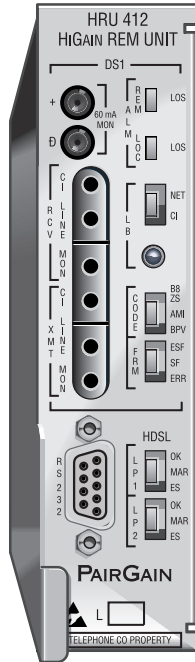


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# HIGAIN REMOTE UNIT

Model	List Number	Part Number	CLEI Code
HRU-412	8	150-1103-08	T1L2CC0AAA

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



**SECTION 150-412-108-02**

## Revision History of This Practice

Revision	Release Date	Revisions Made
02	July 13, 1998	Modified and Updated
01	March 22, 1996	Initial Release

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# USING THIS TECHNICAL PRACTICE

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



**Notes contain information about special circumstances.**



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

## ABBREVIATIONS

<b>AMI</b>	Alternate Mark Inversion
<b>BER</b>	Bit Error Rate
<b>BPV</b>	Bipolar Violations
<b>B8ZS</b>	Binary Eight Zero Substitution
<b>CO</b>	Central Office
<b>CRC</b>	Cyclic Redundancy Check
<b>CSA</b>	Carrier Service Area
<b>ES</b>	Errored Seconds
<b>ESF</b>	Extended Superframe
<b>HDSL</b>	High-bit-rate Digital Subscriber Line
<b>HLU</b>	HiGain Line Unit
<b>HRU</b>	HiGain Remote Unit

<b>SF</b>	Super Frame
<b>SNR</b>	Signal-to-Noise Ratio
<b>SPLB</b>	Special Loopback
<b>ZBTSI</b>	Zero Byte Time Slot Interface

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# OVERVIEW

The PairGain® HiGain® Remote Unit Model HRU-412 List 8 is the remote end of a repeaterless T1 transmission system. An HRU-412 List 8 connects to a HiGain Line Unit (HLU), creating a HiGain system which provides 1.544 Mbps transmission on two unconditioned copper pairs over the full Carrier Service Area (CSA) range. The CSA encompasses approximately 12,000 feet of AWG 24 wire or 9,000 feet of AWG 26 wire, including bridge taps and gauge changes. A HiGain system utilizes 2B1Q High-bit-rate Digital Subscriber Line (HDSL) transmission technology. The HRU-412 List 8 complies with ANSI T1E1.4, T1.403-1989, and T1E1.4/92-002R2 technical standards and recommendations. The HRU-412 List 8 mounts in a single slot of an industry standard 400 Mechanics type shelf. The system also complies with GR-63 Core of Network Equipment Building System (NEBS) Generic Equipment requirements, and Transport System Generic Requirements (TSGR) common requirements TR-TSY-000499.

The HRU-412 List 8 features:

- Customer Interface (CI)
- Front panel DS1 and HDSL LEDs
- Front panel loopback button
- Signature resistance on DS1 and HDSL ports
- Generic and addressable repeater loopback activation codes
- Metallic SmartJack loopback (conforms to TR-TSY-000312)
- Provisioning switches for customer premise equipment (CPE) current, receive (RCV) level, and transmit loss of signal (TLOS) initiated loopback or alarm
- Line or local power options
- Sealing current
- Front panel jacks for test access
- Craft port
- CPE current monitor test points
- Front panel HDSL margin threshold indicator for each loop
- Lightning and power cross protection on HDSL and DS1 interfaces

- 784kbps full-duplex 2B1Q HDSL transmission on two pairs
- DS0 blocking support

The HRU-412 List 8 supports PairGain's 1 x 1 Protection Switching System. The HRU-412 List 8 can be line powered or locally powered and has a simplex sealing current option. The HDSL line input resistive signature is 14  $\Omega$ .



**The HRU-412 List 8 supports PairGain's 1 x 1 Protection Switching System.**

## APPLICATIONS

A HiGain system, consisting of a HiGain line unit and a HiGain remote unit, provides a quick and cost-effective way of delivering T1 High Capacity Digital Service (HCDS) to customers over copper pairs. The HiGain system can be deployed on two unconditioned, non-loaded copper pairs without repeaters, and without the need for bridged tap removal or binder group separation.

The general guidelines for HiGain system usage is that each loop has less than 35 dB of loss at 196 kHz, with 135  $\Omega$  driving and terminating impedances.

Table 1 provides a guide for the loss over various cable gauges at 196 kHz and 135  $\Omega$ . The table applies to the HDSL cable pairs between the HiGain line unit and the HiGain remote unit. Without specific loop insertion loss data, add 3 dB for each bridged tap and 1 dB for each cable gauge change.

The dc cable resistance determines the simplex powering resistance path of the loops. The maximum allowable resistance for a HiGain system is 800  $\Omega$  over two HDSL simplex loops. This means, for example, where 12 kft AWG 24 equals 34.08 dB (insertion loss) resistance is at 622  $\Omega$ , which is well below the limit of 800  $\Omega$ .

**Table 1. HDSL Loss Over Cables**

<b>Cable Gauge</b>	<b>Loss at 196 kHz (db/kft)</b>	<b>Ohms per kft</b>
26/0.4mm	3.88	83
24/0.51mm	2.84	52
22/0.61mm	2.18	32
19/0.91mm	1.54	16

A HiGain system operates with a variety of other T1, POTS, Digital Data Service (DDS) equipment or other HiGain systems sharing the same cable binder group. HiGain systems provide temporary or permanent DS1 service and can provide a means of deploying service in advance of fiber-optic transmission systems.

## SPECIFICATIONS

### HDSL

Line Code	884 kbps 2B1Q full duplex
Output	+13 dBm $\pm$ 0.5 dB at 135 $\Omega$
Line Impedance	135 $\Omega$
Startup Time	15 seconds (typical), 60 seconds (maximum)

### Maximum Provisioning Loss

35 dB at 196 kHz, 135  $\Omega$

### Line Clock Rate

Internal Stratum 4 clock

### Power Consumption

6 Watts (typical), 8 Watts (maximum)

## Electrical Protection

Secondary surge and power cross protection on all DS1 and HDSL ports

## Environmental

Operating Temperature	- 40° C to + 65° C
Humidity	5 to 95% (non-condensing)

## Mounting

Single wide 400 Mechanics type shelf

## DS1

One-way Delay	< 220 microseconds per span
Line Impedance	100 $\Omega$
Pulse Output	0 dB (RLEV = 0), -15 dB (RLEV = 15)
Input Level	> -22.5 dB
Line Rate	1.544 Mbps + 200 bps
Output Wander (MTIE and TVAR)	Compliant with Section 8.2.1 of the T1X1.3/90-026R8 SONET committee report
Line Format	AMI, B8ZS, or ZBTISI
Frame Format	ESF, SF, or unframed

## Dimensions

Height:	5.6 in. (14.22 cm)
Width:	1.4 in. (3.55 cm)
Depth:	5.6 in. (14.22 cm)
Weight:	1 lb. 2 oz. (510.85 g)

# FUNCTIONAL DESCRIPTION

This section describes the functions of the HRU-412 List 8.

