PAIRGAIN™ TECHNOLOGIES HIGAIN-2™ REMOTE UNIT MODEL HRU-612

List 1 PairGain #150-1218-01 CLEI Code: T1LIVC04AA

CONTENTS **PAGE**

CAUTION
This product incorporates static sensitive components. Proper electrostatic discharge procedures must be followed.

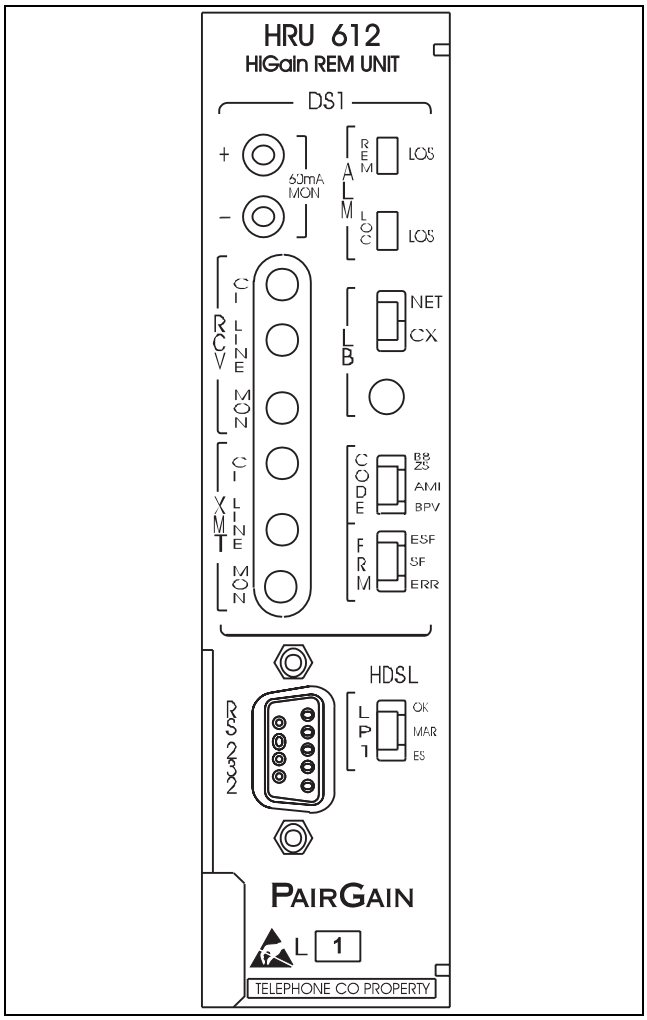

Figure 1. HRU-612 List 1 Front Panel. The PairGain HRU-612 is the remote side of a single pair repeaterless T1 transmission system.

A. PRODUCT OVERVIEW

1. DESCRIPTION AND FEATURES

1.01 PairGain's HiGain-2 Remote Unit Model HRU-612, Issue 1, List 1, Figure 1, is the remote end of a single pair repeaterless T1 transmission system. When used in conjunction with a HiGain-2 Line Unit HLU-611 the system provides 1.544 Mb/s transmission on one unconditioned copper pair over the cable ranges shown in Table 1. The HiGain-2 system utilizes 2B1Q VHDSL (Very High-bit-rate Digital Subscriber Line) transmission technology. HiGain-2 complies with the ANSI T1E1.4, T1.403-1989 and T1E1.4/92-002R2 technical standards & recommendations. The HRU-612 List 1 mounts in a single slot of any industry standard 400 mechanics shelf or in equivalent enclosures manufactured by PairGain Technologies. The system also complies with TR-TSY-000063 (Network Equipment Building System (NEBS) Generic Equipment requirements) and TR-TSY-000499 (Transport System Generic Requirements - TSGR) common requirements.

1.02 Revision History of this practice.
Revision 02 — August 21, 1996
a) Extended temperature ratings from 0° to +50° C to -40° to +65° C.
b) Extended the PPM offset range from ±64PPM to ±100PPM.

1.03 Features of the HRU-612 Issue 1 List 1 HiGain-2 Remote Unit are as follows:
- ANSI T1.403 DS1 Customer Interface
- VHDSL Line Powered operation - no local power required
- Front Panel DS1 and VHDSL Status Display
- Generic & addressable repeater Loopback activation codes.
- Metallic smart-jack loopback. Conforms to TR-TSY-000312.
- RS-232 front panel terminal access for craft
- Provisioning switches for CPE current, RCV LBO and XMT LOS initiated loopback or AIS.
- Front panel jacks for test access
- CPE current monitor test points
- Front panel VHDSL margin threshold indicator.
- Lightning and power cross protection on VHDSL and DS1 interfaces
- 1568 kb/s full-duplex 2B1Q VHDSL Transmission on 1 pair
- DS0 blocking.

2. APPLICATIONS

2.01 The primary application of the HiGain-2 System is to provide a quick and cost-effective way of delivering T1 High Capacity Digital Service (HCDS) to customers over a metallic cable pair. The HiGain-2 system can be deployed on 1 unconditioned, non-loaded pair of wires without repeaters, and without the need for either bridged tap removal or binder group separation.

2.02 The general guidelines, on which the range deployment rules in Table 1 are based, require that the VHDSL HiGain-2 loop (which operates at twice the line rate of standard HiGain HDSL products) have less than 35 dB of loss at the 2B1Q line rate of 392 kHz, @ 135 ohm source and load impedances.

2.03 The HiGain-2 system operates with any number of other T1, POTS, Digital Data Service (DDS) or other HiGain-2 Systems sharing the same cable binder group. HiGain-2 systems can be used with customers requiring DS1 service on a temporary or permanent basis. HiGain-2 also provides a means of quickly deploying service in advance of fiber-optic transmission systems. Using HiGain-2 T1 service can be connected within a few days or even a few hours. Fiber optic systems can be installed at a leisurely pace and cut-over from HiGain-2 when the time allows. The HiGain-2 system can then be easily removed and utilized elsewhere.

