HIGAIN REMOTE UNIT

Model	List Number	Part Number
HRU-402	2	150-1592-02
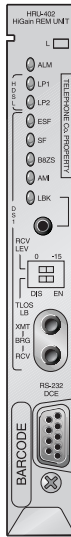
PAIRGAIN TECHNOLOGIES, INC.
ENGINEERING SERVICES TECHNICAL PRACTICE

SECTION 150-402-102-01

Revision History of This Practice

Revision	Release Date	Revisions Made
01	July 27, 1998	Initial release

USING THIS MANUAL

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

Notes contain information about special circumstances.

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

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PRODUCT OVERVIEW

This technical practice describes the PairGain® HiGain® Remote Unit, Model HRU-402 List 2, and its use with and without doubler and line units. This remote unit functions as the remote end of a repeaterless T1 transmission system. An HRU-402 List 2 connects to a HiGain Line Unit (HLU) and HiGain Doubler Units (HDUs), creating a HiGain system which provides 1.544 Mbps transmission on two unconditioned copper pairs over the full Carrier Service Area (CSA) range. See the section titled "Applications" on page 3 for HiGain doubler and doubler compatible line units that can be used with the HRU-402 List 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. The HRU-402 List 2 is housed in a remote enclosure at the Customer Premises Equipment (CPE) site. Optional HDUs provide the ability to increase the range between the HLU and HRU to five CSA spans. The CSA encompasses approximately 60 kft of American Wire Gauge (AWG) wire.
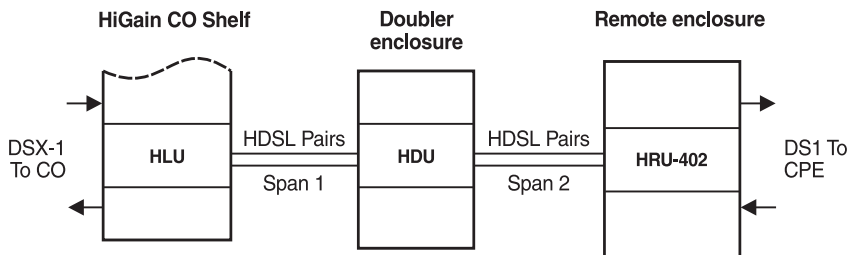
Figure 1. *Typical HiGain System*

FEATURES

- Front panel with:
  - Receive (RCV) and Transmit (XMT) Bridged (BDG) access jacks for testing
  - DS1 and HDSL status Light Emitting Diodes (LEDs)
  - Craft port access (RS-232 DB-9 connector)
- American National Standards Institute (ANSI) T1.403 DS1 NI
- Generic and addressable repeater loopback activation codes
- Line power or local power options
- Optional sealing current
- Lightning and power cross protection on HDSL and DS1 interfaces
- 784 kbps full-duplex 2B1Q HDSL Transmission on two pairs
- DS0 blocking
- Compatible with PairGain 1 x 1 Protection Switching System
- Narrow SLIM mechanics (half-width 400 mechanics)
- Lower Power Consumption
- Supports one to four span line powered and five span local powered circuits
- Ultra Low Wander
- Improved DS1 Auto Mode
- Local/Line Power Switch
- BPVT and Bit Error Rate (BER) Options
- Remote DS1 Alarm (RDA) Option
- Alarm Pattern (ALMP) Option
- DS1 Line Code Auto Options

For additional information on features of the HRU-402 List 2, see "Features" on page 45.

APPLICATIONS

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

Each cable pair loop has less than 35 decibel (dB) of loss at 196 kHz with 135Ω driving and terminating impedances. Table 1 provides a guide for the loss of various cable gauges at 196 kHz and 135Ω. Table 1 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 1.   *HDSL Loss Over Cables*

Cable Gauge	Loss at 196 kHz (dB/kft)	Ω 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

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 and cut-over from the installed HiGain system. The installed HiGain system can then be easily removed and utilized elsewhere.

The HRU-402 List 2 can be used with all HiGain doublers and doubler compatible line units for two or three span applications. The remote unit can

also be used with the following line and doubler units for four and five span applications:

- HLU-231 List 8x

- HLU-319 List 5x

- HLU-388 List 8x

- HDU-409, HDU-407 or HDU-404

PRODUCT DESCRIPTION

Front Panel

Figure 2 and Table 2 identify the remote unit front panel components. Table 2 also describes the functions of the front panel components.
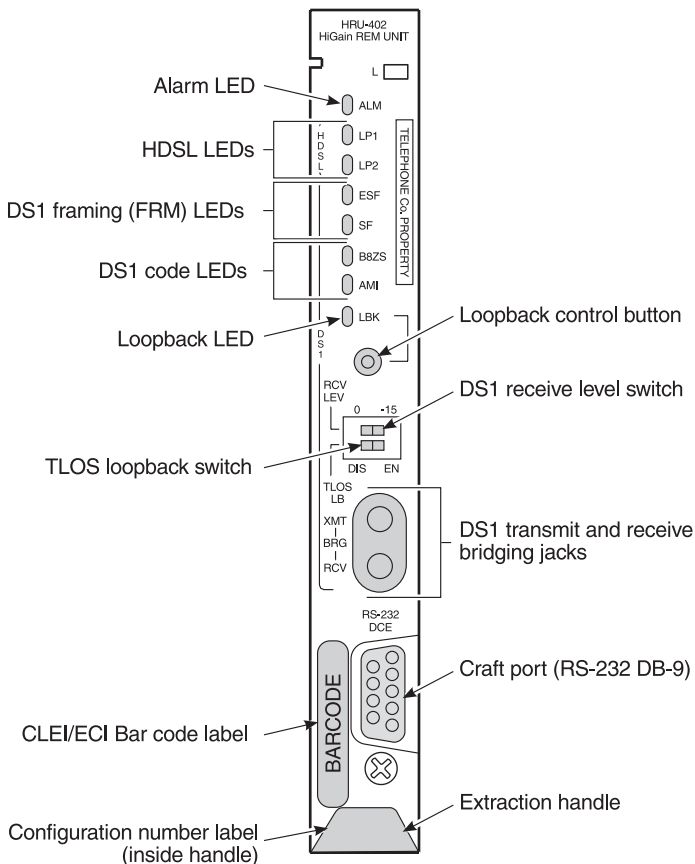
Figure 2.   Front Panel

Table 2.   Front Panel Components

Name	Function
DS1 XMT and RCV Bridging Jacks	Provides bridging test and monitor access jacks to the CPE DS1 interface. Provides both monitor and test access capability. See Figure 25 for circuit details.
Alarm (ALM) LED	Shows alarm states for Remote and Local Loss of Signal (LOS)
Solid Red	Indicates a LOS condition at HRU T1 input.
Blinking Red	Indicates a LOS condition at HLU T1 input.
Loopback (LBK) LED	Shows loopback states to and from the NET (Network) and to and from the Customer Interface (CI) and an ARMED condition.
Solid Yellow	Indicates NREM
Blinking 1 Per Second	Indicates CLOC loopback state.
Blinking 4 Per Second	HRU is in an ARMED state.
LBK Control Button	Press the button for five seconds to activate a remote loopback towards the Network Remote Loopback (NREM) state. The unit can be unlooped by either pressing the button in again for five seconds or by the standard loopdown coded messages. Also provides the ability to control NREM.[a]
DS1 Code LEDs	Indications for DS1 code options.
B8ZS	DS1 Code Option=B8ZS: Solid green indicates that the DS1 line code option is set to Bit 8-Zero substitution (B8ZS). The solid green light does not indicate the actual DS1 line code being received which may be Alternate Mark Inversion (AMI) or B8ZS. The light blinks one time per second when a string of excessive zeros is detected.
	DS1 Code Option=Auto: Solid green indicates DS1 code being detected at B8ZS.
AMI	DS1 Code Option=AMI: Solid green indicates that the user DS1 line code option is set to AMI. This light blinks one time per second when a Bipolar Violation (BPV) is detected.
	DS1 Code Option=AMI: Solid green indicates the DS1 code is being detected as AMI.
DS1 Framing (FRM) LEDs	Indications for framing patterns.
Extended Super Frame (ESF)	Solid green indicates ESF framing. The light blinks one time per second when a frame error is indicated.
Super Frame (SF)	Solid green indicates SF framing. The light blinks off for 0.5 seconds when a frame error is indicated.[b]

Table 2.*   *Front Panel Components (Continued)

Name	Function
Craft Port (RS-232 DB-9 Connector)	Provides bidirectional communication between the unit and an external maintenance terminal through an RS-232 interface to allow configuration and performance monitoring through the Maintenance Terminal menus. See the section "Connecting to a Terminal Emulator" on page 15 for operating procedures.
HDSL LEDs	Displays HDSL Loop 1 (LP1) and Loop 2 (LP2) Conditions.
Solid Green	Indicates HDSL loop is in sync.
Blinking Green 1 time per second	Indicates HDSL loop is trying to acquire sync.
Blinking Green 4 times a second	Indicates a Margin alarm condition on the HDSL loop.
Blinking Green 10 Times a second.	Indicates a Cycle Redundancy Check (CRC) error on the HDSL loop.
OFF	Indicates no activity on the HDSL loop.
Extraction Handle	Handle used to remove the HRU-402 List 2 from the remote enclosure.
DS1 RCV Level (LVL) Switch	Sets DS1 RCV level.
0	Sets the DS1 receive level towards the CI to 0 dB.
-15	Sets the DS1 receive level towards the CI to a -15 dB.
Transmit Loss of Signal (TLOS) Loopback (LB) Switch	Enables or disables TLOS loopback option.
DIS	Disables the TLOS option.
EN	Enables the TLOS option.
Bar Code Label	Contains human-readable Common Language Equipment Identifier (CLEI) code number and Equipment Catalog Item (ECI) bar code number.
Configuration Number Label	Contains either a five-digit or six-digit warranty configuration number or a standalone two or three-digit configuration number as follows: • Digit 1= Last digit of shipment year • Digits: 2 and 3= Shipment month • Digits: 4 and 5= Configuration number

(a.) Any existing loopbacks are terminated before NREM loopback is activated.

(b.) If DS1 signals are not detected, the ESF, SF, B8ZS and AMI LEDs will not light.

Rear Panel

The HRU-402 List 2 has four user options that must be set before you install the unit into a shelf or enclosure. Two of these options, DS1 Receive Level and TLOS, are located on the front panel. The other two, Sealing Current (SCURR) and Local Power (LPWR), are located at the back of the printed circuit board adjacent to the card-edge connector as shown in Figure 3. For the sealing current option, you can choose to either disable or enable the current flow over the HDSL pairs (see Table 3). For the Local Power option, you can choose to either force the HRU to use local power or line power.

