HiGain Line Unit

Quick Installation Guide

Model	List Number	Part Number	CLEI Code
HLU-388	2E	150-1141-25	T1L2BBYAAA

PairGain Technologies, Inc.
Engineering Services Technical Practice

Section 350-388-125-01

PairGain

Revision History of This Practice

Revision	Release Date	Revisions Made
01	June 30, 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.

INSPECTING SHIPMENT

Upon receipt of the equipment:

- Unpack each container and visually inspect it for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to PairGain. 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 PairGain as described in the Warranty. If you must store the equipment for a prolonged period, store the equipment in its original container.

ABBREVIATIONS

AMI	Alternate Mark Inversion
B8ZS	Bipolar with 8 Zero Substitution
CO	Central Office
CSA	Carrier Service Area
ES	Errored Seconds
ESF	Extended Superframe
HDSL	High-bit-rate Digital Subscriber Line
HDU	HiGain Doubler Unit
HLU	HiGain Line Unit
HRU	HiGain Remote Unit
NVRAM	Non-Volatile Random Access Memory
SF	Super Frame
ZBTSI	Zero Byte Time Slot Interface

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PRODUCT OVERVIEW

The PairGain® HiGain® HLU-388 List 2E 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 HiGain doubler units (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 TR-TSY-000063 (Network Equipment Building System (NEBS) Generic Equipment Requirements) and TR-TSY-000499 (Transport System Generic Requirements (TSGR) Common Requirements).

HLU-388 FEATURES

- Selectable DS1 pre-equalizer
- 130 to 200 Vdc HDSL line power for HDU and HRU
- Front panel HDSL Signal-to-Noise margin display
- Compatible with high-density DDM+ shelves
- Selectable loopback activation codes
- RS-232 Craft port for connection to a maintenance terminal
- Compatible with PairGain Management System
- Ground fault detect circuit
- Front panel operator setup
- Lightning and power cross protection on HDSL interfaces
- Full duplex 2B1Q HDSL transmission at 784 kbps on two wire pairs
- Front panel status LED
- On/off power cycling from front panel
- DS1 Loss Of Signal (LOS) detector (125 consecutive 0s)

- Margin threshold alarm
- HDSL Alarm Indicator Signal (AIS) and SmartJack AIS options
- Easily restored factory default settings
- Circuit ID option

COMPATIBILITY

The HLU-388 List 2E is compatible with the following T1 repeater shelves and associated equipment:

- Shelf (23-inch)
  - Larus FT2 1188 (28-slot, connectorized)
  - AT&T DS1 Ext. (28-slot, connectorized)
- Shelf (19-inch)
  - Larus FT21187 (20-slot, connectorized)
- Cabinet Distant Terminal (23-inch)
  - Larus FT2 1190 (12 slots) for a 51A cabinet.

FRONT PANEL

Figure 1 shows the HLU-388 front panel. Table 1 describes the front panel components.

