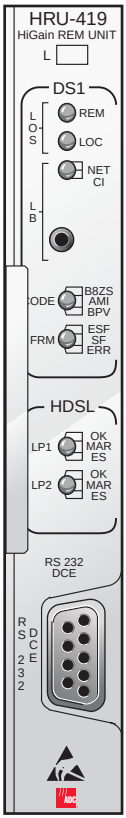
USER MANUAL



HRU-419 HiGain Remote Unit
Product Catalog: 150-419-100-03
CLEI: T1L2CCLAAA

Revision History of This Manual

To order copies of this manual, use document catalog number 150-419-100-03.

Issue	Release Date	Revisions Made
1	July 21, 1997	Initial release
2	September 25, 1998	Update revision
3	February 25, 2003	ADC rebrand

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USING THIS MANUAL

The following conventions are used in this manual:

- `Monospace type` indicates screen text.
- Keys you press are indicated by small icons such as Y or ENTER. Key combinations to be pressed simultaneously are indicated with a plus sign as follows: CTRL + ESC.
- Items you select are in **bold**.

The following types of messages are conveyed by icons:

Notes provide information about special circumstances.

Genenral cautions indicate the possibility of personal injury, product failure, or equipment damage if instructions are ignored or not completely followed.

An Electrostatic Discharge (ESD) caution indicates that a device or assembly is susceptible to damage from electrostatic discharge.

An electrical shock caution indicates the presence of a dangerous level of electrical power and the potential for serious personal injury or equipment damage.

A laser caution indicates the potential for permanent eye damage or blindness due to direct exposure to laser beams.

For a list of abbreviations used in this document, refer to “Appendix B-Abbreviations” on page 51.

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

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OVERVIEW

The ADC® HiGain® HRU-419 List 1 Remote Unit (HRU), is the remote end of a repeaterless T1 transmission system. When used with any HiGain Line Unit (HLU) or HiGain Doubler Unit (HDU) the HiGain system provides 1.544 Mbps on two unconditioned copper pairs over the full Carrier Service Area (CSA) range. The HRU-419 mounts on a STS-3192 High Density shelf or in an equivalent remote enclosure manufactured by ADC Telecommunications.

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

The HiGain system uses HDSL transmission technology as recommended by Bellcore TA-TSY-001210. The HRU-419 complies with: ANSI T1E1.4, T1.403-1989 and 1995, and T1E1.4/92-00R2R technical standards and recommendations. The system also complies with TR-TSY-000063 Network Equipment Building System (NEBS) Generic Equipment requirements, TR-TSY-000499 Transport System Generic Requirements (TSGR) common requirements, and TR-TSY-000312 Functional Criteria for DSX-1 Interface Connection.

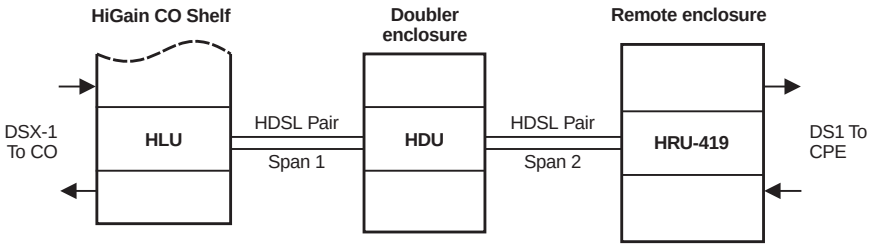

Figure 1. *Typical HiGain System*

FEATURES

- DS1 and HDSL status LEDs
- HDSL margin threshold indicator
- RS-232 Craft port for connection to a maintenance terminal
- ANSI T1.403 DS1 Customer Interface (CI)
- Generic and addressable repeater loopback activation codes
- Metallic SmartJack loopback.
- Provisioning switches for Customer Premises Equipment (CPE) current, Receive (RCV) Level and XMT LOS (TLOS) initiated loopback and Alarm Indication Signal (AIS)
- Line or local power options
- Optional sealing current
- Supports three-span line powering
- CPE current monitor test points available on PC board
- Lightning and power cross protection on HDSL and DS1 interfaces
- 784 kbps full-duplex 2-Bits–1–Quaternary (2B1Q) HDSL Transmission on two pairs
- DS0 blocking
- Conforms to High-density 3192 STS mechanics

The HRU-419 is an HRU-419 List 8 unit for STS-3192 High-density mechanics. However, the HRU-419 List 1 does not support the following HRU-419 List 8 features:

- Front Panel DS1 Test Jacks
- Protection switching
- Front panel CPE current monitor

APPLICATIONS

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

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

The HiGain systems can:

- operate with any number of other T1, Plain Old Telephone Service (POTS), or other HiGain systems sharing the same cable binder group.
- 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.
- easily be installed allowing service to be provided within hours. Fiber optic systems can be installed at a leisurely pace and cut-over from the installed HiGain system when convenient to do so. The installed HiGain system can then be easily removed and utilized elsewhere.

Table 1. *HDSL Loss Over Cables*

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

FRONT PANEL

Figure 2 shows the HRU-419 front panel components. Table 3 describes the functions of the front panel components and Table 4 describes the status conditions indicated by the LEDs.

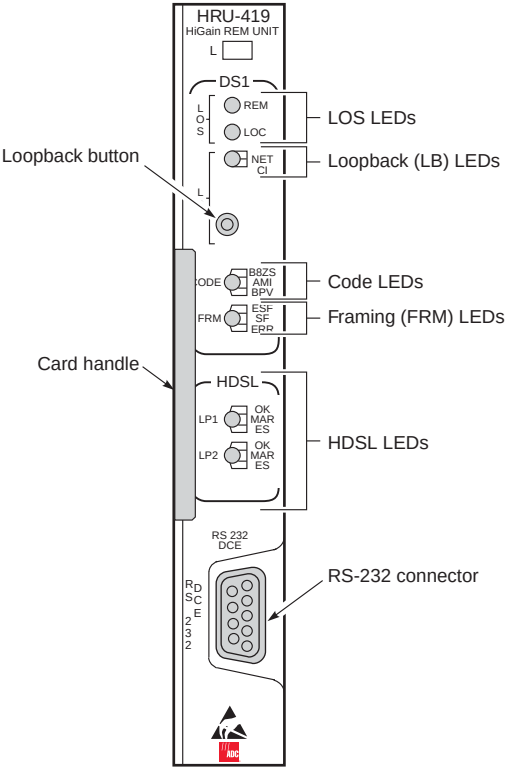

Figure 2. *HRU-419 Front Panel*

Table 2. *HRU-419 Front Panel Components*

Name	Function
LOS LEDs	Show Loss of Signal (LOS) alarm states (see Table 3 on page 6 and Table 4 on page 7).
Loopback LEDs	Show loopback states (see Table 3 on page 6 and Table 4 on page 7).
Loopback button	Provides the ability to perform loopback test procedures (see “Using the Loopback (LB) Button” on page 46.
Code LEDs	Provide indications for line code options (see Table 3 on page 6 and Table 4 on page 7).
Framing LEDs	Provides indications for framing patterns (see Table 3 on page 6 and Table 4 on page 7).
HDSL LEDs	Display HDSL Loop 1 and Loop 2 Conditions (see Table 3 on page 6 and Table 4 on page 7).
Card Handle	Used to insert and remove the HRU-419 from the card shelf.
RS-232 Craft port	Configured as data circuit-terminating equipment (DCE) which allows you to control the HRU-419 through a maintenance terminal (or a PC with terminal emulation software).

Table 3. *HRU-419 Front Panel Component Functions*

Name	Function
LOS LEDs	Remote and Local Loss Of Signal (LOS).
REM LOS	Displays remote (REM) LOS.
LOC LOS	Displays local (LOC) LOS.
LB LEDs	Loopback to/from the NET (Network) and to/from the CI.
NET	Displays NET loopback state.
CI	Displays CI loopback state.
Loopback (LB)	Activates the remote unit metallic loopback state by pressing the button for five (5) seconds. The unit can be unlooped by either pressing the button again for five seconds or through the standard loopdown coded messages.
CODE LEDs	Indications for line code options.
B8ZS	Indicates that the DS1 line code option is set to Bidirectional 8-Zero Substitution (B8ZS).
AMI	Indicates that the user DS1 line code option is set to Alternate Mark Inversion (AMI).
BPV	Indicates that a Bipolar Violation (BPV) is received at the remote's DS1 input.
FRM LEDs	Indications for framing patterns.
ESF	Displays ESF framing.
SF	Displays SF framing.
ERR	Framing error.
HDSL LEDs	Display HDSL Loop 1 and Loop 2 conditions
LP1 (Loop 1)	
OK	Display synchronization state for HDSL Loop 1.
MAR	Indicates that the Signal-to-Noise (S/N) margin has dropped below the margin threshold value.
ES	Indicates at least one HDSL Cyclic Redundancy Check (CRC) error is detected from the upstream module.
LP2 (Loop 2)	
OK	Displays synchronization state for HDSL Loop 2.
MAR	Indicates that the S/N margin has dropped below the margin threshold value.
ES	Indicates at least one HDSL CRC error is detected from the upstream module.
RS-232 Craft port	Provides bi-directional 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.

