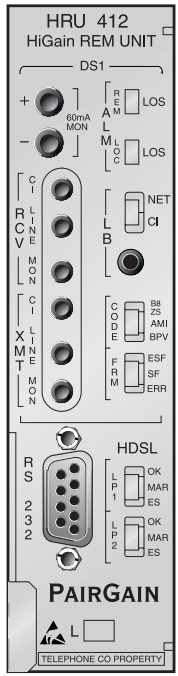
HIGAIN REMOTE UNIT

Model	List Number	Part Number
HRU-412	8B	150-1103-82



PAIRGAIN TECHNOLOGIES, INC.
ENGINEERING SERVICES TECHNICAL PRACTICE
SECTION 150-412-182-01

Revision History of This Practice
Revision 01- December 22, 1997
A) Initial Release

PAIRGAIN

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.

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OVERVIEW

The PairGain® HiGain® Remote Unit Model HRU-412 List 8B is the remote end of a repeaterless T1 transmission system. An HRU-412 List 8B connects to a HiGain Line Unit (such as the HLU-319 List 4B), creating a HiGain system which provides 1.544 Mbps transmission on two unconditioned copper pairs covering 3658 m of 0.51 mm wire or 2743 m of 0.4 mm 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 8B complies with ANSI T1E1.4, T1.403-1989, and T1E1.4/92-002R2 technical standards and recommendations. The HRU-412 List 8B mounts in a single slot of an industry standard 400 Mechanics type shelf. The system complies with Transport System Generic Requirements (TSGR) common requirements TR-TSY-000499.

The HRU-412 List 8B features:

- ANSI T1.403 DS1 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 Smart Jack 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
- Front panel jacks for test access
- Craft port
- Front panel HDSL margin threshold indicator for each loop
- Secondary lightning and power-cross protection on HDSL and DS1 interfaces
- 784 kbps full-duplex 2B1Q HDSL transmission on each of the two pairs
- DS0 blocking support

APPLICATION

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 have less than 35 dB of loss at 196 kHz, with 135 ohm driving and terminating impedances.

Table 1 provides a guide for the loss over various cable gauges at 196 kHz and 135 ohms. 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 ohms over two HDSL simplex loops. This means, for example, where 3.7 km of 0.51 mm wire equals 34.08 dB (insertion loss), resistance is at 622 ohms which is well below the limit of 800 ohms.

Table 1. *HDSL Loss over Cables*

Cable Gauge	Loss at 196 kHz (db/km)	Ohms per km
0.4 mm	12.7	272.3
0.51 mm	9.3	170.6
0.61 mm	7.2	105
0.91 mm	5.1	52.5

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	784 kbps 2B1Q full duplex
Output	+13.5 dBm ± 0.5 dBm at 135 ohms
Line Impedance	135 ohms
Startup Time	15 seconds (typical), 60 seconds (maximum)

Maximum Provisioning Loss

35 dB at 196 kHz, 135 ohms

Line Clock Rate

Internal Stratum 4 clock

Power Consumption

4 watts (typical), 4.9 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 HDSL span
Line Impedance	100 ohms
Pulse Output Level	0 dB (RLEV = 0), -15 dB (RLEV = 15)
Pulse Input Level	> -22.5 dB
Line Rate	1.544 Mbps ± 200 bps

Output Wander (MTIE and TVAR)	Compliant with Section 7.2.1 of the T1X1.3/90-026R7 SONET committee report
Line Format	AMI, B8ZS, or ZBTSI
Frame Format	ESF, SF, or unframed

Dimensions

Height:	14.22 cm
Width:	3.55 cm
Depth:	14.22 cm
Weight	511 g

FUNCTIONAL DESCRIPTION

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

Operational Capabilities

HiGain utilizes PairGain's 2B1Q HDSL transceiver system to establish two full-duplex 784 kbps data channels between the HLU-319 List 4B and a remotely mounted HRU-412 List 8B. 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 the HLU-319 List 4B and the HRU-412 List 8B, which comprise one HiGain system.

The HRU-412 List 8B power supply converts a local -48 Vdc input to voltages and currents required for internal use. The power supply generates +5 Vdc output.

Front Panel Features

Figure 1 shows the front view of the HRU-412 List 8B. Table 2 describes the HRU-412 List 8B front panel components.

