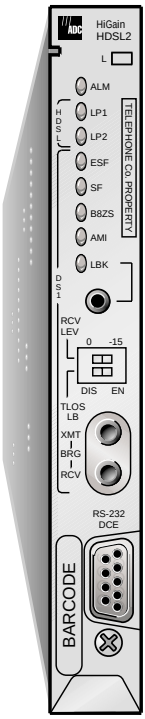
HiGain

TECHNICAL PRACTICE



HRU-402 List 4
Remote Unit
Part Number: 150-1592-04
CLEI Code: T1L3KLRD

Revision History of This Practice

To order copies of this document, use document catalog number LTPH-TP-1024-02.

Issue	Release Date	Revisions Made
01	September 3, 1999	Initial Release
02	January 3, 2001	Style and format changes

USING THIS TECHNICAL PRACTICE

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

Notes contain information about special circumstances.

Caution symbols indicate the possibility of personal injury or equipment damage.

The Electrostatic Discharge (ESD) susceptibility symbol indicates that a device or assembly is susceptible to damage from electrostatic discharge.

For a list of abbreviations used in this document, refer to "Appendix C - Abbreviations" on page 41.

UNPACK AND INSPECT YOUR SHIPMENT

Upon receipt of the equipment:

1 Unpack the container and inspect the product for signs of damage. If the equipment has been damaged in transit, immediately report the extent of the damage to the transportation company and to your sales representative. When storing the equipment for a prolonged period, use the original container.

2 Verify the contents using the packing list to ensure complete and accurate shipment.

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OVERVIEW

The ADC® HiGain® Remote Unit, HRU-402, functions as the remote end of a repeaterless T1 transmission system. When used with HiGain Line Units (HLUs) and HiGain Doubler Units (HDUs), the HiGain system provides 1.544 Mbps data transfer on two unconditioned copper pairs over the full Carrier Service Area (CSA) range.

In addition to HiGain Maintenance Terminal screens, the HRU-402 List 4 provides special performance monitoring and sectionalized analysis information for fault isolation. This performance monitoring feature supports real-time and on-demand reporting.

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

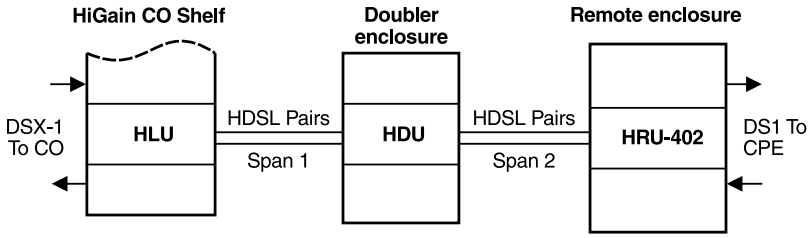


Figure 1. *Typical HiGain System*

FEATURES

- Front panel featuring:
  - Status LEDS for DS1 and HDSL
  - RS-232 craft port for connection to a maintenance terminal
  - Receive (RCV) and transmit (XMT) test access jacks
  - HDSL margin threshold indicator
- Local or line powering options
- Real-time Performance Monitoring (PM) and sectionalized analysis
  - ANSI T1.403 Performance Report Messages (PRM)
  - Supplemental Performance Report Messages (SPRM)
  - Network Performance Report Messages (NPRM)
  - Alarm Indicator Signal-Customer Interface (AIS-CI)
  - Remote Alarm Indicator-Customer Interface (RAI-CI)
  - SuperFrame Remote Alarm Indicator (SF-RAI)
  - On-demand access to stored PM information for applications which do not support real-time monitoring through craft port or inband and out-of-band commands
  - Mode analysis and SF to Extended SuperFrame (ESF) frame format conversion for fault isolation
- Support for the Network Remote (NREM), SmartJack (SMJK), Customer Local Loopback (CLOC), and Transmit Loss of Signal (TLOS) loopback commands

PRODUCT DESCRIPTION

The HRU-402 front-panel features are identified in Figure 2 and described in Table 1 on page 4.

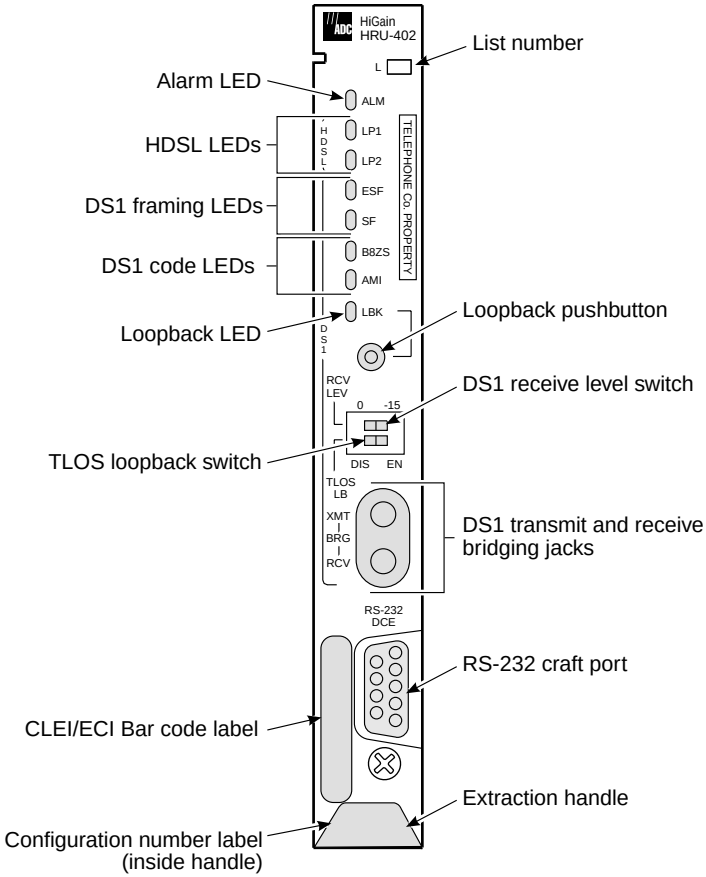


Figure 2. *HRU-402 Front Panel*

Table 1. *HRU-402 Front-Panel Features*

Name	Function
List number	Identifies a specific version of the product.
Status LEDs	See Table 2 on page 5 for status descriptions.
Loopback (LPBK) Control button	Press the button for 5 seconds to activate a remote loopback towards the Network (NREM). The unit can be unlooped by either pressing the LPBK pushbutton again for 5 seconds or by sending the loopdown codes. (a)
DS1 Receive (RCV) Level (LEV) switches	Sets DS1 receive level output toward the Customer Interface (CI) when the unit is provisioned for Network Interface (NI) output level. (b)
0	Sets the DS1 receive level toward the CI to 0 dB. (c)
-15	Sets the DS1 receive level toward the CI to -15 dB.
Transmit Loss of Signal (TLOS) Loopback (LB) switch	Enables (ENA) or disables (DIS) the TLOS loopback option. If enabled, this option displays the TLOS message from the HLU when the HRU is in a logic loopback state caused by a loss of its T1 input from the CI.
DS1 XMT and RCV Bridging jacks	Provides bridging test and monitor access jacks to the CPE DS1 interface. Provides both monitor and test access capability.
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.
CLEI/ECI Bar code label	Contains human-readable Common Language Equipment Identifier (CLEI) code number and Equipment Catalog Item (ECI) bar code 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) Disabled when provisioned for DSX-1 option.
(c) Default setting.

STATUS LEDS

Table 2 describes the functions of the Status LEDs on the front panel.

