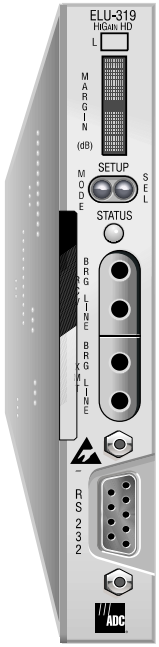
HiGain

USER MANUAL



ELU-319 List 5E and List 6E Line Unit
Product Catalog: 150-1236-55 and 150-1236-65

Revision History of This Manual

To order copies of this document, use document catalog number 150-319-205-05.

Revision	Release Date	Revisions Made
01	August 21, 1998	Initial Release
02	March 26, 1999	Corrections to Technical Specifications
03	April 20, 1999	Warranty modifications
04	January 26, 2000	Practice title change
05	February 8, 2002	ADC Rebranding

USING THIS MANUAL

The following conventions are used in this manual:

- `Monospace type` indicates screen text.
- Keys you press are indicated by small icons such as Y or ENTER. Key combinations to be pressed simultaneously are indicated with a plus sign as follows: CTRL + ESC.
- Items you select are in **bold**.
- Three types of messages, identified by icons, appear in text.

Notes contain information about special circumstances.

Cautions indicate the possibility of personal injury or equipment damage.

The Electrostatic Discharge (ESD) symbol indicates that a device or assembly is susceptible to damage from electrostatic discharge.

For a list of abbreviations used in this document, refer to "Appendix C - Abbreviations" on page 46.

INSPECTING SHIPMENT

Upon receipt of the equipment:

- Unpack each container and inspect the contents for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to ADC DSL Systems, Inc. Order replacement equipment, if necessary.
- Check the packing list to ensure complete and accurate shipment of each listed item. If the shipment is short or irregular, contact ADC DSL Systems, Inc. as described in "Appendix B - Product Support" on page 45. If you must store the equipment for a prolonged period, store the equipment in its original container.

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PRODUCT OVERVIEW

The ADC® HiGain® ELU-319 List 5E and List 6E are the Central Office (CO) side of a repeaterless, G.703 E1 transmission system. When used in conjunction with a HiGain Remote Unit (ERU) the system provides 2.048 Mbps transmission on two unconditioned copper pairs for delivering G.703 E1 High Capacity Digital Service (HCDS). This line unit can be used in applications with or without EDUs.

The HCDS includes loops up to 3.7 km of 0.51-mm wire or 2.7 km of 0.4-mm wire, including bridged taps. The HiGain system uses HDSL transmission technology as recommended by Bellcore TA-TSY-001210.

NEW FEATURES

- Four-span range with three doublers (14.6 km, 0.51 mm /24 AWG)
- Four line-powered spans (three doublers and a remote)
- Low line-power option (140 V) for circuits with a single doubler
- Reduced power consumption
- Ultra-low wander (Stratum 1 compliant)
- Selectable Power Feed (PWRF) modes: AUTO, HIGH and LOW
- HDSL grounded loop detection
- BER alarm options
- ERU Loopback screen
- Inventory Screen (for Circuit ID and unit IDs)
- Default setting screen option

STANDARD ELU FEATURES

- Front panel features:
  - HDSL SNR margin display
  - G.703 splitting and bridge access
  - Status LED
  - RS-232 craft port for connection to a maintenance terminal
- Compatible with Span Terminating Shelf (STS) high-density shelves
- Selectable loopback activation codes
- Network Management and Administration (NMA) interface
- Lightning and power cross protection on HDSL interfaces
- Full duplex 2B1Q HDSL transmission on two pairs each at 1040 kbps
- Margin threshold alarmELU-319 List 5E and List 6E

APPLICATIONS

HiGain systems provide a cost-effective, easy-to-deploy method for delivering G.703 E1 High Capacity Digital Service (HCDS) over metallic pairs.

- The service is deployed over two unconditioned, non-loaded copper pairs, yet it demonstrates a quality that is competitive with fiber optics.
- Conventional, in-line, E1 repeaters are not required.
- Cable pair conditioning, pair separation and bridged tap removal are not required.

Each loop has no more than 35 dB of loss at 260 kHz, with driving and terminating impedances of 135 Ω. Table 1 provides a "loss" guide for the various cable gauges at 260 kHz and 135 Ω. Table 1 applies to the HDSL cable pairs between the ELU, ERU, and EDU modules. In the absence of specific insertion loss measurement data, add 3 dB for each bridged tap and 1 dB for each cable gauge change.

Table 1. *HDSL Loss Over Cables*

Cable Gauge (AWG/mm)	Loop Loss at 260 kHz (dB/km)	Loop Resistance (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

The E1 operating ranges on unimpaired cable pairs are shown in Table 2 as a function of cable gauge and average margin.

Table 2. *E1 Ranges (km) on Unimpaired Cables vs. Average Margin (M) in dB*

Cable Gauge (mm/AWG)	M = 11	M = 7	M = 3
0.4 mm/26 AWG	2.7 km	3.0 km	3.3 km
0.51 mm/24 AWG	3.6 km	4.5 km	4.4 km
0.61 mm/22 AWG	4.7 km	5.2 km	5.7 km
0.91 mm/19 AWG	6.6 km	7.3 km	8.0 km

In general, HiGain systems:

- Operate with any number of other E1, POTS, Digital Data Service (DDS) or other HiGain systems sharing the same cable binder group.
- Can be used with customers requiring G.703 service on a temporary or permanent basis.
- Provide a means of quickly deploying service in advance of fiber-optic transmission systems.

With a HiGain system, service can be provided within hours. Fiber-optic systems can be installed incrementally and cut-over from the installed HiGain system when convenient to do so.

Applications without HiGain Doublers

This section addresses ELU-319 List 5E and List 6E operation when used without doublers. For applications without doublers, the ELU-319 List 5E and List 6E is directly connected to the ERU by the two HDSL cable pairs. ELU-319 List 5E and List 6E is compatible with all HiGain ERUs.

Applications with HiGain Doublers

For doubler applications, one to three doublers may be used in the HDSL loops between the ELU and ERU.

The ELU-319 List 5E and List 6E can power three doublers and a remote unit (ERU-412 List 1E and List 2E) for a total of four spans.

These extended ranges are only available when using the EDU-409 micro-doubler with the ERU-412 List 1E and 2E. Older doublers (EDU-451) cannot be used in circuits with more than two doublers in any line or local power system.

For additional information on the associated HiGain plugs, refer to the respective technical practice.

For compatibility guidelines on mixing newer doublers with older ERU and ELU models, refer to “HiGain Doubler Circuit Deployment” on page 5.

COMPATIBILITY

E1 REPEATER SHELVES AND RELATED EQUIPMENT

The ELU-319 List 5E and List 6E are compatible with the following E1 repeater shelves and associated equipment:

- ADC HMS-317(28-slot, 23-inch shelf)
- ADC HHS-319 (3-slot, 19-inch horizontal shelf)
- ADC HMS-308 (8-slot remote enclosure)
- Charles Ind. #3192 (28-slot connectorized)
- Charles Ind. #3192-9F Alarm Card
- Larus #1185 (28-slot connectorized)
- Larus #1184 Alarm Card
- Charles Ind. #3192-WR (28-slot wire wrap)
- Charles Ind. #343-00 (12- to 14-slot wire wrap)
- Charles Ind. #319-02 (22-slot connectorized)
- Charles Ind. #319-04 (22-slot wire wrap)
- Charles Ind. #340-00 (9- to 11-slot wire wrap)

The Charles Ind. 343-00 and 340-00 shelves do not support the ELU-319 List 5E System Alarm output on pin H. Also, if slots 1 and 2 of these shelves are wired for the 3408 Fault Locate unit, they must be rewired to accept the ELU-319.

HiGain Doubler Circuit Deployment

All generations of HiGain ELU and ERU modules are compatible with each other. Although all HiGain doublers are backward-compatible with all prior ELU and ERU models, some of the circuit application enhancements of newer doubler models require that all circuit modules be of the same type in order to realize these enhancements. Enhanced doubler applications preclude the mixing of newer doubler models with older models of the ERU and ELU.

Table 3 provides HiGain doubler deployment rules to achieve maximum circuit enhancement:

- Maximum number of doublers allowed for a given circuit, depending upon the doubler and line unit models used to implement the circuit.
- Any restrictions on the ERU models.

All spans are fully HCDS-compliant unless otherwise specified. Circuits that use more than one type of doubler are governed by the most limiting doubler rules. For example, if the EDU-451 is used with the EDU-409, use the EDU-451 deployment rules.

Table 3. *HiGain Doubler Deployment*

Maximum Number of Doublers Per Circuit				
	EDU-451 List 1 and List 2		EDU-409 List 1	
ELU Model	Line Powered Remote	Local Powered[1] Remote	Line Powered Remote	Local Powered[a] Remote
ELU-319 List 5E and 6E	1	2	2/3 [2]	2

(1) The ERU-412 List 1D and List 2D can be powered locally. The ERU-412 List 1E and List 2E cannot be powered locally.
(2) The ERU-412 List 1D and 2D supports two doublers. The ERU-412 List 1E and List 2E supports three doublers.

PRODUCT DESCRIPTION

The ELU-319 List 5E and List 6E includes:

- A front panel featuring:
  - A status display
  - System option buttons
  - Status LED
  - G.703 access jacks
  - RS-232 craft port
  - Warranty Control number
- Card-edge connector

FRONT PANEL

The ELU-319 List 5E front panel is shown is Figure 1. The front panel components are described in Table 4 on page 7.

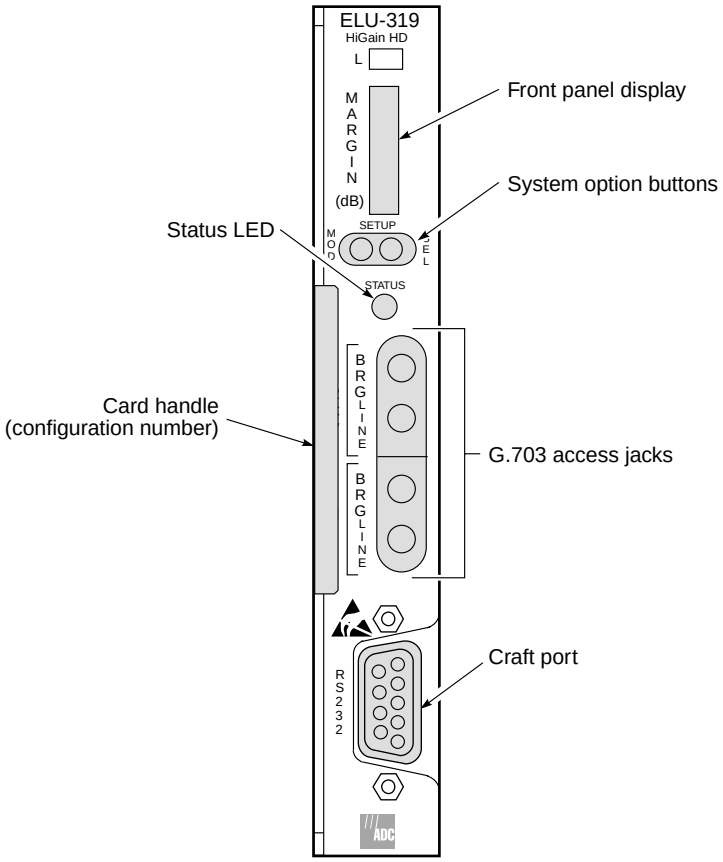

Figure 1. *ELU-319 List 5E and List 6E Front Panel*

Table 4. *Front Panel Components and Labels*

Front Panel Feature	Function
Front panel display	Displays four-character status, provisioning, and alarm system messages.
System option buttons (MODE and SEL)	Permits the user options to be monitored and modified without the need of a maintenance terminal. Used to initiate all HiGain loopbacks and to display G.703 line parameters and line unit identity.
Status LED	See Table 5 for status descriptions.
G.703 access jacks	
LINE	Provides splitting jack access to (XMT) and from (RCV), the HDSL span at the G.703 interface. Breaks the XMT and RCV paths to permit test signal insertion and retrieval.
BRIDGE	Provides non-intrusive bridging jack access to (XMT) and from (RCV) the HDSL span at the DSX-1 interface. Allows the two E1 payloads to be monitored.
Craft (RS-232) port	Provides bidirectional communication between the unit and an external terminal to allow configuration and performance monitoring through the Maintenance Terminal screens.
Configuration number	Contains either a five-digit or six-digit warranty configuration number or a standalone two or three-digit configuration number as follows: • Digit 1 = Last digit of shipment year • Digits: 2 and 3 = Shipment month • Digits: 4 and 5 = Configuration number The configuration number can also be found on a small bar label that also contains the Julian date code and part number. This gummed label may be attached to the PC board or to the front panel.