See "Local and Line Powering" on page 49 and "Simplex Sealing Current Information" on page 50 for further information.

S1

Sealing current (SCURR)

Local power (LPWR)
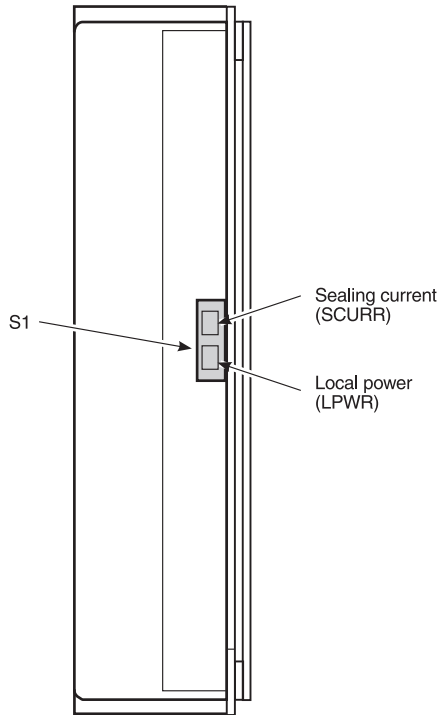
Figure 3. *Backplane User Option Locations*

Table 3. *Rear Panel Components*

Name	Function
Sealing Current- Rear Unit Switch S1	
DIS[a]	Prevents the flow of simplex sealing current over the HDSL pairs towards the upstream unit.
ENA[b]	Allows the flow of simplex sealing current over the HDSL pair towards the upstream unit. The local power option LPWR must also be set to ENA to allow sealing current to flow.
Local/Line Power- Rear Unit Switch S1	
DIS[a]	Forces the HRU to its Line Power mode where it obtains its power from the upstream line unit over the HDSL pairs.
ENA	Forces the HRU to its Local Power mode where it obtains its power from the -48V supply applied to its edge connector pins 35(-) and 17(+) when present. If -48V of local power is not present, the HRU reverts to its Line Power mode.

(a.) Denotes factory default setting.

(b.) This simplexed sealing current is polarity sensitive and will not flow if the HDSL loops adjacent to the HRU are reversed. Reversed loops are indicated by a CHREV message in the ALARMS line of the SPAN STATUS Maintenance screen

INSTALLATION

This section describes the installation process for the HRU-402 List 2.

INSPECTING YOUR SHIPMENT

When you receive the equipment, inspect it for signs of damage. If damage has occurred, immediately report the extent of damage to the transportation company and to PairGain Technologies, Inc. (see "Appendix C: Product Support" on page 58 for more information).

Your shipment should consist of:

- One HRU-402 List 2

- *PairGain Technologies HiGain Remote Unit 402 List 2* technical practice

INSTALLING THE HRU-402 LIST 2

The HRU-402 List 2 mounts in the following shelves (indoor use):

- HRE-420 (single-wide, single mount)

- HRE-422 (double-wide, double mount)

- HRE-425 (12-slot wall or rack mount)

- HRE-427 (seven-unit wall or rack mount)

- 400 Mechanics type shelves

For outdoor applications, the HRU-402 List 2 mounts in the following shelves:

- HRE-450 (single-unit)

- HRE-454 (four-unit)

To install the HRU-402 List 2 (Figure 4):

1   Set the user options as described in "Rear Panel" on page 8.

2   Slide the remote unit into the card guides for the desired slot, then push the unit into the enclosure until it is seated in the card-edge connector.

Remote enclosure
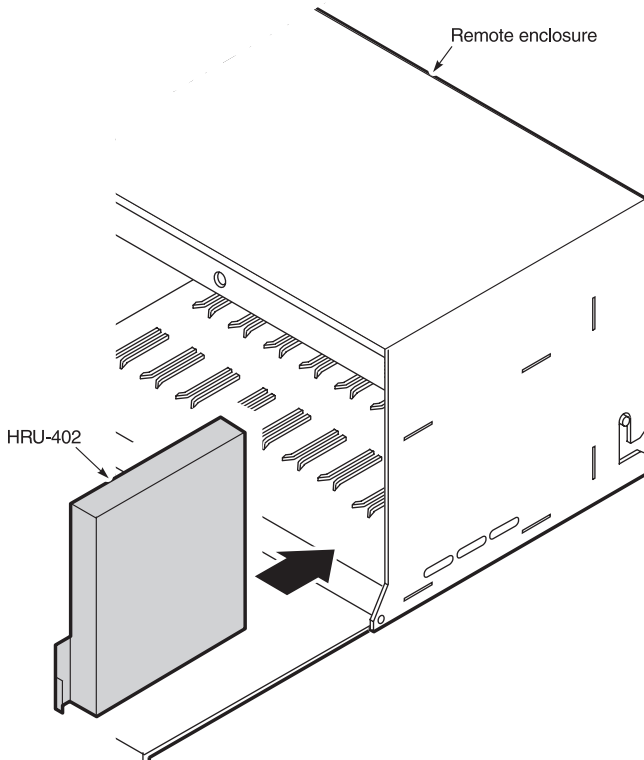
HRU-402

Figure 4.   HRU-402 Installed in a Remote Enclosure

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

INSTALLATION TEST

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-402 List 2 displays system condition messages at the Remote and Maintenance Terminals, and by color-coded LED displays on the front panel, the HLU displays system conditions by four-character LCD messages. To facilitate test messaging with CO test personnel, four-character, front-panel messages for the HLU-231 List 8 are provided in Table 4 on page 13.

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

To test the loopbacks:

1 Press the loopback (LBK) button on the remote unit front panel for at least five seconds (see Figure 2 for the location of this button).

2 Verify that the Yellow HRU front panel LBK 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-402 List 2 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 remote unit from its loopback state by again pressing the loopback button for five seconds. Verify that the LBK 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-402 List 2. If it fails, the problem is at the CO.

7 If the sealing current option is enabled, insert a milliampmeter in series with the Tip or Ring of either HDSL pair and verify that approximately 10 mA of sealing current is flowing in either conduction (approximately 20 mA total).

8   When the HRU is looped back towards the CPE or CLOC, the LBK LED blinks yellow at 1 time per second.

9   When HiGain is in special loopback ARMED state, the LBK LED blinks yellow at four times a second.

FRONT PANEL MESSAGES

The following table lists and describes front panel messages that may appear on the ASCII terminal menus while the HRU-402 List 2 is connected to the HLU-231 List 8.

Table 4.   *HLU-231 List 8 Four-Character Front Panel Messages*

Message	Name	Description
CREM	Customer Remote Loopback	Signal from customer is looped back to customer at the HLU-231.
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.
NREM	Network Remote Loopback	DSX signal is looped back to DSX at HRU.
SMJK	Remote SmartJack Loopback	Signal from DSX is looped back at HRU by the HRU SmartJack.
TLOS	Transmit Loss Of Signal	HRU is in a logic loopback state caused by a loss of its T1 input from the CI, if enabled at the HRU by its TLOS switch option.
FERR	Framing Bit Error Occurred	Framing bit error occurred at HLU T1 input.
LBPV	Local Bipolar Violation	A bipolar violation received at the T1 input to the HLU-231.
SIG 1 or 2	Signal 1 or Signal 2	The HLU and HRU or 1st Doubler transceivers are trying to establish contact with each other on Loops 1 or 2 of span 1.
S2L1 or 2	Signal 2 Loop 1 or Loop 2	The 1st Doubler and either HRU or 2nd Doubler transceivers are trying to establish contact with each other on loops 1 or 2 of span 2.

Table 4. *HLU-231 List 8 Four-Character Front Panel Messages (Continued)*

Message	Name	Description
S3L1 or 2	Signal 3 Loop 1 or Loop 2	The 2nd Doubler and either HRU or 3rd Doubler transceivers are trying to establish contact with each other on loops 1 or 2 of span 3.
S4L1 or 2	Signal 4 Loop 1 or Loop 2	The 3rd Doubler and either HRU or 4th Doubler transceivers are trying to establish contact with each other on loops 1 or 2 of span 4.
S5L1 or 2	Signal 5 Loop 1 or Loop 2	The 4th Doubler and HRU transceivers are trying to establish contact with each other on loops 1 or 2 of span 5.
A2L1 or 2	Acquisition 2 Loop 1 or Loop 2	The 1st Doubler and either HRU or 2nd Doubler multiplexers are trying to establish synchronization with each other on Loops 1 or 2 of span 2.
A3L1 or 2	Acquisition 3 Loop 1 or Loop 2	The 2nd Doubler and either HRU or 3rd Doubler multiplexers are trying to establish synchronization with each other on loops 1 or 2 of span 3.
A4L1 or 2	Acquisition 4 Loop 1 or Loop 2	The 3rd Doubler and either HRU or 4th Doubler multiplexers are trying to establish synchronization with each other on loops 1 or 2 of span 4.
A5L1 or 2	Acquisition 5 Loop 1 or Loop 2	The 4th Doubler and HRU multiplexers are trying to establish synchronization with each other on loops 1 or 2 of span 5.
H1ES	HDSL CRC Error Channel 1	HLU HDSL Loop 1 CRC error.
H2ES	HDSL CRC Error Channel 2	HLU HDSL Loop 2 CRC error.
ARM	HiGain System ARMED	Armed to respond to Intelligent Repeater Loop Codes.
ACO	Alarm CutOff	A minor alarm has occurred and 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 for reliable system operation.
PWR FEED SHRT	Power Feed Short	Indicates a short between the two HDSL pairs in Span 1.

Table 4. *HLU-231 List 8 Four-Character Front Panel Messages (Continued)*

Message	Name	Description
PWR FEED OFF	Power Feed Off	HDSL span power has been turned off by setting the PWFD option to DIS.
PWR FEED GRD	Power Feed Ground	One of the HDSL loops has been grounded.
BAD RT?	No response from HRU	The HLU does not receive any response from the HRU. Thus, the HRUs integrity is questionable.
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.
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.
LOSW	Loss of Sync Word	Indicates that 1 of the HDSL has lost sync. If the LOSW is detected, a minor alarm signal will occur.
LLOS	Local Loss of Signal	Indicates that no signal is 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. Causes minor alarm.