TABLE 1. HIGAIN-2 VHDSL LOOP LIMITS

Cable Gauge	Loss @ 392 kHz dB/kft	Ohms per kft	Maximum Loop For 35 dB Loss	Ohms @ Maximum Loop Length
26/0.4 mm	4.97	83.3	7.0 kft / 2.13 km	583
24/051mm	3.87	51.9	9 kft / 2.74 km	467
22/0.61mm	3.01	32.4	12 kft / 3.66 km	389
19/0.91mm	2.17	16.1	16 kft / 4.87 km	258

3. SPECIFICATIONS

VHDSL Line Code

1568 kb/s 2B1Q full duplex

VHDSL Output

+13 dBm +/- 0.5 dB @ 135 ohms

VHDSL Line Impedance

135 ohms

VHDSL Line DC resistive signature

180 Kohms

Maximum Provisioning Loss

35 dB @ 392 kHz, 135 ohms

Line Clock Rate

Internal Stratum 4 clock

VHDSL Startup Time

15 seconds typ., 60 seconds max.

One-way DS1 Delay

<220 microseconds

DS1 Line Impedance

100 ohms

DS1 Pulse Output

0 dB (LBO = 0), -15 dB (LB0 =15).

DS1 Input Level

> -22.5 dB

DS1 Line Rate

1.544 Mb/s +/- 200 bits/sec

DS1 Output Wander (MTIE & TVAR)

Compliant with Section 7.2.1 of the T1X1.3/90-026R7 SONET committee report.

DS1 Line Format

AMI, B8ZS or ZBTSI

DS1 Frame Format

ESF, SF or unframed

Power Consumption

6 watts typ.:8 watts max.

Electrical Protection

Secondary surge and power cross protection on all DS1 & VHDSL ports.

Operating Temperature & Humidity (non-condensing)

-40º to +65º Celsius & 5-95%

Mounting

Single width 400 type mechanics slot.

Dimensions

5.6 “H x 1.4 “W x 5.6 “D.

Weight

1 Pound.

4. CERTIFICATION

4.01 FCC Compliance: The HRU-612 List 1 has been tested and found to comply with the limits for Class A. digital devices pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

4.02 UL Recognized: The HRU-612 List 1 is a UL Recognized component. Use normal caution when installing or modifying telephone lines. Dangerous voltages may be present. It is also considered imprudent to install telephone wiring during a lightning storm. Always disconnect all telephone lines and power connections from wall outlets before servicing or disassembling this equipment.

4.03 CSA Certification: The HRU-612 List 1 has been tested and found to comply with CSA Standard C22.2-950 telecommunication features.

4.04 Refer to the installation section of the appropriate instruction manual for the unit you are installing for:

- Cabling information
- Proper connections
- Grounding information
- Line vs local power

All wiring external to the product(s) should follow the provisions of the current edition of the National Electrical Code.

5. WARRANTY

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

5.02 This module should not be field repaired. 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 will void the warranty.

5.03 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 92680
ATTN: Repair and Return Dept.
(714) 832-9922
(800) 638-0031

5.04 PairGain will continue to repair or replace faulty modules beyond the warranty program at a nominal charge. Contact your PairGain sales representative for details and pricing.

6. TECHNICAL ASSISTANCE

6.01 PairGain Technical Assistance is available 24-hours-a-day, 7-days-a-week by contracting PairGain's Customer Service Engineering group at one of the following numbers:

Telephone:	**(800) 638-0031**
	(714) 832-9922
Fax:	**(714) 832-9924**

During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday - Friday, excluding holidays), technical assistance calls are 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 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) 730-3299. Transmission speeds up to 28.8 kbps are supported with a character format of 8-N-1.

B. FUNCTIONAL DESCRIPTION

7. FUNCTIONAL OPERATION

7.01 HiGain-2 utilizes PairGain's 2B1Q VHDSL transceiver technology to establish a full-duplex 1568 kb/s data channels between the HLU and a remotely mounted HRU-612 HiGain-2 Remote Unit.

7.02 The HRU-612 power supply converts the metallic 170 Vdc power feed that is received on the VHDSL pair to voltages and currents required by the HRU-612 circuitry. The power supply generates +5, -5 and 30 Vdc outputs. The 30V output is converted to a 60 ma current feed used to simplex power the NID (Network Interface Device). Caution should be used when the HRU is used to power CSUs. Some CSUs require more output voltage than the 30 volts provided by the HRU. The HRU can not power both an NID and a CSU at the same time.

7.03 The HRU-612 typically dissipates 6 watts of power and may consume up to 8 watts when feeding 60 mA. of simplex current to the CI.

7.04 The worst case -48V power consumption by a HiGain-2 system from the CO is 18 watts per DS1 service.

7.05 A 9-pin (RS-232) DB-9 connector, configured as DCE (see Figure 3), is provided on the front panel of the HRU-612. This provides access to the monitoring features of HiGain-2's maintenance, provisioning and performance monitoring interface. A very basic interface is available via a 'dumb terminal'. Figures 7 through 13 show the menu selections that are available from the terminal. Table 3 defines the various terms used in the screen displays. The port is configured as DCE with 8 data bits, 1 stop bit and no parity. Striking the SPACE bar several times invokes autobaud from 1200 to 9600 baud. Note that if the RS-232 port in an HRE-421 is used to access the HRU-612, a null modem must be used since the HRE-421 is configured as DTE .

7.06 The HRU-612 provides embedded status monitoring functions that are accessed via the RS-232 port. A main menu, shown in Figure 7, is presented when a terminal is connected as described in the previous paragraph. Figures 7-13 illustrate the displays provided from the terminal port. Information displayed shows the status of the HLU at the distant end of the VHDSL spans as well as the HRU-612. The HLU shares its status with the HRU-612 via the embedded operations channel so there is no need to physically connect to the distant end for its status.

