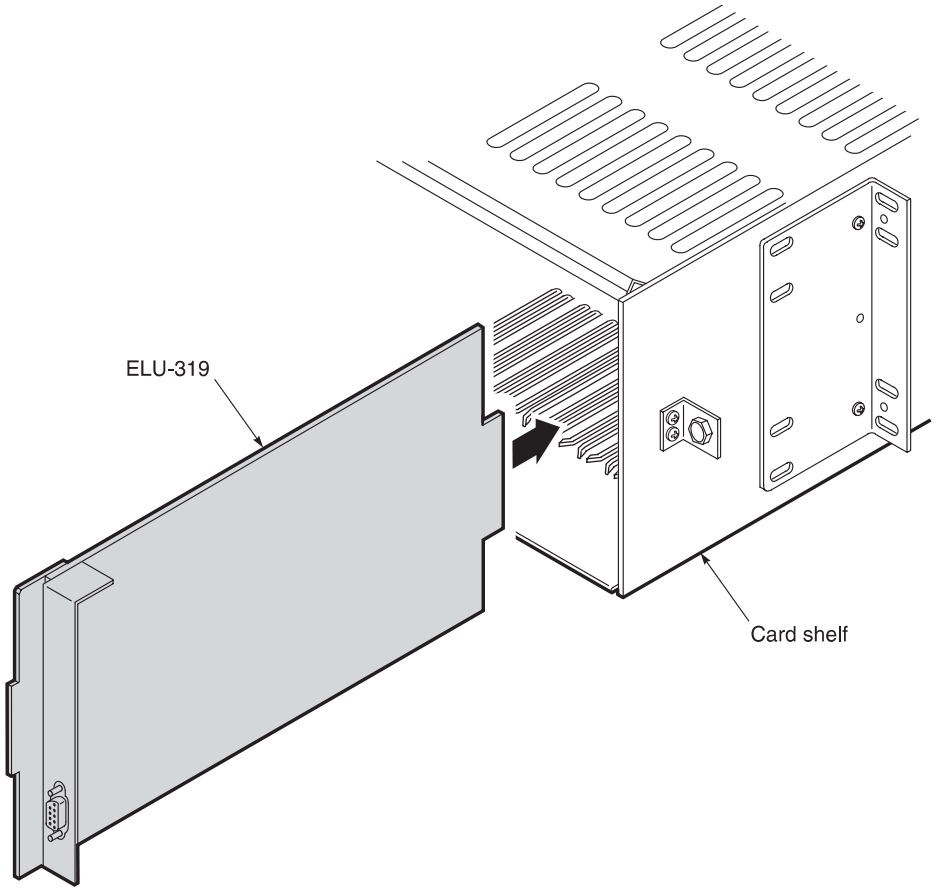


Figure 6. *ELU–319 Inserted Into a Card Shelf*

3 Push the unit into the card edge connector until it is entirely within the card guide, indicating that the unit is properly seated.

11. Connecting to a Dumb Terminal

11.1 The nine-pin RS-232 connector on the ELU-319 front panel allows you to use a standard RS-232 cable to connect your system to a dumb terminal or PC running a terminal emulation program. Once connected to a dumb terminal, you can access the maintenance, provisioning, and performance screens. Figure 7 shows the ELU-319 DB-9 RS-232 I/O.

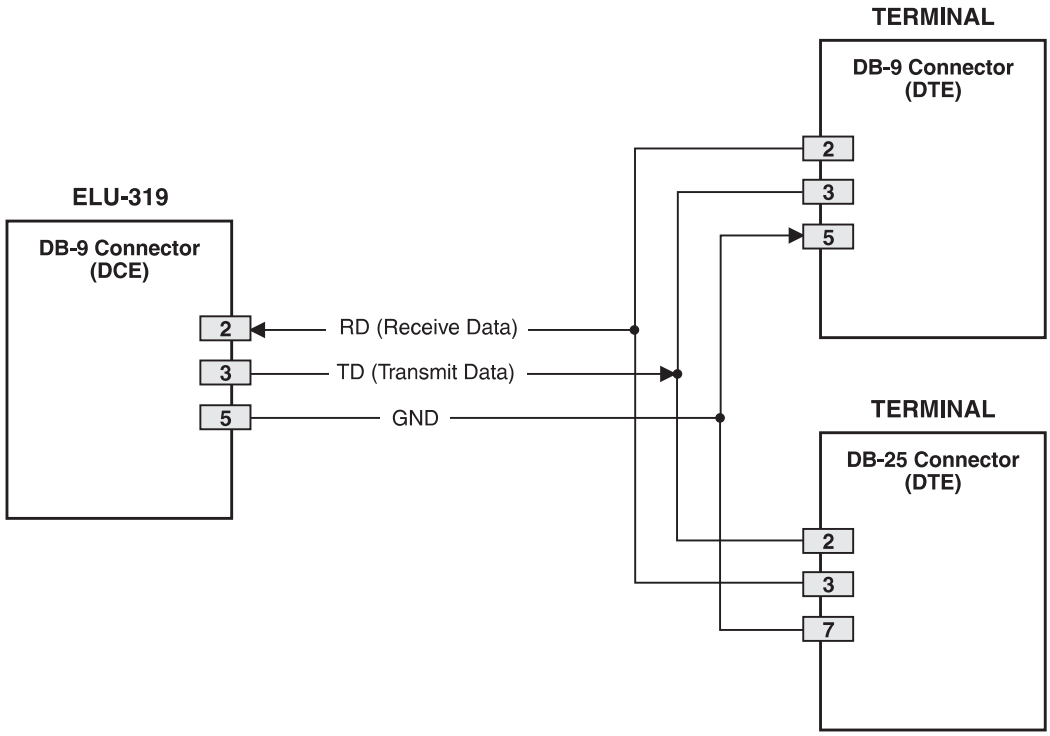


Figure 7. *DB-9 RS-232 I/O*

11.2 The dumb terminal is configured as DCE. To connect the ELU-319 to a dumb terminal, connect the RS-232 COM port of the dumb terminal to the ELU-319 front panel RS-232 connector using a serial cable (Figure 8):

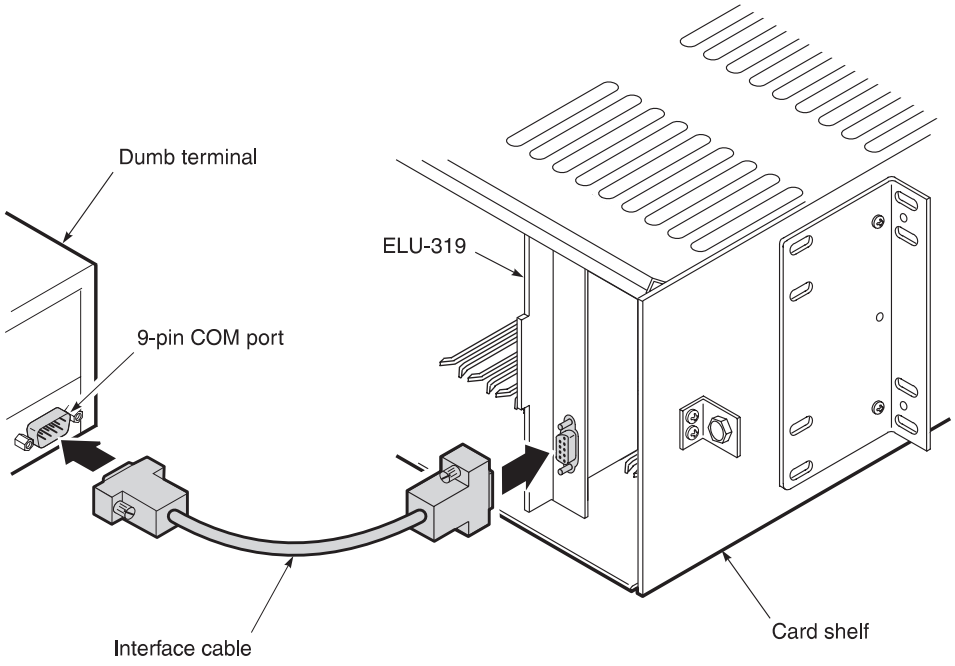


Figure 8. *Connecting the ELU-319 to a Dumb Terminal*

12. Initialization

12.1 Power-up Sequence. When an ELU-319 is first inserted into a card shelf, it attempts to synchronize with the ERU. The following types of messages appear in the four-character display as the HDSL signal is acquired across loops 1 and 2:

- HDSL
- SIG: Signal messages indicating that the HLU and HRU transceivers are establishing contact with each other over both loops.
  - – SIG1
  - – SIG2
- HDSL
- ACQ: Acquisition messages indicating that the HLU and HRU multiplexers are establishing synchronization over both loops.
  - – ACQ1
  - – ACQ2

Upon successful initialization, the Status LED lights steady green and the margins for Loop 1 and Loop 2 alternately display in two-second intervals. The power saving feature removes all messages from the four-character display after five minutes.