CONNECTING TO A TERMINAL EMULATOR

This section covers the maintenance terminal screens for both non-doubler and doubler applications. The 9-pin craft port (RS-232 DB-9 connector) on the HRU-402 List 2 front panel allows you to use a RS-232 cable to connect your system to an ASCII terminal or PC running a terminal emulation program. Once connected, you can access the Maintenance and Remote Terminal menus (the Set Clock and Loopback are the only interactive options available on the remote unit).

To connect a maintenance terminal:

1 Connect a standard, 9-pin, serial terminal cable to the Craft port (RS-232 DB-9 connector) on the HRU-402 List 2. Figure 5 shows the

HRU-402 List 2, DB-9, and two types (DB-9 and DB-25) of RS-232 I/O interfaces on the HLUs.
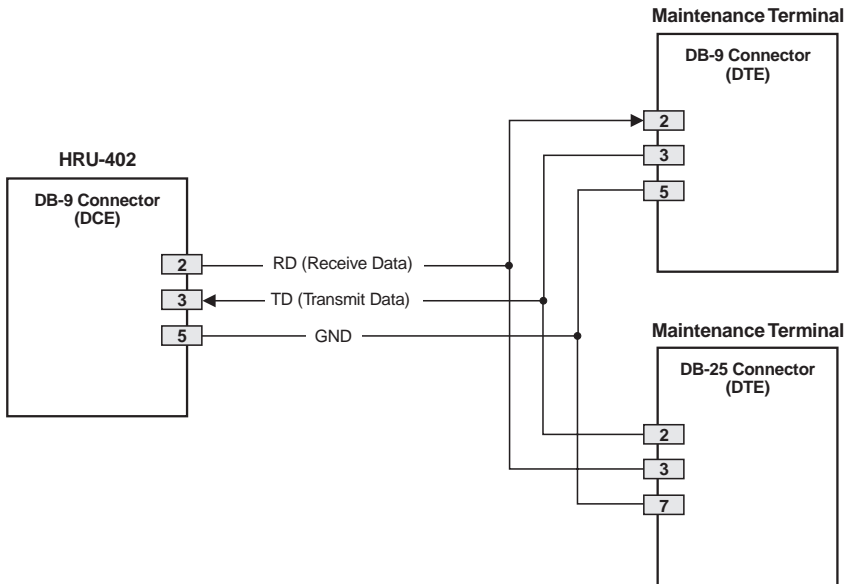
Figure 5. *DB-9 and DB-25 RS-232 I/O Interfaces*

2 Once the serial cable is connected to the Craft port (RS-232 DB-9 connector) on the HRU-402 List 2, connect the other end of the cable to the 9-pin COM port (RS-232) of the maintenance terminal (Figure 6). The maintenance terminal is configured as Data Circuit-Terminating Equipment (DCE).
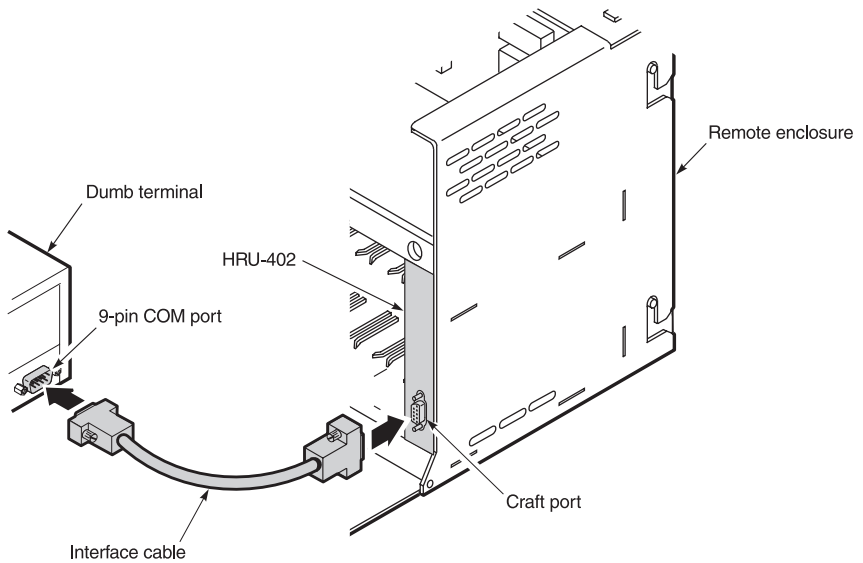
Figure 6.   Connecting the HRU-402 to a Maintenance Terminal

3   Configure the maintenance 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.*

USING THE MAINTENANCE TERMINAL

This section describes the use of the maintenance terminal software for viewing system performance.

LOGIN

The HRU-402 List 2 supports local and remote login. Local login connects the Craft port (RS-232 connector) to the database in the HRU-402 List 2. Remote login connects the remote unit to the HLU using the HDSL Embedded Operation Channel (EOC) as the data link between the two units. Remote login creates menus and screens for the HRU-402 List 2 that are identical to those at the HLU. See the appropriate line unit technical practice for more information about the menus and screens.

> **The screen displays shown in this practice are typical for remote login sessions for systems comprised of the following line units and doublers: HLU-231 List 8x, HLU-319 List 5x, HLU-388 List 5x, HDU-409, HDU-407 and HDU-404. These screens differ somewhat from those obtained when the HRU-402 is used with older generation line units. Refer to the individual line unit practice for specific remote login screen display formats.**

To log on and access the menus and screens using the maintenance terminal.

1 Press the `SPACEBAR` several times to activate the autobaud feature and to display the login screen.

   The initial remote unit session after power-up is always Local Login (Figure 7 shows the main menu of a local session). The main menu heading *HiGain HRU-402 Maintenance Terminal Main Menu* identifies the screen as a Local Login session. However, after the remote unit and HLU establish synchronization, the port interface will reset to a remote session. First generation HLUs do not support Remote Login sessions.

2 Once the remote unit and HLU have established synchronization, the Remote Login screen (Figure 8) is displayed. Press the `ENTER` key to bring up the Remote Login Main Menu screen (shown in Figure 10).

This screen can be identified by the heading, *HiGain HLU-231 Remote Terminal Main Menu.* This is the remote unit you will be connected to.

3   At this point, you may choose to terminate the remote session by pressing ▯ under the remote logoff option (Figure 10). Terminating the remote session allows other units in the circuit, such as doublers, or the HLU itself, to initiate a RS-232 session.

This is necessary because a HiGain circuit can only support one RS-232 session at a time. An active session at any module prohibits active sessions at all other circuit modules.

> **The HRU-402 List 2 automatically performs a remote logoff if no activity at the keyboard is detected after 5 minutes. This prevents remote sessions that were not properly terminated from blocking access to the Craft port at other locations.**

```
HI-GAIN HRU-402 MAINTENANCE TERMINAL MAIN MENU (ver x)

                    A. VIEW SPAN STATUS
                    B. SET CLOCK
                    C. SYSTEM SETTINGS
                    D. VIEW PERFORMANCE DATA
                    E. VIEW PERFORMANCE HISTORY
                    G. VIEW ALARM HISTORY
```
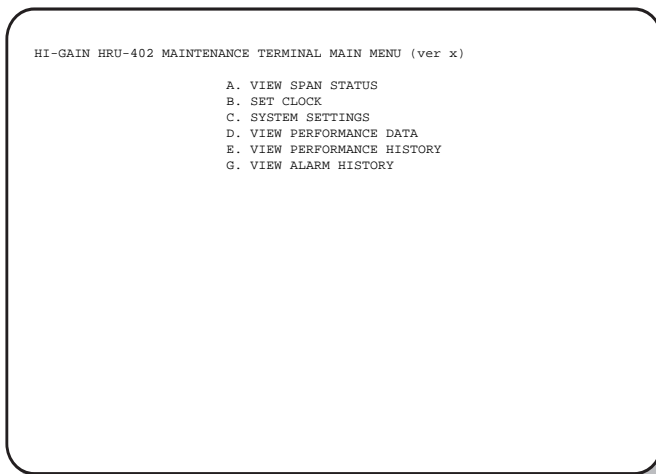
Figure 7.   *Local Login Main Menu Screen*

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+                                                      +
+   RRRRR   EEEEEE  M     M    OO    TTTTTTT EEEEEEE    +
+   R    R  E       MM   MM  OO  OO     T    E          +
+   RRRRR   EEEEEE  M  M  M  O      O   T    EEEEEE      +
+   R   R   E       M     M  OO  OO     T    E          +
+   R    R  EEEEEE  M     M    OO       T    EEEEEEE    +
                                 BY
                        PAIRGAIN  TECHNOLOGIES
++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                        HIT <ENTER> TO LOG IN
```
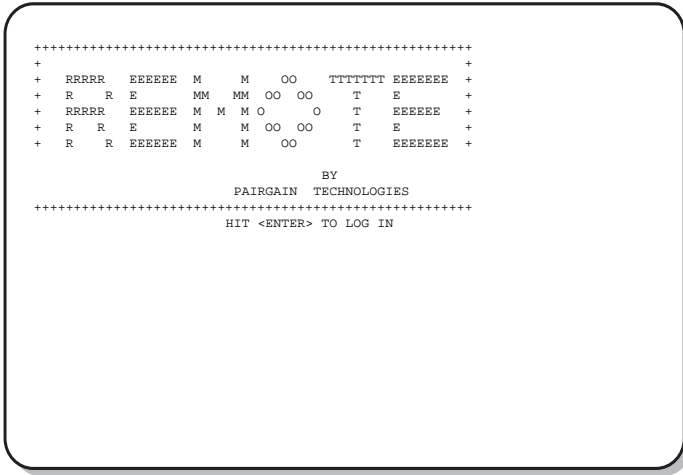
Figure 8. *Remote Login Main Menu Screen*

NAVIGATING THE HRU MAINTENANCE MENUS

System Spans

There are five to seven view-only screens available for viewing system performance, status and history, depending on the number of spans in a particular application. Figure 9 is a graphical representation of system spans. The HRU Maintenance Terminal menus allows the user to monitor multi-span applications from the HLU to the HRU.
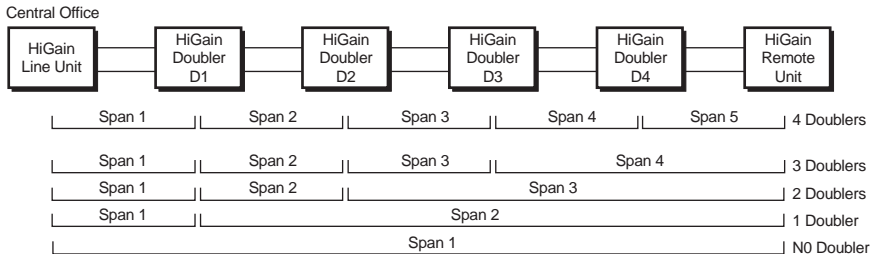
Figure 9. *System Spans*

Navigation Keys

Table 5 describes keys you can use on the maintenance terminal keyboard to navigate within the HRU-402 List 2 Maintenance menus.

Table 5.   *Maintenance 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
C	Clears the current values
D	Selects the default settings

HRU MAINTENANCE TERMINAL MAIN MENU

Table 6 describes the function of each menu selection.

Table 6.   Maintenance and 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-402 span (non-doubler applications), and the HLU, HDU and HRU-402 for multi-span applications.	"View Span Status" on page 23
Set Clock[a]	Allows you to set the HRU time and date.	"Set Clock" on page 27
System Settings	Allows you to view all system settings.	"System Settings" on page 28
Loopback[b] [c]	Allows system loopbacks to be initiated.	"Loopback Menu" on page 30
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 span (non-doubler applications), and the available spans (doubler applications) in 15-minute intervals over a 4-hour time period.	"View Performance Data" on page 33
View Performance History	Provides access to submenus that allow you to view the ES and UAS between the HLU and the HRU-402 span (non-doubler applications) and the available spans (doubler applications) in 24-hour intervals over a 7-day period.	"View 7 Day History" on page 36
View Alarm History	Provides access to submenus that allow you to view alarm conditions between the HLU and the HRU-402 span (non-doubler applications) and the available spans (doubler applications).	"View Alarm History" on page 38
Inventory Screen[b]	Displays the model number and ID of all circuit plugs.	"View System Inventory" on page 40

(a.) Set in the Local Login mode only.
(b.) Available when the HRU is connected the HLU-231 List 8x, HLU319 List 5x or HLU-388 List 5x.
(c.) Available when the HRU is connected to the HLU-231 List 7B.