## OPERATIONAL CAPABILITIES

HiGain utilizes PairGain's 2B1Q HDSL transceiver system to establish two full-duplex 784 kbps data channels between the HLU and a remotely mounted HRU-412 List 8. This provides a total capacity of 1.568 Mbps between the two units. PairGain's HDSL technology provides full-duplex services at standard T1 rates over copper wires between an HLU and an HRU, which comprise one HiGain system.

The HRU-412 List 8 power supply converts the power feed voltage received on the simplex pairs (or the -48 Vdc input when locally powered) to voltages and currents required by the HRU-412 circuitry. The power supply generates +5, -5 and 30 Vdc outputs. The 30 Vdc output is converted to a 60 mA current feed to power a Network Interface Device (NID) if required. Exercise caution when powering a unit that requires more than 30 Vdc. The HRU-412 List 8 cannot power a NID and another product simultaneously.

The HRU-412 List 8 dissipates 6 Watts of power and may consume up to 8 Watts when feeding 60 mA of simplex current to the CI.

The HRU-412 List 8 can be used with the HLU-232 line unit to form an automatic 1 x 1 protection switch system. For this application, the HRU-412 List 8 must be installed in the two slot HRE-422 remote enclosure. This enclosure provides access to the HRU-412 List 8 protection switch output, on pins 12 and 40, which control the protection switching function.

Figure 1 shows a block diagram of the HRU-412 List 8.

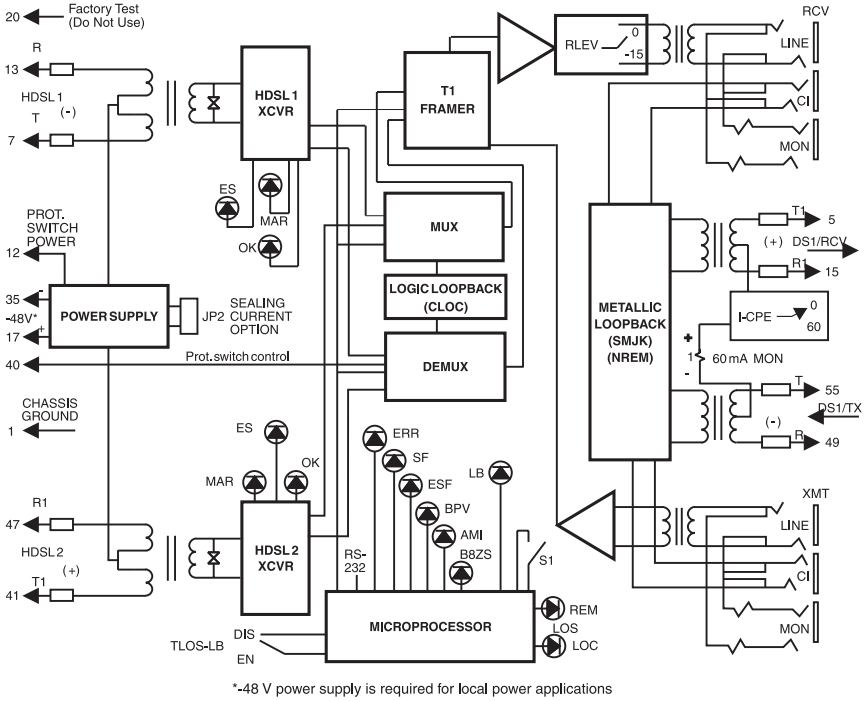
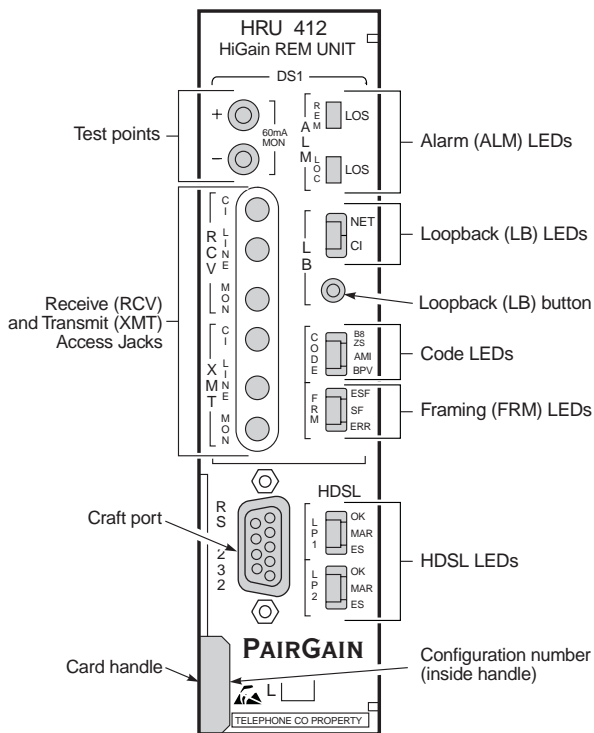


Figure 1. HRU-412 List 8 Block Diagram

# FRONT PANEL FEATURES

Figure 2 shows the front view of the HRU-412 List 8. Table 2 describes the HRU-412 List 8 front panel components.