Table 4. *Reading the HRU-419 Front Panel LEDs*

Name		Description
REM LOS		
	On	Lights red when the LOS is detected at the T1 input to the remote HLU unit. This condition causes the HRU to transmit the AIS pattern towards the CPE.
	Off	Normal transmission of data.
LOC LOS		
	On	Lights red when the LOS is detected at the T1 input to the local HRU. This condition causes an AIS-CI signal to be transmitted towards the customer and an AIS-CI signal to be sent to the DSX-1 from the HLU. This state is not sent to the HLU and does not register an LOS ALRM condition.
	Off	Normal transmission of data.
NET		
	On	Lights green when the HRU is in a loopback state in which the signal from the NET is being looped back to the NET.
	Off	No NET loopbacks are active.
CI		
	On	Lights yellow when the HRU is in a loopback state when the signal from the CI is being looped back to the CI.
	Off	No CI loopbacks are active.
B8ZS		Lights green when DS1 line code option set to B8ZS. If the user DS1 line code option is set to Auto, LED indicates that the code of the DS1 signal being received at the HRUs DS1 input is B8ZS.
AMI		Lights yellow when DS1 line code option set to AMI. If the user DS1 line code option is set to Auto, LED indicates that the code of the DS1 signal being received at the HRUs DS1 input is AMI.
BPV		Blinks red every time a BPV, other than those associated with a B8ZS code, is received at the HRU DS1 input.
ESF		Blinks green when the framing pattern of the signal being received at the HRU DS1 input is ESF.
SF		Blinks yellow when the framing pattern of the signal being received at the HRU DS1 input is SF.
ERR		Lights red when a DS1 frame error has occurred.

Table 4. *Reading the HRU-419 Front Panel LEDs (Cont.)*

Name	Description
LP1	Blinks green when HDSL Loop 1 is synchronizing with the HLU.
OK	Lights green when HDSL Loop 1 is synchronized and ready to receive and transmit data.
MAR	Blinks yellow when a problem in Loop 1 (doubler applications only) of the HDSL cable pairs that are non-adjacent to the HRU. Blinking once per second indicates a Loss of Sync Word (LOSW) problem in Span all ones Loop 1 HDSL pair between the HLU and doubler. Blinking twice per second indicates a LOSW problem in Span two's Loop 1 HDSL pair between the first and second doublers.
ES	Blinks red every second when one HDSL CRC error is detected on Loop 1 from the upstream module.
LP2	Blinks green when HDSL Loop 2 is synchronizing with the HLU.
OK	Lights green when HDSL Loop 2 is synchronized and ready to receive and transmit data.
MAR	Blinks yellow when a problem in Loop 2 (doubler applications only) of the HDSL cable pairs that are non-adjacent to the HRU. Blinking once per second indicates a LOSW problem in Span two's Loop 2 HDSL pair between the HLU and doubler. Blinking twice per second indicates a LOSW problem in Span 2s Loop 2 HDSL pair between the first and second doublers.
ES	Blinks red every second in which at least one HDSL CRC error is detected on Loop 2 from the upstream module.

COMPATIBILITY

The HRU-419 is compatible with the following shelves and mounting hardware listed in Table 5.

Table 5. *HRU-419 Shelf and Mounting Hardware Compatibility*

Manufacturer	Description
Charles Industries	# 3192 (28 slot connectorized)
Charles Industries	# 3192-9F Alarm Card
Larus	# 1185 (28 slot connectorized)
Larus	# 1184 Alarm Card
Charles Industries	#3192-WR (28 slot wire wrap)
Charles Industries	#343-00 (12-14 slot wire wrap)
Charles Industries	#319-02 (22 slot connectorized)
Charles Industries	#319-04 (22 slot wire wrap)
Charles Industries	#340-00 (9-11 slot wire wrap)
ADC HMS-318	22-slot, 19-inch shelf
ADC HHS-319	Three-slot, 19-inch horizontal shelf
ADC HMS-317	28-slot, 23-inch shelf
ADC HMS-308	Eight-slot remote enclosure
ADC HCS-402	Two-slot portable enclosure

LOCAL AND LINE POWERING

The HRU-419 unit can be line or local powered. The unit always uses the local -48 V power source if it is present, and defaults to line power in the absence of local power. List 6 and higher versions of the HLU-231, and all versions of the HLU-319 and HLU-388, and versions 6.4 and above of the HLU-231 List 1, 2, 3, 3A and 4 units automatically turn off their line power supply when connected to a locally powered HRU-419. The earlier versions of the HLU-231 (Lists 1, 2, 3, 3A and 4) must first have their PWRF user option set to *disable to work properly with a locally powered HRU-419.*

When locally powered, the HRU-419 also provides from 20 mA (long loop) to 30 mA (short loop) of simplex sealing current towards all versions of the HLU over the 2 HDSL pairs. Jumper JP1, shown in Figure 7 on page 17, allows the sealing current to be enabled or disabled (see“The HRU-419 Circuit Board” on page 16).

This simplexed sealing current is polarity sensitive and will not flow if the two HDSL loops adjacent to the HRU are reversed.

Reversed loops are indicated by a CHREV message in the "Alarms" field of the Span Status screen shown in “View Span Status” on page 24.

The simplex sealing current is not compatible with the List 1, 2, or 3 HDU-451 doublers. These doublers block the flow of simplexed sealing current. The HDU-451 List 4, the HDU-437 or the HDU-439 must be used with the HRU-419 to provide a path through which the simplexed sealing current can flow.

If local power is lost to the HRU in a non-doubler or a single doubler circuit, the system will lose sync. When the HLU or HDU attempts to re-acquire sync, it will detect that the HRU is not locally powered and apply line power to it.

THREE-SPAN LINE POWERING

The HRU-419 can be used with the following line units and doublers for three-span line powering applications:

- Line units: HLU-231 List 7D and 7B. HLU-431 List 1D
- Doublers: HDU-437 List 1, HDU-439 List 1

Three-span line powered circuits must have no more than 2000 Ω of total loop resistance.

For further information see the *HiGain Mini Doublers, Model HDU-437 and HDU-439, technical practice.*

INSTALLATION

This section provides information on inspection and installation of the HRU-419.

INSPECTING YOUR SHIPMENT

When you receive the equipment, inspect it for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to ADC.

Your shipment should consist of:

- One HRU-419 List 1
- This document

INSTALLING THE HRU-419

The HRU-419 mounts in an STS-3192 High Density shelf or in equivalent card shelves manufactured by ADC Telecommunications (HHS-319, HMS-317 and HMS-308).

To install the HRU-419 (Figure 3), Set the user options as described in the following:

1 Slide the HRU-419 into the card guides for the desired slot, then push the unit into the enclosure until it touches the backplane card edge connector.

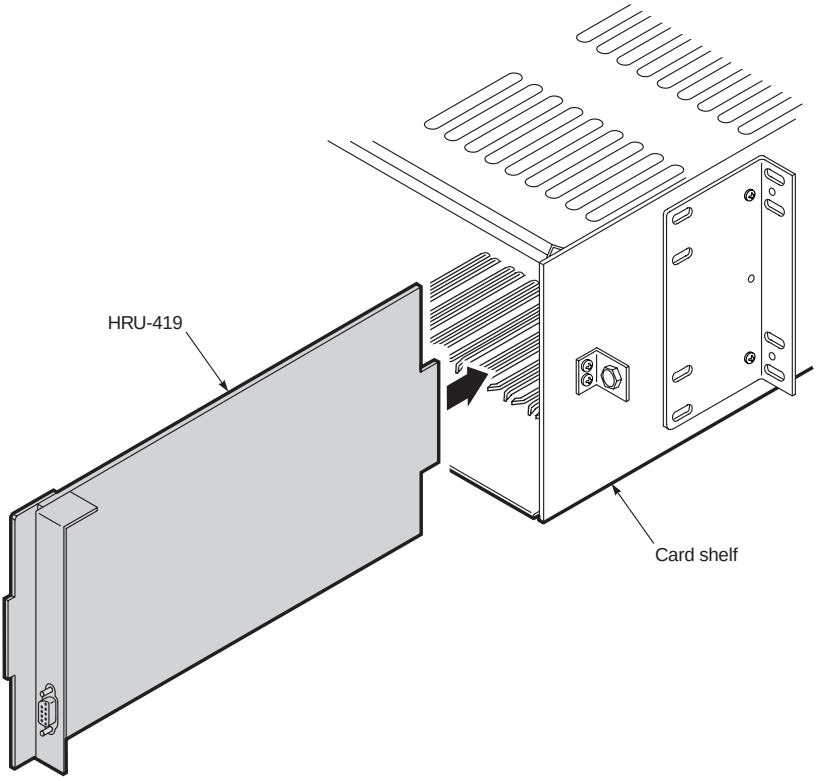

Figure 3. *HRU-419 Installed in a Card Shelf*

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

CONNECTING TO A MAINTENANCE TERMINAL

The 9-pin RS-232 connector on the front of the HRU-419 allows you to connect your system to a maintenance terminal or PC running a terminal emulation program with a standard RS-232 cable. Once connected to a maintenance terminal, you can access the view-only Maintenance and Remote Terminal menus (the Set Clock option is the only user-configurable option on the HRU-419). Figure 4 shows the HRU-419 DB-9 RS-232 I/O.