12.2 Margin Displays. The margin display indicates the worst-case signal-to-noise ratio measured for each loop. A value of *06* or greater is adequate for reliable system operation. The system displays the margin settings for both Loop 1 and Loop 2 using the following format:

```
1 = xx
2 = xx
```

where "xx" represents the margin for each loop.

C. SETTING OPTIONS FROM THE FRONT PANEL

13. Using the Mode and Select (SEL) Setup Buttons

13.1 The ELU-319 front panel Mode and Select Setup buttons provide the means for setting the following four system parameters:

- Power Feed (PWRF for the HDSL line power)
- Errored Seconds Alarm Threshold (ESAL)
- Loopback Timeout (LBTO)
- Alarm (ALM)

The Set Clock, Margin Alarm Threshold, and Circuit ID options cannot be set using the front panel Mode and Select Setup buttons, but must be set using the Maintenance Terminal menus (see Section D).

13.2 The ELU-319 stores the system parameter settings in non-volatile RAM (NVRAM) to prevent loss of settings in the event that shelf power is lost or the ELU-319 is unplugged.

13.3 Table 8 lists the system options and defines each of the modes and settings. Options are listed in the sequence in which they appear in the four-character display. Table 9 lists the four-character display messages.

Table 8. *System Options*

Mode	Choice	Description
PWFD	DIS	Disables powering to the ERU over the HDSL pairs.
	ENA*	Enables powering to the ERU over the HDSL pairs.
ESAL	17	Activates a minor alarm after 17 HDSL CRC errors on either HDSL loop, or a total of 17 BPVs and FERR occur within 24 hours.
	170	Activates a minor alarm when 170 ES occur within 24 hours.
	NONE*	Prevents generation of a minor alarm due to excessive ES.
LBTO	NONE	Disables automatic time-out cancellation of all loopbacks.
	20	Sets automatic cancellation of all loopbacks to 20 minutes after initiation.
	60*	Sets automatic cancellation of all loopbacks to 60 minutes after initiation.
	120	Sets automatic cancellation of all loopbacks to 120 minutes after initiation.
ALM	DIS*	Terminates an existing minor alarm on pin H by disabling its signal, and prevents another minor alarm from occurring.
	ENA	Enables pin H to be grounded when a minor alarm condition occurs.
MARG	0 to 15	Displays the Margin Alarm Threshold (in dB) set through the maintenance terminal. If the margin on either loop drops below this value, a minor alarm is reported (MAL1/2).
	4*	
CONF	YES	Confirms that all four operating modes are to be updated to their current choices.
	NO*	Uses previous settings and prevents newly selected parameters from being updated.

* Indicates the ELU–319 factory default settings.

Table 9. *Four-Character Display Messages*

Message	Full Name	Description
LBPV	Local Bipolar Violation	A bipolar violation has been received at the G.703 input to the ELU.
SIG 1 or 2	Signal 1 or Signal 2	The ELU and ERU transceivers are trying to establish contact with each other on Loops 1 or 2 of Span 1.
S2L1 or 2	Signal 2 Loop 1 or Loop 2	The EDU and ERU transceivers are trying to establish contact with each other on Loops 1 or 2 of Span 2.
ACQ 1 or 2	Acquisition 1 or Acquisition 2	The ELU and ERU multiplexers are trying to establish synchronization over Loop 1 or 2 of Span 2.
A2L1 or 2	Acquisition 2 Loop 1 or Loop 2	The EDU and ERU multiplexers are trying to establish synchronization with each other on Loops 1 or 2 of Span 2.
H1ES	HDSL Loop 1 Errored Second	HDSL CRC error on Loop 1. Also displays when 24-hour ES threshold has been exceeded.
H2ES	HDSL Loop 2 Errored Seconds	HDSL CRC error on Loop 2. Also displays when 24-hour ES threshold has been exceeded.
ACO	Alarm Cut Off	A minor alarm has occurred and was changed to an ACO condition.
SELF TEST	Self Test	The ELU-319 is in self-test mode. This occurs during every power cycle. The self-test sequence includes the input G.703 transceiver chip when the HDSL loops are not in synchronization. This can cause the AIS pattern, normally transmitted from the ELU, to exhibit Bipolar Violations (BPVs) at the G.703 input.
ALRM	Alarm Condition Exists	A minor alarm condition is in effect.
1=xx or 2=yy	HDSL Loop Margins	Indicates the worst-case signal-to-noise ratio measured for each loop. A value of 06 or greater is adequate for reliable system operation.
PWR FEED SHRT	Power Feed Short	Indicates a short-circuit between the two HDSL pairs, or the ERU cannot communicate with the ELU.
PWR FEED OPEN	Power Feed Open	Indicates an open circuit in the Tip and Ring of either HDSL pair.
BAD RT?	No response from ERU	The ELU does not receive any response from the ERU. The ERU or span may be at fault.
VER	ELU software version number	Displays during the System Settings review mode.
LIST 000X	ELU list number	Displays during the System Settings review mode.
LOSW	Loss of Sync Word	Indicates that one of the HDSL loops has lost synchronization (minor alarm).
LLOS	Local Loss of Signal	Indicates that no signal is detected at the G.703 input to the ELU (minor alarm).
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the G.703 input to the ERU (minor alarm).
G.703	G.703 BPV errors	Indicates that the number of BPVs at the ELU or ERU G.703 inputs have exceeded the 24-hour ES threshold (minor alarm).
MAL1(2)	Margin Alarm Loop 1 or 2	The margin on HDSL loop 1 or 2 has dropped below the threshold (1 to 15 dB) set through the maintenance terminal.

13.4 Setting System Options. To initiate the Option Setting Mode:

1 Press the Mode Setup button for two seconds and then release.

The message in the four-character display alternates between the Mode name and its current setting.

2 Press and release the Select Setup button to display all possible parameter settings (one at a time).

3 After the desired setting has been selected, press the Mode Setup button.

This updates the current displayed mode to the selected setting, then scrolls to the next configurable parameter. After the last parameter has been selected, the display shows:

```
CONF NO
```

4 Do one of the following:

- If you do not want to change any of the parameters, press the Mode Setup button.
- If you want to accept the changed parameters, press the Select Setup button.

  A CONF YES message displays and the selected changes are installed.

  In either case the display returns to its normal mode.

The display also returns to its normal mode, without installing any new changes, if neither button is pressed for 30 seconds.

13.5 Setting Options to Factory Default Values. Table 8 (see page 17) also shows the factory default values for the system options. To set the options to the factory default values:

1 Press the Select Setup button for six seconds until the following message appears:

```
DFLT NO
```

2 Do one of the following:

- To set the default values press the Select Setup button while the DFLT NO message is displayed. The following message then appears indicating that the factory default values are now in effect:

  ```
  DFLT YES
  ```

- To terminate the DFLT mode without setting the factory default values, press the Mode Setup button or do nothing for 30 seconds. This returns the options to the selected values and the display resets to its normal state.

13.6 System Inventory. To view a system inventory:

1 Press the Mode Setup button for three or more seconds.

The display scrolls through the software version number, its List number, and all option settings.

2 Repeat this process until you have verified the system settings.

D. SETTING OPTIONS FROM THE MAINTENANCE TERMINAL

14. Using the Maintenance Terminal Menus

14.1 After you have connected the ELU-319 to a dumb terminal, you must configure the dumb terminal to the following communication settings.

- 1200 to 9600 baud (9600 baud is recommended)
- Parity: None
- 8 data bits
- 1 stop bit
- Hardware Flow Control set to None
- VT Terminal Emulation

If using the Microsoft Windows terminal emulation program, from the Settings, Terminal Preference menu, you must deselect *Show Scroll Bars* and *Use Function, Arrow, and Ctrl Keys for Windows*

14.2 **Navigating the Maintenance Terminal menus.** Table 10 describes keys you can use on the dumb terminal's keyboard to navigate within the Maintenance Terminal menus.

Table 10. *Dumb Terminal Navigational Keys*

Key	Function
<U>	Updates a report
<C>	Clears a report
<S>	Selects the next Span Status screen
<P>	Selects the previous page of a report
<N>	Selects the next page of a report
<E>	Exits the current menu
<Esc>	Exits the current menu

14.3 **Selecting an Option.** The Maintenance Terminal menus use two different means of selecting an option:

- Press the key indicated to the left of the selection.
- Press the letter in parenthesis of the parameter to be changed.

15. Maintenance Terminal Main Menu

15.1 There are eight menus available for system administration from the Maintenance Terminal Main menu. Table 11 describes the function of each menu selection.