**Figure 2.** HRU-412 List 8 Front Panel

**Table 2.** HRU-412 List 8 Front Panel Components

Name	Function
Test points	Allow the 60 mA CPE current option 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.
Receive (RCV) and transmit (XMT) jacks	Provide splitting and monitor access to the CPE DS1 interface. The jacks are transformer isolated from the CPE DS1 metallic interface.
Alarm LEDs	REM LOS LED lights red to indicate a loss of signal (LOS) at the T1 input to the HLU. This LOS condition causes the HRU-412 List 8 to transmit the alarm indicating signal (AIS) pattern toward the CPE. LOC LOS LED lights red to indicate a loss of signal (LOS) at the T1 input to the HRU-412 List 8. This LOS condition transmits the AIS pattern toward the DSX-1 (TLOS Disabled) or to execute a logic loopback in the HRU-412 List 8 (TLOS Enabled).
Loopback (LB) LEDs	NET LED lights green to indicate the HRU-412 List 8 is in a loopback state where the signal from the network is looping back to the network. CIS LED lights yellow to indicate the HRU-412 List 8 is in a loopback state in which the signal from the customer interface (CI) is looping back to the CI.
Code LEDs	B8ZS LED lights green to indicate that the user DS1 code option is set to B8ZS. AMI LED lights yellow to indicate that the user DS1 code option is set to AMI. BPV LED lights red to indicate that the user DS1 code option is set to BPV. If the user DS1 code option is set to AUTO, the lit LED indicates what DS1 signal is being received. Note that these settings are made on the HLU.
Framing LEDs	ESF LED lights green to indicate that the framing pattern of the received signal is Extended Super Frame (ESF). SF LED lights yellow to indicate that the framing pattern of the received signal is Super Frame (SF). ERR LED lights red to indicate that a DS1 frame error has occurred. No frame LED lights when the HRU-412 List 8 input pattern is unframed or when the framing option is set to UNFR (unframed). Note that this settings is made on the HLU.

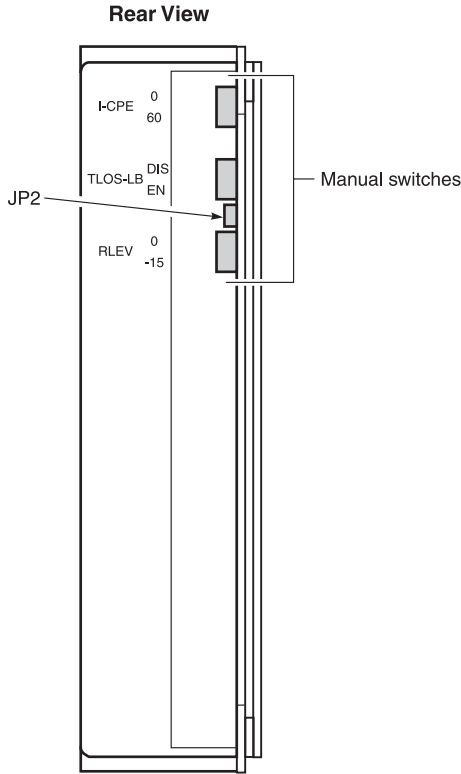


**Table 2. HRU-412 List 8 Front Panel Components (Cont.)**

Name	Function
HDSL LEDs	<p>LP1 OK LED flashes green while HDSL Loop 1 is synchronizing with the HLU. The LED lights green to indicate that loop 1 is properly synchronized with the HLU.</p> <p>LP1 MAR LED lights yellow when the HRU-412 List 8 margin on HDSL loop 1 has dropped below the user-defined margin threshold value. This indicator flashes yellow at a slow rate to indicate that a loss of sync word (LOSW) exists in span 1, loop 1 of the HDSL pair between the HLU and the doubler. This indicator flashes yellow at a rapid rate to indicate that a LOSW problem exists in span 2, loop 1 of the HDSL pairs between the first and second doublers.</p> <p>LP1 ES LED flashes red every second that a CRC error is detected on loop 1 from the upstream module.</p> <p>LP2 OK LED flashes green while HDSL Loop 1 is synchronizing with the HLU. The LED lights green to indicate that loop 2 is properly synchronized with the HLU.</p> <p>LP2 MAR LED lights yellow when the HRU-412 List 8 margin on HDSL loop 2 has dropped below the user-defined margin threshold value. This indicator flashes yellow at a slow rate to indicate that a loss of sync word (LOSW) exists in span 1, loop 2 of the HDSL pair between the HLU and the doubler. This indicator flashes yellow at a rapid rate to indicate that a LOSW problem exists in span 2, loop 2 of the HDSL pairs between the first and second doublers.</p> <p>LP2 ES LED flashes red every second that a CRC error is detected on loop 2 from the upstream module.</p>
RS-232 (Craft) port	Provides a connection port for an ASCII terminal. The ASCII terminal allows access to the maintenance, provisioning, and performance monitoring menus and screens.
Card handle	Pull on the card handle to remove the HRU-412 List 8 from the shelf slot.
Configuration Number	<p>Contains either a five or six-digit warranty configuration number or a stand-alone two or three-digit configuration number as follows:</p> <ul style="list-style-type: none"> <li>Digit 1 - Last digit of shipment year</li> <li>Digit 2 and 3 - Shipment month</li> <li>Digit 4, 5, and 6 - Configuration number</li> </ul>


# REAR PANEL FEATURES

The HRU-412 List 8 back panel features are shown in Figure 3. Table 3 describes the features.



**Figure 3.** HRU-412 List 8 Rear Panel

**Table 3. Rear Panel Components**

Switch	Setting	Function
I-CPE	0	Sets the CPE current to 0 mA.
	60	Sets the CPE current to 60 mA to power an external NID.
 <p>The CPE current control signals terminate on pins 32 and 34 of the card-edge converter. These access pins are for factory test only and are not used. Single slot remote enclosures and seven slot enclosures use the pins to control the CPE options in older HRU units. These enclosures must be optimized for 0 mA current to prevent a conflict between external connections to pins 32 and 34 and the settings of the I-CPE switch.</p>		
TLOS-LB	DIS	Does not allow the HRU-412 List 8 to enter its logic loopback state when a loss of the T1 XMT signal from the CPE causes the HLU to transmit the AIS signal toward the DSX-1.
	EN	Allows the HRU-412 List 8 to enter its logic loopback state when a loss of the T1 XMT signal from the CPE causes the HLU to transmit the AIS signal toward the DSX-1. While in this loopback state, the HRU-412 List 8 transmits the AIS signal toward the CPE and returns the network signal back to the network. The HLU displays TLOS in its front panel display. This condition remains until a valid T1 signal is received from the CPE or until the 3-in-5 in-band loopdown command is issued. Once the TLOS initiated loopback occurs, it will not reoccur until the CPE T1 signal has been reapplied and then removed. This feature prevents the HRU-412 List 8 from oscillating into and out of TLOS loopback when a loopdown command is issued in the absence of a T1 signal from the CPE. This TLOS option must never be enabled when the HRU-412 List 8 is used with old line units that do not support this feature. These older line units (List 6 and under) cannot loopdown an HRU-412 List 8 that is in a TLOS loop-up state when they receive the 3-in-5 in-band loopdown command.