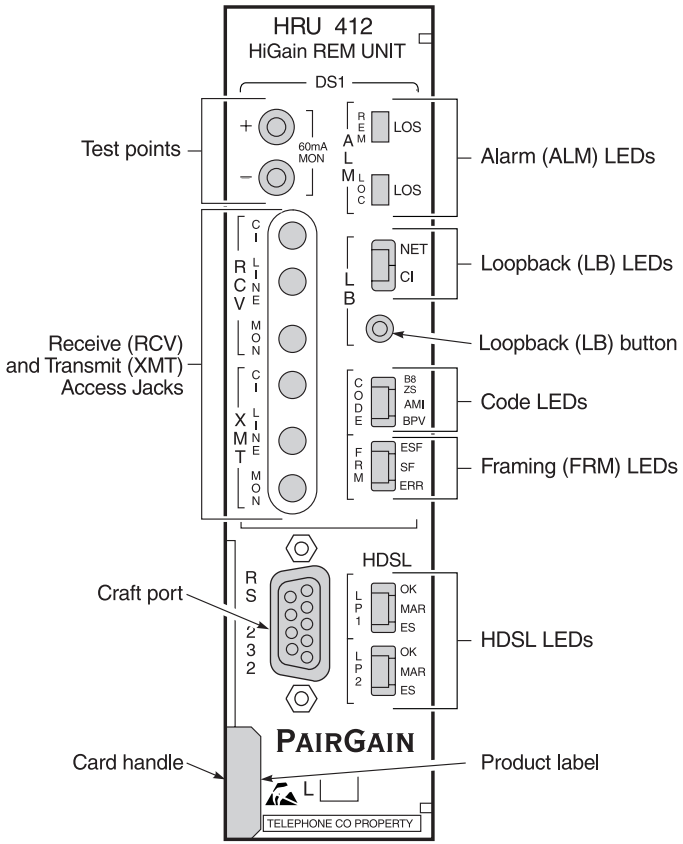


Figure 1. *HRU-412 List 8B Front Panel*

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

Name	Function
Test points	Not applicable.
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-319 List 4B. This LOS condition causes the HRU-412 List 8B to transmit the alarm indicating signal (AIS) pattern toward the CPE. LOC LOS LED is lit red to indicate a loss of signal (LOS) at the T1 input to the HRU-412 List 8B. This LOS condition transmits the AIS pattern toward the DSX-1 (TLOS Disabled) or to execute a logic loopback in the HRU-412 List 8B (TLOS Enabled).
Loopback (LB) LEDs	NET LED lights green to indicate the HRU-412 List 8B 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 8B 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-319 List 4B.
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 8B input pattern is unframed or when the framing option is set to UNFR (unframed). Note that this settings is made on the HLU-319 List 4B. (Continued)

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

Name	Function
HDSL LEDs	LP1 OK LED flashes green while HDSL Loop 1 is synchronizing with the HLU-319 List 4B. The LED lights green to indicate that loop 1 is properly synchronized with the HLU-319 List 4B. LP1 MAR LED lights yellow when the HRU-412 List 8B margin on HDSL loop 1 has dropped below the user-defined margin threshold value. This indicator flashes yellow to indicate that a loss of sync word (LOSW) exists between the HLU-319 List 4B and the HRU-412 List 8B. LP1 ES LED flashes red every second that a CRC error is detected on loop 1 from the upstream module. LP2 OK LED flashes green while HDSL Loop 1 is synchronizing with the HLU-319 List 4B. The LED lights green to indicate that loop 2 is properly synchronized with the HLU-319 List 4B. LP2 MAR LED lights yellow when the HRU-412 List 8B margin on HDSL loop 2 has dropped below the user-defined margin threshold value. This indicator flashes yellow to indicate that a loss of sync word (LOSW) exists between the HLU-319 List 4B and the HRU-412 List 8B. LP2 ES LED flashes red every second that a CRC error is detected on loop 2 from the upstream module.
Craft port	Provides a RS-232 connection port for a dumb terminal. The dumb terminal allows access to the maintenance, provisioning, and performance monitoring menus and screens.
Card handle	Pull the card handle to remove the HRU-412 List 8B from the shelf slot.
Product label	Provides a customer-specific product label for the HRU-412 List 8B.