Table 2. *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	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 1 time per second	Indicates the HDSL loop is trying to acquire sync.
Blinking 4 times per second	Indicates a margin alarm condition on the HDSL loop.
Blinking 10 times per second	Indicates a Cycle Redundancy Check (CRC) error on the HDSL loop.
OFF	Indicates no activity on the HDSL loop.
DS1 Framing (FRM) LEDs (ESF and SF)	Indications for framing patterns. [a]
ESF LED = Solid green	Indicates Extended SuperFrame (ESF). The LED blinks one time per second when a frame error is indicated.
SF LED = Solid green	Indicates SuperFrame (SF). The LED blinks two times per second when a frame error is indicated.
OFF	Indicates unframed or no signal.
DS1 Line Code LEDs (B8ZS and AMI)	Line code is a user-selectable system setting. The DS1 Line Code LED reports status based on the line code setting.[a]
B8ZS = Solid green	DS1 Code Option = B8ZS: Indicates that the DS1 line code option is set to Binary 8 Zeroes Suppression (B8ZS). The LED blinks one time per second when a string of successive zeros is detected.
	DS1 Code Option = AUTO: Indicates the DS1 line code is being detected as B8ZS. [b]
AMI = Solid green	DS1 Code Option = AMI: Indicates that the user DS1 line code option is set to Alternate Mark Inversion (AMI). The solid green LED does not indicate the actual DS1 line code being received, which may be AMI or B8ZS. This LED blinks one time per second when a Bipolar Violation (BPV) is detected.

Continued

Table 2. *Status LED Descriptions (Continued)*

LED Status	Indicates
	DS1 Code Option = AUTO: Indicates the DS1 line code is being detected as AMI.(b)
Loopback (LPBK) LED	Shows loopback states to and from the network, to and from the Customer Interface (CI), and an ARMED condition.
Solid yellow	Indicates Network Remote Loopback (NREM), SMJK, or TLOS.
Blinking 1 time per second	Indicates Customer Local Loopback (CLOC) loopback state.
Blinking 4 times per second	Indicates the HRU is in an ARMED state.

(a) If DS1 signals are not detected, the ESF, SF, B8ZS, and AMI LEDs will not light.
(b) Auto DS1 code option not available when attached to a HLU-231 List 8D, HLU-231 List 8E, HLU-319 List 5D, HLU-319 List 5E, HLU-388 List 5D or HLU-388 List 5E.

COMPATIBILITY

The HRU-402 can be used with the following line units:

- HLU-231 List 8x
- HLU-319 List 5x
- HLU-388 List 5x
- HLU-200

The HRU-402 can be used with the following doublers:

- HDU-404, HDU-407, and HDU-409
- HDU-437, HDU-439 List 1 or List 1B
- HDU-451 List 4 or List 4B

The HRU-402 is compatible with the following shelves (for indoor use):

- HRE-420 (single-wide, single mount)
- HRE-422 (double-wide, double mount)
- HRE-425 (12-slot wall or rack mount)
- HRE-427 (seven-unit wall or rack mount)
- 200 Mechanics type shelves
- 400 Mechanics type shelves

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

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

INSTALLATION

Upon receipt of the equipment, visually 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 Technologies. (See "Appendix B - Product Support" on page 37.)

SETTING PANEL CIRCUIT BOARD OPTIONS

Be sure to wear an antistatic wrist strap. Avoid touching static-sensitive components on the circuit board.

HRU-402 has two user options that must be set before you install it into a shelf or an enclosure. These options are set by the two-position switches at S1, located near the card-edge connections at the back of the HRU circuit board. Figure 3 on page 9 shows the location of the switch options and how to enable or disable the switches.

- The uppermost switch, the Sealing Current (SCURR) option, allows you to enable or disable the flow of sealing current over the HDSL pairs. (See "Set the SCURR Option" on page 9).
- The lowermost switch, the Local or Line Power (LPWR) option, provisions the HRU for the use of local power or line power.

Table 3 on page 10 and Table 4 on page 10 summarize the switch selections. Factory default settings are shown in bold.

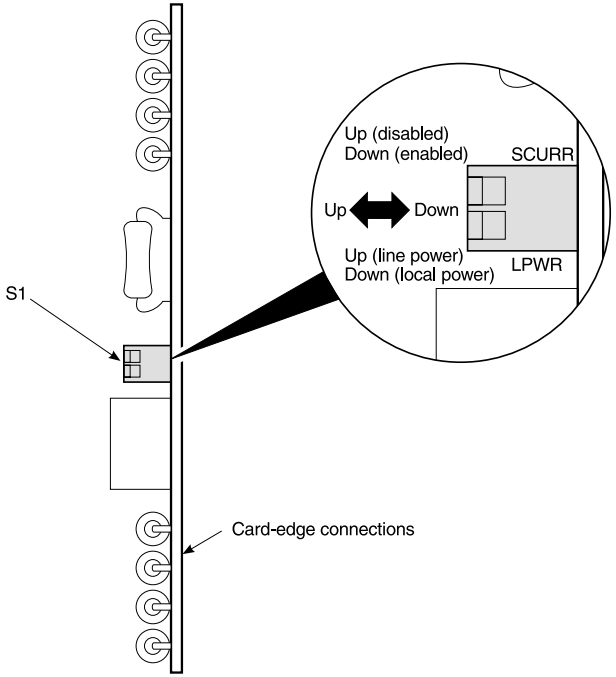


Figure 3. *Location of Switch S1 on HRU-402 Circuit Board*

Set the SCURR Option

The HRU-402 can source from 30 mA (short loop) to 20 mA (long loop) of simplex sealing current towards the upstream unit over the two HDSL pairs. Do one of the following:

- If the HRU-402 is to be used with an HDU-451 List 1, 2, 3, or 3B doubler, disable the simplex sealing current. These doublers are only compatible with the metallic sealing current of earlier remote units.
- If the HRU-402 is to be used only with those doublers listed under "Compatibility" on page 7, enable the simplex sealing current option; the compatible doublers provide a path through which the simplexed sealing current can flow.

Table 3 summarizes the SCURR option settings. The default setting is in boldface type.

Table 3. *Switch S1 - SCURR Option Settings*

Switch Position	Function
Up (disabled)	Disables the flow of simplex sealing current over the HDSL pairs towards the upstream unit.
Down (enabled)	Enables the flow of simplex sealing current over the HDSL pair towards the upstream unit. This simplexed sealing current is polarity-sensitive and will not flow if the HDSL loops adjacent to the HRU are reversed. Reversed loops are indicated by a CHREV message in the Alarms line of the Span Status Maintenance screen.

Set the LPWR Option

The HRU-402 can be provisioned for local or line power. Do one of the following:

- If the HRU-402 is to be powered by the upstream line unit, place the LPWR switch in the Up position.
- If the HRU-402 is to be powered by a local -48 Vdc supply, place the LPWR switch in the Down position.

Table 4 summarizes the LPWR option settings. The default setting is in boldface type.

Table 4. *Switch S1 - LPWR Option Settings*

Switch Position	Function
Up (line power)	Provisions the HRU-402 for the Line Power mode so that it receives power from the upstream line unit over the HDSL pairs.
Down (local power)	Provisions the HRU-402 for the Local Power mode so that it receives power from the -48 Vdc supply applied to edge connector pin 35 (-) and pin 17 (+). If local power is not present, the HRU reverts to the Line Power mode.

INSTALL THE HRU-402

To install the HRU-402 in a remote enclosure:

1 Verify that you have properly set the SCURR and LPWR options according to the guidelines described in "Setting Panel Circuit Board Options" on page 8.