**Table 3. Rear Panel Components (Cont.)**

Switch	Setting	Function
RLEV	0	Configures the T1 RCV level to 0 dB. This sets the T1 output signal level from the HRU-412 List 8 toward the NI to 0 dB. Use this setting when the HRU-412 List 8 is not functioning as a NID but is connected to an external NID. It allows the external NID to set the appropriate NI level.
	15	Configures the T1 RCV level to -15 dB. This sets the T1 output signal level from the HRU-412 List 8 toward the NI level to -15 dB. This setting is recommended when the HRU-412 List 8 functions as a NID.
JP2		Allows the enabling or disabling of the sealing current. To enable, connect JP2 across both terminals. To disable (default), remove the jumper from the inner terminal and leave it attached to the outer terminal only.

## LOCAL AND LINE POWERING

The HRU-412 List 8 unit can be line powered or local powered. It always chooses the local -48 Vdc power source, if present. It defaults to line power only in the absence of local power. Some older HLU automatically turn off their line powering when connected to the HRU-412 List 8. The older versions of the HLU-231 (Lists 1, 2, 3, 3A, and 4) must have their PWRF user option disabled for them to work properly with a locally powered HRU-412 List 8. Refer to the appropriate HLU technical practice if you need more information about its local and line powering capabilities.

When locally powered, the HRU-412 List 8 provides 15 mA (short loop) to 10 mA (long loop) simplex sealing current toward all versions of the HLU over the two HDSL pairs. JP2, shown in Figure 3, allows the sealing current to be enabled or disabled. To enable the sealing current, connect JP2 across both terminals. To disable the sealing current, remove the jumper from the inner terminal and attach it to the outer terminal. The factory default setting is disabled. This simplex sealing current is polarity sensitive and will not flow if the HDSL loops at the HRU-412 List 8 are reversed. Reversed loops are indicated by a CHREV message in the ALARMS line of the Span Status screen.

The simplex sealing current is not compatible with doublers HDU-451 List 1, 2, or 3. These doublers block the flow of simplex sealing current. To allow the flow of sealing current, use doublers HDU-451 List 4, HDU-439, HDU-438, HDU-409, HDU-407 or HDU-404 with the HRU-412 List 8.

If local power is lost to an HRU-412 List 8, the last span loses sync. When the HLU or HDU attempts to reestablish sync, it detects that the HRU-412 List 8 is not locally powered and applies line power to it. The HRU-412 List 8 then powers up and operates normally if the HRU-412 List 8 is within range to support line powering.

The -48 Vdc local power supply must have a 105 mA output current capacity (5 W) to power each HRU-412 List 8 when the I-CPE option is set to 0 mA. The -48 Vdc local power supply must have a 145 mA output current capacity (8 W) to power each HRU-412 List 8 when the I-CPE option is set to 60 mA.

A Teltrend WPS-2005 Wall-Mount Power Supply, or equivalent, is capable of powering two HRU-412 List 8 units with the I-CPE option switch set to 0 mA or one HRU-412 List 8 with the I-CPE option switch set to 60 mA.

The HRU-412 List 8 can be used in limited (2000  $\Omega$ ) and unlimited (full CSA) three span line powering applications. The line units and doublers compatible with limited and unlimited line powering are shown below:

- 1 Limited: loop resistance < 2000  $\Omega$ 
  - Line units: HLU-231 List 7D and 7B; HLU-431 List 1D
  - Doublers: HDU-437 List 1 and 1B; HDU-439 List 1 and 1B
- 2 Unlimited: full CSA range on all three spans
  - Line units: HLU-231 List 8, 8D and 8E; HLU 319 List 5, 5D, and 5E; HLU-388 List 5 and 5D
  - Doublers: HDU-409; HDU-407; HDU-404



**The HRU-412 List 8 supports up to three spans (with the use of two doublers).**

For more information on doublers, see the technical practices for the HiGain Mini Doublers and the HiGain Micro Doubler.

# INSTALLATION

This section describes how to install the HRU-412 List 8.

## UNPACK AND INSPECT THE SHIPMENT

Upon receipt of the equipment:

- 1 Unpack the container and visually inspect the product for signs of damage. If the equipment has been damaged in transit, immediately report the extent of the damage to the transportation company and to your sales representative.
- 2 Verify the contents using the packing list to ensure complete and accurate shipment.

If you must store the equipment for a prolonged period, store it in the original container.

## INSTALL THE HRU-412 LIST 8

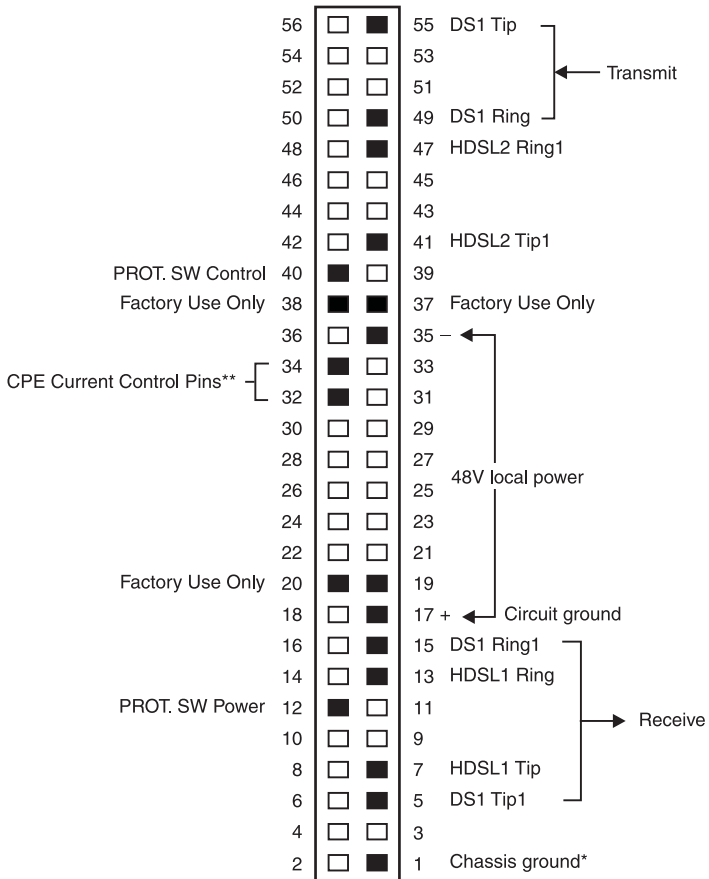
The HRU-412 List 8 mounts in the following shelves (indoor use):

- PairGain's HRE-421 (double-width, single-mount)
- HRE-422 (double-wide, double mount)
- HRE-424 (double-wide, four-unit wall mount)
- HRE-420 (single-wide, single mount)
- HRE-427 (seven-unit wall or rack mount)
- HRE-425 (12 slot wall or rack mount)

For outdoor applications, the HRU-412 List 8 mounts in the following shelves:

- HRE-454 (four-unit)
- HRE-450 (single-unit)
- 400 Mechanics type shelves

The HRU-412 List 8 pin-outs are shown in Figure 4. The active pins are shown in black.