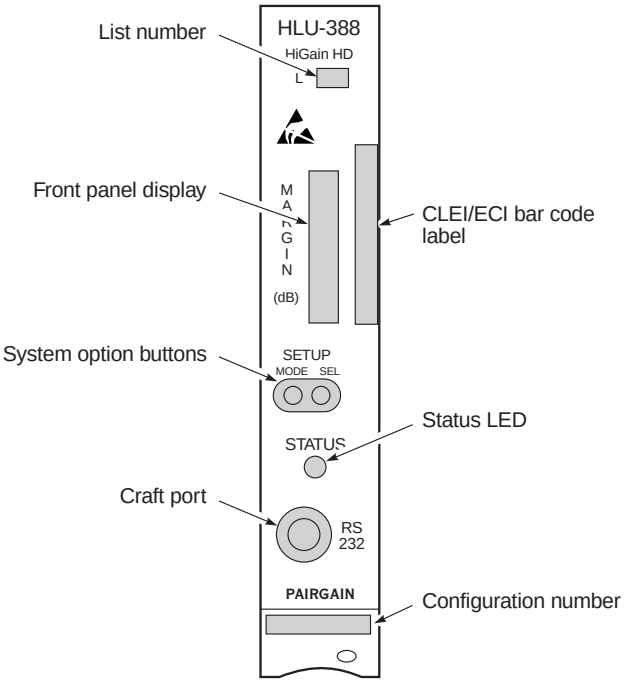

Figure 1. *The HLU-388 Front Panel*

Table 1. *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 DSX-1 line parameters and line unit identity.
Status LED	See Table 2 for status descriptions.
Craft (RS-232) port	Bantam 210 jack provides bidirectional communication between the unit and an external terminal to allow configuration and performance monitoring through the Maintenance Terminal menus.
CLEI/ECI bar code label	Provides the human-readable Common Language Equipment Identifier (CLEI) code number and the Equipment Catalog Item (ECI) bar code number.
Configuration Number	The configuration number is a two or three-digit number that is either the last digits of a five or six-digit warranty control number or a standalone configuration number of two or three digits. For example, a 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).

The HLU-388 front panel tri-color Status LED has the following states:

Table 2. *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 HLU-388 Customer Remote Loopback (CREM) or a Network Local Loopback (NLOC) is in effect.
Flashing yellow	HLU-388 is in an Armed state.

FRONT PANEL MESSAGES

The front panel display has many useful system diagnostic messages. They are listed in Table 3. The display turns on when power is initially applied to the HLU-388. 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.

Table 3. *Front Panel Display Messages*

Message	Full Name	Description
CREM	Customer Remote Loopback	Signal from customer is looped back to the customer at HLU-388.
NLOC	Network Local Loopback	DSX-1 signal is looped back to DSX-1 at the HLU.
CLOC	Customer Local Loopback	Signal from customer is looped back to the customer at the HRU.
NREM	Network Remote Loopback	DS1 signal is looped back to DS1 at the HRU.
SMJK	Remote SmartJack Loopback	Signal from DS1 is looped back at the HRU by the HRU SmartJack module.
TLOS	Transmit Loss Of Signal	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.
FERR	Framing Bit Error Occurred	Framing bit error occurred at the HLU T1 input.
LBPV	Local Bipolar Violation	A bipolar violation has been received at the T1 input to the HLU-388.
SIG 1 or 2	Signal 1 or Signal 2	The transceivers of the HLU, HRU 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 HRU or second doubler 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 multiplexers of the HLU and HRU or first doubler are trying to establish synchronization over loops 1 or 2 of span 1.
H1ES	HDSL CRC Error Channel 1	HLU HDSL Loop 1 CRC error.
H2ES	HDSL CRC Error Channel 2	HLU HDSL Loop 2 CRC error.
ARM	HiGain System ARMED	Armed to respond to Intelligent Repeater Loop Codes.

Table 3. *Front Panel Display Messages (Cont.)*

Message	Full Name	Description
ACO	Alarm CutOff	A system alarm has occurred, and has been retired to an ACO condition, by pressing the SEL button on the HLU front panel.
SELF TEST	Self Test	The HLU is in a self-test mode. This occurs every power ON/OFF cycle.
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. 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 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 using the A1LB/A2LB/A5LB Intelligent Office Repeater (IOR) Power Down code.
BAD RT?	No response from HRU	The HLU does not receive any response from the HRU. Thus, the integrity of the HRU or the two HDSL loops (they may be open) is questionable.
FRM	Frame: SF, ESF, UNFR, NONE	Defines the type of frame pattern being received from the DSX-1. Displayed during System Settings review mode.
CODE	Line Code: AMI, B8ZS	The line code that the HLU-388 is receiving at its DSX-1 interface, if the DS1 option is set to Auto. Otherwise, it mimics either of the other two DS1 line code settings, AMI or B8ZS. Displayed during System Settings review mode.
LOSW	Loss of Sync Word	Indicates that one of the HDSL loops has lost sync. Causes a system alarm.