Back Panel Features

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

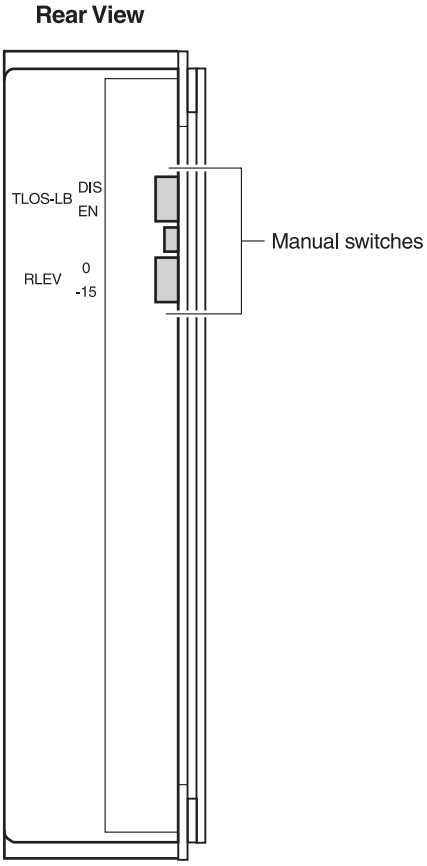


Figure 2. *HRU-412 List 8B Back Panel (Rear View)*

Table 3. *Back Panel User Options*

Switch	Setting	Function
TLOS-LB	DIS	Does not allow the HRU-412 List 8B to enter its logic loopback state when a loss of the T1 XMT signal from the CPE causes the HLU-319 List 4B to transmit the AIS signal toward the DSX-1.
	EN	Allows the HRU-412 List 8B to enter its logic loopback state when a loss of the T1 XMT signal from the CPE causes the HLU-319 List 4B List 4B to transmit the AIS signal toward the DSX-1. While in this loopback state, the HRU-412 List 8B transmits the AIS signal toward the CPE and returns the network signal back to the network. The HLU-319 List 4B 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 8B 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 8B is used with old line units that do not support this feature. These older line units (List 6 and under) cannot loopdown an HRU that is in a TLOS loop-up state when they receive the 3-in-5 in-band loopdown command.
RLEV	0	Configures the T1 RCV level to 0 dB. This sets the T1 output signal level from the HRU-412 List 8B toward the CI to 0 dB. Use this setting when the HRU-412 List 8B 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 8B toward the CI level to -15 dB. This setting is recommended when the HRU-412 List 8B functions as a NID.

Local Powering

The HRU-412 List 8B unit is local powered. The -48 Vdc local power supply must have a 83 mA output current capacity (4 W) to power each HRU-412 List 8B.

A Teltrend WPS-2005 Wall-Mount Power Supply, or equivalent, is capable of powering two HRU-412 List 8B units.

INSTALLATION

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

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 8B

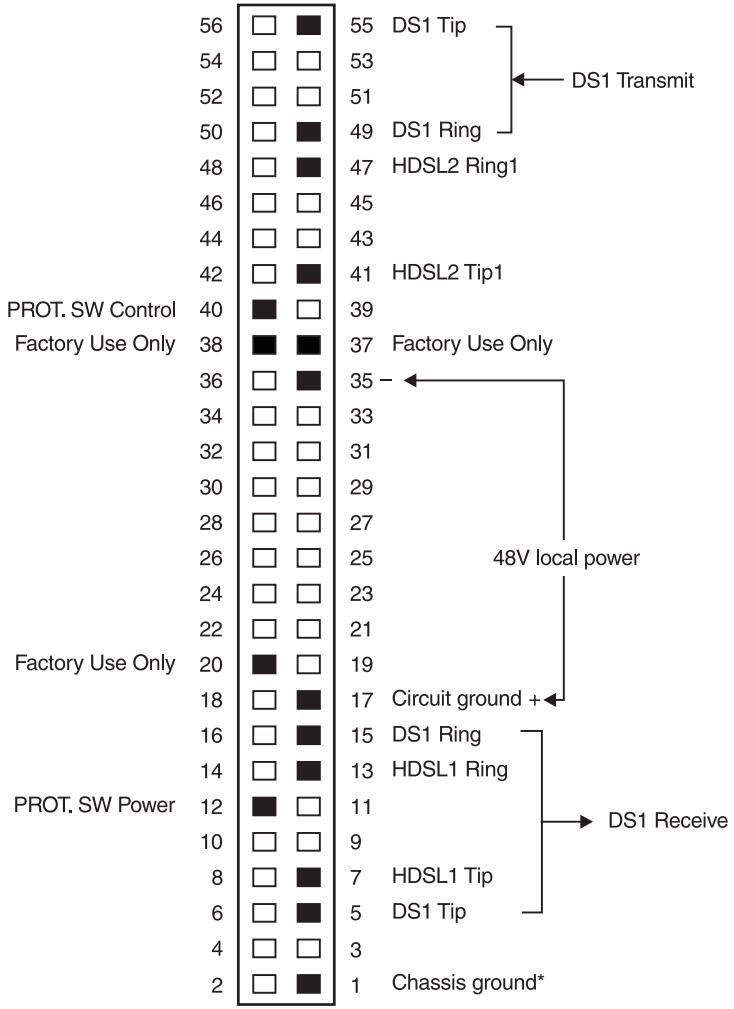
The HRU-412 List 8B mounts in PairGain's HRE-420 single width, single mount remote indoor enclosure.