```
HI-GAIN HLU-231 REMOTE TERMINAL MAIN MENU (ver V6.x-8)
                    CIRCUIT ID#:
                    A. VIEW SPAN STATUS
                    C. SYSTEM SETTINGS
                    D. LOOPBACK MODE: NONE
                    E. VIEW PERFORMANCE DATA
                    F. VIEW PERFORMANCE HISTORY
                    G. VIEW ALARM HISTORY
                    H. VIEW SYSTEM INVENTORY
                    I. REMOTE LOGOFF
```
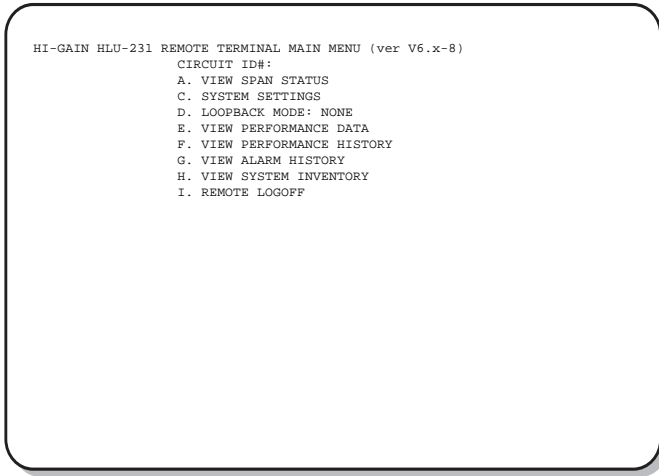
Figure 10.   Main Menu Remote Login Screen

View Span Status

The View Span Status screen allows you to view the system status from the HLU to the HRU. The screen shows information about:

• HDSL Loops 1 and 2

• DS1 interface

• Loopbacks

• Alarms

• Local power

• Time and date

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

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

```
TIME: 00:14:11                    SPAN STATUS
DATE: 02/02/98                    Circuit ID#:
ALARMS:   NONE
LOOPBACK: OFF
POWER LEVEL: LOW
                          HLU                      HRU
                    HDSL-1      HDSL-2      HDSL-1      HDSL-2
                    cur/min/max cur/min/max cur/min/max cur/min/max
MARGIN:             21/17/21    20/17/21    21/18/21    20/18/21    dB
PULSE ATTN:         19          19          19          19          dB
INS LOSS:           23          23          23          23          dB
PPM OFFSET:         00          00          06          05          ppm
24 HOUR ES:         00002       00004       00005       00007       seconds
24 HOUR UAS:        00016       00013       00002       00001       seconds
DS1 STATUS          HLU                     HRU
24 HOUR BPV Seconds: 00000                  00004
24 HOUR UAS Count:   00015                  00001
Frame type:         ESF                     ESF
Code type:          B8ZS                    B8ZS
                    (E)xit (C)lear (U)pdate
```

Figure 11.   *View Span Status Screen for Non-doubler Applications*

At this screen you have the following options:

1   Press E to exit and return to the previous menu.

2   Press C to clear the current values.

3   Press U to update the current values.

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

```
TIME: 00:14:11                         SPAN 5 STATUS
DATE: 02/02/98                         Circuit ID#:
ALARMS:   NONE
LOOPBACK: OFF
POWER LEVEL: HIGH
                    HDU4                         HRU
              HDSL-1    HDSL-2       HDSL-1    HDSL-2
              cur/min/max cur/min/max cur/min/max cur/min/max
MARGIN:        21/21/21   21/21/21   21/21/21   21/21/21    dB
PULSE ATTN:       19         19         20         19       dB
INS LOSS:         23         23         25         23       dB
PPM OFFSET:       00         00         17         17       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 (C)lear (U)pdate (S)pan
```

Figure 12.   *Span 5 Status Screen for Four Doubler Applications*

HDU 1 (one doubler) through HDU4 (four doublers) appear in the Span
Status screen for doubler applications. The doublers are configured along five
spans.

You can do the following:

1   Press E to return to the previous menu.

2   Press C to clear the current values.

3   Press U to update current values.

4   Press S to view the next available span.

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 10.
Loopback	Indicates Off condition or identifies specific active loopback. See Table 8.
Power Level	Indicates the HDSL Power Feed voltage mode: High or Low.
Margins	Indicates the excess signal to noise ratio at all HDSL ports, 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 Offset	Indicates the relative offset of the crystal oscillator in the HRU-402 from the HLUs crystal oscillator. Any value between ± 100 is adequate.
HDSL 24 Hour ES	The number of one second intervals that contained at least one HDSL 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 ZBTSI 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, which it displays when the DS1 CODE option is set to AUTO.

Set Clock

This option is available during Local Login only (see Figure 7).

1   From the Local Login screen, press B to display the Set Clock screen.

```
                            SET CLOCK
  TIME: 00:14:33
  DATE: 02/02/98
  CIRCUIT ID#:


  Format: HH:MM
          MM/DD/YY


  NEW TIME:

  NEW DATE:
```
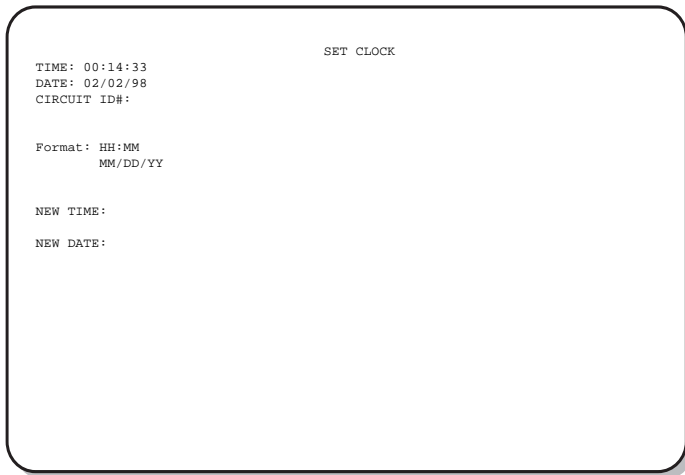
Figure 13.   Set Clock Screen

2   At the Time prompt, enter the time (in 24-hour format) by pressing the
       ENTER key. The cursor defaults to the New Time field. Setting the
       seconds is optional.

3   At the Date prompt, enter the date (mm/dd/yy) by pressing the ENTER
       key. The cursor defaults to the New Date field.

4   Type E to exit the Set Clock menu. The system date and time is updated
       and the Remote Terminal Main Menu is displayed.

> **If you input an invalid entry, the following messages display
> followed by the name of field where the invalid entry
> occurred:**
> **> error**
> **The Set Date option sets the date at the HRU unit only. All
> other units have this option set by the HLU.**

System Settings

The System Settings screen allows you to analyze and view configurable parameters set at the HLU. These screens are for viewing only and cannot be altered. The system settings can only be set at the HLU.

1   Type **C** from either the Maintenance Terminal Main Menu or the Remote Terminal Main menu to view the System Settings screen:

```
                      SYSTEM SETTINGS
TIME: 12:46:06
DATE: 02/02/98                       CIRCUIT ID#:
A. EQUALIZATION....: EXT        P. MARGIN ALARM THRESH: 4
B. SMART-JACK LPBK.:ENABLED     Q. RLOS (DS1 LOS)ALARM: ENABLED
C. SPECIAL LPBK....: GNLB       R. ALARM PATTERN......: AIS
F. POWER...........: AUTO       S. BPVT...: DISABLED
G. ZBTSI...........: OFF
H. BER ALARM THRESH: NONE
I. LOOPBACK TIMEOUT: 60
J. ALARM...........: DISABLED
K. DS1 LINE CODE...: AUTO
L. FRAMING.........: AUTO
M. AIS ON HDSL LOSW: 2 LOOPS
N. AIS ON SMJK/NREM: ENABLED
O. DS0 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
                               (D)efaults, (E)xit
                Enter the option letter to change setting
(C)onfirm
```

Figure 14.   System Settings Screen

2   View HRU-402 List 2 system settings. Change system settings at the HLU connected to the remote unit.

3   Type **D** to set the default settings.

4   Type **E** exit and return to the previous screen.

Table 8 lists the System Settings fields and descriptions.

Table 8. *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 EX1, 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).
SmartJack LPBK	Indicates settings of either *ENA* or *DIS* for SmartJack loopback: where signal from DS1 is looped back at the HRU to the DSX-1.
Special LBPK	Indicates the special loopback settings of either: Generic loopback (GNLB), where the HiGain system responds to the generic in-band loopback codes, or A1LB and A2LB, A3LB, A4LB, or A5LB.
Power	Indicates whether power feed to the HRU-402 from the HLU is either OFF, AUTO, HIGH, or LOW.
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.
BER Alarm Thresh (BERT)	Indicates whether the Bit Error Rate threshold is set to either 10^{-7}, 10^{-6}, or none.
Loopback Timeout	Indicates one of four settings: None (DIS 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 DIS.
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).

Table 8. *System Settings Fields and Descriptions (Continued)*

Field	Description
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.
Margin Alarm (ALM) Threshold (THRES)	Indicates the settings for the margin alarm thresholds.
Remote (DS1 LOS) Alarm (RDA)	Indicates whether a LOS (Loss of Signal) at the HRU DS1 input will generate an AIS and Alarm or LOS and no Alarm condition at the HLU.
BPVT Transparency	Indicates whether the Bipolar Violation Transparency option is enabled or disabled.
Alarm (ALM) Pattern	Indicates whether the Alarm Pattern option is set to AIS or LOS.

Loopback Menu

The loopback menu only appears if the HRU-402 List 2 is connected to an:

- HLU-231 List 7B or List 8x

- HLU-319 List 5x

- HLU-388 List 5x

All other HLU types do not allow loopbacks to be initiated from the remote unit Craft port.

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

1   From the Remote Terminal Main Menu, type **D** to display the Loopback Menu. When no doublers are in use, the following screen displays:

```
                        LOOPBACK MENU

   TIME: 00:15:34
   DATE: 02/02/98
   CIRCUIT ID#:


                 A. DISABLE LOOPBACKS
                 B. NETWORK LOOP HLU        (NLOC)
                 C. NETWORK LOOP HRU        (NREM)
                 G. CUSTOMER LOOP HLU       (CREM)
                 H. CUSTOMER LOOP HRU       (CLOC)

                        (E)xit
```
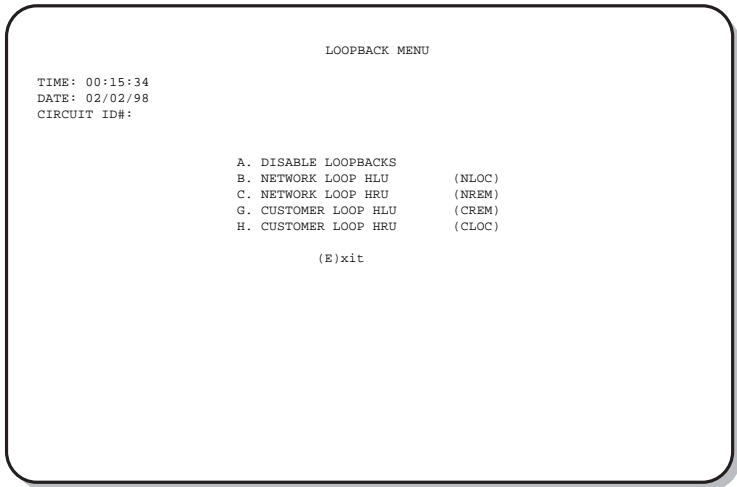
Figure 15.   *Loopback Screen Without Doublers*

2   Type **A** to disable loopbacks.

3   Type **B** for HLU network loop settings.

4   Type **C** for HRU network loop settings.

5   Type **G** for HLU customer loop settings.

6   Type **H** for HRU customer loop settings.

7   Type **E** to exit and return to the previous menu.

When doublers are in use, the following Loopback screen displays:

```
                              LOOPBACK MENU
       TIME: 00:03:33
       DATE: 02/02/98
       CIRCUIT ID#:

       A. DISABLE LOOPBACKS
       B. NETWORK LOOP HLU (NLOC)        M. NETWORK LOOP DOUBLER 4 (NDU4)
       C. NETWORK LOOP HRU (NREM)        N. CUSTOMER LOOP DOUBLER 4 (CDU4)
       D. NETWORK LOOP DOUBLER 1  (NDU1)
       F. NETWORK LOOP DOUBLER 2  (NDU2)
       G. CUSTOMER LOOP HLU       (CREM)
       H. CUSTOMER LOOP HRU       (CLOC)
       I. CUSTOMER LOOP DOUBLER 1 (CDU1)
       J. CUSTOMER LOOP DOUBLER 2 (CDU2)
       K. NETWORK LOOP DOUBLER 3  (NDU3)
       L. CUSTOMER LOOP DOUBLER 3 (CDU3)

                              (E)xit
```

Figure 16. *Loopback Screen with Four Doublers*

The following options are available:

1   Choose one of the options between A through N.

2   Type E to exit and return to the previous menu.

Table 9 lists the HRU-402 List 2 Loopback Field Messages and Descriptions.

Table 9.   *Loopback Field Messages and Descriptions*

Messages	Full Name	Description
NREM	Network Remote Loopback	Loopback at HRU (remote) towards network.
NLOC	Network Local Loopback	Loopback at HLU (local) towards network.
CLOC	Customer Local Loopback	Loopback at HRU (local) towards CI.
CREM	Customer Remote Loopback	Loopback at HLU (remote) towards CI.
NDU1	Network Doubler 1 Loopback	Loopback at first doubler towards network.
CDU 1	Customer Doubler 1 Loopback	Loopback at first doubler towards CI.
NDU2	Network Doubler 2 Loopback	Loopback at second doubler towards network.
CDU 2	Customer Doubler 2 Loopback	Loopback at second doubler towards CI.
NDU3	Network Doubler 3 Loopback	Loopback at third doubler towards network.
CDU 3	Customer Doubler 3 Loopback	Loopback at third doubler towards CI.
NDU4	Network Doubler 4 Loopback	Loopback at fourth doubler towards network.
CDU 4	Customer Doubler 4 Loopback	Loopback at fourth doubler towards CI.

View Performance Data

The View Performance Data screen shows the number of Error Seconds (ES) and Unavailable Seconds (UAS) occurrences in 15-minute increments for a 24-hour period. The presentation format is: Errored Seconds/Unavailable Seconds (ES/UAS) for the HLU and the HRU-402 List 2 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).

1   From the Remote Terminal Main Menu, type `E` to display the Performance Data screen. You can also access this screen through the Maintenance Terminal Main Menu by typing `D`. When no doublers are in use, the following Performance Data screen displays:

```
Date: 02/02/98            PERFORMANCE DATA
CIRCUIT ID#:
                  ERRORED SECONDS/UNAVAILABLE SECONDS
                   DS1          HDSL-1        HDSL-2
          HLU      HRU      HLU      HRU      HLU      HRU
20:30    000/000  000/000  000/000  000/000  000/000  000/000
20:45    000/000  000/000  000/000  000/000  000/000  000/000
21:00    000/000  000/000  000/000  000/000  000/000  000/000
21:15    000/000  000/000  000/000  000/000  000/000  000/000
21:30    000/000  000/000  000/000  000/000  000/000  000/000
21:45    000/000  000/000  000/000  000/000  000/000  000/000
22:00    000/000  000/000  000/000  000/000  000/000  000/000
22:15    000/000  000/000  000/000  000/000  000/000  000/000
22:30    000/000  000/000  000/000  000/000  000/000  000/000
22:45    000/000  000/000  000/000  000/000  000/000  000/000
23:00    000/000  000/000  000/000  000/000  000/000  000/000
23:15    000/000  000/000  000/000  000/000  000/000  000/000
23:30    000/000  000/000  000/000  000/000  000/000  000/000
23:45    000/000  000/000  000/000  000/000  000/000  000/000
00:00    000/000  000/000  000/000  000/000  000/000  000/000
00:15    000/015  004/001  002/016  005/002  004/013  007/001

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

Figure 17. *Performance Data Screen*

You can do the following:

1   Type `E` to exit and return to the previous menu.

2   Type `P` to return to the previous screen.

3   Type `N` for the next Performance Data screen.

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

```
Date: 02/02/98        SPAN 5 PERFORMANCE DATA
CIRCUIT ID#:
                    ERRORED SECONDS/UNAVAILABLE SECONDS
                DS1              HDSL-1              HDSL-2
          HLU      HRU      HDU1     HDU2     HDU1     HDU2
08:00   000/000  000/000  000/000  000/000  000/000  000/000
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

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

Figure 18.   Span 5 Performance Data Screen

The doubler units (HDU through HDU4) appear in the performance date screen for doubler applications.

The presentation format is: ES/UAS for the HLU and the HRU-402 List 2 DS1 signal, and ES/UAS for the HDU1 and HDU2 over both HDSL loops one and two.

You can do the following:

1   Type **E** to exit to the previous menu.

2   Type **P** to go to the previous screen.

3   Type **N** to view the next screen.

4   Type **S** to view the next span.

View 7 Day History

The View 7 Day History screen shows the number of ES/UAS occurrences in 24 hour increments for a seven day period. The presentation format is: ES/UAS for the HLU and the HRU-402 List 2 for the DS1 signal, HDSL Loop 1 and HDSL Loop 2 (for non-doubler applications). For doubler applications, the available View 7 Day History screens (one or more doublers) displayed are dependent upon the span being viewed.

1   From the Remote Terminal Main Menu screen, type F to display the Performance History screen for non-doubler applications (Figure 19). You can also access this screen through the Maintenance Terminal Main Menu by typing E.

