HiGain

USER MANUAL

HRU-402
HiGain REM UNIT

ADC L 1A

ALM
LP1
LP2
ESF
SF
B8ZS
AMI
LBK

H D S L

TELEPHONE Co. PROPERTY

D S 1

-7.5/
0   -15

R
C
V
L
E
V   -7.5   -15

XMT
BRG
RCV

RS-232
DCE

BARCODE

HRU-402 List 1A Remote Unit
Product Catalog: 150-1592-11
CLEI: T1L3KLPD

Revision History of This Manual

Revision	Release Date	Revisions Made
01	December 8, 1998	Initial Release
02	May 17, 2002	ADC rebranding

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Disclaimer of Liability

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 personal injury or equipment damage.

UNPACK AND INSPECT YOUR SHIPMENT

Upon receipt of the equipment:

- Unpack each container and inspect the contents for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to ADC DSL Systems, Inc. Order replacement equipment, if necessary.

- Check the packing list to ensure complete and accurate shipment of each listed item. If the shipment is short or irregular, contact ADC DSL Systems, Inc. as described in "Appendix C: Product Support" on page 57. If you must store the equipment for a prolonged period, store the equipment in its original container.

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OVERVIEW

This user manual describes the HiGain® Remote Unit, Model HRU-402 List 1A. This remote unit functions as the remote end of a repeaterless T1 transmission system. An HRU-402 connects either to a HiGain Line Unit (HLU) or a HiGain Doubler Unit (HDU), creating a HiGain system that provides 1.544 Mbps transmission on two unconditioned copper pairs over the full Carrier Service Area (CSA) range. The HRU-402 List 1A is line powered only.

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 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 four CSA spans. The total CSA encompasses approximately 48 kft using 19 American Wire Gauge (AWG) wire.
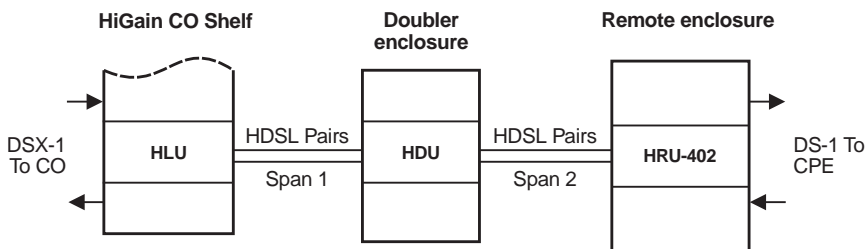
Figure 1.   *Typical HiGain System*

FEATURES

- Front panel with:

    - Loopback Button

    - Receive Level Switches

    - Receive (RCV) and Transmit (XMT) Bridged (BRG) access jacks for testing

    - Digital Service Level 1 (DS-1) and HDSL status Light Emitting Diodes (LEDs)

    - Craft port access (RS-232 DB-9 connector)

- American National Standards Institute (ANSI) T1.403 DS-1 Network Interface (NI)

- Generic and addressable repeater loopback activation codes

- Line powered

- Lightning and power cross protection on HDSL and DS-1 interfaces

- 784 kbps full-duplex 2 Binary 1 Quaternary (2B1Q) HDSL transmission on each of two pairs

- Digital Signal Level 0 (DS0) blocking

- Compatible with ADC 1 x 1 protection switching system using the HRE-422 List 5 remote enclosure.

- Narrow 200-type mechanics (half-width 400 mechanics)

- Low power consumption

- Supports one to four span circuits

- Ultra-low wander

- Bipolar Violation Transparency (BPVT) and Bit Error Rate (BER) options

- Remote DS-1 Alarm (RDA) option

- Alarm Pattern (ALMP) option

- Improved DS-1 Line Code auto options

BPVT AND BER FEATURES

The HRU-402 and its associated line units improve compatibility with Data Link Control (DLC) feeder applications due to T1 Bipolar Violation Transparency (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 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 CRC errors 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 CRC errors 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 (Bit Error Rate[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 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 present in any HiGain 98 line unit circuit.

APPLICATIONS

HRU-402 List 1A provides a cost-effective and easy-to-deploy method for delivering T1 service over two metallic pairs. Conventional, in-line T1 repeaters, cable pair conditioning, pair separation, and bridged tap removal are not required.

The HRU-402 List 1A:

- operates with any number of 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.

- provides a means of quickly deploying service in advance of fiber-optic transmission systems.

- is 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.

Each cable pair loop has less than 35 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 AWG (0.4 mm)	3.88	83
24 AWG (0.51 mm)	2.84	52
22 AWG (0.61 mm)	2.18	32
19 AWG (0.91 mm)	1.54	16

COMPATIBILITY

The HRU-402 List 1A can be used with all HiGain doublers and doubler compatible line units for two or three span applications. The HRU-402 List 1A can also be used with the following line and doubler units for four span applications:

- HLU-231 List 8x

- HLU-319 List 5x

- HLU-388 List 5x

- HDU-409

- HDU-407

- HDU-404

The HRU-402 mounts in the following types of 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-slot wall or rack mount)

- 200 Mechanics type shelves

- 400 Mechanics type shelves

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

- HRE-450 (single-slot)

- HRE-454 (four-slot)

PRODUCT DESCRIPTION

The HRU-402 List 1A front panel is shown is Figure 2. The front panel components are described in Table 2.
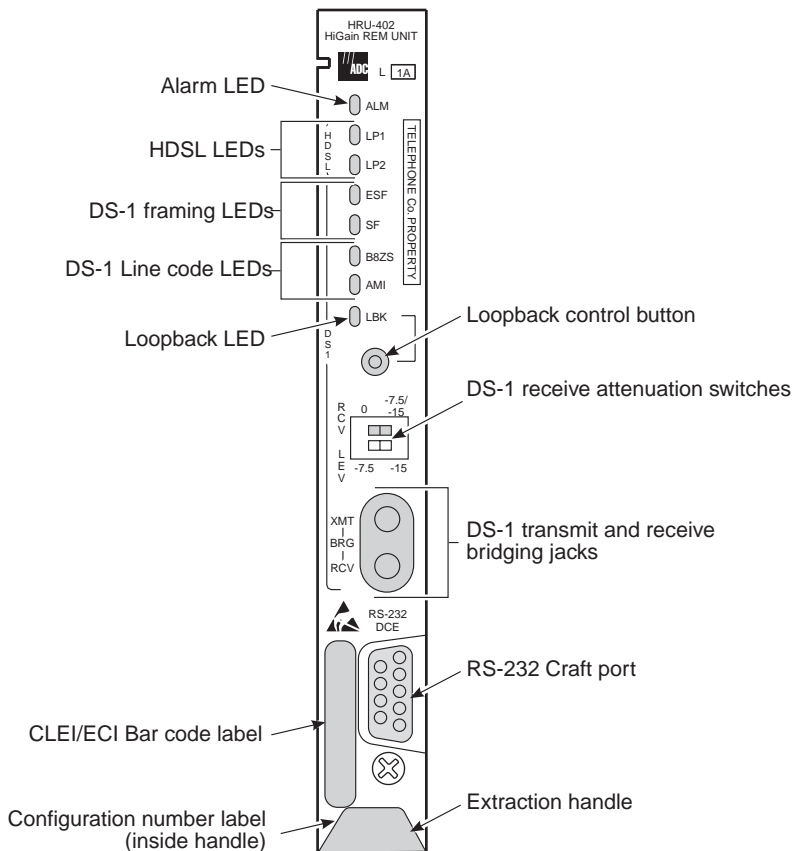
Figure 2.   *Front Panel*

Table 2. *Front-panel Features*

Name	Function
Status LEDs	See Table 3 on page 9 for status descriptions.
Loopback (LPBK) Control button	Pressing the button for five seconds activates a remote loopback towards the Network at the Remote unit Loopback (NREM). The unit can be unlooped by either pressing the LPBK control button again for five seconds or by the standard loopdown coded messages. Also provides the ability to loopdown other loopbacks.[a]
DS-1 Receive (RCV) Level (LEV) switches	Sets DS-1 RCV. Line build out level output toward the Customer Interface (CI).
0	Sets the DS-1 receive level toward the CI to 0 dB.[b]
-7.5/-15	Sets the DS-1 receive level toward the CI according to the switch setting below.
-7.5	Sets the DS-1 receive level toward the CI to -7.5 dB if switch above is set to -7.5/-15.
-15	Sets the DS-1 receive level toward the CI to -15 dB if switch above is set to -7.5/-15.
DS-1 XMT and RCV Bridging jacks	Provides bridging test and monitor access jacks to the CPE DS-1 interface. Provides both monitor and test access capability. See Figure 5 on page 17 for circuit details.
RS-232 Craft port	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 20 for operating procedures.
CLEI/ECI 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, 5 or 6 = Configuration number
Extraction handle	Handle used to remove the HRU-402 from the remote enclosure.

