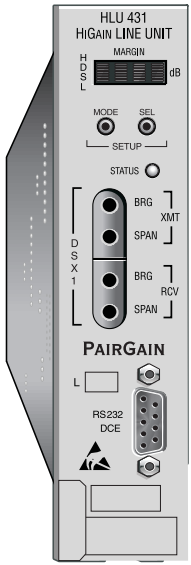
HiGain Line Unit

Quick Installation Guide

Model	List Number	Part Number
HLU-431	1F	150-1504-16



PairGain Technologies, Inc.
Engineering Services

Section 350-431-116-01

PairGain

Revision History of This Practice

Revision	Release Date	Revisions Made
01	January 8, 1999	Initial release

USING THIS TECHNICAL PRACTICE

Two types of messages, identified by icons, appear in the text.

Notes contain information about special circumstances.

Cautions indicate the possibility of equipment damage or the possibility of personal injury.

If you have comments or questions about this Technical Practice, you can send email to *technical_publications@pairgain.com*. Type the product name and section number of the document in the subject area of the email message.

INSPECTING SHIPMENT

Upon receipt of the equipment:

- Visually inspect it for any signs of shipping damage. Immediately report any damage to the shipping agent.
- Check the packing list to ensure complete and accurate shipment of each listed item. If the shipment is incomplete or inaccurate, contact PairGain as described in the "Certification and Warranty" on page 25. If you must store the equipment for a prolonged period, store the equipment in its original container.

TABLE OF CONTENTS

PRODUCT OVERVIEW

The PairGain® HiGain® Line Unit Model HLU-431 List 1F is the Central Office (CO) side of a repeaterless T1 transmission system and is used in conjunction with the HiGain Remote Unit (HRU) to provide a complete HiGain High-bit-rate Digital Subscriber Line (HDSL) system.

This guide addresses HLU-431 List 1F operation when used with and without doublers. For applications without doublers, the HLU-431 List 1F is directly connected to the HRU by the two cable pairs. For doubler applications, one doubler may be used in the HDSL loops between the HLU-431 List 1F and the HRU.

Figure 1 on page 2 shows the front panel of the HLU-431 List 1F. Table 2 on page 3 identifies front panel features.

FEATURES

- 784 kbps full duplex 2BIQ HDSL transmission on two pairs
- Selectable DS-1 pre-equalizer
- Front panel HDSL S/N margin display
- Front panel status LED
- Selectable loopback voltage
- RS-232 Craft port
- Low voltage (140V) doubler application
- Shelf management interface

COMPATIBILITY

The HLU-431 mounts in the HiGain Remote Enclosure (HRE) or HiGain Universal Enclosure (HUE) shelves listed below. The HLU-431 slot pins are shown in Figure 2 on page 4.

- HRE-420, Single-slot indoor
- HRE-422, Dual-slot indoor

- HRE-425, Twelve-slot indoor
- HRE-450, Single-slot outdoor
- HRE-454, Four-slot outdoor
- HUE-443, three-slot indoor

PRODUCT DESCRIPTION

Figure 1 shows the front panel of the HLU-431 List 1F, and Table 2 on page 3 describes the various front panel functions. Table 2 on page 3 describes the LED functions.

