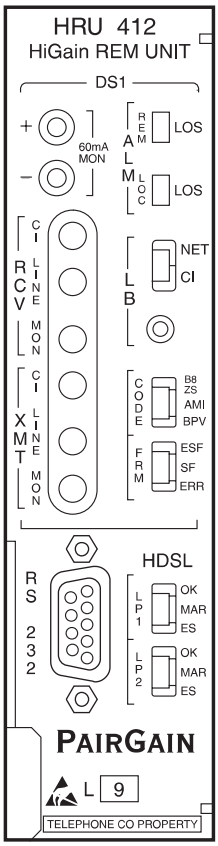
HIGAIN REMOTE UNIT

Model	List Number	Part Number	CLEI Code
HRU-412	9	150-1103-09	T1L2CCKAAA



PAIRGAIN TECHNOLOGIES, INC.
ENGINEERING SERVICES TECHNICAL PRACTICE
SECTION 150-412-109-01

Revision History of this practice.
July 9, 1997
A) Initial Release

PAIRGAIN
THE COPPEROPTICS COMPANY

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USING THIS TECHNICAL PRACTICE

Three types of messages, identified by icons, appear in the text:

A note informs you of special circumstances.

A caution indicates the possibility of equipment damage.

A warning indicates the possibility of personal injury.

A. PRODUCT OVERVIEW

1. Description and Features

1.1 This technical practice describes the PairGain® HiGain™ HRU-412 List 9, a HiGain Remote Unit (HRU) which functions as the remote end of a repeaterless T1 transmission system. When used with HiGain Line Units (HLUs) and HiGain Doubler Units (HDUs), the HiGain system provides 1.544 Mbps on two unconditioned copper pairs over the full Carrier Service Area (CSA) range. This practice describes using the HRU-412 with and without HiGain Doubler Units (HDUs).

1.2 Figure 1 shows a basic HiGain configuration for a T1 High-bit-rate Digital Subscriber Line (HDSL) circuit. The HLU is installed at the Central Office (CO) shelf and the HRU is housed in a remote enclosure at the Customer Premises Equipment (CPE) site. Optional HDUs provide the ability to double or even triple the distance range for customer applications located outside the CSA.

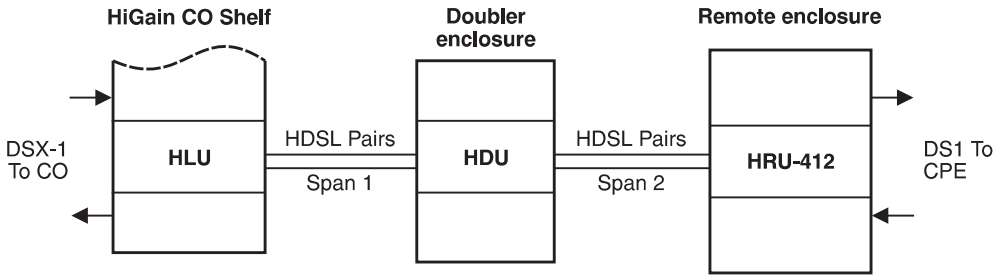


Figure 1. *Typical HiGain System*

1.3 Section C describes using the Maintenance Terminal Main menu for non-doubler applications and the Remote Terminal menus for doubler applications.

1.4 **Standards compliance.** The HiGain system uses HDSL transmission technology as recommended by Bellcore TA-TSY-001210. HiGain complies with:

- ANSI T1E1.4, T1.403-1989 and 1995, and T1E1.4/92-00R2R technical standards and recommendations
- TR-TSY-000063 Network Equipment Building System (NEBS) Generic Equipment requirements
- TR-TSY-000499 Transport System Generic Requirements (TSGR) common requirements

1.5 HRU-412 List 9 features:

- Front panel:
  - – CPE current monitor test points
  - – Receive (RCV) and Transmit (XMT) access jacks for testing
  - – DS1 and HDSL status LEDs
  - – HDSL margin threshold indicator
  - – RS-232 console port for connection to a maintenance terminal
- Performs Super Frame (SF)/Extended Super Frame (ESF) conversion
- ANSI T1.403 Performance Report Messages (PRMs)
- Supplemental Performance Report Messages (SPRMs), Alarm Indication Signal-Customer Interface (AIS-CI), and Remote Alarm Indicator-Customer Interface (RAI-CI) per T1E1.4/92-00R2R
- ANSI T1.403 DS1 Customer Interface (CI)
- Generic and addressable repeater loopback activation codes
- Provisioning switches for Interface-Customer Premises Equipment (I-CPE) current, Super Frame-Remote Alarm Indication (SF-RAI) signal, and Receive Level (RLEV) for the T1 output signal
- Line or local power options
- Optional sealing current
- Lightning and power cross protection on HDSL and DS1 interfaces
- 784 kbps full-duplex 2-Bits-1-Quaternary (2B1Q) HDSL Transmission on 2 pairs
- DS0 blocking
- Compatible with PairGain 1 x 1 Protection Switching System

The Transmit Loss of Signal Loopback (TLOS-LB) option in the HRU-412 List 8 has been replaced by the SF-RAI option. This option controls the generation of an SF-RAI signal in response to an ESF-RAI message.

1.6 Front Panel. Figure 2 and Table 1 identify the HRU-412 front panel components. Table 2 describes the functions of the front panel components and Table 3 describes how to read the different system status conditions indicated by the LEDs.

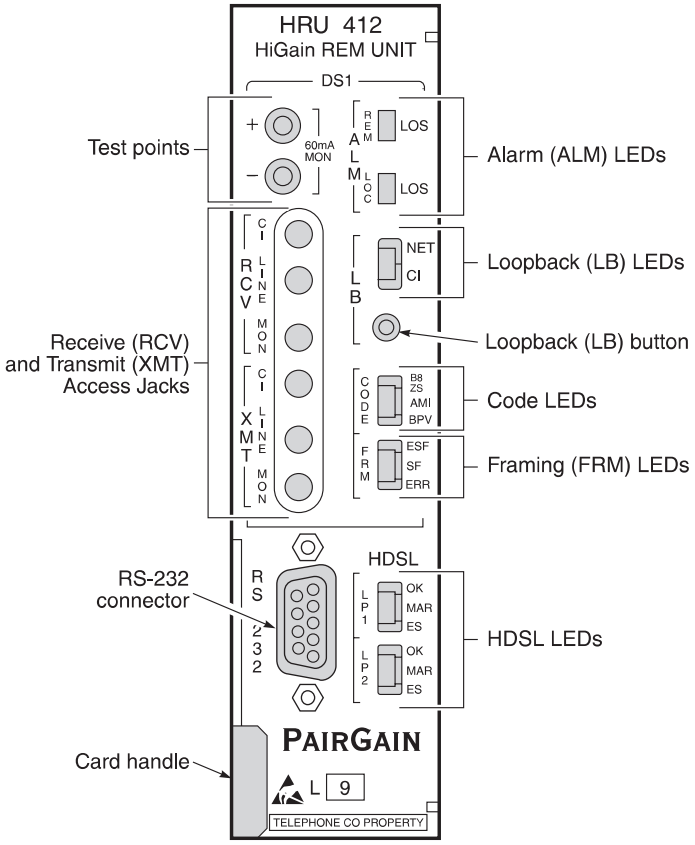


Figure 2. *HRU-412 Front Panel*

Table 1. *HRU-412 Front Panel Components*

Name	Function
Test points	Provides 60 mA MON (monitor) test points (see Table 2).
RCV and XMT Access Jacks	Provides splitting and monitor access jacks to the CPE DS1 interface (see Table 2).
Alarm LEDs	Shows alarm states (see Tables 2 and 3).
Loopback LEDs	Shows loopback states (see Tables 2 and 3).
Loopback button	Provides the ability to perform loopback test procedures (see Section 23).
Code LEDs	Provides indications for line code options (see Tables 2 and 3).
Framing LEDs	Provides indications for framing patterns (see Table 2 and 3).
RS-232 connector	Configured as Data Circuit-Terminating Equipment (DCE) which allows you to control the HRU-412 through a dumb terminal (or a PC with terminal emulation software).
HDSL LEDs	Displays HDSL Loop 1 and Loop 2 Conditions (see Tables 2 and 3).
Card Handle	Handle used to remove the HRU-412 from the remote enclosure.

Table 2. *HRU-412 Front Panel Component Functions*

Name	Function
Test points	60 mA MON (monitor) test points which 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 and XMT Access Jacks	Splitting and monitor access jacks to the CPE DS1 interface. See Figure 3 for circuit details. These jacks are transformer-isolated from the CPE DS1 metallic interface: CI: Customer Interface, LINE: Line Interface, MON: Monitor Interface
ALM LEDs	Remote and Local Loss Of Signal (LOS).
REM LOS	Displays remote (REM) LOS.
LOC LOS	Displays local (LOC) LOS.
LB LEDs	Loopback to/from the NET (Network) and to/from the Customer Interface (CI)
NET	Displays NET loopback state.
CI	Displays CI loopback state.
Loopback (LB) button	Activates the remote unit metallic loopback state by pressing the button for five (5) seconds. The unit can be unlooped by either pressing the button again for five seconds or via the standard loopdown coded messages.
CODE LEDs	Indications for code options.
B8ZS	Indicates that the DS1 line code option is set to Bidirectional 8-Zero substitution (B8ZS).
AMI	Indicates that the user DS1 line code option is set to Alternate Mark Inversion (AMI).
BPV	Indicates that a Bipolar Violation (BPV) is received at the remote's DS1 input.
FRM LEDs	Indications for framing patterns.
ESF	Displays ESF framing.
SF	Displays SF framing.
ERR	Framing error.
RS-232 connector	Provides bi-directional communication between the unit and an external dumb terminal through an RS-232 interface to allow configuration and performance monitoring through the Maintenance Terminal menus. See Section 10 for operating procedures.
HDSL LEDs	Displays HDSL Loop 1 and Loop 2 Conditions
LP1 (Loop 1)	
OK	Displays synchronization state for HDSL Loop 1.
MAR	Indicates that the Signal-to-Noise (S/N) margin has dropped below the margin threshold value.
ES	Indicates at least one HDSL Cyclic Redundancy Check (CRC) error is detected from the upstream module.
LP2 (Loop 2)	
OK	Displays synchronization state for HDSL Loop 2.
MAR	Indicates that the S/N margin has dropped below the margin threshold value.
ES	Indicates at least one HDSL CRC error is detected from the upstream module.

Table 3. *Reading the HRU-412 Front Panel LEDs*

Name	Mode	Description
REM LOS	Steady red	LOS detected at the T1 input to the remote HLU unit. This condition causes the HRU to transmit the AIS pattern towards the CPE.
	Off	Normal transmission of data.
LOC LOS	Steady red	LOS detected at the T1 input to the local HRU unit. This condition causes an AIS-CI signal to be transmitted towards the customer and an AIS-CI signal to be sent to the DSX-1 from the HLU. This state is not sent to the HLU and does not register an LOS ALRM condition.
	Off	Normal transmission of data.
NET	Steady green	The HRU is in a loopback state in which the signal from the NET is being looped back to the NET.
	Off	No NET loopbacks are active.
CI	Steady yellow	The HRU is in a loopback state in which the signal from the CI is being looped back to the CI.
	Off	No CI loopbacks are active.
B8ZS	Steady green	DS1 line code option set to B8ZS. If however the user DS1 line code option is set to Auto, LED indicates that the code of the DS1 signal being received at the HRUs DS1 input is B8ZS.
AMI	Steady yellow	DS1 line code option set to AMI. If the user DS1 line code option is set to Auto, LED indicates that the code of the DS1 signal being received at the HRUs DS1 input is AMI.
BPV	Blinking red	Blinks every time a BPV, other than those associated with a B8ZS code, is received at the HRUs DS1 input.
ESF	Steady green	Indicates that framing pattern of the signal being received at the HRUs DS1 input is ESF.
SF	Steady yellow	Indicates that framing pattern of the signal being received at the HRUs DS1 input is SF.
ERR	Steady red	Indicates a DS1 frame error has occurred.
LP1		
OK	Blinking green	HDSL Loop 1 is synchronizing with the HLU.
	Steady green	HDSL Loop 1 is synchronized and ready to receive and transmit data.
MAR	Blinking yellow	Indicates a problem in Loop 1 (doubler applications only) of the HDSL cable pairs that are non-adjacent to the HRU. Blinking once per second indicates a Loss of Sync Word (LOSW) problem in Span 1's Loop 1 HDSL pair between the HLU and doubler. Blinking twice per second indicates a LOSW problem in Span 2's Loop 1 HDSL pair between the first and second doublers.
ES	Blinking red	Blinks every second in which at least one HDSL CRC error is detected on Loop 1 from the upstream module.
LP2		
OK	Blinking green	HDSL Loop 2 is synchronizing with the HLU.
	Steady green	HDSL Loop 2 is synchronized and ready to receive and transmit data.
MAR	Blinking yellow	Indicates a problem in Loop 2 (doubler applications only) of the HDSL cable pairs that are non-adjacent to the HRU. Blinking once per second indicates a LOSW problem in Span 2's Loop 2 HDSL pair between the HLU and doubler. Blinking twice per second indicates a LOSW problem in Span 2's Loop 2 HDSL pair between the first and second doublers.
ES	Blinking red	Blinks every second in which at least one HDSL CRC error is detected on Loop 2 from the upstream module.