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

- HRE-454 (four-unit)
- HRE-450 (single-unit)

The HRU-412 List 8B is also compatible with industry standard 400 Mechanics type shelves.

The HRU-412 List 8B pinouts are shown in Figure 3. The active pins are shown in black.



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

Figure 3. *HRU-412 List 8B Pinouts*

To install the HRU-412 List 8B:

1 Ensure that the shelf is correctly mounted and wired (refer to the shelf's technical practice).

2 Slide the HRU-412 List 8B 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 8B front panel and push the HRU-412 List 8B into the card-edge connector until it is entirely within the card guides.

Installation Test

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

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 is lit green, indicating that the HRU-412 List 8B is in a digital (NREM) loopback state. If possible, verify that the HLU-319 List 4B front panel displays NREM.

2 Have the CO transmit a T1 test signal to the HLU-319 List 4B and measure the return (loop) signal to verify it is error free.

If the signal is not error free, remove the HRU-412 List 8B from loopback by pressing the loopback button for five seconds. The LB NET LED should be off.

3 Have the CO send the HLU-319 List 4B 4-in-7 in-band loop-up (NLOC) for five seconds.

If possible, verify that the HLU-319 List 4B front panel displays NLOC.

4 Repeat step 2.

If the test passes, a problem exists in the HDSL cable pair(s) or in the HRU-412 List 8B. 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.

CONFIGURE, PROVISION, AND MONITOR PERFORMANCE

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

Connect a DumbTerminal

To connect a dumb terminal:

1 Connect a standard 9-pin serial terminal cable to the Craft (RS-232) port (DB-9 female connector) on the HRU-412 List 8B. See Figure 4 for the wiring configuration.