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

STATUS LEDS

Table 3 describes the functions of the Status LEDs on the front panel.

Table 3. *Status LED Descriptions*

LED Status	Indicates
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.
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 the HDSL loop is trying to acquire sync.
Blinking green 4 times per second	Indicates a margin alarm condition on the HDSL loop.
Blinking green 10 times per second	Indicates a Cycle Redundancy Check (CRC) error on the HDSL loop.
OFF	Indicates no activity on the HDSL loop.
DS-1 Framing (FRM) LEDs (ESF and SF)	Indications for framing patterns.[a] If DS-1 framing is set to Unframed (or THRU), the LEDs will not light.
ESF LED = Solid green	Indicates Extended Super Frame (ESF). The light blinks one time per second when a frame error is indicated.
SF LED = Solid green	Indicates Super Frame (SF). The light blinks twice per .5 second when a frame error is indicated.
OFF	Indicates unframed or no signal

Table 3.   *Status LED Descriptions (Continued)*

LED Status	Indicates
DS-1 Code LEDs (B8ZS and AMI)	Indications for DS-1 code options.[a]
B8ZS LED = Solid green (DS-1 Code Option=B8ZS)	Indicates that the DS-1 line code option is <u>set</u> to B8ZS. The light blinks one time per second when a string of excessive zeros is detected.
B8ZS LED = Solid green (DS-1 Code Option=Auto[b])	Indicates the DS-1 line code is being detected as B8ZS.
AMI LED = Solid green (DS-1 Code Option=AMI)	Indicates that the user DS-1 line code option is <u>set</u> to AMI. The solid green light does not indicate the actual DS-1 line code being received, which may be Alternate Mark Inversion (AMI) or B8ZS. This light blinks one time per second when a Bipolar Violation (BPV) is detected.
AMI LED = Solid green (DS-1 Code Option=Auto[b])	Indicates the DS-1 line code is being detected as AMI.
Loopback (LPBK) LED	Shows loopback states to and from the network and to and from the Customer Interface (CI) and an ARMED condition.
Solid yellow	Indicates Network Remote Loopback (NREM), SMJK, or TLOS.
Blinking 1 per second	Indicates Customer Local Loopback (CLOC) loopback state.
Blinking 4 per second	Indicates the HRU is in an ARMED state.

(a) If DS-1 signals are not detected, the ESF, SF, Bipolar with 8-Zero Substitution (B8ZS) and Alternate Mark Inversion (AMI) LEDs will not light.

(b) Auto DS-1 code option not available when attached to a HLU-231 L8D, HLU-319 L5D, or HLU-388 L5D.

PANEL CIRCUIT BOARD OPTIONS

HRU-402 List 1A has user options that are set before you install the unit into a shelf or an enclosure. The DS-1 RCV LEV configuration switches are located on the front panel (see Figure 2 on page 7). The RCV LEV options are defined in Table 2 on page 8. The TLOS switch adjacent to the card-edge connector is shown in Figure 3. The TLOS options are defined in Table 4.
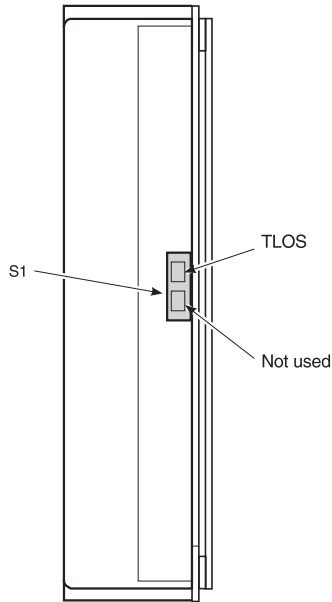
Figure 3.   *TLOS Switch Location*

Table 4.   *Rear Unit TLOS Switch*

TLOS - Rear Unit Switch	
Disable [(a)] (down)	Disables the TLOS option. When an RLOS occurs, AIS will be sent toward the network.
Enable (up)	Enables the TLOS option. When an RLOS occurs, the HRU-402 List 1A initiates a loop back toward the network.
(a) Default setting.	

HLU FRONT PANEL DISPLAY MESSAGES

Table 5 lists and describes the messages that may appear on the HLU line unit front panel display while the HRU-402 is connected to the HLU-231 List 8x, HLU-319 List 5x, or HLU-388 List 5x.

Table 5. *HLU Front Panel Display 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.
NREM	Network Remote Loopback	DSX signal is looped back to DSX at the HRU.
SMJK	Remote SmartJack Loopback	Signal from DSX is looped back to the DSX at the 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 the T1 input to the HLU.
LBPV	Local Bipolar Violation	A bipolar violation occurred at the T1 input to the HLU.
SIG 1 or SIG 2	Signal 1 or Signal 2	The HLU and HRU or first doubler transceivers are trying to establish contact with each other on Loops 1 or 2 of Span 1.
S2L1 or S2L2	Signal 2 Loop 1 or Loop 2	The first doubler and either HRU or second doubler transceivers are trying to establish contact with each other on loops 1 or 2 of Span 2.
S3L1 or S3L2	Signal 3 Loop 1 or Loop 2	The second doubler and either HRU or third doubler transceivers are trying to establish contact with each other on loops 1 or 2 of Span 3.

Continued

Table 5. *HLU Front Panel Display Messages (Continued)*

Message	Name	Description
S4L1 or S4L2	Signal 4 Loop 1 or Loop 2	The third doubler and an HRU are trying to establish contact with each other on loops 1 or 2 of Span 4.
ACQ1 or ACQ2	Acquisition 1 Loop 1 or Loop 2	The line unit and either the first doubler or the remote are trying to establish synchronization with each other on Loops 1 or 2 of Span 1.
A2L1 or A2L2	Acquisition 2 Loop 1 or Loop 2	The first doubler and either HRU or second doubler transceivers are trying to establish synchronization with each other on Loops 1 or 2 of Span 2.
A3L1 or A3L2	Acquisition 3 Loop 1 or Loop 2	The second doubler and either HRU or third doubler transceivers are trying to establish synchronization with each other on loops 1 or 2 of Span 3.
A4L1 or A4L2	Acquisition 4 Loop 1 or Loop 2	The third doubler and an HRU are trying to establish synchronization with each other on loops 1 or 2 of Span 4.
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 has 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 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 GOOD	Power Feed Good	Indicates there is no short or ground on the HDSL pairs.
PWR FEED SHRT	Power Feed Short	Indicates a short between the two HDSL pairs.

Continued

Table 5. *HLU Front Panel Display Messages (Continued)*

Message	Name	Description
PWR FEED OFF	Power Feed Off	HDSL span power has been turned off by setting the PWRF option to DIS.
PWR FEED GND	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. The integrity of the HRU is therefore questionable.
VER	HLU Software Version #	Displayed during the System Settings review mode by pressing the Mode button at the HLU for 3 or more seconds.
LIST 0xL	HLU's List #	Displayed during System Settings review mode.
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 one of the HDSL loops has lost sync. If the LOSW is detected, it causes a minor alarm.
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	Indicates that no signal is detected at the T1 input to the HRU. Causes minor alarm.

CARD-EDGE PINOUT CONNECTOR

The HRU-402 occupies one slot in a remote enclosure. The card-edge pinout connector for the remote unit is shown in Figure 4.