Table 11. *Maintenance Terminal Menus*

Menu	Function	See
View Span Status	Allows you to monitor the HDSL line between the ELU-319 and the ERU-412.	Section 16
Set Clock	Allows you to set the time and date parameters at the ELU-319, and to update the same settings at the ERU-412.	Section 17
System Settings	Allows you to set all user options.	Section 18
Loopback Mode	Allows you to issue and disable loopbacks from both the network and customer side (local and remote).	Section 19
View Performance Data	Allows you to view the Errored Seconds (ES) and Unavailable Seconds (UAS) between the ELU-319 and the ERU-412 in 15-minute intervals over a four-hour time period.	Section 20
View Performance History	Allows you to view the ES and UAS between the ELU-319 and the ERU-412 in 15-minute intervals over a seven-day period.	Section 21
View Alarm History	Allows you to view alarm conditions between the ELU-319 and the ERU-412.	Section 22
Enter Circuit ID #	Allows you to enter a unique circuit ID (up to 24 characters)	Section 23

15.2 To display the Maintenance Terminal Main menu:

1 Press the <Spacebar> several times to initiate the RS-232 connection.

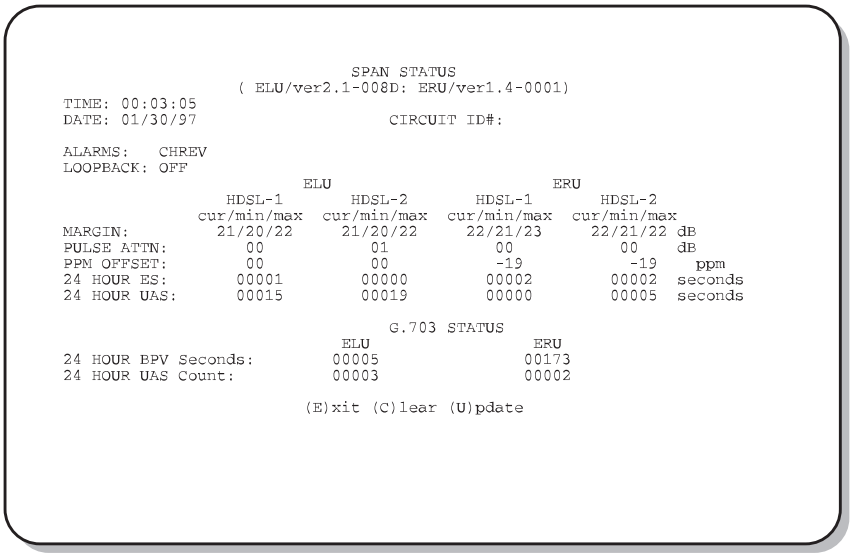
The Maintenance Terminal Main menu displays:

```
HI-GAIN ELU-319 (G.703)   MAINTENANCE TERMINAL MAIN MENU   (ver V2.1L-008D)
                             CIRCUIT ID#:

                          A. VIEW SPAN STATUS
                          B. SET CLOCK
                          C. SYSTEM SETTINGS
                          D. LOOPBACK MODE:  NONE
                          E. VIEW PERFORMANCE DATA
                          F. VIEW PERFORMANCE HISTORY
                          G. VIEW ALARM HISTORY
                          H. ENTER CIRCUIT ID #
```

16. View Span Status Screen

16.1 Allows you to view the span status from the ELU to the ERU by displaying information about the HDSL Loops 1 and 2 (for non-doubler applications), as well as information about HDSL Loops 1 and 2 over Spans 1 and 2 (for doubler applications).

16.2 **Non-Doubler Applications.** Press <A> from the Maintenance Terminal Main menu to open the View Span Status screen:



```
                                SPAN STATUS
                        ( ELU/ver2.1-008D: ERU/ver1.4-0001)
TIME: 00:03:05
DATE: 01/30/97                          CIRCUIT ID#:

ALARMS:   CHREV
LOOPBACK: OFF
                              ELU                              ERU
                      HDSL-1          HDSL-2          HDSL-1          HDSL-2
                   cur/min/max     cur/min/max     cur/min/max     cur/min/max
MARGIN:              21/20/22        21/20/22        22/21/23        22/21/22 dB
PULSE ATTN:             00              01              00              00    dB
PPM OFFSET:             00              00             -19             -19    ppm
24 HOUR ES:          00001           00000           00002           00002  seconds
24 HOUR UAS:         00015           00019           00000           00005  seconds

                                   G.703 STATUS
                                  ELU                ERU
24 HOUR BPV Seconds:            00005              00173
24 HOUR UAS Count:              00003              00002

                            (E)xit (C)lear (U)pdate
```

You can do the following:

- Press <E> to return to the previous menu.
- Press <C> to clear the *cur* (current), *min* (minimum) and *max* (maximum) numeric counts.
- Press <U> to update *cur* (current) values.

16.3 Doubler Applications. EDU 1 (doubler) displays in the Span Status screen for doubler applications.

16.3.1 Span 1 Status. Span 1 is the span between the ELU and the EDU1. Press <A> from the Maintenance Terminal Main Menu to view the Span Status for single-doubler applications:

```
                              SPAN 1 STATUS
                    ( ELU/ver2.1-008D:EDU1/ver1.3-0001)
TIME: 00:13:30
DATE: 01/30/97                        CIRCUIT ID#:

ALARMS:   CHREV
LOOPBACK: OFF
                          ELU                              EDU1
                    HDSL-1        HDSL-2        HDSL-1        HDSL-2
                  cur/min/max   cur/min/max   cur/min/max   cur/min/max
MARGIN:             21/19/22      20/20/22      22/00/22      20/00/22 dB
PULSE ATTN:           00            00            00            00     dB
PPM OFFSET:           00            00            -08           -08     ppm
24 HOUR ES:        00001         00000         00000         00001   seconds
24 HOUR UAS:       00016         00016         00001         00001   seconds

                                  G.703 STATUS
                                ELU                   ERU
24 HOUR BPV Seconds:          00006                 00743
24 HOUR UAS Count:            00003                 00004

                           (E)xit (C)lear (U)pdate (S)pan
```

16.3.2 Span 2 Status. Span 2 is the span between the EDU1 and the ERU. Press <S> to view Span 2:

```
                              SPAN 2 STATUS
                    (EDU1/ver1.3-0001: ERU/ver1.4-0001)
TIME: 00:15:15
DATE: 01/30/97                        CIRCUIT ID#:

ALARMS:   CHREV
LOOPBACK: OFF
                          EDU1                             ERU
                    HDSL-1        HDSL-2        HDSL-1        HDSL-2
                  cur/min/max   cur/min/max   cur/min/max   cur/min/max
MARGIN:             21/00/21      21/00/22      22/21/23      22/20/23 dB
PULSE ATTN:           00            00            00            00     dB
PPM OFFSET:           00            00            -10           -10     ppm
24 HOUR ES:        00001         00000         00003         00003   seconds
24 HOUR UAS:       00056         00056         00000         00000   seconds

                                  G.703 STATUS
                                ELU                   ERU
24 HOUR BPV Seconds:          00006                 00848
24 HOUR UAS Count:            00003                 00004

                           (E)xit (C)lear (U)pdate (S)pan
```

You can do the following:

- Press <E> to return to the previous menu.
- Press <C> to clear the *cur* (current), *min* (minimum) and *max* (maximum) numeric counts.
- Press <U> to update *cur* (current) values.
- Press <S> to return to the Span 1 screen.

16.4 Table 12 shows the Span Status fields and descriptions. Table 13 lists the Alarm field messages and descriptions and Table 14 lists the Loopback field messages and descriptions.

Table 12. *Span Status Fields and Descriptions*

Field	Description
ELU/Ver *w.x-y*	*w.x* = the software version number of the ELU. *y* = List number of the ELU.
ERU or EDU/*w.x-y*	*w.x* = the software version number of the ERU or EDU. *y* = List number of the ERU or EDU.
Time	Time of day when Span Status was checked.
Date	Date when Span Status was checked.
Alarms	Presence or absence of alarm conditions. See Table 13.
Loopback	Indicates Off condition or identifies specific active loopback. See Table 14.
Margin	Indicates the excess signal to noise ratio at either the ELU, EDU or ERU, relative to a 10^{-7} Bit Error Rate: • First value is current margin. • Second value is minimum margin since last cleared. • Third value is maximum margin since last cleared.
Pulse Attn (Attenuation)	Indicates the attenuation of the 2B1Q pulse from the distant end. HiGain operates with pulse attenuations up to 28 dB. This value is related to the cable pair's 196 kHz loss. The pulse attenuation is a more direct indication of the loop attenuation to the 2B1Q signal than the 196 kHz loss.
PPM Offset	Indicates the relative offset of the crystal oscillator in the ERU from the HLU's crystal oscillator. Any value between ± 64 is adequate.
24 Hour ES	The number of one second intervals that contained at least one CRC error within the last 24 hours.
24 Hour UAS	The number of seconds the HDSL loop was out of synchronization within the last 24 hours.
24 Hour BPV Seconds	The number of seconds in which at least one bipolar violation was detected on the G.703 input within the last 24 hours.
24 Hour UAS Count	The number of seconds during which the G.703 input signal was absent (125 or more consecutive 0s) within the last 24 hours.