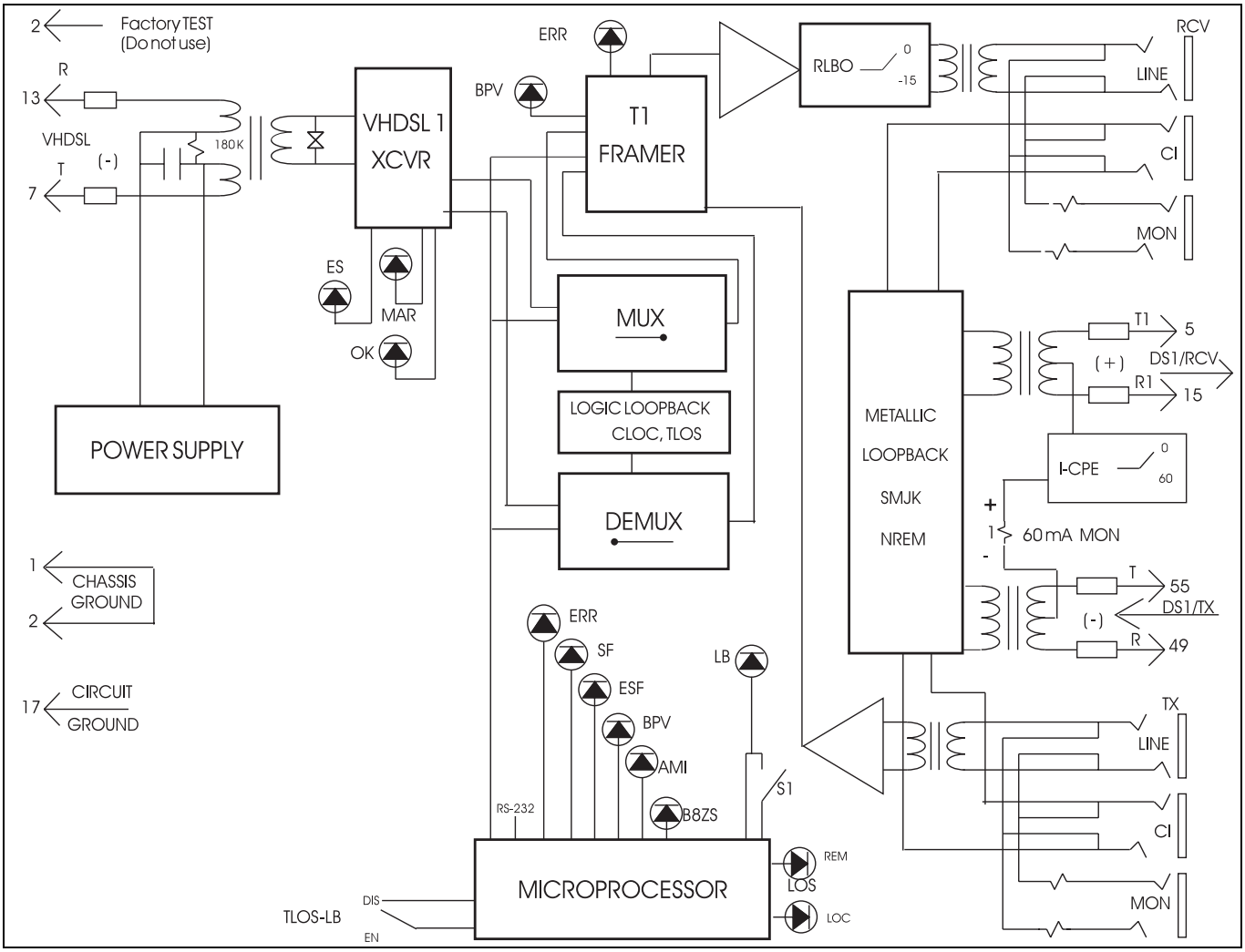

Figure 2. HLU-612 List 1 Block Diagram.

8. FRONT PANEL

8.01 DS1. The top 60% of the front panel addresses the following DS1 interface features.

- 60 MA MON

These two test points allow the 60 mA. CPE current option, if selected, to be measured. The current flowing is related to the voltage measured across the " + " and " - " test points by the following relationship:

CPE CURRENT =1 MA / 1 MV.

Typical readings range from 55 to 65 mv which equate to a 55 to 65 mA. current range.

- RCV & XMT ACCESS JACKS

These provide both splitting and monitor access jacks to the CPE DS1 interface. See Figure 2 for circuit details. Note that these jacks are transformer isolated from the CPE DS1 metallic interface.

- ALM

REM LOS

RED LED that indicates a Loss Of Signal at the T1 input to the REMote (HLU) unit. This condition causes the HRU to transmit the AIS pattern to towards the CPE.

LOC LOS

RED LED that indicates a Loss Of Signal at the T1 input to the LOCal (HRU) unit. This condition causes HiGain-2 to either transmit the AIS pattern towards the DSX-1 or to execute a logic loopback in the HRU as a function of the TLOS user option setting. See Paragraph 9.01 for details.

- LB

NET

GREEN LED indicating the HRU is in a loopback state in which the signal from the NETwork is being looped back to the NETwork.

CI

YELLOW LED indicating the HRU is in a loopback state in which the signal from the customer interface (CI) is being looped back to the CI.

BUTTON

Depressing this front panel button for 5 seconds forces the HRU into its NREM metallic loopback state. The unit can be unlooped by either depressing the button again for 5 seconds or via the standard loopdown coded messages.

- CODE

B8ZS

GREEN LED indicating that the user DS1 code option is set to B8ZS. If however the user DS1 code option is set to AUTO, this LED indicates that the code of the DS1 signal being received at the HRU's DS1 input is B8ZS.

AMI

YELLOW LED indicating that the user DS1 code option is set to AMI. If however the user DS1 code option is set to AUTO, this LED indicates that the code of the DS1 signal being received at the HRU's DS1 input is AMI.

BPV

RED LED that flashes every time a Bipolar Violation, other than those associated with a B8ZS code, is received at the HRU's DS1 input.

- FRM

ESF

GREEN LED indicating that framing pattern of the signal being received at the HRU's DS1 input is ESF.

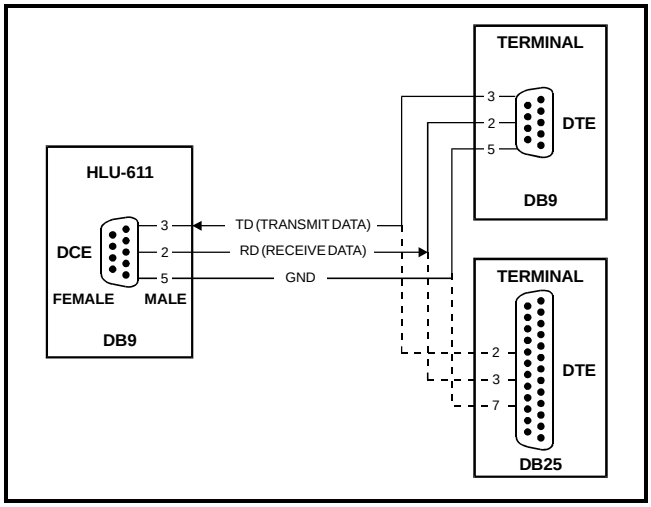

Figure 3. DB-9 Pin-outs.

SF

YELLOW LED indicating that framing pattern of the signal being received at the HRU's DS1 input is SF.

ERR

RED LED indicating a DS1 frame error has occurred.

Note the FRM LED remains off if the HRU input pattern is unframed or if the HiGain-2 FRMG option is set to its unframed (UNFR) mode.