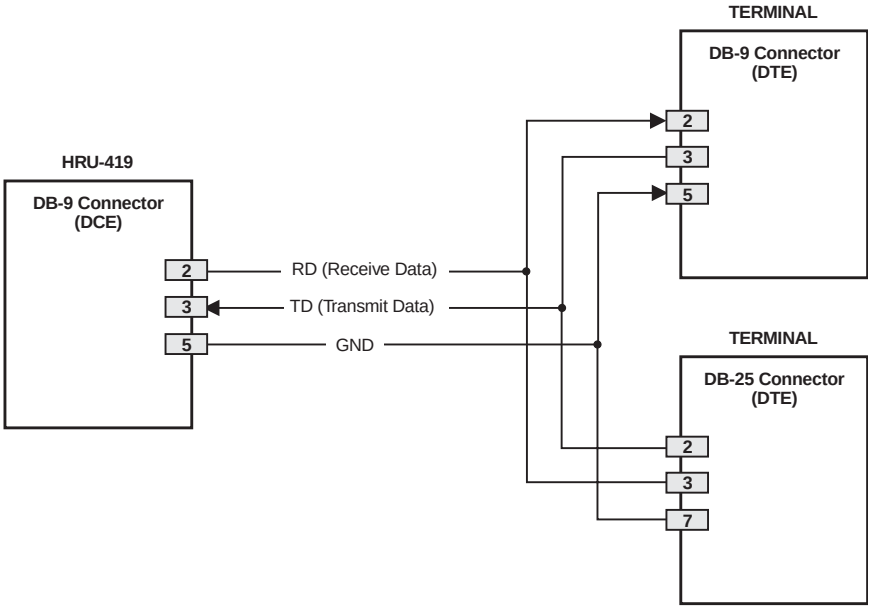

Figure 4. *DB-9 RS-232 I/O*

The maintenance terminal is configured as DTE. To connect the HRU-419 to a maintenance terminal, connect the RS-232 port of the maintenance terminal to the HRU-419 front-panel Craft port using a serial interface cable (Figure 5).

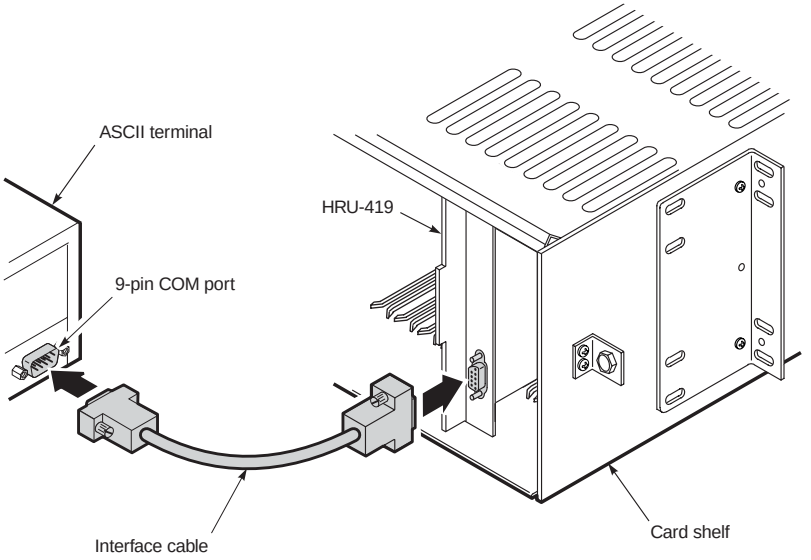

Figure 5. *Connecting the HRU-419 to a Maintenance Terminal*

CARD EDGE PINOUT CONNECTOR

The HRU-419 card edge connector pinout orientation is shown in Figure 6. Table 6 provides the card edge connector pinouts.

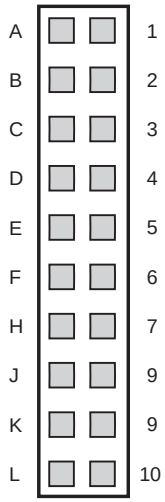

Figure 6. *HRU-419 Card Edge Connector Pinout*

Table 6. *HRU-419 Card Edge Connector Pinouts*

Pin (*)	Signal	Description	Pin (*)	Signal	Description
A	DS1_T_TIP	DS1 Transmit Tip	1	DS1_T_RING	DS1 Transmit Ring
B	DS1_R_TIP	DS1 Receive Tip 1	2	DS1_R_RING	DS1 Receive Ring
E			5	CIRCUIT GND	Circuit Ground
F	HDSL_TIP_A	HDSL Loop 1 (Tip1)	6	HDSL_RING_A	HDSL Loop 1 (Ring1)
J	CHASSIS_GND	Chassis Ground	8	EXT -48V	-48 V External Power
K	HDSL_TIP_B	HDSL Loop 2 (Tip)	9	HDSL_RING_B	HDSL Loop 2 (Ring)

(*)All other pins are not used.

THE HRU-419 CIRCUIT BOARD

The HRU-419 has four user options located on the circuit board, three that are set using two-position switches (JP2, JP3 and JP4), and one set by the connection and positioning of a jumper block header (JP1) as shown in Figure 7 on page 17.

The HiGain system also has several special loopback (SPLB) options that are set at the HLU. Refer to the specific HiGain line unit technical practice for more details.

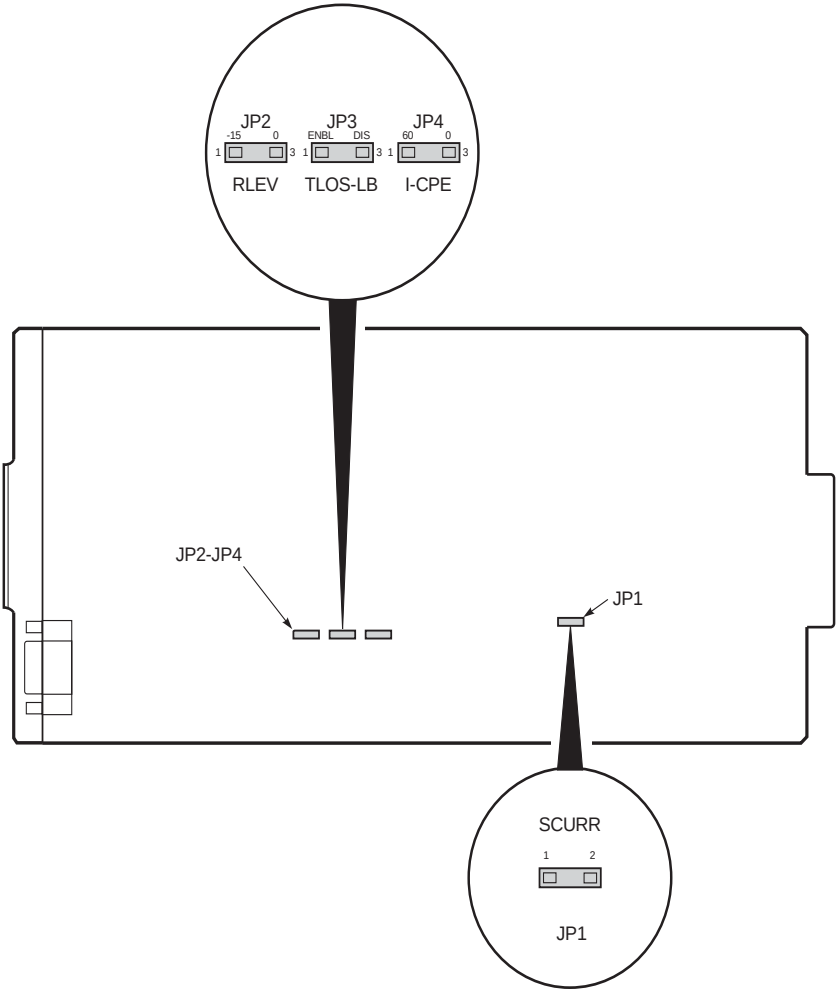

Figure 7. *HRU-419 Circuit Board Connections for User Options*

Sealing Current (SCURR-JP1). The two-prong male JP1 jumper allows you to disable or enable the sealing current. The default is disable. To set the sealing current, do one of the following:

- To enable the sealing current, connect JP1 across both terminals using the supplied female jumper block header.
- To disable the sealing current, remove the jumper block header from both terminals and insert it on the outer terminal for future use.

This simplexed sealing current is polarity sensitive and will not flow if the two 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 shown in Figure 8.

RLEV (JP2). The RLEV switch (JP2) allows you to control the configuration of the T1 Receive Level (RLEV). The default is 0. Setting RLEV to 0 configures the T1 output signal level from the HRU towards the Network Interface (NI) to 0 dB. This setting is recommended when the HRU does not function as the NID but is connected to an external NID, as it allows the external NID to set the appropriate NI level. Setting RLEV to -15 configures the T1 RLEV to -15 dB, and sets the T1 output signal level from the HRU towards the NI level to -15 dB. This setting is recommended when the HRU functions as the NID. To set the RLEV do one of the following:

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

TLOS-LB (JP3). The TLOS-LB switch allows you to enable or disable the configuration of the TLOS loopback. If you set TLOS-LB to disable prior to entering a loopback state, a loss of the T1 XMT signal from the CPE causes the HLU to transmit the AIS signal towards the DSX-1, and prevents the HRU from entering its logic loopback state.