Table 13. *Alarm Field Messages and Descriptions*

Message	Full Name	Description
NONE	No Alarms	No alarm conditions present in system.
LLOS	Local Loss of Signal	No signal from local G.703 interface.
RLOS	Remote Loss of Signal	No signal from remote G.703 interface.
LOSW	Loss of Sync Word	One of the HDSL loops has lost synchronization.
H1ES	HDSL Loop 1 Errored Second	Loop 1s CRC have exceeded the ES threshold.
H2ES	HDSL Loop 2 Errored Second	Loop 2s CRC have exceeded the ES threshold.
G.703	G.703	G.703 input BPVs have exceeded the ES threshold.
MAL1	Margin Alarm (HDSL Loop 1)	The margin on HDSL Loop 1 dropped below the Margin Alarm Threshold (*1* to *15*). Setting the threshold to *0* (zero) inhibits the alarm.
MAL2	Margin Alarm (HDSL Loop 2)	The margin on HDSL Loop 2 dropped below the user Margin Alarm Threshold (*1* to *15*). Setting the threshold to *0* (zero) inhibits the alarm.
ACO	Alarm Cut Off	Alarm cut-off is in effect.
LAIS	Local Alarm Indicating Signal	Indicates an AIS (all 1s) pattern is being transmitted from the local G.703 output port.
RAIS	Remote Alarm Indicating Signal	Indicates an AIS (all 1s) pattern is being transmitted from the remote G.703 output port.
CHREV	Channels Reversed	Channel (loop) 1 and 2 HDSL pairs are reversed at the ERU line input ports.

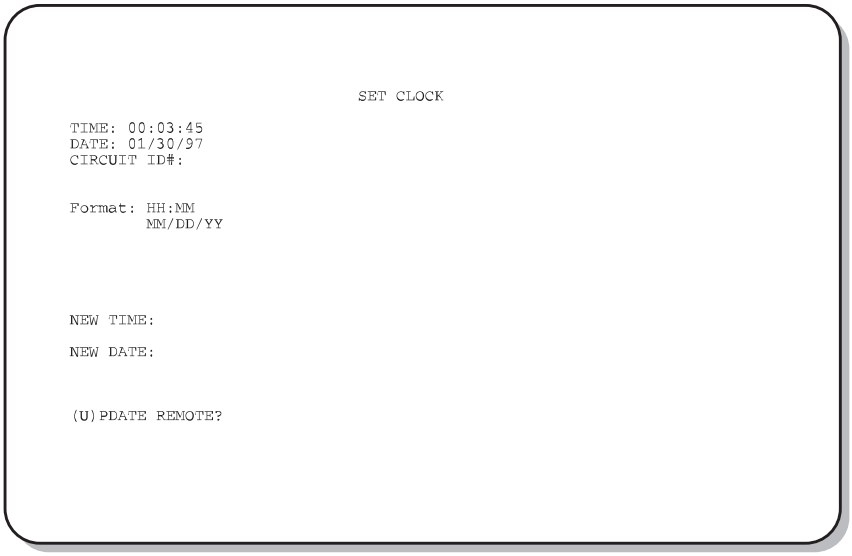
Table 14. *Loopback Field Messages and Descriptions*

Message	Name	Loopback Menu Name	Description*
NREM	Network Remote Loopback	ERU Loop to Network	Loopback at ERU (remote) towards network.
NLOC	Network Local Loopback	ELU Loop to Network	Loopback at ELU (local) towards network.
CREM	Customer Remote Loopback	ELU Loop to Customer	Loopback at ERU (local) towards Customer Interface (CI).
CLOC	Customer Local Loopback	ERU Loop to Customer	Loopback at ERU (local) towards CI.
NDU1	Network Doubler 1 Loopback	Doubler 1 Loop to Network	Loopback at doubler towards network.
CDU 1	Customer Doubler 1 Loopback	Doubler 1 Loop to Customer	Loopback at doubler towards G.703 CPE.

* Loopbacks can be initiated through the Maintenance Terminal menus or by using the ELU front panel Mode and Select Setup buttons.

17. Set Clock Screen

17.1 Press <B> from the Maintenance Terminal Main menu to open the Set Clock screen:



17.2 **Set Time.** The cursor defaults to the New Time field. To set the system time, type the hour and minute in the 24-hour format of hh:mm:ss (setting the seconds is optional), then press <Enter>.

The *New Date* field displays.

If you input an invalid entry, the following messages appears followed by the name of field where the invalid entry occurred:

> error

17.3 **Set Date.** To set the system date, type the month, day and year in a mm/dd/yy format, then press <Enter>.

The *Update Remote* field displays.

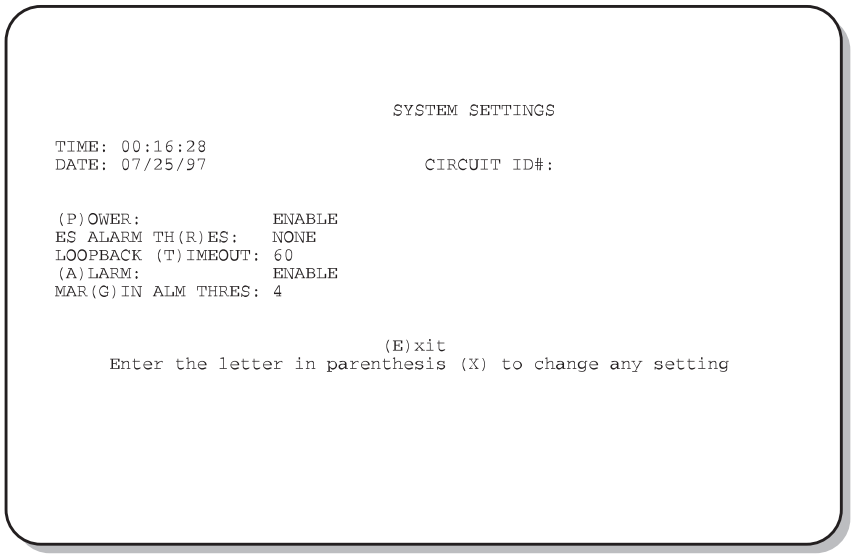
17.4 **Update Remote.** The remote date and time is set using this option. To update the ERU, do one of the following:

- Press <U> to update the ERU to the same date and time set for the ELU. All time information is lost when power is removed. The last date, however, is retained in NVRAM and reappears when power is restored.
- Press <Enter> and the ERU is not updated.

18. System Settings Screen

18.1 The options set from this menu are the same as the options set at the ELU-319 Front Panel interface (except for *Margin Alarm Threshold* which can only be set at this menu). Refer to Table 8 for a listing of system setting options.

Press <C> from the Maintenance Terminal Main menu to display the System Settings screen:



18.2 The following paragraphs explain how to change system settings in the order in which they are presented in System Settings screen. To change any option:

1 Enter its character key which is shown inside the parenthesis within each parameter description.

The screen refreshes with the new settings.

2 After all parameters have been selected:

3 Press <E> to exit, then <C> to confirm.

The newly selected parameters are now activated.

18.3 **(P)ower.** Allows you to *Disable* or *Enable* (system default) line powering of the remote unit over the HDSL pair.

1 Press <P> in the System Settings menu.

The *Power* option changes to the next available setting.

2 Repeat this process until the desired setting appears next to the *Power* option name in the menu.

18.4 **ES Alarm Th(r)es.** Sets the *ES Alarm Thres* (threshold) to a count of *17* or *170* seconds which causes the Status LED to flash red when the selected alarm threshold count has been exceeded. You can also set the alarm threshold count to *None* (system default) which prevents the generation of a minor alarm due to excessive ES.

1 Press <R> in the System Settings menu.

The *ES Alarm Thres* option changes to the next available setting.

2 Repeat this process until the desired setting appears next to the *ES Alarm Thres* option name in the menu.

18.5 **Loopback (T)imeout (LBTO).** Sets loopback timeouts to a count of *20*, *60* (system default) or *120* minutes. You can also set the loopback timeout to *NONE*, which disables the automatic time-out cancellation of all loopbacks.

1 Press <T> in the System Settings menu.

The *Loopback Timeout* option changes to the next available setting.

2 Repeat this process until the desired setting appears next to the *Loopback Timeout* option name in the menu.

18.6 **(A)larm.** Sets the *Alarm* option to *Disable* or *Enable*. The D*isable* Alarm (system default) setting allows you to terminate an existing minor alarm on pin H by disabling its signal, and prevents another minor alarm from occurring. The *Enable* setting enables pin H to be grounded when a minor alarm condition occurs.