56	☐ ■	55	DS-1 TIP
54	☐ ☐	53	
52	☐ ☐	51	
50	☐ ■	49	DS-1 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	
34	☐ ☐	33	
32	☐ ☐	31	
30	☐ ☐	29	
28	☐ ☐	27	
26	☐ ☐	25	
24	☐ ☐	23	
22	☐ ☐	21	
(Factory Use Only) 20	■ ☐	19	
18	☐ ■	17	Circuit Ground
16	☐ ■	15	DS-1 RING1
14	☐ ■	13	HDSL1 RING
Protection Switch Power 12	■ ☐	11	
10	☐ ☐	9	
8	☐ ■	7	HDSL1 TIP
6	☐ ■	5	DS-1 TIP1
4	☐ ☐	3	
2	☐ ■	1	Chassis Ground*

XMT (pins 55, 53, 51, 49)
RCV (pins 15, 13, 11, 9, 7, 5)

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

Figure 4.   *Card-edge Pinouts*

FUNCTIONAL DESCRIPTION

The HiGain 2B1Q HDSL transceiver system establishes two full-duplex 784 kbps data channels between the HLU and a remotely mounted HRU-402. This system provides a total capacity of 1.568 Mbps between the two units. HDSL technology also provides full-duplex services at standard T1 rates over copper wires between an HLU and an HRU-402, which comprise one HiGain system. A block diagram of the HRU-402 is shown in Figure 5 on page 17.

The HRU-402 List 1A power supply converts the 90 to 200 Vdc power that is received on the simplex pairs to the voltage and currents required by the remote unit circuitry.

The HRU-402 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 number: 150-232-100-xx) for more details. For this application, the HRE-422 List 5 remote enclosure must be used. This enclosure provides access to the HRU-402 protection switch output, on pin 12, which controls the protection switching function.

A block diagram of the HRU-402 is shown in Figure 5.
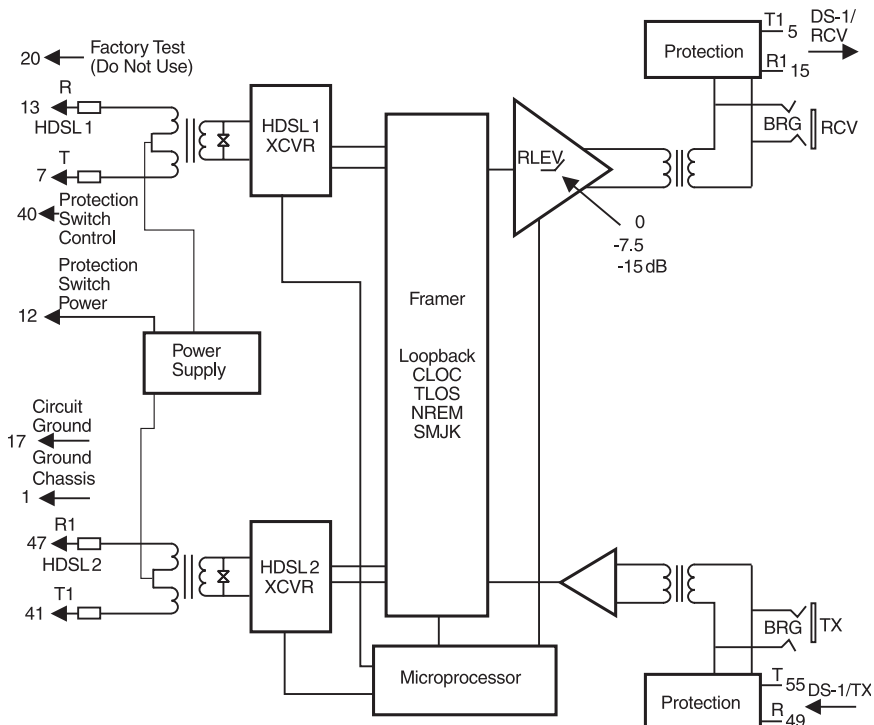
Figure 5.   *HRU-402 Block Diagram*

INSTALLATION

This section describes the installation process for the HRU-402 List 1A.

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 ADC DSL Systems, Inc.

Your shipment should consist of:

- One HRU-402
- *HiGain Remote Unit* user manual

INSTALLING HRU-402 LIST 1A

To install the HRU-402 (Figure 6 on page 19):

1 Set the user options. (See Figure 2 on page 7 (for REV LEV and Figure 3 on page 11 for TLOS switch.)

2 Slide the remote unit into the card guides for the desired slot, then push the unit into the enclosure until it is seated against the card-edge connector.
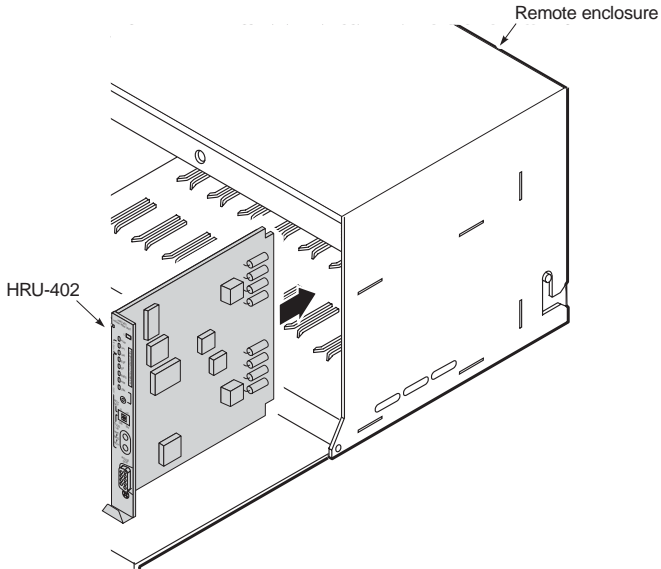
Figure 6.   *Installing the HRU-402 in a Remote Enclosure*

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.

PROVISIONING THE HRU-402

The HRU-402 can be provisioned by accessing system settings screens through the RS-232 Craft port at the HLU (or at the HRU if remote provisioning is enabled). System settings are stored in Non-Volatile Random Access Memory (NVRAM) of the HLU, meaning the data is retained even when power is lost or turned off.

CONNECTING TO A TERMINAL EMULATOR

This section covers the remote terminal screens for both non-doubler and doubler applications. Once connected, you can access the Remote Terminal menu.
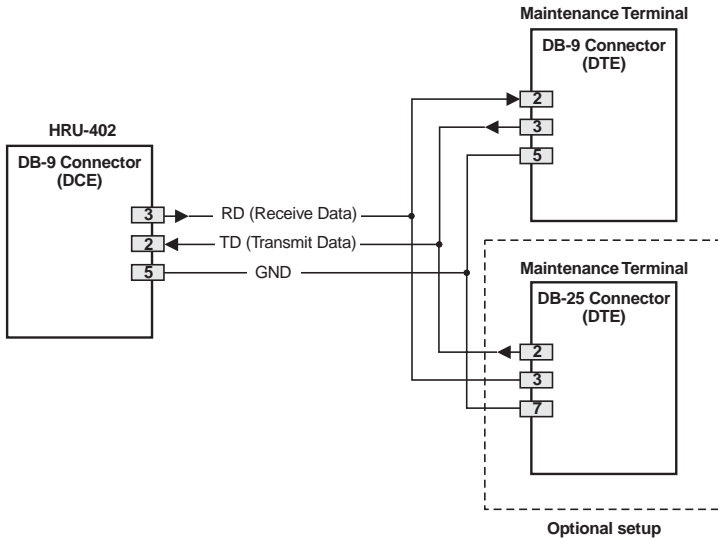
Figure 7.   *DB-9 and DB-25 RS-232 I/O Interfaces*

As shown in Figure 7, the 9-pin craft port (RS-232 DB-9 connector) on the HRU-402 front panel allows you to use a RS-232 cable to connect your

system to an ASCII terminal or a PC running a terminal emulation program. To connect a terminal emulator:

1   Connect a standard, 9-pin, serial terminal cable to the Craft port (RS-232 DB-9 connector) on the HRU-402. Figure 7 shows the HRU-402 DB-9, and two types (DB-9 and DB-25) of RS-232 I/O interfaces on the maintenance terminals (PCs).