```
 Time: 00:16:55                    7 DAY HISTORY
 CIRCUIT ID#:

                                SPAN 1
                     ERRORED SECONDS/UNAVAILABLE SECONDS

                 DS1                  HDSL-1                  HDSL-2
         HLU         HRU         HLU         HRU         HLU         HRU
 01/26  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 01/27  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 01/28  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 01/29  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 01/30  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 01/31  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 02/01  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 current 00000/00015 00004/00001 00002/00016 00005/00002 00004/00013 00007/00001


                            (E)xit     (S)pan
```

Figure 19.   *Performance History Screen for Non-doubler Applications*

2   Type E to exit and return to the previous menu.

3   Type S to view the spans that are currently in use.

When doublers are in use, the following Performance Data screen is displayed:

```
Time: 00:16:55                    7 DAY HISTORY
CIRCUIT ID#:

                                SPAN 5
                   ERRORED SECONDS/UNAVAILABLE SECONDS

              DS1                   HDSL-1                  HDSL-2
         HLU        HRU        HDU4        HRU        HDU4        HRU
01/26   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/27   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/28   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/29   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/30   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
01/31   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
02/01   00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
current 00000/00015 00004/00001 00002/00016 00005/00002 00004/00013 00007/00001



                      (E)xit     (S)pan
```

Figure 20.   Span 5 Performance Data Screen

HDU 1 (one doubler) through HDU4 (four doublers) appear in the Performance History screen for doubler applications.

View Alarm History

The View Alarm History screen allows you to view both active and retired alarms. To view the Alarm History screens:

1 From the Remote Terminal Main Menu, type `G` to display the Alarm History screen for non-doubler applications. You can also access this screen through the Maintenance Terminal Main Menu by typing `E`:

```
                              ALARM HISTORY
        TIME: 00:17:18
        DATE: 02/02/98
        CIRCUIT ID#:
        Type              First     Last     Current          Count
        LOS, DS1-HLU                          OK               000
        LOS, DS1-HRU                          OK               000
        BER                                   OK               000
        SPAN1 LOSW, HDSL1                     OK               000
        SPAN1 LOSW, HDSL2                     OK               000
        SPAN1 MARGIN L1                       OK               000
        SPAN1 MARGIN L2                       OK               000
        PWR-SHRT                              OK               000
        PWR-GND                               OK               000
        LAST CLEARED:  02/02/98-00:11

                              (E)xit (C)lear (U)pdate
```
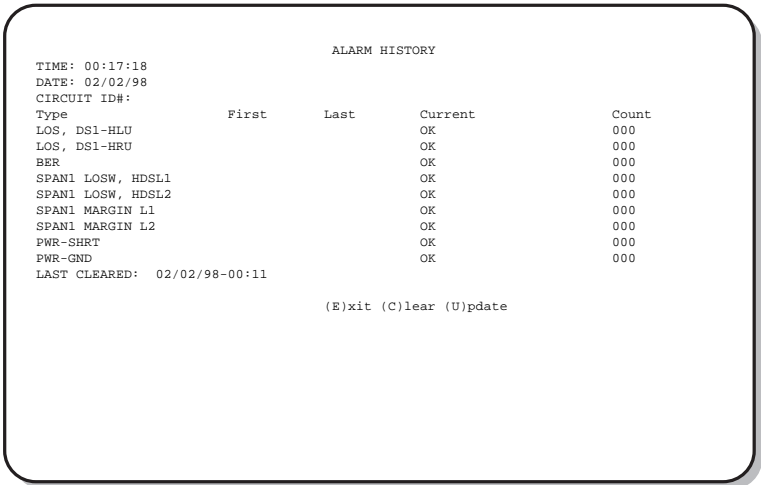
Figure 21.   *Alarm History Screen for Non-doubler Applications*

2 Type `E` to exit the previous menu.

3 Type `C` to clear the current values.

4 Type `U` to update the screen.

Table 10 lists the Alarm History fields and descriptions. These descriptions apply to the Alarm History for doubler applications as well.

Table 10.   *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
BER	First and last instance of BER (10^{-7} or 10^{-6}) threshold crossing. Current condition number of alarm.
Span1 LOSW, HDSL1	First and last instance of LOSW on HDSL1; Current condition, number of alarms
Span1 LOSW, HDSL2	First and last instance of LOSW on HDSL2; Current condition, number of alarms
Span1 Margin L1	First and last instance of exceeded margin on Loop 1; Current condition, number of alarms
Span1 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
PWR GND	HDSL grounded conductor detected
Last Cleared: None	Last time Alarm History cleared

For doubler applications, the following screen displays:

```
 ALARM HISTORY

TIME: 00:17:18
DATE: 02/02/98
CIRCUIT ID#: HLU

Type              First             Last              Current      Count
LOS, DS1-HLU                                                       OK        000
LOS, DS1-HRU                                                       OK        000
BER                                                                OK        000
SPAN5 LOSW, HDSL1                                                  OK        000
SPAN5 LOSW, HDSL2                                                  OK        000
SPAN5 MARGIN L1   02/02/98-03:48    02/02/98-03:48                 OK        001
SPAN5 MARGIN L2   02/02/98-03:48    02/02/98-03:48                 OK        001
PWR-SHRT                                                           OK        000
PWR-GND                                                            OK        000

LAST CLEARED:  02/02/98-03:45


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

Figure 22.   *Four Doublers, Span 5 Alarm History Screen*

Depending upon the doubler configuration, Spans 1, 2 and 3 appear in the Alarm History screen using similar fields as shown in Table 10. The Span 2 Alarm History screen displays for one doubler applications, and the Span 3 Alarm History screen displays for two doubler applications, or more.

The following options are available:

1   Type **E** to exit and return to the previous menu.

2   Type **C** to clear the current values.

3   Type **U** to update the values.

4   Type **S** to view the next span.

View System Inventory

The System Inventory screen allows you to view the model number, list number and software versions of all circuit modules. The screen also allows units which are to be attached to the circuit modules and a Circuit ID (which are assigned to the application) to be viewed.

The IDs can only be set at the HLU. They are limited to 24 alphanumeric characters and, like the system settings, are stored in Non-volatile Random Access Memory (NVRAM), meaning the data remains even when power is lost or turned off.

All six possible unit modules are always listed. Those that have not been detected and are not present in the circuit are labeled Not Available (NA). All detected modules are fully identified. Whenever the line unit loses sync with Span 1, the product types are replaced by the NA label until sync is reestablished and each module can in turn be reidentified.

1   From the Remote Terminal Main Menu screen, type <kbd>H</kbd> to display the System Inventory screen:

```
                            SYSTEM INVENTORY
   TIME: 18:16:37
   DATE: 04/09/98                    A. Circuit ID#:


           UNIT        PRODUCT               UNIT ID

           HLU         HLU-231    L8 V6.0    Not Required
   B.      HRU         HRU-402    L2 V1.0    Customer Plug
   C.      DB1         N/A
   D.      DB2         N/A
   F.      DB3         N/A
   G.      DB4         N/A



   Enter the item letter to change the ID, or (E)xit

```
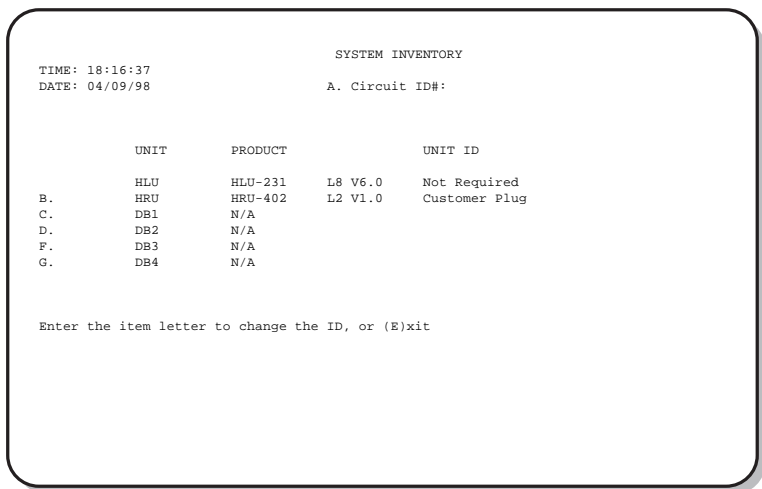
Figure 23.   *Inventory Screen*

2   Type <kbd>A</kbd> through <kbd>G</kbd> to change a circuit ID.

3   Type <kbd>E</kbd> to exit and return to the previous menu.

APPENDIX A: ADDITIONAL TECHNICAL INFORMATION

Appendix A contains additional information about the HRU-402 List 2.

SPECIFICATIONS

Physical

Material	Steel
Finish	Zinc plated
Mounting	Any standard 400 or SLIM (one-half 400)

Dimensions

Height	5.6 in. (14.22 cm)
Width	0.7 in. (1.7 cm)
Depth	5.6 in. (14.22 cm)
Weight	1 lb., 2 oz.

Power

Line-powered consumption	3.1 W (When connected to the following line units: HLU-231 List 8x, HLU-231 List 5x, and HLU-388 List 5x.)
	4.5 W (When connected to all other line units).
Local power consumption	5.2 W (Sealing current on) 4.1 W (Sealing current off)
Maximum provisioning loss	35 dB at 196 kHz, 135Ω
Electrical protection	Secondary surge and power cross protection on all DS1 and HDSL ports

Environment

Operating temperature	-40° to 149°F (-40° to + 65°C)
Operating humidity	5 to 95% non-condensing

HDSL

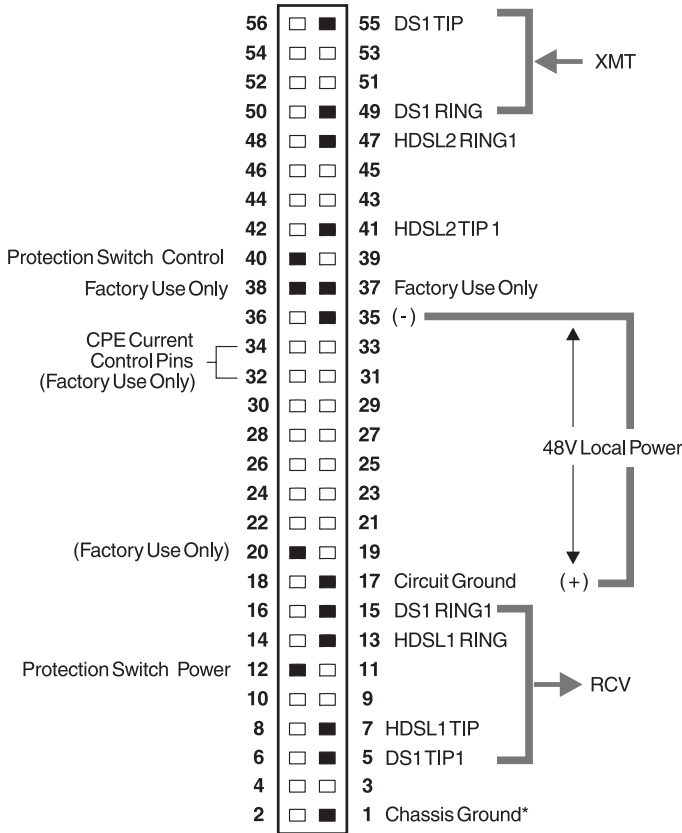|	
Line code	784 kbps 2B1Q full duplex
Output	+13 dB ± 0.5 dB @ 135Ω
Line impedance	135Ω
Line DC resistive signature	14Ω
Start-up time	15 seconds (typical) 30 seconds (maximum)

DS1

Line impedance	100Ω
Pulse output	0 dB (RLEV = 0), -15 dB (RLEV = 15)
Input level sensitivity	> -35 dB
Line rate	1.544 Mbps ± 200 bps
System output wander (looped)	0.3 UI (648 ns.) max
Line format	AMI, B8ZS, or ZBTSI
Frame format	ESF, SF or unframed

Line Clock Rate

Internal stratum	4 clock

CARD-EDGE PINOUT DIAGRAM

The HRU-402 List 2 occupies one slot in a remote enclosure. The card-edge pinout diagram for the remote unit is shown in Figure 24.