1 Press <A> in the System Settings menu.

The *Alarm* option changes to the next available setting.

2 Repeat this process until the desired setting appears next to the *Alarm* option name in the menu.

18.7 **Mar(g)in Alm Thres.** Allows you to set the margin threshold from *0* to *15*. The margin threshold, in dB, is the excess SNR relative to the SNR. A *0* dB setting disables the option. The system default is *4*.

1 Press <G> in the System Settings menu.

The following prompt appears:

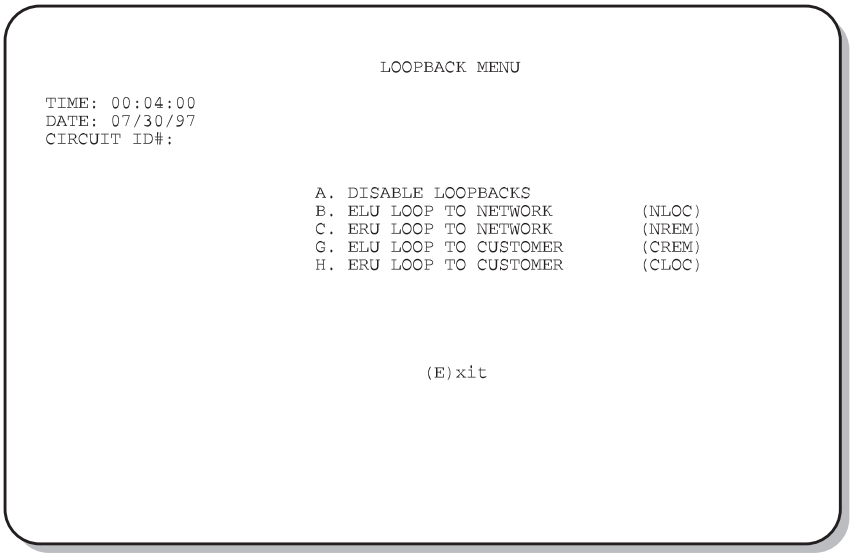
```
enter minimum acceptable HDSL margin (0 TO 15 dB)
```

2 Enter the desired HDSL margin, then press <Enter>.

19. Loopback Mode Screen

19.1 Allows you to send the same set of loopbacks that are available using the front panel Mode and Select Setup buttons. The list of available loopbacks depends on whether the application is non-doubler or doubler. See Table 14 for a listing of loopbacks and descriptions.

19.2 **Non-Doubler Applications.** Press <D> from the Maintenance Terminal Main menu to display the Loopback Menu screen:



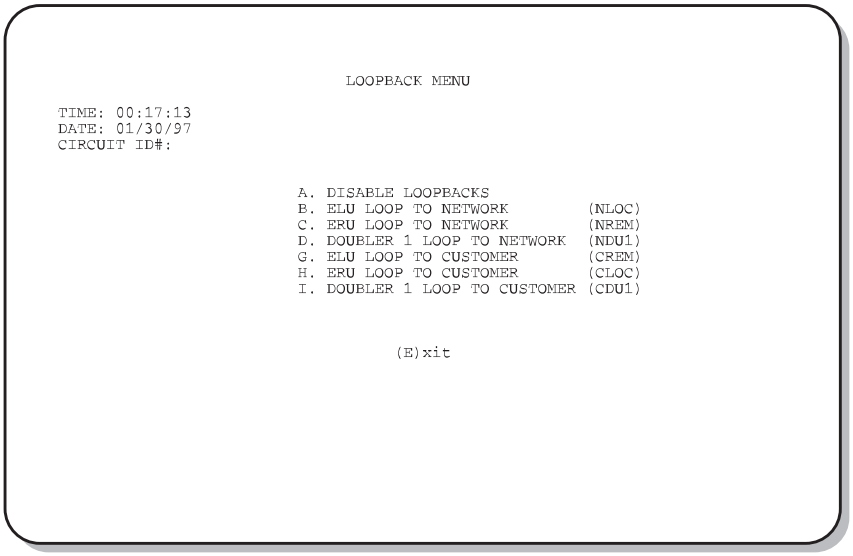
This menu permits you to send four different loopbacks to your HiGain system and provides the ability to disable (cancel) any loopback. Loopbacks continue to function for the period specified in the *LBTO* option set using either the front panel Mode and Select Setup buttons (see Section 13.3) or the System Settings screen (see Section 18.5).

When you select any of the above entries, the following prompt displays:

```
PLEASE WAIT.............
```

A series of dots moves from left to right indicating that the command has been issued. When this process completes, the system returns to the Main menu. The *Loopback Mode* field then displays either the type of loopback now active in the system, or *None* if the active loopback has been disabled.

19.3 Doubler Applications. Press <D> from the Maintenance Terminal Main menu to display the Loopback Menu screen:



This menu permits you to send six different loopbacks to your HiGain system and provides the ability to disable (cancel) any loopback. Loopbacks continue to function for the period specified in the *LBTO* option set using either the front panel Mode and Select Setup buttons (see Section 13.3) or the System Settings screen (see Section 18.5).

When you select any of the above entries, the following prompt displays:

```
PLEASE WAIT.................
```

A series of dots moves from left to right indicating that the command has been issued. When this process completes, the system returns to the Main menu. The *Loopback Mode* field then displays either the type of loopback now active in the system, or *None* if the active loopback has been disabled.

20. View Performance Data Screen

20.1 Permits you to view both the ES and UAS counts for both HDSL loops and each G.703 input at 15-minute intervals per line over a four hour time period.

20.2 **Non-Doubler Applications.** Press <E> from the Maintenance Terminal Main menu to display the Performance Data screen for non-doubler applications:

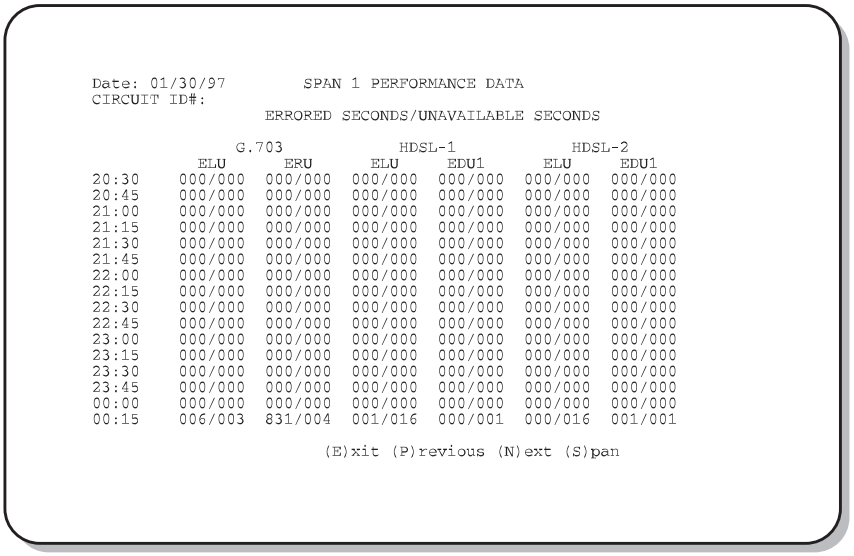
```
Date: 01/30/97            PERFORMANCE DATA
CIRCUIT ID#:
                ERRORED SECONDS/UNAVAILABLE SECONDS

              G.703            HDSL-1           HDSL-2
          ELU      ERU     ELU      ERU     ELU      ERU
20:15  000/000  000/000  000/000  000/000  000/000  000/000
20:30  000/000  000/000  000/000  000/000  000/000  000/000
20:45  000/000  000/000  000/000  000/000  000/000  000/000
21:00  000/000  000/000  000/000  000/000  000/000  000/000
21:15  000/000  000/000  000/000  000/000  000/000  000/000
21:30  000/000  000/000  000/000  000/000  000/000  000/000
21:45  000/000  000/000  000/000  000/000  000/000  000/000
22:00  000/000  000/000  000/000  000/000  000/000  000/000
22:15  000/000  000/000  000/000  000/000  000/000  000/000
22:30  000/000  000/000  000/000  000/000  000/000  000/000
22:45  000/000  000/000  000/000  000/000  000/000  000/000
23:00  000/000  000/000  000/000  000/000  000/000  000/000
23:15  000/000  000/000  000/000  000/000  000/000  000/000
23:30  000/000  000/000  000/000  000/000  000/000  000/000
23:45  000/000  000/000  000/000  000/000  000/000  000/000
00:00  000/000  000/000  000/000  000/000  000/000  000/000

                    (E)xit (P)revious (N)ext
```

You can access earlier and later data, in four-hour increments on six different screens by pressing <P> or <N>. This permits you to cycle through the performance data for a full 24-hour period. You can do the following:

- Press <E> to return to the previous menu.
- Press <P> to return to the previous screen.
- Press <N> to advance to the next available screen.