2   Once the serial cable is connected to the Craft port (RS-232 DB-9 connector) on the HRU-402, connect the other end of the cable to the 9-pin or 25-pin COM port (RS-232) of the maintenance terminal (Figure 8 on page 21). The maintenance terminal is configured as Data Terminal Equipment (DTE).
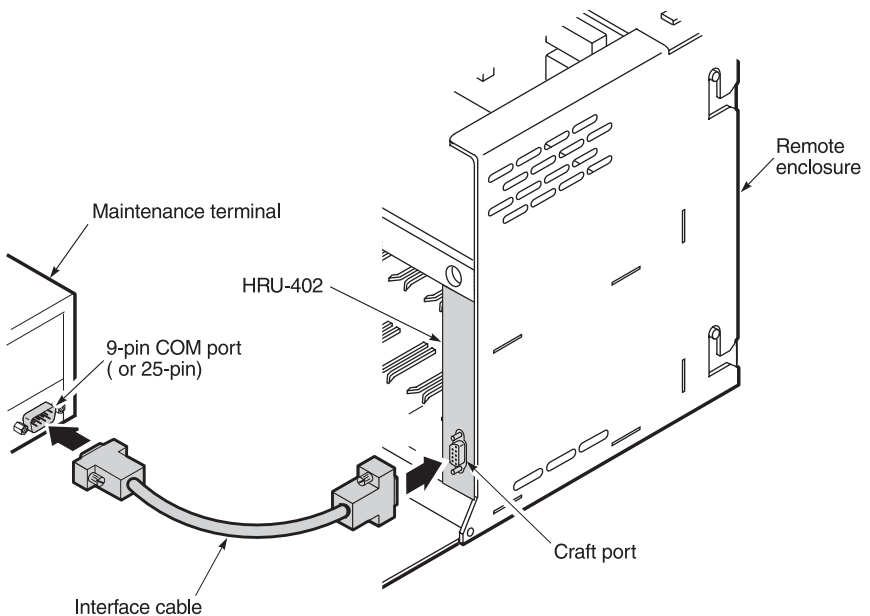
Figure 8.   *Connecting the HRU-402 to a Maintenance Terminal*

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 you are 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."

NAVIGATING THE MAINTENANCE TERMINAL SCREENS

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

LOGIN

The HRU-402 supports both local and remote login capabilities. 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 uses essentially the same menus and screens as those at the HLU. See the appropriate line unit technical practice for more information about the menus and screens.

The HRU-402 always reverts to its remote login mode, if possible. Once in a remote login mode, it will remain there until something occurs that inhibits a remote login session. Then, it is forced to be a local login mode.

All line units that support doubler applications support the remote login feature. The only time the HRU will enter a local login session is when the remote is powered up but both HDSL loops are not in sync with the HLU.

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 technical practice for specific remote login screen display formats.

To log on and access the menus and screens using the maintenance terminal, the remote unit and HLU must have established communication with each other:

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

The Remote Login screen is displayed as shown in Figure 9.

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++
+                                                    +
+   RRRRR   EEEEEE  M     M    OO     TTTTTTT EEEEEE  +
+   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     EEEEEE   +
+                                                    +
+                                                    +
+                   BY          +                    +
+                                                    +
+              PAIRGAIN TECHNOLOGIES+                 +
++++++++++++++++++++++++++++++++++++++++++++++++++++++
             HIT <ENTER> TO LOG IN
```
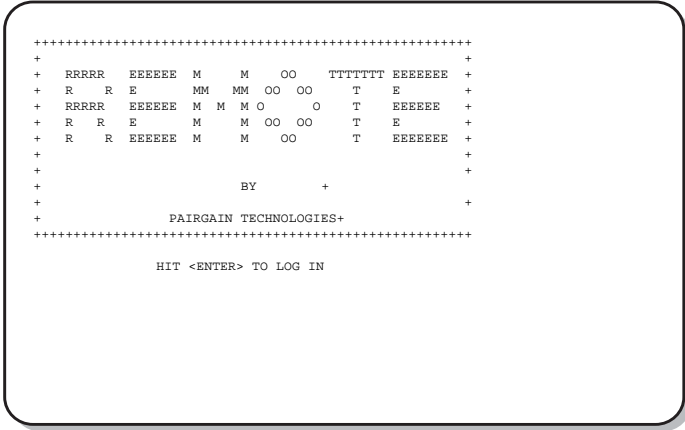
Figure 9.   *Remote Login Screen*

2   Press the **ENTER** key to bring up the Remote Login Main Menu screen (shown in Figure 10 on page 25).

This screen can be identified by the heading, *"Remote Terminal Main Menu"*.

```
HI-GAIN HLU-231   REMOTE TERMINAL MAIN MENU (ver V6.2L-8E)
                      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
```
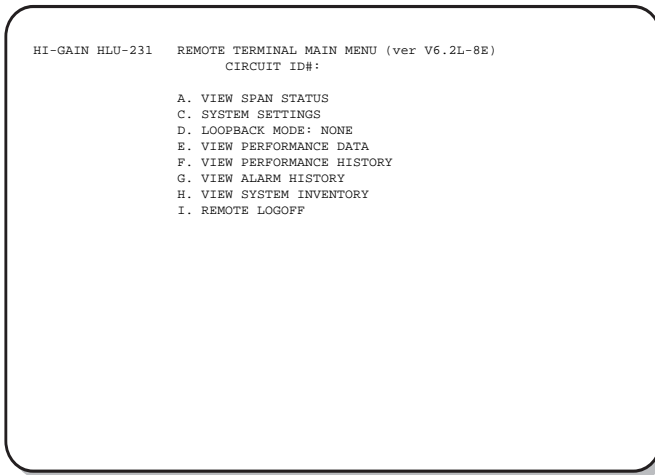
Figure 10.   *HiGain HLU-231 Remote Terminal Main Menu*

3   At this point, you may choose to terminate the remote session by pressing
⬛ for remote logoff. Terminating the remote session allows other units
in the circuit, such as doublers, to initiate a remote login.

This is necessary because a HiGain circuit only supports one remote
login session at a time. An active session at any module (other than the
HLU) prohibits active sessions at all other circuit modules.

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

SYSTEM SPANS

There are five to seven screens available for viewing system performance, status, and history, depending on the number of spans in a particular application. Figure 11 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.

The HRU-402 List 1A is only capable of supporting four spans. For five spans, an HRU-402 List 1 or List 3 with local power capability must be used. See the applicable List 1 or List 3 Technical Practice.

Central Office

| HiGain Line Unit | HiGain Doubler D1 | HiGain Doubler D2 | HiGain Doubler D3 | HiGain Remote Unit |

Span 1	Span 2	Span 3	Span 4	3 Doublers
Span 1	Span 2	Span 3	2 Doublers
Span 1	Span 2	1 Doubler
Span 1	No Doubler
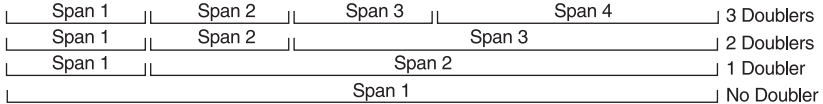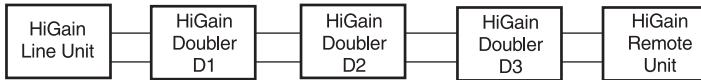
Figure 11. *System Spans*

NAVIGATION KEYS

Table 6 describes keys you can use on the maintenance terminal keyboard to navigate within the HRU-402 menus.

Table 6.   *Maintenance Terminal Navigational Keys*

Key	Function
ENTER	Logs into the Remote Terminal menus
E	Exits the current menu
U	Updates a report/screen
S	Selects the next Span Status screen
I	Remote logoff

INITIALIZING THE MAINTENANCE TERMINAL SCREENS

Press the SPACEBAR several times to initiate the autobaud connection and to initialize the Maintenance Terminal screens. This will return you to the initial Remote Login screen shown in Figure 9 on page 24.

REMOTE TERMINAL MAIN MENU

Figure 12 displays the Remote Terminal Main Menu and Table 7 on page 29 describes the function of each menu selection.