Status LED

Table 5 describes the functions of the Status LED on the front panel.

Table 5. *Status LED Descriptions*

LED Status	Description
Green	Normal operation
Flashing green	HDSL acquisition
Red	Fuse Alarm
Flashing red	System alarm
Yellow	Self Test is in process or an ELU-319 List 5E and List 6E Customer Remote Loopback (CREM) or a Network Local Loopback (NLOC) is in effect.

Front Panel Display

The front panel display is used with the MODE and SEL buttons to display system diagnostic messages. Refer to Table 6 for a listing of the four-character messages.

The front panel display turns on when power is initially applied to the ELU-319 List 5E and List 6E. To conserve power, the display only remains on for 4 minutes. The use of the MODE or SEL buttons activates the front panel display and restarts the 4-minute, power-control timer.

Table 6. *Front Panel Display Messages*

Message	Full Name	Description
CREM	Customer Remote Loopback	Signal from customer is looped back to the customer at ELU-319.
NLOC	Network Local Loopback	G.703 signal is looped back to G.703 at ELU-319 List 5E and List 6E.
CLOC	Customer Local Loopback	Signal from Customer is looped back to the customer at the ERU.
NREM	Network Remote Loopback	G.703 signal is looped back to G.703 at the ERU.
TLOS	Transmit Loss Of Signal	ERU is in a logic loopback state caused by a loss of its E1 input from the CI, if enabled at the ERU by its TLOS switch option.
LBPV	Local Bipolar Violation	A bipolar violation has been received at the E1 input to the ELU-319.
SIG 1 or 2	Signal 1 or Signal 2	The transceivers of the ELU, ERU or first doubler 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 transceivers of the first doubler and either the ERU or second doubler are trying to establish contact with each other on Loops 1 or 2 of Span 2.
S3L1 or 2	Signal 3 Loop 1 or Loop 2	The transceivers of the second doubler and either the ERU or the third doubler are trying to establish contact with each other on Loops 1 or 2 of Span 3.
S4L1 or 2	Signal 4 Loop 1 or Loop 2	The transceivers of the third doubler and either the ERU or the fourth doubler are trying to establish contact with each other on Loops 1 or 2 of Span 4.
ACQ 1 or 2	Acquisition 1 or Acquisition 2	The multiplexers of the ELU and ERU or first doubler are trying to establish synchronization over Loops 1 or 2 of Span 1.
A2L1 or 2	Acquisition 2 Loop 1 or 2	The multiplexers of the first doubler and either the ERU or second doubler are trying to establish synchronization with each other on Loops 1 or 2 of Span 2.
A3L1 or 2	Acquisition 3 Loop 1 or 2	The multiplexers of the second doubler and either the ERU or third doubler are trying to establish synchronization with each other on Loops 1 or 2 of Span 3.
A4L1 or 2	Acquisition 4Loop 1 or 2	The multiplexers of the third doubler and either the ERU or fourth doubler are trying to establish synchronization with each other on Loops 1 or 2 of Span 4.
H1ES	HDSL CRC Error Channel 1	ELU HDSL Loop 1 CRC error.
H2ES	HDSL CRC Error Channel 2	ELU HDSL Loop 2 CRC error.
ACO	Alarm CutOff	A system alarm has occurred, and has been retired to an ACO condition, by pressing the SEL button on the ELU front panel.
SELF TEST	Self Test	The ELU is in a self-test mode. This occurs when there is no communication between the ELU and the EDU/ERU.

Table 6. *Front Panel Display Messages (Cont.)*

Message	Full Name	Description
ALRM	Alarm Condition Exists	A system alarm condition is in effect.
1=xx or 2=yy	HDSL Loop Margins	Indicates the power of the received HDSL signal on each Loop relative to noise. Any value of '06' or greater is adequate for reliable system operation.
PWR FEED SHRT	Power Feed Short	Indicates a short between the two HDSL pairs.
PWR FEED OFF	Power Feed Off	HDSL span power has been turned off by setting the PWFD option to DIS, or HDSL span power has been turned off by use of the A1LB/A2LB/A5LB Intelligent Office Repeater (IOR) Power Down code (see Table 1 on page 2 and Table 9 on page 14).
PWR FEED GND	Power Feed Ground	One of the HDSL loops has been grounded.
BER	Bit Error Rate	A system BER alarm is in effect.
BAD RT?	No response from ERU	The ELU does not receive any response from the ERU; ERU integrity is questionable.
LOSW	Loss of Sync Word	Indicates that one of the HDSL loops has lost sync. Causes a system alarm.
LLOS	Local Loss of Signal	Indicates that no signal is detected at the E1 input to the ELU. Causes a system alarm.
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the E1 input to the ERU. Causes a system alarm.
MAL1 MAL2	Margin Alarm Loop 1 or 2	The margin on HDSL Loop 1 or 2 has dropped below the threshold (1 to 15 dB) as set by the operator.

ELU-319 LIST 5E AND LIST 6E CARD CONNECTOR

Figure 2 shows the card-edge connector of the ELU-319 List 5E and List 6E. Active pins are highlighted in black.

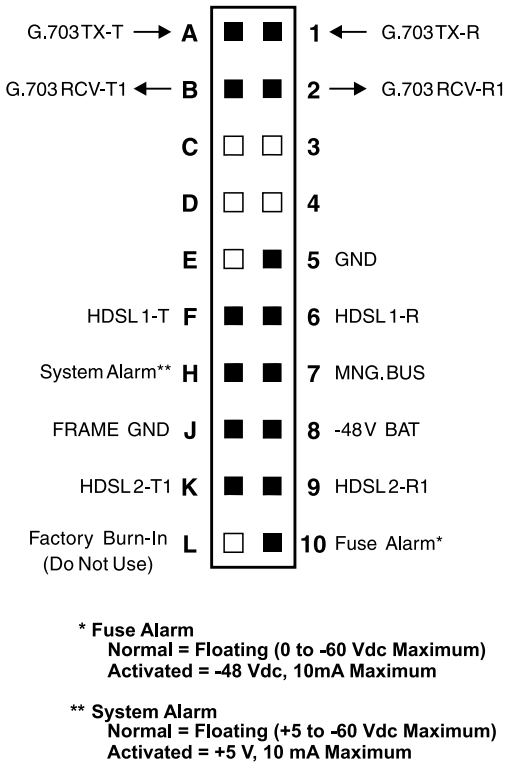

Figure 2. *ELU-319 List 5E and List 6E Card-Edge Connector*

Network Management Control Bus

The ELU-319 List 5E and List 6E provides a Network Management Control Bus on Pin 7 of the card-edge connector. This allows the various ADC Management System protocols to manage the ELU through the HMU-319 HiGain Management Unit. Whenever the ELU-319 is under management, the `MNGD` message displays periodically on the ELU-319 List 5E and List 6E front panel display.

Some ELU-319 List 5E and List 6E features are affected when it is under management. Consult the management unit practice for further information (see "Appendix B - Product Support" on page 45).

Fuse Alarm

Pin 10 on the card-edge connector is a Fuse Alarm that is driven to -48 V whenever its onboard fuse opens. It emulates the function of the Fuse Alarm output from Pin 10 on normal, high-density (HD) repeaters. Pin 10 is connected to Pin 5 of the 1184 Alarm Card (Slot 1 in the HD shelf) and causes the 1184 Fuse ALM LED to light when the Pin 10 signal is activated. Its normally floating output must never be driven above ground or below -80 V. It can sink a current of 10 mA. The ELU-319 does not support the BPV function (Pin E) of normal HD repeaters.

System Alarm Output Pin

Pin H on the card-edge connector (see Figure 2) is the ELU-319 System Alarm output pin. The following notes apply to Pin H:

- Pin H replaces the Local Loss of Signal (LLOS) on normal high-density (3192) repeaters.
- The normally floating output of Pin H can connect to Pin 1 of the 1184 or 3192-9F Alarm Card in position 29 of the High Density (HD) shelf.
- The ELU-319 forces Pin H to +5 V (maximum of 10 mA) for a system alarm condition. Pin H then remains at +5 V for the duration of the alarm condition.
- If the Wescom 1184 Alarm Card is installed in the shelf, its LOS LED lights for every MNRALM.
- The ELU-319 Status LED flashes red for the duration of a system alarm condition.
- Setting the ALM option to DIS only prevents the system alarm bus on Pin H from being activated for a system alarm event. The STATUS LED still flashes red and the “ALRM” message still displays.

Pin H must never be taken above +5 V or below -60 V.

FUNCTIONAL DESCRIPTION

ADC HDSL technology provides full-duplex services at standard E1 rates over copper wires between an ELU and an ERU, which comprise one HiGain system. HiGain systems use ADC 2-Binary 1-Quartenary (2B1Q) HDSL transceiver systems to establish two, full-duplex, 1024 kbps data channels between the ELU-319 and a remotely located EDU or ERU. This provides a total capacity of 2.080 Mbps between the two units.

A block diagram of the ELU-319 is shown in Figure 3. The ELU-319 receives a 2.048 Mbps G.703 data stream from the G.703 digital cross connect interface. The ELU-319 contains a G.703 frame synchronizer controlled by an 8-bit microprocessor that determines the type of framing on the G.703 stream and synchronizes to it. The ELU-319 recognizes Superframe (SF), including D4, or Extended Superframe (ESF) framing. When the data is unframed, the ELU-319 arbitrarily defines a frame bit.

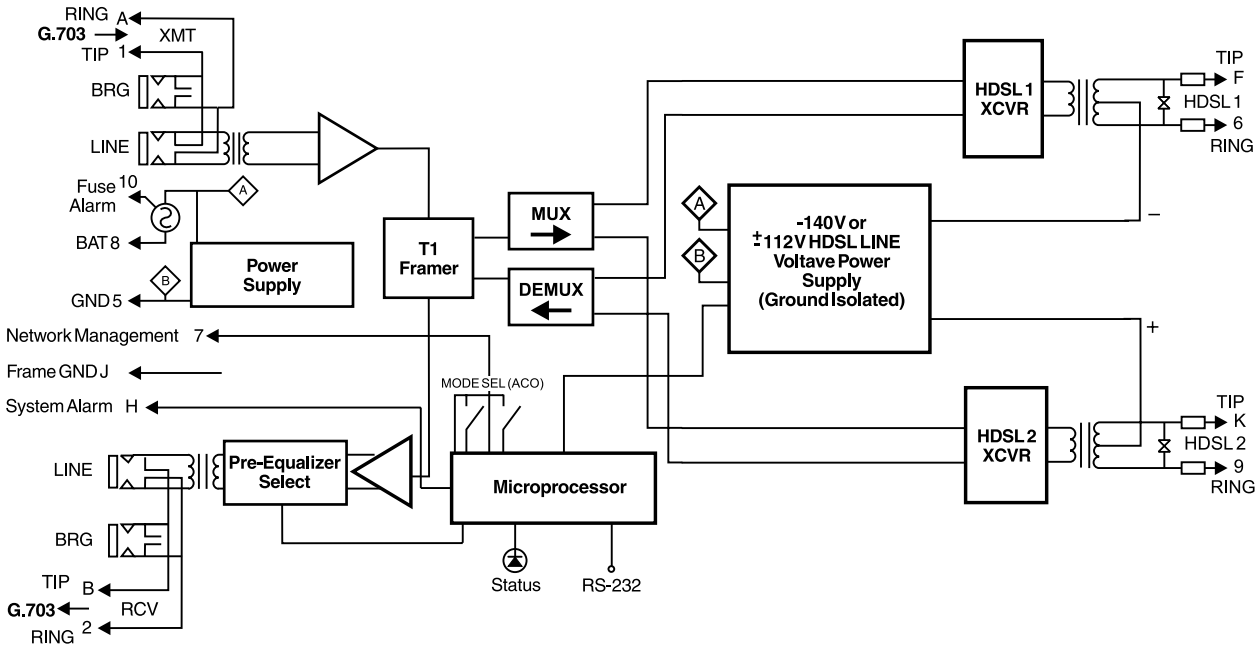

Figure 3. *ELU-319 List 5E and List 6E Block Diagram*

TIMING

The low loop wander (0.3 UI max) of an ELU-319 List 5E and List 6E, when used with a compatible doubler (EDU-409), allows the circuit to be used in all critical timing applications, including those that are used to transport Stratum 1 timing.