All the counters can be set to *0* by pressing <C> (Clear) from the ELU Span Status screen. Since the ELU is considered the master module, this clears *all* performance data screens at both the ELU-319 and the ERU-412. The RS-232 terminal interface at the ERU-412 does not allow the counters to be cleared.

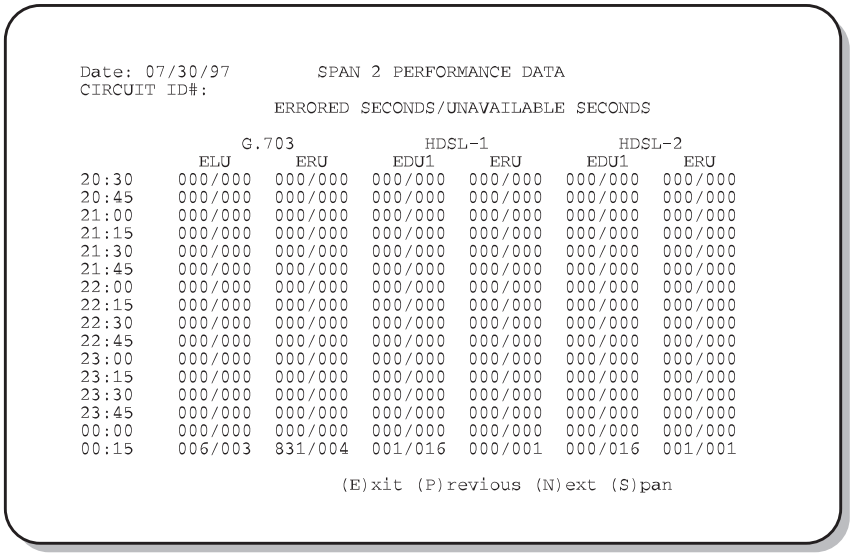
20.3 Doubler Applications. For doubler applications, Span 1 and Span 2 performance data screens are available. Press <E> from the Maintenance Terminal Main menu to open the Performance Data screen for doubler applications:



```
Date: 01/30/97        SPAN 1 PERFORMANCE DATA
CIRCUIT ID#:
                ERRORED SECONDS/UNAVAILABLE SECONDS

              G.703            HDSL-1           HDSL-2
          ELU      ERU      ELU      EDU1     ELU      EDU1
20:30  000/000  000/000  000/000  000/000  000/000  000/000
20:45  000/000  000/000  000/000  000/000  000/000  000/000
21:00  000/000  000/000  000/000  000/000  000/000  000/000
21:15  000/000  000/000  000/000  000/000  000/000  000/000
21:30  000/000  000/000  000/000  000/000  000/000  000/000
21:45  000/000  000/000  000/000  000/000  000/000  000/000
22:00  000/000  000/000  000/000  000/000  000/000  000/000
22:15  000/000  000/000  000/000  000/000  000/000  000/000
22:30  000/000  000/000  000/000  000/000  000/000  000/000
22:45  000/000  000/000  000/000  000/000  000/000  000/000
23:00  000/000  000/000  000/000  000/000  000/000  000/000
23:15  000/000  000/000  000/000  000/000  000/000  000/000
23:30  000/000  000/000  000/000  000/000  000/000  000/000
23:45  000/000  000/000  000/000  000/000  000/000  000/000
00:00  000/000  000/000  000/000  000/000  000/000  000/000
00:15  006/003  831/004  001/016  000/001  000/016  001/001

                (E)xit (P)revious (N)ext (S)pan
```

For both the Span 1 and Span 2 Performance Data screens, you can do the following:

- Press <E> to return to the previous menu.
- Press <C> to clear the *cur* (current), *min* (minimum) and *max* (maximum) numeric counts.
- Press <U> to update current values.
- Press <S> to view the next available Performance Data screen:



```
Date: 07/30/97        SPAN 2 PERFORMANCE DATA
CIRCUIT ID#:
                ERRORED SECONDS/UNAVAILABLE SECONDS

              G.703            HDSL-1           HDSL-2
          ELU      ERU      EDU1     ERU      EDU1     ERU
20:30  000/000  000/000  000/000  000/000  000/000  000/000
20:45  000/000  000/000  000/000  000/000  000/000  000/000
21:00  000/000  000/000  000/000  000/000  000/000  000/000
21:15  000/000  000/000  000/000  000/000  000/000  000/000
21:30  000/000  000/000  000/000  000/000  000/000  000/000
21:45  000/000  000/000  000/000  000/000  000/000  000/000
22:00  000/000  000/000  000/000  000/000  000/000  000/000
22:15  000/000  000/000  000/000  000/000  000/000  000/000
22:30  000/000  000/000  000/000  000/000  000/000  000/000
22:45  000/000  000/000  000/000  000/000  000/000  000/000
23:00  000/000  000/000  000/000  000/000  000/000  000/000
23:15  000/000  000/000  000/000  000/000  000/000  000/000
23:30  000/000  000/000  000/000  000/000  000/000  000/000
23:45  000/000  000/000  000/000  000/000  000/000  000/000
00:00  000/000  000/000  000/000  000/000  000/000  000/000
00:15  006/003  831/004  001/016  000/001  000/016  001/001

                (E)xit (P)revious (N)ext (S)pan
```

21. View Performance History Screen

21.1 Permits you to view both the ES and UAS counts for each HDSL loop and each G.703 input in 24-hour increments for a seven-day period. The present date is represented in the *current* field. For doubler applications, the same information is available for Spans 1 and 2.

21.2 Non-Doubler Applications. Press <F> from the Maintenance Terminal Main menu to display the Performance History screen for non-doubler applications:

```
Time: 00:04:29                    7 DAY HISTORY
CIRCUIT ID#:

                          ERRORED SECONDS/UNAVAILABLE SECONDS

                 G.703                   HDSL-1                  HDSL-2
             ELU         ERU         ELU         ERU         ELU         ERU
01/23   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/24   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/25   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/26   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/27   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/28   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/29   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
```

21.3 Doubler Applications. The doubler is represented as EDU1 over each HDSL loop.

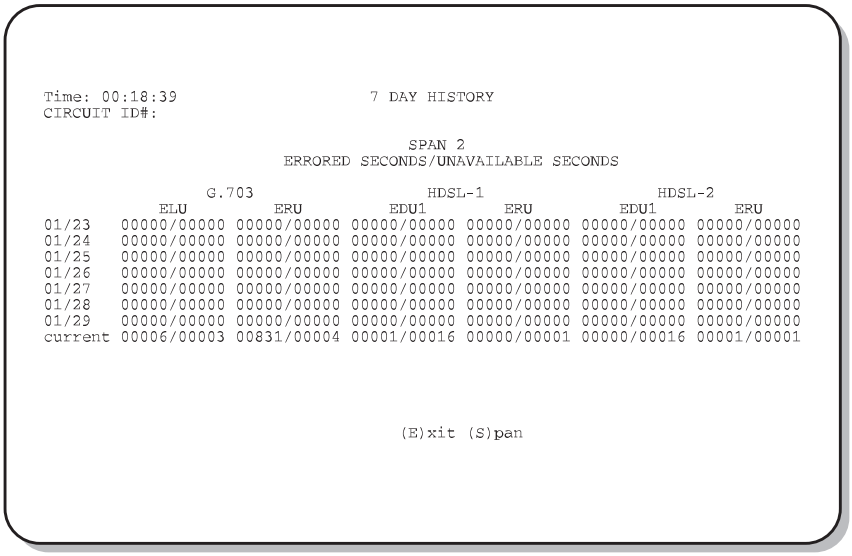
21.3.1 Span 1 Performance History. Press <F> from the Maintenance Terminal Main menu to view the Span 1 Performance History screen:

```
Time: 00:18:39                    7 DAY HISTORY
CIRCUIT ID#:

                                    SPAN 1
                          ERRORED SECONDS/UNAVAILABLE SECONDS

                 G.703                   HDSL-1                  HDSL-2
             ELU         ERU         ELU         EDU1        ELU         EDU1
01/23   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/24   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/25   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/26   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/27   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/28   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/29   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00006/00003 00831/00004 00001/00016 00000/00001 00000/00016 00001/00001




                                  (E)xit (S)pan
```

You can do the following:

- Press <E> to exit.
- Press <S> to view Span 2.