2 Slide the remote unit into the card guides for the desired slot, then push the unit into the enclosure until it seats properly in the card-edge connector (Figure 4).

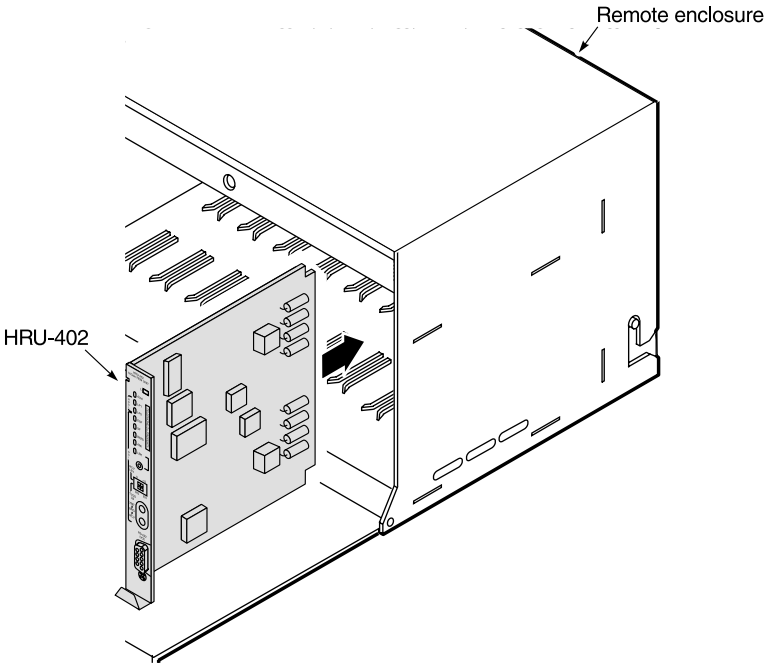


Figure 4. *Installing the HRU-402 in a Remote Enclosure*

REMOTE LOGIN

The HRU supports remote login through a maintenance terminal or PC connected to its front-panel RS-232 craft port. Remote login creates menus and screens for the HRU that are identical to those at the HLU. Once logged on you can access the Remote Terminal Main Menu screens to view system settings and status, and initiate loopbacks. You can also access the HRU performance monitoring capabilities.

CONNECTING TO A MAINTENANCE TERMINAL

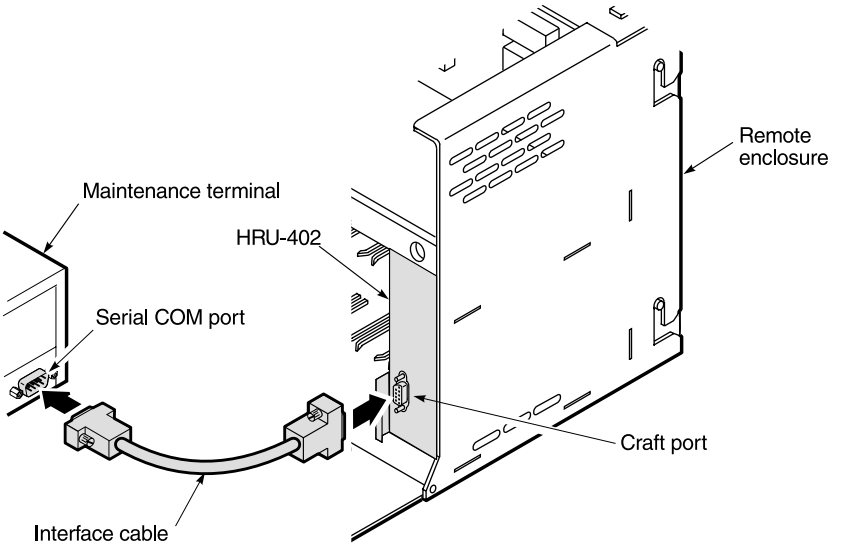


Figure 5. *Connecting to a Maintenance Terminal*

The HRU-402 front-panel RS-232 craft port allows you to use a standard serial cable to connect your system to a maintenance terminal or PC running a terminal emulation program.

1. Connect a standard 9-pin terminal cable to the craft port (Figure 5 on page 12) on the HRU front panel. (For a pinout diagram of the craft port, refer to "Craft Port" on page 35.)
2. Connect the other end of the cable to the serial COM port on the maintenance terminal.
3. Start a terminal emulation program such as ProComm (emulating a VT-100 terminal).
4. Configure the maintenance terminal for 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

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

LOGGING ON AND OFF

To log on and access the Remote Terminal Main Menu screens using the maintenance terminal:

1. Press the **SPACEBAR** several times to activate the autobaud feature and display the Remote Login screen.
2. Press the **ENTER** key to perform a remote login to the HiGain Maintenance Terminal screens (or press **TAB** to access the HRU-402 Performance Monitoring Menu shown on page 18).
   - The Remote Terminal Main Menu items (see Table 5 on page 15) are replications of the HLU screens. Depending on the HLU attached to the HRU-402 List 4, remote provisioning may be available. Refer to the HLU technical practice for details.

- The Performance Monitoring Menu items provide special network surveillance features that monitor network performance and help track problems.

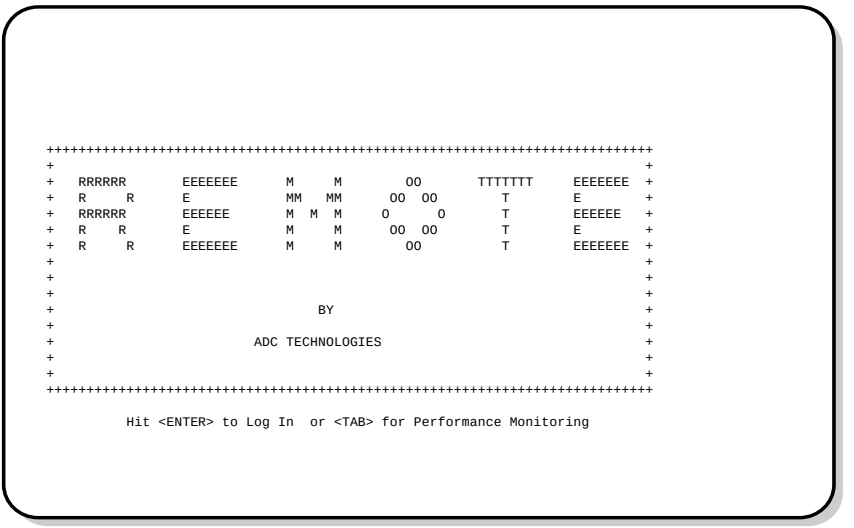


Figure 6. *Remote Terminal Login Screen*

3 From the Remote Terminal Main Menu screen, type the appropriate letter to select the items you wish to view (see Table 5 on page 15).

4 When completed, terminate the remote session by pressing **I** for remote logoff.

Terminating the remote session allows other units in the circuit, such as doublers, or the HLU itself, to initiate an RS-232 session. An active session at any module prohibits active sessions at all other circuit modules.

REMOTE TERMINAL MAIN MENU

Table 5 describes the screens you can access from the Remote Terminal Main Menu. To select a particular menu item, type the letter next to it. For complete information about the Span Status screens, System Settings, and Loopback mode, refer to the HLU technical practice. HLU practices and other ADC documents can be downloaded from the ADC Customer Site.