POWER CONSUMPTION WITHOUT DOUBLERS

The three most important power parameters of an ELU are its maximum power consumption, its maximum power dissipation and its maximum current drain. These three parameters for the ELU-319, as a function of the ERU model and its CPE power option setting, are listed in Table 7.

Table 7. *Maximum Power Parameters for ELU-319 List 5E and List 6E(1)*

ERU Model #	48 V Power Consumption (W)	Heat Dissipation (W)	42.5 V Current (mA)
ERU-412 List 1 and List 2	11	5.0	260
ERU-412 List 1E and List 2E	7.25	4.5	159

(1) Maximum power parameters for ELU-319 List 5E and List 6E on 9 kft, 26 AWG (0.4 mm) loops without doublers.

Maximum Power Dissipation

The Maximum Power Dissipation measures the power that is converted into heat that builds up within the unit. It contributes to the total heat generated in the space around the unit. It is used to determine the maximum number of fully loaded shelves per bay that does not exceed the maximum allowable power dissipation density in watts per square foot to comply with GR-63-CORE.

In COs, the maximum power dissipation for open-faced, natural convection-cooled mountings is limited to 134.7 watts per square foot per GR-63-CORE. The footprint of a standard 13-slot, 23-inch ELU-319 List 5E and List 6E shelf is 7.024 square feet, and the maximum bay dissipation is limited to 946 watts. Use this limit and the parameters in Table 7 to determine the maximum number of ELU circuits that can occupy one CO bay.

This is a worst case situation since it assumes the entire CO is subjected to the maximum power density. More favorable conditions would permit increasing the number of shelves per bay without jeopardizing the CO thermal integrity.

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

The 48 V Power Consumption is the maximum total power that the ELU-319 List 5E and List 6E consumes or draws from its -48 V shelf power source. This parameter is needed when the ELU-319 List 5E and List 6E is in a location remote to the CO it is serving. It determines the battery capacity required to maintain an 8-hour, stand-by battery reserve for emergency situations. Battery capacity limits the maximum number of line units which can be installed in a remote enclosure. Use the data in Table 7 to perform this analysis on a case by case basis.

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. Use the 42.5 V current data in Table 7 to determine the shelf fusing requirements for your particular ELU applications.

POWER CONSUMPTION WITH DOUBLERS

Tables 2 through 6 list the power consumed and dissipated by the ELU-319 List 5E and List 6E when it is used with any of the four basic doubler types in the HiGain family. The maximum current drawn by the CO supply is also listed.

Table 8 covers single doubler, line-powered circuits on 9 kft, 26 AWG (0.4 mm) loops.

Table 8. *EDU-451 List 1 or List 2 Maximum Power Parameters (No Doubler)*

ERU Model	48 V Power Consumption - W	Heat Dissipation - W	42.5 V Current - mA
ERU-412 List 1 and List 2	25.9	7.2	610
ERU-412 List 1E and List 2E	21	6.3	494

Table 9 applies to two doubler, line-powered circuits on 9 kft, 26 AWG (0.4 mm) loops.

Table 9. *EDU-409 List 2 Maximum Power Parameters (Two Doublers)*

ERU Model No.	48 V Power Consumption - W	Heat Dissipation -W	42.5 V Current - mA
ERU-412 List 1E	17.8	6.2	418

Table 10 applies to three doubler, line-powered circuits on 9 kft, 26 AWG (0.4 mm) loops.

Table 10. *EDU-409 List 2 Maximum Power Parameters (Three Doublers)*

ERU Model No.	48 V Power Consumption - W	Heat Dissipation -W	42.5 V Current - mA
ERU-412 List 1E, 3-doubler, line-powered	21	6.6	495
ERU-412 List 1E, 4-doubler, local power	23.7	7.4	557

INSTALLATION

To install the ELU-319 List 5E and List 6E:

1 Slide the ELU-319 List 5E and List 6E into the card guides for the desired slot, then push the unit back until it touches the backplane card-edge connector (see Figure 4).

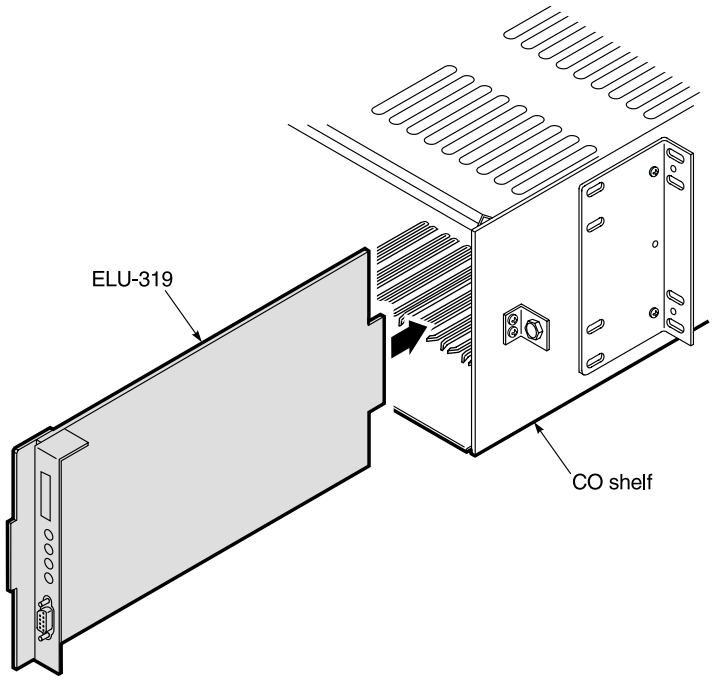

Figure 4. *Installing the ELU-319 List 5E and List 6E into a Shelf*

2 Place your thumbs on the ELU-319 List 5E and List 6E front panel and push the ELU-319 into the card-edge connector until it is entirely within the card guide. This indicates that the card is properly seated.

PROVISIONING

There are two methods for provisioning the ELU-319 List 5E and List 6E:

- Use the MODE and SEL buttons on the front panel
- Access system settings screens through the RS-232 craft port.

No dip switches or jumpers are required to provision the ELU-319 as it contains a non-volatile RAM (NVRAM) which stores the system option settings. System settings are retained if shelf power is lost or if the ELU-319 is unplugged.

SETTING OPTIONS THROUGH SEL AND MODE

To provision the ELU-319 List 5E and List 6E through the MODE and SEL buttons on the front panel:

1 Press the MODE button and release it after the display changes.

The message displayed on the front panel alternates between the first system parameter and its current setting.

2 Press the SEL button to step the display through all possible settings (one at a time) of the selected parameter.

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

This updates the current displayed mode to the selected setting, and then advances to the next configurable parameter.

After the last parameter has been selected, a "Confirm? (Yes/No)" message appears on the front panel display:

```
CONF NO
```

4 Do one of the following:

- To cancel the session without saving the requested parameter changes, press the MODE button or do nothing. (After 30 seconds, the display returns to its normal mode without saving the new changes.)
- To accept the requested parameter changes, press the SEL button. (A `YES` message displays, and the display returns to its normal mode after saving the new changes.)

In either case the display returns to its normal mode.

Factory Default Values

All user options can be set to the factory default values using the SEL and MODE buttons. To set the user options to their default values:

1 Press the SEL button for 6 seconds until the following message appears:

```
DFLT NO
```

2 Press the SEL button while the `DFLT NO` message is displayed.

The message changes to `DFLT YES` indicating the factory default values are now in effect.

To terminate the DFLT mode without setting the factory default values, do one of the following:

- Press the MODE button
- Wait 30 seconds for the display to return to its normal state.

Displaying System Inventory

To scroll through an inventory of system parameters, press the MODE button for 4 or more seconds. The following parameters are displayed:

- ELU software version number
- ELU List number
- Maximum insertion loss of each loop
- All five option settings

CONNECTING TO A MAINTENANCE TERMINAL

The 9-pin, RS-232 craft port on the front panel allows you to connect the ELU-319 List 5E and List 6E to a maintenance terminal or PC running a terminal emulation program. Once connected to a maintenance terminal, you can access the maintenance, provisioning, and performance screens.

To connect to a maintenance terminal:

1 Connect a standard 9-pin terminal cable to the RS-232 craft port on the ELU-319 List 5E and List 6E front panel.

2 Connect the other end of the console cable to the console port on the maintenance terminal.

3 If necessary, start a terminal emulation program.

4 Configure the maintenance terminal to the following communication settings:

- 1200 to 9600 baud (9600 baud is recommended)
- no parity
- 8 data bits
- stop bit
- hardware flow control to OFF

A standard RS-232 (DB-9, female) connector on the front panel provides access to the screen interface feature through a maintenance terminal (Figure 5).

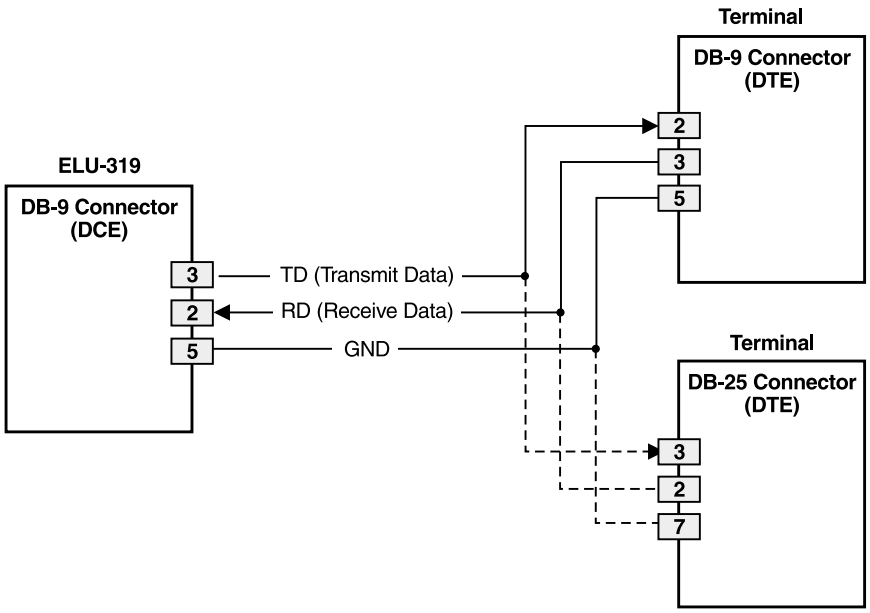

Figure 5. *DB-9 RS-232 I/O Interfaces*

MAINTENANCE

This section explains how to navigate through the Maintenance Terminal screens and describes the Main Menu and its various options.

NAVIGATING THE MAINTENANCE TERMINAL SCREENS

Table 11 lists keys you can use on the maintenance terminal to navigate within the Maintenance Terminal screens.

Table 11. *Navigational Keys on the Maintenance Terminal*

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 screen

To select an option within the Maintenance Terminal screens, you can:

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

An invalid entry produces the following message and identifies the name of a field where the invalid entry occurred:

```
> error
```

This happens only for margin alarm threshold. Otherwise, there is no response to an invalid entry.

ACCESSING THE MAINTENANCE TERMINAL SCREENS

Press the SPACEBAR several times to initiate the autobaud connection and to initialize the Maintenance Terminal screens.

MAINTENANCE TERMINAL MAIN MENU

Figure 6 shows the Maintenance Terminal Main Menu from which you can access eight system administration screens. The function of each screen selection is listed in Table 12.