\* Chassis Ground may be tied to Earth Ground per local practice.  
 Note: Active pins are highlighted in black.

**Figure 4.** HRU-412 List 8 Pinouts

To install the HRU-412 List 8:

- 1 Ensure that the shelf is correctly mounted and wired (refer to the shelf's technical practice for additional information).
- 2 Slide the HRU-412 List 8 into the card guides for the desired slot, then push the unit back until it touches the backplane card-edge connectors.
- 3 Place your thumbs on the HRU-412 List 8 front panel and push the HRU-412 List 8 into the card-edge connector until it is secured in the card guides.

## INSTALLATION TEST

Perform the following procedure to test the HRU-412 List 8.

- 1 Press the loopback button (see Figure 2 for the location of this button) for at least five seconds.

Verify that the LB NET LED lights green, indicating that the HRU-412 List 8 is in a digital (NREM) loopback state. If possible, verify that the HLU front panel displays NREM.

- 2 Have the CO transmit a T1 test signal to the HLU.

Measure the return (loop) signal to verify it is error free. If the signal is not error free, remove the HRU-412 List 8 from loopback by pressing the loopback button for five seconds. The LB NET LED should be off.

- 3 Have the CO send the HLU 4-in-8 in-band loop-up (NLOC) for five seconds.

If possible, verify that the HLU front panel displays NLOC.



**4** Repeat step 2.

If the test passes, a problem exists in the cable pair or in the HRU-412 List 8. If the test fails, the problem is at the CO.

**5** Check that the proper ports are in use for the HDSL and DS1 pair by using an ohm-meter to verify that the HDSL ports have a 180k transmit to receive resistive signature and that the DS1 ports have a 15 ohm transmit to receive resistive signature.

Measure the return (loop) signal to verify it is error free.

**6** If using an external NID, set the I-CPE switch (located on the back panel of the HRU-412 List 8; see Figure 3) to 60 mA and verify the NID is under power. Check that the voltage across the front panel test points (60 mA MON) measure between 55 mV and 65 mV.**7** Enable the sealing current option (JP2 connected) if required. Use a milli-amp meter to verify transmit or receive current in either HDSL pair.

# PROVISION AND MONITOR PERFORMANCE

The following sections describe how to perform configuration, provisioning and performance monitoring functions using the HRU-412 List 8 menus and screens.

## CONNECT AN ASCII TERMINAL

Connect an ASCII terminal:

- 1 Connect a standard 9-pin serial terminal cable to the Craft port, a DB-9 female connector, on the HRU-412 List 8. See Figure 5 for the Craft port wiring diagram.

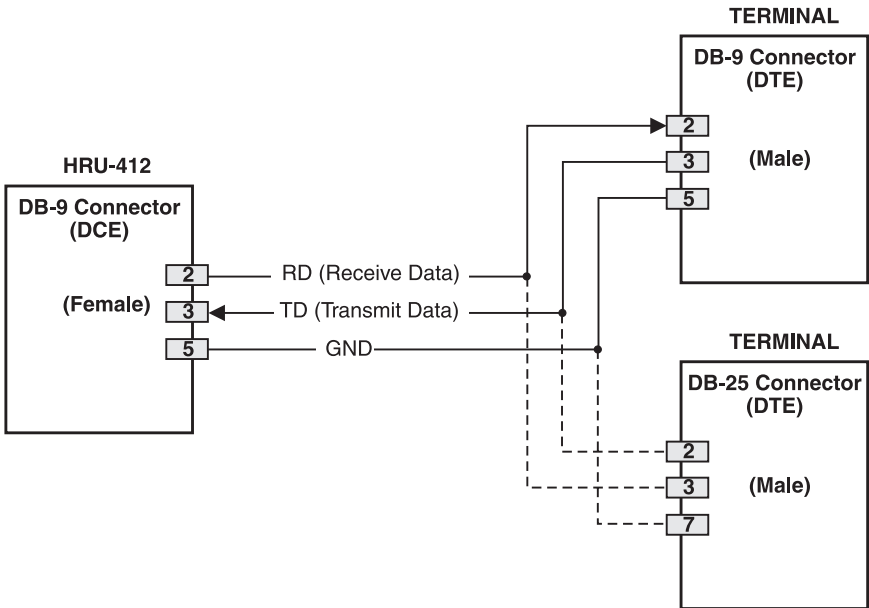


Figure 5. HRU-412 List 8 Craft Port Wiring

- 2 Connect the other end of the terminal cable to the console port on the ASCII terminal.
- 3 Configure the ASCII terminal to the following communication settings:
  - 1200 to 9600 baud
  - no parity
  - 8 data bits
  - 1 stop bit
  - hardware flow control to OFF

## LOG ON AND USE THE MENUS

The HRU-412 List 8 supports local and remote log on. Local log on connects the Craft port to the HRU-412 List 8 internal database. Remote log on connects the HRU-412 List 8 to the HLU using the HDSL Embedded Operation Channel (EOC) as the data link between the two units. Remote log on creates menus and screens at the HRU-412 List 8 that are identical to those at the HLU. See the appropriate line unit technical practice for more information about the menus and screens.

Initial log on to the HRU-412 List 8 is local for non-doubler applications. When the HRU-412 List 8 is not connected to an HLU, the displayed menus and screens are those from the HRU-412 List 8 internal database.

When the HRU-412 List 8 is connected to an HLU and doublers are in use, the port interface resets to remote when the two units synchronize. The remote log off option on the Main Menu (shown when in remote mode only) allows the termination of a remote session. Terminating a remote log on allows other units (such as a doubler) to log on through their Craft port. Terminating each remote session before beginning another is necessary because a HiGain circuit can support the log on of only one unit at a time. An active session for any unit prevents simultaneous sessions for any other circuit.

This section shows you how to log on and access the menus and screens using the ASCII terminal.