8.02 VHDSL The lower 40% of the front panel addresses the following VHDSL interface features.

OK

GREEN LED that flashes while the VHDSL Loop is synchronizing with the HLU. A solid green state indicates that Loop is properly synchronized with the HLU.

MAR

YELLOW LED indicating that the HRU's S/N MARgin on the VHDSL Loop has dropped below the user defined margin threshold value. This option is set at the HLU in the System Settings menu of the maintenance interface system at the RS-232 maintenance port.

ES

RED LED that flashes ever second in which at least one VHDSL CRC error is detected.

9. OPTIONS

9.01 The HiGain-2 List 1 system has several special loopback (SPLB) options that are set at the HLU. Refer to practice # 150-611-100 for more details. The HRU also has three user options set by switches located at the back of the unit as shown in Figure 4. Each switch has two settings as follows (refer to the block diagram in Figure 2 for details):

- **I-CPE**

*0**: Sets the CPE current to 0 mA..

60: Sets the CPE current to 60 mA to power an external NID.

- **TLOS-LB**

*DIS**: A loss of the T1 XMT signal from the CPE causes the HLU to transmit the AIS signal towards the DSX-1 and does not cause the HRU to enter its logic loopback state.

EN: A loss of the T1 XMT signal from the CPE forces the HRU to enter its logic loopback state (TLOS in Figure 5). While in this loopback state, the HRU transmits the AIS signal towards the CPE and returns the Network signal back to the Network. The HLU displays the message TLOS in its 4 character front panel read-out. This condition remains until a valid T1 signal is received from the CPE or until a loopdown command is issued. Note that once the TLOS initiated loopback has occurred, it can not reoccur until the CPE T1 signal has been reapplied and then removed. This "latching" feature prevents the HRU from oscillating into and out of TLOS loopback when a loopdown command is issued in the absence of a T1 signal from the CPE.

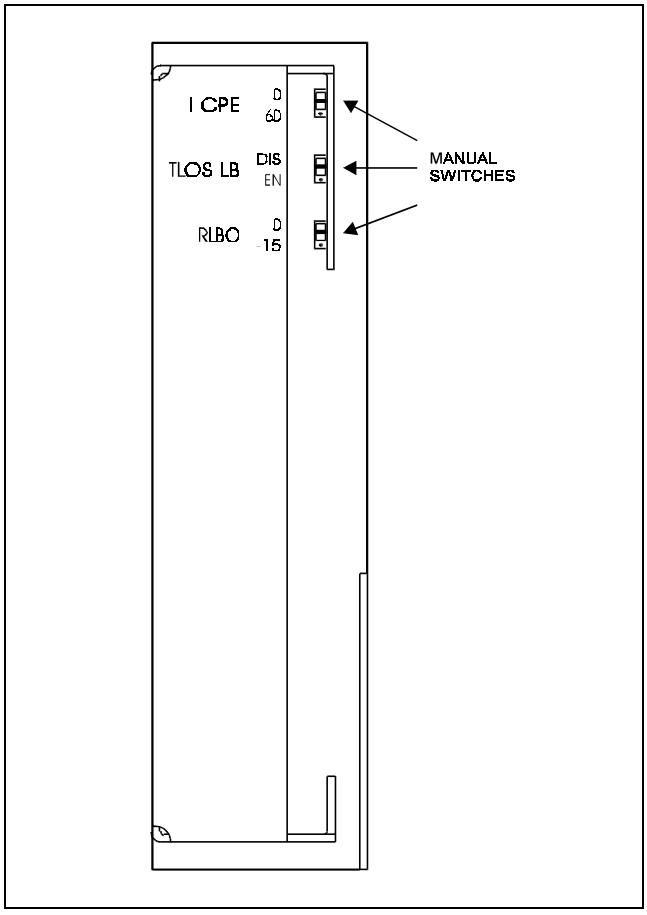

Figure 4. HRU-612 Manual Switches

RLBO

*0**: Configures the T1 RCV LBO to 0 dB. This sets the T1 output signal level from the HRU towards the NI to 0 dB. This setting is recommended when the HRU does not function as the NID but is connected to en external NID. It allows the external NID to set the appropriate NI level.

15: Configures the T1 RCV LBO to -15 dB. This sets the T1 output signal level from the HRU towards the NI level to -15 dB. This setting is recommended when the HRU functions as the NID.

Note that the " * " denotes the factory setting.