Table 5. *Remote Terminal Main Menu Items*

Menu Item	Function
View Span Status	Allows viewing of span status between the HLU and the HRU-402, including span status for doubler devices (multi-span applications).
Set Clock	Allows setting of time and date parameters at the HRU.
System Settings	Allows viewing of all system settings.
Loopback Mode [(a)]	Allows system loopbacks to be initiated.
View Performance Data	Allows viewing of the Errored Seconds (ES) and Unavailable Seconds (UAS) for the HLU to HRU-402 span (non-doubler applications) and any additional spans (doubler applications) in 15-minute intervals over a 4-hour time period.
View Performance History	Allows viewing of the ES and UAS for the HLU to HRU-402 span (non-doubler applications) and any additional spans (doubler applications) in 24-hour intervals over a 31-day period.
View Alarm History	Allows viewing of alarm conditions for the HLU to HRU-402 span (non-doubler applications) and any additional spans (doubler applications).
View System Inventory [(a)]	Displays the model number and ID of all units in the circuit.
View Troubleshooting	Provides a graphical analysis of the circuit and identifies problem areas.
Remote Logoff	Terminates the remote session.

(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.

PERFORMANCE MONITORING

In addition to the standard features of the HRU-402, its functionality has been enhanced to produce unique Performance Monitoring (PM) and testing capabilities.

Network surveillance is a key maintenance strategy. Real-time monitoring of performance through sectionalized analysis allows maintenance personnel to quickly locate a service degradation or failure. This also makes it easier to determine if the customer or network operator must bear responsibility for service and repair.

The Performance Monitoring screens analyze the T1 transmission by tracking the four transmission legs shown in Figure 7.

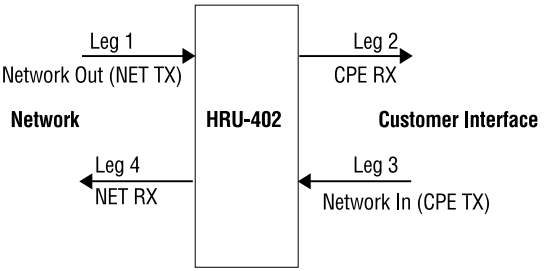


Figure 7. *Sectionalized Analysis of T1 Transmission*

PM APPLICATIONS

When installed individually on one end of a T1 circuit, the remote unit provides the following special network benefits:

- Real-time performance monitoring of DS1 signals in both directions of transmission
- Non-intrusive access to real-time performance monitoring data (CPE-provided ESF signal)

- On-demand access using the craft port, inband or Facility Data Link (FDL) access to stored DS1 PM data including:
  - Current status
  - Sectionalized events
  - Blockage indicator (a quality-of-service summary statistic)
  - ANSI 15-minute and 24-hour statistics
- On-demand access to stored HDSL PM data
- AIS-CI insertion toward the network upon detection of incoming LOS or AIS at the network interface
- RAI-CI insertion toward the network upon receiving RAI from the CPE, if the signal from the network is not impaired
- Loopback toward the network with AIS insertion to the CPE equipment
- Adaptive frame format conversion if enabled in:
  - SF to ANSI T1.403 ESF
  - Non-standard to standard ANSI T1.403 ESF (for example, addition of remote units)
  - AT&T PUB 54016 to ANSI T1.403 ESF (for example, addition of remote units without interference with the 54016 poll response)
- Nonintrusive access to real-time performance monitoring data (CPE-provided SF or ESF signal)

Network Elements (NEs), such as the ADA T3AS test and performance monitoring system, can be used to collect the performance monitoring data to allow full-time surveillance of the DS1 signal. By installing T3AS at a network boundary (for example, Interexchange Carrier [IEC] Point of Presence (POP), and a remote unit at the NI), the Local Exchange Carrier (LEC) can monitor the performance of its portion of the network, and rapidly sectionalize circuit problems. By sectionalizing problems in its network the LEC can know what trouble exists and who is responsible without external involvement.

ACCESSING THE PERFORMANCE MONITORING MENU

To access the HRU-402 Performance Monitoring Menu:

1 Press the **TAB** key at the Remote Login screen. The Performance Monitoring Menu appears (Figure 8).

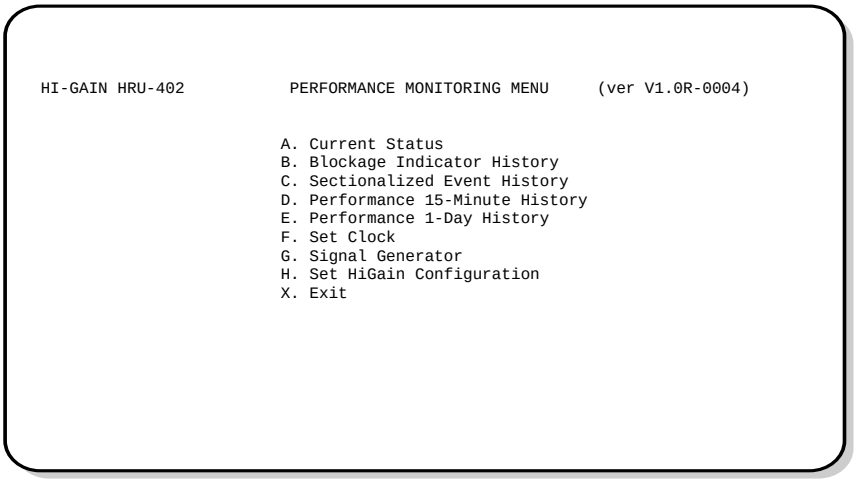


Figure 8. *Performance Monitoring Menu*

2 Type the letter of a menu selection. Table 6 on page 19 describes the various menu selections.

Table 6. *Performance Monitoring Menu Items*

Press Key	To View Screen	Screen Description
A	Current Status	Displays the status of various performance indicators.
B	Blockage Indicator History	Provides a quick summary of circuit performance. The BI provides a relative index of performance for each leg of transmission (NET TX or CPE TX).
C	Sectionalized Event History	Sectionalized Event (SE) Collects information from the remote unit and tallies the alarm and error events for all four legs of the T1 signal.
D	Performance 15-minute History	Displays 15-minute histories for ES, SES, UAS, MON, and CV-L. The last period is the current period.
E	Performance 1-day History	Displays 1-day histories for ES, SES, UAS, MON, and CV-L for 7 days. The last day is the most current day.
F	Set Clock	Sets the date and time during remote login or reset.
G	Signal Generator	Initiates transmission of a test signal from the remote toward either the CI or the network.
H	Set HiGain Configuration	Allows the user to enable or disable the SF to ESF frame format conversion [(a)] at the Network Interface (NI), set the report message generation types, and to reset PM and sectional registers.
X	Exit	Exit the Performance Monitoring Menu.

(a) If the HLU is configured for unframed (UNFR), the SF-to-ESF frame conversion and Out-of Frame (OOF) detection are inhibited.

Current Status Screen

Access this screen from the Performance Monitoring Menu by pressing **A**.

