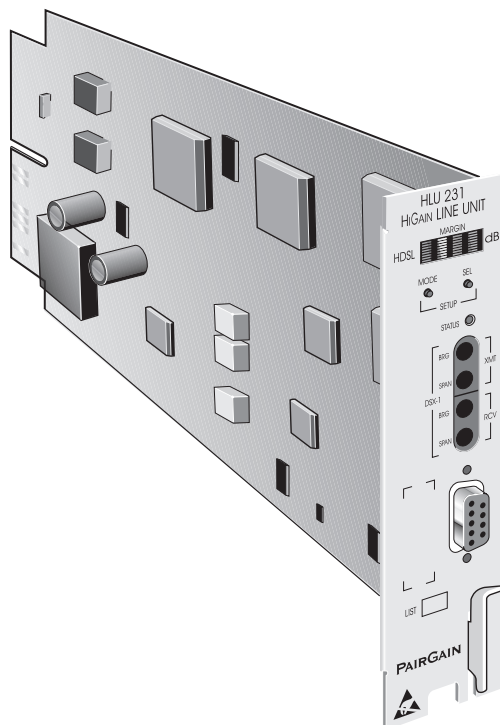


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# HIGAIN LINE UNIT

## QUICK INSTALLATION GUIDE

Model	List Number	Part Number	CLEI Code
HLU-231	7E	150-1111-75	T1L2KSXAAA



**PAIRGAIN TECHNOLOGIES, INC.**  
**ENGINEERING SERVICES TECHNICAL PRACTICE**



**SECTION 350-231-175-01**

## Revision History of This Practice

Revision	Release Date	Revisions Made
01	September 15, 1998	Initial Release

## USING THIS MANUAL

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.**

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# INTRODUCTION

The PairGain® HiGain® HLU-231 List 7E is the Central Office (CO) side of a repeaterless, T1 transmission system. When used in conjunction with a HiGain remote unit (HRU), the system provides 1.544 Mbps transmission on two unconditioned copper pairs over the full Carrier Service Area (CSA) range. This line unit can be used in applications with or without HDUs.

The CSA includes loops up to 12,000 feet of 24 AWG or 9,000 feet of 26 AWG wire, including bridged taps. The HiGain system uses HDSL transmission technology as recommended by Bellcore TA-TSY-001210. The HiGain system complies with GR-63-CORE, TR-TSY-000499, and GR-1089-CORE.

## GROUND FAULT DETECT

The HLU-231 List 7E has been enhanced with a special ground fault-detecting circuit described in paragraph R7-1, Section 7.2.1 of GR-1089-CORE, Issue 1, Revision 1, December, 1996.

Ground faults occurring at any point along any span on any conductor are immediately detected and the HiGain circuit shuts down. The line unit then applies power periodically to the first span to detect the ground fault condition. This power cycling and ground fault protection continues as long as the fault condition exists.

With this feature, the output voltage for the HLU-231 List 7E is as follows:

- The 140V output voltage used in non-doubler unit applications is always unipolar.
- The 200V output voltage used in doubler unit applications is always bipolar.

The specific bipolar voltage levels existing between ground and the two loops for doubler unit applications depend on the following factors:

- loop length
- number of doubler units
- type of doubler units (List x or List xB)
- powering option (local or line) for the HiGain Remote Unit (HRU)

The Ground Fault Detect feature renders the HLU-231 List 7E incompatible with three-span line powering.

## FRONT PANEL FEATURES

[Figure 1](#) shows the HLU-231 Line Unit List 7E front panel features and [Table 1](#) describes their function. [Table 2](#) describes the functions of the Status LED on the front panel.