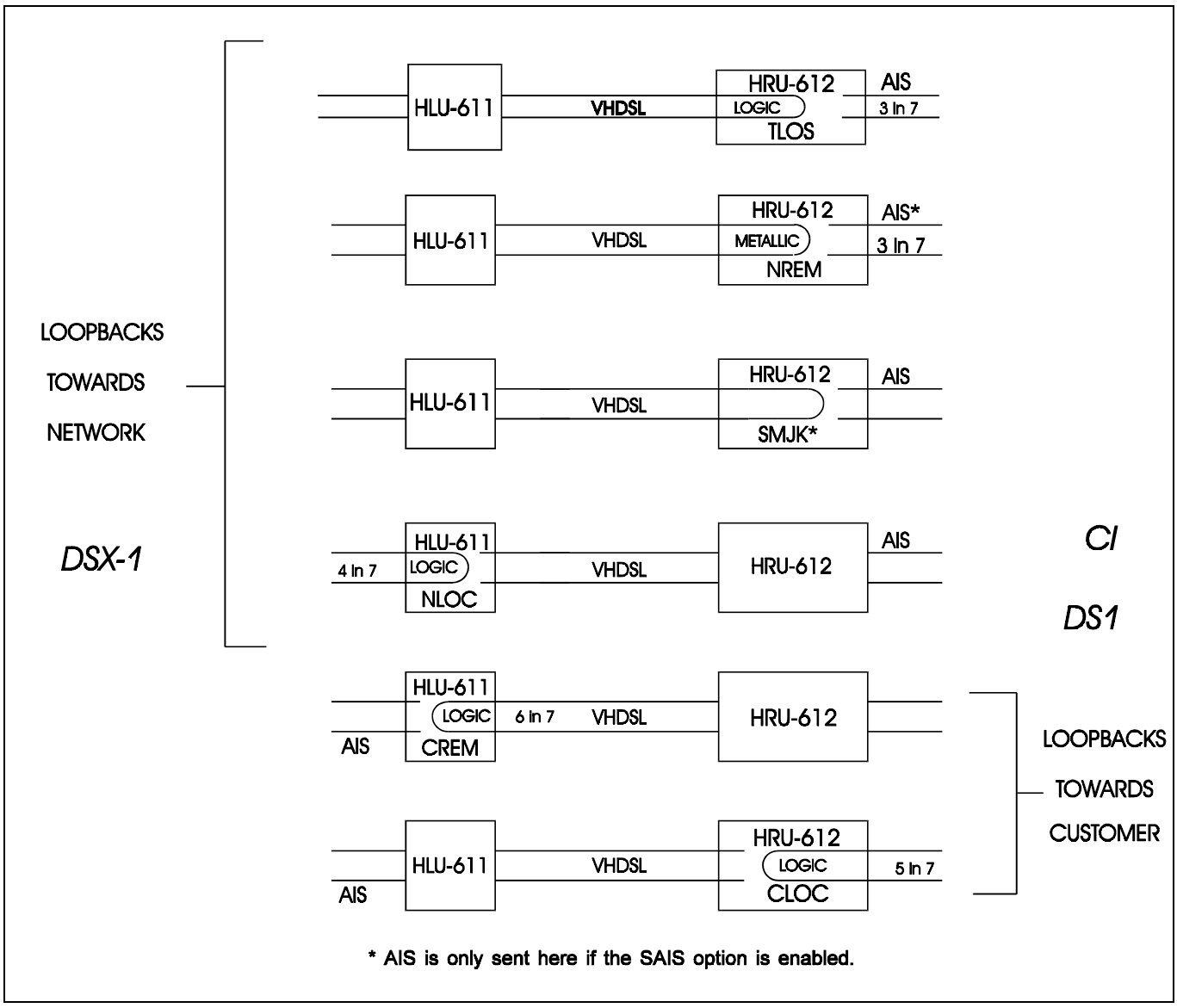

Figure 5. HRU-612 Loopbacks.

10. LOOPBACKS

10.01 Figure 5 shows all 4 HRU loopbacks. Of these, a TLOS and CLOC are logic loopbacks. They occur in the digital multiplexer section of the HRU as shown in Figure 2.

10.02 Both the SMART-JACK and NREM loopbacks shown in Figure 5 execute the standard NID metallic loopback. The only difference is their initiating sequence. NREM is initiated by the HRV front panel pushbutton, the maintenance terminal, the HLU front panel pushbuttons or the 3 in 7 in band commands. The SMART-JACK loopback is only initiated by the standard 3 in 5 in band loop-up command. It has two modes of operation as determined by the two states (ENA or DIS) of the SAIS user option. The ENA option causes the HRU to transmit the AIS signal towards the NI. The DIS option turns off this AIS/NI signal.

10.03 **ENA**: Upon detection of a valid SMART-JACK loopback command, a metallic loopback relay (see Figure 2 for its location) is energized and the T1 interface chip transmits the AIS pattern to the NI and also back to the HRU's T1 receiver circuit. In addition, the customer's T1 XMT input is disconnected and terminated into 100 ohms. The AIS pattern is examined by the HRU for its overall integrity. This pre-looped tests lasts for about 100 milliseconds and terminates in one of the following two conditions:

A, PRE-LOOP FAILED: If the transmit & receive all 1's patterns do not match, a problem in the HRU is indicated and HiGain-2 declares an HRU PRE-LOOPBACK FAIL condition. This terminates the loopback test and returns the HRU to its unlooped normal state. Note that other circuit impairments could also prevent the loopback from occurring.

B, PRE-LOOP PASSED:- If the transmit and receive patterns do match, a HRU PRE LOOPBACK PASS condition is declared. All active circuits are working. The metallic loopback relay remains closed and, in addition, a logic loopback within the HRU is enabled. This logic loopback is required in order to present the all 1's pattern to the NI and at the same time to loop the signal, being received from the network, back towards the network. HiGain-2 is now in its AIS/ENA "smart-jack" loopback state. It remains in this state until a loopdown command is detected or the default time out period (if enabled) expires.

10.04 When the HRU is in its AIS/ENA smart-jack metallic loop back state, its T1 input LOS, Code & Frame monitoring circuits are connected to the unframed AIS pattern which is being looped back to these circuits through the loopback relay. The CPE input signal is no longer being monitored since its input circuit has been opened and terminated into 100 ohms. This forces the FRM LED off, the LOC LOS LED off and the CODE LED to indicate AMI if the HLU CODE option is set to either AUTO or AMI. It will indicate B8ZS if the CODE option is set to B8ZS.

10.05 As can be seen, this AIS/ENA metallic loopback scenario includes and therefore tests **all** HiGain-2 active circuits and fully conforms with TR-TSY-000312. In this sense it out performs the loopback function found in most standard NID devices since these devices do not include either the AIS generator or the CI T1 LOS detector in their loopback path.

10.06 **DIS**: This metallic loopback state is initiated in the same manner as it is when the ENA option is chosen. However, once initiated, the AIS signal is not sent to the NI. Instead the network signal is sent both towards the NI and through the relay back towards the network. As before, the customer's T1 transmit input port is opened and terminated into 100 ohms. No logic loopback is required since the relay is performing the network signal loopback function. This simple metallic loopback state remains until a loopdown command is issued or the default timer (if enabled) expires.

10.07 When the HRU is in its AIS/DIS smart-jack metallic loop back state, its T1 input LOS, Code & Frame monitoring circuits are connected to the network's signal which is being looped back to these circuits through the loopback relay. The CPE input signal is no longer being monitored since its input circuit has been opened and terminated into 100 ohms. The FRM & LOC LOS LEDs indicate the status of this signal from the network. The CODE LED also indicates the code (AMI or B8ZS) of this signal if the CODE option is set to AUTO. It will indicate AMI or B8ZS if the CODE option is set to either AMI or B8ZS respectively.

10.08 The user should be aware that this AIS/DIS smart-jack mode does not check all of the HRU's circuits nor does it send an AIS alerting signal to the NI. Thus it does not comply with TR-312 requirement to transmit the AIS pattern to the CI during the maintenance loopback state.

10.09 All of the HRU loopbacks towards the network (NREM & SMJK) are metallic/logic (AIS/ENA) or metallic only (AIS/DIS) except for the TLOS initiated loopback, which is logic only. The SMJK identifying label indicates that the loopback was initiated by the 3 in 5 in band command. NREM is used to indicate that the metallic loopback was initiated by other than the 3 in 5 command (3 in 7, 16 bit addressable repeater commands or front panel push-button).