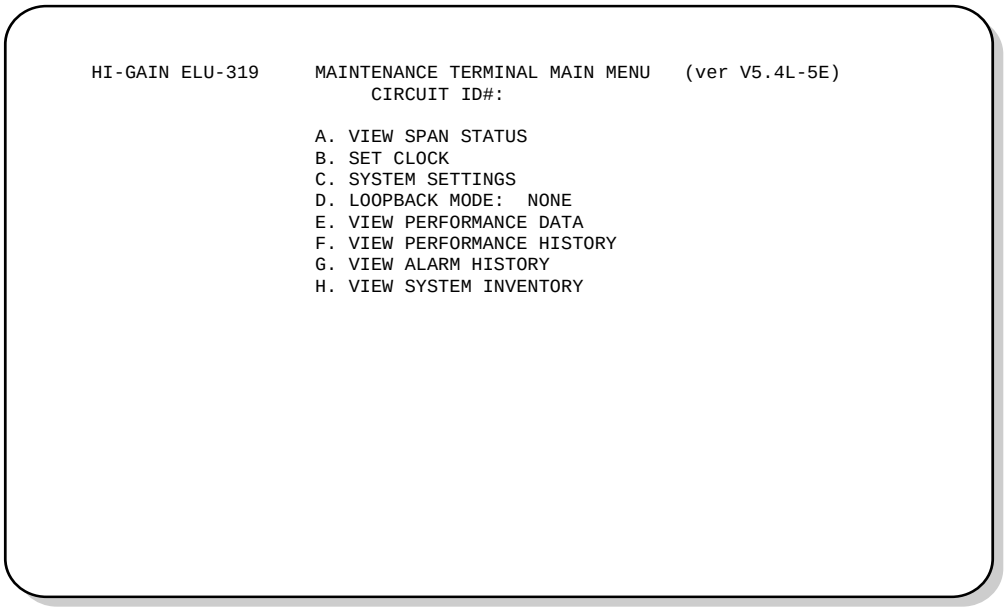

Figure 6. *Maintenance Terminal Main Menu*

Table 12. *Maintenance Terminal Screens*

Screen	Function	See page:
View Span Status	Provides access to subscreens that allow you to monitor the HDSL line between the ELU, EDU, and ERU.	20
Set Clock	Allows you to set both the time and the date parameters at the ELU, and to update the same settings at the ERU.	26
System Settings	Allows you to set all user options.	27
Loopback Menu	Provides access to subscreens that allow you to issue and disable loopbacks from both the network and customer side.	29
View Performance Data	Provides access to subscreens that allow you to view the Errored Seconds (ES) and Unavailable Seconds (UAS) between the ELU, EDU, and ERU in 15-minute intervals over a 4-hour time period.	32
View Performance History	Provides access to subscreens that allow you to view the ES and UAS between the ELU, EDU, and ERU in 24-hour intervals over a 7-day period.	35
View Alarm History	Provides access to subscreens that allow you to view alarm conditions between the ELU and the ERU.	37
View System Inventory	Allows you to enter a unique circuit ID (up to 24 characters).	40

VIEW SPAN STATUS

The View Span Status option allows you to view five system status screens that provide information about the HDSL Loop 1, HDSL Loop 2, and the G.703. For doubler applications, the available Span Status screens depend on whether the system includes one, two, or three doublers.

System Spans

As shown in Figure 7, the ELU can support up to three doublers with four HDSL spans. The Span Status, Performance Data, and Performance History may display as many as five screens to depict an ELU-319 List 5E and List 6E system.

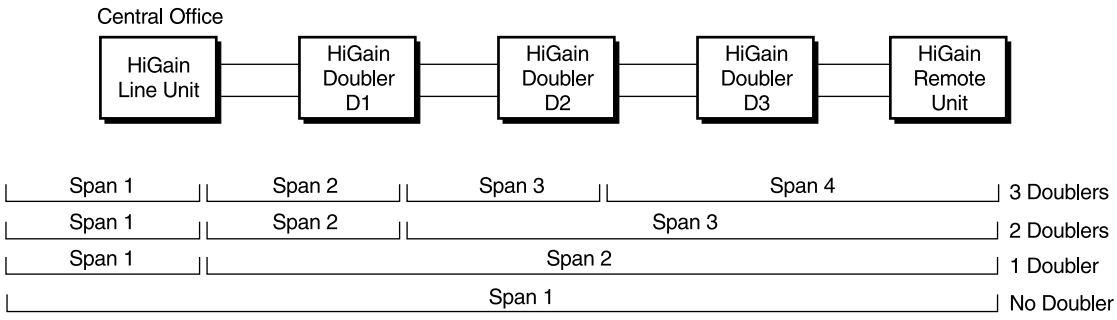

Figure 7. *System HDSL Spans*

From each Span Status screen you can:

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

Span Status Screen: Non-Doubler Applications

Press **A** from the Maintenance Terminal Main Menu to open the Span Status screen (Figure 8). If no doubler (EDU) is present, the screen reports span status for the subscriber lines between the ELU and the ERU.

```
                                    SPAN STATUS
TIME: 00:14:11
DATE: 01/24/00                       Circuit ID#:
ALARMS:   NONE
LOOPBACK: OFF
POWER LEVEL: LOW
                        ELU                          ERU
                  HDSL-1       HDSL-2       HDSL-1       HDSL-2
                cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:           21/17/21     20/17/21     21/18/21     20/18/21 dB
PULSE ATTN:         19           19           19           19    dB
INS LOSS:           23           23           23           23    dB
PPM OFFSET:         00           00           06           05    ppm
24 HOUR ES:       00002        00004        00005        00007  seconds
24 HOUR UAS:      00016        00013        00002        00001  seconds
                                  G.703 STATUS
                             ELU                  ERU
24 HOUR BPV Seconds:        00000                00000
24 HOUR UAS Count:          00000                00000



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

Figure 8. *Span Status Screen (No Doubler)*

Depending on system configuration, some information will change in Figure 8, Figure 9, and Figure 10 on page 23.

Span Status Screen: Doubler Applications

If doublers have been added, status is also reported for these. After pressing **A** to access the Maintenance Terminal Main Menu, press **S** to navigate through the span status screens. Span Status can have up to five screens, depending on the number of EDUs. Figure 9 shows status between an ELU and its first doubler (EDU1). If there is only one doubler, the next screen (Figure 10) shows status between EDU1 and the ERU. If there are additional doublers the Span Status screen will report status on each span.

```
                              SPAN 1 STATUS
TIME: 12:06:04
DATE: 01/24/00            :    Circuit ID#:
ALARMS:   NONE
LOOPBACK: OFF
POWER LEVEL: HIGH
                        ELU                        EDU1
                 HDSL-1       HDSL-2       HDSL-1       HDSL-2
               cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:          21/21/21     21/21/21     21/21/21     21/21/21 dB
PULSE ATTN:         19           19           20           19    dB
INS LOSS:           23           23           25           23    dB
PPM OFFSET:         00           00           17           17    ppm
24 HOUR ES:      00000        00000        00000        00000  seconds
24 HOUR UAS:     00000        00000        00000        00000  seconds

                              G.703 STATUS
                             ELU                ERU
24 HOUR BPV Seconds:        00000              00000
24 HOUR UAS Count:          00000              00000