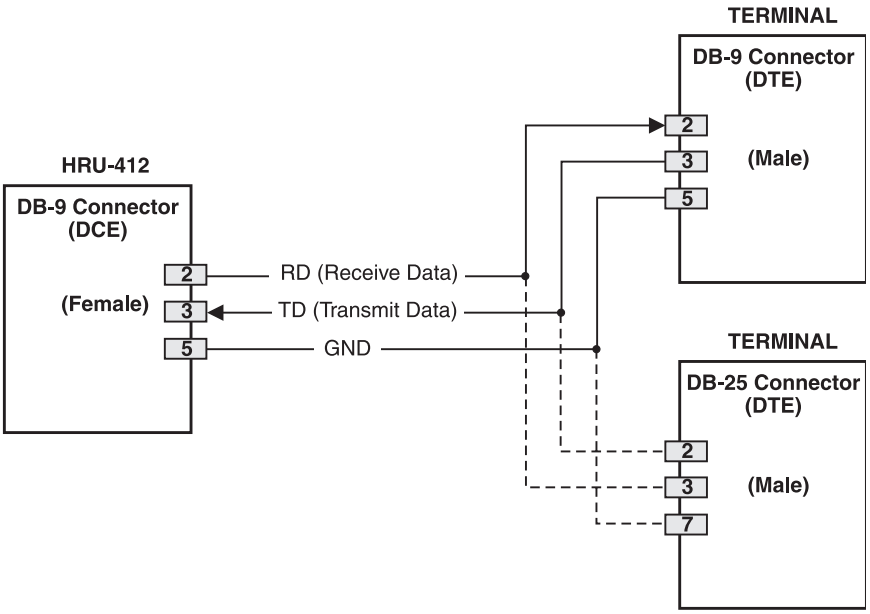


Figure 4. *HRU-412 List 8B Craft Port Wiring Configuration*

2 Connect the other end of the terminal cable to the console port on the dumb terminal.

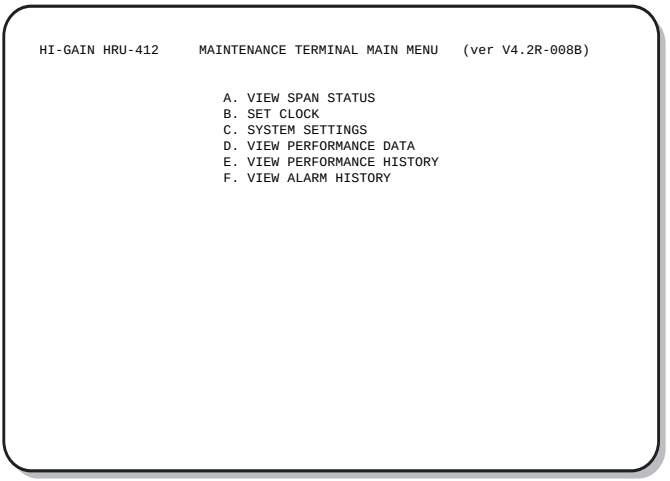
3 Configure the dumb terminal to the following communication settings:

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

Log On and Use the Menus

This section describes how to log on and access the menus and screens using the dumb terminal.

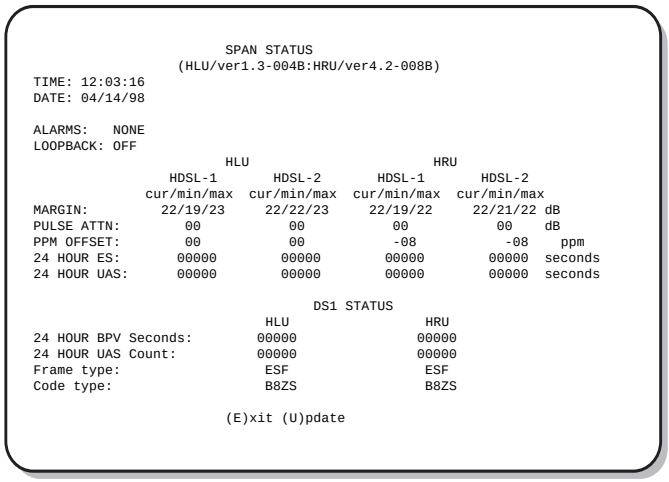
1 Press the spacebar several times to active the autobaud feature and to display the Main Menu.



2 Access options on the Main Menu by typing the letter of the desired option.

View Span Status

1 From the Main Menu, type **A** to display the Span Status screen.



```
                        SPAN STATUS
                  (HLU/ver1.3-004B:HRU/ver4.2-008B)
TIME: 12:03:16
DATE: 04/14/98

ALARMS:   NONE
LOOPBACK: OFF
                          HLU                          HRU
                   HDSL-1       HDSL-2       HDSL-1       HDSL-2
                cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:           22/19/23     22/22/23     22/19/22     22/21/22 dB
PULSE ATTN:         00           00           00           00     dB
PPM OFFSET:         00           00           -08          -08    ppm
24 HOUR ES:       00000        00000        00000        00000  seconds
24 HOUR UAS:      00000        00000        00000        00000  seconds

                                    DS1 STATUS
                                HLU                  HRU
24 HOUR BPV Seconds:          00000                00000
24 HOUR UAS Count:            00000                00000
Frame type:                    ESF                  ESF
Code type:                     B8ZS                 B8ZS

                         (E)xit (U)pdate
```