- 1 Press the spacebar several times to activate the autobaud feature and to display the logon screen. When using doublers, the remote logon screen displays when the HRU-412 List 8 and the HLU synchronize. See Figure 6.

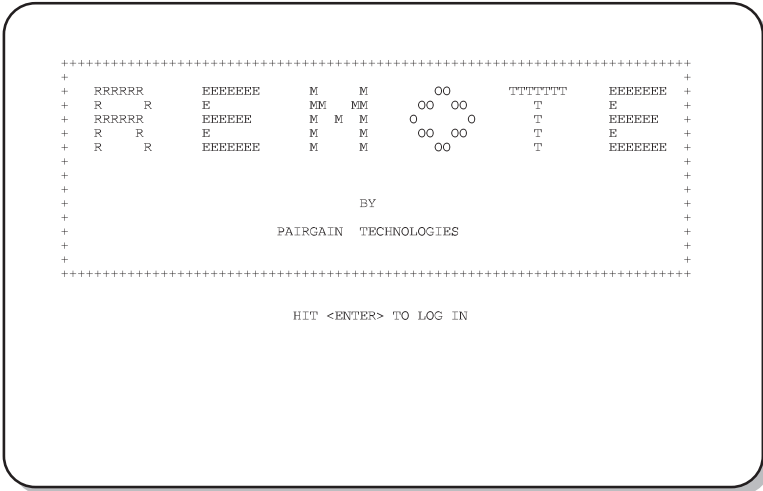
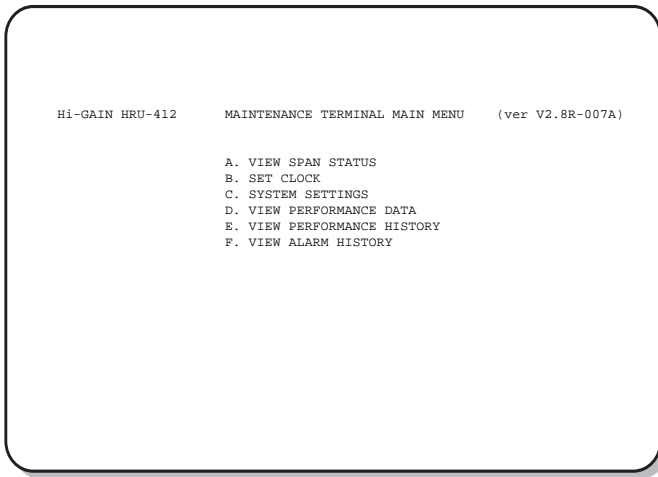


Figure 6. Remote Logon Screen

- 2 Press **ENTER**. The Main Menu displays.



**Figure 7.** *Main Menu, Local Log On*

Access options available on the Main Menu by typing the desired letter and then pressing **ENTER**.

# View Span Status

From the Main Menu, type **A**. The Span Status screen displays.

When no doublers are in use, the following Span Status screen displays:

```

          SPAN STATUS
    (HLU/ver0.0-0000:  HRU/ver2.8-008)

TIME: 08:29:95
DATE: 06/25/97

ALARMS:  NONE
LOOPBACK: OFF

          HDSL-1      HLU      HDSL-2      HRU
          cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:          N/A      N/A      N/A      N/A  dB
PULSE ATTN:     N/A      N/A      N/A      N/A  dB
PPM OFFSET:     N/A      N/A      N/A      N/A  ppm
24 HOUR ES:     00001    00002    00001    00001  seconds
24 HOUR UAS:    00000    00000    01073    01070  seconds

          DSI STATUS
          HLU      HRU
24 HOUR BPV Seconds:  00001    00000
24 HOUR UAS Count:   00000    00000
Frame type:         N/A      Unframed
Code type:          N/A      BBSZ

          (E)xit (U)pdate

```

**Figure 8.** Span Status Screen, No Doublers in Use

- 1 Type **U** to update the screen.
- 2 Type **E** to exit to the Main Menu.

When doublers are in use, the following Span Status screen displays:

```

                SPAN 1 STATUS
          ( HLJ/ver2.2-002D;HDU1/ver2.7-0004)

TIME: 08:41:01
DATE: 06/25/97                CIRCUIT ID#: PairGain2

ALARMS:  NONE
LOOPBACK: OFF

                HLJ                HDU1
                HDSL-1            HDSL-2            HDSL-1            HDSL-2
MARGIN:         cur/min/max      cur/min/max      cur/min/max      cur/min/max
                20/17/21         21/18/21         21/00/22         21/00/22 dB
PULSE ATTN:    00                00                00                00
PPM OFFSET:    00                00                06                06 ppm
24 HOUR ES:    00001            00002            00001            00002
seconds
24 HOUR UAS:   00792            00791            00013            00012
seconds

                DS1 STATUS
                HLJ                HRU
24 HOUR BPV Seconds: 00058         00241
24 HOUR UAS Count:  00013         00009
Frame type:         Unframed       Unframed
Code type:          AMI             AMI

(E)xit (U)pdate (S)pan

```

**Figure 9.** Span 1 Status Screen, Doublers in Use

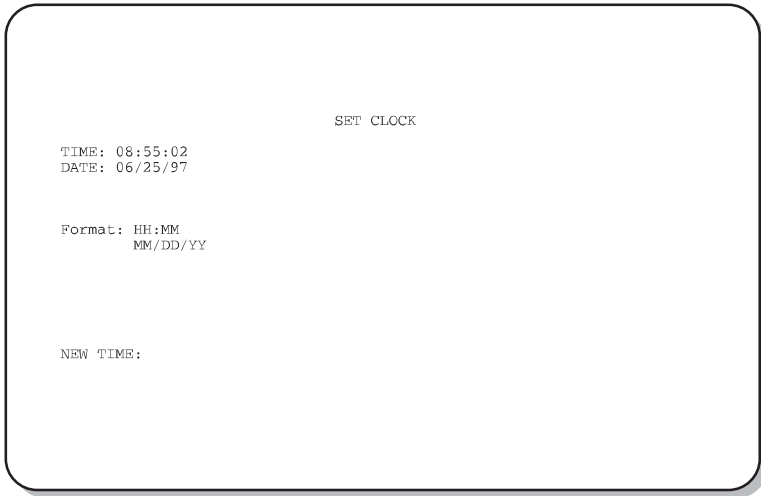
Do any of the following:

- Type **S** to view the next span.
- Type **U** to update the screen.
- Type **E** to exit.

## Set Clock

This option is available during Local log on only.

- 1 From the Main Menu, type **B** to display the Set Clock menu.