21.3.2 Span 2 Performance History. Press <S> to view the Span 2 Performance History screen:



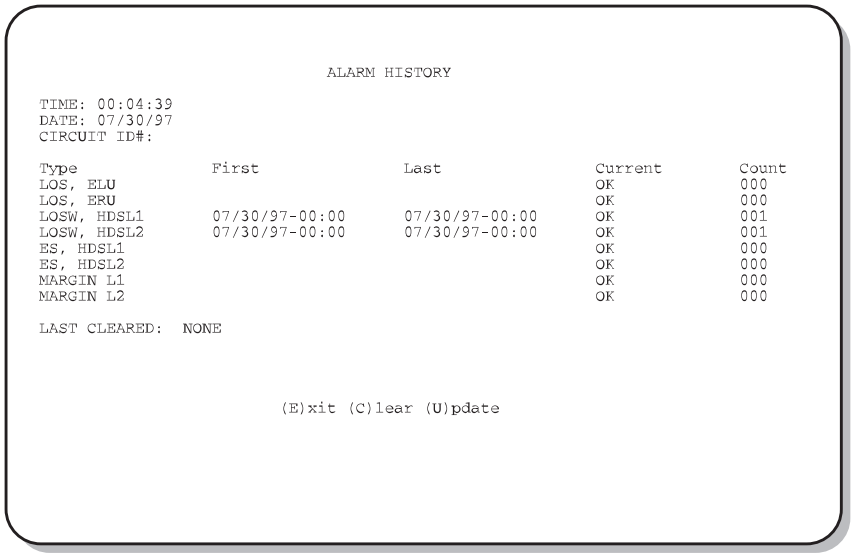
You can do the following:

- Press <E> to exit.
- Press <S> to view Span 1.

22. View Alarm History Screen

22.1 Allows you to view alarms that are currently active.

22.2 **Non-Doubler Applications.** Press <G> from the Maintenance Terminal Main menu to view the Alarm History screen for non-doubler applications:



The following columns display in the Alarm History screen:

- Type: Displays the alarm type
- First: Displays the first instance of the alarm type
- Last: Displays the last instance of alarm type
- Current: Displays the current condition of the circuit for the alarm type
- Count: Displays a numeric count of the alarm type

Table 15 lists the Alarm History types. These descriptions apply to the Alarm History for doubler applications as well (where *Span 1* and *Span 2* display in front of the *LOSW*, *ES* and *Margin* fields).

Table 15. *Alarm History Types*

Type	Description
LOS, ELU	Loss of Signal (LOS) at the ELU.
LOS, ERU	LOS at the ERU.
LOSW, HDSL1	Loss of Sync Word (LOSW) on HDSL1.
LOSW, HDSL2	LOSW on HDSL2.
ES, HDSL1	Errored Seconds (ES) on HDSL1.
ES, HDSL2	ES on HDSL2.
Margin L1	Margin on Loop 1.
Margin L2	Margin on Loop 2.
Last Cleared:	Last time Alarm History cleared.

You can do the following:

- Press <U> to update the screen.
- Press <S> to view another span.
- Press <E> to exit from the Alarm History screen.

22.3 Doubler Applications. Spans 1 and 2 display in front of the *LOSW*, *ES* and *Margin* fields shown in Table 15.

22.3.1 Span 1 Alarm History. Press <G> from the Maintenance Terminal Main menu to view the Span 1 Alarm History screen:

```
                              ALARM HISTORY

TIME: 00:19:40
DATE: 01/30/97
CIRCUIT ID#:

Type              First               Last                Current        Count
LOS, ELU                                                  OK             000
LOS, ERU                                                  OK             000
SPAN1 LOSW, HDSL1 01/30/97-00:00      01/30/97-00:00      OK             001
SPAN1 LOSW, HDSL2 01/30/97-00:00      01/30/97-00:00      OK             001
SPAN1 ES, HDSL1                                           OK             000
SPAN1 ES, HDSL2                                           OK             000
SPAN1 MARGIN L1   01/30/97-00:00      01/30/97-00:00      OK             001
SPAN1 MARGIN L2   01/30/97-00:00      01/30/97-00:00      OK             001

LAST CLEARED:  NONE


                        (E)xit (C)lear (U)pdate (S)pan
```

22.3.2 Span 2 Alarm History. Press <S> from the Alarm History screen to view the Span 2 Alarm History screen:

```
                              ALARM HISTORY

TIME: 00:19:40
DATE: 01/30/97
CIRCUIT ID#:

Type              First               Last                Current        Count
LOS, ELU                                                  OK             000
LOS, ERU                                                  OK             000
SPAN2 LOSW, HDSL1 01/30/97-00:00      01/30/97-00:00      OK             001
SPAN2 LOSW, HDSL2 01/30/97-00:00      01/30/97-00:00      OK             001
SPAN2 ES, HDSL1                                           OK             000
SPAN2 ES, HDSL2                                           OK             000
SPAN2 MARGIN L1   01/30/97-00:00      01/30/97-00:00      OK             001
SPAN2 MARGIN L2   01/30/97-00:00      01/30/97-00:00      OK             001

LAST CLEARED:  NONE


                        (E)xit (C)lear (U)pdate (S)pan
```

You can do the following:

- Press <U> to update the screen.
- Press <S> to view another span.
- Press <C> to clear the *cur* (current), *min* (minimum) and *max* (maximum) numeric counts.
- Press <E> to exit from the Alarm History screen.

23. Enter Circuit ID Screen

23.1 To enter a Circuit ID:

1 Press <H> from the Maintenance Terminal Main menu to view the Enter Circuit ID screen.

The following message displays:

```
enter circuit ID# (24 characters max):
```

2 Enter a unique circuit ID (using any available keyboard character) of no more than 24 characters, then press <Enter>.

3 Press <C> to confirm.

The Circuit ID now appears in the ELU-319 screen.

If more than 24 characters are entered, a beep is emitted and only the first 24 characters are accepted.

23.2 The Circuit ID appears in all ELU-319 screens. The Circuit ID is not set to its default (all blanks) setting when the *DFLT* setting option is utilized. The Circuit ID # is not available at the ERU-412 Maintenance Port.

23.3 The Circuit ID is stored in NVRAM and thus remains if power is lost.

E. TROUBLESHOOTING

24. Loopback Design Description

24.1 Loopbacks permit you to perform isolated diagnostic tests on specific areas of the circuit. The transmitted signal is returned to the sending device after passing through a data communications link or network. This allows you to compare the returned signal with the transmitted signal and to determine if there is a problem with the circuit. You can issue loopbacks either from the Maintenance Terminal Loopback menu (see Section 20) or using the front panel Mode and Select Setup buttons (see Section 26). The HiGain E1 system does not respond to any in-band codes. Figure 9 shows the ELU-319 loopback diagram.