2 Type **U** to update the Span Status screen to the latest information.

3 Type **E** to exit the Span Staus screen.

Set Clock

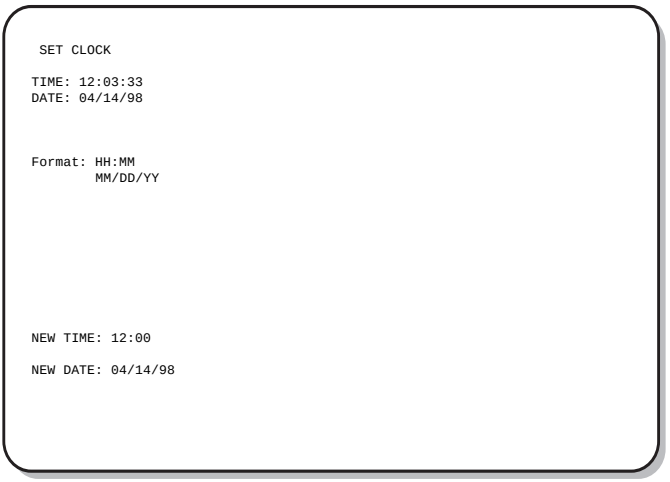
1 From the Main Menu, type **B** to display the Set Clock menu.

2 Enter the time (in 24 hour format, hours and minutes only) at the New Time prompt.

3 Press **ENTER**.

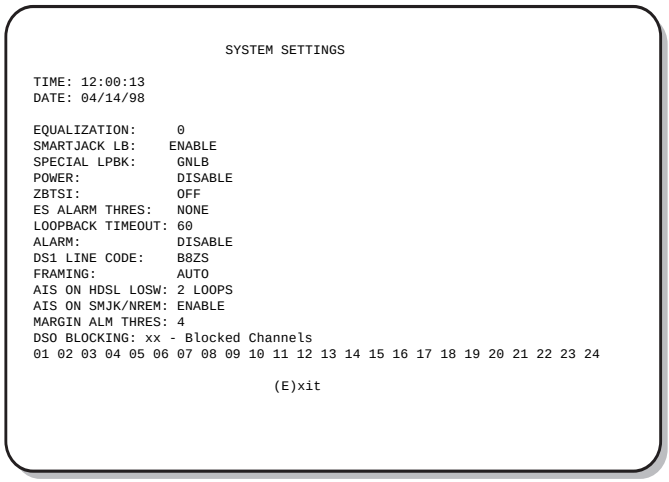
4 Enter the date (mm/dd/yy) at the New Date prompt.

5 Press **ENTER**.



System Settings

From the Main Menu, type **C** to display the System Settings screen.



View HRU-412 List 8B system settings on this screen. Change system settings at the HLU-319 List 4B connected to the HRU-412 List 8B.

View Performance Data

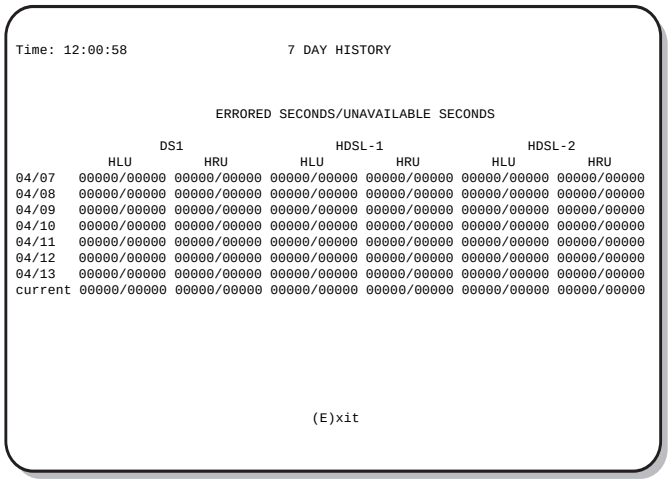
1 From the Main Menu, type **D** to display the Performance Data screen.

```
Date: 04/14/98          PERFORMANCE DATA

                   ERRORED SECONDS/UNAVAILABLE SECONDS

                 DS1             HDSL-1           HDSL-2
            HLU      HRU      HLU      HRU      HLU      HRU
08:15     000/000  000/000  000/000  000/000  000/000  000/000
08:30     000/000  000/000  000/000  000/000  000/000  000/000
08:45     000/000  000/000  000/000  000/000  000/000  000/000
09:00     000/000  000/000  000/000  000/000  000/000  000/000
09:15     000/000  000/000  000/000  000/000  000/000  000/000
09:30     000/000  000/000  000/000  000/000  000/000  000/000
09:45     000/000  000/000  000/000  000/000  000/000  000/000
10:00     000/000  000/000  000/000  000/000  000/000  000/000
10:15     000/000  000/000  000/000  000/000  000/000  000/000
10:30     000/000  000/000  000/000  000/000  000/000  000/000
10:45     000/000  000/000  000/000  000/000  000/000  000/000
11:00     000/000  000/000  000/000  000/000  000/000  000/000
11:15     000/000  000/000  000/000  000/000  000/000  000/000
11:30     000/000  000/000  000/000  000/000  000/000  000/000
11:45     000/000  000/000  000/000  000/000  000/000  000/000
12:00     000/000  000/000  000/000  000/000  000/000  000/000

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

2 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.



2 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: 12:00:37
DATE: 04/14/98
CIRCUIT ID#:

Type                 First                Last                 Current
       Count
LOS, DS1-HLU                                                   OK             000
LOS, DS1-HRU                                                   OK             000
LOSW, HDSL1          04/09/98-00:00       04/09/98-00:00       OK             001
LOSW, HDSL2          04/09/98-00:00       04/09/98-00:00       OK             001
ES, HDSL1                                                      OK             000
ES, HDSL2                                                      OK             000
MARGIN L1            04/09/98-00:00       04/09/98-00:00       OK             001
MARGIN L2                                                      OK             000



LAST CLEARED:   NONE

                       (E)xit   (C)lear   (U)pdate
```