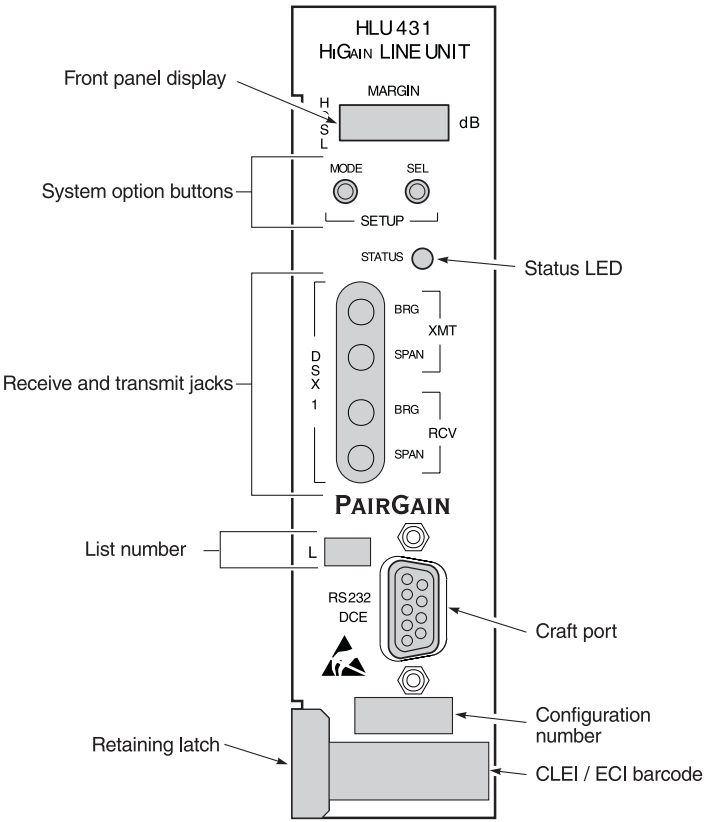


Figure 1. *HLU-431 List 1F Front Panel*

Table 1. *Front Panel Features*

Features	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 DS-1 line parameters and line unit identity.
Status LED	See Table 2 for status descriptions.
Receive and transmit jacks	
SPAN	Provides splitting jack access to (XMT) and from (RCV), the HDSL span at the DSX-1 interface. Breaks the XMT and RCV paths to permit test signal insertion and retrieval.
BRG	Provides non-intrusive bridging jack access to (XMT) and from (RCV), the HDSL span at the DSX-1 interface. Allows the two T1 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.
CLEI and ECI bar code label	Provides the human-readable Common Language Equipment Identifier (CLEI) code number and the Equipment Catalog Item (ECI) bar code number.
List Number	Displays the version of the software that relates to the product.
Configuration Number	Contains either a five 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, 5, and 6 = Configuration number

Table 2. *Status LED States*

State	Description
Green	Normal Operation.
Flashing Green	HDSL Acquisition.
Flashing Red	Minor Alarm.
Red	FUSE ALRM.
Yellow	Self Test in progress or an HLU-431 List 1F loopback in effect (CREM) or (NLOC).
Flashing Yellow	The HLU-431 List 1F is in an ARMED (pre-loopback) state.

Figure 2 shows the card-edge connector pinouts.