Table 3. *Front Panel Display Messages (Cont.)*

Message	Full Name	Description
LLOS	Local Loss of Signal	Indicates that no signal is detected at the T1 input to the HLU. Causes a system alarm.
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the T1 input to the HRU. Causes a system alarm.
DS0	DS0 Blocked Channels	Indicates status of DS0 blocked channels. NONE indicates no channels are blocked. BLK indicates some channels are blocked.
DS1	DS1 BPV Errors	Indicates that the number of BPVs at the HLU or HRU T1 inputs have exceeded the 24-hour ES threshold. Causes a minor alarm.
MNGD	Managed	The HLU-388 is under control of the HMU-319 network management unit. In this state, the front panel Craft port is disabled.
VER xxxx	HLU-388 software version number	The software version number displays during the System Settings review mode. Press the MODE button for three seconds to display the software version.
LIST xxxx	HLU-388 List number	The List number displays during the System Settings review mode. Press the MODE button for three seconds to display the List number.
MAL1 MAL2	Margin Alarm Loop 1 or 2	The margin on HDSL loop 1 (2) has dropped below the threshold (1 to 15 dB) as set by the operator.

CARD-EDGE CONNECTOR

Figure 2 shows the HLU-388 card-edge connector pinouts.

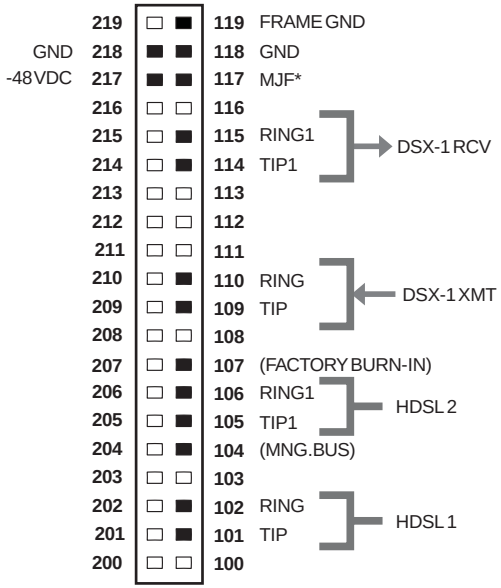

Figure 2. *HLU-388 Card Edge Connector Pinouts*

INSTALLATION

This product contains static-sensitive components. Be sure to ground yourself properly before touching the HLU-388.

1 Slide the HLU-388 into the shelf card guides for the desired slot, then push the unit in until it is entirely within the card guide.

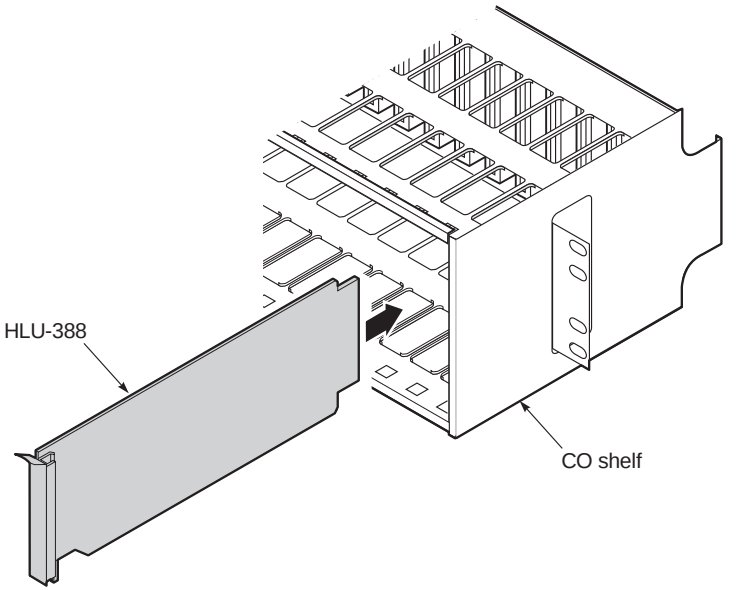

Figure 3. *Installing the HLU-388*

2 Push the HLU-388 into the card-edge connector until it is entirely within the card guides and the retaining latch closes, which indicates that the card is properly seated.