The TLOS option must never be set to enable when the HRU-419 is used with old line units that do not support this feature. These older line units (List numbers lower than 6) cannot loopdown an HRU that is in a TLOS loop-up state when they receive the 2-in 5-in-band loopdown command.

If you set the TLOS-LB switch to enable prior to entering a loopback state, the HRU transmits the AIS signal towards the CPE and returns the network signal back to the network. The HLU displays the message "TLOS" in its four-character front panel LCD. This condition remains until a valid T1 signal is received from the CPE or until the 3-in 5- in-band loopdown command is issued. Once the TLOS-initiated loopback has occurred, it cannot reoccur until the CPE T1 signal has been reapplied and then removed. This "latching" feature prevents the HRU from oscillating into and out of TLOS loopback when a loopdown command is issued in the absence of a T1 signal from the CPE. To set the TLOS-LB, do one of the following:

- To enable the TLOS-LB, move the switch to ENA.
- To disable *the TLOS-LB, move the switch to* DIS.

I-CPE (JP4). The I-CPE switch allows you control the current settings for the interface at the customer premises equipment. The default is 0. To set the I-CPE, do one of the following:

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

THE MAINTENANCE AND REMOTE TERMINAL

This section covers both the Maintenance Terminal menus (for non-doubler applications) and the Remote Terminal menus (for doubler applications). The screens for either application are identical, except for the Set Clock option which is set from the Maintenance Terminal menu only. After you have connected the HRU-419 to a maintenance terminal, you must configure the maintenance terminal to the following communication settings.

- 1200 to 9600 baud (9600 baud is recommended)
- No parity
- 8 data bits
- 1 stop bit
- Hardware Flow Control set to None
- VT Terminal Emulation

To use 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.

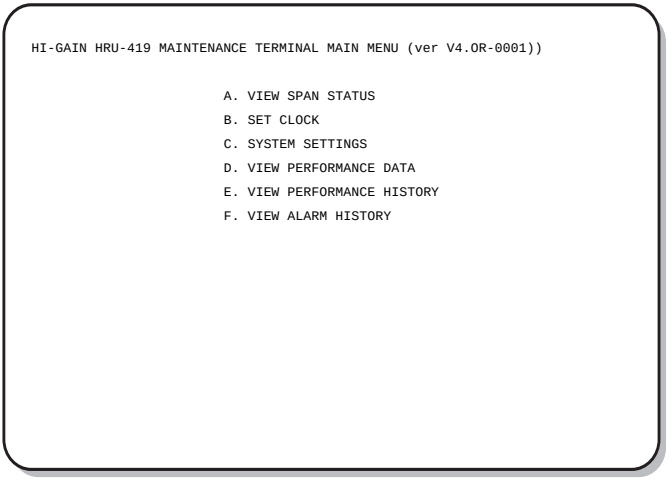

Figure 8. *Maintenance Terminal Main Menu*

A hidden "G" selection is available from the Maintenance Terminal Main menu if you are using an HLU-231 List 7B unit in your circuit. A “G” selection causes the Remote Log-in screen to appear. By selecting this option, the terminal is then directly connected to the HLU, thus permitting you to set system options which are view-only at the HRU-419.

Doubler Applications. The Remote Terminal Log-in menu displays for doubler applications. Press the **SPACEBAR** several times to initiate the RS-232 connection, then press **ENTER** to view the Remote Terminal Main menu. The following two screens display respectively.

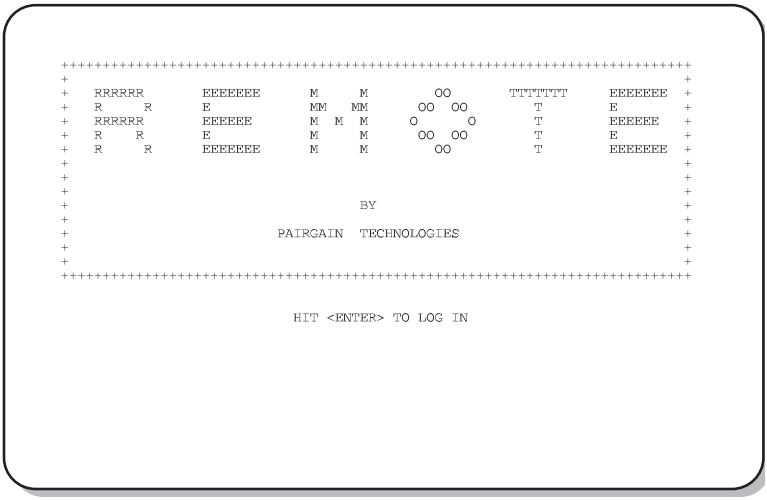

Figure 9. *Remote Terminal Log in Screen*

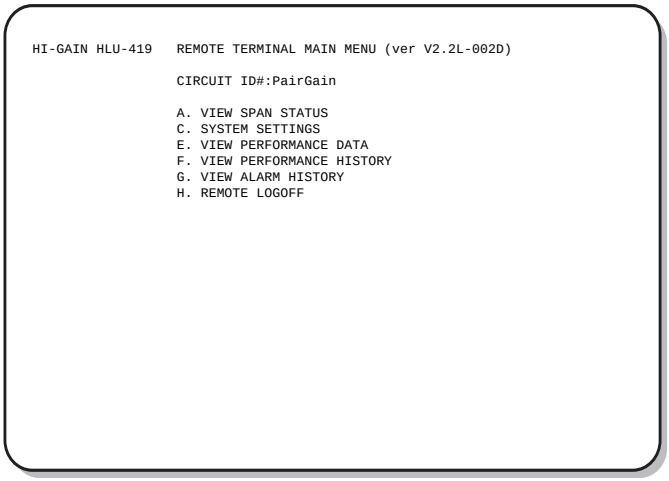

Figure 10. *Remote Terminal Main Menu*

Navigating the Maintenance and Remote Terminal menus.

Table 7 describes the navigational keys for the Maintenance and Remote Terminal menus.

Table 7. *Maintenance and Remote 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

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

- Press the key indicated to the left of the option.
- Press the letter of the option name shown in parenthesis.

MAINTENANCE AND REMOTE TERMINAL

The Maintenance and Remote terminal menus have five view-only performance screens for viewing system performance. Table 8 describes the function of each screen.

Table 8. *Maintenance and Remote Terminal Menus*

Screen	Function
View Span Status	Allows you to monitor the HDSL line between the HLU and the HRU-419 span (non-doubler applications), and the HLU, HDU and HRU-419, Spans 1 and 2 (for one doubler applications), and Spans 1, 2 and 3 (for two doubler applications).
Set Clock*	Allows you to set both the time and the date parameters at the HLU, and to update the same settings at the HRU-419.
System Settings	Allows you to view all system settings.
View Performance Data	Allows you to view the Errored Seconds (ES) and Unavailable Seconds (UAS) between the HLU and the HRU-419 span (non-doubler applications), and the available spans (doubler applications) in 15-minute intervals over a four-hour time period.
View Performance History	Allows you to view the ES and UAS between the HLU and the HRU-419 span (non-doubler applications) and the available spans (doubler applications) in 24-hour intervals over a seven-day period.
View Alarm History	Allows you to view alarm conditions between the HLU and the HRU-419 span (non-doubler applications) and the available spans (doubler applications).

(*) Set from the Maintenance Terminal menu only

After the maintenance terminal has been properly configured, you can press the **SPACEBAR** several times to invoke the autobaud feature. Based on your configuration, one of the following two screens display.

Non-Doubler Applications. The Maintenance Terminal Main menu displays for non-doubler applications. Press the **SPACEBAR** several times to initiate the RS-232 Craft port.

View Span Status

The View Span Status screen allows you to view the system status from the HLU to the HRU-419. The screen shows information about the HDSL Loops 1 and 2 and the DS1 (for non-doubler applications). For doubler applications, the available Span Status screens are dependent upon whether there are one or two doublers.

Press **A** from the Maintenance Terminal Main menu to open the View Span Status screen:

```
                                SPAN STATUS
                        HLU/ver0.0-0000:HRU/ver4.0-0FF)

TIME: 05:25:24                  SPAN STATUS
DATE: 06/18/97                  Circuit ID#:
ALARMS:   NONE
LOOPBACK: OFF

                           HLU                         HRU
                      HDSL-1       HDSL-2       HDSL-1       HDSL-2
                  cur/min/max  cur/min/max  cur/min/max  cur/min/max

MARGIN:               N/A          N/A          N/A        N/A    dB
PULSE ATTN:           N/A          N/A          N/A        N/A    dB
PPM OFFSET:           N/A          N/A          N/A        N/A    dB
24 HOUR ES:         00003        00003        00005      00006  seconds
24 HOUR UAS:        00000        00000        09613      09642  seconds
                                DS1 STATUS

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


                      (E)xit       (U)pdate
```

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

You can do the following:

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

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

Press **A** from the Remote Terminal Main Menu to view the Span Status screen for single doubler applications:

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.