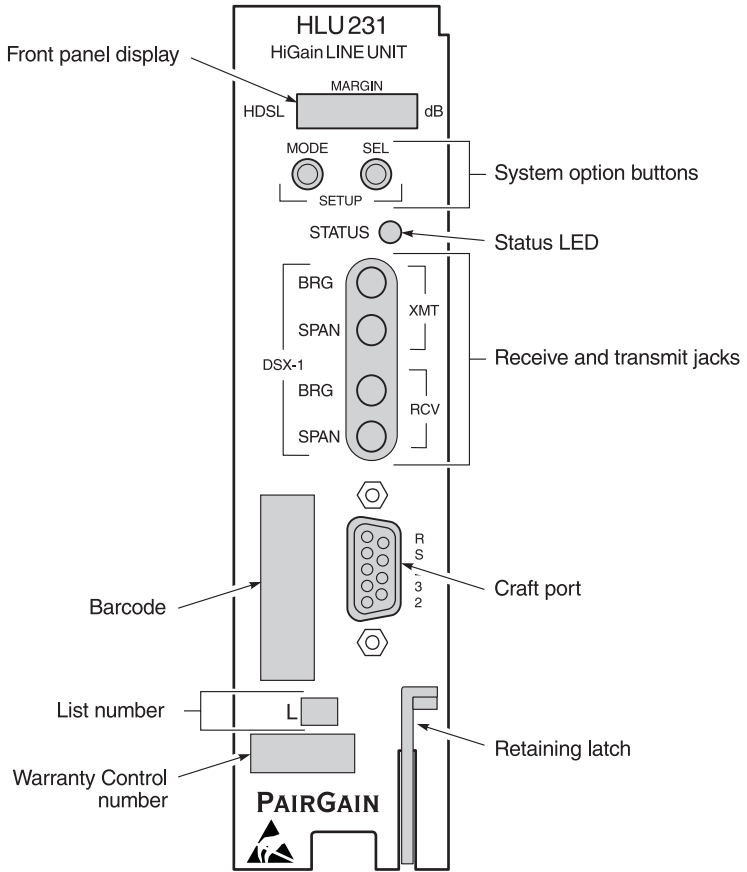


Figure 1. HLU-231 List 7E Front Panel

**Table 1. Front Panel Features**

<b>Front Panel Feature</b>	<b>Function</b>
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 DSX-1 line parameters and line unit identity.
Status LED	See the following table 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.
BRIDGE	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.
Bar code label	Provides the human-readable Common Language Equipment Identifier (CLEI) code number and the Equipment Catalog Item (ECI) bar code number.
Warranty control number	The configuration number is a two or three-digit number that is either the last digits of a 5 or 6-digit warranty control number or is a standalone number of two or three digits. For example, a warranty control number of "80107" would indicate a warranty beginning in the year 1998 (8), during the month of January (01), and the unit's configuration number of 7 (07).
Retaining latch	Secures the HLU-231 to the shelf.



**Table 2. LED Status**

<b>LED Status</b>	<b>Description</b>
Green	Normal operation
Flashing green	HDSL acquisition
Red	Fuse Alarm
Flashing red	System alarm
Yellow	Self Test is in process or an HLU-231 List 7E Customer Remote Loopback (CREM) or a Network Local Loopback (NLOC) is in effect.
Flashing yellow	HLU-231 List 7E is in an Armed state.

## COMPATIBILITY

The HLU-231 List 7E is designed to mount in the following shelves with 220 mechanics:

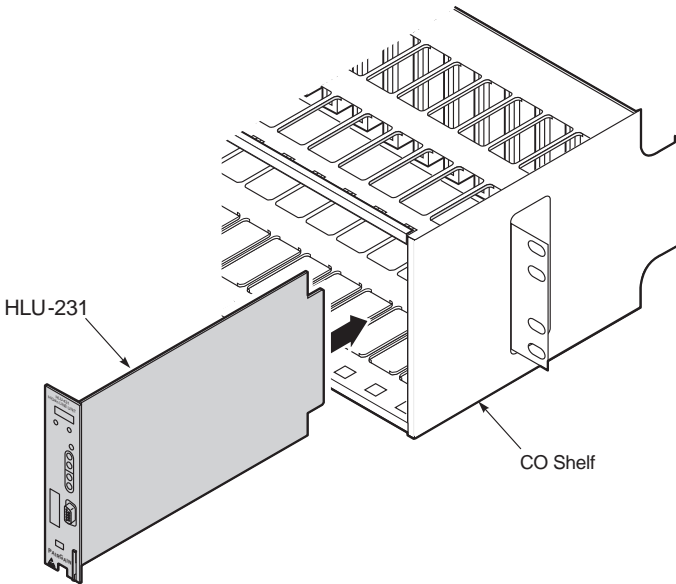
- PairGain HCS-417 (23")
- PairGain HCS-418 (19")
- PairGain HCS-402 (2-slot)
- AT6T 220 Office Repeater Bay (ORB)
- AT6T Small Cross Section Shelf (SXSS)
- Kentrox 220
- Wescom® 342-30

# INSTALLATION

Upon receipt of the equipment, visually inspect the HLU-231 for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to PairGain Technologies (see “[Product Support](#)” on page 21).