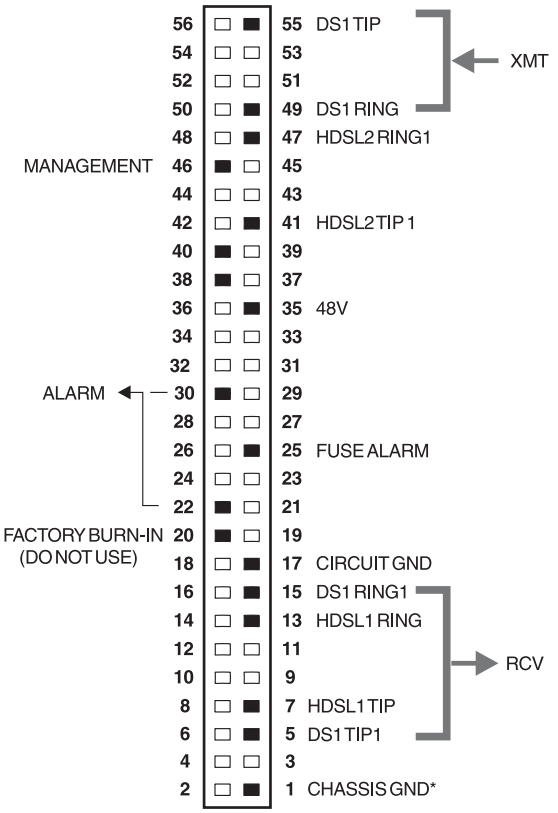


Figure 2. *Card-edge Connector Pinouts*

INSTALLATION

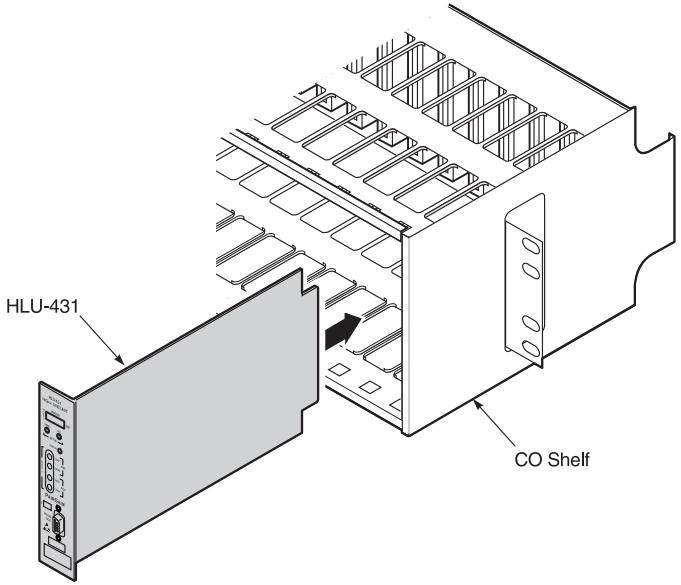


Figure 3. *Installing the HLU-431 List 1F*

To install the HLU-431 into a shelf:

1 Slide the unit into the shelf card guides for the desired slot.

2 Push the unit in until it touches the backplane card-edge connector and the retaining latch on the front panel opens.

3 Place your thumbs on the HLU-431 front panel and push the card into the card-edge connector until the unit is within the card guides and properly seated.

HDSL LINE VOLTAGE OPERATION

The HDSL line voltage is set to 0V on Loop 2 and to -140V on Loop 1. This setting keeps the HDSL cable pair voltage at or below ground potential, thereby avoiding corrosion problems that may be caused by cable voltages more positive than ground.

For both doubler and non-doubler applications, this setting also allows the HLU-431 List 1F to power single doubler circuits without exceeding 140V line voltage. This is required when, for example, the HLU-431 List 1F is used with Positron HDSL dc/ac convertor circuits to provide high voltage isolation between the cable pairs and the HLU-431 List 1F. Such an application occurs when HiGain is the transport system between utility company power substations which must be isolated from the cable pair to avoid damage from Ground Potential Rise (GPR) faults.

PROVISIONING

The HLU-431 List 1F contains a non-volatile RAM (NVRAM) which stores the system option settings. Use the front panel MODE and SEL buttons or a PC connected to the Craft port to set the system options. All system options are retained if shelf power is lost or if the HLU-431 List 1F is unplugged. Table 3 on page 9 lists the system options for the HLU-431 List 1F.

USING THE SEL AND MODE FRONT PANEL BUTTONS

To provision the HLU-431 List 1F through the SEL and MODE front-panel buttons:

1 Press the MODE button for approximately 1 second. 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 of the parameter being displayed.

3 Press the MODE button to select the desired parameter and move to the next parameter. After you have configured the last parameter, the display prompts you to confirm the settings.

4 Do one of the following:

- Press the SEL button to install the settings.
- Press the MODE button to bypass the settings.

If neither button is pressed in 30 seconds, the settings are bypassed.

DEFAULT SETTINGS

To return the system options back to the original factory default settings:

1 Press the SEL button until the DFLT NO message appears.

2 Press the SEL button again. DFLT YES displays indicating the factory default values are now in effect.

To terminate the DFLT mode without setting the factory default values, press the MODE button or do nothing for 30 seconds.

USING THE CRAFT PORT

The Craft port, a 9-pin RS-232 connector, on the HLU-431 front panel allows you to use a standard RS-232 cable to connect your system to a maintenance terminal or PC running a terminal emulation program. Once connected you can access the maintenance, provisioning, and performance screens.

To provision the HLU-431 through the Craft port:

1 Configure the maintenance 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, deselect *Show Scroll Bars* and *Use Function*, *Arrow*, and *Ctrl Keys for Windows*.

2 Use a serial cable to connect the RS-232 COM port on the maintenance terminal to the HLU-431 front panel Craft port.

3 On each screen, enter the key represented by the letter in parenthesis for the parameter to be changed.

- Each entry of this letter scrolls the parameter to its next value.
- After all selections have been made, press E to exit and C to confirm the changes. This activates the new choices and returns control to the Main Menu screen.

The following user options cannot be set from the front panel buttons: Circuit ID, DS0 Blocking, and Margin Alarm Threshold.