One Doubler, Span 2 Status: For one doubler configurations, Span 2 is the span between the first doubler (HDU1) and the HRU-419. Press **S** to view the Span 2 Status screen:

You can do the following:

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

Two Doublers, Span 3 Status. For two doubler configurations, Span 3 is the span between the second doubler (HDU2) and the HRU-419. Press **S** to view the Span 3 Status screen:

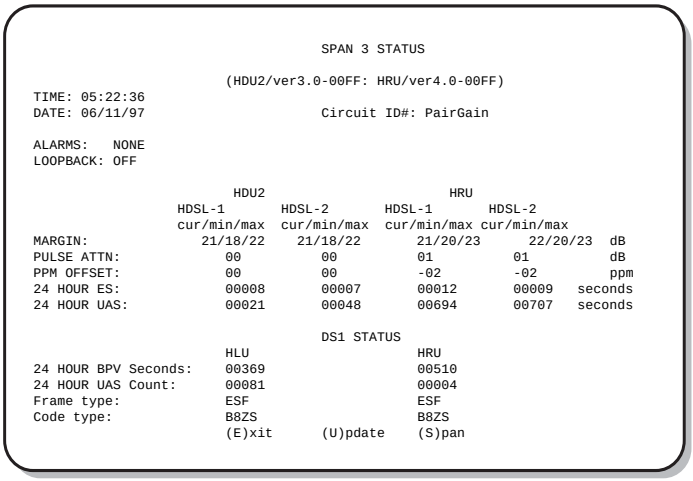

Figure 12. *Span 3 Status for Two Doublers Application*

You can do the following:

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

Table 9 lists the Span Status fields and descriptions. Table 10 lists all possible alarms and their descriptions. Table 11 lists all possible loopbacks and their descriptions.

Table 9. *Span Status Fields and Descriptions*

Field	Description
HLU/Ver w.x-y	"w.x" = the software version number of the HLU. "y" = List # of the HLU.
HRU or HDU/w.x-y	“w.x” = the software version number of the HRU or HDU. “y” = List # of the HRU or HDU.
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. Table 11.
Margins	Indicates the excess signal to noise ratio at either the HLU or HRU, relative to a 10^{-7} Bit Error Rate. First value is current margin. Second value is minimum margin since last cleared. Third value is maximum margin since last cleared. NA indicates 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-419 from the HLUs crystal oscillator. Any value between ± 64 is adequate.
HDSL 24 Hour ES	The number of one-second intervals that contained at least one CRC error. This value is a running total of the last 24 hours.
HDSL 24 Hour UAS	The number of seconds during the last 24 hours the HDSL loop was out of synchronization.
DS1 BPV Seconds (ES)	The number of seconds during the last 24 hours in which at least one bipolar violation was detected on the DS1 input.
DS1 UAS Count	The number of seconds during which the DS1 input signal was absent (125 or more consecutive 0s).
Frame type	Type of DS1 framing used on the input stream (SF, ESF, Unframed or No Activity).
Code type	Type of DS1 line coding used (AMI, B8ZS, AMI: ZBTSI or B8ZS: ZBTSI). The latter two conditions indicate the code type that is being received when HiGain is set to its ZBTS mode. In either the AMI or B8ZS DS1 code mode, it displays the selected code as opposed to the code type that is actually being received.

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

Table 10. *HRU-419 Alarm Field Messages and Descriptions*

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

Table 11. *HRU-419 Loopback Field Messages and Descriptions*

Message	Full Name	Description
TLOS	Transmit Loss of Signal	HRU logic loopback initiated by a loss of the T1 input from the CI.
SMJK	SmartJack Loopback	Loopback at HRU towards network initiated by 2-in 5-in-band loopback code or out-of-band ESF data link code when *SMJK* is enabled.
NREM	Network Remote Loopback	Loopback at HRU (remote) towards network initiated from CO (network) by intelligent line repeater #1 code, HRU front panel loopback button or maintenance terminal.
NLOC	Network Local Loopback	Loopback at HLU (local) towards network initiated from CO (network) by intelligent office repeater code or by pressing both the HLU Mode and Sel front panel pushbuttons.
CLOC	Customer Local Loopback	Loopback at HRU (local) towards CI initiated from CPE (customer) by intelligent line repeater #1 code.
CREM	Customer Remote Loopback	Loopback at HLU (remote) towards customer initiated from CPE (customer) by intelligent office repeater code.
ARM	Armed	HiGain has detected the intelligent repeater loopback (2 in 5) arming code.
NDU1	Network Doubler 1 Loopback	Loopback at first doubler towards network initiated by HLU.
CDU 1	Customer Doubler 1 Loopback	Loopback at first doubler towards CI initiated by HLU.
NDU2	Network Doubler 2 Loopback	Loopback at second doubler towards network initiated by HLU.
CDU 2	Customer Doubler 2 Loopback	Loopback at second doubler towards CI initiated by HLU.

Set Clock

Press **B** from the Maintenance Terminal Main menu to open the Set Clock menu:

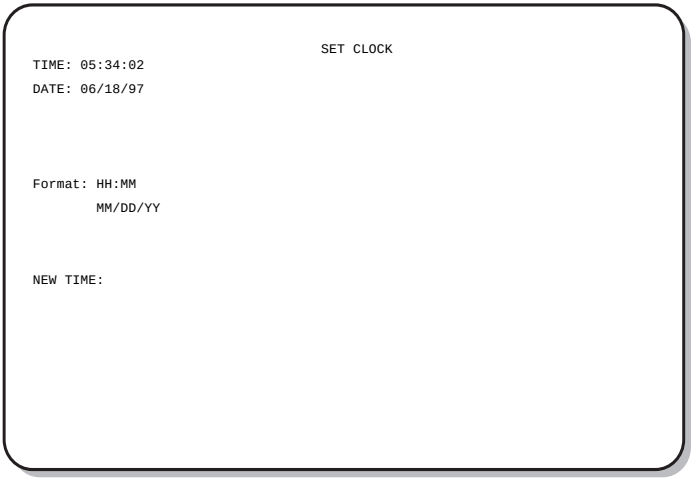

Figure 13. *Set Clock Menu*

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

The New Date field displays.

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

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

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

System Settings

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

Press **C** from either the Maintenance Terminal Main Menu or the Remote Terminal Main menu to view the System Settings screen.

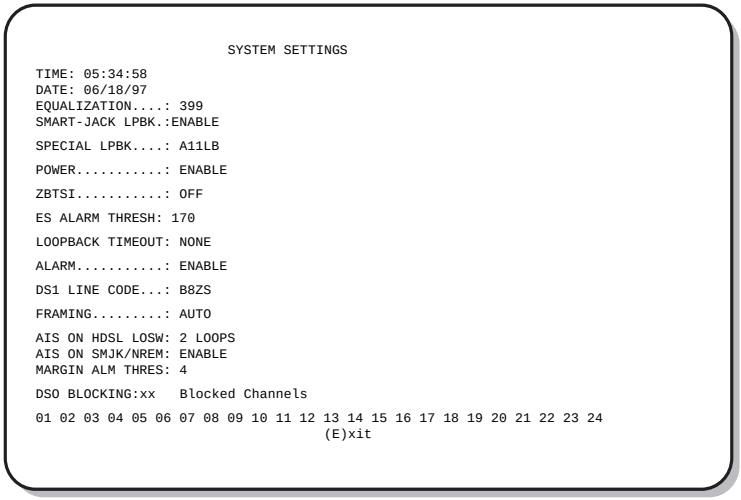

Figure 14. *System Settings Screen*

Table 12 lists the System Settings fields and descriptions.

Table 12. *System Settings Fields and Descriptions*

Field	Description
Time	Time of day when System Settings were checked.
Date	Date when System Settings were checked.
Equalization	Indicates settings for equalizer of either 0 (DSX-1 for 0-133 ft), 133 (DSX-1 for 133-266 ft), 266 (DSX-1 for 266-399 ft), 399 (DSX-1 399-533 ft), 533 DSX-1 for 533-655 ft).
SmartJack LB	Indicates settings of either ENA or DIS for SmartJack loopback: where signal from DSX is looped back at the HRU by the HRU SmartJack module.
Special LBPK	Indicates the special loopback settings of either: Generic loopback (GNLB), where the HiGain system responds to the generic (3/4 in 7) in-band loopback codes, or A1LB and A2LB, A3LB, A4LB, or A5LB.
Power	Indicates whether power feed to the HRU-419 from the HLU is either enabled or disabled.
ZBTSI	Indicates whether ZBTS is either On or Off. An On setting tells the system that the ESF frame is operating in its Zero Byte Time Slot Interface (ZBTSI) mode. An Off setting tells the system that the ESF frame is operating in its normal non-ZBTSI mode.
ES Alarm THRES	Indicates whether the ESAL threshold is set to either: None, 17 or 170.
Loopback Timeout	Indicates one of four settings: None (disables automatic time-out cancellation of all loopbacks) or a choice of either 20, 60, or 120, which sets automatic cancellation (timeout) of all loopbacks to either 20, 60 or 120 minutes after initiation.
Alarm	Indicates whether alarms are enabled or disabled.
DS1 Line Code	Indicates one of three settings: Auto, B8ZS, or AMI.
Framing	Indicates whether framing is either Auto or UNFR (unframed).
AIS on HDSL LOSW	Indicates the settings for alarm indication signals on HDSL LOSW on the HDSL loops.
AIS on SMJK/NREM	Indicates settings of either ENA or DIS for alarm indication signals for the SmartJack Network Remote Loopback (NREM).
Margin ALM THRES	Indicates the settings for the margin alarm thresholds.
DS0 Blocking	Indicates status of DS0 blocked channels and identifies the channels that have been blocked (using "xx" symbols underneath each blocked channel). A None setting indicates no channels are blocked. A BLK setting indicates some channels are blocked.