## INSTALLING THE HLU-231

To install the HLU-231 into a PairGain shelf, slide the unit into the shelf card guides for the desired slot, then push the unit in until it is entirely within the card guide and the retaining latch locks into place, indicating that the unit is properly seated.

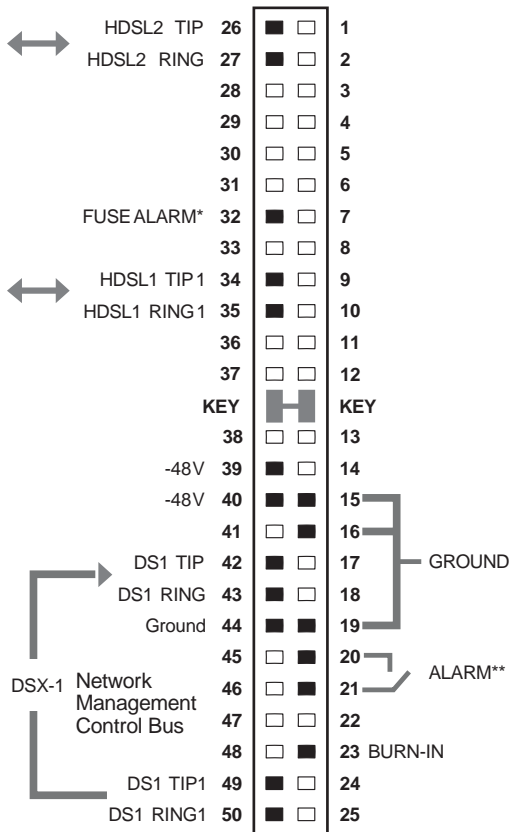


**Figure 2.** *Installing the HLU-231 List 7E*

# HLU-231 CARD-EDGE CONNECTOR

The HLU-231 card-edge connector pinouts are shown in [Figure 3](#).

The HLU-231 uses pins 20 and 21 as alarm-relay output. The Kentrox 220 T-Term shelf uses the same pins for external equalizer output. If the HLU-231 is installed into a Kentrox shelf, the HLU-231 ALM option must be disabled (see [“Provisioning”](#) on page 8 for further information).



\* Fuse alarm is normally floating and at -48V when activated.

\*\* System minor alarm contacts (pins 20 and 21) are normally open and close upon alarm.

**Figure 3.** HLU-231 Card-Edge Connector Pinouts

# PROVISIONING

The HLU-231 List 7E contains a non-volatile RAM (NVRAM) which stores the system option settings. The options are set through the SEL (Select) and MODE buttons on the front panel, or through a terminal connected to the RS-232 interface. System option settings are retained if shelf power is lost or if the HLU-231 List 7E is unplugged.

## SETTING OPTIONS THROUGH SEL AND MODE

To provision the HLU-231 List 7E through the SEL and MODE front-panel buttons:

- 1 Press the MODE button for approximately one 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 (one at a time) 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 their original factory default:

- 1 Press the SEL button until the DFLT NO message appears.
- 2 Press the SEL button again and DFLT YES will be displayed 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.

## CONNECTING TO A MAINTENANCE TERMINAL

The 9-pin RS-232 connector on the HLU-231 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-231 through the RS-232 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



**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 Craft port on the maintenance terminal to the HLU-231 front panel RS-232 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 four user options must be set via the RS-232 Interface: Circuit ID, Time and Date, DS0 Blocking, and Margin Alarm Threshold.

## SYSTEM SETTINGS

The asterisks (\*) in the following system settings descriptions indicate the factory default settings.

*Table 3. System Settings*

Front Panel Display Code	Selection	Description
EQL	EXT*	Removes the Internal Equalizer which is replaced by an External Equalizer.
	0	Sets the Equalizer to DSX-1 for 0 to 133 feet.
	133	Sets the Equalizer to DSX-1 for 133 to 266 feet.
	266	Sets the Equalizer to DSX-1 for 266 to 399 feet.
	399	Sets the Equalizer to DSX-1 for 399 to 533 feet.
	533	Sets the Equalizer to DSX-1 for 533 to 655 feet.
LPBK	DIS	Configures the HiGain system to ignore all in-band SmartJack loopback commands.
	ENA*	Enables the HiGain system to recognize all in-band SmartJack loopback commands.