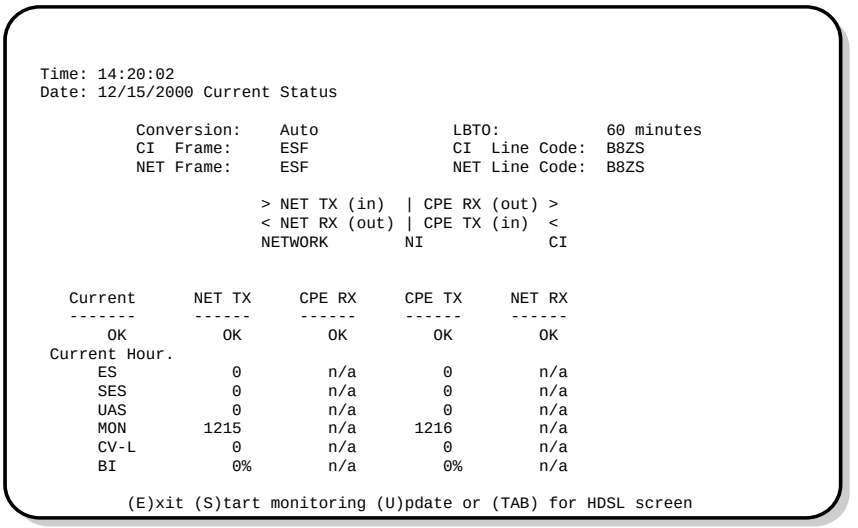


Figure 9. *Current Status Screen*

This screen displays the status of various performance indicators for the current hour for the four legs of the system (NET TX, CPE RX, CPE TX and NET RX). Parameters displayed are defined in Table 7.

Table 7. *Status Screen Parameters*

Abbreviation on Screen	Parameter
ES	Errored Seconds
SES	Severely Errored Seconds
UAS	Unavailable Seconds
MON	Monitored Seconds
CV-L	Line Code Violations
BI	Blockage Indicator

All the parameters, except Blockage Indicator (BI), are displayed for all four legs. Blockage Indicator is meaningful only for legs 1 (NET TX) and 3 (CPE TX). No data is accumulated or displayed for legs 2 (CPE RX) and 4 (NET RX).

All parameters are displayed in counts for the current hour, except for BI, which is displayed as a percentage.

The current settings of several remote unit options are displayed near the top of the screen.

- To update (refresh) the screen, press **U** at any time.
- To clear the display so that counts accumulated since the most recent update may be observed, press **S**.
- To view the HDSL screens, press **TAB**.
- To return to the Performance Monitoring Menu, press **E**.

Pressing S does not clear BI or performance registers in the remote unit. Return to the Performance Monitoring Menu and reselect the Current Status screen to obtain an accurate performance evaluation for the current hour.

Blockage Indicator History Screen

Blockage Indicator (BI) is a summary statistic which provides a quick indicator of circuit performance. The BI provides a relative index of performance for each leg of transmission (NET TX or CPE TX).

Access the Blockage Indicator History from the Performance Monitoring Menu by pressing **B**.

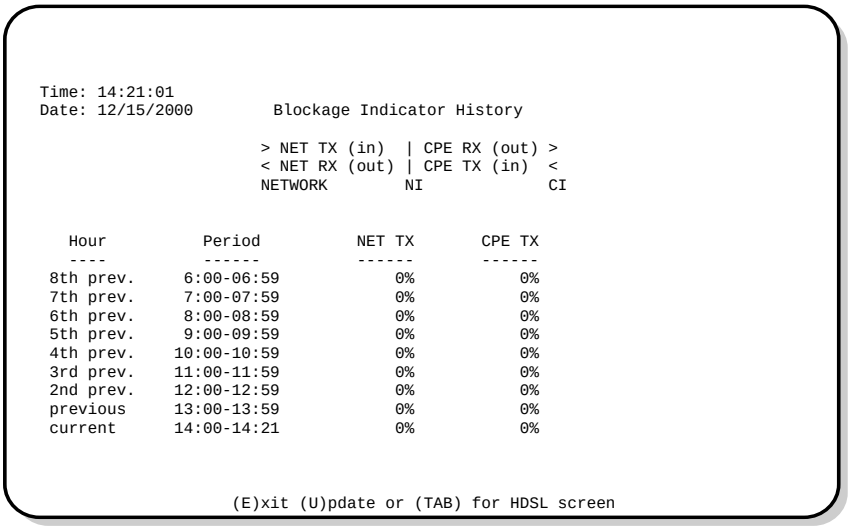


Figure 10. *Blockage Indicator History Screen*

This screen displays the BI as a percentage for the current hour and for each of the eight preceding hours. Since BI is recorded only for leg 1 (NET TX) and leg 3 (CPE TX) of the remote unit, only those legs are displayed.

- Press **U** to update the screen.
- Press **TAB** to view the HDSL screens.
- Press **E** to return to the Performance Monitoring Menu.

BI is calculated using the following formula:

BI = [(UAS + .4 SES+.2 ES) / MON] x 100

where:	BI = 0%	indicates the circuit leg is clean.
	BI = 99%	indicates that the circuit leg is out of service.
	BI = % that is BI < 99%	indicates partial trouble in the circuit leg. This percentage is greater than 0% and less than 99%. The higher the BI percentage, the more trouble on that particular circuit leg.
	MON	the number of seconds that were monitored in obtaining the UAS, SES and ES data.
	ES	Errored Seconds are a combination of DS1 path and line parameters as defined in ANSI T1.231-1997.
	SES	Severely Errored Seconds are based on parameters similar to ES, but are more severe in number.
	UAS	Unavailable Seconds. Upon the onset of 10 contiguous SES, line unavailability is declared. For the line (including HDSL loops) to become available, there must be a minimum period of 10 seconds which are free of SES.

Sectionalized Event History Screen

Access this screen from the Performance Monitoring Menu by pressing **C**.

```
Time: 01:04:08           Sectionalized Event History
Date: 12/15/2000
                      > NET TX (in)  | CPE RX (out) >
                      < NET RX (out) | CPE TX (in)  <
                      NETWORK        NI             CI

  #     Date       Time     NET TX    CPE RX    CPE TX    NET RX
  -     ----       ----     ------    ------    ------    ------
 14     8/31       1:00        OK        OK      ALARM    AIS-CI
 13     8/31       1:00      ALARM      AIS      ALARM    AIS-CI
 12     8/31       1:00      ALARM      AIS       OOF        OK
 11     8/31       1:00      ALARM      AIS        OK        OK
 10     8/31       1:00      ALARM       OK        OK        OK
  9     8/31       1:00         OK       OK        OK        OK
  8     8/31       1:01         ES       OK       SES        OK
  7     8/31       1:02         OK       OK       SES        OK
  6     8/31       1:02        RAI      RAI       SES        OK
  5     8/31       1:03        RAI      RAI        OK        OK
  4     8/31       1:03         OK       OK        OK        OK
  3     8/31       1:03         OK       OK      ALARM    AIS-CI
  2     8/31       1:03         OK       OK        OK        OK
  1     8/31       1:03         OK       OK       RAI       RAI
  0     8/31       1:03         OK       OK       RAI     RAI-CI
       (E)xit (P)revious (U)pdate (N)ext or (TAB) for HDSL screen
```

Figure 11. *Sectionalized Event History Screen*

This screen displays the 100 most recent sectionalized events for all four legs along with their times of occurrence.

- Press **N** to view the next Sectionalized Event History screen.
- Press **P** to view a previous Sectionalized Event History screen.
- Press **U** to update the screen.
- Press **TAB** to view the HDSL screens.
- Press **E** to return to the Performance Monitoring Menu.

Sectionalized events are time stamped and presented for all four legs with the most recent event displayed first.

Sectionalized events use the following status definitions:

Table 8. *Sectionalized Event Descriptions*

Screen Section	Events
OK	Signal is clean
ES	Errored Seconds condition
SES	Severely Errored Seconds condition
ALARM	LOS
AIS	Alarm Indicator Signal condition
RAI	Remote Alarm Indicator condition
AIS-CI	Customer AIS
RAI-CI	Customer RAI
NOT SECT	No Sectionalized Data Available
OOF	Out of frame condition

Sectionalized events isolate trouble to a particular circuit leg. For example, an ES listed under the NET TX column indicates that an errored second condition exists on the NET TX (In) circuit leg beginning with the time stamp and continuing until an “OK” or other new event is recorded.