*Figure 10. Set Clock Screen*

- 2 Enter the time (in 24 hour format) at the Time prompt.
- 3 Press **ENTER**.
- 4 Enter the date (mm/dd/yy) at the Date prompt.
- 5 Press **ENTER**.
- 6 Type **E** to exit the Set Clock menu.



## System Settings

- 1 From the Main Menu, type **C** to display the System Settings menu.

```

                                SYSTEM SETTINGS

TIME: 08:57:36
DATE: 06/25/97                                CIRCUIT ID#: PairGain2

EQUALIZATION:          399
SMART-JACK LB:        ENABLE
SPECIAL LPBK:         CNLB
POWER:                 ENABLE
ZBTST:                OFF
ES ALARM THRES:       NONE
LOOPBACK TIMEOUT:     20
ALARM:                 DISABLE
DSL LINE CODE:        AUTO
FRAMING:              AUTO
AIS ON HDSL LOSW:     2 LCOPS
AIS ON SMJR/NREM:     ENABLE
MARGIN ALM THRES:     15
DSO BLOCKING: 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

```

**Figure 11.** System Settings Menu

- 2 View the HRU-412 List 8 system settings. Change system settings at the HLU connected to the HRU-412 List 8.

# View Performance Data

- 1 From the Main Menu, type **D** to display the Performance Data screen.

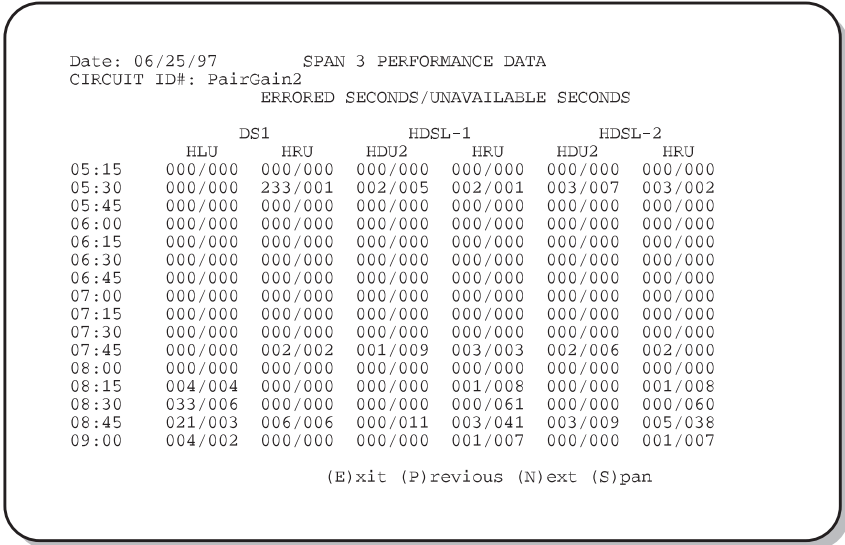


Figure 12. Performance Data Screen

- 2 If spans are in use, do any of the following:
  - Type **S** to view the spans.
  - Type **P** to view a previous span.
  - Type **N** to view the next span.
- 3 Type **E** to exit the Performance Data screen.

## View 7 Day History

- 1 From the Main Menu, type **E** to display the 7 Day History screen.

```

Time: 09:14:01                7 DAY HISTORY
CIRCUIT ID#: PairGain2

                                SPAN 3
                                ERRORED SECONDS/UNAVAILABLE SECONDS

                                DS1                HDSL-1                HDSL-2
                                HLU                HRU                HDU2                HRU
06/18  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000
06/19  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000
06/20  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000
06/21  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000
06/22  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000
06/23  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000
06/24  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000  00000/00000
current 00062/00015  00241/00009  00003/00025  00010/00121  00008/00022  00012/00115

                                (E)xit (S)pan

```

**Figure 13.** 7 Day History Screen

- 2 If spans are in use, type **S** to view them.
- 3 Type **E** to exit the 7 Day History screen.

## View Alarm History

- 1 From the Main Menu, type **F** to display the Alarm History screen.

```

                                ALARM HISTORY

TIME: 09:20:33
DATE: 06/25/97
CIRCUIT ID#: PairGain2

Type           First           Last           Current       Count
LOS, DS1-HLJ                OK             000
LOS, DS1-HRU                OK             000
SPAN3 LOSW, HDLS1 06/25/97-08:37    06/25/97-09:17    OK             004
SPAN3 LOSW, HDLS2 06/25/97-08:37    06/25/97-09:17    OK             006
SPAN3 ES, HDLS1                OK             000
SPAN3 ES, HDLS2                OK             000
SPAN3 MARGIN L1 06/25/97-09:00    06/25/97-09:18    OK             003
SPAN3 MARGIN L2 06/25/97-08:38    06/25/97-09:18    OK             004
PWR-OPEN        06/25/97-08:31    06/25/97-09:17    OK             013
PWR-SHRT        06/25/97-08:58    06/25/97-09:17    OK             003

LAST CLEARED: 06/25/97-08:31

                                (E)xit (U)pdate (S)pan

```

**Figure 14.** Alarm History Screen

- 2 Type **U** to update the Alarm History screen to the most current data.
- 3 If spans are in use, type **S** to view them.
- 4 Type **E** to exit the Alarm History screen.

Table 4 lists the HRU-412 List 8 alarm types and descriptions.