C. INSTALLATION AND TEST

11. INSTALLATION

11.01 Upon receipt of the equipment, 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.

11.02 The HRU-612, List 1 is designed to mount in PairGain's HRE-421 (double width, single mount), HRE-422 (double width, double mount), HRE-424 (double width, 4 unit wall mount), HRE-420 (single width, single mount) or HRE-425 (10 unit wall or rack mount) Remote indoor Enclosures. For outdoor applications, the HRE-423 (3 unit) and HRE-450 (single width, single mount) enclosures are available. The HRU is also compatible with industry standard 400 type multi-mount shelves. The HRU's pin-outs are shown in Figure 6.

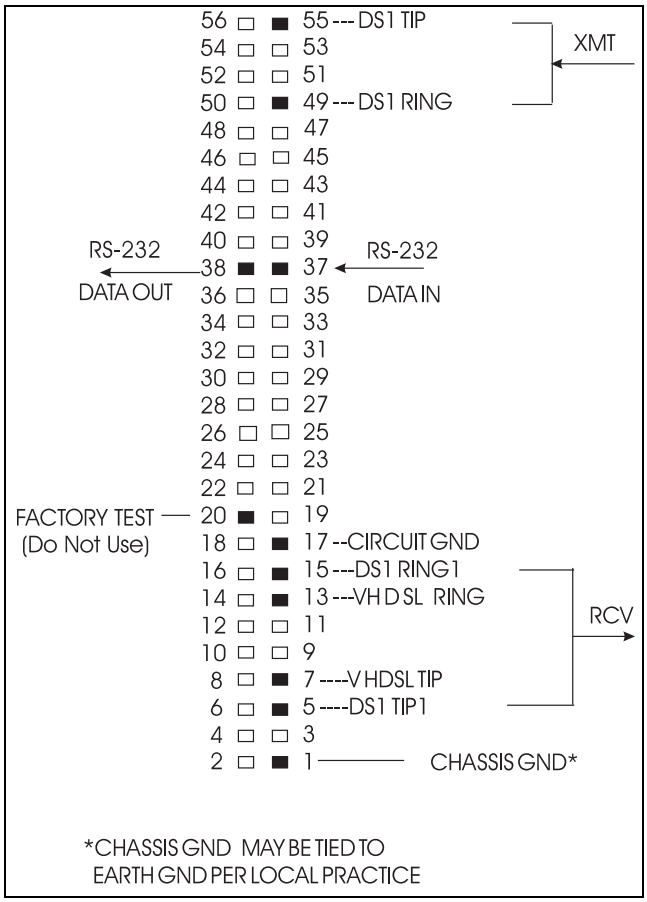

Figure 6. HRU-612 Pin-outs.

TABLE 2. HRU-612 Test Procedures.

Step	Action
1	Depress the loopback LB button on the HRU front panel for at least 5 seconds.
2	Verify that the GREEN HRU front panel loopback LB NET LED turns on, indicating that the HRU is in its digital (NREM) loopback state. Also verify, if possible, that the HLU displays the message ”NREM” also indicating that the HRU is in loopback (see Figure 5).
3	Have the C.O. tester transmit a T1 test signal into the HLU and measure that the returned (looped) signal is error free.
4	If the above test fails, remove the HRU from its loopback state by again depressing the HRU loopback button for 5 seconds. Verify that the loopback NET LED is off.
5	Have the C.O. tester send the HLU (4 in 7) in-band loop-up (NLOC) for 5 seconds. Verify that the HLU displays the message “ NLOC” indicating that the HLU unit is in its network loopback state.
6	Repeat step 3. If the test passes, the problem is in the cable pair or the HRU. If it fails, the problem is in the C.O.
7	To verify that the proper ports are use for the VHDSL & DS1 pairs, use an ohm-meter to verify that the VHDSL HRU-612 port has a 180 k T to R resistive signature in contrast to the DS1 ports which have a 15 ohm T to R resistive signature.
8	If the CPE 60 mA. switch option is set. Verify that the external NID is under power and that the voltage across the HRU-612’s front panel “60 mA MON” test points measures between 55 and 65 mv. This indicates that the CPE current is between 55 & 65 mA. Note that the external NID’s LOOP POWER option must be set to its “THRU” position when powered by the HRU.

NOTE: When T1 loopback tests are made on the HiGain-2 system with external metallic loopback connections at either end, the DS1 code that exists at the metallic loopback interface may be different from the DS1 code being received at the opposite end when the DS1 user option is set to AUTO. For example, if the HRU has a metallic loopback and the HLU’s receive pattern’s code is changed from AMI to B8ZS and then the all 0 pattern is sent into the HLU, the HRU remains in its AMI mode and thus loops all 0’s. This causes the HRU to indicate a LOS condition which then causes the HLU to output the AIS pattern.

12. TESTING

12.01 Table 2 provides a step by step test procedure for the HRU-612 unit. This procedure allows verification of the integrity of the VHDSL channel to the HLU Line Hit as well as the DS1 channels to the customer and the HLU DSX-1 interface. Table 3 lists the HLU status messages which may also be helpful when coordinating turn-up with CO personnel.

12.02 The HLU’s 4 character front panel has many useful diagnostic messages. They are listed in Table 3.

12.03 If trouble is encountered at the T1 interface, verify that the unit is making a positive connection with the mounting assembly’s connector.

TABLE 3. HLU 4 CHARACTER FRONT PANEL MESSAGES.

Message	Full Name	Description
CREM	Customer Remote Loopback	Signal from customer is looped back to customer at HLU-611
NLOC	Network Local Loopback	DSX signal is looped back to DSX at HLU
CLOC	Customer Local Loopback	Signal from Customer is looped back to customer at HRU-612
NREM	Network Remote Loopback	DSX signal is looped back to DSX at HRU
SMJK	Remote Smartjack Loopback	Signal from DSX is looped back at HRU by the HRU smartjack module.
TLOS	Transmits loss of signal	HRU is in a logic loopback state caused by a loss of its T1 input from the NI, if enabled by the SAFS option.
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-611.
SIG1	Signal	The HLU & HRU transceivers are trying to establish contact with each other.
ACQ1	Acquisition	The HLU & HRU multiplexers are trying to establish synchronization over each loop.
HES	HDSL CRC Error	At least 1 CRC error on the VHDSL Loop in the last second.
ARM	HiGain-2 System ARMED	Armed to respond to Intelligent Repeater Loop Codes
ACO	Alarm CutOff	A MNRALM has occurred, and been retired to an ACO condition, by depressing 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 minor alarm condition is in effect.
M =xx	VHDSL Loop Margin	Indicates the power of the received VHDSL signal 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 VHDSL pair.
PWR FEED OPEN	Power Feed Open	Indicates an open circuit in the T&R of the VHDSL pair.
BAD RT?	No response from HRU	The HDSL Power Feed circuits are good but the HLU does not receive any response from the HRU. Thus the HRU’s integrity is questionable.