View Performance Data

The View Performance Data screen shows the number of ES and UAS occurrences in 15-minute increments for a 24-hour period. The presentation format is: ES/UAS (Errored Seconds/Unavailable Seconds) for the HLU and the HRU-419 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 whether there are one or two doublers.

Press **D** from the Maintenance Terminal Main menu to view the Performance Data screen for non-doubler applications:

```
Date: 06/18/97          PERFORMANCE DATA
CIRCUIT ID#:
                ERRORED SECONDS/UNAVAILABLE SECONDS
                DS1             HDSL-1          HDSL-2
          HLU       HRU       HLU       HRU       HLU       HRU
01:45     000/000   000/000   000/000   000/000   000/000   000/000
02:00     000/000   000/000   000/000   000/000   000/000   000/000
02:15     000/000   001/000   001/000   001/000   001/000   001/000
02:30     000/000   000/000   000/000   000/000   000/000   000/000
02:45     000/000   000/000   000/000   000/000   000/000   000/000
03:00     000/000   000/000   000/000   000/000   000/000   000/000
03:15     000/000   000/000   000/000   000/000   000/000   000/000
03:45     001/001 003/000   000/000   001/096 000/000   001/096
04:00     000/000   090/000   000/000   000/000   000/000   000/000
04:15     000/000   000/000   000/000   000/000   000/000   000/000
04:30     000/000   001/000   001/000   001/000   001/000   001/000
04:45     000/000   000/000   000/000   000/000   000/000   000/000
05:00     000/000   000/000   000/000   000/000   000/000   000/000
05:15     001/000   058/000   000/000   001/000   000/000   001/000
05:30     000/000   127/000   001/000   001/351 001/000   001/351

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

Figure 15. *Performance Data Screen for Non-Doubler Applicatiions*

- You can do the following:
- Press **P** to view the previous screen.
- Press **N** to view the next screen.
- Press **E** to exit.

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

Press **E** from the Remote Terminal Main menu to view the Span 1 Performance Data screen.

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

                ERRORED SECONDS/UNAVAILABLE SECONDS
                DS1             HDSL-1           HDSL-2
          HLU       HRU       HLU       HRU       HLU       HRU
01:45     000/000   000/000   000/000   000/000   000/000   000/000
02:00     000/000   000/000   000/000   000/000   000/000   000/000
02:15     000/000   001/000   001/000   001/000   001/000   001/000
02:30     000/000   000/000   000/000   000/000   000/000   000/000
02:45     000/000   000/000   000/000   000/000   000/000   000/000
03:00     000/000   000/000   000/000   000/000   000/000   000/000
03:15     000/000   000/000   000/000   000/000   000/000   000/000
03:45     000/000   000/000   000/000   000/000   000/000   000/000
04:00     000/000   090/000   000/000   000/000   000/000   000/000
04:15     000/000   000/000   000/000   000/000   000/000   000/000
04:30     000/000   000/000   000/000   000/000   000/000   000/000
04:45     000/000   000/000   000/000   000/000   000/000   000/000
05:00     000/000   000/000   000/000   000/000   000/000   000/000
05:15     000/000   000/000   000/000   000/000   000/000   000/000
05:30     000/000   000/000   000/000   000/000   000/000   000/000

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

Figure 16. *Span 1 Perfromance Data Screen*

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

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

                ERRORED SECONDS/UNAVAILABLE SECONDS
                DS1             HDSL-1           HDSL-2
          HLU       HRU       HLU       HRU       HLU       HRU
01:45     000/000   000/000   000/000   000/000   000/000   000/000
02:00     000/000   000/000   000/000   000/000   000/000   000/000
02:15     000/000   001/000   001/000   001/000   001/000   001/000
02:30     000/000   000/000   000/000   000/000   000/000   000/000
02:45     000/000   000/000   000/000   000/000   000/000   000/000
03:00     000/000   000/000   000/000   000/000   000/000   000/000
03:15     000/000   000/000   000/000   000/000   000/000   000/000
03:45     000/000   000/000   000/000   000/000   000/000   000/000
04:00     000/000   090/000   000/000   000/000   000/000   000/000
04:15     000/000   000/000   000/000   000/000   000/000   000/000
04:30     000/000   000/000   000/000   000/000   000/000   000/000
04:45     000/000   000/000   000/000   000/000   000/000   000/000
05:00     000/000   000/000   000/000   000/000   000/000   000/000
05:15     000/000   000/000   000/000   000/000   000/000   000/000
05:30     000/000   000/000   000/000   000/000   000/000   000/000

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

Figure 17. *Span 2 Perfromance Data Screen*

Press **S** from the Span 1 Performance Data screen to view the Span 3 Performance Data screen for two doublers.

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

                ERRORED SECONDS/UNAVAILABLE SECONDS
                DS1             HDSL-1           HDSL-2
          HLU       HRU       HLU       HRU       HLU       HRU
01:45     000/000   000/000   000/000   000/000   000/000   000/000
02:00     000/000   000/000   000/000   000/000   000/000   000/000
02:15     000/000   001/000   001/000   001/000   001/000   001/000
02:30     000/000   000/000   000/000   000/000   000/000   000/000
02:45     000/000   000/000   000/000   000/000   000/000   000/000
03:00     000/000   000/000   000/000   000/000   000/000   000/000
03:15     000/000   000/000   000/000   000/000   000/000   000/000
03:45     000/000   000/000   000/000   000/000   000/000   000/000
04:00     000/000   090/000   000/000   000/000   000/000   000/000
04:15     000/000   000/000   000/000   000/000   000/000   000/000
04:30     000/000   000/000   000/000   000/000   000/000   000/000
04:45     000/000   000/000   000/000   000/000   000/000   000/000
05:00     000/000   000/000   000/000   000/000   000/000   000/000
05:15     000/000   000/000   000/000   000/000   000/000   000/000
05:30     000/000   000/000   000/000   000/000   000/000   000/000

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

The presentation format is: ES/UAS for the HLU and the HRU-419 DS1 signal, and ES/UAS for the HLU and HDU1 over both HDSL Loop 1 and HDSL Loop 2.

- You can do the following:
- Press **P** to view the previous screen.
- Press **N** to view the next screen.
- Press **E** to exit.
- Press **S** to view the next available span.

View Performance History

The View Performance History screen shows the number of ES and UAS occurrences in 24-hour increments for a seven-day period. The presentation format is: ES/UAS for the HLU and the HRU-419 DS1 signal, HDSL Loop 1 and HDSL Loop 2 (for non-doubler applications). For doubler applications, the available View Performance History screens displayed are dependent upon whether there are one doubler or two doublers.

Press **E** from the Maintenance Terminal Main menu to open the Performance History screen for non-doubler applications.

```
Time: 05:58:43                        7 DAY HISTORY
CIRCUIT ID#: PairGain
                                      SPAN 3
                            ERRORED SECONDS/UNAVAILABLE SECONDS

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




                                      (E)xit
```

Figure 18. *7 Day History Screen for Non-Doubler Applications*

The HDU 1 (one doubler) and HDU2 (two doublers) appear in the Performance History screen for doubler applications.

Press **F** from the Remote Terminal Main menu to view the Span 1 Performance Data screen for one doubler, Span1 and Span 2 Performance History.

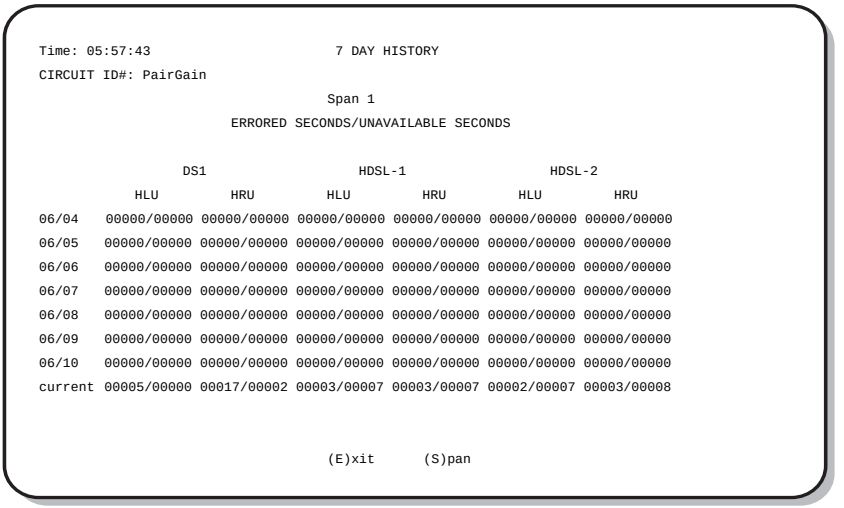

Figure 19. *7 Day History Span 2*

The presentation format is: ES/UAS for the HLU and the HRU-419 DS1 signal, and ES/UAS for the HDU1 and HRU-419 over both HDSL Loop 1 and HDSL Loop 2.

Press **S** again to view the Span 3 Perfromance Data scrren for two doublers, Span 3.

View Alarm History

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

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