2. Specifications

Physical

Material ..... Steel

Finish ..... Zinc plated

Mounting ..... Any standard 400 mechanics shelf

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.

Power

Consumption ..... 6 W (with I-CPE set to 0)

8 W (with I-CPE set to 60)

Maximum Provisioning Loss ..... 35 dB at 196 kHz, 135 Ω

Electrical Protection ..... Secondary surge and power cross protection on all DS1 and HDSL ports

Environment

Operating Temperature ..... - 40 to + 65ºC

Operating Humidity ..... 5 to 95% non-condensing

HDSL

Line Code ..... 784 kbps 2B1Q full duplex

Output ..... +13 dB ± 0.5 dB @ 135 Ω

Line Impedance ..... 135 Ω

Line DC resistive signature ..... 14 Ω

Startup Time ..... 15 seconds (typical)

60 seconds (maximum)

DS1

Line Impedance ..... 100 Ω

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 7.2.1 of the T1X1.3/90-026R7 SONET Committee Report

Line Format ..... AMI, B8ZS, or ZBTSI

Frame Format ..... ESF, SF or unframed

Line Clock Rate

Internal Stratum 4 clock

3. Theory of Operation

3.1 HiGain utilizes 2B1Q HDSL transceiver systems to establish two full-duplex 784 kbps data channels between the HLU and a remotely-mounted HRU-412. This provides a total capacity of 1.568 Mbps between the two units. A block diagram of the HRU-412 is shown in Figure 3.

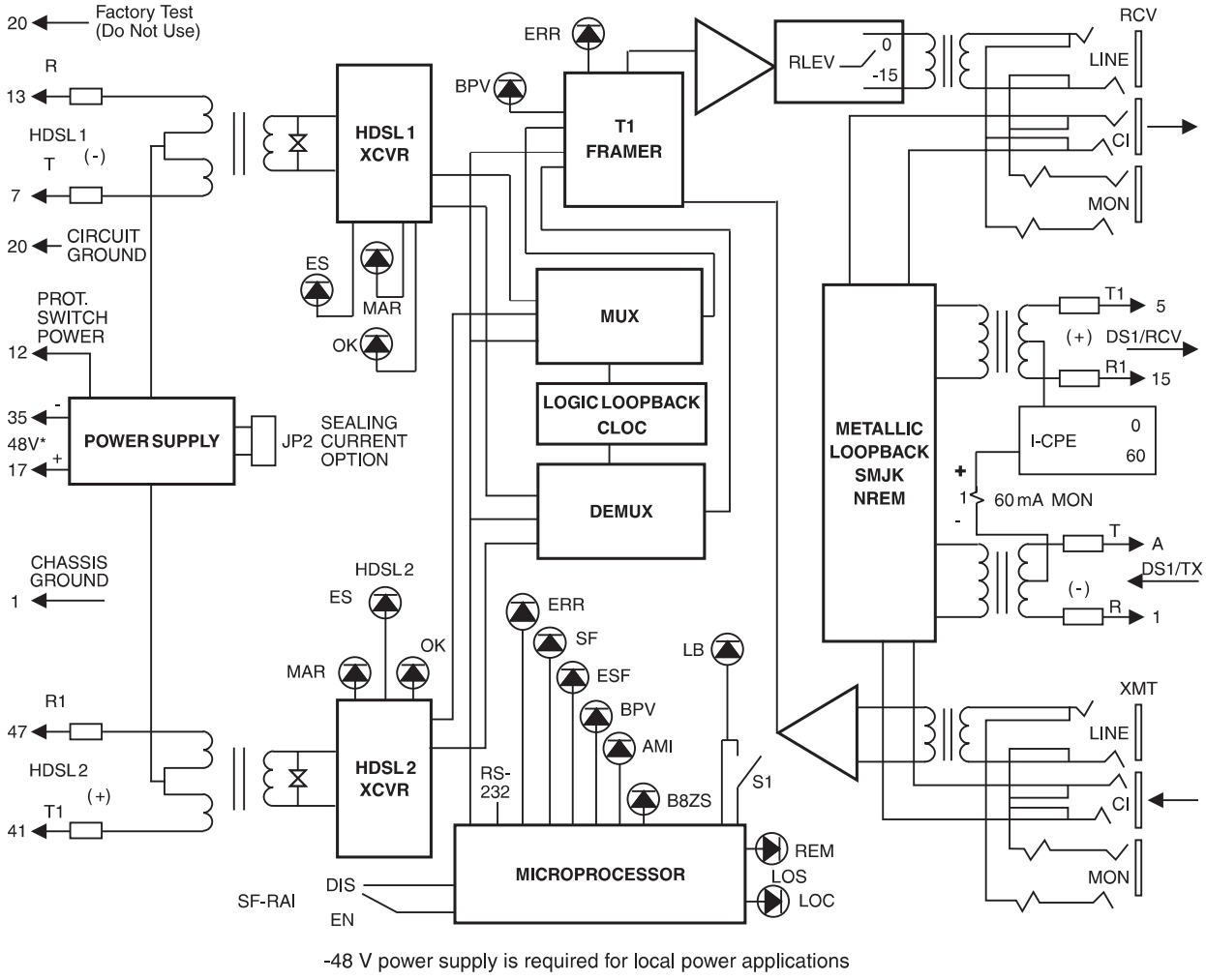


Figure 3. *HRU-412 List 9 Block Diagram*

3.2 The HRU-412 power supply converts the 90 to 130 Vdc power feed that is received on the simplex pairs (or the -48V 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 used to simplex power the Network Interface Device (NID).

Caution should be used when the HRU is used to power Channel Service Units (CSUs). Some CSUs require more output voltage than the 30 Vdc provided by the HRU. The HRU cannot power both a NID and a CSU at the same time.

3.3 The HRU-412 typically dissipates 6 W of power with the I-CPE backplane switch set to 0, and 8 W with the I-CPE backplane switch set to 60 (see section 8.1).

4. Applications

4.1 The HiGain system provides a cost-effective, easy-to-deploy method for delivering T1 service over a single metallic pair. Conventional in-line T1 repeaters are not required. Cable pair conditioning, pair separation and bridged tap removal are not required.

4.2 General guidelines require that the loop has less than 35 dB of loss at 196 kHz, with 135 ohms driving and terminating impedances. Table 4 provides a guide for the loss of various cable gauges at 196 kHz and 135 ohms. The table applies to the HDSL cable pairs between the HLU, HRU and HDU modules. Without specific insertion loss measurement data, add 3 dB for each bridged tap and 1 dB for each cable gauge change.

Table 4. *HDSL Loss Over Cables*

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

4.3 HiGain systems:

- Operate with any number of other T1, Plain Old Telephone Service (POTS), or other HiGain systems sharing the same cable binder group.
- Can be used with customers requiring T1 service on a temporary or permanent basis.
- Provide a means of quickly deploying service in advance of fiber-optic transmission systems.
- Are easily installed allowing service to be provided within hours. Fiber optic systems can be installed at a leisurely pace and cut-over from the installed HiGain system when convenient to do so. The installed HiGain system can then be easily removed and utilized elsewhere.

5. Local and Line Powering

5.1 The HRU-412 List 9 can be line or local powered. The unit always uses the local -48 V power source if it is present, and defaults to line power in the absence of local power. List 6 and higher versions of the HLU-231, all versions of the HLU-319 and HLU-388, and versions 6.4 and above of the HLU-231 List 1, 2, 3, 3A and 4 units automatically turn off their line power supply when connected to a locally powered HRU-412 List 9. The earlier versions of the HLU-231 (Lists 1, 2, 3, 3A and 4) must first have their PWRF user option set to *Disable* to work with a locally powered HRU-412 List 9 unit.

The HRU-412 List 9 does not support three-span line powering.

5.2 When locally powered, the HRU-412 List 9 also provides from 20 mA (short loop) to 30 mA (long loop) of simplex sealing current toward all versions of the HLU over the two HDSL pairs. Jumper JP2 allows this sealing current to be enabled or disabled. See Section 8.1 for further information.

5.3 The simplex sealing current is not compatible with the List 1, 2, or 3 HDU-451 doublers. These doublers block the flow of simplexed sealing current. The HDU-451 List 4 must be used with the HRU-412 List 9 to provide a path through which the simplexed sealing current can flow.

5.4 If local power is lost to the HRU in a non-doubler or a single doubler circuit, the system loses synchronization. When the HLU or HDU attempts to re-acquire synchronization, it detects that the HRU is not locally powered and applies line power to it. If local power is lost to the HRU in a two doubler application, the circuit is permanently down since the HLU cannot provide line power to the HRU in circuits with two doublers.

5.5 The -48V local power supply must have a 125 mA output current capacity (6 W) to power each HRU-412 when the I-CPE option is set to 0. The -48 V local power supply must have a 175 mA output current capacity (8 W) to power each HRU-412 whose I-CPE option is set to 60 mA.

5.6 A Teltrend WPS-2005 Wall-Mount Power Supply, or equivalent, is capable of powering two HRU-412 units (with the I-CPE option switch set to 0 mA) or one unit (with the I-CPE option switch set to 60 mA). Each unit provides spade lugs to access the -48 V output.

You can reach Teltrend at: 1 (800) TEL-TREN.

B. INSTALLATION

6. Inspecting Your Shipment

6.1 When you receive the equipment, 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.

6.2 Your shipment should consist of:

- One HRU-412 List 9
- This document

7. HRU-412 Card Edge Pin-Out Diagram

7.1 The HRU-412 occupies one slot in a remote enclosure. The card edge pin-out diagram for the HRU-412 is shown in Figure 4.

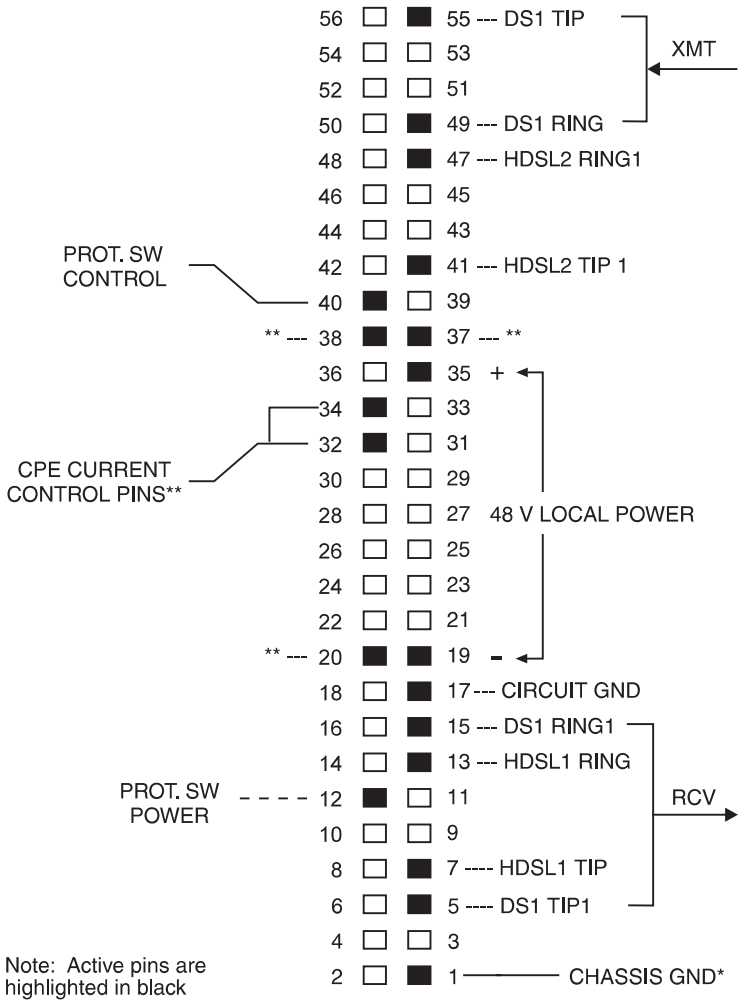


Figure 4. *HRU-412 Card Edge Pin-outs*

8. User Options on the HRU-412 Backplane

8.1 The HRU-412 has four user options that must set before you install the unit into a shelf or enclosure. Three of these options are set by using manual switches and the fourth (sealing current) is set using jumper JP2. These options are located on the backplane of the unit as shown in Figure 5.

HiGain systems also have several special loopback (SPLB) options that are set at the HLU. Refer to the specific technical practice for the HLU used in your configuration for more details.