```
HI-GAIN HLU-231   REMOTE TERMINAL MAIN MENU (ver V6.2L-8E)
                         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
```
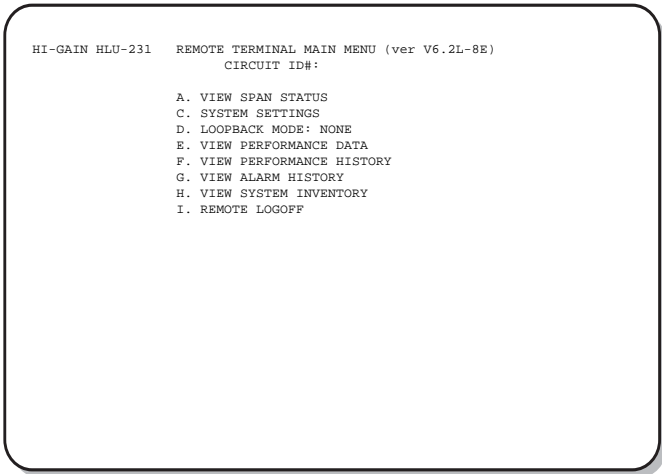
Figure 12.   Remote Terminal Main Menu

Table 7. *Remote Terminal Menu Descriptions*

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 30.
System Settings	Allows you to view all system settings.	"System Settings" on page 33.
Loopback[(a)] Mode	Allows system loopbacks to be initiated.	"Loopback Mode" on page 38.
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-402 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 46.
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 Performance History" on page 49.
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 51.
View System Inventory[(a)]	Displays the model number and ID of all circuit plugs.	"View System Inventory" on page 54.
Remote Logoff	Disconnects the HRU-402 login from the line unit.	

(a) Available only when the HRU is connected to the HLU-231 List 8x, HLU-319 List 5x, HLU-388 List 5x or HLU-231 List 7B.

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:

- Time and date

- Alarms

- Loopbacks

- Power level

- HDSL Loops 1 and 2

- DS-1 interface

From the Remote Terminal Main Menu (Figure 12 on page 28), 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: HIGH
                    HLU        HRU
              HDSL-1    HDSL-2      HDSL-1      HDSL-2
              cur/min/maxcur/min/max cur/min/max cur/min/max
MARGIN:       18/17/19   18/17/19    18/17/19    18/17/19dB
PULSE ATTN:    2719   20     19   dB
INS LOSS:      3323   25     23   dB
PPM OFFSET:    0000   17     17   ppm
24 HOUR ES:       00017000120000500005   seconds
24 HOUR UAS:      00016000130000700001   seconds

                          DS-1 STATUS

                     HLU                    HRU
24 HOUR BPV Seconds:  00006                  00035
24 HOUR UAS Count:    00010                  00020
Frame type:          Unframed               Unframed
Code type:           AMI                    AMI

                     (E)xit (U)pdate
```

Figure 13. *View Span Status Screen for Non-doubler Applications*

At the View Span Status screen you have the following options:

- Press **E** to exit and return to the previous menu.

- Press **U** to update the current values.

When doublers are in use, Figure 14 displays:

```
TIME: 00:14:11    SPAN 1 STATUS
DATE: 02/02/98    CIRCUIT ID#:
ALARMS: CHREV
LOOPBACK: OFF
POWER LEVEL: HIGH
                HLU       HDU1
            HDSL-1      HDSL-2       HDSL-1      HDSL-2
            cur/min/maxcur/min/max cur/min/max cur/min/max
MARGIN:     19/18/20   19/18/19   19/18/20    19/17/20dB
PULSE ATTN:   2727   27    27   dB
INS LOSS:     3333   33    33   dB
PPM OFFSET:   0000   -02   -03  ppm
24 HOUR ES:   00010000090001600019   seconds
24 HOUR UAS:  00025000320000400006   seconds


                        DS-1 STATUS

                    HLU                 HRU
24 HOUR BPV Seconds:   00006               00035
24 HOUR UAS Count:     00010               00020
Frame type:            Unframed            Unframed
Code type:             AMI                 AMI

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

Figure 14.   Span 1 Status Screen for Doubler Applications

HDU1 (one doubler) through HDU3 (three doublers) appear in the Span Status screen for doubler applications. The doublers are configured along four spans.

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.

Table 8 on page 32 describes each status item shown in Figure 14.

Table 8.   *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.
Loopback	Indicates Off condition or identifies specific active loopback. See Table 10 on page 41.
Power Level	Indicates the HDSL Power Feed voltage mode: High, Low, or Disabled.
Margins	Indicates the excess signal to noise ratio at all HDSL ports, relative to a 10^{-7} Bit Error Rate, in xx/xx/xx format where:
	First value is current margin.
	Second value is minimum margin since last cleared.
	Third value is maximum margin since last cleared.
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. This value is a running total of the last 24 Hours.
DS-1 24-Hour BPV Seconds (ES)	The number of seconds in which at least one bipolar violation was detected on the DS-1 input. This value is a running total of the last 24 Hours.

Continued

Table 8. *Span Status Fields and Descriptions (Continued)*

Field	Description
DS-1 24-Hour UAS Count	The number of seconds during which the DS-1 input signal was absent (125 or more consecutive 0s). This value is a running total of the last 24 Hours.
DS-1 Frame type	Type of DS-1 framing detected on the input stream (SF, ESF, Unframed or No Activity). This value is a running total of the last 24 Hours.
DS-1 Code type	Type of DS-1 line coding used (AMI, B8ZS, AMI: Zero Byte Time Slot Interface[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 DS-1 code mode, the selected code is displayed when in auto mode, the code type displayed is what is being received. (Auto is not available when attached to HLU-231 List 8D, HLU-319 List 5D, or HLU-388 List 5D.) This value is a running total of the last 24 Hours.

SYSTEM SETTINGS

The System Settings screen allows you to analyze and view configurable parameters.

Provisioning from the remote is allowed when connected to particular HiGain line units. See the HiGain Line Unit technical practice to determine whether remote provisioning is allowed.

1   Type C from the Remote Terminal Main menu to view the System Settings screen (Figure 15 on page 34):

The HRU-402 System Settings screen will appear different from the screen shown below if the HRU-402 is locally logged in. When remotely logged in and attached to an HLU-231 List 8D, an HLU-319 List 5D, or an HLU-388 List 5D, some of the settings will not be shown.

```
                          SYSTEM SETTINGS

TIME: 03:40:57
DATE: 10/04/98                    CIRCUIT ID#:

EQUALIZATION....: 0                    MARGIN ALARM THRESH: 4
SMART-JACK LPBK.: ENABLED              RLOS(DS1 LOS) ALARM: ENABLED
SPECIAL LPBK....: GNLB                 ALARM PATTERN......: AIS
POWER..........: AUTO                  BPVT..............: ENABLED
ZBTSI..........: OFF
BER ALARM THRESH: NONE
LOOPBACK TIMEOUT: NONE
ALARM..........: DISABLED
DS1 LINE CODE...: AMI
FRAMING........: AUTO
AIS ON HDSL LOSW: 2 LOOPS
AIS ON SMJK/NREM: ENABLED