	56 ☐ ■	**55**	DS1 TIP
	54 ☐ ☐	**53**	
	52 ☐ ☐	**51**	XMT
	50 ☐ ■	**49**	DS1 RING
	48 ☐ ■	**47**	HDSL2 RING1
	46 ☐ ☐	**45**	
	44 ☐ ☐	**43**	
	42 ☐ ■	**41**	HDSL2 TIP 1
Protection Switch Control	**40** ■ ☐	**39**	
Factory Use Only	**38** ■ ■	**37**	Factory Use Only
	36 ☐ ■	**35**	(-)
CPE Current	**34** ☐ ☐	**33**	
Control Pins	**32** ☐ ☐	**31**	
(Factory Use Only)	**30** ☐ ☐	**29**	
	28 ☐ ☐	**27**	
	26 ☐ ☐	**25**	48V Local Power
	24 ☐ ☐	**23**	
	22 ☐ ☐	**21**	
(Factory Use Only)	**20** ■ ☐	**19**	
	18 ☐ ■	**17**	Circuit Ground (+)
	16 ☐ ■	**15**	DS1 RING1
	14 ☐ ■	**13**	HDSL1 RING
Protection Switch Power	**12** ■ ☐	**11**	RCV
	10 ☐ ☐	**9**	
	8 ☐ ■	**7**	HDSL1 TIP
	6 ☐ ■	**5**	DS1 TIP1
	4 ☐ ☐	**3**	
	2 ☐ ■	**1**	Chassis Ground*

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

Figure 24. *Card-edge Pinouts*

FEATURES

The following describes additional information on some of the features included with the HRU-402 List 2.

Bipolar Violation Transparency (BPVT) and Bit Error Rate (BER) Options

The HRU-402 List 2 and its associated line units improve compatibility with Data Link Control (DLC) feeder applications due to T1 BPVT transmit capability between T1 interfaces. This feature is required to support protection switching in DLC applications. Each DLC terminal must be able to monitor the integrity of its Receive T1 payload and then switch to the protect line when the integrity of the path drops below specific user selected limits. An essential requirement of this feature is the need for each DLC terminal to detect BPVTs in its T1 input. Standard HDSL systems correct input T1 BPVTs and thus prevent them from being detected by DLC terminals to which they are connected. The HRU-402 List 2 and its associated line units remove this limitation and become BPVT transparent by detecting and counting input BPVTs at each end and then replicating them at the distant end T1 output port.

In addition, the CRCs in each direction of every HDSL loop of each span are also counted and added in with the BPVT count to produce a Total Error Count (TEC). TEC indicates the integrity of both the T1 and HDSL paths. A TEC in each direction is calculated every second by adding the number of BPVTs to the number of HDSL CRCs in that direction. The maximum TEC count is 12000. This TEC number is converted into BPVTs at the distant end during the following second at a rate of 1 BPVT every 128 T1 bits up to a maximum of 12000 (BER=7.7×10^{-3}). This maximum rate is more than adequate since it exceeds the maximum 10^{-3} BER required by most DLC systems.

The BPVT transparency option is controlled by the BPVT user option, which can be enabled (ENA) or disabled (DIS).

This BPVT is a "smart" option in that it is only available if the HRU-402 is connected to an HLU-231 List 8x, HLU-319 List 5x, or HLU-388 List 5x.

The BER option also uses this (BPVT/CRC) TEC to generate an alarm if enabled. The HLU combines the one second TEC counts in both directions for the last 60 seconds. The line unit uses this one minute Total System Error Count (TSEC) to generate an alarm if it exceeds the selected BER threshold of (1E-6 or 1E-7) as follows:

- BER option=1E-6. Alarm is generated if TSEC>92

- BER option=1E-7. Alarm is generated if TSEC>9

Once initiated, the alarm clears when the TSEC drops below its associated threshold count. For irregular intermittent errors, the alarm can come and go in intervals as short as one second. Alarms usually require the full 60 seconds or longer to clear depending on the frequency of the transient errors. This BER option is always present in any line unit circuit since it is independent of the versions of the other HiGain modules in the circuit.

Remote DS1 Alarm (RDA) Option

The Receive Loss of Signal (RLOS) alarm output at the HLU can be inhibited by disabling the RDA option. This prevents a LOS condition at the DS1 input to the HRU-402 List 2 from activating a system alarm output at the HLU. However, the HLU front panel Status LED still flashes red and the ALRM RLOS message is displayed to alert the user of the LOS state. LOS is sent towards the network from the HLU. This option prevents the common occurrences of a CPE LOS condition from generating recurring alarms and Alarm Indication Signal (AIS) payloads.

Alarm Pattern Option (ALMP) Option

To further improve HiGain's compatability with the switch-to-protect features used in DLC feeder applications, the line unit has an ALMP which allows the user to select either AIS or LOS T1 output payloads for the following alarms:

- LOSW on any loop (output the selected alarm pattern at both ends)

- T1 LOS (output the selected alarm pattern at the upstream end)

- Margin alarm if HAIS=1L (output the selected alarm pattern at both ends)

When the HRU-402 List 2 is connected to older HLUs that do not support these options, the options are forced to their following default states:
- **BPVT: DIS**
- **RDA: ENA**
- **BER: None**
- **ALMP: AIS.**

DS1 Line Code Auto Option

When the DS1 line code option is set to AUTO mode, both the HLU and HRU-402 List 2 set their T1 output codes to the codes reserved at the opposite end of the T1 input. AUTO mode forces the input and the output codes in each direction of transmission to be identical. In the AUTO mode of older HiGain units, the DS1 output code was determined by the input code at the local T1 input port instead of at the distant end.

If the HRU-402 List 2 is connected to an older HLU, its DS1 AUTO mode performs as it does in older models where its output code is set by its input code.

FUNCTIONAL DESCRIPTION

This section describes the functions of the HRU-402 List 2.

Operational Capabilities

HiGain utilizes PairGain's 2B1Q HDSL transceiver system to establish two full-duplex 784 kbps data channels between the HLU and a remotely mounted HRU-402 List 2. This system provides a total capacity of 1.568 Mbps between the two units. PairGain's HDSL technology also provides full-duplex services at standard T1 rates over copper wires between an HLU and an HRU-402 List 2, which comprise one HiGain system. A block diagram of the HRU-402 List 2 is shown in Figure 25.

The HRU-402 List 2 power supply converts the 90 to 200 Vdc power that is received on the simplex pairs (or the -48V input when locally powered) to voltages and currents required by the remote unit circuitry. The remote unit typically dissipates 2.5W of power.

The HRU-402 List 2 can be used with the HLU-232 line unit to form an automatic 1 by 1 protection switch system. Refer to the *HiGain Line Unit Model HLU-232* practice (section #: 150-232-100-xx) for more details. For this application, the HRU-402 List 2 must be installed in the two slot HRE-422 remote enclosure. This enclosure provides access to the HRU-402 List 2 protection switch output, on pin 12, which controls the protection switching function.
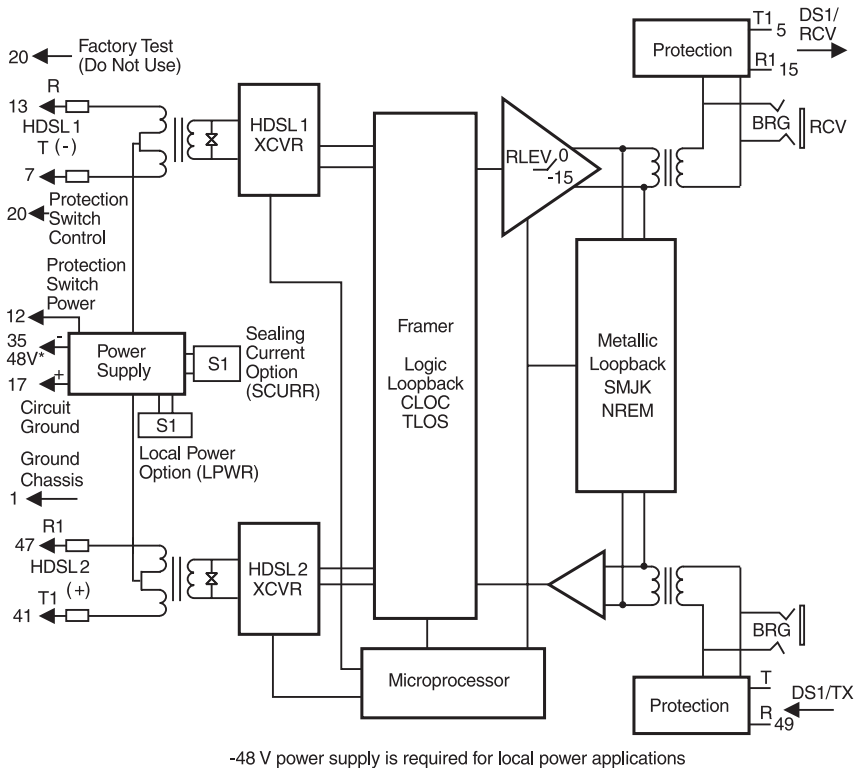
Figure 25.   *HRU-402 List 2 Block Diagram*

Local and Line Powering

The HRU-402 List 2 can be line or local powered. The remote unit always chooses the local -48 Vdc power source from the power supply attached to pair 35(-) and 17(+) of the card-edge connector (Figure 24 on page 44).

To set local or line power for the remote unit, switch the local power (LPWR) switch (S1) to ENA (see Figure 3 for switch location). When LPWR is set to DIS, the HRU must be line powered. The earlier versions of the HLU-231 (Lists 1, 2, 3, 3A and 4) must first have their PWRF user option set to DIS when connected with a locally powered HRU-402 List 2 unit. When enabled, local power automatically takes precedence over line power. If local power is lost, the remote unit reverts to line power.