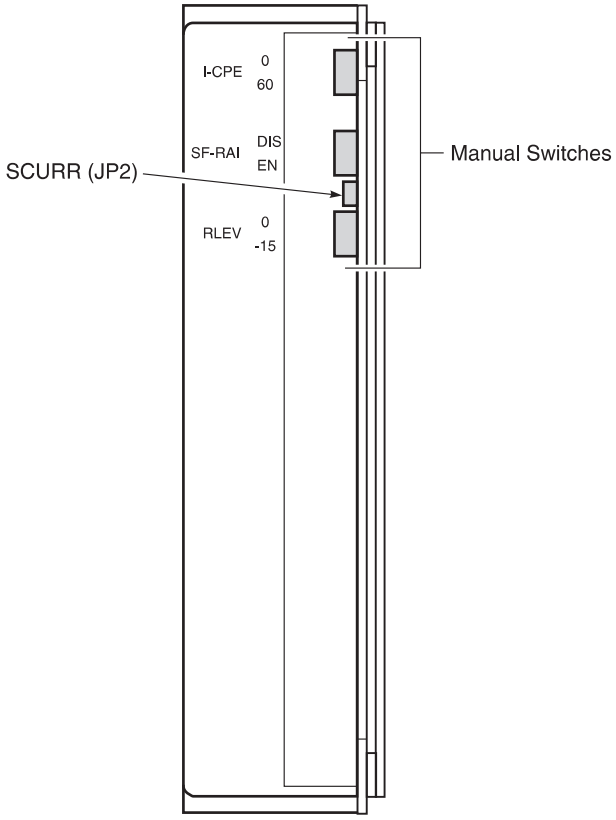


Figure 5. *Backplane User Option Locations*

8.2 Sealing Current (SCURR). The two-prong male JP2 jumper allows you to disable or enable the sealing current. The default is *disable*. To set the sealing current, do one of the following:

- To enable the sealing current, connect JP2 across both terminals using the supplied female jumper block header.
- To disable the sealing current, remove the jumper block header from both terminals and insert it on the outer terminal for future use.

This simplexed sealing current is polarity sensitive and does not flow if the two HDSL loops adjacent to the HRU are reversed. Reversed loops are indicated by a Channel Reverse (CHREV) message in the Alarms line of the Span Status Maintenance screen shown in Section 13.

8.3 I-CPE. The I-CPE switch allows you control the current settings for the interface at the customer premises equipment. The default is *0*. To set the I-CPE, do one of the following:

- To set the CPE current to 0 mA, move the I-CPE switch to *0*.
- To set the CPE current to 60 mA, move the I-CPE switch to *60*.

The CPE current control signals terminate on pins 32 and 34 of the card-edge converter. These access pins are provided for factory test only and must never be used. Older single slot HRE-421 remote enclosures and the HRE-427 seven-slot enclosure use the pins to control the CPE options in older HRU units. These enclosures must be optimized from 0-CPE current to prevent a conflict between external connections to pins 32 and 34 and the settings of the I-CPE switch.

8.4 SF-RAI. The SF-RAI switch allows you to enable or disable the generation of an SF-RAI signal in response to an ESF-RAI message. The default is *disable*. To set the SF-RAI, do one of the following:

- To enable the SF-RAI signal activation, (which occurs in response to an ES-RAI message and which in turn transmits an SF-RAI Yellow Alarm to the CI), move the switch to *ENA*. All three of the following conditions must be met:
  - The signal from the network must be ESF.
  - The signal from the network must contain the RAI Yellow Alarm Bit-patterned message in the facility data link.
  - The signal being transmitted to the CI must be SF.

  If one, two or all of the conditions listed above are not met, the SF-RAI signal activation cannot be enabled.
- To disable the SF-RAI signal activation, move the switch to *DIS*.

8.5 RLEV. The RLEV switch allows you to control the configuration of the T1 Receive Level (RLEV). The default is *0*. Setting RLEV to *0* configures the T1 output signal level from the HRU towards the Network Interface (NI) to 0 dB. This setting is recommended when the HRU does not function as the NID but is connected to an external NID, and allows the external NID to set the appropriate NI level. Setting RLEV to *-15* configures the T1 RLEV to -15 dB, and 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. To set the RLEV do one of the following:

- To set the T1 output signal level to O dB, move the RLEV switch to *0*.
- To set the T1 output signal level to -15 dB, move the RLEV switch to *15*.

9. Installing the HRU-412

9.1 The HRU-412 mounts in PairGain HiGain Remote Enclosures (HREs) and in any industry standard 400 mechanics shelves.

9.2 To install the HRU-412 (Figure 6):

1 Set the user options as described in Section 8.

2 Slide the HRU-412 into the card guides for the desired slot, then push the unit into the enclosure until it touches the backplane card edge connector.

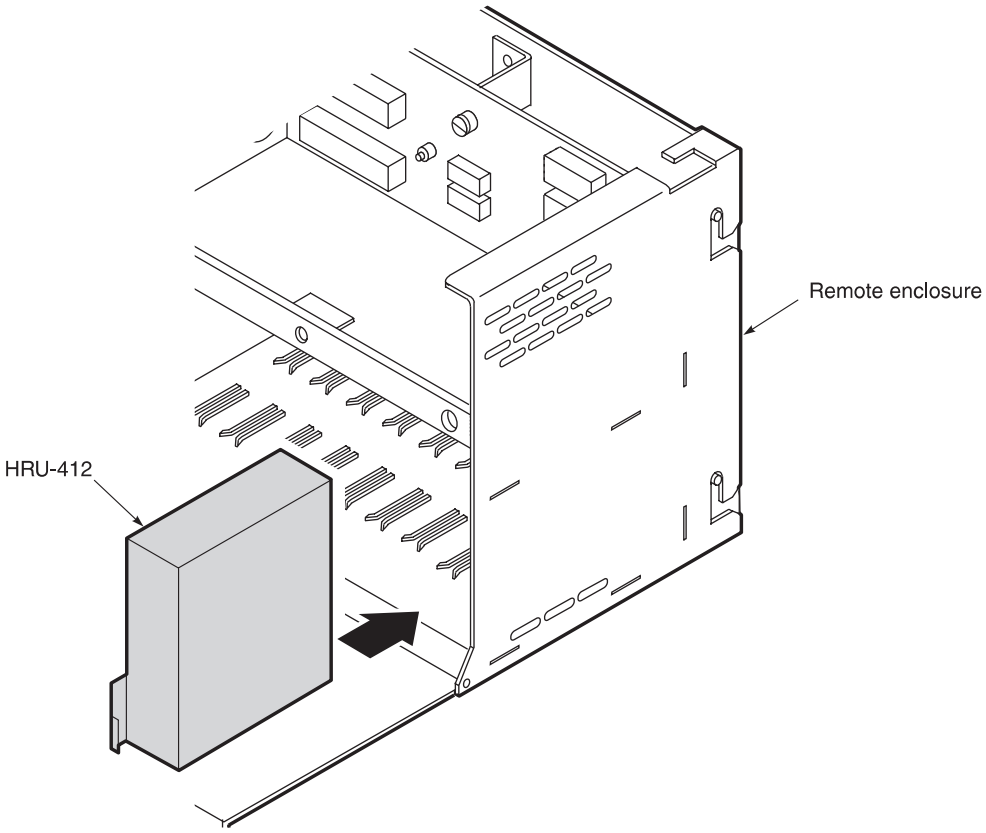


Figure 6. *HRU-412 Installed in a Remote Enclosure*

3 Push the unit into the card edge connector until it is entirely within the card guide, indicating that the unit is properly seated.

10. Connecting to a Dumb Terminal

10.1 The 9-pin RS-232 connector on the front of the HRU-412 allows you to connect your system to a dumb terminal or PC running a terminal emulation program with a standard RS-232 cable. Once connected to a dumb terminal, you can access the view-only Maintenance/Remote Terminal menus (the *Set Clock* option is the only user-configurable option on the HRU-412). Figure 7 shows the HRU-412 DB-9 RS-232 I/O.

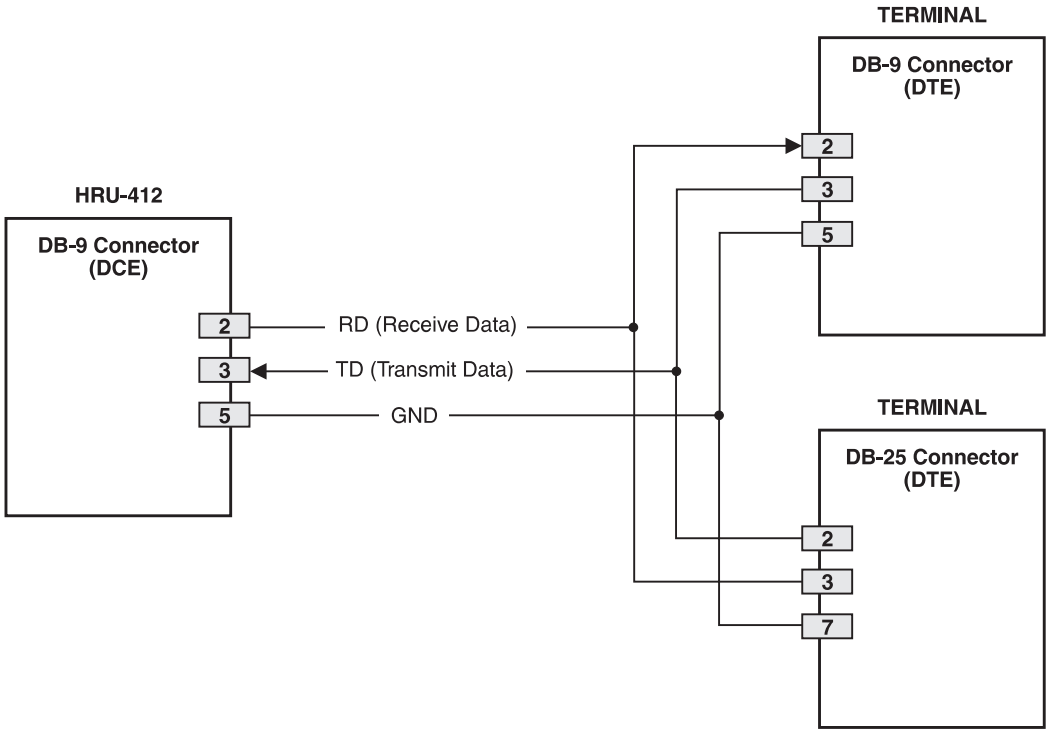


Figure 7. *DB-9 RS-232 I/O*

10.2 The dumb terminal is configured as DCE. To connect the HRU-412 to a dumb terminal, connect the RS-232 COM port of the dumb terminal to the HRU-412 front-panel RS-232 connector using a serial interface cable (Figure 8).

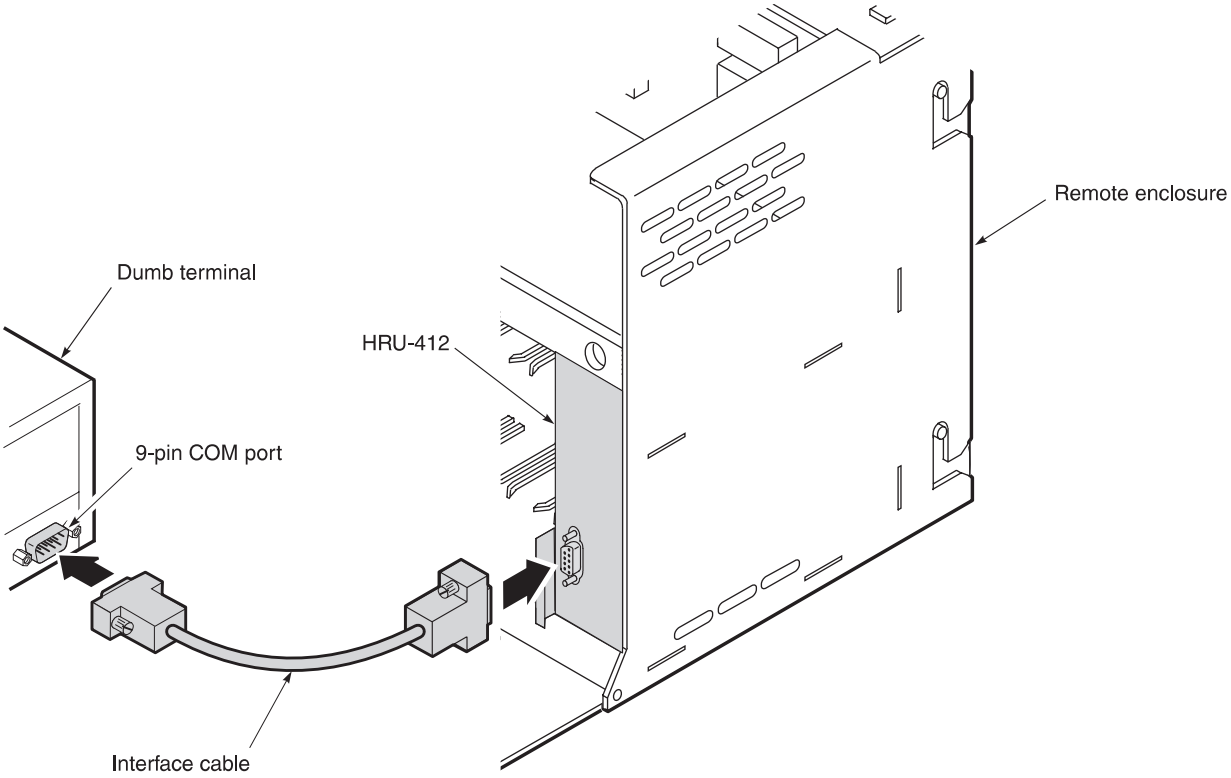


Figure 8. *Connecting the HRU-412 to a Dumb Terminal*

C. USING THE MAINTENANCE/REMOTE TERMINAL

11. Using the Maintenance/Remote Terminal Menus

11.1 This section covers both the Maintenance Terminal menus (for non-doubler applications) and the Remote Terminal menus (for doubler applications). The screens for either application are identical, except for the *Set Clock* option which is set from the Maintenance Terminal menu only. After you have connected the HRU-412 to a dumb terminal, you must configure the dumb terminal to the following communication settings.