SYSTEM OPTIONS SETTINGS

Table 3. *HLU-431 List 1F System Options*

Mode	Selection	Description
EQL	0 [(a)]	Sets the equalizer to DSX-1 for 0 - 133 feet.
	133	Sets the equalizer to DSX-1 for 133 - 266 feet.
	266	Sets the equalizer to DSX-1 for 266 - 399 feet.
	399	Sets the equalizer to DSX-1 for 399 - 533 feet.
	533	Sets the equalizer to DSX-1 for 533 - 655 feet.
ZBTS	ON	Tells HiGain that the ESF frame is operating in its ZBTSI mode.
	OFF [(a)]	Tells HiGain that the ESF frame is operating in its normal non-ZBTSI mode.
ESAL	17	Activates the alarm input signal to the LITESPAN microprocessor and flashes the red STATUS LED when 17 Errored Seconds (ES) (17 HDSL CRC errors on either HDSL loop or a total of 17 BPVs and FERR) occur within a 24-hour period.
	170	Activates the alarm input signal to the LITESPAN microprocessor and flashes the red STATUS LED when 170 ES (170 HDSL CRC errors on either HDSL loop or a total of 170 BPVs and FERR) occur within a 24-hour period.
	NONE [(a)]	Prevents generation of an alarm due to excessive Errored Seconds.
ALM	DIS [(a)]	Disables assertion of the Alarm input signal to the LITESPAN processor from the HLU processor. The HDSL LED still flashes red for an alarm condition even when the ALM DIS option is chosen.
	ENA	Enables assertion of the Alarm input signal to the LITESPAN processor from the HLU processor.
DS0	BLK	The DS0 blocking option can only be set through the RS-232 maintenance port with a terminal. The four-character HLU-431 List 1F front panel LED readout for BLK indicates at least one channel is blocked.
	NONE [(a)]	No channels are blocked.

Table 3. *HLU-431 List 1F System Options (Cont.)*

Mode	Selection	Description
LBTO	NONE	Disables automatic time-out cancellation of all loopbacks.
	20	Sets automatic cancellation of all loopbacks to 20 minutes after initiation.
	60 [a]	Sets automatic cancellation of all loopbacks to 60 minutes after initiation.
	120	Sets automatic cancellation of all loopbacks to 120 minutes after initiation.
LPBK	DIS	Configures the HLU-200 to ignore the 2-in-5 SmartJack loopback command.
	ENA [a]	Enables the HLU-200 to respond to the 2-in-5 SmartJack loopback command.
SPLB	GNLB [a]	Configures the HiGain system to respond to the generic (3/4/5/6-in-7) in-band loopback (GNLB) codes.
	A1LB and A2LB	Configures the HiGain system to respond to the Teltrend addressable repeater in-band loopback codes.
	A3LB	Configures the HiGain system to respond to the Wescom addressable repeater in-band loopback codes.
	A4LB	Configures the HiGain system to respond to the Wescom Mod 1 addressable repeater in-band loopback codes.
	A5LB	Configures the HiGain system to respond to the Teltrend Mod 1 addressable repeater in-band loopback codes.
PWRF	DIS	Disables powering to the HRU or doubler over the HDSL pairs.
	ENA [a]	Enables powering to the HRU or doubler over the HDSL pairs.
DS1	B8ZS	Places both the HLU and HRU into their B8ZS modes.
	AMI [a]	Places both the HLU and HRU into their AMI modes.
	AUTO	The HLU and HRU independently monitor their incoming T1 bit streams for the B8ZS pattern. If either unit detects this pattern, it enters its B8ZS mode.