Table continued on next page

TABLE 3. HLU 4 CHARACTER FRONT PANEL MESSAGES (CONTINUED)

Message	Full Name	Description
VER	HLU Software Version #	This is displayed during the System Settings review mode. Depress the Mode button for 3 seconds.
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 the HLU is set to receive and transmit at its DSX-1 interface. Displayed during System Settings mode defined above.
LOSW	Loss of Sync Word	Indicates that the VHDSL loop has lost sync. Causes a minor alarm.
LLOS	Local Loss of Signal	Indicates that no signal is detected at the T1 input to the HLU. Causes a minor alarm.
RLOS	Remote Loss of Signal	Indicates that no signal is detected at the T1 input to the HRU. Causes a minor alarm.
DS1	DS1 BPV errors	Indicates that the number of BPVs at the HLU and HRU DS1 inputs that have exceeded the 24 hour ES threshold. Causes a minor alarm
DS0	DS0 Blocked Channels	Indicates status of DS0 blocked channels. NONE indicates no channels are blocked. BLK indicates some channels are blocked.

TABLE 4. HRU-612 STATUS MENU DEFINITIONS

Message	Full Name	Description
ALARMS		
NONE	No Alarms	
LLOS	Local Loss of Signal	No signal from local T1 interface
RLOS	Remote Loss of Signal	No signal from remote T1 interface
LOSW	Loss of Sync Word	The VHDSL loops has lost sync.
HES	VHDSL Loop Errored Second	The VHDSL CRC errors have exceeded the user selectable ES threshold
DS1	Digital Service 1	BPV's have exceeded the user selectable ES threshold.
R(L)AIS	Alarm Indicating Signal	Indicates an AIS (all 1's) pattern is being transmitted from the remote(R) or Local (L) T1 output port.
LOOPBACKS		
SMJK	Smartjack Loopback	Loopback at HRU towards network initiated by 2 in 5 in-band loopback code or out-of-band ESF data link code. See Figure 5.
NREM	Network Remote Loopback	Loopback at HRU (remote) towards network initiated by intelligent line repeater code, HRU or HLU front panel push-button or maintenance terminal . See Figure 5.
NLOC	Network Local Loopback	Loopback at HLU (local) towards network initiated by intelligent office repeater code or HLU front panel push buttons or maintenance terminal. See Figure 5.
CLOC	Customer Local Loopback	Loopback at HRU (local) towards CI initiated by intelligent line repeater code or HLU front panel push buttons or maintenance terminal. See Figure 5.
CREM	Customer Remote Loopback	Loopback at HLU (remote) towards customer initiated by intelligent office repeater code or HLU front panel push buttons or maintenance terminal. See Figure 5.
ARM	Armed	HiGain-2 has detected the intelligent repeater loopback (2 in 5) arming code.
TLOS	Transmit Loss of Signal	HRU is in its TLOS initiated loopback state.

TABLE 5. GLOSSARY OF HIGAIN TERMS

Term	Definition
MARGINS	Indicates the excess signal to noise ratio, at either the HLU or HRU, relative to a 10-7 Bit Error Rate. 1st value is current margin, 2nd value is minimum margin since (C)leared last, 3rd value is maximum value since cleared and NA means Not Available.
PULSE ATTENUATION	Indicates the attenuation of the 2B1Q pulse from the distant end. HiGain-2 operates with nominal pulse attenuations up to 28 dB. This value is related to the cable pair's 392 kHz loss. The pulse attenuation is a more direct indication of the loop attenuation to the 2B1Q signal than the 392 kHz loss.
PPM	Indicates the relative offset of the crystal oscillator in the HRU-612 from the HLU-611's crystal oscillator. Values usually range from -100 to +100.
VHDSL 24 Hour ES (Errored Seconds)	The number of 1 second intervals that contained at least 1 CRC error. This value is a running total of the last 24 Hours.
VHDSL 24 Hour UAS (Unavailable Seconds)	The number of seconds the VHDSL loop was out of sync.
DS1 BPV Seconds (ES)	The number of seconds in which at least 1 bipolar violation was detected on the DS1 input.
DS1 UAS Count	The number of seconds during which the DS1 input signal was absent (125 or more consecutive 0's)
Frame type	Type of DS1 framing used on the input stream (SF, ESF, Unframed or No Activity)
Code type	Type of DS1 line coding used (AMI, B8ZS, AMI : ZBTSI or B8ZS : ZBTSI). The latter two conditions indicate the code type that is being received when HiGain-2 is set to its ZBTS mode. In either the AMI or B8ZS DS1 code mode, it displays the selected code as opposed to the code type that is actually being received.
Ver Vw.xL	"w.x" = the software version number of the HLU
Vw.xR	"w.x" = the software version number of the HRU.
yzL	"yz" = List number of the HLU
yzR	"yz" = List number of the HRU.

```
        HI-GAIN HRU-612   MAINTENANCE TERMINAL MAIN MENU   (ver V1.0R-0001)


                          A. VIEW SPAN STATUS
                          B. SET CLOCK
                          C. SYSTEM SETTINGS
                          D. VIEW PERFORMANCE DATA
                          E. VIEW PERFORMANCE HISTORY
                          F. VIEW ALARM HISTORY
```

FIGURE 7. HRU-612 MAIN MENU.

```
                              SPAN STATUS
                    (HLU/ver1.4-0001:HRU/ver1.0-0001)
TIME: 01:00:30
DATE: 09/24/94

ALARMS:   LAIS RAIS LLOS RLOS
LOOPBACK: OFF
                    HLU                          HRU
                    HDSL                         HDSL
                 cur/min/max                  cur/min/max
MARGIN:            20/18/21                     19/18/20 dB
PULSE ATTN:           00                           00    dB
PPM OFFSET:           00                           -08   ppm
24 HOUR ES:        00001                        00001  seconds
24 HOUR UAS:       00001                        00013  seconds

                                    DS1 STATUS
                                HLU                  HRU
24 HOUR BPV Seconds:          00001                00000
24 HOUR UAS Count:            03619                03631
Frame type:                No Activity          No Activity
Code type:                     AMI                  AMI

                              (E)xit (U)pdate
```