                   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

                          (E)xit
```

Figure 15.   System Settings Screen

2   View the HRU-402 system settings.

3   Type E to exit and return to the previous screen.

Table 9 on page 35 lists the System Settings fields and descriptions.

Table 9. *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 EXT, 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 DS-1 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, A1LB, A2LB, A3LB, A4LB, or A5LB.
Power	Indicates whether power feed to the HRU-402 from the HLU is either DISABLED, LOW, AUTO, or HIGH.
ZBTSI[a]	Indicates whether ZBTSI is either On or Off. An On setting tells the system that the ESF frame is operating in its ZBTSI mode. An Off setting tells the system that the ESF frame is operating in its normal non-ZBTSI mode.
BER Thresh (BERT) Alarm	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 (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.
DS-1 Line Code	Indicates one of three settings: Auto [a], B8ZS, or AMI.
Framing	Indicates whether framing is either Auto or UNFR (or THRU).
AIS on HDSL [a] LOSW	Indicates the settings for Alarm Indication Signal (AIS) on HDSL LOSW on the HDSL loops.
AIS on SMJK/NREM	Indicates settings of either enabled or disabled for alarm indication signals for the SmartJack Network Remote Loopback (NREM).
DS0 Blocking [a]	Indicates status of DS0 blocked channels and identifies the channels that have been blocked (using "xx" symbols underneath each blocked channel).

Continued

Table 9. *System Settings Fields and Descriptions (Continued)*

Field	Description
Margin Alarm (ALM) Threshold (THRES)	Indicates the settings for the margin alarm thresholds.
Remote (DS-1 LOS) Alarm (RDA)	Indicates whether a LOS (Loss of Signal) at the HRU DS-1 input generates 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 Pattern (ALMP)	Indicates whether the Alarm Pattern option is set to AIS or LOS.

(a) Settings not available when attached to an HLU-231 List 8D, an HLU-319 List 5D, or an HLU-388 List 5D.

ADDITIONAL INFORMATION ON SELECTED OPTIONS

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

Remote DS-1 Alarm (RDA) Option

The Remote Loss of Signal (RLOS) alarm output at the HLU can be inhibited by disabling the RDA option. This prevents a LOS condition at the DS-1 input to the HRU-402 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 AIS payloads.

Alarm Pattern (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 option 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)

The ALMP option determines the HRU payload during one of the above alarm conditions.

When the HRU-402 is connected to older HLUs, the options below are not supported, are not displayed, and are forced to the following default states:

- **BPVT: DIS**

- **RDA: ENA**

- **BER: None**

- **ALMP: AIS**

DS-1 Line Code "Auto" Option

The DS-1 Line Code "Auto" Option is not available when attached to an HLU-231 List 8D, an HLU-319 List 5D, or an HLU-388 List 5D.

When the DS-1 line code option is set to AUTO mode, both the HLU and HRU-402 set their T1 output codes to the codes received 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 DS-1 output code was determined by the input code at the local T1 input port instead of at the distant end.

If the HRU-402 is connected to an older HLU, its DS-1 AUTO mode performs as it does in older models where its output code is set by its local T1 input code.

LOOPBACK MODE

The Loopback Mode menu only appears if the HRU-402 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. For more details, refer to the specific technical practice for the HLU used in your configuration.

1   From the Remote Terminal Main Menu, type `D` to display the Loopback
Menu. When no doublers are in use, Figure 16 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
```
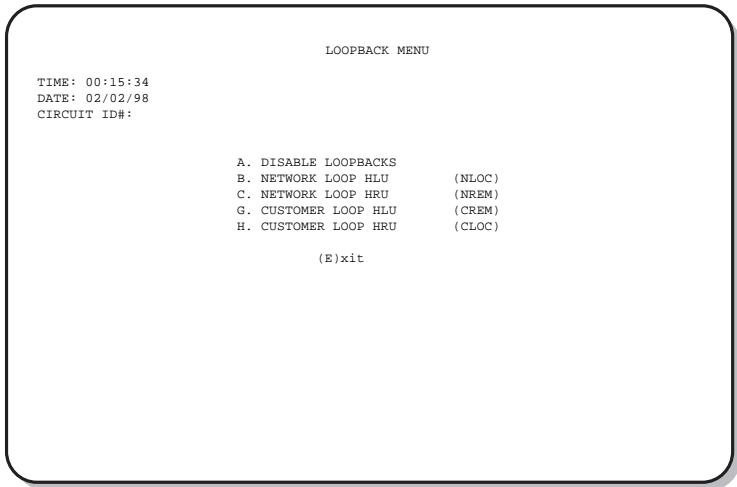
Figure 16.   Loopback Menu Without Doublers

2   Type `A` to select the disable loopbacks option.

3   Type `B` to select HLU network loopback.

4   Type `C` to select HRU network loopback.

5   Type `G` to select HLU customer loopback.

6   Type `H` to select HRU customer loopback.

7   Type `E` to exit and return to the main menu.

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

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

A. DISABLE LOOPBACKS
B. NETWORK LOOP HLU(NLOC)
C. NETWORK LOOP HRU (NREM)
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 17.   Loopback Menu with Three Doublers

Table 10 on page 41 lists the HRU-402 List 1A Loopback Field Messages and Descriptions.

To initiate a loopback:

• Choose one of the options (listed in Table 10) between A through L .

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

Table 10.   *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.
CDU1	Customer Doubler 1 Loopback	Loopback at first doubler towards CI.
NDU2	Network Doubler 2 Loopback	Loopback at second doubler towards network.
CDU2	Customer Doubler 2 Loopback	Loopback at second doubler towards CI.
NDU3	Network Doubler 3 Loopback	Loopback at third doubler towards network.
CDU3	Customer Doubler 3 Loopback	Loopback at third doubler towards CI.

Loopback Operation

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.
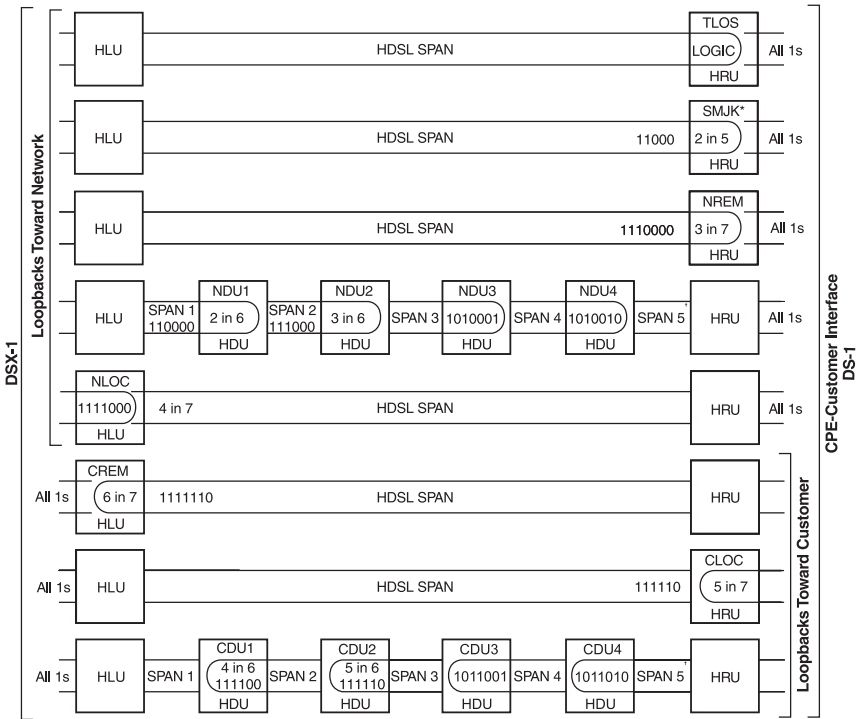
* Set the SAIS option to ENA to send the AIS pattern to the CI during Smart-Jack loopback. Use the 3-in-5 code to loop down.

† Five span operation requires a locally-powered remote (HRU-402 List 1 or List 3).

***Figure 18.** HiGain System Loopbacks*

The HRU-402 supports four types of loopbacks (Figure 18 on page 42).

- 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 NREM and SmartJack Loopbacks have two modes of operation as determined by the SmartJack Alarm Indication Signal (SAIS) user option settings at the HLU (ENA or DIS). The ENA option causes the HRU to transmit the Alarm Indication Signal (AIS) towards the CPE. The DIS option turns off the AIS/CPE signal. 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.

- Transmit Loss of Signal (TLOS): initiated by a DS-1 LOS condition at the HRUs DS-1 input port if the TLOS option is enabled. The DSX signal is looped back logically to the DSX at the HRU.

The HLU supports the following two loopbacks:

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

- Customer Remote Loopback (CREM): the signal from the customer is looped back to the customer at the HLU.

If doublers are used, then the following loopbacks (up to 6 additional) can be supported:

- Network Doubler Unit (NDU1 - NDU3) loopbacks. The DSX-1 signal is looped back to the DSX-1 at the looped doubler.

- Customer Doubler Unit (CDU1 - CDU3) loopbacks. The signal from the customer is looped back to the customer at the looped doubler.

SmartJack Set to ENA

Upon detection of a valid SmartJack Loopback command, a loopback is activated and the T1framer 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. The AIS pattern is examined by the HRU for its overall integrity. This pre-loop test lasts for about 300 ms and terminates in one of the following two conditions:

- Pre-loop Failed- If the transmit and receive all 1s 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 loopback remains active. 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 Loopback state, its T1 input LOS, Code and Frame monitoring circuits are connected to the unframed all ones pattern which is being looped back to these circuits through the T1 Interface chip. The CPE input signal is no longer being monitored since its input circuit has been opened and terminated. This forces the FRM LEDs off, the Local (LOC) Loss of Signal (LOS) LED off and the Code LEDs to indicate AMI if the HLU Code option is set to either AUTO or AMI. The code LEDs indicates B8ZS if the Code option is set to B8ZS.