HDSL LINE VOLTAGE

The HLU-388 sets the HDSL line voltage to either 140 V (for non-doubler applications) or 200 V (for doubler applications) on loop 1. The 140 V output voltage used in non-doubler unit applications is always negative and unipolar. This keeps the HDSL cable pair voltage at or below ground potential, thereby avoiding corrosion problems caused by cable voltages more positive than ground.

The 200 V output voltage used in doubler unit applications is always bipolar, due to the HLU-388 ground fault detect (GFD) circuit. 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)
- whether the HRU is line powered or locally powered

The GFD circuit immediately detects ground faults occurring at any point along any span on any conductor, and forces the HiGain power supply to shut off. The line unit then applies the HDSL power periodically to the first span. If the ground fault is still present, the HDSL power is again shut off. This power cycling and ground fault protection continues as long as the fault condition exists.

PROVISIONING

There are two methods for provisioning the HLU-388:

- Use the MODE and SEL buttons on the front panel.
- Access system settings menus through the Craft port.

No dip switches or jumpers are required to provision the HLU-388.

The HLU-388 contains a non-volatile RAM (NVRAM) which stores the system option settings. System settings are retained if shelf power is lost or if the HLU-388 is unplugged.

USING THE FRONT PANEL BUTTONS

To provision the HLU-388 through the MODE and SEL buttons on the front panel:

1 Press the MODE button and release it after 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 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, the following 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 `CONF YES` message displays, and the display returns to its normal mode after saving the new changes.)

RESTORING DEFAULT SETTINGS

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 six seconds until the following message appears, then release the button:

`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 *or*
- Wait 30 seconds for the display to return to its normal state.

USING THE MAINTENANCE TERMINAL MENUS

The 9-pin, Craft (RS-232) port on the front panel allows you to connect the HLU-388 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.

Connecting to the Craft Port

A miniature, 3-pin, 210 Bantam-type jack on the front panel serves as an RS-232 Craft port and allows connection between the HLU-388 and a maintenance terminal or PC running a terminal emulation program. The Craft port is configured as Data Communications Equipment (DCE). A 210 to DB-9 adapter is provided with every unit to facilitate the use of standard RS-232, DB-9 cables. Once connected to a maintenance terminal, you can access the maintenance, provisioning, and performance screens.

To connect to a maintenance terminal:

1 Insert the 210-to-DB9 adapter into the RS-232 Jack on the HLU-388 front panel.

2 Connect an RS-232 cable to the adapter.

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

4 If necessary, start a terminal emulation program.

5 Configure the maintenance terminal to the following communication settings:

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

Navigating the Maintenance Terminal Menus

Table 4 lists keys you can use on the maintenance terminal to navigate the Maintenance Terminal menus.

Table 4. *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.

Selecting an Option

To select an option within the Maintenance Terminal menus, 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 or DSO blocking.

System Options Settings

Table 5. *HLU-388 System Options*

Mode	Selection	Description
EQL	0*	Sets the equalizer to DSX-1 for 0 - 132 feet.
	133	Sets the equalizer to DSX-1 for 133 - 265 feet.
	266	Sets the equalizer to DSX-1 for 266 - 398 feet.
	399	Sets the equalizer to DSX-1 for 399 - 532 feet.
	533	Sets the equalizer to DSX-1 for 533 - 655 feet.
LPBK	DIS	Configures the HiGain system to ignore the (2 in 5) in-band SmartJack loopback command.
	ENA*	Enables the HiGain system to recognize the (2 in 5) in-band SmartJack loopback command.
SPLB	GNLB*	Configures the HiGain system to respond to the generic (3/4/5/6 in 7) in-band loopback 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 and doubler.
	ENA*	Enables powering to the HRU and doubler.
ZBTS	ON	Notifies the HiGain system that the ESF frame is operating in its ZBTSI mode.