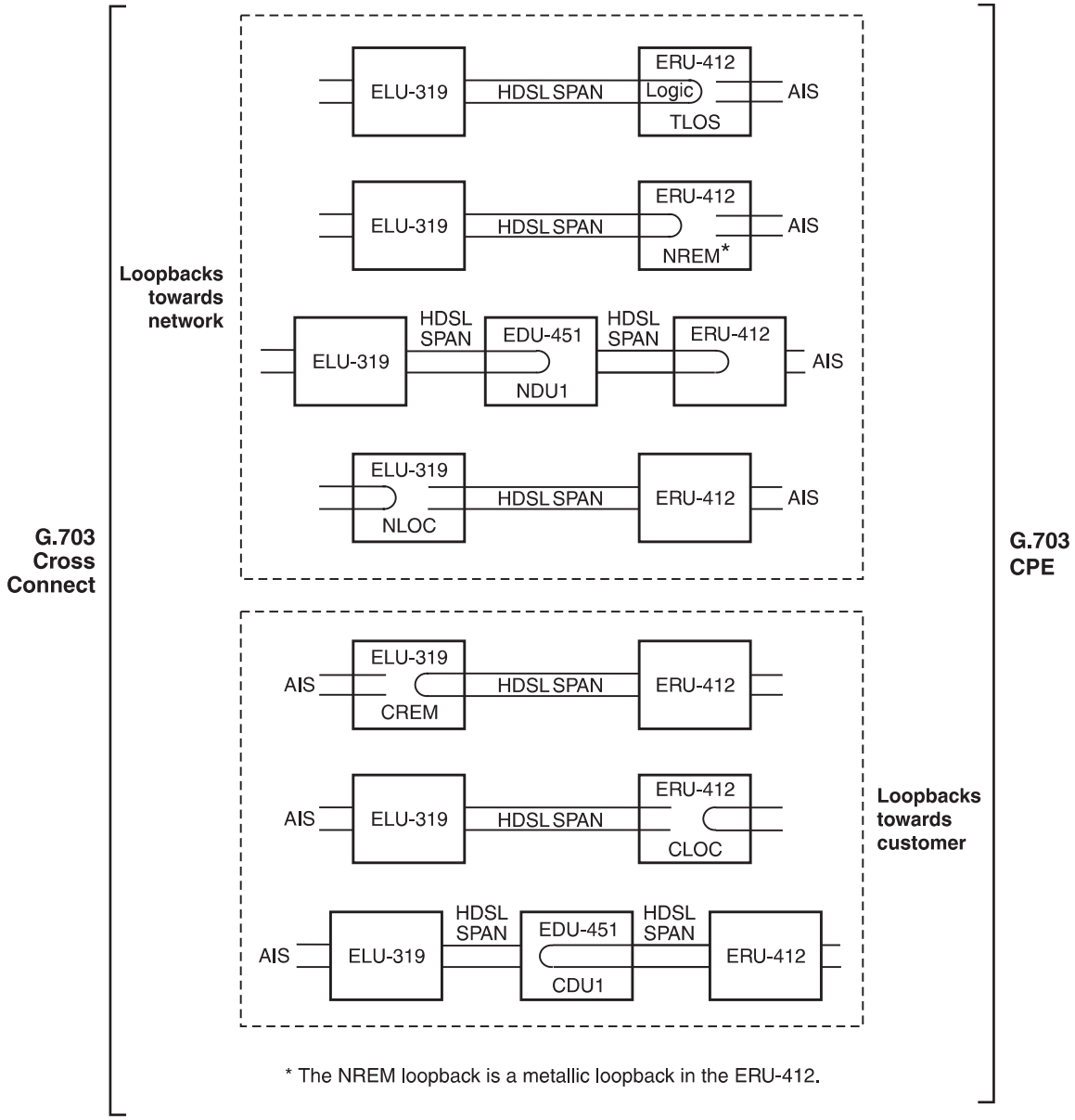


Figure 9. *ELU-319 Loopback Diagram*

24.2 If the system fails to respond to a loopback command, go to the front panel Option Setting mode (Section 13.5) and execute the *DFLT...YES* option. This resets the system parameters to their default values and allows the system to respond to the loopback commands.

24.3 **Metallic Loopbacks.** The XMT (transmit) and RCV (receive) G.703 ports contain splitting access and bridging miniature 210-type jacks as shown in Figure 3. Connecting a cable between the two BRG jacks and another cable between the two Line jacks to split the XMT and RCV jacks creates metallic loopbacks towards both the G.703 cross connect and the ELU-319.

24.4 **Loopbacks Towards Network.** The HiGain loopbacks toward the network are as follows:

- Transmit Loss of Signal (TLOS). An ERU logic loopback initiated by a loss of the G.703 input from the CI. This loopback can only be initiated from the ERU.
- Network Remote (NREM): The G.703 signal is looped back to the G.703 at the ERU.
- Network Doubler Loopback 1 (NDU1): Loopback at first doubler towards network initiated by HLU.
- Network Local Loopback (NLOC): The G.703 signal is looped back to the G.703 at the ELU.

24.5 **Loopbacks Towards Customer.** The HiGain loopbacks toward the customer are as follows:

- Customer Remote (CREM): Loopback at ELU (remote) towards customer initiated from CPE (customer) by intelligent office repeater code.
- Customer Local (CLOC): Signal from CI is looped-back to CI at ERU.
- Customer Doubler 1 Loopback (CDU1): Loopback at first doubler towards CI initiated by ELU.

25. Loopbacks Issued from the Front Panel

25.1 All loopbacks (with the exception of the TLOS logic loopback) can be initiated from the front panel Mode and Select Setup buttons. To facilitate test messaging with CO test personnel, see the ELU four-character front panel messages shown in Tables 9, 13 and 14.

25.1.1 Starting a Loopback.

1 Simultaneously press both the ELU front panel Mode and Select Setup buttons for at least three seconds to initiate a manual loopback session. The following message appears in the four-character display:

```
MAN

LPBK

NLO?
```

The "?" indicates that you can now select from the available loopbacks (for example NLOC, NREM, CLOC, and CREM in a non-doubler configuration).

2 Press the Mode button to advance to the next available loopback.

3 Press the Select button to select the displayed loopback.

The selected loopback cycles through the system for the time period defined by your Loopback Timeout (LBTO) setting.

25.1.2 Terminating a Loopback.

Once a loopback is sent it can be terminated by pressing the Mode button:

1 If neither button is pressed for 30 seconds and no loopback is in effect, the manual loopback session terminates (times out) and the normal margin displays reappear.

2 If a loopback is in effect, the 30-second time-out is inhibited. The active loopback and the manual loopback session continue until the loopback times out in accordance with the user LBTO setting. Only one loopback can exist at any given time.

3 Simultaneously press both the ELU front panel Mode and Select Setup buttons again for three seconds to terminate any active loopback.

This ends the manual loopback session, and returns the display to normal.

26. TLOS Loopback

26.1 The Transmit Loss of Signal (TLOS) is controlled by a user switch option in the ERU–412. When this option is enabled it forces the ERU-412 into a logic loopback state when its G.703 input signal is lost. This enabled TLOS option is not recommended since there is no convenient way to open the loopback state except by removing the TLOS condition by the reapplication of the input signal. When this TLOS option is disabled, no loopback occurs. Instead, an ERU LOS condition causes the ELU to output the AIS signal. This alerts the network that a LOS condition exists at the input to the ERU. See the *PairGain Technologies HiGain Remote Unit Model ERU-412, Issue 1, Section 150-412-200* technical practice for more information.

F. PRODUCT SUPPORT

27. Technical Support

27.1 PairGain Technical Assistance is available 24-hours-a-day, 7-days-a-week by contacting PairGain Customer Service Engineering group at:

Telephone: (800) 638-0031 or (714) 832-9922

Fax: (714) 832-9924

27.2 During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday - Friday, excluding holidays), technical assistance calls are normally answered directly by a Customer Service Engineer. At other times, a request for technical assistance is handled by an on-duty Customer Service Engineer through a callback process. This process normally results in a callback within 30 minutes of initiating the request.

27.3 **Bulletin Board Services.** PairGain maintains a computer bulletin board system for obtaining current information on PairGain products, product troubleshooting tips and aids, accessing helpful utilities, and for posting requests or questions. This system is available 24-hours-a-day by calling (714) 730-3299. Transmission speeds up to 28.8 kbps are supported with a character format of 8-N-1.

28. PairGain Warranty

28.1 PairGain Technologies warrants this product to be free of defects and to be fully functional for a period of 60 months from the date of original shipment, given proper customer installation and regular maintenance. PairGain will repair or replace any unit without cost during this period if the unit is found to be defective for any reason other than abuse or improper use or installation.

28.2 Do not try to repair the unit. If it fails, replace it with another unit and return the faulty unit to PairGain for repair. Any modifications of the unit by anyone other than an authorized PairGain representative voids the warranty.

28.3 If a unit needs repair:

1 Call PairGain for a Return Material Authorization (RMA) number at (800) 638-0031.

2 Return the defective unit, freight prepaid, along with a brief description of the problem, to:

PairGain Technologies, Inc.
ATTN: Repair and Return Dept.
14402 Franklin Avenue
Tustin, CA 92780
USA

28.4 PairGain continues to repair faulty modules beyond the warranty program at a nominal charge. Contact your PairGain sales representative for details and pricing.

29. Certification

29.1 **FCC compliance.** The ELU-319 has been tested and found to comply with the limits for Class A digital devices pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense

G. ABBREVIATIONS AND GLOSSARY

30. Abbreviations and Glossary

ACO	Alarm Cutoff
ALM	Alarm
ALRM	Alarm
AWG	American Wire Gauge
2B1Q	Two Bits One Quaternary
BER	Bit Error Ratio
BPV	Bi–Polar Violation
BRG	Bridging
CI	Customer Interface
CRC	Cyclic Redundancy Check
CO	Central Office
CEV	Controlled Environmental Vault
CPE	Customer Premises Equipment
DCE	Data Circuit-Terminating Equipment
DDS	Digital Data Service
DTE	Data Terminal Equipment
EDU	E1 Doubler Unit
ELU	E1 Line Unit
ERU	E1 Remote Unit
ES	Errored seconds
ESAL	Errored Seconds Alarm Threshold
FIFO	First-in First out
FSW	Frame Sync Word
HCDS	High Capacity Digital Service
HDB3	High Density Bipolar 3
HDSL	High-bit-rate Digital Subscriber Line
HMS	HiGain Management Shelf
kbps	kilobits per second
LBTO	Loopback Timeout
LED	Light Emitting Diode
LOS	Loss of Signal
LOSW	Loss of Sync Word
LLOS	Local Loss of Sync
NEBS	Network Equipment Building System

NVRAM	Non-volatile Random Access Memory
POTS	Plain-old telephone service
PWRF	Power Feed
RAM	Random Access Memory
RCV	Receive
RLOS	Remote Loss of Signal
SF	Super Frame
SNR	Signal-to-Noise Ratio
TLOS	Transmit Loss of Signal
TSGR	Transport System Generic Requirements
UAS	Unavailable Seconds
XMT	Transmit

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