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

Figure 9. *Span 1 Status Screen*

```
                              SPAN 2 STATUS
TIME: 12:06:04
DATE: 01/24/00            :    Circuit ID#:
ALARMS:   NONE
LOOPBACK: OFF
POWER LEVEL: HIGH
                        EDU1                       ERU
                 HDSL-1       HDSL-2       HDSL-1       HDSL-2
               cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:          21/21/21     21/21/21     21/21/21     21/21/21 dB
PULSE ATTN:         19           19           20           19    dB
INS LOSS:           23           23           25           23    dB
PPM OFFSET:         00           00           17           17    ppm
24 HOUR ES:      00000        00000        00000        00000  seconds
24 HOUR UAS:     00000        00000        00000        00000  seconds

                              G.703 STATUS
                             ELU                ERU
24 HOUR BPV Seconds:        00000              00000
24 HOUR UAS Count:          00000              00000


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

Figure 10. *Span 2 Status Screen*

Span Status Fields, Alarms, and Loopbacks

Table 13 lists the Span Status fields and descriptions. Table 14 on page 25 lists all possible alarms and their descriptions. Table 14 on page 25 lists all possible loopbacks and their descriptions.

Table 13. *Span Status Fields and Descriptions*

Field	Description
Time	Time of day when Span Status was checked.
Date	Date when Span Status was checked.
Circuit ID	Shows the user-defined circuit ID.
Alarms	Presence or absence of alarm conditions. See Table 18 on page 41.
Loopback	Indicates Off condition or identifies specific active loopback.
Power Level	Indicates the HDSL line voltage in its Low (-140 V) or High (±112 V) state.
Margin	Indicates the excess signal-to-noise ratio, at either the ELU or ERU, relative to a 10^{-7} Bit Error Rate. First value is current margin, second value is minimum margin since last cleared, and third value is maximum value since last cleared. NA means Not Available. Minimum and maximum margin are cleared and updated every time the Span Status screen is cleared and every day when the system clock passes 12:00 p.m. midnight.
Pulse Attenuation (ATTN)	Indicates the attenuation of the 2B1Q pulse from the distant end. The value is related to the 260 kHz loss of the cable pair. The pulse attenuation is a more direct indication of the loop attenuation to the 2B1Q signal than is the 260 kHz loss. The normal HiGain ATTN operation range is from 0 to 28 dB.
Insertion Loss (INS LOSS)	Indicates the difference in the amount of power received before and after something is inserted into the circuit (another telephone instrument) or a call is connected. Usually expressed in decibel/kilometer.
PPM Offset	Indicates the relative offset of the crystal oscillator in the ELU from the ERU or EDU crystal oscillator. Any value between -100 and +100 is adequate.
24-Hour ES	The number of 1-second intervals that contained at least one CRC error. This value is a running total of the last 24 hours.
24-Hour UAS	The number of seconds the HDSL loop was out of sync.
24-Hour BPV Seconds	The number of seconds in which at least one bipolar violation was detected on the G.703 input over a 24-hour period.
24-Hour UAS Count	The number of seconds during which the G.703 input signal was absent (125 or more consecutive 0's) over a 24-hour period.
(HG)	HG = HiGain. The loopback was initiated by a HiGain front-panel or maintenance terminal loopback command.

The Status Menu displays a four-character code that identifies the signal being transmitted or received (where xxx is LLOS, RLOS, LAIS, or RAIS).

RCV (xxxx) - Signal received (xxxx) at the E1 input to either the ELU or ERU.

XMT (xxxx) - Signal transmitted (xxxx) at the E1 output of either the ELU or ERU.

Table 14. *ELU-319 List 5E and List 6E Status Menu Messages: Alarms*

Message	Full Name	Description
LLOS	Local Loss of Signal	No signal from ELU-319 List 5E local E1 input.
RLOS	Remote Loss of Signal	No signal from ERU E1 input.
LOSW1 LOSW2	Loss of Sync Word 1 or 2	One of the HDSL loops has lost synchronization.
BER	Bit Error Rate	The total system error count (TSEC) has exceeded the user-selected threshold.
MAL1	Margin Alarm 1	The margin on the HDSL Loop 1 has dropped below the threshold (1 to 15 dB) set by the user. Setting the threshold to zero inhibits the margin alarm.
MAL2	Margin Alarm 2	The margin on the HDSL Loop 2 has dropped below the threshold (1 to 15 dB) set by the user. Setting the threshold to zero inhibits the margin alarm.
CHREV	Channels Reversed	The Loop 1 and Loop 2 HDSL pairs are reversed at the ERU input port. Loop 1 is specified to carry the (-) simplex DC voltage, and Loop 2 is specified to carry the (+) simplex DC voltage.
NREM	Network Remote Loopback	Loopback at ERU to network initiated from CO (network) by Intelligent Line Repeater (ILR) #2 code, Manual Loopback buttons on the ELU-319 List 5E front panel, ERU front panel button or by the maintenance terminal.
NLOC	Network Local Loopback	Loopback ELU-319 (local) to network initiated from CO by IOR code, the ELU-319 List 5E front panel Manual Loopback buttons or maintenance terminal.
NDU1	Network Doubler 1 Loopback	Loopback at Doubler #1 to network initiated by IOR code or by Manual Loopback buttons on the ELU-319 List 5E front panel or by the maintenance terminal.
NDU2	Network Doubler 2 Loopback	Loopback at Doubler #2 to network initiated by IOR code or by Manual Loopback buttons on the ELU-319 List 5E front panel or by the maintenance terminal.
NDU3	Network Doubler 3 Loopback	Loopback at Doubler #3 to the network initiated by IOR code, the Manual Loopback buttons on ELU-319 List 5E front panel or by the maintenance terminal.
CLOC	Customer Local Loopback	Loopback at ERU (local) to CI initiated from CPE by the ILR code or the Manual Loopback buttons on the ELU-319 List 5E front panel or by the maintenance terminal.
CREM	Customer Remote Loopback	Loopback at ELU-319 List 5E (remote) to customer initiated by IOR code or the Manual Loopback buttons on the ELU-319 List 5E front panel or by the maintenance terminal.
CDU1	Customer Doubler 1 Loopback	Loopback at Doubler #1 to CI initiated by ILR code, the Manual Loopback buttons on ELU-319 List 5E front panel or by the maintenance terminal.
CDU2	Customer Doubler 2 Loopback	Loopback at Doubler #2 to CI initiated by ILR code, the Manual Loopback buttons on the ELU-319 List 5E front panel or by the maintenance terminal.
CDU3	Customer Doubler 3 Loopback	Loopback at Doubler #3 to CI initiated by ILR code or by Manual Loopback buttons on the ELU-319 List 5E front panel or by the maintenance terminal.
TLOS	Transmit Loss of Signal Loopback	ERU is in a logic loopback state caused by a loss of its E1 input from the CI (if enabled at the ERU via its TLOS switch option).

SET CLOCK

Press **B** from the Maintenance Terminal Main Menu to open the Set Clock screen (Figure 11).

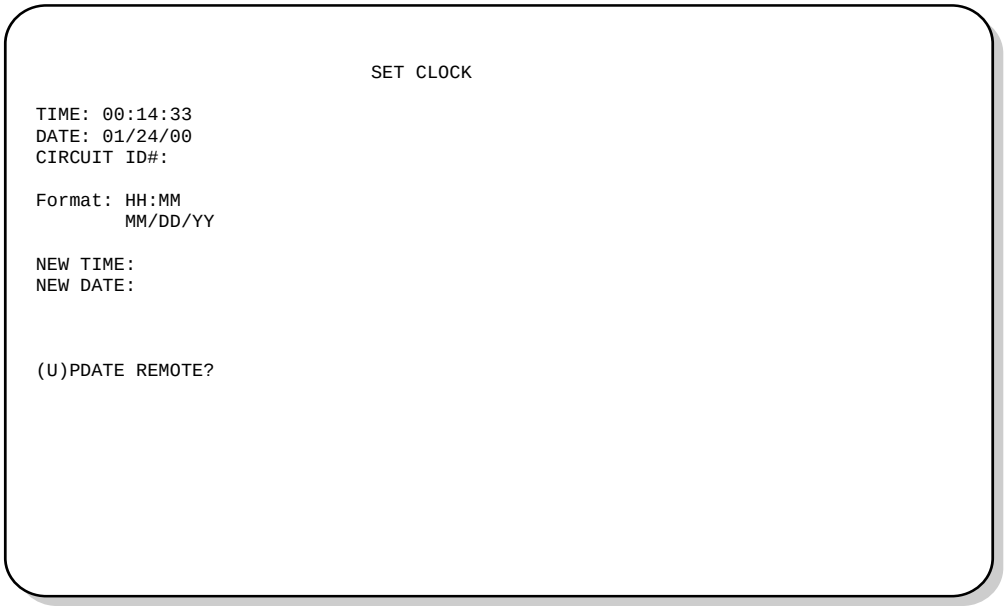

Figure 11. *Set Clock Screen*

All time information is lost when power is removed. The last date, however, is retained in NVRAM and reappears when power is restored.

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.

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.

When editing entries in the Clock screen and when using the Terminal emulation program in Windows 3.1, pressing the BACKSPACE key deletes two characters instead of just one.

Update the ERU Time and Date

The remote unit date and time is set by using this option. To update the remote, do one of the following:

- Press **U** to update the ERU to the same date and time set for the ELU-319 List 5E and List 6E.
- Press **ENTER** to not update.

SYSTEM SETTINGS

The options set from the System Settings screen are the same as the options set through the ELU-319 List 5E and List 6E front panel Mode and SEL buttons (except for Margin Alarm Threshold, which can only be set at this screen). Refer to Table 15 on page 29 for a listing of system setting options.

Press **C** from the Maintenance Terminal Main Menu to open the System Settings screen (Figure 12).

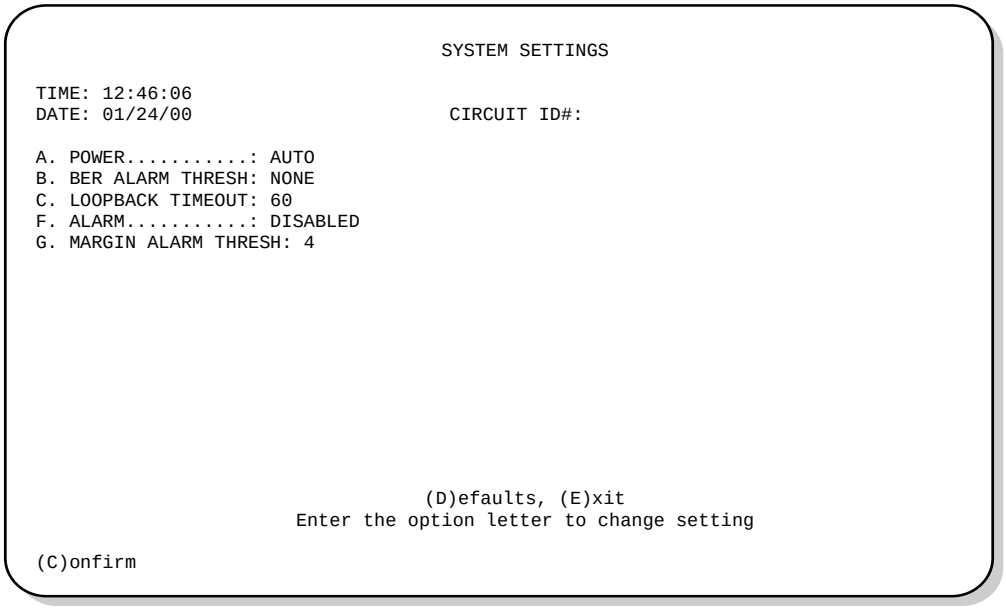

Figure 12. *System Settings Screen*

To change any option:

1. Enter the character key, which is shown inside the parenthesis within each parameter description. This causes the screen to refresh with the new settings.
2. After all parameters have been selected, press **E** to exit, then **C** to confirm. The newly selected parameters are now activated.

BER Options

The BER option uses the BPV/CRC Total Error Count (TEC) to generate an Alarm if enabled. The ELU combines the one second TEC counts in both directions for the last 60 seconds. It uses this 1-minute Total System Error Count (TSEC) to generate an alarm if it exceeds the selected BER threshold of (1E-6 or 1E-7) as follows:

- BER option = 1E-6. Alarm is generated if TSEC > 92.
- BER option = 1E-7. Alarm is generated if TSEC > 9.

Once initiated, the alarm clears when the TSEC drops below its associated threshold count. For dribbling type of errors, the alarm can come and go in intervals as short as 1 second. Alarms due to bursty impulse noise transients usually require the full 60 seconds or longer to clear depending on the frequency of the transients. This BER option is always present in any line unit circuit since it is independent of the versions of the other HiGain modules in the circuit. When connected to an ERU, only the BPVs detected by the ELU are included in the TBC. The BPVs at the ERU are not counted.

Margin Alarm Threshold

To set the Margin Alarm Threshold:

1 Select **G** from the System Settings Main Menu screen.

2 Enter the desired minimum acceptable alarm threshold from the 0 to 15 dB range. This causes a system alarm to occur if either the margin on HDSL Loop 1 (MAL1) or Loop 2 (MAL2) drops below the selected threshold value.

Since the margin can never drop below 0, choosing 0 for the margin threshold turns the margin alarm off.

HDSL Line Voltage Options

The HDSL Line power feed PWRF option has four settings, DISABLED, LOW, AUTO and HIGH, as described below.

- **DISABLED** disables any voltage from being applied to the HDSL cable pairs. It is useful to prevent craft personnel from being exposed to the HDSL line voltage when they are working on the cable pairs.
- **LOW** limits the HDSL simplex voltage to -140 V maximum. This is the standard voltage used in all non-doubler applications and has no effects in these applications. It can be chosen to limit line-powered, single-doubler circuits or locally-powered, two-doubler circuits up to 140 V, if the appropriate HiGain plugs (EDU-409) are used along with the ELU-319 List 5E. These HiGain units are the only ones that have sufficiently low power consumption to allow their doubler circuits to be line-powered from 140 V.
- **AUTO** is the conventional mode in which the ELU automatically maintains the HDSL-like voltage at 140 V maximum for non-doubler applications and ± 112 V for doubler applications.
- **HIGH** forces the HDSL line voltage to its high ± 112 V level for applications. It is needed to allow the ELU to power circuits that are providing power to remote Personal Communication Systems (PCS) sites.

GROUND FAULT DETECT

The ELU-319 List 5E and List 6E has a Ground Fault Detect (GFD) circuit which detects a ground or a resistive path to ground on any wire of any loop of any span with a non-zero voltage. For low (140 V) applications, such a circuit is active during start-up by applying the bipolar voltage to the loops. It deactivates when going to the nominal operation mode of unipolar negative voltage (0 V and -140 V). The circuit is constantly active during high (±112 V) applications.

When the circuit is active, the system is compliant with Class A2 requirements of GR-1089. When the circuit is not active, the system is compliant with Class A3 requirements of GR-1089.

Whenever the GFD circuit detects a grounded loop, the line power is immediately removed from the spans and a PWR FEED GND alarm is generated and displayed. The power is reapplied 30 seconds later as part of a new start-up procedure. If the ground condition persists on the span, the power is removed when the GFD circuit detects this condition.

The indication of the location of the ground fault can be obtained by monitoring the voltages on the spans on the ELU side as it sequentially powers devices in subsequent spans.

SYSTEM SETTINGS SCREEN OPTIONS

Table 15 describes the System Settings screen options and their counterpart codes for the front panel display. Factory default settings are shown in bold.

Table 15. *ELU-319 List 5E and List 6E System Settings Screen Options*

System Settings Screen Options	Front Panel Display Code	Selection	Description
Power	PWRF	DIS	Disables powering to the HDSL pair.
		LOW	Keeps the HDSL line voltage at -140 V maximum for all applications.
		AUTO	Allows the HDSL line voltage to automatically switch between -140 V maximum for non-doubler applications and ±112 V for doubler applications.
		HIGH	Forces the HDSL line voltage to ±112 V for all applications.
BER Alarm Threshold	BERT	1E-6	Activates (closes) the SmartJack alarm relay contacts on pins 20 and 21 and flashes the red STATUS LED when the BER exceeds 10^{-6}.
		1E-7	Activates (closes) the system alarm relay contacts on pins 20 and 21 and flashes the red STATUS LED when $10^{-6} > BER > 10^{-7}$.
		NONE	Prevents generation of a system alarm due to BER.
Loopback Timeout	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.
Alarm	ALM	**DIS**	Opens the system alarm relay contacts if closed, and disables activation of the system alarm relay when a system alarm condition occurs.
		ENA	Enables activation of the system alarm relay when a system alarm condition occurs.
Margin Alarm Threshold	MARG	0 to 15 dB	The Margin Alarm Threshold can only be set via the RS-232 craft port with a terminal. It determines the minimum allowable margin below which a system alarm can occur. Zero disables the alarm.
		4dB	Default value

LOOPBACK MENU

The Loopback Menu permits you to issue loopbacks to the HiGain system. There are four possible Loopback Menus:

- Loopback Menu: No doubler
- Loopback Menu: One doubler
- Loopback Menu: Two doublers
- Loopback Menu: Three doublers

In all instances, press **D** from the Maintenance Terminal Main Menu to display the Loopback Menu. Figure 13 shows an example of a Loopback Menu when no doublers are present; Figure 14 shows an example when three doublers are present.

Loopback Menu: No Doubler

Figure 13 shows the Loopback Menu when no doublers are present.

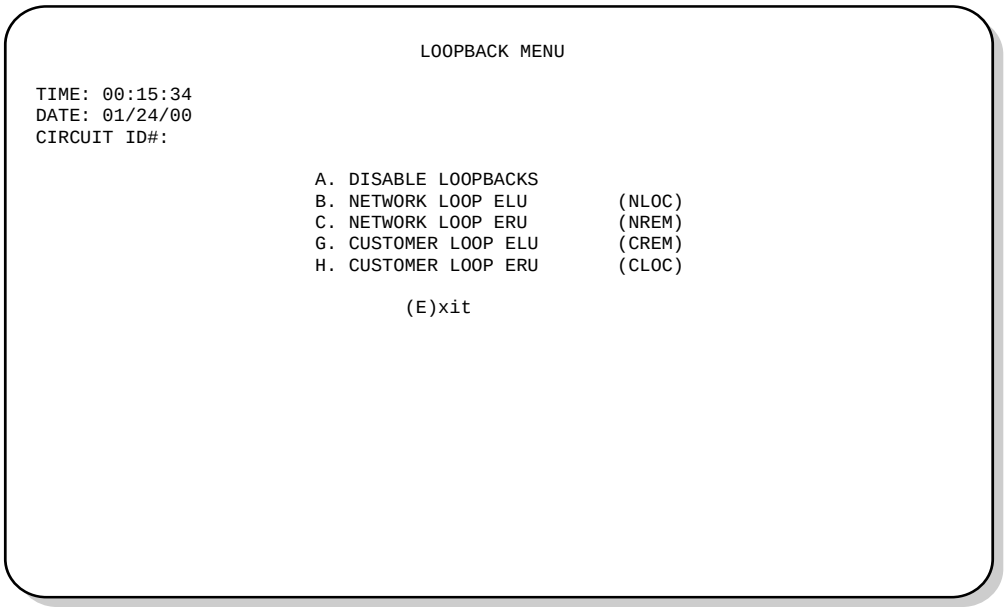

Figure 13. *Loopback Menu: No Doubler*

Loopback Menu: Four Doublers

Figure 14 shows the Loopback Menu with three doublers.

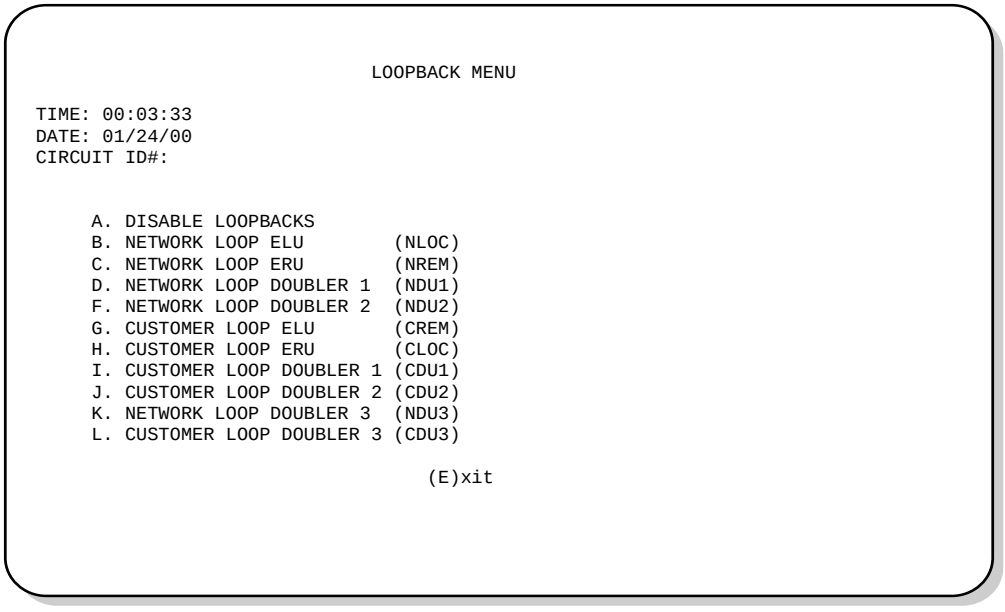

Figure 14. *Loopback Menu: Three Doublers*

Initiating a Loopback

To send one of the available loopbacks, press the appropriate letter in the Loopback Menu. The following prompt appears:

```
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 Maintenance Terminal Main Menu. The selected loopback four letter designation now appears in the Loopback Mode field in the Maintenance Terminal Main Menu (see Figure 15 in which an NLOC loopback is in progress). The loopback continues to cycle in the system depending upon your Loopback Timeout setting.

The Loopback Menu screen is also available at the ERU connected to the ELU-319 List 5E and List 6E, allowing all HiGain System loopbacks to be initiated from either end of the circuit.

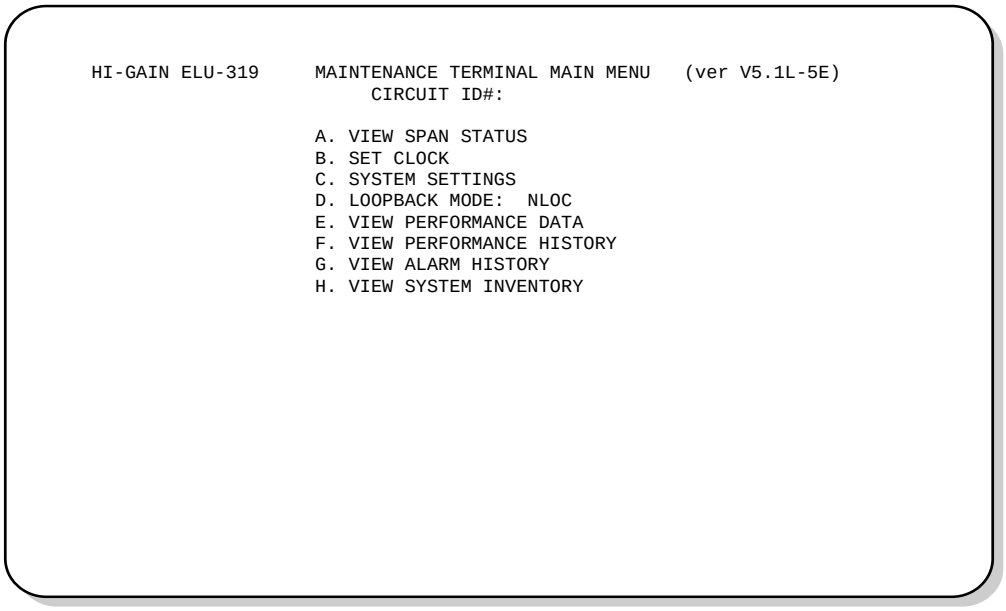

Figure 15. *NLOC Loopback Mode in the Maintenance Terminal Main Menu*

Disabling Loopbacks

The Disable Loopbacks option allows you to disable (cancel) any of the loopbacks listed in the screen. To disable loopbacks, press **A** in the Loopback Menu. The following prompt appears:

```
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 Maintenance Terminal Main Menu in which the Loopback Mode will display as None.

PERFORMANCE DATA SCREENS

The Performance Data screens show the Errored (ES) and Unavailable Seconds (UAS) for both HDSL loops and each E1 input at 15-minute intervals over a 4-hour time interval. Earlier and later data, in 4-hour time periods on different span screens, can be accessed by pressing **P** (Previous) or **N** (Next) respectively. All Performance Data counters can be set to zero by pressing **C** (Clear) from the ELU-319 List 5E and List 6E Span Status screen shown in Figure 16 on page 33 and Figure 17 on page 34.

Since the ELU-319 is considered the master module, this clears all performance data screens at both the ELU-319 and the ERU. The RS-232 interface at the ERU does not allow the counters to be cleared.

Errored and Unavailable seconds are defined in Table 16.

Table 16. *Errored and Unavailable Seconds Definitions*

ES and UAS	Definition
HDSL Errored Second	A second in which at least one HDSL CRC has occurred.
HDSL Unavailable Second	A second in which an HDSL loop has loss from sync at least once.
G.703 Errored Second	A second in which at least one BPV has occurred.
G.703 Unavailable Second	A second in which at least one E1 LOS condition (175 ± 75) zeros has occurred.

From each Performance Data screen you can do the following:

- Press **P** to view the previous 4-hour data screen.
- Press **N** to view the next 4-hour data screen.
- Press **E** to exit.
- Press **S** to view the next available span.

Performance Data Screen: Without Doubler

Press **E** from the Maintenance Terminal Main Menu to view the Performance Data screen for applications (Figure 16) without a doubler. This screen shows the Errored and Unavailable Seconds for the HDSL span between the ELU-319 List 5E and List 6E and the ERU.

```
Date: 01/24/00              PERFORMANCE DATA
CIRCUIT ID#:
                  ERRORED SECONDS/UNAVAILABLE SECONDS

            G.703              HDSL-1             HDSL-2
          ELU      ERU      ELU      ERU      ELU      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

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

Figure 16. *Performance Data Screen: Without Doubler*

Performance Data Screen: With Doubler

The Performance Data Screen displays information by span. With no doubler, there is only one span (Figure 16). With multiple doublers (up to three), there can be as many as five span screens.

1 Press **E** from the Maintenance Terminal Main Menu to view the Performance Data screen.

2 Press **S** from the Performance Data screen to advance through the performance data screens for the various spans.

Figure 17 is an example of a Performance Data screen that lists performance data for the fourth span (Doubler #3 to the ERU).

```
Date: 01/24/00        SPAN 5 PERFORMANCE DATA
CIRCUIT ID#:
               ERRORED SECONDS/UNAVAILABLE SECONDS

              G.703            HDSL-1           HDSL-2
           ELU      ERU      EDU3     ERU      EDU3     ERU
00:00    000/000  000/000  000/000  000/000  000/000  000/000
00:15    000/000  000/000  000/000  000/000  000/000  000/000
00:30    000/000  000/000  000/000  000/000  000/000  000/000
00:45    000/000  000/000  000/000  000/000  000/000  000/000
01:00    000/000  000/000  000/000  000/000  000/000  000/000
01:15    000/000  000/000  000/000  000/000  000/000  000/000
01:30    000/000  000/000  000/000  000/000  000/000  000/000
01:45    000/000  000/000  000/000  000/000  000/000  000/000
02:00    000/000  000/000  000/000  000/000  000/000  000/000
02:15    000/000  000/000  000/000  000/000  000/000  000/000
02:30    000/000  000/000  000/000  000/000  000/000  000/000
02:45    000/000  000/000  000/000  000/000  000/000  000/000
03:00    000/000  000/000  000/000  000/000  000/000  000/000
03:15    000/000  000/000  000/000  000/000  000/000  000/000
03:30    000/000  000/000  000/000  000/000  000/000  000/000
03:45    000/000  000/000  000/000  000/000  000/000  000/000

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

Figure 17. *Span 5 Performance Data Screen*

VIEW PERFORMANCE HISTORY

The View Performance History option allows you to access the 7 Day History screens that show the number of ES and UAS occurrences in 24-hour increments for a 7 day period. Errored Seconds and Unavailable Seconds for both HDSL loops and each of the two G.703 inputs are listed for the current and previous 7 days. The counters on all 7 Day History can be set to zero by pressing **C** (Clear).

Since the ELU-319 is considered the master module, this clears all performance data screens at both the ELU-319 and the ERU. The RS-232 terminal interface at the ERU does not allow the counters to be cleared.

The 7 Day History Screen: Without Doubler

Press **F** (View Performance History) from the Maintenance Terminal Main Menu to open the 7 Day History screen for applications (Figure 18) without a doubler. The 7 Day History Span 1 screen shows the ES and UAS for the HDSL loop between the ELU-319 List 5E and List 6E and the ERU.

```
Time: 00:16:55                    7 DAY HISTORY
CIRCUIT ID#:

                                    SPAN 1
                          ERRORED SECONDS/UNAVAILABLE SECONDS

                 G.703                  HDSL-1                  HDSL-2
            ELU          ERU          ELU          ERU          ELU          ERU
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
01/30   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/31   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
02/01   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00000/00015 00004/00001 00002/00016 00005/00002 00004/00013 00007/00001

                                    (E)xit
```

Figure 18. *7 Day History Screen for Span 1 (No Doubler)*

The 7 Day History Screen: With Doubler

The 7 Day History screen displays information by span. With no doubler, there is only one span (Figure 18). With multiple doublers (up to three), there can be as many as four span screens.

1 Press **F** (View Performance History) from the Maintenance Terminal Main Menu to open the 7 Day History screen.

2 Press **S** from the 7 Day History screen to advance through the history screens for the various spans.

Figure 19 is an example of a 7 Day History screen that lists performance data for the fourth span (Doubler #3 to the ERU).