Table 3. *HLU-431 List 1F System Options (Cont.)*

Mode	Selection	Description
FRMG	AUTO (a)	Configures HiGain to operate in an auto-framing (AUTO) mode in which it continuously searches the input T1 bit stream for a valid SF or ESF frame pattern. This feature is required for fractional T1 applications (DS0 blocking) where it ensures proper channel time slot alignment. While HiGain can also process unframed data in this AUTO mode, it is recommended that the UNFR mode be used for all unframed applications. Using the AUTO mode for unframed applications runs the risk of detecting pseudo-valid frame sequences, which can affect the data integrity.
	UNFR	Configures HiGain to operate in an unframed mode. This mode disables the auto framing process and forces HiGain to function as a transparent bit pipe.
HAIS	2LP (a)	Causes HiGain to transmit the AIS signal at both the HLU and HRU T1 output ports when both of the HDSL loops are not in sync (LOSW).
	1LP	Causes HiGain to transmit the AIS signal at both the HLU and HRU T1 output ports when either of the two HDSL loops is not in sync (LOSW) or if a minor alarm occurs.
SAIS	ENA (a)	Causes the HRU to transmit the AIS signal towards the CI when in NREM loopback.
	DIS	Prevents the AIS signal from being transmitted to the NI and replaces it with the network test signal in the HRU List 6 and 8 or by a quiet termination (LOS) in the HRU List 7.
MARG	0 to 15 dB	The Margin Alarm Threshold determines the minimum allowable margin below which an alarm will occur.
	4 (a)	Default value.
CONF	YES	Confirms that all operating modes (listed in this table) are to be updated to their current selections.
	NO (a)	Prevents the most recently selected operating mode selections from being updated. They remain as they were before the system options settings mode was entered.

(a) Factory default settings.

TESTING

The HLU-431 List 1F four-character front panel display has many useful system diagnostic messages. These messages are listed in Table 4 through Table 7. This display turns on when power is initially applied to the HLU-431 List 1F. To conserve power, the display only remains on for 5 minutes if neither the MODE or SEL buttons are pressed. The use of either button activates the four-character display and restarts the 5-minute power-control timer.

DOUBLER APPLICATIONS

The low voltage limit (140V) of the HLU-431 HDSL power supply limits its doubler applications to just one doubler. It can power one doubler and one remote unit if the doublers are one of the following: HDU-404, HDU-407 or HDU-409. The remote must be an HRU-402. If any other HiGain doublers or remote units are used, then the remote unit must be locally powered.

ALARMS

Only one alarm can be displayed at a time on the front panel display, therefore, only the highest priority alarm is displayed if more than one alarm exists. The following table lists the alarms in order of priority.

Table 4. *Status Menu Alarm Messages*

Message	Full Name	Description
ALRM	Alarm Condition Exists	A system alarm condition is in effect.
LLOS	Local Loss of Signal	No signal at the HLU-431 List 1F local T1 interface.
RLOS	Remote Loss of Signal	No signal at the HRU remote T1 interface.
LOSW	Loss of Sync Word	HDSL Loop 1 or 2 has lost sync.
H1ES or H2ES	HDSL Loop 1 or 2 Errored Second	Loop 1 or 2 CRCs have exceeded the user selected ES threshold.
DS1	Digital Service 1	DS1 input BPVs at the HRU have exceeded the user selected ES threshold.
RAIS or LAIS	Remote Alarm Indicating Signal	Indicates an AIS pattern of all ones is being transmitted from the remote or T1 output port.
MAL1 or MAL2	Margin Alarm 1 or 2	The margin on HDSL Loop 1 or 2 has dropped below the threshold (1 to 15 dB) set by the user.
CHREV	Channels Reserved	The Loop 1 and 2 HDSL pairs are reversed at the HRU input port. Loop 1 is specified to carry the (-) simplex dc voltage, and Loop 2 is specified to carry the (+) simplex dc voltage.
ACO	Alarm Cut-off	A minor alarm occurred and was retired to an ACO condition after pressing the SEL button on the HLU front panel.