Table 5. *HLU-388 System Options (Cont.)*

Mode	Selection	Description
	OFF*	Notifies the HiGain system that the ESF frame is operating in its normal non-ZBTSI mode.
ESAL	17	Flashes the red STATUS LED when 17 Errored Seconds (ES) (17 HDSL CRC errors on either HDSL loop or a total of 17 BPVs) occur within a 24-hour period.
	170	Flashes the red STATUS LED when 170 ES (170 HDSL CRC errors on either HDSL loop or a total of 170 BPVs) occur within a 24-hour period.
	NONE*	Prevents generation of an alarm due to excessive errored seconds.
LBTO	NONE	Disables automatic time-out cancellation of all loopbacks.
	20	Sets automatic cancellation of all loopbacks to 20 minutes after initiation.
	60*	Sets automatic cancellation of all loopbacks to 60 minutes after initiation.
	120	Sets automatic cancellation of all loopbacks to 120 minutes after initiation.
ALM	DIS*	This generic HiGain ALM option is not supported by the HLU-388 List 2E. Its setting has no effect on the unit operation.
	ENA	
DS1	B8ZS	Places both the HLU and HRU into their B8ZS modes.
	AMI*	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. If no B8ZS patterns are received for five seconds, it reverts back to its AMI mode.

Table 5. *HLU-388 System Options (Cont.)*

Mode	Selection	Description
FRMG	AUTO*	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 insures 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 the HiGain system 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*	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*	Causes the HRU-412 List 6 and List 7 to transmit the AIS signal towards the CI when in NREM or SmartJack loopback.
	DIS	Causes the HRU-412 List 6 to transmit the signal from the network toward the CI when an HRU NREM or SmartJack loopback is executed. The AIS signal is off.
CONF	YES	Confirms that all operating modes (listed in this table) are to be updated to their current selections.
	NO*	Prevents the most recently selected operating mode selections from being updated. They remain as they were before the system options settings mode was entered.
MARG	0 to 15 dB	The Margin Alarm Threshold can only be set using a terminal connected to the RS-232 Craft port. This setting determines the minimum allowable margin below which an alarm will occur. Setting the threshold to “0” inhibits the margin alarm.
	4 dB*	Default value.

Table 5. *HLU-388 System Options (Cont.)*

Mode	Selection	Description
DS0	BLK	The DS0 blocking option can only be set using a terminal connected to the RS-232 Craft port. The 4-character HLU-388 front panel LED readout only displays the status of the blocking option. BLK indicates at least one channel is blocked.
	NONE*	No channels are blocked.

* Denotes the default setting.

ALARMS

Only one alarm can be displayed at a time, 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 6. *HDSL System Alarms*

Front-Panel Message	Alarm	Description	To inhibit:
ALRM LOSW	Loss of Sync Word*	One of the HDSL loops has lost synchronization.	Cannot be inhibited.
ALRM LLOS	Local Loss of Signal	Loss of the DSX-1 input signal.	Cannot be inhibited.
ALRM RLOS	Remote Loss of Signal	Loss of the HRU DSX-1 input signal.	Disable the RDA (Remote DS1 Alarm) option. This prevents an LOS condition at the DS1 input to a HRU 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 towards the network from the HLU. 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 DS1 input is not present at the HRU. Places the HRU in loopback towards the network.	Set the TLOS switch at the HRU to disable.
ALRM H1ES	HDSL Loop 1 Errored Seconds	HDSL Loop 1 has exceeded the user-selected 24-hour Errored Seconds threshold. If both H1ES and H2ES occur simultaneously, only H1ES displays on the front panel.	Set ESAL system option to NONE.

Table 6. *HDSL System Alarms (Cont.)*

Front-Panel Message	Alarm	Description	To inhibit:
ALRM H2ES	HDSL Loop 2 Errored Seconds	HDSL Loop 2 has exceeded the user-selected 24-hour Errored Seconds threshold. If both H1ES and H2ES occur simultaneously, only H1ES displays on the front panel.	Set ESAL system option to NONE.
ALRM DS1	Bipolar Violations	The total number of bipolar violations (BVP) at either the HLU-388 or the HRU DS1 inputs has exceeded the user-selected 24-hour threshold.	Set ESAL system option to NONE.
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).