2 Type **C** to clear the Alarm History screen.

3 Type **U** to update the Alarm History screen to the most current data.

4 Type **E** to exit the Alarm History screen.

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

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

Message	Full Name	Description
NONE	No Alarms	No active alarms, or alarms previously detected are no longer active or have been reset.
LOS DS1 HRU	Local Loss of Signal	No signal at the HRU-412 List 8B T1 interface.
LOS DS1 HLU	Remote Loss of Signal	No signal at the HLU-319 List 4B interface.
LOSW	Loss of Sync Word	One of the HDSL loops has lost sync.
H1ES	HDSL Loop 1 Errored Second	Loop 1 CRC exceed the ES threshold set at the HLU-319 List 4B.
H2ES	HDSL Loop 2 Errored Second	Loop 2 CRC exceed the ES threshold set at the HLU-319 List 4B.
SPAN 1 MARGIN	Power Feed Open	Indicates status of HDSL loop 1 margin.
SPAN 2 MARGIN	Power Feed Short	Indicates status of HDSL loop 2 margin.

LOOPBACKS

The HRU-412 List 8B supports 6 types of loopbacks (see Figure 6).

- TLOS (transmit loss of signal)
- CREM (customer remote loopback)
- NREM (network remote loopback)
- NLOC (network local loopback)
- CLOC (customer local loopback)
- SMJK (SmartJack loopback)