- 1200 to 9600 baud (9600 baud is recommended)
- Parity: None
- 8 data bits
- 1 stop bit
- Hardware Flow Control set to None
- VT Terminal Emulation

If using the Microsoft Windows terminal emulation program, from the Settings, Terminal Preference menu, you must deselect *Show Scroll Bars* and *Use Function, Arrow, and Ctrl Keys for Windows.*

11.2 Navigating the Maintenance/Remote Terminal menus. Table 5 describes keys you can use on the dumb terminal's keyboard to navigate within the Maintenance/Remote Terminal menus.

Table 5. *Dumb Terminal Navigational Keys*

Key	Function
<Enter>	Logs into the Remote Terminal menus
<E>	Exits the current menu
<U>	Updates a report
<S>	Selects the next Span Status screen
<P>	Selects the previous page of a report
<N>	Selects the next page of a report

11.3 Selecting an Option. The Maintenance/Remote Terminal menus use two different means of selecting an option:

- Press the key indicated to the left of the selection.
- Press the letter in parenthesis of the parameter to be changed.

12. Maintenance/Remote Terminal Main Menu

12.1 There are five view-only performance screens available for viewing system performance from the Maintenance/Remote Terminal menus. Table 6 describes the function of each menu selection.

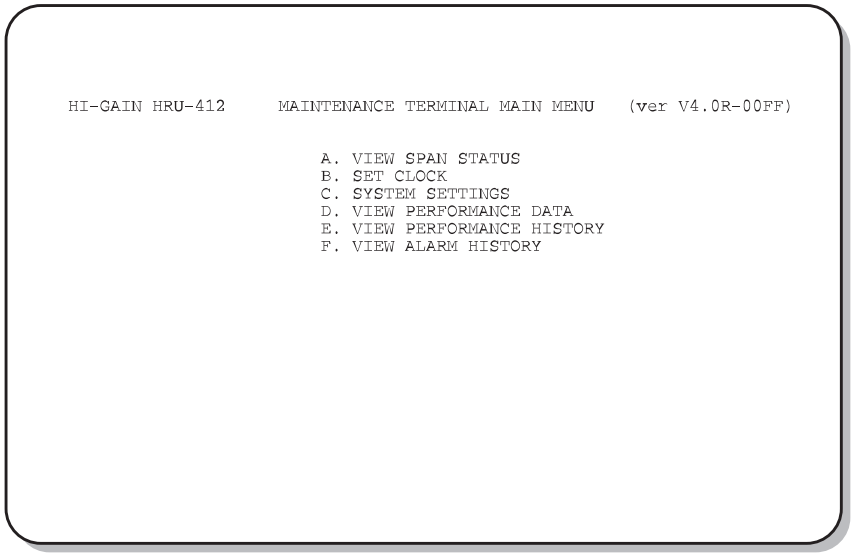
Table 6. *Maintenance/Remote Terminal Menus*

Menu	Function	See
View Span Status	Provides access to a submenu that allows you to monitor the HDSL line between the HLU and the HRU-412 span (non-doubler applications), and the HLU, HDU and HRU-412, Spans 1 and 2 (for one doubler applications), and Spans 1, 2 and 3 (for two doubler applications).	Section 13
Set Clock*	Allows you to set both the time and the date parameters at the HLU, and to update the same settings at the HRU-412.	Section 14
System Settings	Allows you to view all system settings.	Section 15
View Performance Data	Provides access to submenus that allow you to view the Errored Seconds (ES) and Unavailable Seconds (UAS) between the HLU and the HRU-412 span (non-doubler applications), and the available spans (doubler applications) in 15-minute intervals over a four-hour time period.	Section 16
View Performance History	Provides access to submenus that allow you to view the ES and UAS between the HLU and the HRU-412 span (non-doubler applications) and the available spans (doubler applications) in 24-hour intervals over a seven-day period.	Section 17
View Alarm History	Provides access to submenus that allow you to view alarm conditions between the HLU and the HRU-412 span (non-doubler applications) and the available spans (doubler applications).	Section 18

* set from the Maintenance Terminal menu only

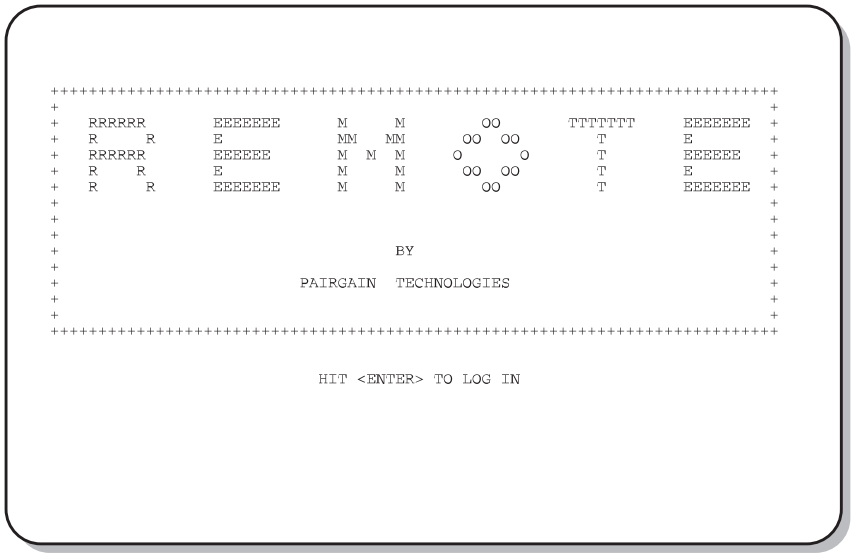
12.2 After the dumb terminal has been properly configured, you can press the <Spacebar> several times to invoke the autobaud feature. Based on your configuration, one of the following two screens display.

12.3 Non-Doubler Applications. The Maintenance Terminal Main menu displays for non-doubler applications. Press the <Spacebar> several times to initiate the RS-232 connection:



A hidden "G" selection is available from the Maintenance Terminal Main menu if you are using an HLU-231 List 7B unit in your circuit. A *G* selection causes the Remote Log-in screen to appear. By selecting this option, the terminal is then directly connected to the HLU, thus permitting you to set system options which are view-only at the HRU-412.

12.4 Doubler Applications. The Remote Terminal Log-in menu displays for doubler applications. Press the <Spacebar> several times to initiate the RS-232 connection, then press <Enter> to view the Remote Terminal Main menu. The following two screens display respectively:



```
HI-GAIN HLU 319       REMOTE TERMINAL MAIN MENU   (ver V2.2L-002D)
                         CIRCUIT ID#: PairGain

                    A. VIEW SPAN STATUS
                    C. SYSTEM SETTINGS
                    E. VIEW PERFORMANCE DATA
                    F. VIEW PERFORMANCE HISTORY
                    G. VIEW ALARM HISTORY
                    H. REMOTE LOGOFF
```

13. View Span Status

13.1 The View Span Status screen allows you to view the system status from the HLU to the HRU-412. The screen shows information about the HDSL Loops 1 and 2 and the DS1 (for non-doubler applications). For doubler applications, the available Span Status screens displayed are dependent upon the configuration (one doubler or two doublers).

13.2 **Non-Doubler Applications.** Press <A> from the Maintenance Terminal Main menu to open the View Span Status screen:

```
                              SPAN STATUS
                      (HLU/ver0.0-0000:HRU/ver4.0-00FF)
TIME: 05:25:24
DATE: 06/18/97

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:              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:        00003        00003        00005        00006  seconds
24 HOUR UAS:       00000        00000        09613        09642  seconds

                                 DS1 STATUS
                               HLU                  HRU
24 HOUR BPV Seconds:         00003                00547
24 HOUR UAS Count:           00003                00000
Frame type:                    N/A              Unframed
Code type:                     N/A                 B8ZS

                          (E)xit (U)pdate
```

You can do the following:

- Press <E> to return to the previous menu.
- Press <U> to update current values.

13.3 Doubler Applications. HDU 1 (one doubler) and HDU2 (two doublers) appear in the Span Status screen for doubler applications.

13.3.1 One Doubler, Span 1 Status. Press <A> from the Remote Terminal Main Menu to view the Span Status screen for single doubler applications:

```
                              SPAN 1 STATUS
                     ( HLU/ver2.2-002D:HDU1/ver2.7-0004)
TIME: 05:16:11
DATE: 06/11/97                        CIRCUIT ID#: PairGain

ALARMS:   NONE
LOOPBACK: OFF
                          HLU                          HDU1
                    HDSL-1       HDSL-2       HDSL-1       HDSL-2
                  cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:             21/18/21     21/18/21     21/18/22     21/18/22 dB
PULSE ATTN:           00           00           00           00     dB
PPM OFFSET:           00           00           07           07     ppm
24 HOUR ES:         00004        00004        00002        00003   seconds
24 HOUR UAS:        05516        05518        00018        00021   seconds

                                   DS1 STATUS
                                  HLU                    HRU
24 HOUR BPV Seconds:            00369                  00448
24 HOUR UAS Count:              00081                  00004
Frame type:                   Unframed               Unframed
Code type:                      B8ZS                   B8ZS

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

You can do the following:

- Press <E> to return to the previous menu.
- Press <U> to update current values.
- Press <S> to view the next available span.

13.3.2 One Doubler, Span 2 Status. For one doubler configurations, Span 2 is the span between the first doubler (HDU1) and the HRU-412. Press <S> to view the Span 2 Status screen:

```
                              SPAN 2 STATUS
                     (HDU1/ver2.7-0004: HRU/ver4.0-00FF)
TIME: 05:22:36
DATE: 06/11/97                        CIRCUIT ID#: PairGain

ALARMS:   NONE
LOOPBACK: OFF
                          HDU1                          HRU
                    HDSL-1       HDSL-2       HDSL-1       HDSL-2
                  cur/min/max  cur/min/max  cur/min/max  cur/min/max
MARGIN:             21/18/22     21/18/22     21/20/23     22/20/23 dB
PULSE ATTN:           00           00           01           01     dB
PPM OFFSET:           00           00          -02          -02     ppm
24 HOUR ES:         00008        00007        00012        00009   seconds
24 HOUR UAS:        00021        00048        00694        00707   seconds

                                   DS1 STATUS
                                  HLU                    HRU
24 HOUR BPV Seconds:            00369                  00510
24 HOUR UAS Count:              00081                  00004
Frame type:                       ESF                    ESF
Code type:                      B8ZS                   B8ZS

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

You can do the following:

- Press <U> to update the screen.
- Press <S> to revert back to Span 1.
- Press <E> to exit from the Span 2 Status screen.