* When both HDSL loops lose sync word (LOSW), a system alarm condition exists. However, since the HLU-388 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-388 loopback messages are described in Table 7.

Table 7. *Loopback Messages*

Message	Full Name	Description
SMJK	SmartJack Loopback	Loopback at HRU (remote) toward the Network 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 Network initiated by upstream in-band codes or from the maintenance terminal.
NLOC	Network Local Loopback	Loopback at HLU (local) toward the Network 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 through its TLOS switch option.
NDU1	Network Doubler 1 Loopback	The loopback at doubler 1 toward the Network initiated by in-band codes, or the maintenance terminal.
NDU2	Network Doubler 2 Loopback	The loopback at doubler 2 toward the Network 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.

Table 7. *Loopback Messages (Cont.)*

Message	Full Name	Description
CDU2	Customer Doubler 2 Loopback	The loopback at doubler 2 toward CI initiated by in-band codes or the maintenance terminal.

SPECIFICATIONS

HDSL Line Code	784 kbps 2B1Q
HDSL Output	+13.5 dBm ±0.5 dB at 135Ω
HDSL Line Impedance	135Ω
Maximum Provisioning Loss	35 dB at 196 kHz, 135Ω
Line Clock rate	Internal “Stratum 4” clock
HDSL Start-up Time	30 sec. (typical), 60 sec. (maximum) per span
One-way DS1 Delay	<200 µs per span without doublers.
DSX-1 Line Impedance	100Ω
DSX-1 Pulse Output	pre-equalized for 0 to 655 feet of ABAM cable ABAM cable shields must be grounded at both ends
DSX-1 Input Level	+1.5 to -7.5 dBDSX
DS1 Line Rate	1.544 Mbps ±200 bps
DS1 Line Format	AMI, B8ZS or ZBTSI
DS1 Frame Format	ESF, SF or UNFR
Maximum Heat Dissipation	6W (without doubler), 9W (with doubler) typical

Maximum Power Consumption	14W (without doubler), 25W (without doubler)
Fusing	Internal; connected to "FUSE ALARM" output on pin 10
HDSL Span Voltage	130 to 200 VDC (absolute value between loops)
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. Secondary surge protection on DS1 ports.
Operating Temperature	-40° to +65° C (-40° to +149° F)
Operating Humidity	5% to 95% (non-condensing)
Mounting	DDM+ high-density shelf or equivalent
Dimensions	
Height:	3.5 in. (8.0 cm)
Width:	0.72 in. (1.8 cm)
Depth:	10.25 in. (26.0 cm)
Weight:	1 lb. (.45 kg)

PRODUCT SUPPORT

This section contains product support and warranty information.

RELATED DOCUMENTATION

The HLU-388 List 2E has a complete technical practice that you can download from the PairGain Technical Manuals Web page at 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. Type the product name and the section number of the document in the subject area of the email message.

TECHNICAL SUPPORT

PairGain Technical Assistance is available 24 hours per day, 7 days per 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

MODIFICATIONS

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by PairGain Technologies, Inc. may void the user's authority to operate the equipment.

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

STANDARDS COMPLIANCE

The HLU-388 List 2E has been tested and verified to comply with the applicable sections of the following standards.

- GR 63-CORE - Network Equipment-Building System (NEBS) Requirements
- GR 1089-CORE - Electromagnetic Compatibility and Electrical Safety

To comply with the intrabuilding wiring requirements of GR-1089-CORE, section 4.5.9, the shields of the ABAM-type cables that connect the HLU-388 DSX-1 output ports to the cross-connect panel must be grounded at both ends.

Corporate Office
14402 Franklin Avenue
Tustin, CA 92780
Tel: (714) 832-9922
Fax: (714) 832-9924
For Technical Assistance:
(800) 638-0031

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