LOOPBACKS

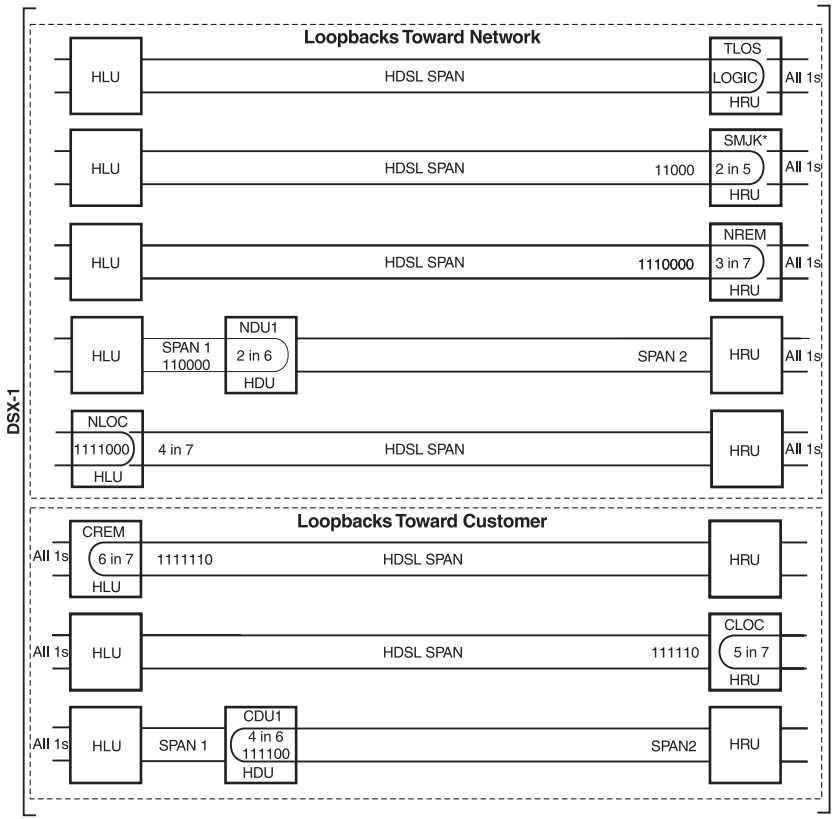
The HLU-431 List 1F loopback messages are listed in the following tables. A block diagram showing the GNLB locations and their activation codes are shown on page 13.

Table 5. *Status Menu Loopback Messages (with and without Doublers)*

Message	Full Name	Description
SMJK	SmartJack Loopback	Loopback at HRU (remote) toward the Channel Bank Assembly (CBA) initiated by either the (2-in-5) in-band loopback code or the out-of-band ESF data link code.
NREM	Network Remote Loopback	Loopback at HRU (remote) toward the CBA initiated by upstream in-band codes or from the maintenance terminal.
NLOC	Network Local Loopback	Loopback at HLU (local) toward the CBA initiated by upstream in-band codes or from the maintenance terminal.
CLOC	Customer Local Loopback	Loopback at HRU (local) toward CI initiated from CPE (customer) by in-band codes or from the maintenance terminal.
CREM	Customer Remote Loopback	Loopback at HLU (remote) toward customer initiated from CPE (customer) by in-band codes or from the maintenance terminal.
ARM	Armed	The HiGain system detected the IR loopback (2-in-5) arming code.
TLOS	Transmit Loss of Signal (Loopback)	HRU is in a logic loopback state caused by a loss of its T1 input from the CI, if enabled at the HRU by its TLOS switch option.

Table 6. *Status Menu Loopback Messages: (Doublers Only)*

Message	Full Name	Description
NDU1	Network Doubler 1 Loopback	The loopback at doubler 1 toward the CBA initiated by in-band codes, or the maintenance terminal.
CDU1	Customer Doubler 1 Loopback	The loopback at doubler 1 toward CI initiated by in-band codes or the maintenance terminal.



* Set the SAIS option to ENA to send the all ones pattern to the CI during Smart-Jack loopback. Use the 3-in-5 code to loop down.

Figure 4. *Loopback Functions*

FOUR-CHARACTER DIAGNOSTIC MESSAGES

The HLU-431 diagnostic messages are listed in the table below.

Table 7. *Four-Character Front Panel Messages*

Message	Full Name	Description
FERR	Framing Bit Error Occurred	Framing bit error occurred at HLU T1 input.
LBPV	Local Bipolar Violation	A bipolar violation has been received at the T1 input to the HLU-319.
SIG 1 or 2	Signal 1 or Signal 2	The HLU and HRU or first HDU transceivers are trying to establish contact with each other on Loops 1 or 2 of Span 1.
S2L1 or 2 [(a)]	Signal 2 Loop or Loop 2	The first Doubler and the HRU 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 HLU and HRU or first HDU multiplexers are trying to establish synchronization over each of Loops 1 or 2 of Span 1.
A2L1 or 2 [(a)]	Acquisition 2 Loop 1 or Loop 2	The first HDU and the HRU multiplexers are trying to establish synchronization with each other on Loops 1 or 2 of Span 2.
ACO	Alarm CutOff	A minor alarm has occurred, and been retired to an ACO condition, by pressing the SEL button on the HLU front panel.
Self Test		The HLU is in a self-test mode. This occurs every power ON/OFF cycle.
ALRM	Alarm Condition Exists	A minor 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 in Span 1. This same message can occur with an HRU that is drawing the correct amount of power over good cable pairs but cannot communicate with the HLU.
PWR FEED OPEN	Power Feed Open	Indicates an open circuit in the Tip and Ring of either HDSL pair in Span 1.