13.3.3 Two Doublers, Span 3 Status. For two doubler configurations, Span 3 is the span between the second doubler (HDU2) and the HRU-412. Press <S> to view the Span 3 Status screen:

```
                          SPAN 3 STATUS
                  (HDU2/ver3.0-00FF: HRU/ver4.0-00FF)
TIME: 05:22:36
DATE: 06/11/97                      CIRCUIT ID#: PairGain

ALARMS:   NONE
LOOPBACK: OFF
                          HDU2                          HRU
                  HDSL-1        HDSL-2        HDSL-1        HDSL-2
                cur/min/max   cur/min/max   cur/min/max   cur/min/max
MARGIN:           21/18/22      21/18/22      21/20/23      22/20/23 dB
PULSE ATTN:         00            00            01            01     dB
PPM OFFSET:         00            00           -02           -02     ppm
24 HOUR ES:       00008         00007         00012         00009   seconds
24 HOUR UAS:      00021         00048         00694         00707   seconds

                                 DS1 STATUS
                                  HLU                   HRU
24 HOUR BPV Seconds:            00369                 00510
24 HOUR UAS Count:              00081                 00004
Frame type:                      ESF                   ESF
Code type:                       B8ZS                  B8ZS

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

You can do the following:

- Press <U> to update the screen.
- Press <S> to view another span.
- Press <E> to exit from the Span 3 Status screen.

13.4 Table 7 lists the Span Status fields and descriptions. Table 8 lists all possible alarms and their descriptions. Table 9 lists all possible loopbacks and their descriptions.

Table 7. *Span Status Fields and Descriptions*

Field	Description
Time	Time of day when Span Status was checked.
Date	Date when Span Status was checked.
Alarms	Presence or absence of alarm conditions. See Table 8.
Loopback	Indicates Off condition or identifies specific active loopback. See Table 9.
Margins	Indicates the excess signal to noise ratio at either the HLU or HRU, relative to a 10^{-7} Bit Error Rate. First value is current margin. Second value is minimum margin since last cleared. Third value is maximum margin since last cleared and NA means that the margin is not available.
Pulse Attenuation	Indicates the attenuation of the 2B1Q pulse from the distant end. HiGain operates with pulse attenuations up to 28 dB. This value is related to the cable pair's 196 kHz loss. The pulse attenuation is a more direct indication of the loop attenuation to the 2B1Q signal than the 196 kHz loss.
INS Loss *	Indicates the approximate attenuation of the HDSL loop at 196 kHz. It is generated by multiplying the pulse attenuation by 1.25.
PPM	Indicates the relative offset of the crystal oscillator in the HRU-412 from the HLUs crystal oscillator. Any value between ± 64 is adequate.
HDSL 24 Hour ES	The number of one second intervals that contained at least one CRC error. This value is a running total of the last 24 Hours.
HDSL 24 Hour UAS	The number of seconds the HDSL loop was out of synchronization.
DS1 BPV Seconds (ES)	The number of seconds in which at least one 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 0s).
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 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.
HLU/Ver w.x-y	"w.x" = the software version number of the HLU. "y" = List # of the HLU.
HRU or HDU/w.x-y	"w.x" = the software version number of the HRU or HDU. "y" = List # of the HRU or HDU.

* INS Loss displayed only in the Span Status screen for the HLU-231 List 7B and List 7D models.

Table 8. *HRU-412 Alarm Field Messages and Descriptions*

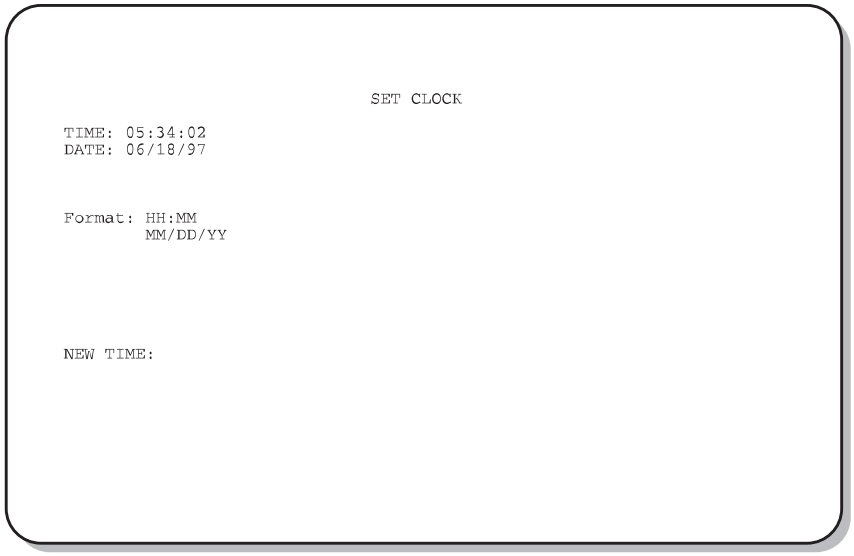
Message	Full Name	Description
NONE	No Alarms	No alarm conditions present in system.
LLOS	Local Loss of Signal	No signal from HRUs T1 interface.
LOSW	Loss of Sync Word	One of the HDSL loops has lost synchronization.
H1ES	HDSL Loop 1 Errored Second	Loop 1's CRC have exceeded the ES threshold.
H2ES	HDSL Loop 2 Errored Second	Loop 2's CRC have exceeded the ES threshold.
DS1	Digital Service 1	BPVs have exceeded the ES threshold.
ACO	Alarm Cut Off	An ACO is in effect.
AIS	Alarm Indicating Signal	Indicates an AIS (all ones) pattern is being transmitted from the local T1 output port.

Table 9. *HRU-412 Loopback Field Messages and Descriptions*

Messages	Full Name	Description
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 when *SMJK* is enabled.
NREM	Network Remote Loopback	Loopback at HRU (remote) towards network initiated from CO (network) by intelligent line repeater #1 code, HRU front panel loopback button or maintenance terminal.
NLOC	Network Local Loopback	Loopback at HLU (local) towards network initiated from CO (network) by intelligent office repeater code or by pressing both the HLU Mode and Sel front panel pushbuttons.
CLOC	Customer Local Loopback	Loopback at HRU (local) towards CI initiated from CPE (customer) by intelligent line repeater #1 code.
CREM	Customer Remote Loopback	Loopback at HLU (remote) towards customer initiated from CPE (customer) by intelligent office repeater code.
ARM	Armed	HiGain has detected the intelligent repeater loopback (2 in 5) arming code.
NDU1	Network Doubler 1 Loopback	Loopback at first doubler towards network initiated by HLU.
CDU 1	Customer Doubler 1 Loopback	Loopback at first doubler towards CI initiated by HLU.
NDU2	Network Doubler 2 Loopback	Loopback at second doubler towards network initiated by HLU.
CDU 2	Customer Doubler 2 Loopback	Loopback at second doubler towards CI initiated by HLU.

14. Set Clock

14.1 Press <B> from the Maintenance Terminal Main menu to open the Set Clock screen:



14.2 **Set Time.** The cursor defaults to the "New Time" field. To set the system time, type the hour and minute in the 24-hour format of hh:m:ss (setting the seconds is optional), then press <Enter>.

The "New Date" field displays.

If you input an invalid entry, the following messages display followed by the name of field where the invalid entry occurred:

> error

14.3 **Set Date.** To set the system date, type the month, day and year in a mm/dd/yy format, then press <Enter>.

The system date and time is updated and the Maintenance Terminal Main menu displays.

15. System Settings

15.1 The System Settings screen allows you to view configurable parameters set at the HLU.

15.2 Press <C> from either the Maintenance Terminal Main Menu or the Remote Terminal Main menu to view the System Settings screen:

```
                                SYSTEM SETTINGS

TIME: 05:34:58
DATE: 06/18/97

EQUALIZATION:      399
SMART-JACK LB:     ENABLE
SPECIAL LPBK:      A1LB
POWER:             ENABLE
ZBTSI:             OFF
ES ALARM THRES:    170
LOOPBACK TIMEOUT:  NONE
ALARM:             ENABLE
DS1 LINE CODE:     B8ZS
FRAMING:           AUTO
AIS ON HDSL LOSW:  2 LOOPS
AIS ON SMJK/NREM:  ENABLE
MARGIN ALM THRES:  4
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
xx xx
                                (E)xit
```

15.3 Table 10 lists the System Settings fields and descriptions.

Table 10. *System Settings Fields and Descriptions*

Field	Description
Time	Time of day when System Settings were checked.
Date	Date when System Settings were checked.
Equalization	Indicates settings for equalizer of either 0 (DSX-1 for 0-133 ft), 133 (DSX-1 for 133-266 ft), 266 (DSX-1 for 266-399 ft), 399 (DSX-1 399-533 ft), 533 DSX-1 for 533-655 ft).
Smart-Jack LB	Indicates settings of either *ENA* or *DIS* for smartjack loopback: where signal from DSX is looped back at the HRU by the HRU smartjack module.
Special LBPK	Indicates the special loopback settings of either: Generic loopback (GNLB), where the HiGain system responds to the generic (3/4 in 7) in-band loopback codes, or A1LB and A2LB, A3LB, A4LB, or A5LB.
Power	Indicates whether power feed to the HRU-412 from the HLU is either enabled or disabled.
ZBTSI	Indicates whether ZBTS is either *On* or *Off*. An *On* setting tells the system that the ESF frame is operating in its Zero Byte Time Slot Interface (ZBTSI) mode. An *Off* setting tells the system that the ESF frame is operating in its normal non-ZBTSI mode.
ES Alarm THRES	Indicates whether the ESAL threshold is set to either: None, 17 or 170.
Loopback Timeout	Indicates one of four settings: None (disables automatic time-out cancellation of all loopbacks) or a choice of either 20, 60, or 120, which sets automatic cancellation (timeout) of all loopbacks to either 20, 60 or 120 minutes after initiation.
Alarm	Indicates whether alarms are enabled or disabled.
DS1 Line Code	Indicates one of three settings: Auto, B8ZS, or AMI
Framing	Indicates whether framing is either Auto or UNFR (unframed)
AIS on HDSL LOSW	Indicates the settings for alarm indication signals on HDSL LOSW on the HDSL loops.
AIS on SMJK/NREM	Indicates settings of either ENA or DIS for alarm indication signals for the smartjack Network Remote Loopback (NREM).
Margin ALM THRES	Indicates the settings for the margin alarm thresholds.
DS0 Blocking	Indicates status of DS0 blocked channels and identifies the channels that have been blocked (using "xx" symbols underneath each blocked channel). A *None* setting indicates no channels are blocked. A *BLK* setting indicates some channels are blocked.

16. View Performance Data

16.1 The View Performance Data screen shows the number of ES and UAS occurrences in 15-minute increments for a 24-hour period. The presentation format is: ES/UAS or Errored Seconds/Unavailable Seconds for the HLU and the HRU-412 for the DS1 signal, HDSL Loop 1 and HDSL Loop 2 (non-doubler applications). For doubler applications, the available View Performance Data screens displayed are dependent upon the configuration (one doubler or two doublers).

16.2 **Non-Doubler Applications.** Press <D> from the Maintenance Terminal Main menu to view the Performance Data screen for non-doubler applications:

Date: 06/18/97 PERFORMANCE DATA

ERRORED SECONDS/UNAVAILABLE SECONDS

	DS1		HDSL-1		HDSL-2	
	HLU	HRU	HLU	HRU	HLU	HRU
01:45	000/000	000/000	000/000	000/000	000/000	000/000
02:00	000/000	000/000	000/000	000/000	000/000	000/000
02:15	000/000	001/000	001/000	001/000	001/000	001/000
02:30	000/000	000/000	000/000	000/000	000/000	000/000
02:45	000/000	000/000	000/000	000/000	000/000	000/000
03:00	000/000	000/000	000/000	000/000	000/000	000/000
03:15	000/000	000/000	000/000	000/000	000/000	000/000
03:30	000/000	000/000	000/000	000/000	000/000	000/000
03:45	001/001	003/000	000/000	001/096	000/000	001/096
04:00	000/000	090/000	000/000	000/000	000/000	000/000
04:15	000/000	000/000	000/000	000/000	000/000	000/000
04:30	000/000	001/000	001/000	001/000	001/000	001/000
04:45	000/000	000/000	000/000	000/000	000/000	000/000
05:00	000/000	000/000	000/000	000/000	000/000	000/000
05:15	001/001	058/000	000/000	001/000	000/000	001/000
05:30	000/000	127/000	001/000	001/351	001/000	001/351

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

You can do the following:

- Press <P> to view the previous screen.
- Press <N> to view the next screen.
- Press <E> to exit.

16.3 Doubler Applications. HDU 1 (one doubler) and HDU2 (two doublers) appear in the Span Status screen for doubler applications.

16.3.1 One Doubler, Span 1 and Span 2 Performance Data. Press <E> from the Remote Terminal Main menu to view the Span 1 Performance Data screen:

```
Date: 06/11/97          SPAN 1 PERFORMANCE DATA
CIRCUIT ID#: PairGain
                  ERRORED SECONDS/UNAVAILABLE SECONDS

                DS1              HDSL-1              HDSL-2
            HLU       HRU       HLU      HDU1       HLU      HDU1
01:45     000/000   000/000   000/000   000/000   000/000   000/000
02:00     000/000   000/000   000/000   000/000   000/000   000/000
02:15     000/000   000/000   000/000   000/000   000/000   000/000
02:30     000/000   000/000   000/000   000/000   000/000   000/000
02:45     000/000   000/000   000/000   000/000   000/000   000/000
03:00     000/000   000/000   000/000   000/000   000/000   000/000
03:15     000/000   000/000   000/000   000/000   000/000   000/000
03:30     000/000   000/000   000/000   000/000   000/000   000/000
03:45     000/000   000/000   000/000   000/000   000/000   000/000
04:00     000/000   000/000   000/000   000/000   000/000   000/000
04:15     000/000   000/000   000/000   000/000   000/000   000/000
04:30     000/000   000/000   000/000   000/000   000/000   000/000
04:45     000/000   000/000   000/000   000/000   000/000   000/000
05:00     000/000   000/000   000/000   000/000   000/000   000/000
05:15     000/000   000/000   000/000   000/000   000/000   000/000
05:30     000/000   000/000   000/000   000/000   000/000   000/000

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

16.3.2 The presentation format is: ES/UAS for the HLU and the HRU-412 DS1 signal, and ES/UAS for the HLU and HDU1 over both HDSL Loop 1 and HDSL Loop 2.

You can do the following:

- Press <P> to view the previous screen.
- Press <N> to view the next screen.
- Press <E> to exit.
- Press <S> to view the next available span.