Figure 8. HRU Status Display.

```
                                SET CLOCK

      TIME: 14:32:51
      DATE: 07/13/95
      CIRCUIT ID#: PairGain Technologies


      Format: HH:MM
              MM/DD/YY









      NEW TIME:

      NEW DATE:
```

FIGURE 9. Set Clock Menu.

```
                            SYSTEM SETTINGS

   TIME: 14:34:37
   DATE: 07/13/95                    CIRCUIT ID#: PairGain Technologies

   E(Q)UALIZATION:     EXT
   SMART-JACK (L)B:    ENABLE
   (S)PECIAL LPBK:     A2LB
   (P)OWER:            ENABLE
   (Z)BTSI:            OFF
   ES ALARM TH(R)ES:   NONE
   LOOPBACK (T)IMEOUT: 120
   (A)LARM:            DISABLE
   (D)S1 LINE CODE:    AMI
   (F)RAMING:          UNFR
   AIS ON (H)DSL ALRM: DISABLE
   AIS ON S(M)JK/NREM: ENABLE
   MAR(G)IN ALM THRES: 4
   DSO (B)LOCKING: xx - Blocked Channels
   01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

                            (E)xit
        Enter the letter in parenthesis (X) to change any setting
```

Figure 10. System Settings Menu.

```
Date: 07/13/95            PERFORMANCE DATA
CIRCUIT ID#: PairGain Technologies
                  ERRORED SECONDS/UNAVAILABLE SECONDS

                 DS1                HDSL
             HLU       HRU       HLU       HRU
10:30    000/000   000/000   000/000   000/000
10:45    000/000   000/000   000/000   000/000
11:00    000/000   000/000   000/000   000/000
11:15    000/000   000/000   000/000   000/000
11:30    000/898   002/884   001/016   002/000
11:45    000/900   000/900   000/000   000/000
12:00    000/900   000/900   000/000   000/000
12:15    000/900   000/900   000/000   000/000
12:30    000/900   000/900   001/000   000/000
12:45    000/900   000/900   000/000   000/000
13:00    000/900   000/900   000/000   000/000
13:15    000/900   000/900   000/000   000/000
13:30    000/900   000/900   000/000   000/000
13:45    000/900   000/900   000/000   000/000
14:00    000/900   000/900   000/000   000/000
14:15    000/900   000/900   001/000   000/000

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

Figure 11. Performance Data.

```
Time: 14:30:01                    7 DAY HISTORY
CIRCUIT ID#: PairGain Technologies


                      ERRORED SECONDS/UNAVAILABLE SECONDS

                DS1                    HDSL
            HLU          HRU          HLU          HRU
07/06   00000/00000 00000/00000 00000/00000 00000/00000
07/07   00000/00000 00000/00000 00000/00000 00000/00000
07/08   00000/00000 00000/00000 00000/00000 00000/00000
07/09   00000/00000 00000/00000 00000/00000 00000/00000
07/10   00000/00000 00000/00000 00000/00000 00000/00000
07/11   00000/00000 00000/00000 00000/00000 00000/00000
07/12   00000/00000 00000/00000 00000/00000 00000/00000
current 00001/10976 00003/11000 00003/00016 00002/00000




                                   (E)xit
```

Figure 12. Performance Data History.

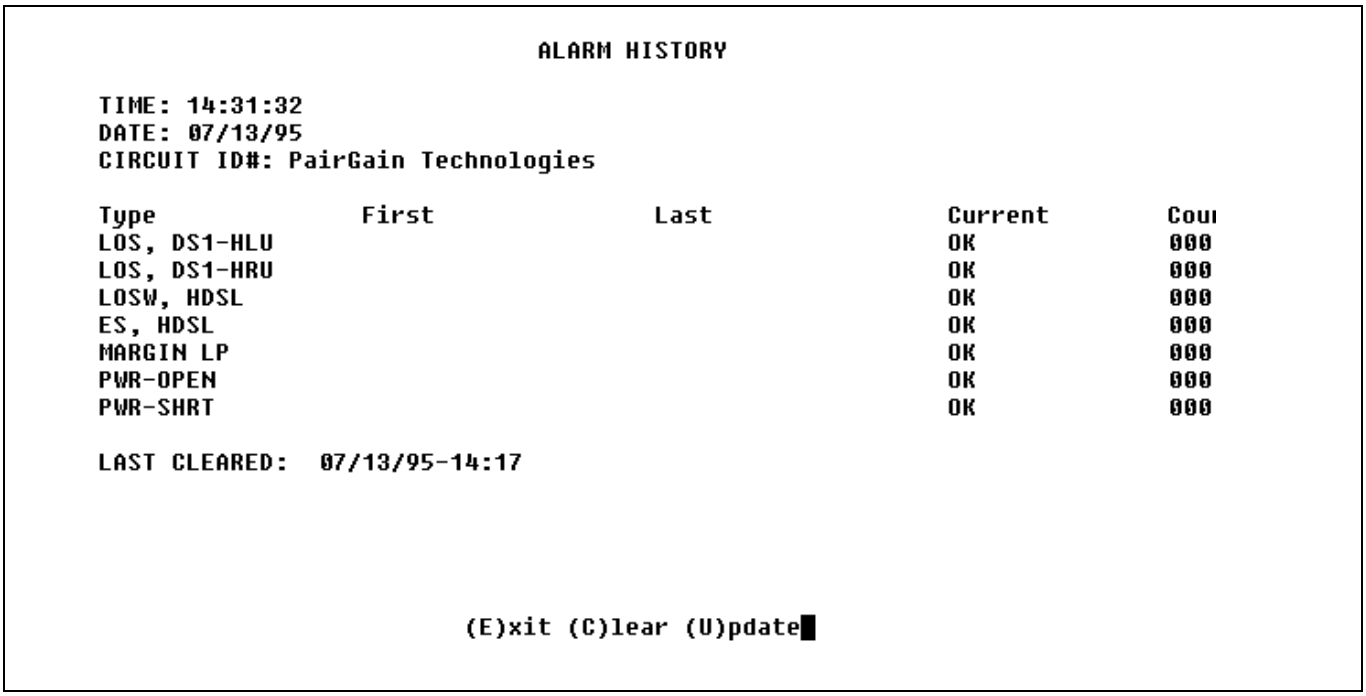

Figure 13. HLU Alarm History.