**Table 4.** *HRU-412 List 8 Alarm History Screen Definitions*

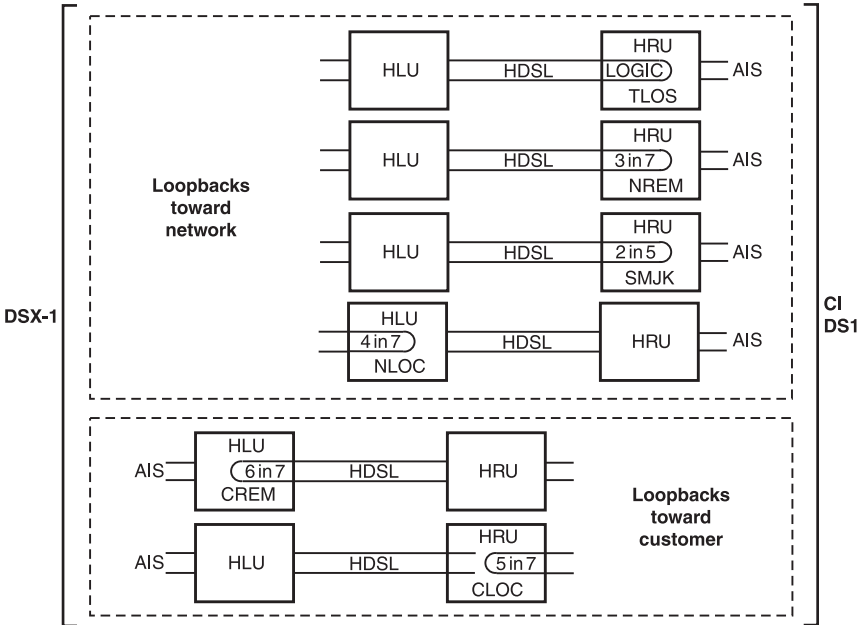
<b>Message</b>	<b>Full Name</b>	<b>Description</b>
NONE	No Alarms	No active alarms, or alarms previously detected are no longer active or have been reset.
LLOS	Local Loss of Signal	No signal from local T1 interface.
RLOS	Remote Loss of Signal	No signal from remote T1 interface.
LOSW	Loss of Sync Word	One of the HDSL loops has lost sync.
H1ES	HDSL Loop 1 Errored Second	Loop 1 CRC exceeds the ES threshold set at the HLU.
H2ES	HDSL Loop 2 Errored Second	Loop 2 CRC exceeds the ES threshold set at the HLU.
DS1	Digital Service 1	BPVs exceed the ES threshold set at the HLU.
ACO	Alarm Cut Off	An Alarm Cut Off is in effect.
AIS	Alarm Indicating Signal	An AIS (all ones) pattern is transmitting from the local T1 output port.
MAL1	Margin Alarm 1	The margin on HDSL Loop 1 dropped below the threshold set on the System Settings menu.
MAL2	Margin Alarm 2	The margin on HDSL Loop 2 dropped below the threshold set on the System Settings menu.
LAIS	Local Alarm Indicating Signal	Indicates an AIS pattern (all ones) is transmitting from the local T1 output port.
CHREV	Channel Reversed	The channel 1 and 2 HDSL pairs are reversed at the HRU-412 List 8 line input ports.
RAIS	Remote Alarm Indicating Signal	Indicates an AIS pattern (all ones) is transmitting from the remote T1 output port.

# LOOPBACKS

The HRU-412 List 8 supports 6 types of loopbacks (see [Figure 15](#)).

- TLOS (transmit loss of signal)
- CREM (customer remote loopback)
- NREM (network remote loopback)
- NLOC (network local loopback)
- CLOC (customer local loopback)
- SMJK (SmartJack)
- ARM (intelligent repeater loopback 2-in-5 arming code)

Loopback tests initiate at the CO, using in-band commands.



**Figure 15.** HRU-412 List 8 Loopbacks

A SmartJack loopback causes the T1 interface chip to transmit the AIS pattern to the NI and back to the HRU-412 List 8 T1 receiver circuit. The T1 input to the HRU-412 List 8 at the XMT port is disconnected and terminated in 100  $\Omega$ . The AIS pattern is examined by the HRU-412 List 8 for its overall integrity. The SmartJack loopback lasts about 100 milliseconds and terminates in one of the following conditions:

- Pre-loop failed: if the transmit and receive patterns (all ones) do not match, there is a problem in the HRU-412 List 8. The HLU declares an HRU pre-loopback fail condition. This terminates the loopback test and returns the HRU-412 List 8 to its unlooped normal state, indicating a defective HRU-412 List 8 at the HLU.
- Pre-loop passed: if the transmit and receive patterns do match, an HRU pre-loopback pass condition is declared. All active circuits are working. The metallic loopback relay remains closed and a logic loopback within the HRU-412 List 8 is enabled.

Logic loopback is required in order to present the all ones pattern to the CI and at the same time to loop the signal received from the network back toward the network. The HiGain system is in the AIS/ENA SmartJack loopback state. It remains in this state until a loopdown command is detected or the default time out period (if enabled at the HLU) expires.

When the HRU-412 List 8 is in the AIS/ENA SmartJack metallic loopback state, the T1 input LOS, Code, and 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 monitored, since the input circuit is open and terminates in 100  $\Omega$ . This forces the FRM LED off and the LOC LOS LED off. The CODE LED indicates AMI if the HLU CODE option is set to AUTO or AMI. It indicates B8ZS if the CODE option is set to B8ZS. The AIS/ENA metallic loopback scenario tests all of the HiGain system's active circuits and fully conforms to TR-TSY-000312.

When the HRU-412 List 8 is in an AIS/DIS SmartJack metallic loopback state, the T1 input LOS, Code, and Frame monitoring circuits are connected to the network signal, which is being looped back to these circuits through the loopback relay. The CPE input signal is no longer being monitored, since the input circuit was opened and terminated in 100  $\Omega$ . The FRM and LOC LOS LEDs indicate the status of this signal from the network. The CODE LED indicates the code (AMI or B8ZS) if the CODE option is set to AUTO. It indicates AMI or B8ZS if the CODE option is set to AMI or B8ZS, respectively.

All HRU-412 List 8 loopbacks toward the network (NREM and SMJK) are metallic/logic (AIS/ENA) or metallic only (AIS/DIS). The TLOS loopback is a logic loopback.

The SMJK and NREM loopbacks perform the same functions; their initiation differs. The SMJK identifying label indicates that the loopback was initiated by the 2-in-5 in-band command. NREM initiates by any in-band command except the 2-in-5 command. These other in-band commands include 3-in-8 command, 16-bit addressable repeater commands, or activation using the front panel MODE and SEL buttons.



**When T1 loopback tests are made on the HiGain system with external metallic loopback connections at either end, the DS1 code at the metallic loopback interface may be different from the DS1 code at the opposite end when the DS1 user option is set to AUTO. For example, if the HRU-412 List 8 has a metallic loopback and the HLU receive pattern code is changed from AMI to B8ZS, an all 0s pattern is sent to the HLU. The HRU-412 List 8 remains in AMI mode and loops all 0s causing the HRU-412 List 8 to indicate an LOS condition. The result is that the HLU outputs an AIS pattern.**



# 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

## 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

## UL LISTING

The HRU-412 List 8 is UL listed. Use caution when installing or modifying telephone lines. Dangerous voltages may be present. Do not install telephone wiring during a lightning storm. Always disconnect telephone lines and power connections from wall outlets before servicing or disassembling this equipment.

## **CSA CERTIFICATION**

The HRU-412 List 8 has been tested and found to comply with CSA Standard C22.2-950 with telecommunication features.

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



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