On signals without FAR END or NEAR END PRM present, event data in the CPE RX and NET RX circuit legs will be limited to trouble alarms.

Performance 15-Minute History Screen

Access this screen from the Performance Monitoring Menu by pressing **D**.

```
Time: 14:22:13           Performance 15-Min History
Date: 12/15/2000
                       > NET TX (in)  | CPE RX (out) >
                       < NET RX (out) | CPE TX (in)  <
                       NETWORK        NI             CI

                                NET TX                          CPE TX
 #  Date   Time     ES   SES   UAS   MON  CV-L      ES   SES   UAS   MON  CV-L
 -  ----   ----     --   ---   ---   ---  ----      --   ---   ---   ---  ----
44  8/16  11:00      0     0     0   900     0       0     0     0   900     0
45  8/16  11:15      0     0     0   900     0       0     0     0   900     0
46  8/16  11:30      0     0     0   900     0       0     0     0   900     0
47  8/16  11:45      0     0     0   900     0       0     0     0   900     0
48  8/16  12:00      0     0     0   900     0       0     0     0   900     0
49  8/16  12:15      0     0     0   900     0       0     0     0   900     0
50  8/16  12:30      0     0     0   900     0       0     0     0   900     0
51  8/16  12:45      0     0     0   900     0       0     0     0   900     0
52  8/16  13:00      0     0     0   900     0       0     0     0   900     0
53  8/16  13:15      0     0     0   900     0       0     0     0   900     0
54  8/16  13:30      0     0     0   900     0       0     0     0   900     0
55  8/16  13:45      0     0     0   900     0       0     0     0   900     0
56  8/16  14:00      0     0     0   900     0       0     0     0   900     0
57  8/16  14:15      0     0     0   448     0       0     0     0   448     0
            (E)xit (P)revious (N)ext or (TAB) for HDSL screen
```

Figure 12. *Performance 15-Minute History Screen*

The screen displays 15-minute histories for the parameters ES, SES, UAS, MON (monitored time during the 15-minute period), and CV-L. The last line of the first screen is always the current period.

- Press **N** to view the next Performance 15-Minute History screen.
- Press **P** to view a previous Performance 15-Minute History screen.
- Press **TAB** to view the HDSL screens.
- Press **E** to return to the Performance Monitoring Menu.

Performance 1-Day History Screen

Access this screen from the Performance Monitoring Menu by pressing **E**.

```
Time: 14:22:41
Date: 12/15/2000        Performance 1-Day History

                      > NET TX (in)  | CPE RX (out) >
                      < NET RX (out) | CPE TX (in)  <
                      NETWORK        NI             CI

                              NET TX                          CPE TX
 #  Date   Time     ES   SES   UAS   MON  CV-L      ES   SES   UAS   MON  CV-L
 -  ----   ----     --   ---   ---   ---  ----      --   ---   ---   ---  ----
 5  8/10  23:59      0     0     0     0     0       0     0     0     0     0
 6  8/11  23:59      0     0     0     0     0       0     0     0     0     0
 0  8/12  23:59      0     0     0     0     0       0     0     0     0     0
 1  8/13  23:59      0     0     0     0     0       0     0     0     0     0
 2  8/14  23:59      0     0     0 30063     0       0     0     0 30063     0
 3  8/15  23:59      0     0     0 86400     0       0     0     0 86400     0
 4  8/16  14:15      0     0     0 51840     0       0     0     0 51840     0



                  (E)xit (U)pdate or (TAB) for HDSL screen
```

Figure 13. *Performance 1-Day History Screen*

This screen displays 1-day histories for the parameters ES, SES, UAS, CV-L, and MON (monitored during the number of seconds indicated) for 7 days.

- Press **U** to update the screen.
- Press **TAB** to view the HDSL screens.
- Press **E** to return to the Performance Monitoring Menu.

Set Date and Time Screen

Access this screen from the Performance Monitoring Menu by pressing **F**. This screen displays the current time recorded by the remote unit in hh:mm format and the current date in mm/dd/yy format.

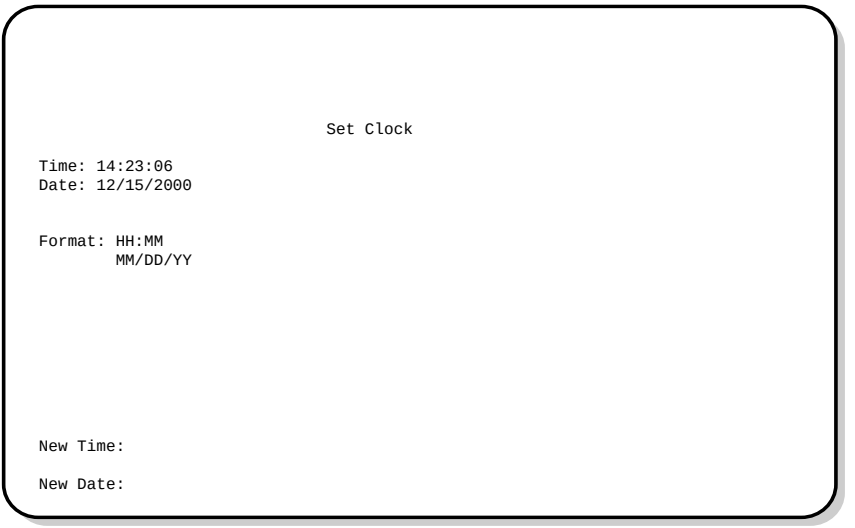


Figure 14. *Set Clock Screen*

- Enter a new time in the same format as that displayed, or retain the current time by pressing **ENTER** at the prompt.
- Enter a new date in the same format as that displayed, or retain the current date by pressing **ENTER** at the prompt.
- Type **C** to confirm the time and date changes.

The Set Clock screen overrides the settings established by the line unit. The Set Clock screen establishes the time and date stamps for Performance Monitoring.

Signal Generator Screen

Access this screen from the Performance Monitoring Menu by pressing **G**.

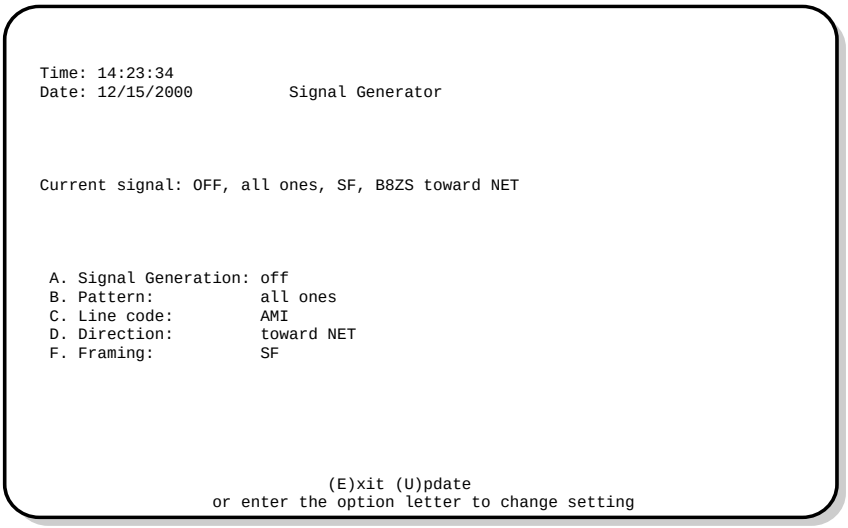


Figure 15. *Signal Generator Screen*

This screen allows transmission of a test signal from the remote unit toward either the CI or the network.