Press <S> from the Span 1 Performance Data screen to view the Span 2 Performance Data screen:

```
Date: 06/11/97          SPAN 2 PERFORMANCE DATA
CIRCUIT ID#: PairGain
                  ERRORED SECONDS/UNAVAILABLE SECONDS

                DS1              HDSL-1              HDSL-2
          HLU       HRU      HDU1       HRU      HDU1       HRU
01:45     000/000   000/000  000/000   000/000   000/000   000/000
02:00     000/000   000/000  000/000   000/000   000/000   000/000
02:15     000/000   000/000  000/000   000/000   000/000   000/000
02:30     000/000   000/000  000/000   000/000   000/000   000/000
02:45     000/000   000/000  000/000   000/000   000/000   000/000
03:00     000/000   000/000  000/000   000/000   000/000   000/000
03:15     000/000   000/000  000/000   000/000   000/000   000/000
03:30     000/000   000/000  000/000   000/000   000/000   000/000
03:45     000/000   000/000  000/000   000/000   000/000   000/000
04:00     000/000   000/000  000/000   000/000   000/000   000/000
04:15     000/000   000/000  000/000   000/000   000/000   000/000
04:30     000/000   000/000  000/000   000/000   000/000   000/000
04:45     000/000   000/000  000/000   000/000   000/000   000/000
05:00     000/000   000/000  000/000   000/000   000/000   000/000
05:15     000/000   000/000  000/000   000/000   000/000   000/000
05:30     000/000   000/000  000/000   000/000   000/000   000/000

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

16.3.3 Two Doublers, Span 3 Performance Data. Press <S> again to view the Span 3 Performance Data screens (two doublers):

```
Date: 06/11/97          SPAN 3 PERFORMANCE DATA
CIRCUIT ID#: PairGain
                  ERRORED SECONDS/UNAVAILABLE SECONDS

                DS1              HDSL-1              HDSL-2
          HLU       HRU      HDU2       HRU      HDU2       HRU
01:45     000/000   000/000  000/000   000/000   000/000   000/000
02:00     000/000   000/000  000/000   000/000   000/000   000/000
02:15     000/000   000/000  000/000   000/000   000/000   000/000
02:30     000/000   000/000  000/000   000/000   000/000   000/000
02:45     000/000   000/000  000/000   000/000   000/000   000/000
03:00     000/000   000/000  000/000   000/000   000/000   000/000
03:15     000/000   000/000  000/000   000/000   000/000   000/000
03:30     000/000   000/000  000/000   000/000   000/000   000/000
03:45     000/000   000/000  000/000   000/000   000/000   000/000
04:00     000/000   000/000  000/000   000/000   000/000   000/000
04:15     000/000   000/000  000/000   000/000   000/000   000/000
04:30     000/000   000/000  000/000   000/000   000/000   000/000
04:45     000/000   000/000  000/000   000/000   000/000   000/000
05:00     000/000   000/000  000/000   000/000   000/000   000/000
05:15     000/000   000/000  000/000   000/000   000/000   000/000
05:30     000/000   000/000  000/000   000/000   000/000   000/000

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

The presentation format is: ES/UAS for the HLU and the HRU-412 DS1 signal, and ES/UAS for the HDU2 and HRU over both HDSL Loop 1 and HDSL Loop 2.

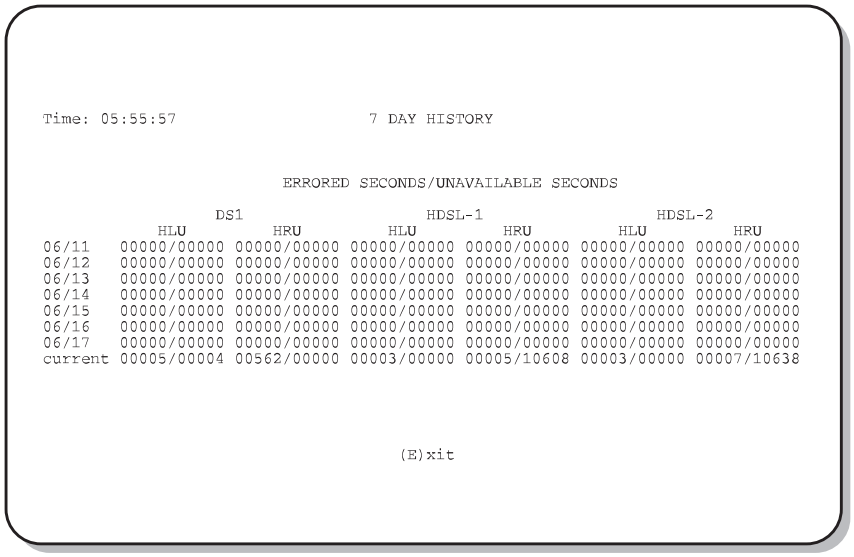
You can do the following:

- Press <P> to view the previous screen.
- Press <N> to view the next screen.
- Press <E> to exit.
- Press <S> to view the next available span.

17. View Performance History

17.1 The View Performance History screen shows the number of ES and UAS occurrences in 24-hour increments for a seven-day period. The presentation format is: ES/UAS for the HLU and the HRU-412 for the DS1 signal, HDSL Loop 1 and HDSL Loop 2 (for non-doubler applications). For doubler applications, the available View Performance History screens displayed are dependent upon the configuration (one doubler or two doublers).

17.2 **Non-Doubler Applications.** Press <E> from the Maintenance Terminal Main menu to open the Performance History screen for non-doubler applications.



```
Time: 05:55:57                    7 DAY HISTORY


                          ERRORED SECONDS/UNAVAILABLE SECONDS

                DS1                    HDSL-1                  HDSL-2
          HLU          HRU          HLU          HRU          HLU          HRU
06/11   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/12   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/13   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/14   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/15   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/16   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/17   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00005/00004 00562/00000 00003/00000 00005/10608 00003/00000 00007/10638



                                    (E)xit
```

17.3 **Doubler Applications.** HDU 1 (one doubler) and HDU2 (two doublers) appear in the Performance History screen for doubler applications.

17.3.1 One Doubler, Span 1 and Span 2 Performance History. Press <F> from the Remote Terminal Main menu to view the Span 1 Performance Data screen:

```
Time: 05:57:43                    7 DAY HISTORY
CIRCUIT ID#: PairGain

                                   SPAN 1
                          ERRORED SECONDS/UNAVAILABLE SECONDS

              DS1                    HDSL-1                    HDSL-2
          HLU         HRU         HLU         HDU1          HLU         HDU1
06/04   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/05   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/06   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/07   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/08   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/09   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/10   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00005/00000 00017/00002 00001/00061 00000/00006 00001/00061 00000/00006



                                   (E)xit (S)pan
```

17.3.2 The presentation format is: ES/UAS for the HLU and the HRU-412 DS1 signal, and ES/UAS for the HLU and HDU1 over both HDSL Loop 1 and HDSL Loop 2.

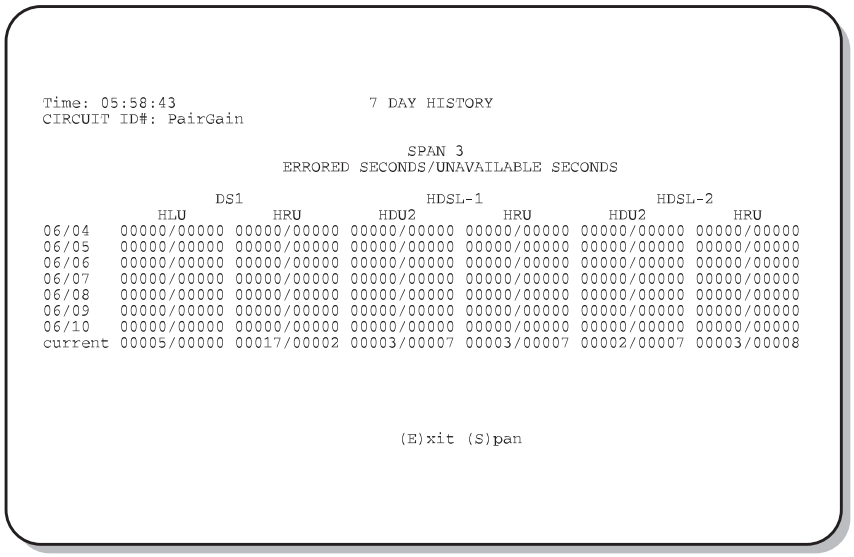
You can do the following:

- Press <E> to exit.
- Press <S> To view Span 2:

```
Time: 05:58:43                    7 DAY HISTORY
CIRCUIT ID#: PairGain

                                   SPAN 2
                          ERRORED SECONDS/UNAVAILABLE SECONDS

              DS1                    HDSL-1                    HDSL-2
          HLU         HRU         HDU1        HRU         HDU1        HRU
06/04   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/05   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/06   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/07   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/08   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/09   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/10   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00005/00000 00017/00002 00003/00007 00003/00007 00002/00007 00003/00008



                                   (E)xit (S)pan
```

The presentation format is: ES/UAS for the HLU and the HRU-412 DS1 signal, and ES/UAS for the HDU1 and HRU-412 over both HDSL Loop 1 and HDSL Loop 2.

17.3.3 Two Doublers, Span 3 Performance Data. Press <S> again to view the Span 3 Performance Data screens (two doublers):



```
Time: 05:58:43                    7 DAY HISTORY
CIRCUIT ID#: PairGain

                                   SPAN 3
                          ERRORED SECONDS/UNAVAILABLE SECONDS

                  DS1                    HDSL-1                  HDSL-2
            HLU          HRU         HDU2         HRU         HDU2         HRU
06/04   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/05   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/06   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/07   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/08   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/09   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
06/10   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00005/00000 00017/00002 00003/00007 00003/00007 00002/00007 00003/00008



                                  (E)xit (S)pan
```

The presentation format is: ES/UAS for the HLU and the HRU-412 DS1 signal, and ES/UAS for the HDU2 and the HRU-412 over both HDSL Loop 1 and HDSL Loop 2.

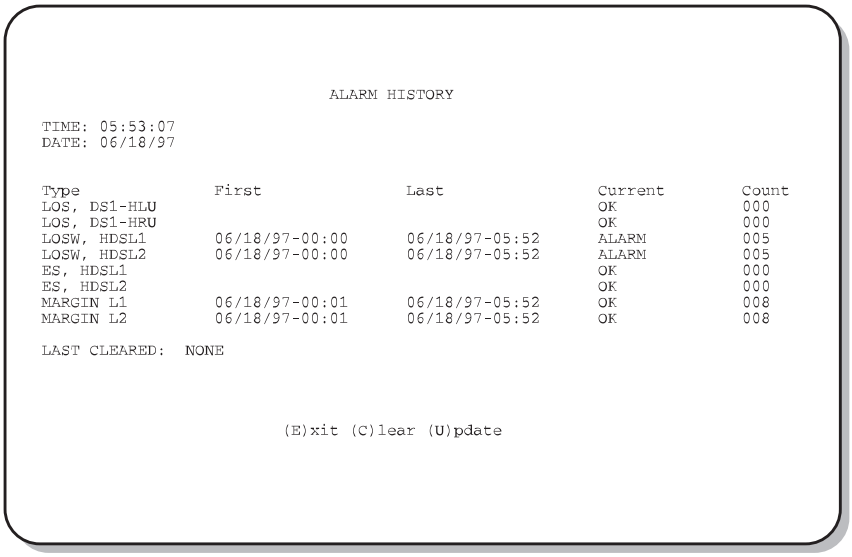
You can do the following:

- Press <E> to exit.
- Press <S> to view the next available span.