```
Time: 03:09:34                    7 DAY HISTORY
CIRCUIT ID#:

                                   SPAN 4
                          ERRORED SECONDS/UNAVAILABLE SECONDS

                 G.703                    HDSL-1                   HDSL-2
            ELU          ERU         EDU3         ERU         EDU3         ERU
01/05   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/06   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/07   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/08   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/09   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/10   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/11   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00001/00000 01094/00798 00000/01101 00369/00004 00000/01101 00141/00006

                                     (E)xit
```

Figure 19. *7 Day History Screen Span 4*

VIEW ALARM HISTORY

The View Alarm History screen allows you to view alarms that are currently active. In the Alarm History screen the following is displayed:

- First and Last columns contain the time and date stamp of the first and last occurrence of each alarm
- Current column shows the status of each alarm.
- The count column lists the number of times each alarm occurred.
- The maximum non-overflowing count is 999.

From each Alarm History screen you can do the following:

- Press U to update the screen.
- Press S to view another span.
- Press C to clear all data from the screen.
- Press E to exit from the Alarm History screen.

Table 17 lists the Alarm History fields and descriptions. These descriptions apply to the Alarm History for doubler applications as well.

Table 17. *Alarm History Fields and Descriptions*

Field	Description
Type	Identifies the type of alarm.
LOS, G.703-ELU	First and last instance of LOS at the ELU; Current condition, number of alarms.
LOS, G.703-ERU	First and last instance of LOS at the ERU; Current condition, number of alarms.
BER	First and last instance of a BER at the ERU; Current condition, number of alarms.
Span 1 LOSW, HDSL1	First and last instance of LOSW on HDSL1; Current condition, number of alarms.
Span 1 LOSW, HDSL2	First and last instance of LOSW on HDSL2; Current condition, number of alarms.
Span 1 Margin L1	First and last instance of exceeded margin on Loop 1; Current condition, number of alarms.
Span 1 Margin L2	First and last instance of exceeded margin on Loop 2; Current condition, number of alarms.
PWR-SHRT	Power short condition; Current condition, number of alarms.
PWR-GND	Power ground condition; Current condition, number of alarms.
Last Cleared: None	Last time Alarm History cleared; Current condition, number of alarms.

Alarm History Screen: Without Doubler

Press **G** from the Maintenance Terminal Main Menu to view the Alarm History screen for an application without a doubler (Figure 20).

```
 ALARM HISTORY

TIME: 00:04:06
DATE: 01/24/00
CIRCUIT ID#:

Type              First               Last                Current        Count
LOS, G.703-ELU                                           OK              000
LOS, G.703-ERU                                           OK              000
BER                                                      OK              000
SPAN1 LOSW, HDSL1 01/24/00-00:00      01/24/00-00:00      OK              001
SPAN1 LOSW, HDSL2 01/24/00-00:00      01/24/00-00:00      OK              001
SPAN1 MARGIN L1   01/24/00-00:00      01/24/00-00:00      OK              001
SPAN1 MARGIN L2                                          OK              000
PWR-SHRT                                                 OK              000
PWR-GND                                                  OK              000

LAST CLEARED:  NONE


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

Figure 20. *Alarm History Screen for Span 1*

Alarm History Screen: With Doubler

The Alarm History screen displays information by span. With no doubler, there is only one span (Figure 20). With multiple doublers (up to three), there can be as many as four span screens.