**Table 3. System Settings (Cont.)**

<b>Front Panel Display Code</b>	<b>Selection</b>	<b>Description</b>
SPLB	GNLB*	Configures the HiGain system to respond to the generic (3/4 in 7) in-band loopback codes.
	A1LB and A2LB	Configures the HiGain system to respond to the in-band loopback codes of the Teltrend addressable repeater.
	A3LB	Configures the HiGain system to respond to the in-band loopback codes of the Wescom addressable repeater.
	A4LB	Configures the HiGain system to respond to the in-band loopback codes of the Wescom Mod 1 addressable repeater.
	A5LB	Configures the HiGain system to respond to the in-band loopback codes of the Teltrend Mod 1 addressable repeater.
PWRF	DIS	Disables powering to the HDSL pair.
	LOW	Keeps the HDSL line voltage at -140V maximum for all applications.
	AUTO*	Allows the HDSL line voltage to automatically switch between -140V maximum for non-doubler applications and $\pm 112V$ for doubler applications.
	HIGH	Forces the HDSL line voltage to $\pm 112V$ for all applications.
ZBTS	ON	Tells the HiGain system that the ESF frame is operating in its Zero-Byte Timeslot Interchange (ZBTSI) mode.
	OFF*	Tells the HiGain system that the ESF frame is operating in its normal non-ZBTSI mode.
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.

**Table 3. System Settings (Cont.)**

<b>Front Panel Display Code</b>	<b>Selection</b>	<b>Description</b>
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.
DS1	AUTO	The HLU-231 List 7E and HRU monitors the incoming HRU T1 bit streams for the Bipolar with 8-Zero Substitution (B8ZS) pattern. If the HRU detects this pattern, the HLU enters its B8ZS mode. It reverts back to its Alternate Mark Inversion (AMI) output mode if no B8ZS patterns are received at the HRU input for five seconds. The HLUs T1 input can detect either AMI or B8ZS when in the AUTO mode.
	B8ZS	Places both the HLU-231 and HRU into their B8ZS modes.
	AMI*	Places both the HLU-231 and HRU into their AMI modes.
FRMG	AUTO*	Configures the HiGain system 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 insures proper channel time slot alignment. While the HiGain system can also process unframed data in this AUTO mode, it is recommended that the unframed (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 the HiGain system to operate in an unframed mode. This mode disables the auto framing process and forces the HiGain system to function as a transparent bit pipe.



**Table 3. System Settings (Cont.)**

<b>Front Panel Display Code</b>	<b>Selection</b>	<b>Description</b>
HAIS	2LP*	Causes the HiGain system to transmit the AIS signal at both the HLU-231 and HRU T1 output ports when both of the HDSL loops are not in sync (LOSW).
	1LP	Causes the HiGain system to transmit the AIS signal at both the HLU-231 and HRU T1 output ports when either of the two HDSL loops is not in sync (LOSW) or if a Margin alarm occurs.
SAIS	ENA*	Causes the List HRU to transmit the AIS signal towards the Customer Interface (CI) when in NREM or SmartJack loopback (see Figure 5).
	DIS	Causes the HRU to either transmit the signal from the network towards the CI RCU port or to open and terminate its RCV CI port when an HRU NREM or SmartJack loopback is executed. The AIS signal is not sent (towards the CI).
DS0	BLK	The DS0 blocking option can only be set via the RS-232 Craft port with a terminal. The four-Character Line Unit front panel only displays the status of the blocking option. BLK indicates at least one channel is blocked.
	NONE*	Indicates no channels are blocked.
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.

# TESTING

Minor alarm and diagnostic messages routinely appear on the HLU-231 front-panel four-character display. This display automatically turns on when power is initially applied to the HLU-231. To conserve power, the display only remains on for five minutes if neither the MODE or SEL buttons are pressed. The use of either button activates the four-character display and restarts the five-minute power-control timer.