Table 7. *Four-Character Front Panel Messages (Cont.)*

Message	Full Name	Description
PWR FEED OFF	Power Feed Off	HDSL span power has been turned off by setting the PWRF option to DIS.
BAD RT?	No response from HRU	The HLU does not receive any response from the HRU. Thus, the HRU's integrity is questionable.
VER	HLU Software Version #	Displays during the System Settings review mode. Depress the MODE button for 3 seconds to view the software version.
LIST 0xL	HLU's List #	Displayed during System Settings review mode defined above.
FRM	Frame: SF, ESF, UNFR, NONE	Defines the type of frame pattern being received from the DSX-1. Displayed during System Settings mode defined above.
CODE	Line Code: AMI, B8ZS	This is the line code that HLU-431 List 1F is receiving at its DSX-1 interface. Displayed during System Setting review mode.
DS0	DS0 Blocked Channels	Indicates status of DS0 blocked channels. NONE indicates no channels are blocked. BLK indicates some channels are blocked.
MNGD	Managed	The HLU-431 List 1F is under control of the HMU network management unit. In this state, the RS-232 Craft port on the HLU-431 front panel is inoperative.

(a) These messages only apply to systems with doublers present.

POSITRON HIGH-VOLTAGE ISOLATION APPLICATIONS

Since the HLU-431 List 1F restricts its output voltage to 140V for all applications including doublers, it can be used with Positron High Voltage Protection (HVP) equipment. This equipment consists of High Voltage HDSL isolation transformers and dc-to-dc converters located in external High Voltage Interface (HVI) cabinets. The two HLU HDSL pairs are routed into the HIV cabinet where each terminates into a two-wire HDSL transformer card. The HDSL-simplexed line voltage is accessed at the center taps of these two transformers and then applied to a dc-to-dc converter circuit. The converter creates an identical, but isolated, output voltage that is

reinserted onto the outgoing HDSL pairs through a holding coil and then sent on to power the doubler. This equipment is used to provide high voltage metallic isolation between the HLU and the cable network. Such isolation is required when the HLU can be exposed to Ground Potential Rise (GPR) faults that can occur. For example, if the HLU is located in a power utility substation or on a high voltage tower. The maximum input voltage that the dc-to-dc converter can tolerate is 150V which makes it compatible with the HLU-431 List 1F whose maximum output voltage is 140V. For more information on the HDSL-compatible HVP equipment, contact Positron at 303-688-5800.

Although compatible with HiGain, the placement of Positron equipment in HiGain HDSL circuits does slightly degrade circuit margins. To ensure an adequate margin under all operating conditions, PairGain recommends that the maximum range of HiGain spans that contain Positron DC isolation equipment be reduced from 35 dB to 31 dB.

APPENDIX A: SPECIFICATIONS

Maximum Power Consumption	14W (without doubler); 18W (with doubler)
Maximum Heat Dissipation	6W (without doubler); 7W (with doubler)
Mounting	400 mechanics
Dimensions	
Height:	5.6 inches (14 cm)
Width:	1.4 inches(3.5 cm)
Depth:	5.6 inches (14 cm)
Weight:	1 lb. 2 oz. (.51 kg)

APPENDIX B: SERVICE AND SUPPORT

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

TECHNICAL SUPPORT

Technical assistance is available 24 hours a day, 7 days a week by contacting PairGain Customer Service Group at:

Telephone:	(800) 638-0031 or (714) 832-9922 The 800 telephone support line is toll-free in the U.S. and Canada.
Fax:	(714) 832-9924
Email	support@pairgain.com

During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday through 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.

BBS

In addition, PairGain maintains an on-line Bulletin Board System (BBS) for obtaining current information on PairGain products, product troubleshooting tips and aids, helpful utilities, and for posting requests or questions. This system is available 24-hours a day by calling (714) 730-2800. You can access the BBS if you have a Hayes-compatible modem with a 2400 to 28,800 baud rate. The following setup format is required: 8 Data Bits, No Parity, 1 Stop Bit.