The following line units automatically turn off their line power supply when they are connected to a locally powered HRU-402 List 2:

- List 6 and higher versions of the HLU-231

- All versions of the HLU-319 and HLU-388

Refer to the appropriate HLU technical practice if you need more information about its local and line powering capabilities.

If local power is lost to an HRU-402 List 2, the last span loses sync. When the HLU or HDU attempts to reestablish sync, it detects that the remote unit is not locally powered and applies line power to it. The remote unit then powers up and operates normally if it is within range to support line powering.

The -48V local power supply must have 110 mA output current capacity (5.2W) to power each HRU-402 List 2.

A Teltrend© WPS-2005 Wall-Mount Power Supply (-48V and 250 mA) is capable of powering two HRU-402 List 2 units. The 2005 provides spade lugs to access its -48V output.

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

The HRU-402 List 2 supports four-span line powering and five-span local powering applications.

Simplex Sealing Current Information

When locally powered, the HRU-402 List 2 can source from 30 mA (short loop) to 20 mA (long loop) of simplex sealing current towards the upstream unit over the two HDSL pairs. The SCURR (S1) switch, located on the printed circuit board at the back of the unit, allows this sealing current to be enabled (ON) or DIS (OFF). See "Rear Panel" on page 8 for further information.

The simplex sealing current flow is blocked if it is used with HDU-451 List 1, 2, 3 or 3B doublers. These doublers are only compatible with the metallic sealing current of earlier remote units. To provide a path through which the simplexed sealing current can flow, the following doublers must be used with the HRU-402 List 2:

- HDU-451 List 4, 4B

- HDU-437, HDU-439 List 1 or 1B

- HDU-409, HDU-404, and HDU-407

Loopback Design Description

Loopbacks permit you to perform isolated diagnostic tests at specific points 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.

The HRU-402 List 2 supports four types of loopbacks (Figure 26).

- 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 facility data link (FDL) code.

  The SmartJack loopback shown in Figure 26 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 CPE. The DIS option transmits a quiet signal to the CPE. To send the AIS pattern to the CPE during SmartJack or NREM loopbacks, set the SAIS to ENA before the loopback is initiated.

- Customer Local Loopback (CLOC): Signal from CI is looped-back to customer at HRU-402 List 2.

- TLOS: Initiated by a DS1 LOS condition at the HRUs DS1 input port if the TLOS option is enabled.
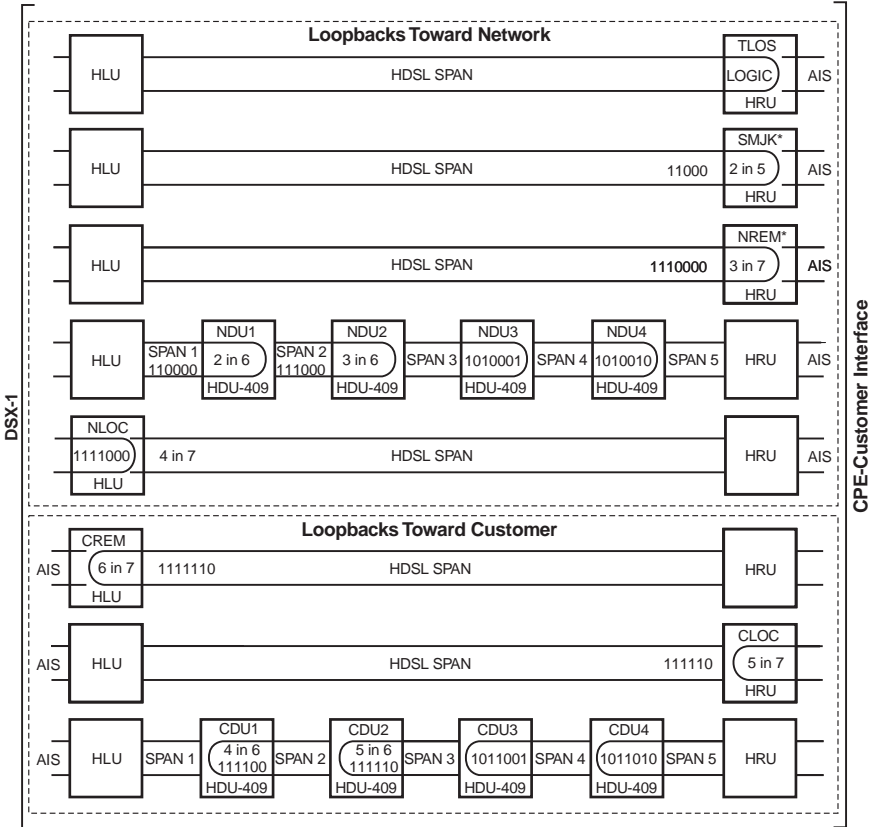
Figure 26. *HiGain System Loopbacks*

The HLU supports the following loopbacks:

- Network Local Loopback (NLOC): The DSX -1 signal is looped back to the DSX -1 at the HLU.

- Customer Remote Loopback (CREM): Signal from the customer is looped back to the customer at the HRU-402 List 2.

SAIS Set to ENA

Upon detection of a valid SmartJack loopback command, a metallic loopback relay (see Figure 26) is energized and the T1 interface chip transmits the AIS pattern to the NI and also back to the HRU-402 T1 receiver circuit. In addition, the customer's T1 XMT input is disconnected and terminated into 100Ω. The AIS pattern is examined by the HRU for its overall integrity. This prelooped test lasts for about 100 ms and terminates in one of the following two conditions:

- Pre-loop Failed: If the transmit and receive all ones 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 ones pattern to the CPE 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 SmartJack 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 SmartJack 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 100Ω. This forces the FRM LED off, the Local (LOC) Loss (LOS) LED off and the Code LED to indicate AMI if the HLU Code option is set to either AUTO or AMI. The HRU-402 List 2 LED indicates B8ZS if the Code option is set to B8ZS.

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 CPE. Instead the network signal is sent through the relay back towards the network, and the signal sent towards the NI is quiet. As before, the customer's T1 transmit input port is opened and terminated into 100Ω. 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 SmartJack metallic loop back state, its 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 its input circuit has been opened and terminated into 100Ω. 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.

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 or by the FDL command. NREM is used to indicate that the metallic loopback was initiated by other than the 3-in-5 or FDL command (3-in-7, 16-bit, addressable, repeater commands or front panel push-button).

The HRU-402 List 2 front panel LBK button is used to initiate and terminate HRU loopbacks. To initiate a loopback in the HRU, press the LBK button for five seconds. Pressing this button terminates all HiGain loopbacks that may be present before executing an NREM loopback in the HRU. A loopback state in the HRU can be terminated by pressing the LB button.

APPENDIX B: ABBREVIATIONS

2B1Q	2Binary1Quaternary
AIS	Alarm Indication Signal
ALM	Alarm
ALMP	Alarm Pattern Option
AMI	Alternate Mark Inversion
AWG	American Wire Gauge
B8ZS	Bidirectional 8-zero Substitution
BDG	Bridged
BER	Bit Error Rate
BERT	BIT Error Rate Threshold
BPV	Bipolar Violation
BPVT	Bipolar Violation Transparency
CI	Customer Interface
CO	Central Office
CLOC	Customer Local Loopback
CPE	Customer Premises Equipment
CRC	Cyclic Redundancy Check
CSA	Carrier Service Area
CSU	Channel Service Unit
dB	Decibel
DCE	Data Circuit-terminating Equipment
DIS	Disable
DL	Data Link

DLC	Data Link Control
DS1	Digital Service, Level 1
DSX-1	Digital System Cross-connect Frame
EN	Enable
ES	Errored Seconds
ESF	Extended Super Frame
ESF DL	Extended Super Frame Data Link
FRN	Frame
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
LBK	Loopback
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LOS	Loss of Signal
LOSW	Loss of Sync Word
LPWR	Local Power
LVL	Level
NEBS	Network Equipment Building System
NET	Network
NI	Network Interface

NID   Network Interface Device

NIU   Network Interface Unit

NREM   Network Remote Loopback

NVRAM   Non-volatile Random Access Memory

POTS   Plain Old Telephone Service

RCV   Receive

RDA   Remote DS1 Alarm

RLEV   Receive Level

RLOS   Receive Loss of Signal

SAIS   SmartJack AIS

SCURR   Sealing Current

SF   Super Frame

S/N   Signal-to-Noise

SPLB   Special Loopback

TEC   Total Error Count

TLOS-LB   Transmit Loss of Signal-Loopback

TSEC   Total System Error Count

TSGR   Transport System Generic Requirements

UAS   Unavailable Seconds

UL   Underwriters Laboratory

W   Watts

XMT   Transmit

ZBTSI   Zero Byte Time Slot Interface

APPENDIX C: PRODUCT SUPPORT

This section contains product support and warranty information.

TECHNICAL SUPPORT

PairGain Technical Assistance is available 24 hours a day, 7 days a week by contacting PairGain Customer Service Engineering group at:

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

During normal business hours (8:00 AM to 5:00 PM, Pacific Time, Monday through Friday, excluding holidays), technical assistance calls are normally answered directly by a Customer Service Engineer. At other times, a request for technical assistance is handled by an on-duty Customer Service Engineer through a callback process. This process normally results in a callback within 30 minutes of initiating the request.

In addition, PairGain maintains a computer bulletin board system for obtaining current information on PairGain products, product troubleshooting tips and aids, accessing helpful utilities, and for posting requests or questions. This system is available 24-hours a day by calling (714) 730-2800. Transmission speeds up to 28.8 kbps are supported with a character format of 8-N-1.

WARRANTY

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

Do not try to repair the unit. If it fails, replace it with another unit and return the faulty unit to PairGain for repair. Any modifications of the unit by anyone other than an authorized PairGain representative voids the warranty.

If a unit needs repair, call PairGain for a Return Material Authorization (RMA) number and return the defective unit, freight prepaid, along with a brief description of the problem, to:

> PairGain Technologies, Inc.
> 14352 Franklin Avenue
> Tustin, CA 92780
> ATTN: Repair and Return Dept.
> (800) 638-0031

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

FCC COMPLIANCE

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

Refer to the installation section of the appropriate instruction manual for the unit you are installing to get information on:

- Cabling
- Correct connections
- Grounding

MODIFICATIONS

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

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

Corporate Office

14402 Franklin Avenue
Tustin, CA 92780

Tel: (714) 832-9922
Fax: (714) 832-9924

For Technical Assistance:

(800) 638-0031

ISO 9001

DNV Certification, Inc.
Certificated Firm

PAIRGAIN