# ALARMS

Only one alarm can be displayed at a time, so the highest priority alarm is displayed if more than one alarm exists. [Table 4 on page 15](#) lists the alarms ordered by priority:

**Table 4. Alarm Descriptions**

<b>Message</b>	<b>Full Name</b>	<b>Description</b>
NONE	No Alarms	
LOSW	Loss of Sync Word <sup>a</sup>	One of the HDSL loops has lost synchronization.
LLOS	Local Loss of Signal	Loss of the DSX-1 input signal.
RLOS	Remote Loss of Signal	Loss of the HRU DS1 input signal.
H1ES or H2ES	HDSL Loop 1 Errored Second or HDSL Loop 2 Errored Second	The number of errored seconds (ES) on HDSL Loop 1 or Loop 2 has exceeded the ES threshold value.
DS1	Digital Service 1	Bipolar violations for either the HLU-231 or HRU DS1 input have exceeded the ES threshold value.
R(L)AIS	Remote (Local) Alarm Indication Signal	Indicates that an Alarm Indication Signal of all ones is being transmitted from the remote (local) T1 output port.
MAL1 or 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.
CHREV	Channels Reversed	The Loop 1 and Loop 2 HDSL pairs are reversed at the HDU or HRU line input ports.

- a. When both HDSL loops lose sync word (LOSW), a system alarm condition exists. However, since the HLU-231 enters a self test cycling mode, the front panel LED lights yellow instead of red and the `SELF TEST` message displays instead of the `ALRM` message.

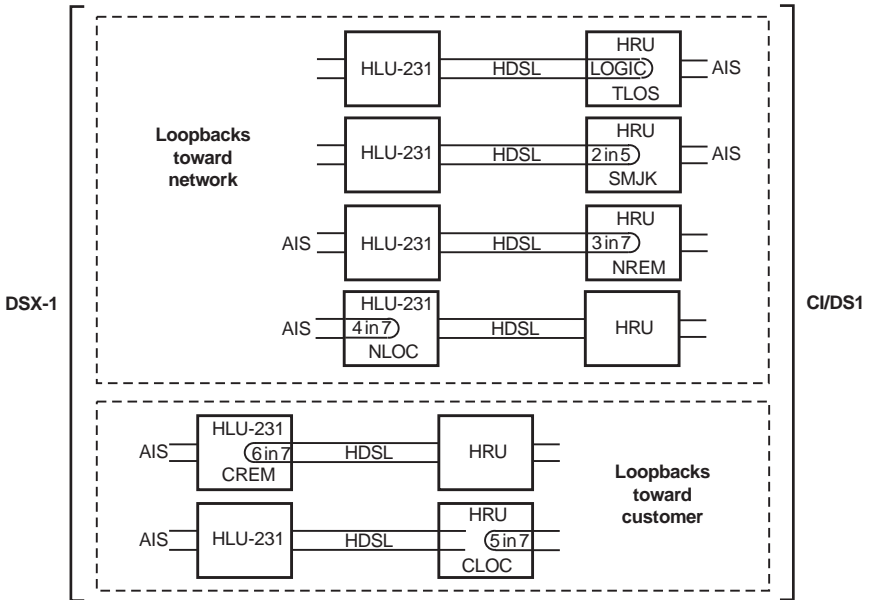
## LOOPBACKS

The HLU-231 loopback messages are listed in [Table 5](#) and [Table 6](#). A block diagram showing the GNLB locations and their activation codes are shown on [Figure 4 on page 17](#).

**Table 5.** *Loopback Messages*

<b>Message</b>	<b>Full Name</b>	<b>Description</b>
SMJK	Smart-Jack Loopback	Loopback at HRU toward the HLU 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 toward the HLU initiated by upstream in-band codes or from the maintenance terminal.
NLOC	Network Local Loopback	Loopback at HLU toward the network initiated by upstream in-band codes or from the maintenance terminal.
NDU $n$	Network Doubler $n$ Loopback	Loopback at Doubler # $n$ to network initiated by IOR code or by Manual Loopback buttons on the HLU-231 List 7E front panel or by the maintenance terminal.
CLOC	Customer Local Loopback	Loopback at HRU toward customer initiated from Customer Premises Equipment (CPE) by in-band codes or from the maintenance terminal.
CREM	Customer Remote Loopback	Loopback at HLU toward customer initiated from CPE by in-band codes or from the maintenance terminal.
CDU $n$	Customer Doubler $n$ Loopback	Loopback at Doubler # $n$ to CI initiated by ILR code, the Manual Loopback buttons on HLU-231 List 7E front panel or by the maintenance terminal.
ARM	Armed	The HiGain system detected the Intelligent Repeater 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 customer, if enabled at the HRU via its TLOS switch option.