```
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
```

Figure 20. *Performance History Screen for Non-doubler Applications*

You can do the following

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

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

Table 13. *Alarm History Fields and Descriptions*

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

Remote Logoff

Press **H** from the Remote Terminal Main Menu to log off the system. The Remote Logoff screen displays indicating that you have logged off the HRU-419.

LOOPBACKS

This section contains information for loopbacks and testing.

Loopbacks allow you to perform isolated diagnostic tests on specific areas of the circuit. The transmitted signal is returned to the sending device after passing through a data communications link or network. This allows you to compare the returned signal with the transmitted signal and to determine if there is a problem with the circuit. Ideally, personnel performing loopback testing are in direct communication with each other in order to correlate messages displayed at both the HRU and HLU during the test. Figure 21 shows the loopback diagram.

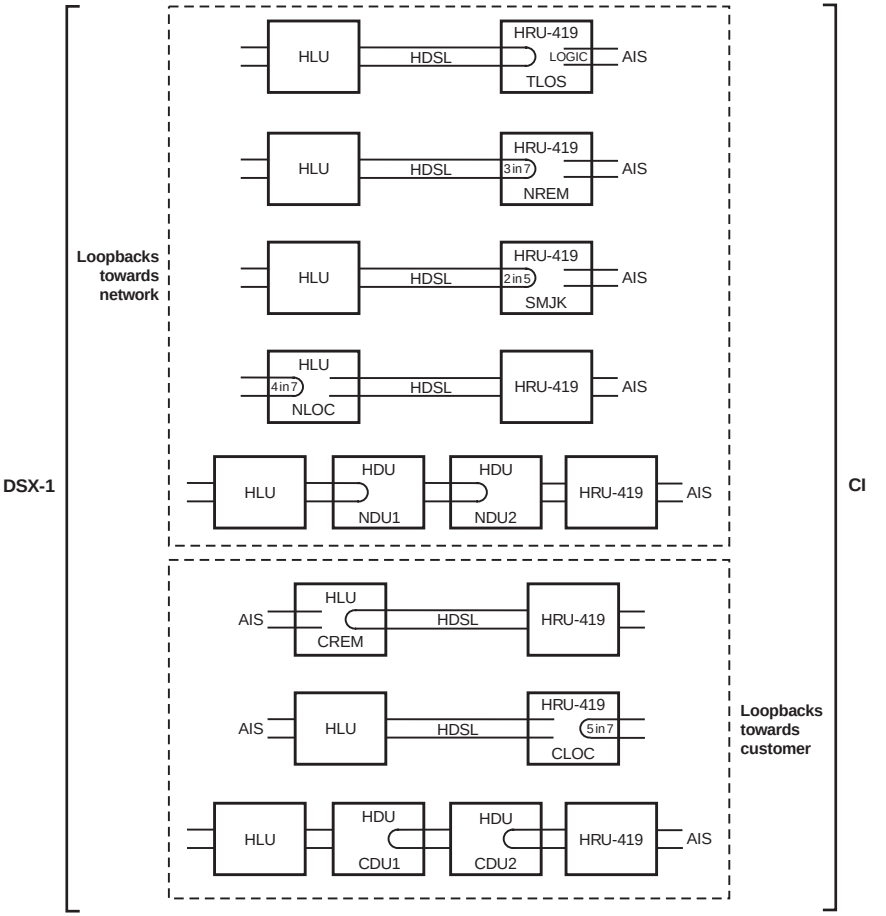

Figure 21. *HRU-419 Loopbacks*

LOOPBACKS TOWARD THE NETWORK

The HiGain loopbacks toward the network are as follows:

- Transmit Loss of Signal (TLOS): An HRU logic loopback initiated by a loss of the T1 input from the CI.
- Network Remote (NREM): The DSX signal is looped back to the DSX at the HRU.
- SmartJack (SMJK): Loopback at the HRU towards the network initiated by a 2-in 5-in-band loopback code or out-of-band ESF data link code.
- Network Local Loopback (NLOC): The DSX signal is looped back to the DSX at the HLU.
- Network Doubler Loopback 1 (NDU1): Loopback at first doubler towards network initiated by HLU.
- Network Doubler Loopback 2 (NDU2): Loopback at second doubler towards network initiated by HLU.

LOOPBACKS TOWARD THE CUSTOMER

The HiGain loopbacks toward the customer are as follows:

- Customer Remote (CREM): Loopback at HLU (remote) towards customer initiated from CPE (customer) by intelligent office repeater code.
- Customer Local (CLOC): Signal from CI is looped-back to CI at HRU.
- Customer Doubler 1 Loopback (CDU1): Loopback at first doubler towards CI initiated by HLU.
- Customer Doubler 2 Loopback (CDU2): Loopback at second doubler towards CI initiated by HLU.

SMARTJACK (SMJK) LOOPBACK

The SmartJack loopback shown in Figure 21 is the standard NID metallic loopback. It has two modes of operation as determined by the SAIS user option settings at the HLU (ENA or DIS). The ENA option causes the HRU to transmit the AIS signal towards the NI. The DIS option turns off the AIS/NI signal. To send the AIS pattern to the CI during SmartJack or NREM loopbacks, set the SAIS to ENA.

SAIS SET TO ENA

Upon detection of a valid SmartJack loopback command, a metallic loopback relay (see Figure 22 on page 50) is energized and the T1 interface chip transmits the AIS pattern to the NI and also back to the HRU-419 T1 receiver circuit. In addition, the customer's T1 XMT input is disconnected and terminated into 100 Ω The AIS pattern is examined by the HRU for its overall integrity. This pre-looped test lasts for about 100 ms and terminates in one of the following two conditions:

- Pre-loop Failed - If the transmit and receive all ones patterns do not match, there is a problem in the HRUand an HRU Pre-Loopback Fail condition occurs. 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 do 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 NI and at the same time to loop the signal being received from the network back towards the network. This places 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 100 Ω This forces the FRM LED off, the LOC LOS LED off and the Code LED to indicate AMI if the

HLU Code option is set to either AUTO or AMI. The HRU LED indicates B8ZS if the Code option is set to B8ZS.

The AIS/ENA metallic loopback scenario includes and therefore tests all HiGain active circuits and fully conforms with TR-TSY-000312. In this sense it outperforms the loopback function found in most standard NID devices, since these devices, do not include either the AIS generator or the CI T1 LOS detector in their loopback path.

SAIS SET TO DIS

This metallic loopback state is initiated in the same manner as when the ENA option is chosen. However, once initiated, the AIS signal is not sent to the NI. Instead the network signal is sent both towards the NI and through the relay back towards the network. The customer's T1 transmit input port is opened and terminated into 100 Ω. No logic loopback is required since the relay is performing the network signal loopback function. This simple metallic loopback state remains until a loopdown command is issued or the default timer (if enabled) expires.

When the HRU is in its AIS/DIS SmartJack metallic loop back state, its T1 input LOS, Code and Frame monitoring circuits are connected to the network's signal which is being looped back to these circuits through the loopback relay.

The CPE input signal is no longer being monitored since its input circuit has been opened and terminated into 100 Ω. The FRM and LOC LOS LEDs indicate the status of this signal from the network. The Code LED also indicates the code (AMI or B8ZS) of this signal if the Code option is set to AUTO. It indicates AMI or B8ZS if the Code option is set to either AMI or B8ZS respectively.

All of the HRU loopbacks towards the network (NREM and SMJK) are metallic/logic (AIS/ENA) or metallic only (AIS/DIS). The SMJK and NREM loopbacks are identical. They differ only in how they are initiated. The SMJK identifying label indicates that the loopback was initiated by the 3- in 5-in band command. NREM is used to indicate that the metallic loopback was initiated by other than the 3-in 5-command (3-in 7-, 16-bit addressable repeater commands or front panel push-button).

The HRU-419 front panel loopback (LB) button can be used to terminate any HRU loopback (by pressing and holding the button down for five seconds).

LOSS OF SYNC WORD (LOSW) CONDITIONS

The HAIS option provides two choices for the T-1 transmit outputs at both the HLU and HRU for HDSL loss of sync conditions.

HAIS SET TO 1 LOOP

The 1 Loop choice causes the AIS pattern to be transmitted at both T-1 outputs when either of the two HDSL loops experience an out-of-sync (LOSW) condition or when a margin alarm occurs. This choice causes the 12 channels on the surviving loop to be lost as they are replaced by the AIS pattern. However, it does allow both downstream and upstream equipment to be made aware of the loss of one HDSL loop or a loop with a low margin. This is the preferred setting to be able to initiate an AIS state with just one conductor open in either of the HDSL pairs. Short loops, below approximately 16 dB of loss at 200 kHz, can remain in sync with one conductor open. Since the loop is still in sync, no LOSW condition occurs. However, the margin on a one-conductor loop drops approximately 5 to 10 dB. If the Margin alarm is set to 5 dB below normal margin at 'turn-up,' then when one conductor does open, a margin alarm occurs and causes the AIS condition. This alerts maintenance personnel to the problem.