18. View Alarm History

18.1 The View Alarm History screen allows you to view alarms that are currently active.

18.2 **Non-Doubler Applications.** Press <F> from the Maintenance Terminal Main menu to view the Alarm History screen for non-doubler applications:



```
                              ALARM HISTORY

TIME: 05:53:07
DATE: 06/18/97

Type              First               Last                Current       Count
LOS, DS1-HLU                                              OK            000
LOS, DS1-HRU                                              OK            000
LOSW, HDSL1       06/18/97-00:00      06/18/97-05:52      ALARM         005
LOSW, HDSL2       06/18/97-00:00      06/18/97-05:52      ALARM         005
ES, HDSL1                                                 OK            000
ES, HDSL2                                                 OK            000
MARGIN L1         06/18/97-00:01      06/18/97-05:52      OK            008
MARGIN L2         06/18/97-00:01      06/18/97-05:52      OK            008

LAST CLEARED:  NONE


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

Table 11 lists the Alarm History fields and descriptions. These descriptions apply to the Alarm History for doubler applications as well.

Table 11. *Alarm History Fields and Descriptions*

Field	Description
Type	Identifies the type of alarm
LOS, DS1-HLU	First and last instance of LOS at the HLU; Current condition, number of alarms
LOS, DS1-HRU	First and last instance of LOS at the HRU; Current condition, number of alarms
Span 1 LOSW, HDSL1	First and last instance of LOSW on HDSL1; Current condition, number of alarms
Span 1 LOSW, HDSL2	First and last instance of LOSW on HDSL2; Current condition, number of alarms
Span-1 ES, HDSL1	First and last instance of ES on HDSL1; Current condition, number of alarms
Span 1 ES, HDSL2	First and last instance of ES on HDSL2; Current condition, number of alarms
Span 1 Margin L1	First and last instance of exceeded margin on Loop 1; Current condition, number of alarms
Span 1 Margin L2	First and last instance of exceeded margin on Loop 2; Current condition, number of alarms
PWR Open	Power condition: Open or Closed
PWR SHRT	Power short condition
Last Cleared: None	Last time Alarm History cleared

You can do the following

- Press <U> to update the screen.
- Press <S> to view another span.
- Press <E> to exit from the Alarm History screen.

18.3 Doubler Applications. Depending upon the doubler configuration, Spans 1, 2 and 3 appear in the Alarm History screen using similar fields as shown in Table 11. The Span 2 Alarm History screen displays for one doubler applications, and the Span 3 Alarm History screen displays for two doubler applications.

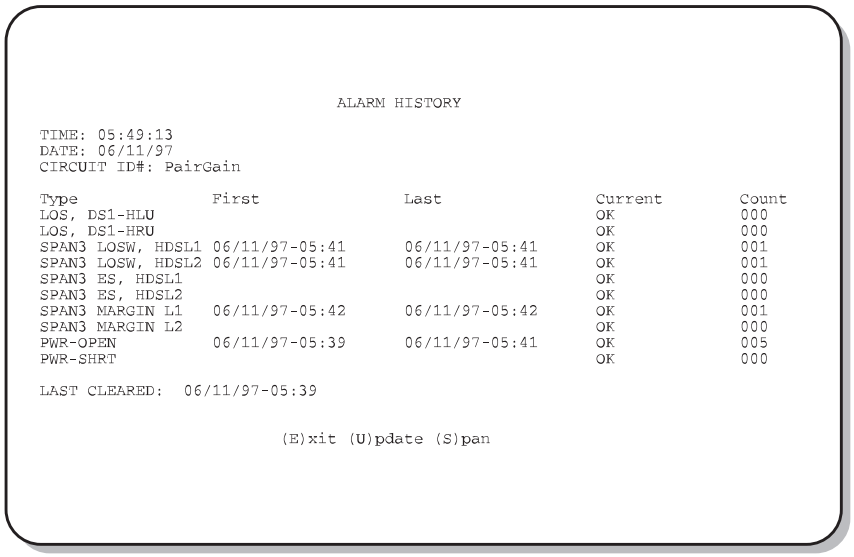
18.3.1 One Doubler, Span 1 Alarm History. Press <G> from the Remote Terminal Main menu to view the Span 1 Alarm History screen:

```
                              ALARM HISTORY

TIME: 05:48:18
DATE: 06/11/97
CIRCUIT ID#: PairGain

Type              First               Last                Current        Count
LOS, DS1-HLU                                              OK             000
LOS, DS1-HRU                                              OK             000
SPAN1 LOSW, HDSL1 06/11/97-05:39      06/11/97-05:39      OK             001
SPAN1 LOSW, HDSL2 06/11/97-05:39      06/11/97-05:39      OK             001
SPAN1 ES, HDSL1                                           OK             000
SPAN1 ES, HDSL2                                           OK             000
SPAN1 MARGIN L1   06/11/97-05:41      06/11/97-05:41      OK             001
SPAN1 MARGIN L2   06/11/97-05:41      06/11/97-05:41      OK             001
PWR-OPEN          06/11/97-05:39      06/11/97-05:41      OK             005
PWR-SHRT                                                  OK             000

LAST CLEARED:  06/11/97-05:39

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

18.3.2 One Doubler, Span 2 Alarm History. Press <S> from the Alarm History screen to view the Span 2 Alarm History screen:

```
                              ALARM HISTORY

TIME: 05:49:13
DATE: 06/11/97
CIRCUIT ID#: PairGain

Type              First               Last                Current        Count
LOS, DS1-HLU                                              OK             000
LOS, DS1-HRU                                              OK             000
SPAN2 LOSW, HDSL1 06/11/97-05:41      06/11/97-05:41      OK             001
SPAN2 LOSW, HDSL2 06/11/97-05:41      06/11/97-05:41      OK             001
SPAN2 ES, HDSL1                                           OK             000
SPAN2 ES, HDSL2                                           OK             000
SPAN2 MARGIN L1   06/11/97-05:42      06/11/97-05:42      OK             001
SPAN2 MARGIN L2                                           OK             000
PWR-OPEN          06/11/97-05:39      06/11/97-05:41      OK             005
PWR-SHRT                                                  OK             000

LAST CLEARED:  06/11/97-05:39

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

18.3.3 Two Doublers, Span 3 Alarm History. Press <S> from the Alarm History screen to view the Span 3 Alarm History screen:



```
                              ALARM HISTORY

TIME: 05:49:13
DATE: 06/11/97
CIRCUIT ID#: PairGain

Type              First               Last                Current      Count
LOS, DS1-HLU                                              OK           000
LOS, DS1-HRU                                              OK           000
SPAN3 LOSW, HDSL1 06/11/97-05:41      06/11/97-05:41      OK           001
SPAN3 LOSW, HDSL2 06/11/97-05:41      06/11/97-05:41      OK           001
SPAN3 ES, HDSL1                                           OK           000
SPAN3 ES, HDSL2                                           OK           000
SPAN3 MARGIN L1   06/11/97-05:42      06/11/97-05:42      OK           001
SPAN3 MARGIN L2                                           OK           000
PWR-OPEN          06/11/97-05:39      06/11/97-05:41      OK           005
PWR-SHRT                                                  OK           000

LAST CLEARED:  06/11/97-05:39

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

You can do the following:

- Press <U> to update the screen.
- Press <S> to view another span.
- Press <E> to exit from the Alarm History screen.

19. Remote Logoff

19.1 Press <H> from the Remote Terminal Main Menu to log off from the system. The Remote Logoff screen displays indicating that you have logged off from the HRU-412.

D. PERFORMANCE MONITORING

20. Basic Features

20.1 The unique performance monitoring features of the HRU-412 List 9 provide the functionality of the Genius Jack, an intelligent Network Interface Unit (NIU) that provides nonintrusive, real-time performance monitoring and sectionalizing of DS1 circuits and standard loopback functionality. The Genius Jack is installed at the demarcation point between the local exchange carrier and the customer premise networks.

20.2 The HRU-412 performs frame format conversion causing the network side of the HRU-412 to operate in the preferred ANSI T1.403 ESF frame format with PRMs, while the CPE side operates in the frame format provided by the end user's Channel Service Unit (CSU). Such frame format conversions allow the HRU-412 to take advantage of the unique ESF PRM information to isolate service-affecting faults to either the NI or the CPE, to the transmit or receive paths within the NI or CPE.

21. Supplemental Test Indicators

21.1 **SF/ESF Conversion.** If the signal from the CI is in SF format, the HRU-412 converts the signal to ESF format prior to transmission to the network. In this case, the ESF signal from the network is converted to SF prior to transmission to the CI. Frame format conversions are summarized in Table 12. If the signal from the network is in SF format, then these conversions are not performed.

Table 12. *Frame Format Conversions and PRM/SPRM Insertion*

Signal from Network	Signal from Customer	Signal to Network	Signal to Customer
SF	SF	SF	SF
SF	ESF	Not allowed	
ESF	SF	ESF including HRU-generated PRMs and SPRMs	SF
ESF	SF	ESF including HRU-generated PRMs and SPRMs	ESF (DL unchanged)
ESF	ESF with PRMs	ESF including customer PRMs modified by HRU-generated SPRMs	ESF

21.2 If the ESF signal from the network contains the bit-patterned RAI/Yellow Alarm message in the ESF Data Link (DL), and the signal to the CI is in SF format, then generation of an SF format RAI/Yellow Alarm may optionally occur depending upon the setting of the SF-RAI option switch, as described in Section 8.

21.3 Performance Report Messages (PRMs).

ANSI T1.403 PRMs are 13-byte message oriented signals sent once per second in the ESF DL, and provide an indication of the quality of the signal from the network at the network interface.

If the signal from the CI does not contain PRMs, then the HRU-412 generates PRMs and inserts them into the DL of the signal in the network. PRMs are not generated if the signal from the CI already contains PRMs.

PRM generation by the HRU-412 does not interfere with AT&T Pub 54016 poll and response messages.

Commonly available network elements and test equipment are capable of reading PRMs and providing both real-time and historical performance information. Examination of PRMs generated by the HRU-412 and performance characteristics of the signal received from the CI, allows the technician to determine if a fault or impairment exists in only one or both directions of transmission.

21.4 Supplemental Performance Report Messages (SPRMs).

SPRMs make use of the U1, U2 and R bits of the PRM, and provide a means for test equipment to sectionalize circuit failures or impairments. SPRMs are generated by the HRU-412 when the PRMs are either being generated by the HRU-412, or when PRMs are present in the signal from the CI.

The U1 bit is set in a PRM in the event that one or more CRC-6 errors or framing errors were detected by the HRU-412 in the signal from the network, since the last PRM was transmitted. In the instance where PRMs are present in the signal from the CI, the U1 bit is used in lieu of HRU-412-generated PRMs to identify impairments or faults in the signal from the network.

The U2 bit is set in a PRM in the event that one or more CRC-6 errors, framing errors, or line code violations were detected by the HRU-412 in the signal from the CI, since the last PRM was generated.

The R bit is used to provide further information about HRU-412 operation. Table 13 lists the defined R bit patterns and descriptions.

Table 13. *R-bit patterns*

R-bit Pattern	Description
11111111	The HRU-412 is generating PRMs
10001000	The HRU-412 is passing through PRMs generated at the CI
10101010	An HRU-412 hardware fault has been detected

The Applied Digital Access (ADA) T3AS Test and Monitoring System is capable of processing SPRMs. Please refer to the ADA application note (23-0000-0002) for more information on SPRMs. You can reach ADA at (800) 854-2242.

21.5 Alarm Indication Signal-Customer Interface (AIS-CI).

The AIS-CI is a variation of the ANSI T1.403 AIS signal (unframed all ones), and is intended to specifically indicate a loss of signal from the customer installation. AIS-CI meets the T1.403 requirements for AIS so that equipment which supports detection of AIS-CI will still detect AIS.

The AIS-CI signal is a repetitive interleaving of 1.11 seconds of an unframed all ones pattern and 0.15 seconds of all ones modified by the AIS-CI signature. The AIS-CI signature is a repeating 6176 bit pattern in which bit numbers 3088, 3474 and 5760 are set to zero.

To prevent the HLU from transmitting its AIS signal, which would interfere with the AIS-CI signal being sent from the HRU, a local HRU LOS condition is not transmitted to the HLU. Thus the HLU does not indicate an RLOS alarm status when this condition exists.

The ADA T3AS Test and Monitoring System is capable of detecting AIS-CI.

21.6 Remote Alarm Indication-Customer Interface (RAI-CI).

The RAI-CI is a variation of the ANSI T1.403 ESF bit patterned RAI/Yellow Alarm message, and is intended to specifically indicate that RAI has been detected in the signal from the CI when no defect or failure is detected in the signal from the network. RAI-CI meets the T1.403 requirements for RAI so that equipment which does support detection of RAI-CI will still detect RAI.

The RAI-CI signal is identical to the T1.403 ESF bit patterned RAI/Yellow Alarm message except that for a period of 90 milliseconds, every 1.08 seconds, the standard RAI pattern of '0000000011111111' is replaced by '0011111011111111.'

The ADA T3AS Test and Monitoring System is capable of detecting RAI-CI.

Please refer to the following ADA document for more information on AIS-CI, RAI-CI and SPRM signals: "T1E1.2 2/96-025R1, Contribution to ATIS Working Group T1.E1.2, Standards Project: Additions to ANSI T1.403 and ANSI T1.408, Title: Add Signals AIS-CI and RAI-CI and SPRM (PRM bits U1, U2 and R)."

22. Loopback Design Description

22.1 Loopbacks permit you to perform a isolated diagnostic tests on specific areas of the circuit. The transmitted signal is returned to the sending device after passing through a data communications link or network. This allows you to compare the returned signal with the transmitted signal and to determine if there is a problem with the circuit. Ideally, personnel performing loopback testing are in direct communication with each other in order to correlate messages displayed at both the HRU and HLU during the test. Figure 9 shows the loopback diagram (see Section 13.4, Table 9 for a comprehensive description of loopback messages).