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

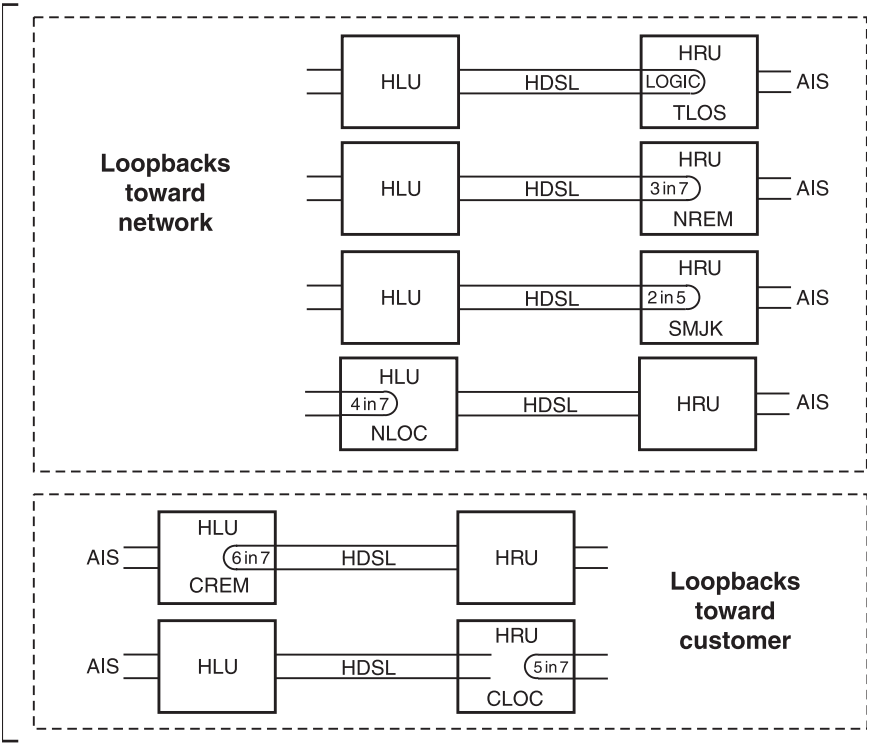


Figure 5. *HRU-412 List 8B Loopbacks*

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

1 Pre-loop failed. If the transmit and receive patterns (all 1s) do not match, there is a problem in the HRU-412 List 8B. The HLU declares an HRU pre-loopback fail condition. This terminates the loopback test and returns the HRU-412 List 8B to its unlooped normal state, indicating a defective HRU-412 List 8B.

2 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 8B is enabled.

Logic loopback is required in order to present the all 1s 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 then 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-319 List 4B) expires.

When the HRU-412 List 8B is in the AIS/ENA SmartJack metallic loopback state (as set at the HLU-319 List 4B), 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 ohms. This forces the FRM LED off, 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 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 ohms. 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 8B loopbacks toward the network (NREM and SMJK) are metallic/logic (AIS/ENA) or metallic only (AIS/DIS), except for the TLOS 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. Initiate NREM using other in-band commands, including the 3-in-7 command or 16-bit addressable repeater commands, from the front-panel MODE and SEL buttons or through the a dumb terminal connected to the Craft port.

CERTIFICATION AND WARRANTY

The HRU-412 List 8B is VCCI certified and UL listed. Information on certification and warranty is shown below.

VCCI Certification

This equipment has been tested and found to comply with the limits for VCCI Class A Requirements. 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 this instruction manual, may cause harmful interference to radio communication.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

UL Listing

The HRU-412 List 8B is listed with the Underwriter Laboratory.

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.

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

Warranty

PairGain Technologies, Incorporated warrants its products to be free of defective and faulty workmanship for a period of 60 months, under normal use, from the date of shipment. PairGain's obligation, under this warranty, is limited to replacing or repairing, at PairGain's option, any such product which is returned during the warranty period per PairGain's instructions and which product, in PairGain's sole opinion, is determined to be defective upon examination at our plant.

The transportation charges from the Buyer to PairGain will be prepaid by the Buyer. When the equipment is shipped back to the Buyer, PairGain will pay the charges, unless no trouble is found (NTF), in which case the buyer will pay for the shipment.

PairGain may use reconditioned parts for such repair or replacement. This warranty ***does not*** apply to any product which has been repaired, worked upon, or altered by persons not authorized by PairGain or in PairGain's sole judgment has subjected to misuse, accident, fire or other casualty, or operation beyond its design range.

Repaired products have a 90-day warranty, or until the end of the original warranty period--whichever period is greater.

Modules sent to PairGain for repair will be repaired or replaced and returned to you as soon as possible. Normally, current products are repaired within 14 calendar days, and out-of-production products are repaired within 30 calendar days.

TECHNICAL SUPPORT

PairGain provides technical support by phone, fax, and the World Wide Web.

Phone or Fax

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

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

A Customer Service Engineer answers technical assistance calls Monday through Friday between 8:00 AM and 5:00 PM, Pacific Time, excluding holidays. At all other times, an on-duty Customer Service Engineer returns technical assistance calls within 30 minutes.

Returns

To return equipment to PairGain:

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

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

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

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

- Company name, address, and the name of a person PairGain can contact regarding this equipment.
- The purchase order number provided to Customer Service when the RMA number was requested.

- A description of the equipment, as well as the number of units that you are returning. Be sure to include the model and part number of each unit.
- The shipping address to which PairGain should return the repaired equipment.
- The reason for the return:

  a) The equipment needs an ECO/ECN upgrade.

  b) The equipment is defective.

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

  c) If there is another reason for returning the equipment, please let us know so we can determine how best to help you.

4 Pack the equipment in a shipping carton.

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

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

Attention: **CRF RMA (Number)**

World Wide Web

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

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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PAIRGAIN