HAIS SET TO 2 LOOPS

The 2 Loops choice requires both HDSL loops to be out-of-sync (LOSW) before the AIS signal is transmitted. This choice preserves the integrity of the 12 surviving channels when just one loop is lost.

USING THE LOOPBACK (LB) BUTTON

HiGain system testing 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. The HRU-419 displays system condition messages at the Remote and Maintenance Terminals, and through color-coded LED displays on the front panel. The Front Panel Messages are included in Table 2 on page 5.

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

1 Press the loopback LB button on the HRU front panel for at least five seconds.

2 Verify that the Green HRU front panel loopback LB NET LED turns on, indicating that the HRU is in its digital (NREM) loopback state. Also verify, if possible, that the HLU displays the message NREM also indicating that the HRU is in loopback (see Figure 21).

3 Have the CO tester transmit a T1 test signal into the HLU and measure that the returned (looped) signal is error free.

4 If the above test fails, remove the HRU from its loopback state by again depressing the HRU loopback button for five seconds. Verify that the loopback NET LED is off.

5 Have the CO tester send the HLU (4-in 7-) in-band loop-up (NLOC) for five seconds. Verify that the HLU displays the message "NLOC" indicating that the HLU unit is in its network loopback state.

6 If the test passes, the problem is in the cable pair or the HRU. If it fails, the problem is at the CO.

7 If the I-CPE 60 mA current option is set to 60 mA, insert an ammeter in series with the T (Tip) and R (Ring) of either of the two DS1 pairs. Terminate these pairs with an external NID set to line power and verify that 30 mA current is flowing.

8 If the sealing current option is enabled (JP1 connected), insert a milliameter in service with the T or R of either HDSL pair and verify that at least 20 mA of sealing current is flowing.

When T1 loopback tests are performed using external metallic loopback connections at either end, the DS1 code that exists at the metallic loopback interface may be different from the DS1 code being received at the opposite end when the DS1 user option is set to AUTO.
For example, if the HRU has a metallic loopback, and the HLUs receive pattern code is changed from AMI to B8ZS, and then the all 0 pattern is sent into the HLU, the HRU remains in its AMI mode and thus loops all 0s. This causes the HRU to indicate a LOS condition which then causes the HLU to output the AIS pattern.

APPENDIX A- TECHNICAL SPECIFICATIONS

Physical

Material	Steel
Finish	Zinc plated
Mounting	STS, 3192 High Density

Dimensions

Height	4.75 in. (12.06 cm)
Width	0.70 in. (1.78 cm)
Depth	10.5 in. (26.67 cm)
Weight	0.5 lb. (0.23 kg)

Power

Consumption	4.5 W (with I-CPE set to 0), 6.3 W (with I-CPE set to 60 mA)
Maximum Provisioning Log	35 dB at 196 kHz, 135-Ω
Electrical Protection	Secondary surge and power cross protection on all DS1 and HDSL ports

Environmental

Operating Temperature	- 40 to + 65ºC
Operating Humidity	5 to 95% non-condensing

HDSL

Line Co	784 kbps 2B1Q full duplex
Output	+13 dB ± 0.5 dB @ 135 Ω
Line Impedance	135 Ω
Line DC resistive signature	14 Ω
Startup Time	15 seconds (typical), 60 seconds (maximum)

DS1

Delay (one-way)	<220 µs per span
Line Impedance	100 Ω
Pulse Output	0 dB (RLEV = 0), -15 dB (RLEV = -15)
Input Level	> - 22.5 dB
Line Rate	1.544 Mbps ± 200 bps
Output Wander (MTIE and TVAR)	Compliant with Section 7.2.1 of the T1X1.3/90-026R7 SONET Committee Report
Line Form	AMI, B8ZS, or ZBTSI
Frame Form	ESF, SF or unframed

Line Clock Rate

Internal Stratum 4 clock

FUNCTIONAL DESCRIPTION

This section describes the functions of the HRU-419.

OPERATIONAL CAPABILITIES

HiGain utilizes 2B1Q HDSL transceiver systems to establish two full-duplex 784 Kbps data channels between the HLU and a remotely-mounted HRU-419. This provides a total capacity of 1.568 Mbps between the two units. A block diagram of the HRU-419 is shown in Figure 22.

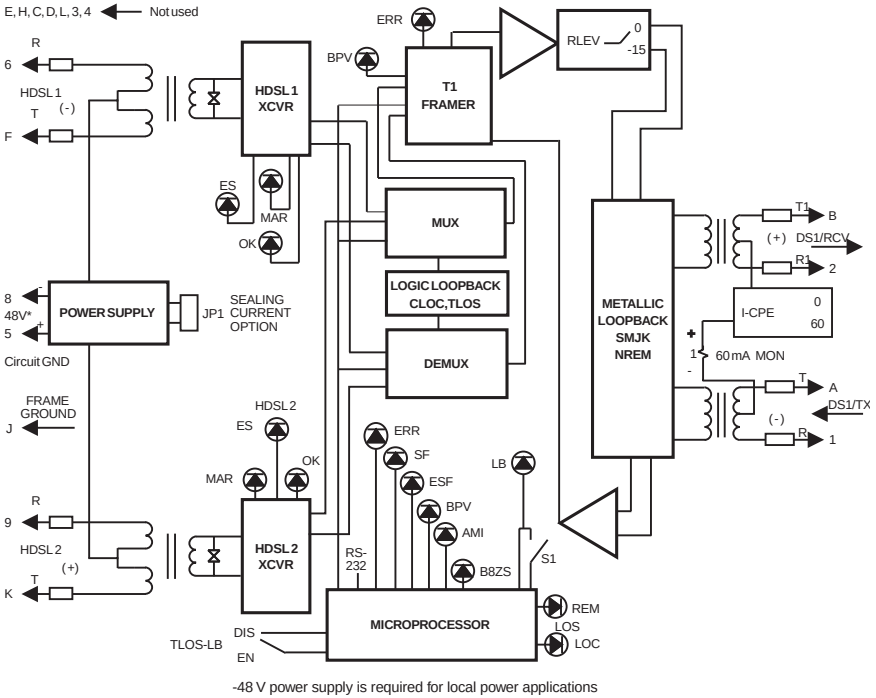

Figure 22. *HRU-419 Block Diagram*

The HRU-419 power supply converts the 90 to 130 Vdc power feed that is received on the simplex pairs (or the -48V input when locally powered) to voltages and currents required by the HRU-419 circuitry. The power supply generates +5, +3.3 and 30 Vdc outputs. The 30V output is converted to a 60 mA current feed used to simplex power the Network Interface Device (NID).

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

The HRU-419 typically dissipates 4.5 W of power with the I-CPE jumper switch set to 0, and 6.3 W with the I-CPE jumper switch set to 60.

APPENDIX B- ABBREVIATIONS

2B1Q 2–Bits–1–Quaternary

AIS Alarm Indication Signal

AMI Alternate Mark Inversion

B8ZS Bipolar 8-Zero Substitution

BPV Bipolar Violation

CI Customer Interface

CPE Customer Premises Equipment

CRC Cyclic Redundancy Check

CSA Carrier Service Area

CSU Channel Service Unit

DCE Data Circuit-Terminating Equipment

HDSL High-bit-rate Digital Subscriber Line

HDU HiGain Doubler Unit

HLU HiGain Line Unit

HRU HiGain Remote Unit

I-CPE Interface-Customer Premises Equipment

LOS Loss of Signal

LOSW Loss of Sync Word

NEBS Network Equipment Building System

NI Network Interface

NID	Network Interface Device
POTS	Plain Old Telephone Service
RLEV	Receive Level
SCURR	Sealing Current
S/N	Signal-to-Noise
SPLB	Special Loopback
TLOS	Transmit Loss of Signal
TSGR	Transport System Generic Requirements

APPENDIX C - PRODUCT 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 extension 73000 (USA and Canada) 952.917.3000 Fax: 952.917.3237	• Quotation Proposals • Ordering and Delivery • General Product Information
Systems Integration 800.366.3891, extension 73000 (USA and Canada) 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 800.366.3891, extension 73223 or 952.917.3223 Fax: 952.917.3244 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/technicalsupport
Online Technical Publications	• www.adc.com/documentationlibrary/technicalpublications

Product Return Department
800.366.3891 extension 73748 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 telephone numbers with an 800 prefix are toll-free in the USA and Canada.

CERTIFICATION AND WARRANTY

FCC CLASS A 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.

LIMITED WARRANTY

Product warranty is determined by your service agreement. Contact your sales representative or Customer Service for details.

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.

SAFETY STANDARDS COMPLIANCE

The equipment has been tested and verified to comply with the applicable sections of the following standards:

- GR 63-CORE - Network Equipment-Building System (NEBS) Requirements
- GR 1089-CORE - Electromagnetic Compatibility and Electrical Safety
- Binational standard, UL-60950/CSA C22.2 No. 60950-00 Third Edition: Safety of Information Technology Equipment

For technical assistance, refer to “Appendix C - Product Support” on page 53.

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