Figure 4 illustrates the loopback functions.



**Figure 4.** Loopback Operation

## FOUR-CHARACTER DIAGNOSTIC MESSAGES

The HLU-231 diagnostic messages are listed in [Table 6](#).

**Table 6.** *Four-Character Diagnostic Messages*

<b>Message</b>	<b>Full Name</b>	<b>Description</b>
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.
SIG1 or SIG2	Signal 1 or Signal 2	The HLU & HRU transceivers are trying to establish contact with each other.
S(n)L1 or 2	Signal (n) Loop 1 or Loop 2	The transceivers of a doubler and either the HRU or another doubler are trying to establish contact with each other on loops 1 or 2 of span (n).
H1(2)ES	HDSL CRC Error Channel 1(2)	HLU HDSL Loop 1(2) CRC error.
ACQ1(2)	Acquisition 1(2)	The HLU & HRU multiplexers are trying to establish synchronization over each loop.
A(n) L1 or 2	Acquisition (n) Loop 1 or 2	The multiplexers of a doubler and either the HRU or another doubler are trying to synchronize with each other on loops 1 or 2 of span (n).
ARM	HiGain System ARMED	Armed to respond to Intelligent Repeater Loop Codes.
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.

**Table 6. Four-Character Diagnostic Messages (Cont.)**

<b>Message</b>	<b>Full Name</b>	<b>Description</b>
1=xx or 2=yy	HDSL Loop Margins	Indicates the relative S/N at each HDSL transceiving input port. Any value of '06' or greater is adequate for reliable system operation.
PWR FEED OPEN	Power Feed Open	Indicates an open circuit in the T&R of either HDSL pair.
PWR FEED SHRT	Power Feed Short	Indicates a short between the 2 HDSL pairs in span 1. This same message can occur with an HRU is drawing the correct amount of power over good cable pairs but cannot communicate with the HLU.
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.
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 HRU	The HLU does not receive any response from the HRU. Thus, the HRU's integrity is questionable.
VER	HLU Software Version #	This displayed during the System Settings review mode. Depress the MODE button for three seconds to enter System Settings review mode.
LIST 0xL	HLUs 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.
CODE	Line Code: AMI, B8ZS	This is the line code that the HLU is set to receive and transmit at its T1 interfaces. Displayed during System Settings mode defined above.

# SPECIFICATIONS

## Maximum Power Consumption

The maximum power consumption varies with the type of remote and doubler units on the system and the CPE power setting. See the HLU-231 List 7E Technical Specification (150-231-175-xx) for the maximum power consumption for your system.

## Maximum Heat Dissipation

5 Watts (without doublers), 7 Watts (with doublers)

## Mounting

STS high density slot

## Dimensions

Height:	5.9" (15 cm)
Width:	1.4" (3.5 cm)
Depth:	10" (25.4 cm)

# DOCUMENTATION

The HLU-231 List 7E has a complete technical practice that you can download from the PairGain Technical Manuals Web page at: [www.pairgain.com](http://www.pairgain.com). A password is required. If you do not have a password, contact your PairGain sales representative.

If you have any comments on any PairGain documentation, send mail to [Technical\\_publications@pairgain.com](mailto:Technical_publications@pairgain.com). Type the product name and the section number of the document in the subject area of the email message.



# PRODUCT SUPPORT

This section contains product support and warranty information.

## TECHNICAL SUPPORT

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

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

**Fax:** (714) 832-9924

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.

In addition, PairGain maintains a computer bulletin board system for obtaining current information on PairGain products, product troubleshooting tips and aids, accessing helpful utilities, and for posting requests or questions. This system is available 24 hours a day by calling (714) 730-2800. Transmission speeds up to 28.8 kbps are supported with a character format of 8-N-1.

## 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 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

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

## 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 the appropriate instruction manual for the unit you are installing to get information on:

- Cabling
- Correct connections
- Grounding



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**Corporate Office**

14402 Franklin Avenue  
Tustin, CA 92780

Tel: (714) 832-9922

Fax: (714) 832-9924

**For Technical Assistance:**

(800) 638-0031