1 Set up the test signal by typing the letter of the desired test option (options **B** through **F** are described in Table 9 on page 30).

2 After the pattern, line code, direction and framing options have been selected, do one of the following:

- Press **U** to update the screen.
- Press **A** to activate signal generation and perform an update.

While signal generation is active, options B through F can still be changed, but they do not take effect until U is pressed.

3 Press **E** to return to the Performance Monitoring Menu. The Signal Generator Screen can be exited while signal generation is still active.

Table 9 describes the signal generator test options.

Table 9. *Signal Generator Test Options*

Press Key	To Select	Options
A	Signal Generation	On or Off
B	Pattern	Pattern options: all ones, all zeroes, 2^{20-1} pseudo random, 2^{20-1} pseudo random, 2^{20-1} pseudo random, 1:7 pattern, 2:8 pattern, 3:24 pattern
C	Line Code	Line code options: AMI or B8ZS
D	Direction	Direction options: toward NET or toward CPE
F	Framing	Framing Options: SF, ESF, no framing

Set HiGain Configuration

Access this screen from the Performance Monitoring Menu by pressing **H**.

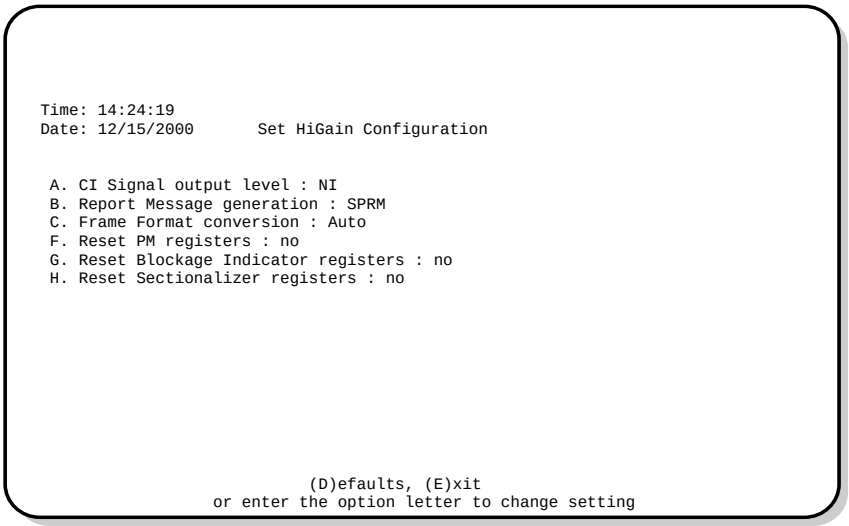


Figure 16. *Set HiGain Configuration Screen*

1. Press **D** to restore the default settings.
2. Press **E** to return to the Performance Monitoring Menu.

Table 10 lists the screen options available. Default settings are indicated in bold type.

Table 10. *User Options for the Set HiGain Configuration Screen*

Press Key	To Set Option	Options	Description
A	CI signal output level	DSX-1 or **NI**	Selects the T1 equalizer to DSX-1 setting or the Network Interface setting.
B	Report message generation		Selects the type of performance reporting messages.
		NONE	No PRM generation. The data link from the CPE is passed through transparently.
		SPRM	The HRU monitors incoming datalink traffic and modifies the PRM to a SPRM. If there is no PRM within 5 seconds of startup or a LOS condition exists, the HRU generates its own SPRM. Other High-level Data Link Control (HDLC) messages and Bit-Oriented Messages (BOMs) are passed on transparently.
		SPRM + NPRM	In addition to the SPRM message, the HRU adds an NPRM.
		NPRM	The HRU only generates NPRM, however, if there is a PRM from the customer, the HRU tags on an NPRM. Any HDLC traffic from the CPE (including ATT PUB and BOMs) is passed on.
C	Frame format conversion	Disable	Disables SF to ESF frame format conversion at the network interface.
		Auto	Remote unit passes ESF through or converts SF to ESF if it detects ESF coming from the network. At the same time, it converts a network ESF signal back to SF if it detects SF coming from the CPE. Auto Conversion enables the remote unit to transmit PRM back to the network to aid in network troubleshooting.
F	Reset PM registers	**No** or Pending	The “Pending” selection resets the 24 hour/15 min and 7 day/24 hour PM registers to zero.
G	Reset Blockage Indicator registers	**No** or Pending	The “Pending” selection resets all blockage events to zero.
H	Reset Sectionalizer registers	**No** or Pending	The “Pending” selection resets any and all sectionalized events stored in the registers to zero.

APPENDIX A - SPECIFICATIONS

DS1

Pulse Output	0 dB (RLEV = 0), -15 dB (RLEV = 15)
Input level sensitivity	>-35 dB

DSX-1

Pulse Output	6 V pk-pk, pre-equalized for 0 to 655 feet of ABAM cable
Input Level	+1.5 to -7.5 dB DSX

Power Consumption/Heat Dissipation

Line power consumption/heat dissipation	3.1 W (when connected to the following line units: HLU-231 List 8x, HLU-319 List 5x, and HLU-388 List 5x)
	4.5 W (when connected to all other line units)
Local power consumption/heat dissipation	5.2 W (sealing current on)
	4.1 W (sealing current off)
Maximum provisioning loss	35 dB at 196 kHz, 135 Ω
Electrical protection	Secondary surge and power cross-protection on all DS1 and HDSL ports

Input Voltage -42 to -56 Vdc, locally powered

Operating Environment

Operating temperature	-40 °C to +85 °C
Operating humidity	5% to 95% non-condensing

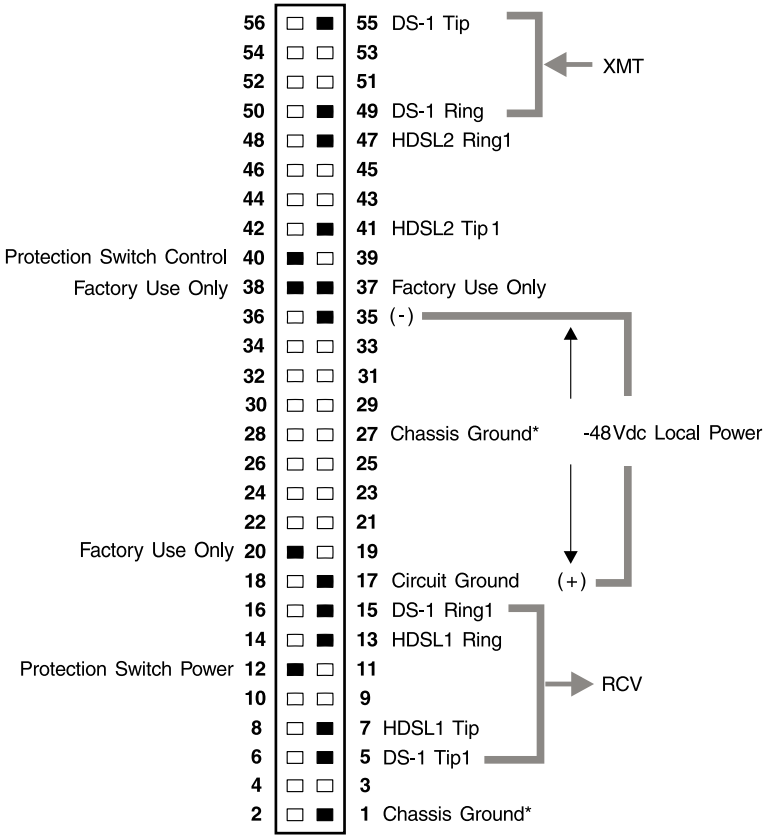
Mounting 200 or 400 type mechanics

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)

CARD-EDGE CONNECTOR

The HRU-402 card-edge connector pinouts are shown in Figure 17.