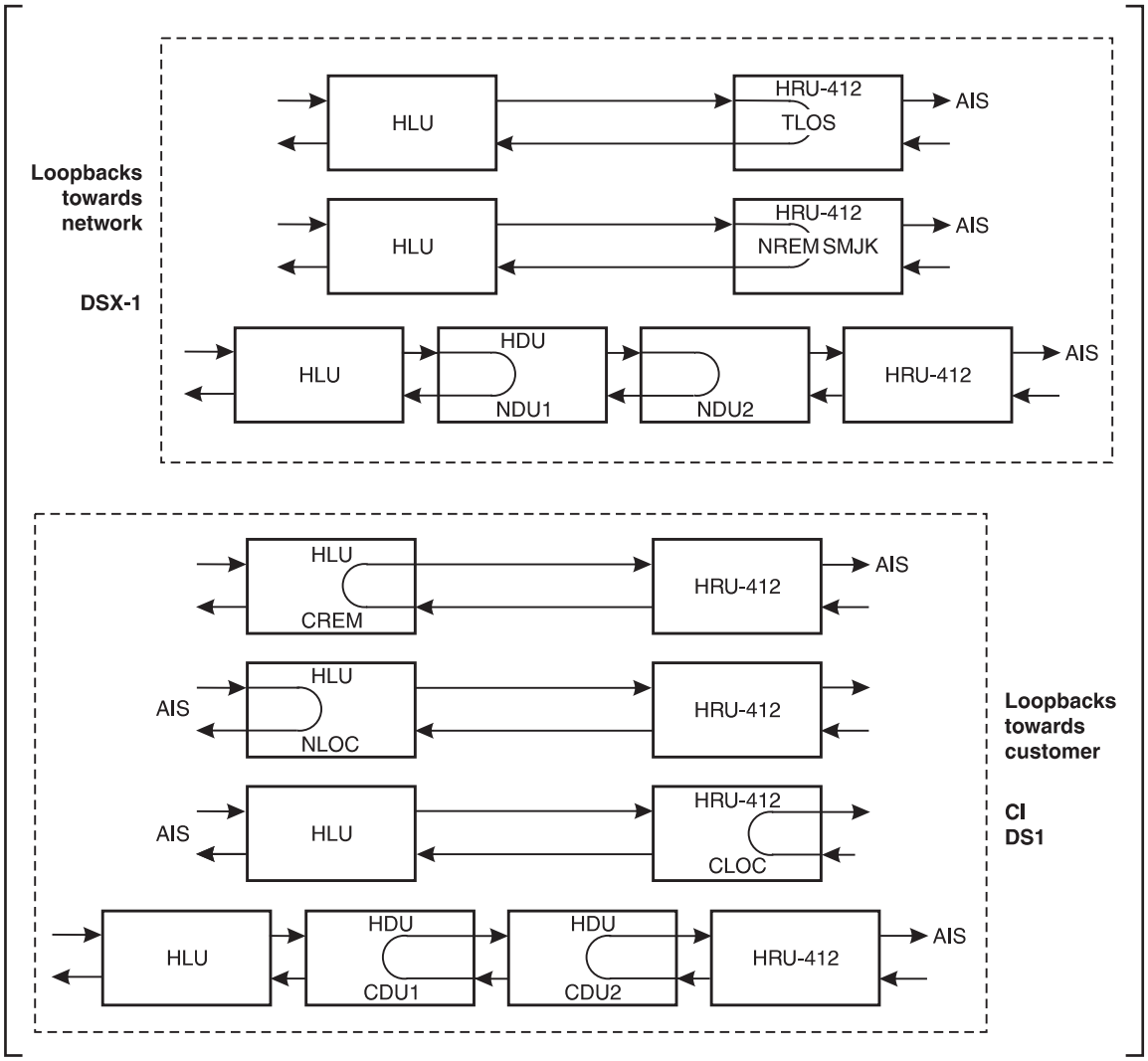


Figure 9. *HiGain System Loopbacks*

22.2 **HRU Loopbacks.** The HRU loopbacks are as follows:

- Network Remote (NREM): The DSX signal is looped back to the DSX at the HRU.
- Smartjack (SMJK): Loopback at the HRU towards the network initiated by a 2 in 5 in-band loopback code or out of band ESF data link code.
- Customer Local Loopback (CLOC): Signal from CI is looped-back to customer at HRU-412.

22.3 HLU Loopbacks. The HLU loopbacks are as follows:

- Network Local Loopback (NLOC): The DSX signal is looped back to the DSX at the HLU.
- Customer Remote Loopback (CREM): Signal from the customer is looped back to the customer at the HRU.

22.4 The Smart-jack loopback shown in Figure 9 is the standard NID metallic loopback. It has two modes of operation as determined by the SAIS user option settings at the HLU (*ENA* or *DIS*). The *ENA* option causes the HRU to transmit the AIS signal towards the NI. The *DIS* option turns off the AIS/NI signal. To send the AIS pattern to the CI during Smart-Jack or NREM loopbacks, set the SAIS to *ENA*.

22.5 SAIS Set to *ENA*. Upon detection of a valid Smart-jack loopback command, a metallic loopback relay (see Figure 3) is energized and the T1 interface chip transmits the AIS pattern to the NI and also back to the HRU-412 T1 receiver circuit. In addition, the customer's T1 XMT input is disconnected and terminated into 100 Ω. The AIS pattern is examined by the HRU for its overall integrity. This pre-looped test lasts for about 100 ms and terminates in one of the following two conditions:

- Pre-loop Failed - If the transmit and receive all 1's patterns do not match, a problem in the HRU is indicated and HiGain declares an HRU PRE-LOOPBACK FAIL condition. This terminates the loopback test and returns the HRU to its unlooped normal state. This indicates a defective HRU.
- Pre-loop Passed - If the transmit and receive patterns match, the system declares an HRU Pre-loop Passed condition. All active circuits are working. The metallic loopback relay remains closed and, in addition, enables a logic loopback within the HRU. 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. This puts the HiGain system 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.

When the HRU is in its AIS/ENA smart-jack metallic loop back state, its 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 being monitored since its input circuit has been opened and terminated into 100 Ω. 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*. The HRU-412 LED indicates B8ZS if the *Code* option is set to B8ZS.

As can be seen, the AIS/ENA metallic loopback scenario includes and therefore tests all HiGain 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.

22.6 SAIS Set to *DIS*. This metallic loopback state is initiated in the same manner as 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 Ω. 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.

When the HRU is in its AIS/DIS smart-jack metallic loop back state, its T1 input LOS, Code and 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 Ω. The FRM and 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 indicates AMI or B8ZS if the Code option is set to either *AMI* or *B8ZS* respectively.

22.7 All of the HRU loopbacks towards the network (NREM and SMJK) are metallic/logic (AIS/ENA) or metallic only (AIS/DIS). The SMJK and NREM loopbacks are identical. They differ only in how they are initiated. 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).

22.8 The HRU-412 front panel loopback (LB) button can be used to terminate any HRU loopback, irrespective of how it was initiated.

23. Loopback Test Procedures

23.1 Testing of your HiGain system allows you to verify the integrity of the HDSL channels to the HLU as well as the DS1 channels to the customer and the HLU DSX-1 interface. While the HRU-412 displays system condition messages at the Remote and Maintenance Terminals, and via color-coded LED displays on the front panel, the HLU displays system conditions via four-character LCD messages. To facilitate test messaging with CO test personnel, HLU Four-Character Front Panel Messages are provided in Table 14.

23.2 If you encounter trouble at the T1 interface, verify that the unit is making a positive connection with the mounting assembly connector.

1 Press the loopback LB button on the HRU front panel for at least five 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, which also indicates that the HRU-412 is in loopback.

3 Have the CO 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-412 from its loopback state by again pressing the loopback button for five seconds. Verify that the loopback NET LED is off.

5 Have the CO tester send the HLU (4 in 7) in-band loop-up (NLOC) for five 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-412. If it fails, the problem is at the CO.

7 If the I-CPE 60 mA switch option is set to *60 mA*, verify that the external NID is under power and that the voltage across the front panel "60 mA MON" test points measures between 55 and 65 mV. This indicates that the CPE current is between 55 and 65 mA. The external NIDs Loop Power option must be set to its *THRU* position when powered by the HRU-412.

8 If the sealing current option is enabled (JP2 connected), insert a milliampmeter in service with the Tip or Ring of either HDSL pair and verify that at least 20 mA of sealing current is flowing.

When T1 loopback tests are made using external metallic loopback connections at either end, the DS1 code 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-412 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-412 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.

***Table 14**. HLU Four Character Front Panel Messages*

Message	Name	Description
CREM	Customer Remote Loopback	Signal from customer is looped back to customer at the HLU.
NLOC	Network Local Loopback	DSX signal is looped back to DSX at the HLU.
CLOC	Customer Local Loopback	Signal from customer is looped back to customer at the HRU.
SMJK	Remote Smartjack Loopback	Signal from DSX is looped back at HRU by the HRU smartjack.
FERR	Framing Bit Error Occurred	Framing bit error occurred at HLU T1 input.
LBPV	Local Bipolar Violation	A bipolar violation received at the T1 input to the HLU.
SIG 1 or 2	Signal 1 or Signal 2	The HLU and HRU transceivers are attempting to establish contact.
ACQ 1 or 2	Acquisition 1 or Acquisition 2	The HLU and HRU multiplexers are trying to establish synchronization over each loop.
H1ES	HDSL CRC Error Loop 1	At least one CRC error on HDSL Loop 1 in last second.
H2ES	HDSL CRC Error Loop 2	At least one CRC error on HDSL Loop 2 in last second.
ARM	HiGain 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 pressing the Sel button on the HLU front panel.
SELF TEST	Self Test mode	HLU is in self test mode. This occurs every power On/Off cycle.
ALRM	Alarm Condition Exists	A minor alarm MNRALM condition is in effect.
1=xx or 2=yy	HDSL Loop Margins	Indicates the power of the received HDSL signal on each Loop relative to noise. Any value of *06* or greater is adequate.
PWR FEED SHRT	Power Feed Short	Indicates a short between the two HDSL pairs. This same message can occur with an HRU that is drawing the correct amount of power over good cable pairs, but is not communicating with the HRU.
PWR FEED OPEN	Power Feed Open	Indicates an open circuit in the Tip and Ring of either HDSL pair.
BAD RT?	No response from HRU	The HLU does not receive any response from the HRU.
VER	HLU Software Version #	Displayed during the System Settings review mode by pressing the Mode button at the HLU for three 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	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	One of the HDSL loops has lost synchronization. Causes minor alarm.
LLOS	Local Loss of Signal	No signal detected at the T1 input to the HLU. Causes minor alarm.
RLOS	Remote Loss of Signal	No signal is detected at the T1 input to the HRU. 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 minor alarm.
DS0	DS0 Blocked Channels	Indicates status of DS0 blocked channels. NONE indicates no channels are blocked. BLK indicates some channels are blocked.

E. PRODUCT SUPPORT

24. Technical Support

24.1 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

24.2 During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday - 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.

24.3 **Bulletin Board Services.** 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.

25. PairGain Warranty

25.1 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 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 improper use or installation.

25.2 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.

25.3 If a unit needs repair:

1 Call PairGain for a Return Material Authorization (RMA) number at (800) 638-0031.

2 Return the defective unit, freight prepaid, along with a brief description of the problem, to:

PairGain Technologies, Inc.
ATTN: Repair and Return Dept.
14402 Franklin Avenue
Tustin, CA 92780
USA

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

26. Certification

26.1 **FCC compliance.** The HRU-412 List 9 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 their own expense.

26.2 **UL Recognized.** The HRU-412 List 9 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.

26.3 **CSA Certification.** The HRU-412 List 9 has been tested and found to comply with CSA Standard C22.2-950 with telecommunication features.

F. ABBREVIATIONS AND GLOSSARY

27. Abbreviations and Glossary

2B1Q	2–Bits–1–Quaternary
ADA	Applied Digital Access
AIS	Alarm Indication Signal
AIS-CI	Alarm Indication Signal-Customer Interface
AMI	Alternate Mark Inversion
B8ZS	Bi-directional 8-zero Substitution
BPV	Bipolar Violation
CI	Customer Interface
CO	Central Office
CLOC	Customer Local Loopback
CPE	Customer Premises Equipment
CRC	Cyclic Redundancy Check. A process used to check the integrity of a block of data.
CSA	Carrier Service Area
CSU	Channel Service Unit. A device used to terminate a digital channel on a customer's premises.
DCE	Data Circuit-Terminating Equipment
DL	Data Link
DS1	Digital Service, Level 1
DSX	Digital System Cross-Connect frame. A bay or panel to which T-1 lines and DS-1 circuit packs are wired.
ES	Errored Seconds
ESF	Extended Super Frame
ESF DL	Extended Super Frame Data Link
HCDS	High Capacity Digital Service
HDSL	High-bit-rate Digital Subscriber Line
HDU	HiGain Doubler Unit

HLU	HiGain Line Unit
HRE	HiGain Remote Enclosure
HRU	HiGain Remote Unit
I-CPE	Interface-Customer Premises Equipment
LOS	Loss of Signal
LOSW	Loss of Sync Word
NEBS	Network Equipment Building System
NI	Network Interface
NID	Network Interface Device
NIU	Network Interface Unit
NREM	Network Remote Loopback
POTS	Plain Old Telephone Service
PRM	Performance Report Message
RAI-CI	Remote Alarm Indicator-Customer Interface
RLEV	Receive Level
SCURR	Sealing Current
SF	Super Frame
S/N	Signal-to-Noise
SF-RAI	Super Frame-Remote Alarm Indication
SPLB	Special Loopback
SPRM	Supplemental Performance Report Message
TLOS-LB	Transmit Loss of Signal-Loopback
TSGR	Transport System Generic Requirements
UAS	Unavailable Seconds
ZBTSI	Zero Byte Time Slot Interface

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For Technical Assistance:
(800) 638-0031

ISO 9001
DNV
DNV Certification, Inc.
Certificated Firm

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THE COPPEROPTICS COMPANY