SAIS Set to DIS

This SMJK Loopback state is initiated in the same manner as when the ENA option is chosen. However, once initiated, the AIS is not sent to the CPE. Instead the network signal is sent both towards the NI and through the loopback towards the network. As before, the customer's T1 transmit input port is opened and terminated. This 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 Loopback 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. The FRM and LOC LOS LEDs indicate the status of this signal from the network. The Code LEDs also indicate 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.

The TLOS, 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 2-in-5 in band or by the ESF-DL command. NREM is used to indicate that the loopback was initiated by other than the 2-in-5 or ESF-DL command (3-in-7, 16-bit, addressable, repeater commands, front panel push-button, or Craft port). TLOS is used to indicate that the loopback was initiated by a LOS of T1 input at the HRU from the customer.

The HRU-402 front panel loopback button is used to initiate NREM and terminate an NREM loopback. To initiate an NREM loopback at the HRU, press the loopback button for five seconds. Pressing this button terminates all HiGain loopbacks that may be present (except SMJK) before executing an NREM loopback in the HRU. If another HiGain loopback is active, the user will have to press the loopback button for up to 10 seconds (five seconds to loop down and five more seconds to loop up NREM.

Loopback Test Procedures

Testing the HiGain system allows you to verify the integrity of the HDSL channels to the HLU as well as the DS-1 channels to the customer and the HLU DSX-1 interface. While the HRU-402 displays system condition messages at the Remote Terminal and by color-coded LED displays on the front panel, the HLU indicates system conditions by a four-character LED message display and by a tri-color status LED. To facilitate test messaging with central office test personnel, front-panel messages for the HLU-231 List 8x are provided in . The four character messages also apply to the HLU-319 List 5x and the HLU-388 List 5x.

> **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 control button on the remote unit front panel for at least 5 seconds (see Figure 2 on page 7 for the location of this button).

2   Verify that the yellow HRU front panel LPBK 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 is in loopback.

3   Have the CO tester transmit a T1 test signal into the HLU to measure the returned (looped) signal for errors.

4   If the above test fails, remove the remote unit from its loopback state by again pressing the loopback control button for 5 seconds. Verify that the LPBK LED goes 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. If it fails, the problem is at the CO.

7   When the HRU is looped back towards the CPE or Customer Local Loopback (CLOC), the LPBK LED blinks yellow at one time per second.

8   When HiGain is in a Special Loopback (SPLB) ARMED state, the LPBK LED blinks yellow at four times a second unless in NREM or CLOC loopback.

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 for the HLU and the HRU-402 and doublers if so configured. This screen displays ES/UAS for the HLU and HRU-402 DS-1 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, two or three doublers).

From the Remote Terminal Main Menu, type **E** to display the Performance Data screen. When no doublers are in use, the following Performance Data screen displays:

```
Date: 10/04/98            PERFORMANCE DATA
CIRCUIT ID#:

                ERRORED SECONDS/UNAVAILABLE SECONDS

            DS1              HDSL-1           HDSL-2
        HLU      HRU      HLU      HRU      HLU      HRU
00:00  000/000  000/000  000/000  000/000  000/000  000/000
00:15  000/000  016/012  010/016  003/005  007/013  002/001
00:30  000/000  000/000  000/000  000/000  000/000  000/000
00:45  006/010  012/005  000/000  000/000  000/000  001/000
01:00  000/000  000/000  000/000  000/000  000/000  000/000
01:15  000/000  000/000  000/000  000/000  000/000  000/000
01:30  000/000  000/000  000/000  000/000  000/000  000/000
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  001/000  001/000  000/000  001/000  000/000
03:15  000/000  006/003  006/000  002/002  004/000  002/000
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

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

Figure 19.   Performance Data Screen Without Doublers

You can do the following:

- Type **E** to exit and return to the main menu.

- Type **P** to return to the previous screen.

- Type **N** for the next screen.

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

```
Date: 10/04/98        SPAN 1 PERFORMANCE DATA
CIRCUIT ID#:
                  ERRORED SECONDS/UNAVAILABLE SECONDS

               DS-1              HDSL-1              HDSL-2
         HLU       HRU       HLU       HDU1      HLU       HDU1
00:00    000/000   000/000   000/000   000/000   000/000   000/000
00:15    000/000   016/012   010/016   003/005   007/013   002/001
00:30    000/000   000/000   000/000   000/000   000/000   000/000
00:45    006/010   012/005   000/000   000/000   000/000   001/000
01:00    000/000   000/000   000/000   000/000   000/000   000/000
01:15    000/000   000/000   000/000   000/000   000/000   000/000
01:30    000/000   000/000   000/000   000/000   000/000   000/000
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   001/000   001/000   000/000   001/000   000/000
03:15    000/000   006/003   006/000   002/002   004/000   002/000
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

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

Figure 20.   *Span 1 Performance Data Screen*

The doubler units (HDU1 through HDU3) appear in the performance data screen for doubler applications.

The presentation format is: ES/UAS for the HLU and the HRU-402 DS-1 signal, and ES/UAS for the HLU and HDU1 over both HDSL Loops 1 and 2.

You can do the following:

- Type **E** to exit to the main menu.

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

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

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

VIEW PERFORMANCE HISTORY

The View Performance History (7-Day) screen shows the number of ES/UAS occurrences in 24-hour increments for a 7-day period for the HLU and the HRU-402 and doublers if so configured. This screen displays ES/UAS for the HLU and HRU-402 DS-1 signal, HDSL Loop 1 and HDSL Loop 2 (for non-doubler applications). For doubler applications, the available View Performance 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 21).

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


                    ERRORED SECONDS/UNAVAILABLE SECONDS

              DS-1                 HDSL-1               HDSL-2
         HLU        HRU        HLU        HRU        HLU        HRU
 08/19  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 08/20  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 08/21  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 08/22  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 08/23  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 08/24  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 08/25  00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000
 current 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000 00000/00000



                                (E)xit
```

Figure 21. *Performance History Screen for Non-doubler Applications*

2   Type `E` to exit and return to the main menu.

When doublers are in use, the following Performance History (7-Day) screen is displayed:

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

                               SPAN 1
                   ERRORED SECONDS/UNAVAILABLE SECONDS

               DS-1                     HDSL-1                  HDSL-2
          HLUHRUHLU   HDU1HLU     HDU1
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 22.   Span 1 Performance History Screen

HDU1 (one doubler) through HDU3 (three doublers) appear in the Performance History screen for doubler applications.

- Type **S** to view the spans that are currently in use.
- Type **E** to exit to the main menu.

VIEW ALARM HISTORY

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

From the Remote Terminal Main Menu, type **G** to display the Alarm History screen for non-doubler applications.

```
                          ALARM HISTORY
TIME: 00:17:18
DATE: 10/04/98
CIRCUIT ID#:

Type            First         Last        Current   Count
LOS, DS1-HLU    10/04/98-00:36  10/04/98-00:00OK      001
LOS, DS1-HRU    10/04/98-00:00  10/04/98-00:00OK      001
BER                                         OK        000
SPAN1 LOSW, HDSL1 10/04/98-00:00  10/04/98-00:00OK    001
SPAN1 LOSW, HDSL2 10/04/98-00:00  10/04/98-00:00OK    001
SPAN1 MARGIN L1                             OK        000
SPAN1 MARGIN L2  10/04/98-00:00  10/04/98-00:00OK     001
PWR-SHRT                                    OK        000
PWR-GND                                     OK        000

LAST CLEARED: NONE

                          (E)xit (U)pdate
```

Figure 23. *Alarm History Screen for Non-doubler Applications*

You can do one or more of the following:

- Type **U** to update the screen.

- Type **E** to exit the main menu.

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, DS-1-HLU	First and last instance of LOS at the HLU (current condition, number of alarms)
LOS, DS-1-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 alarms)
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-SHRT	First and last instance of a Power short condition
PWR-GND	First and last instance of an HDSL grounded conductor detected (current condition, number of alarms)
Last Cleared:	Last date and time Alarm History was cleared

For doubler applications, the following screen displays:

```
                         ALARM HISTORY

         TIME: 03:48:09
         DATE: 10/04/98
         CIRCUIT ID#:

         Type              First              Last             Current      Count
         LOS, DS1-HLU      10/04/98-00:36     10/04/98-00:36   OK           001
         LOS, DS1-HRU      10/04/98-00:00     10/04/98-00:00   OK           001
         BER                                                   OK           000
         SPAN1 LOSW, HDSL1 10/04/98-00:00     10/04/98-00:00   OK           001
         SPAN1 LOSW, HDSL2 10/04/98-00:00     10/04/98-00:00   OK           001
         SPAN1 MARGIN L1                                       OK           000
         SPAN1 MARGIN L2   10/04/98-00:00     10/04/98-00:00   OK           001
         PWR-SHRT                                              OK           000
         PWR-GND                                               OK           000

         LAST CLEARED:  NONE


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

Figure 24.   Four Doublers, Span 1 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 11 on page 52. The Span 2 Alarm History screen displays for one doubler applications, the Span 3 Alarm History screen displays for two doubler applications, and the Span 4 Alarm History screen displays for 3 doubler applications.