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

Figure 17. *Card-Edge Connector Pinouts*

CRAFT PORT

Figure 18 shows the pinout for the craft port connector and its connection to a DB-9 or DB-25 connector on a maintenance terminal.

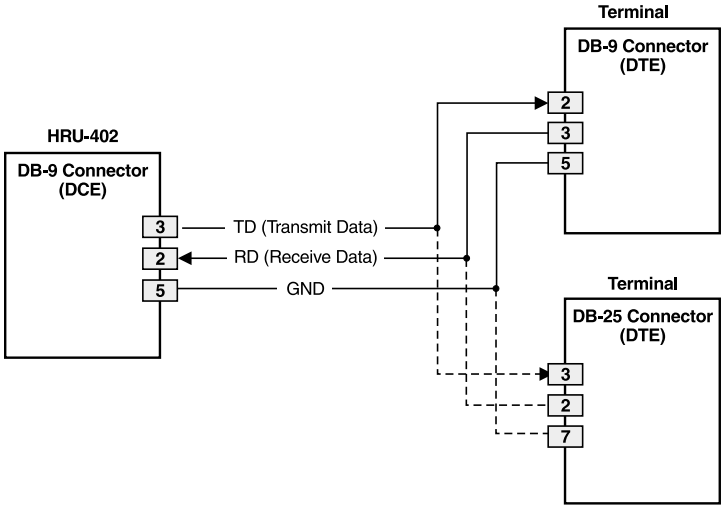


Figure 18. *RS-232 Craft Port Pinout*

NIU QUERY COMMAND

Upon receipt of the 16-bit NIU query command while in loopback mode, the HRU responds by utilizing logic inversion for conveying information on top of the command signal. The number of logic inversions indicate which mode is being queried. The command is declared valid after receipt of the pattern for 5 seconds. The response (logic inversions) are sent within 20 seconds after the command. If the command is still present, the response repeats every 15 seconds.

The 16-bit framed SF or ESF inband pattern is model-specific and is D5D5 or D5DA (hexadecimal).

Monitored seconds are not incremented while in loopback. PM data and sectionalized events are not collected during or as a result of loopback.

Table 11 lists some of the model-specific query commands.

Table 11. *Model-specific NIU Query Commands*

Model	Inband Pattern (hexadecimal)	Logic Inversion
ADC HRU-402 List 4	D5D5, D5DA	20
ADC HRU-412 List 9B	D5D5	20
ADA 2011 List 2	D5D5	220
ADA 2011 List 3	D5D5	300
ADA 2011 List x	D5D5	270 + model number 0
ADA 2021 List x	D5DA	330 + model number 0
Teltrend	D5D5	570

APPENDIX B - PRODUCT SUPPORT

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

TECHNICAL SUPPORT

Technical assistance is available 24 hours a day, 7 days a week by contacting ADC Wireline Systems Division Customer Service Engineering Group at one of the following numbers:

Telephone:	800.638.0031 or 714.730.3222 The 800 telephone support line is toll-free in the U.S. and Canada.
Fax:	714.832.9924
Email:	wsd_support@adc.com

A Customer Service Engineer answers technical assistance calls Monday through Friday between 7:30 AM and 5:30 PM, Pacific Time, excluding holidays. At all other times, an on-duty Customer Service Engineer returns technical assistance calls within 30 minutes.

RETURNS

To return equipment to ADC Wireline Systems Division:

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

2 Call or write ADC Wireline Systems Division Customer Service to ask for a Return Material Authorization (RMA) number and any additional instructions. Use the telephone number, fax number, or email address listed below:

- Telephone: 800.370.9670
- Fax: 714.832.9923
- Email Address: rma@adc.com

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

- Company name, address, telephone number, and the name of a person Customer Service can contact regarding this equipment.
- The purchase order number provided to Customer Service when the RMA number was requested.
- A description of the equipment, as well as the number of units that you are returning. Be sure to include the model and part number of each unit.
- The shipping address to which Customer Service should return the repaired equipment.
- The reason for the return:
  - The equipment needs an ECO/ECN upgrade.
  - The equipment is defective.

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

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

4 Pack the equipment in a shipping carton.

5 Write the ADC Wireline Systems Division address and the RMA number you received from Customer Service clearly on the outside of the carton and return to:

ADC Wireline Systems Division
14352 Franklin Ave.
Tustin, CA 92780-7013

Attention: **RMA (Number)**

All shipments are to be returned prepaid. ADC will not accept any collect shipments.

APPENDIX C - ABBREVIATIONS

A

ADA: Applied Digital Access, Inc.
AIS: Alarm Indicating Signal
AIS-CI: Alarm Indicator Signal-Customer Interface
AMI: Alternate Mark Inversion
ANSI: American National Standards Institute

B

B8ZS: Binary 8 Zeroes Suppression
BI: Blockage Indicator
BOM: Bit-Oriented Message
BPV: Bipolar Violation

C

CI: Customer Interface
CLEI: Common Language Equipment Identifier
CLOC: Customer Local Loopback
CO: Central Office
CPE: Customer Premises Equipment
CRC: Cycle Redundancy Check
CSA: Carrier Service Area
CV-L: Line Code Violation

D

DIS: Disable
DS1: Digital Service, Level 1
DSX: Digital System Cross-Connect frame

E

ECI: Equipment Catalog Item
ENA: Enable
ES: Errored Seconds
ESF: Extended SuperFrame

F

FDL: Facility Data Link
FRM: Frame

H

HDLC: High-level Data Link Control
HDSL: High-bit-rate Digital Subscriber Line

HDU: HiGain Doubler Unit
HLU: HiGain Line Unit
HRE: HiGain Remote Enclosure
HRU: HiGain Remote Unit

I

IEC: Interexchange Carrier

L

LEC: Local Exchange Carrier
LEV: Level
LOS: Loss of Signal
LPBK: Loopback
LPWR: Local or Line Power

M

MON: Monitor Seconds

N

NE: Network Element
NEBS: Network Equipment-Building System
NI: Network Interface
NIU: Network Interface Unit

NPRM: Network Performance Report Messages
NREM: Network Remote Loopback

O

OOF: Out-of Frame

P

PM: Performance Monitoring
POP: Point of Presence
PRM: Performance Report Messages

R

RAI: Remote Alarm Indicator
RAI-CI: Remote Alarm Indicator-Customer Interface
RCV: Receive
RMA: Return Material Authorization

S

SCURR: Sealing Current
SE: Sectionalized Event
SES: Severely Errored Seconds
SF: SuperFrame
SF-RAI: SuperFrame Remote Alarm Indicator
SMJK: SmartJack
SPRM: Supplemental Performance Report Messages

T

T3AS: Integrated test and performance monitory system from ADA that connects to the network at the DS3 and DS1 transport rates.
TLOS: Transmit Loss of Signal TLOS

U

UAS: Unavailable Seconds

X

XMT: Transmit

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.

STANDARDS COMPLIANCE

The HRU-402 List 4 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-1950/CSA-C22.2 No. 950-95: Safety of Information Technology Equipment

For technical assistance, refer to “Appendix B - Product Support” on page 37.

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