1 Press G from the Maintenance Terminal Main Menu to view the Alarm History screen.

2 Press S from the Alarm History screen to advance through the alarm history screens for the various spans.

Figure 21 is an example of an Alarm History screen that lists history for the fourth span (Doubler #3 to the ERU).

```
 ALARM HISTORY

TIME: 00:04:06
DATE: 01/24/00
CIRCUIT ID#:

Type              First               Last               Current        Count
LOS, G.703-ELU                                          OK              000
LOS, G.703-ERU                                          OK              000
BER                                                     OK              000
SPAN1 LOSW, HDSL1 01/24/00-00:00:00   01/24/00-00:00:00 OK              001
SPAN1 LOSW, HDSL2 01/24/00-00:00:00   01/24/00-00:00:00 OK              001
SPAN1 MARGIN L1   01/24/00-00:00:00   01/24/00-00:00:00 OK              001
SPAN1 MARGIN L2                                         OK              000
PWR-SHRT                                                OK              000
PWR-GND                                                 OK              000

LAST CLEARED:  NONE


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

Figure 21. *Alarm History Screen for Span 4*

SYSTEM INVENTORY SCREEN

The System Inventory screen lists the six possible units that can comprise one HiGain circuit: one ELU, one ERU and up to three doublers. The information in the System Inventory Screen is presented as follows:

- All six possible unit modules are always listed. The doublers are shown as: DB1, DB2, and DB3.
- The model number, list number and software revision number of every unit that is present in the circuit is listed in the Product column. Units that are not detected are not considered to be present in the circuit and are labeled N/A.
- Each of the unit IDs is limited to 24-character alphanumeric characters. To change an ID, select its line identifying letter. The IDs, like the system settings, are stored in NVRAM and remain so when power is lost.
- The ELU has no unit ID number since it is usually identified by the Circuit ID number, which appears in every screen.
- All detected modules have the product number listed. Whenever the ELU-319 loses sync with Span 1, the product types are replaced by the N/A label until sync is reestablished and each module can in turn be reidentified. Only the Circuit ID appears in the other ELU-319 List 5E and List 6E Terminal Maintenance screens.

Press **H** from the Main Menu to display the System Inventory screen (Figure 22).

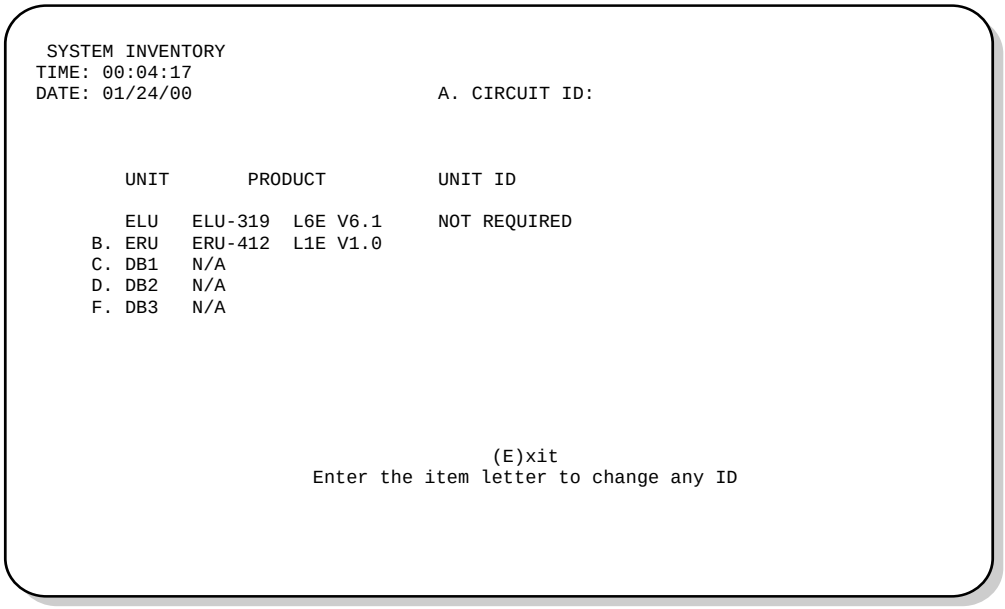

Figure 22. *System Inventory Screen*

To set a Circuit ID, press **ENTER** after selecting the set of alphanumeric ID characters. Choose **C** to confirm. If more than 24 characters are entered, a warning beep is emitted and only the first 24 characters are accepted.

On initial turn up, the Circuit and Unit IDs are set to blanks. However, executing the default option from either the front panel or System Settings screen has no effect on the ID values.

SYSTEM ALARMS

Table 18 lists possible ELU-319 List 5E and List 6E alarm states. The accompanying front panel message is listed in the Alarm column. More than one alarm condition can exist at any given time, but only one message can be displayed. For multiple alarms, only the highest priority alarm displays.

Table 18. *HDSL System Alarms*

Front-Panel Message	Alarm	Description	To inhibit:
ALRM LOSW	Loss of Sync Word(1)	One of the HDSL loops has lost synchronization.	Cannot be inhibited.
ALRM LLOS	Local Loss of Signal	Loss of the G.703 input signal.	Cannot be inhibited.
ALRM RLOS	Remote Loss of Signal	Loss of the ERU G.703 input signal.	Disable the RDA (Remote G.703 Alarm) option. This prevents an LOS condition at the G.703 input to a ERU from activating Pin H. The front panel Status LED still flashes red and the ALRM RLOS message displays to alert you of the LOS state. LOS is sent toward the network from the ELU. This option prevents the common occurrences of a CPE LOS condition from generating recurring alarms and AIS payloads.
ALRM TLOS	Transmit Loss of Signal	The G.703 input is not present at the ERU. Places the ERU in loopback towards the network.	Set the TLOS switch at the ERU to disable.
ALRM BER	Bit Error Rate exceeded	The combined E1 and HDSL BER has exceeded set threshold limits of 10^{-6} or 10^{-7}.	Select NONE for the BER system option.
ALRM MAL1 or ALRM MAL2	Margin Alarm Loop1 or Margin Alarm Loop2	The margin on HDSL Loop 1 or Loop 2 has dropped below the minimum threshold value set by the terminal MARGIN ALARM THRES.	Set the Margin Alarm Threshold option to 0 (zero).

(1) When both HDSL loops lose sync word (LOSW), a system alarm condition exists. However, since the ELU-319 enters a self test cycling mode, the front panel LED lights yellow instead of red, and the SELF TEST message is displayed instead of the ALRM message.

RETIRING SYSTEM ALARMS

To retire a system alarm, press the SEL button and execute an Alarm Cut Off (ACO). An ACO turns the alarm off and replaces the ALRM message with an ACO message. The second part of the ALRM message, which defines the cause of the alarm, remains. Both parts of the message remain until the alarm condition clears or another higher priority alarm occurs.

SELF TEST

The Self Test mode that occurs when both HDSL loops are not in sync has been enhanced to include the input G.703 transceiver chip. The Self Test procedure can cause the AIS pattern, which is normally transmitted from the ELU-319 during these out of sync intervals, to exhibit occasional BPVs.

LOOPBACK OPERATION

INITIATING MANUAL LOOPBACK SESSIONS

A manual loopback session allows you to select one of four HiGain system loopbacks.

Any of the HiGain loopbacks can be executed using the MODE and SEL buttons.

In general, to execute a manual loopback session using the MODE and SEL buttons:

- **The next loopback option can be presented by pressing the MODE button, but the previously executed loopback remains active until the SEL button is pressed and a different loopback is activated.**
- **If neither button is pressed for a period of 30 seconds, and no loopback is in effect, the manual loopback session terminates and the normal margin displays reappear.**
- **If any loopback is in effect, the 30-second timeout is inhibited. The active loopback and the manual loopback session continue until the loopback times out in accordance with the LBTO setting.**
- **Pressing both buttons for 3 seconds terminates any active loopback, ends the Manual loopback session and returns the display to normal mode.**

To initiate a manual loopback session:

1 Press both the MODE and SEL buttons on the front panel for at least 3 seconds. The following message appears on the front panel display:

`MAN LPBK`

followed by the message:

`NLO?`

2 Do one of the following:

- To execute an E1 loopback, press the SEL button. The message changes from `NLO?` to `NLOC`.
- To execute an NREM loopback:
  - Press the MODE button. The message changes from `NLO?` to `NRE?`
  - Press the SEL button to execute the NREM loopback.

3 To execute a CRE loopback, press the MODE button again.

4 To execute a CLO loopback, press the MODE button a third time.

These same loopbacks can be initiated from the RS-232 craft port by choosing the Loopback Mode, option D, from the Main Menu. This displays the Loopback Menu (Figure 13 on page 30) from which any of the loopbacks can be initiated or terminated.

All loopbacks can be initiated by a command from HiGain itself (front panel buttons or maintenance screen selections).

LOOPBACK TEST PROCEDURES

The following sections provide step-by-step test procedures for the ELU-319 as a function of the loopback option selected. These procedures allow verification of the integrity of the HDSL channels at every module location as well as the G.703 channels to the customer and the local G.703 interface.

If trouble is encountered on the ELU-319 List 5E G.703 interface, verify that the ELU is making a positive connection with its mounting assembly (shelf) connector.

The transmit and receive E1 G.703 ports have splitting access jacks and miniature, 210-series, bridging jacks as shown in Figure 1 on page 6. Connecting one cable between the two bridging jacks and another between the two SPAN jacks splits the XMT and RCV and creates metallic loopbacks towards both the G.703 and the ELU-319. If separate plugs are inserted into both SPAN jacks with the other end disconnected, the BRG jacks can be used to send and receive test patterns towards the G.703.

LOOPBACK OPERATION

The complete family of loopbacks that a HiGain system equipped with the EDU-409 can execute is shown in Figure 23. Six of those loopbacks, NDU1, NDU2, NDU3; CDU1, CDU2, CDU3 occur in the doubler. The loopbacks can be initiated from the ELU RS-232 craft port, the ELU front-panel MODE and SEL buttons, or from a family of Special Loopback (SPLP) inband loopback commands.

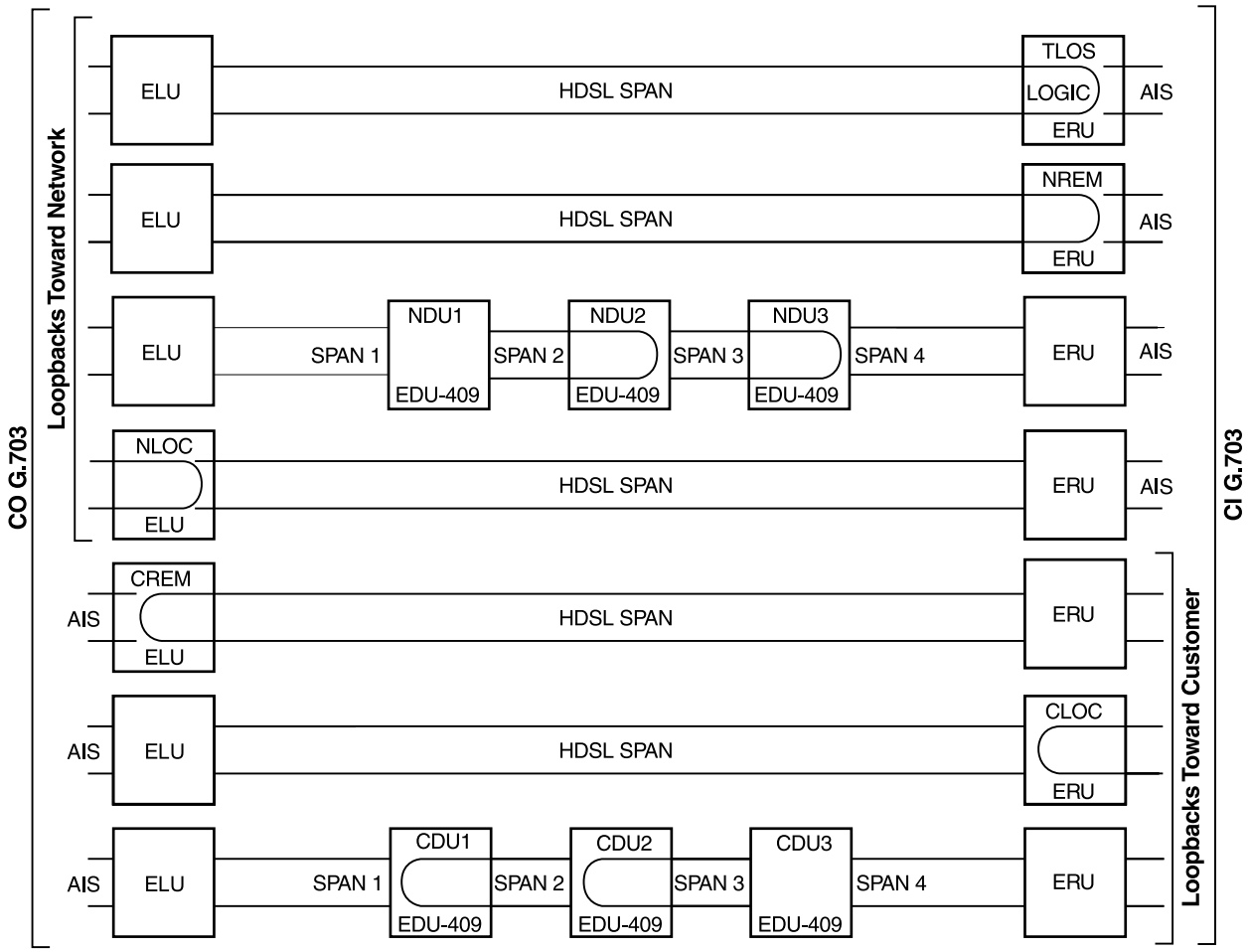

Figure 23. *Non-doubler and Doubler Loopback Configurations*

APPENDIX A - SPECIFICATIONS

HDSL Line Code	1040 kbps 2B1Q full duplex
HDSL Output	+13.5 dBm ±0.5 dB at 135 Ω
Maximum Provisioning Loss	35 dB at 260 kHz, 135 Ω
Line Clock rate	Internal “Stratum 4” clock
HDSL Start-up Time	30 seconds (typical), 60 seconds (maximum) per span
One-way G.703 Delay	<200 µs per span without doublers; doubler delay <80 µs
G.703 Line Impedance	75 Ω (List 5E), 120 Ω (List 6E)
G.703 Pulse Output	2.3 V ± 10% (@ 75 Ω), 2.7 V ± 10% (@120 Ω)
G.703 Input Level	+1.5 to -7.5 dBDSX
G.703 Line Rate	2.048 Mbps ±200 bps
G.703 Line Format	HDB3
G.703 Frame Format	Unframed only
Maximum Heat Dissipation	5 W (without doubler), 7 W (with doubler) typical
Fusing	Internal; connected to “FUSE ALARM” output on pin H
HDSL Span Voltage	-140 Vdc to ± 112 Vdc
Margin Indicator	Displays HDSL span SNR margin for both HDSL spans relative to 10^{-7} BER operation
Electrical Protection	Secondary surge and power cross protection on HDSL ports; requires external primary protection
Operating Temperature	-40 °F to +158 °F (-40 °C to +70 °C)
Operating Humidity	5% to 95% (non-condensing)
Mounting	STS high-density slot
Dimensions	
Height:	4.75 in (12.1 cm)
Width:	0.625 in (1.59 cm)
Depth:	10 in (25.4 cm)
Weight:	8 oz (.23 kg)
Wander (Looped)	0.3 UI maximum (1 UI = 648 ns)
WB Jitter (Looped)	0.2 UI maximum
NB Jitter (Looped)	0.1 UI maximum

APPENDIX B - PRODUCT SUPPORT

ADC Customer Service Group provides expert pre-sales and post-sales support and training for all its products.

Technical support is available 24 hours a day, 7 days a week by contacting the ADC Technical Assistance Center (TAC).

Sales Assistance 800.366.3891 extension 73000 (USA and Canada) 952.917.3000 Fax: 952.917.3237	• Quotation Proposals • Ordering and Delivery • General Product Information
Systems Integration 800.366.3891, extension 73000 (USA and Canada) 952.917.3000	• Complete Solutions (from concept to installation) • Network Design and Integration Testing • System Turn-Up and Testing • Network Monitoring (upstream or downstream) • Power Monitoring and Remote Surveillance • Service/Maintenance Agreements • Systems Operation
ADC Technical Assistance Center 800.638.0031 714.730.3222 Fax: 714.730.2400 Email: wsd_support@adc.com	• Technical Information • System/Network Configuration • Product Specification and Application • Training (product-specific) • Installation and Operation Assistance • Troubleshooting and Repair/Field Assistance
Online Technical Support	• www.adc.com/Knowledge_Base/index.jsp
Online Technical Publications	• www.adc.com/library1/
Product Return Department 800.366.3891 ext. 73748 or 952.917.3748 Fax: 952.917.3237 Email: repair&return@adc.com	• ADC Return Material Authorization (RMA) number and instructions must be obtained before returning products.
All 800 lines are toll-free in the USA and Canada.	

APPENDIX C - ABBREVIATIONS

Below is a list of acronyms used throughout this document.

2B1Q	2 Binary, 1 Quaternary
AIS	Alarm Indicator Signal
BPV	Bipolar Violation
CI	Customer Installation
CO	Central Office
CLOC	Customer Local Loopback
CPE	Customer Premises Equipment
CRC	Cyclic Redundancy Check
CREM	Customer Remote Loopback
DDS	Digital Data Service
G.703	E1 Transmission System
ES	Errored Seconds
ESF	Extended Superframe
HCDS	High Capacity Digital Service
HDSL	High-bit-rate Digital Subscriber Line
HDU	HiGain Doubler Unit
HLU	HiGain Line Unit
HRU	HiGain Remote Unit
LOS	Loss of Signal
LOSW	Loss of Sync Word
NLOC	Network Local Loopback
NMA	Network Management and Administration
NREM	Network Remote Loopback
POTS	Plain Old Telephone Service
SF	SuperFrame
SNR	Signal-to-Noise Ratio
STS	Span Termination System
UAS	Unavailable Seconds

CERTIFICATION AND WARRANTY

CISPR-A COMPLIANCE

This unit complies with the limits for CISPR-A for radiated emissions. 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, can 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.

Refer to the installation section of the appropriate instruction manual for the unit you are installing to get information on cabling, correct connections and grounding

UL COMPLIANCE

The ELU-319 List 5E and List 6E is listed with the Underwriters Laboratories and meets all applicable Canadian safety standards of the CUL mark.

LIMITED WARRANTY

ADC DSL Systems, Incorporated (“ADC”) warrants that, for a period of sixty (60) months from the date of shipment, the hardware portion of its products will be free of material defects and faulty workmanship under normal use. ADC's obligation, under this warranty, is limited to replacing or repairing, at ADC's option, any such hardware product which is returned during the 12-month warranty period per ADC's instructions and which product is confirmed by ADC not to comply with the foregoing warranty.

ADC warrants that, for a period of 90 days from the date of purchase, the software furnished with its products will operate substantially in accordance with the ADC published specifications and documentation for such software. ADC’s entire liability for software that does not comply with the foregoing warranty and is reported to ADC during the 90-day warranty period is, at ADC’s option, either (a) return of the price paid or (b) repair or replace of the software. ADC also warrants that, for a period of thirty (30) days from the date of purchase, the media on which software is stored will be free from material defects under normal use. ADC will replace defective media at no charge if it is returned to ADC during the 30-day warranty period along with proof of the date of shipment.

The transportation charges for shipment of returned products to ADC will be prepaid by the Buyer. ADC will pay transportation charges for shipment of replacement products to Buyer, unless no trouble is found (NTF), in which case the Buyer will pay transportation charges.

ADC may use reconditioned parts for such repair or replacement. This warranty ***does not*** apply to any product which has been repaired, worked upon, or altered by persons not authorized by ADC or in ADC's sole judgment has subjected to misuse, accident, fire or other casualty, or operation beyond its design range.

Repaired products have a 90-day warranty, or until the end of the original warranty period—whichever period is greater.

ADC DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WITH RESPECT TO ITS PRODUCTS AND ANY ACCOMPANYING WRITTEN MATERIALS. FURTHER, ADC DOES NOT WARRANT THAT SOFTWARE WILL BE FREE FROM BUGS OR THAT ITS USE WILL BE UNINTERRUPTED OR REGARDING THE USE, OR THE RESULTS OF THE USE, OF THE SOFTWARE IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY OR OTHERWISE.

MODIFICATIONS

Any changes or modifications made to this device that are not expressly approved by ADC Telecommunications, Incc. may void the user's warranty.

All wiring external to the products should follow the provisions of the current edition of the National Electrical Code.

STANDARDS COMPLIANCE

The ELU-319 List 5E and List 6E has been tested and verified to comply with the applicable sections of the following international standard: EN-60950. Low Voltage Directive.

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DOCUMENT: 150-319-205-05, ISSUE 5
1218231