The following options are available:

- Type **E** to exit and return to the main menu.

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

- 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 circuit 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) of the HLU, meaning the data remains even when power is lost or turned off.

Setting circuit IDs is allowed when connected to particular HiGain line units. See the HiGain line unit technical practice to determine whether remote provisioning is allowed.

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 (N/A). All detected modules are fully identifiable. Whenever the line unit loses sync with Span 1, the product types are replaced by the N/A label until sync is reestablished and each module can in turn be determined. However, the unit IDs remain available.

1   From the Remote Terminal Main Menu screen, type H to display the
        View System Inventory screen:

```
                          SYSTEM INVENTORY
        TIME: 03:49:22
        DATE: 10/04/98        CIRCUIT ID:


            UNIT      PRODUCT          UNIT ID

            HLU    HLU-231  L8E V6.2    NOT REQUIRED
            HRU    HRU-402  L1A V1.3
            DB1    HDU-404  L2  V1.1
            DB2    HDU-404  L2  V1.1
            DB3    HDU-404  L2  V1.1
            DB4    N/A




                            (E)xit
```

Figure 25.   *View System Inventory Screen*

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

APPENDIX A: SPECIFICATIONS

Physical

Material	Steel
Finish	Zinc-plated
Mounting	Any standard 400 or 200 type mechanics

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. (.51 kg)

Power

Line power Consumption	3.1 W (when connected to the following line units: HLU-231 List 8x, HLU-319 L5x, and HLU-388 L5x) 4.5 W (when connected to all other line units)
Maximum provisioning loss	35 dB at 196 kHz, 135Ω
Electrical protection	Secondary surge and power cross protection on all DS-1 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)

Continued

DS-1

Line impedance	100Ω
Pulse output	0 dB (Receive Level [REC LEV] = 0), -7.5 db (REC LEV = -7.5), -15 dB (REC LEV = 15)
Input level sensitivity	> -22.5 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 (THRU)

Line Clock Rate

Internal stratum 4 clock

APPENDIX B: SERVICE AND SUPPORT

ADC Customer Service Group provides expert pre-sales and post-sales support and training for all its products.

Technical support is available 24 hours a day, 7 days a week by contacting the ADC Technical Assistance Center.

Sales Assistance 800.366.3891 ext. 73000 (USA and Canada) or 952.917.3000 Fax: 952.917.3237	• Quotation Proposals • Ordering and Delivery • General Product Information
Systems Integration 800.366.3891, ext. 73000 (USA and Canada) or 952.917.3000	• Complete Solutions (from concept to installation) • Network Design and Integration Testing • System Turn-Up and Testing • Network Monitoring (upstream or downstream) • Power Monitoring and Remote Surveillance • Service/Maintenance Agreements • Systems Operation
ADC Technical Assistance Center 800.638.0031 or 714.730.3222 Fax: 714.730.2400 Email: wsd_support@adc.com	• Technical Information • System/Network Configuration • Product Specification and Application • Training (product-specific) • Installation and Operation Assistance • Troubleshooting and Repair/Field Assistance
Online Technical Support	• www.adc.com/Knowledge_Base/index.jsp
Online Technical Publications	• www.adc.com/library1/
Product Return Department 800.366.3891 ext. 73748 (USA and Canada) or 952.917.3748 Fax: 952.917.3237 Email: repair&return@adc.com	• ADC Return Material Authorization (RMA) number and instructions must be obtained before returning products.
All 800 lines are toll-free in the USA and Canada.	

APPENDIX C: ABBREVIATIONS

2B1Q	2 Binary 1 Quaternary
AIS	Alarm Indication Signal
ALM	Alarm
ALMP	Alarm Pattern
AMI	Alternate Mark Inversion
AWG	American Wire Gauge
B8ZS	Bipolar with 8-zero Substitution
BRG	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
dB	Decibel
DCE	Data Communications Equipment
DIS	Disable
DL	Data Link
DLC	Data Link Control

DS0	Digital Signal Level 0
DS-1	Digital Service Level 1
DSX-1	Digital System Cross-Connect Frame
DTE	Data Terminal Equipment
ENA	Enable
ES	Errored Seconds
ESF	Extended Super Frame
ESF-DL	Extended Super Frame-Data Link
FDL	Facility Data Link
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	Current-Customer Premises Equipment
LPBK	Loopback
LCD	Liquid Crystal Display
LOS	Loss of Signal
LOSW	Loss of Sync Word
LEV	Level
NI	Network Interface
NREM	Network Remote Loopback
NVRAM	Non-Volatile Random Access Memory
POTS	Plain Old Telephone Service
RCV	Receive

RDA   Remote DS-1 Alarm

REC LEV   Receive Level

RLOS   Remote Loss of Signal

SAIS   SmartJack AIS

SF   Super Frame

SPLB   Special Loopback

TEC   Total Error Count

TSEC   Total System Error Count

TSGR   Transport System Generic Requirements

UAS   Unavailable Seconds

UL   Underwriters Laboratory

XMT   Transmit

ZBTSI   Zero Byte Time Slot Interchange

CERTIFICATION AND WARRANTY

FCC COMPLIANCE

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

UL LISTING

The HRU-402 List 1A are listed with the Underwriter Laboratory.

Use caution when installing or modifying telephone lines. Dangerous voltages may be present. Do not install telephone wiring during a lightning storm. Always disconnect telephone lines and power connections from wall outlets before servicing or disassembling this equipment.

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

WARRANTY

ADC DSL Systems, Incorporated ("ADC") warrants that, for a period of sixty (60) months from the date of shipment, the hardware portion of its products will be free of material defects and faulty workmanship under normal use. ADC's obligation, under this warranty, is limited to replacing or repairing, at ADC's option, any such hardware product which is returned during the 12-month warranty period per ADC's instructions and which product is confirmed by ADC not to comply with the foregoing warranty.

ADC warrants that, for a period of 90 days from the date of purchase, the software furnished with its products will operate substantially in accordance with the ADC published specifications and documentation for such software. ADC's entire liability for software that does not comply with the foregoing warranty and is reported to ADC during the 90-day warranty period is, at ADC's option, either (a) return of the price paid or (b) repair or replace of the software. ADC also warrants that, for a period of thirty (30) days from the date of purchase, the media on which software is stored will be free from material defects under normal use. ADC will replace defective media at no charge if it is returned to ADC during the 30-day warranty period along with proof of the date of shipment.

The transportation charges for shipment of returned products to ADC will be prepaid by the Buyer. ADC will pay transportation charges for shipment of replacement products to Buyer, unless no trouble is found (NTF), in which case the Buyer will pay transportation charges.

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

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

ADC DISCLAIMS ALL OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WITH RESPECT TO ITS PRODUCTS AND ANY ACCOMPANYING WRITTEN MATERIALS. FURTHER, ADC DOES NOT WARRANT THAT SOFTWARE WILL BE FREE FROM BUGS OR THAT ITS USE WILL BE UNINTERRUPTED OR REGARDING THE USE, OR THE RESULTS OF THE USE, OF THE SOFTWARE IN TERMS OF CORRECTNESS, ACCURACY, RELIABILITY OR OTHERWISE.

MODIFICATIONS

Any changes or modifications made to this device that are not expressly approved by ADC DSL Systems, Inc. voids the user's warranty.

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

ADC DSL Systems, Inc.

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Tustin, CA 92780-7013
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Fax: 714.832.9924

Technical Assistance

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