World Wide Web

PairGain product and company information can be found at *http://www.pairgain.com* using any Web browser.

For firmware updates, click the "Firmware" icon on the PairGain home page, enter your password and select the type of firmware you wish to upgrade.

Returns

To return equipment to PairGain:

1 Locate the number of the purchase order under which the equipment was purchased. You will need to provide this number to PairGain Customer Service to obtain a return authorization.

2 Call or write PairGain Customer Service to ask for a Return Material Authorization (RMA) number and any additional instructions. Use the telephone or fax number listed below:

- Telephone: 800) 370-9670
- Fax: (714) 730-2961

3 Include the following information, in writing, along with the equipment you are returning:

- Company name, address, and the name of a person PairGain can contact regarding this equipment.
- The purchase order number provided to Customer Service when the RMA number was requested.
- A description of the equipment, as well as the number of units that you are returning. Be sure to include the model and part number of each unit.
- The shipping address to which PairGain should return the repaired equipment.
- The reason for the return, for example:

  The equipment needs an ECO/ECN upgrade.

  The equipment is defective.

If the equipment is defective, please tell us what you observed just before the equipment malfunctioned. Be as detailed in your description as possible.

4 Pack the equipment in a shipping carton.

5 Write PairGain's address and the Return Material Authorization Number you received from Customer Service clearly on the outside of the carton:

PairGain Technologies, Inc.
14352 Franklin Ave.
Tustin, CA 92780-7013

Attention: **CRF RMA (Number)**

FCC and warranty information can be found on the inside back cover of this manual.

APPENDIX C: ABBREVIATIONS

2B1Q	2 Binary, 1 Quartenary
ACO	Alarm Cut-Off
ALM	Alarm
B8ZS	Bipolar with Eight Zero Substitution
BVP	Bipolar Violation
CBA	Channel Bank Assembly
CI	Customer Interface
CLEI	Common Language Equipment Interface
CO	Central Office
COM	Communications
CPE	Customer Premises Equipment
CRC	Cyclical Redundancy Check
DS0	Digital Signal Level 0
DSX-1	DS-1 Cross-connect frame
ECI	Equipment Catalog Item
ES	Errored Seconds
ESF	Extended Superframe
GNLB	Generic Loopback
GPR	Ground Potential Rise
HDSL	High-bit-rate Digital Subscriber Line
HDU	HiGain Doubler Unit
HUE	HiGain Universal Enclosure
HLU	HiGain Line Unit
HMS	HiGain Management Shelf
HMU	HiGain Management Unit
HRE	HiGain Remote Enclosure
HRU	HiGain Remote Unit
HVI	High Voltage Interface
HVP	High Voltage Protection
LED	Light Emitting Diode
LLOS	Local Loss of Signal
LOS	Loss of Signal
LOSW	Loss of Sync Word
MAL	Margin Alarm
MNGD	Managed
NVRAM	Non-volatile Random Access Memory
RLOS	Remote Loss of Signal
RCV	Receive
ZBTS	Zero Byte Timeslot

CERTIFICATION AND WARRANTY

FCC COMPLIANCE

This unit complies 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, 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 this manual for guidance on: Cabling, correct connections, grounding.

WARRANTY

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 correct customer installation and regular maintenance. PairGain will repair or replace at Pairgain's option any unit without cost during this period if the unit is found to be defective for any reason other than abuse or incorrect use or installation.

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.

If a unit needs repair, call PairGain for a Return Material Authorization (RMA) number and return the defective unit, freight prepaid, along with a brief description of the problem, to:

PairGain Technologies, Inc.
14352 Franklin Avenue
Tustin, CA 92780
ATTN: Repair and Return Dept.
(800) 638-0031

Refer to the instructions under "Returns" on page 21 for complete return instructions.

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

MODIFICATIONS

Any changes or modifications made to this device that are not expressly approved by PairGain Technologies, Inc. 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.

For technical assistance, refer to "Appendix B: Service and Support" on page 20.

Corporate Office
14402 Franklin Avenue
Tustin, CA 92780
Tel: (714) 832-9922
Fax: (714) 832-9924

For Technical Assistance:
(800) 638-0031

ISO 9001
DNV
DNV Certification, Inc.
Certificated Firm

PAIRGAIN